DELIVERABLE D4.2
MAPPING OF POTENTIAL HEAT END-USERS AROUND VERMILION SITES IN FRANCE

WP4: ENHANCING PETROLEUM SEDIMENTARY BASINS FOR GEOTHERMAL ELECTRICITY AND THERMAL POWER PRODUCTION

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1 EXECUTIVE SUMMARY

1.1 DESCRIPTION OF THE DELIVERABLE CONTENT AND PURPOSE

Deliverable D4.2 consists in identifying and mapping the potential geothermal heat end-users located around Vermilion sites in France. The purpose of this inventory is to identify all the potential activities and projects that can be developed by august 2020 (milestone MS4) .

The present report first describes the method used for the inventory. We visited our current users at Parentis (greenhouse) and Arcachon (district heating in operation) to get technical feedback. We then met with local stakeholders: one-to-one meetings with mayors in the aquitaine basin and round-table discussions in the Paris basin. We involved the public regulatory offices when possible: ADEME (office in charge of implementing energy policies) and BRESS (office in charge of technical regulation of subsurface use at the energy ministry).

The report then describes each of the projects currently identified: objective, energy needs, schedule are critical parameters. In the Aquitaine basin, the most advanced project consists in providing heat to a high school. In the Paris basin, a greenhouse project and a secondary school are planned nearby our facilities.

Next steps are milestone MS3 (decision to proceed to detailed feasibility work, August 2019), deliverable D4.3 (heat exchanger installed, April 2020) and milestone MS4 (heat production to end-user, August 2020).

1.2 BRIEF DESCRIPTION OF THE STATE OF THE ART AND THE INNOVATION BREAKTHROUGHS

Many conferences and papers address the synergies between oil/gas and geothermal industry. The concept of “coproduction” of oil and geothermal energy is often related to conversion of heat from hot water produced together with oil , to electricity through “organic rankin” thermodynamic cycles.

Vermilion proposes to apply the coproduction concept to the *direct* use of heat by end-users. The key innovation in D4.2 is the involvement of local stakeholders to develop low-carbon energy projects and create local value.

1.3 CORRECTIVE ACTION (IF RELEVANT)

n/a

1.4 IPR ISSUES (IF RELEVANT)

n/a

2 DELIVERABLE REPORT

2.1 INTRODUCTION

The objective of the deliverable D4.2 is to give an overview of all the potential heat end-users near Vermilion sites in France. In order to achieve this, a methodology was followed and meetings were organized with local decision-makers.

2.2 POSSIBLE APPLICATIONS OF GEOTHERMAL RESSOURCE

This present report complements report D4.1, which consisted in mapping heat resources in Vermilion portfolio in France. Report D4.1 showed that the fluid temperature produced at the wellhead (on average 95% brine / 5% oil) can be as high as 95°C, while the brine stored in water tanks at surface and reinjected in dedicated water injection wells after separation is at lower temperature, ranging from 50°C to 70°C.

Figure 1 represents the Lindal diagram that summarizes the spectrum of geothermal heat direct uses according to temperature range.

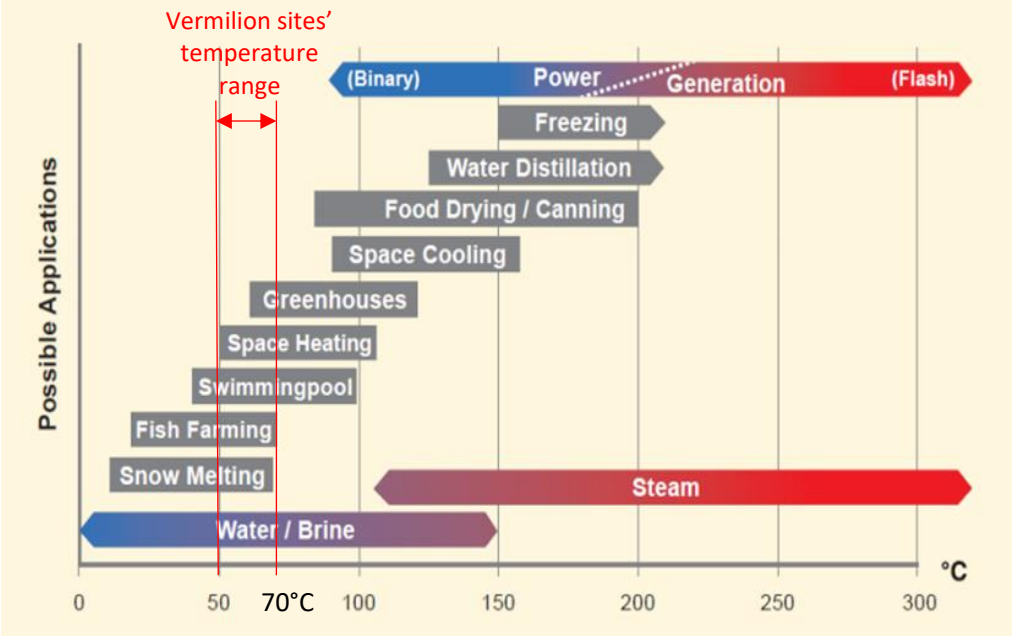

Figure 1: Lindal diagram of geothermal heat direct uses according to temperature ranges. (Source: Gehringer and Loksha, *Geothermal Handbook: Planning and Financing Power Generation*, ESMAP 2012)

Vermilion brine geothermal temperature covers several geothermal applications:

Space heating: Vermilion's resource is already used to heat up an eco-district in Arcachon. A visit was organised on 13/02/19 to gather learnings from the ENGIE Cofely that is exploiting the heat network (Annex 2.2). The Vermilion MEET team also attended a workshop related to district heating on 19/03/19, organised by key public stakeholders ADEME/BRGM/FNCCR/region IDF/AFPG. Details of district heating opportunities near Vermilion sites are given in section 2.4.

Greenhouses: Vermilion's resource is already used by Tom d'Aqui, a tomato greenhouse grower, to heat up 15 ha of greenhouse at Parentis oil facilities since 2008. A visit was organised on 06/03/19 to gather leanings (Annex 2.1). Other opportunities for greenhouse projects are presented in section 2.4.

Snow melting: not applicable because both Aquitaine and Paris basin have oceanic climates that block long winter: only 9 days/year of snow around Paris (last 10 years average).

Fish farming : not applicable. This application was investigated at a rear sturgeon installation in the Aquitaine basin (https://www.caviar-perlita.com). Heat is provided at a competitive price by a former oil well converted to a geothermal well. The geothermal resource (up to 200 m3/hr at 70°C) is used to maintain the breeding basins at a constant 17°C, therefore speeding up the breeding cycle by 18 months and also removing the seasonality. 400 t/year of caviar are produced and energy needs are about 45 GWh/year. The site visit (March 6th 2019) highlighted the very specific conditions for breeding (river stream nearby, very sensitive biological process) and the niche market. Therefore fish farming does not represent a potential market around Vermilion sites.

Swimming pool: This option has not been explored. To our knowledge there are no swimming pool projects under planning in the area where we operate.

A previous study carried out by Pôle AVENIA/ALCIMED (Analyse des voies de valorisation de la chaleur fatale issue des activités de geosciences, 2015) gives a panel of potential uses of residual heat produced by subsurface activities producing water. Eight mature markets and four emerging markets have been prioritised. The mature markets not already listed above are: wood drying and food drying process. The four emerging markets are: micro-algae production, biogas plant heating, insect breeding for food, aquaponics.

A report by public service ADEME (Etude des potentiels de production et de valorisation de chaleur fatale en Île-de-France, 2017) provides energy needs by type of potential users and capital cost estimates.

2.3 METHOD

The methodology used to evaluate the potential heat end-users is described in this section.

2.3.1 Scope

Table 1 below lists the Vermilion production sites in France and their resources' characteristics. The table is ranked by thermal capacity (estimated with a dT of 25°C).

Two sites (Parentis and Les Arbousiers) already have heat delivery ongoing: they are out-of-scope. Two other fields (Vic Bilh, Itteville) already have heat end-user identified with feasibility study ongoing: they are out-of-scope. Three fields have very too low surface temperature for direct use of heat: these are also out-of-scope. Finally, Courbey and Lavergne fields are located in a very sensitive environment: out-of-scope. Ten sites remain within scope.

Oil field (location)	Brine flow (m3/d)	Surface Temperature (°C)	Pth (MW)	Comment
Chaunoy (Saint Mery)	6103	70	5.9	in scope
Vert le Grand (Vert le Grand)	3402	70	3.3	in scope
Cazaux (La Teste / Cazaux)	3353	60	3.3	in scope
Malnoue (Malnoue)	1825	70	1.8	in scope
Lugos (Lugos)	1642	50	1.6	in scope
Vulaine (Saint-Loup-de-Naud)	1589	65	1.5	in scope
Champotran (Vaudoy)	1079	60	0.8	in scope
Charmotte (La Chapelle Rablais)	511	50	0.5	in scope
Charmotte (Fontains)	409	50	0.4	in scope
Les Pins (Arcachon)	350	65	0.3	in scope. water capacity to increase in 2019
Les Arbousiers (La Teste)	850	70	0.8	out of scope. heat delivery ongoing (ecodistrict)
Vic Bilh (Saint Jean Poudge)	2450	65	2.4	out of scope. Heat delivery project planned (Spiruline)
Chuelles (Chuelles)	1900	20		out f scope. direct use of heat not possible
St Firmin (Saint Firmin)	1700	20		out f scope. direct use of heat not possible
Chateaurenard (Triguères)	1100	20		out f scope. direct use of heat not possible
Parentis (Parentis)	10613	55	10.0	out of scope. heat delivery ongoing (greenhouse)
Itteville (Itteville)	829	60	0.8	out of scope. Heat delivery project planned (disctrict heating)
Courbey and Lavergne (Cap Ferret)	288	50	0.3	out of scope. very sensitive area
Donemarie (Mons en Montois)	194	70	0.2	out of scope. too small potential

Table 1: Vermilion sites' characteristics.

How far from the resource should one search for end-users ? With network connection costs estimated between 500 to 1500 €/linear meter depending on urban density, pipe material and diameter (source AVENIA-ALCIMED study 2015; CEREMA), geothermal heat cannot be transported very far to remain economic compared to other sources. A energy density of 1.5 MWh/linear meter is generally used as an economic limit for heat network (source CEREMA). An initial 3 km search radius was used for map-based search of end-users.

2.3.2 GIS and cartographic search

To identify all the potential heat end-users, a mapping study was carried out by using the GIS (Geographic Information System) tool. A description of the GIS used by Vermilion is given in Deliverable Report D4.1.

As for the inventory, the following GIS layers were used:

- Active injection wells,
- Water tanks at facilities sites,
- Active injection flowlines,
- Potential users: public data available about existing heat network, industry zones, public buildings, heat consumption density.

These potential heat end-users identified are summarised in Annex 1.

2.3.3 Meetings with current heat users

Please note, thanks to the European regulation on personal data protection, we do not provide any specific name of people in this report.

Vermilion currently supplies geothermal heat to two local users: Tom d'Aqui that is a tomato greenhouse grower company, and an Eco-district which heating network is operated by ENGIE Cofely that is a French leader company in heating networks and renewable energy services for districts and municipalities.

Meetings were held to gather information and learnings and see how these examples can be replicated on other sites. Details are provided in Annex 2.

Date	stakeholder	Function
11/02/2019	Mr. A	Operations Department Manager at ENGIE Cofely
06/03/2019	Mr. B	Director General at Tom d'Aqui
	Mr. C	Energy Manager at Tom d'Aqui

Table 2: Meeting with current heat users.

2.3.4 Meetings with local stakeholders

All sites described in Table 1 have been investigated for end-users. Most of the potential heat users are public stakeholders.
In the Aquitaine basin, meetings were held with relevant services of town halls of Arcachon and La Teste/Cazaux. The mayor of Lugos (Aquitaine) was interviewed by phone. The Cazaux military base was contacted by email.
In the Paris basin all mayors concerned with Vermilion activity were contacted by email, with follow-up discussions by phone. A workshop regarding Chaunoy / Champotran / Malnoue / Vulaines / Charmottes heat opportunities was then organised with the chamber of agriculture and the representatives of department Seine-et-Marne. A meeting was also held at the departmental office about Vert-le-grand heat opportunities.
Follow-up discussions are ongoing.
The Vermilion MEET team also attended a workshop related to district heating in the Paris area, organised by key public stakeholders ADEME/BRGM/FNCCR/region IDF/AFPG.

Table 3 summarizes the meetings that were held.

Date	Stakeholder	Function	Potential project(s)	Vermilion site(s) concerned
10/01/2019	Mr. D	Director, Seine et Marne attractivity	Heat projects in department 77	Chaunoy/Champotran/Charmottes/Vulaines/Malnoue
17/01/2019	Ms. E	Director, sustainable development at department 91 (Essone)	Heat projects in department 91	Vert-Le-Grand
31/01/2019	Mr. F	Director, Arcachon city hall services	Heat projects in Arcachon	Les Pins
12/03/2019	Mr. G	Deputy Director , La Teste city hall services	Housing plans in Cazaux	Cazaux
19/03/2019	ADEME/BRGM/FNCCR/AFPG/Paris region representatives	ADEME geothermal team	Geothermal projects in Paris area	all
04/04/2019	Mr. H	Tom d'Aqui's CEO	Installation of a 15-hectare tomato greenhouse	Chaunoy
05/04/2019	Mr. I	In charge of public high schools' renovation in the Nouvelle Aquitaine region	Condorcet high school's heating system renovation	Les Pins
11/04/2019	Mr. J	President of the CCBRC (Community of Communes Brie des Rivières and Châteaux)	Construction of a 110-hectare ZAC	Champotran
	Ms. K	Vice-President of the CCBRC (Community of Communes Brie des Rivières and Châteaux)	Construction of a new secondary school	Vaudoy
06/05/2019	Mr. L	SORGEM's Deputy Director-General	Housing construction La-Croix-Blanche	Vert-le-Grand

Table 3: meetings with prospective heat users

2.3.5 Key parameters for choosing heat delivery projects

A number of parameters are required as part of the inventory to select the most relevant projects (milestone MS3). The parameters are mainly defined after ADEME's own project funding criteria (ADEME is the public office in charge of implementing energy policies). The Information gathering is still ongoing as we write this report.

2.3.5.1 Feasibility of execution by August 2020 (Milestone MS4: heat exchanger in place, heat production starts)

2.3.5.2 Heat needs

- Customer energy needs: maximum power required, monthly/daily/hourly energy needs.
- Geothermal energy coverage %: how much of the user's energy needs can be covered by Vermilion geothermal resource over a 20-year horizon ?
- Network/building energy efficiency: How energy-effective are the heat network (if existing) and the buildings ?

2.3.5.3 Project's impact and benefits

- CO_2 footprint reduction for end-user, by replacing natural gas with geothermal heat.
- Job creation: competitive energy costs can help create economic activity such as greenhouses.
- Share of renewable energy: how will the geothermal heat help the end-user achieve a higher share of renewable energy in its energy mix ?
- Impact on Vermilion's local/regional acceptability
- End-user energy cost reduction: in the case of coproduction, wells and surface facilities are already in place and most of operating costs are covered by oil revenues, therefore a competitive heat price is expected to be achieved for the customer. Up to now Vermilion has provided heat to its end-user (section 2.3.3) at almost no cost. However the French context has evolved significantly as French government announced in December 2017 that by 2040 latest, exploitation of oil wells will cease. Conversion to geothermal activity is encouraged. It is therefore in everyone's interest to evaluate a business model for heat nearby Vermilion's existing facilities. Moreover, energy consumption reduction is an important pillar of the French energy strategy, meaning that energy must have a realistic cost for the customer. Finally, a fair price means a better customer service. The objective is therefore to achieve a "win-win" energy price, both for Vermilion and for the end-user. Market intelligence tells us that the "ceiling price" is about 40 - 45 €/MWh.

2.3.5.4 Project cost

Project cost shall be in line with the Grant provided by the EU. Project cost increases as distance between the end-user and the resource increases, we therefore prefer projects right next to our facilities/wells.

2.4 POTENTIAL HEAT END-USERS

By applying the method described in the previous section, potential heat end-users close by Vermilion sites in France have been identified and are described in this section.
The map below shows the location of the most advanced projects where Vermilion can be involved as a MEET decision-maker.

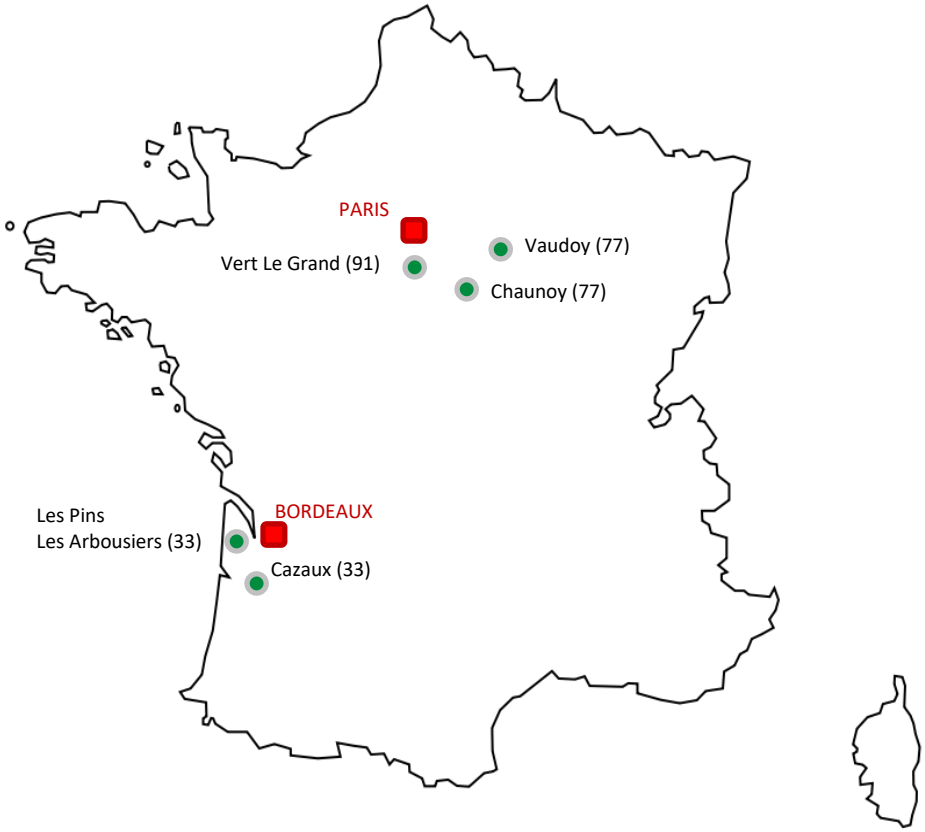

Figure 2: Position of the potential heat end-users identified near Vermilion sites in France.

2.4.1 Paris basin

The Paris basin potential is mainly about agricultural activities because the Vermilion sites are quite isolated.

2.4.1.1 Chaunoy field

Water flow rate	Temperature	Thermal power available
6103 m3/day	70°C	5.9 MW

Table 4: Chaunoy thermal resource

In Chaunoy area, two potential projects have been identified.

- **Tom d'Aqui's activity extension**

The tomato grower Tom d'Aqui is considering an activity extension in the Paris Basin, based on their success in Parentis. Based on Parentis greenhouse data, the project could be as big as 15 ha and require about 60 GWh of energy annually, bearing in mind that numbers must be adjusted to Paris climate. Tom d'Aqui is investigating the feasibility of the project, and a decision is expected by June 2019.

- **« ZAC des Bordes » Project**

A 10-hectare project is planned by CCBRC (Communauté de Communes Brie des Rivières et Châteaux) and will include an horticultural greenhouse activity. The public decision-makers are very positive about using Chaunoy's geothermal resource to heat the agricultural area. The two sites are about 6 km apart from each other (Figure 3). Follow-up meeting is planned for May 2019.

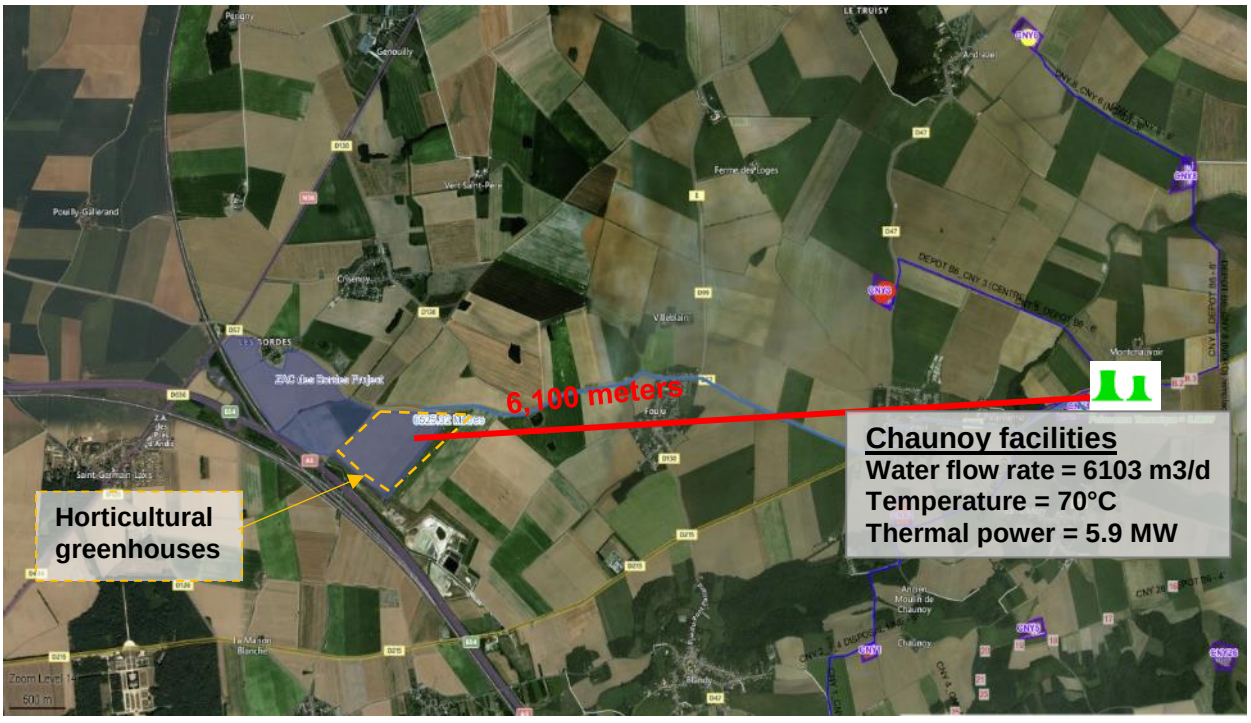

Figure 3: Position of ZAC des Bordes project which includes horticultural greenhouses.

2.4.1.2 Champotran field (Vaudoy facilities)

Water flow rate	Temperature	Thermal power available
1079 m3/day	60°C	1 MW

Table 5: Vaudoy thermal resource

A secondary school close by Jouy-le-Châtel will be built by 2022 on a 3.5-hectare area and will have a 400 student capacity, with possible extension to reach a 600 student capacity. The department Seine-et-Marne is interested to use Vermilion's resource for heat and sanitary water supplies as part of their low-carbon energy regional plans.

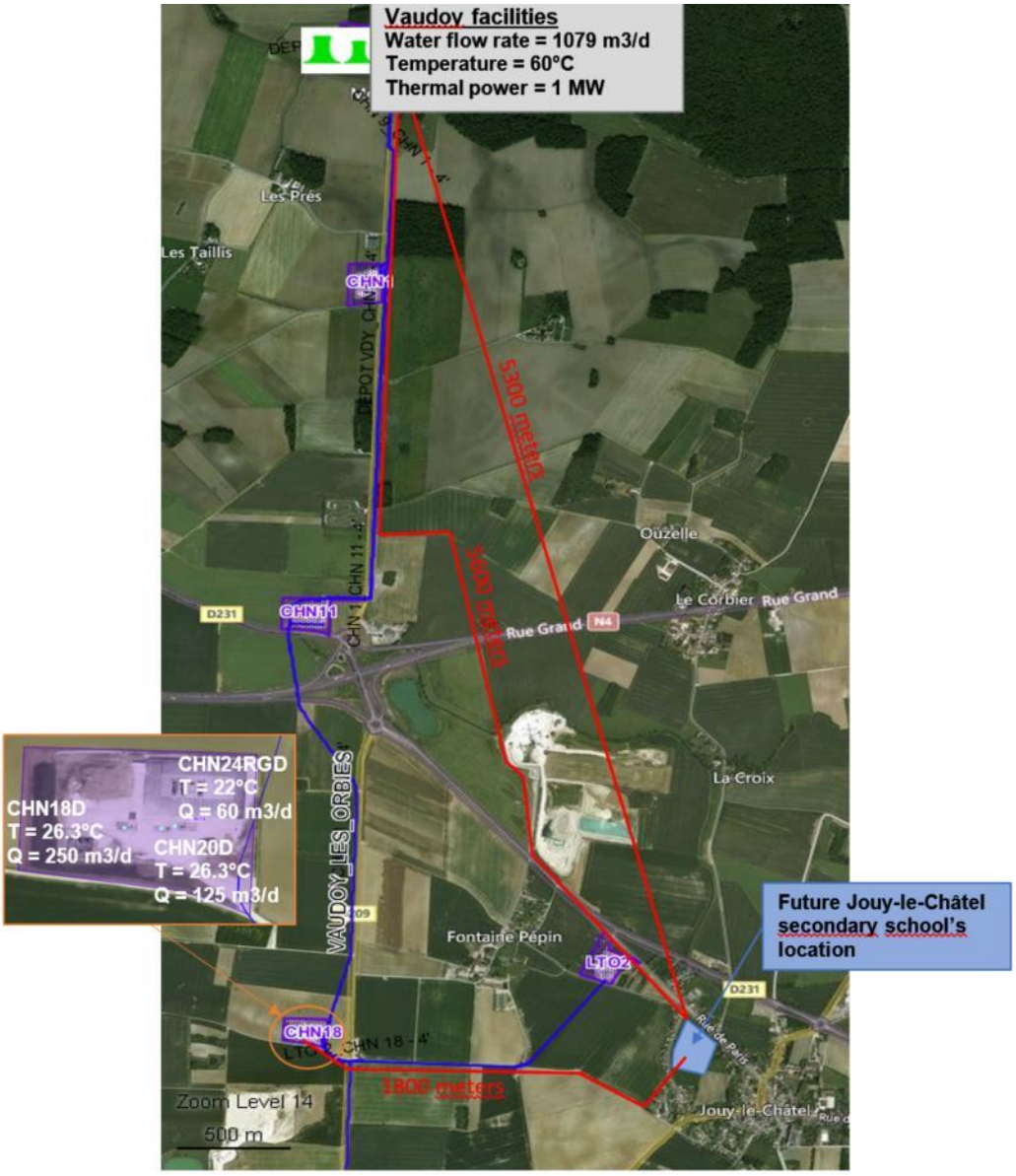

Figure 4: Position of the future Jouy-le-Châtel secondary school and Vermilion sites.

The Champotran surface facilities, that provide the highest thermal resource, are located more than 5 km away from the project location. Three injection wells (CHN18D, CHN20D and CHN24RGD) are located closer to the project location, however flow rates and temperatures are lower, thus heat pumps are probably required to meet the project heat demand.

2.4.1.3 Vert-le-Grand

Water flow rate	Temperature	Thermal power available
3402 m3/day	70°C	3.3 MW

Table 6: Vert-le-Grand thermal resource

The Mayors of Plessis-Pâté and Sainte-Geneviève-des-Bois are planning to build housing located 5 km from Vert-le-Grand facilities. About 500 equivalent residential units are planned, starting July 2023. Temperature and flow rate at nearby LCX wells are too low. Meeting with housing developer SORGEM is planned in May 2019.

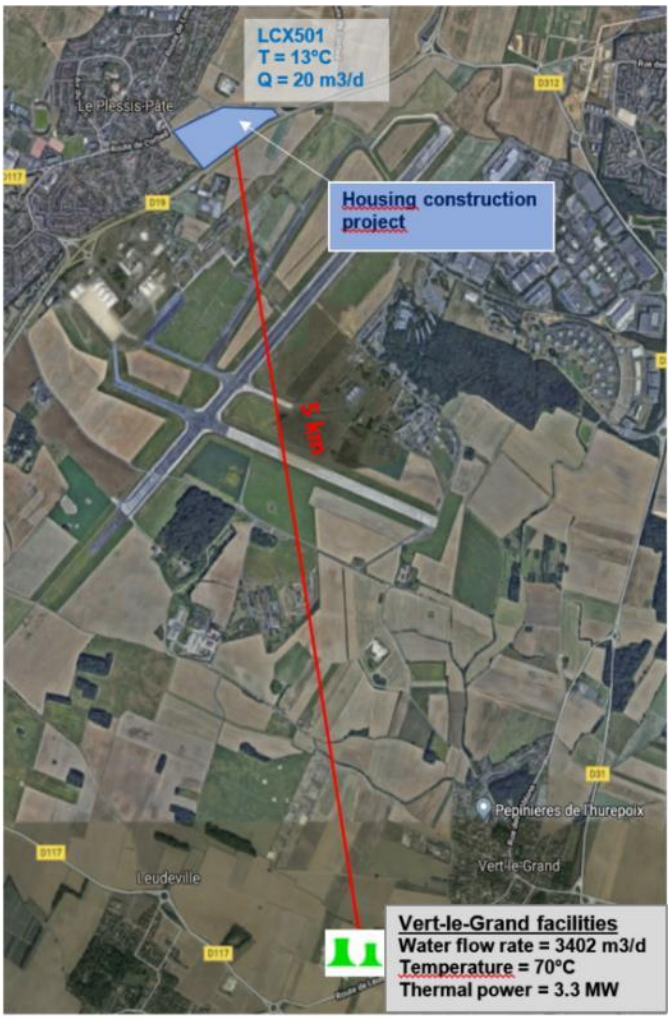

Figure 5: Position of the future housing district

2.4.1.4 Summary table for Paris basin

	CHAUNOY		CHAMPOTRAN	VERT-LE-GRAND
PROJECT	**Tom d'Aqui**	**ZAC des Bordes**	**New secondary school**	**Housing construction**
Description	15-ha tomato greenhouse	horticultural greenhouses	Public building on a 3.5-ha area	Residential district
Heat needs (if known)	~60 GWh/year	/	/	500 equivalent residential units = 6 GWh/year[1]
Start date	-	-	September 2022	July 2023
Potential Blocker to investigate		Distance to heat resource (connexion cost)	/	Distance to heat resource (connexion cost)
Next meeting	June 2019	May 2019	-	06/05/2019

Table 7: Summary table on the potential projects identified in the Paris basin.

[1] For space heating, heat needs are estimated to be 12 MWh/year/equivalent residential unit (Source: ADEME/AMORCE, 2017).

2.4.2 Aquitaine basin

2.4.2.1 Les Pins / Les Arbousiers

The geothermal resource, partly used by the eco-district, shall soon be enhanced to 750 kW by bringing an extra producer well online in 2019 (Table 8).

	LPS2 injector well	LEA 3 injector well	LEA 1 producer to be reactivated
Temperature (°C)	60	70	70
Water rate (m3/d)	350	850	400
Thermal power (kW)	350	800	400
Status	Available	Used for eco-district heating (section 2.3.3)	Available in 2019
Incremental thermal power available (kW)	750 Kw		

Table 8: Les Arbousiers / Les Pins thermal resource

Three potential users are being considered (Figure 6).

User 1: Condorcet high school

The public building's heat network is planned to be renovated, it is located 300 m from LPS2 injection well. The required power capacity is 550 KW for a heat consumption of 810 MWh (2017 data). The decision maker seems determined to evaluate feasibility quickly (within months). Heat resource can probably be enhanced if pipes are insulated (ongoing study). Pipeline temperature monitoring is planned for May 2019.

User 2: Extension of eco-district

The number of equivalent residential units are expected to double (+500 housing) by 2020, which will require energy needs equivalent to the heat delivered today: about 2500 MWh /year and thermal capacity of 1 MW. The extension is planned next to the current housing and could use LPS2 injection resource as well as LEA3 injector resource because both injection lines go through LEA3 surface location.

User 3: Real estate project after road rehabilitation

A housing development is planned about 1 km east of LEA3 injection site . No detailed information is available at the time.

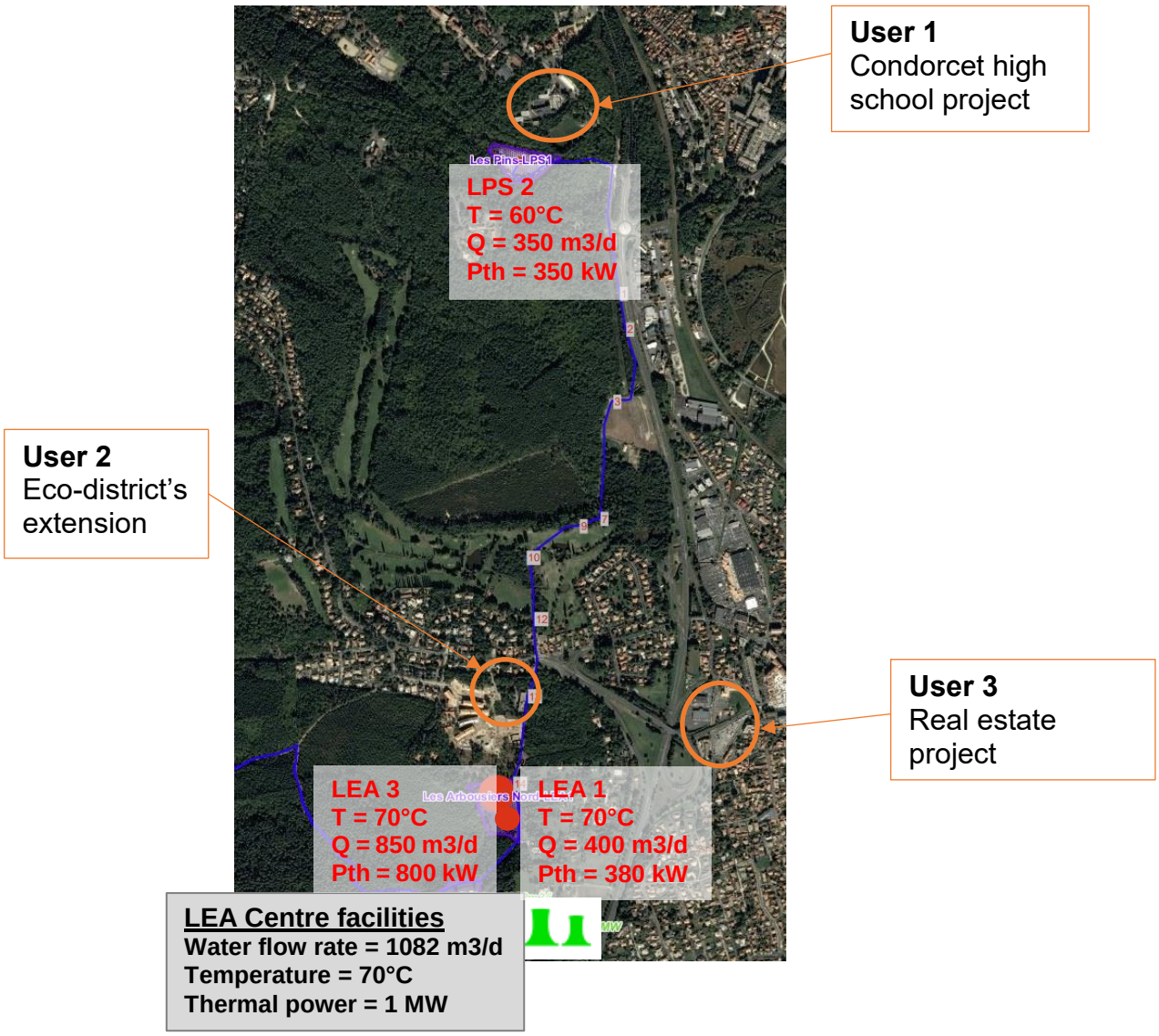

Figure 6: Position of the potential end – users

2.4.2.2 Cazaux

Water flow rate	Temperature	Thermal power available
3300 m3/day	60°C	3 MW

Table 9: Cazaux thermal resource

Two potential projects can be considered in Cazaux (Figure 7).

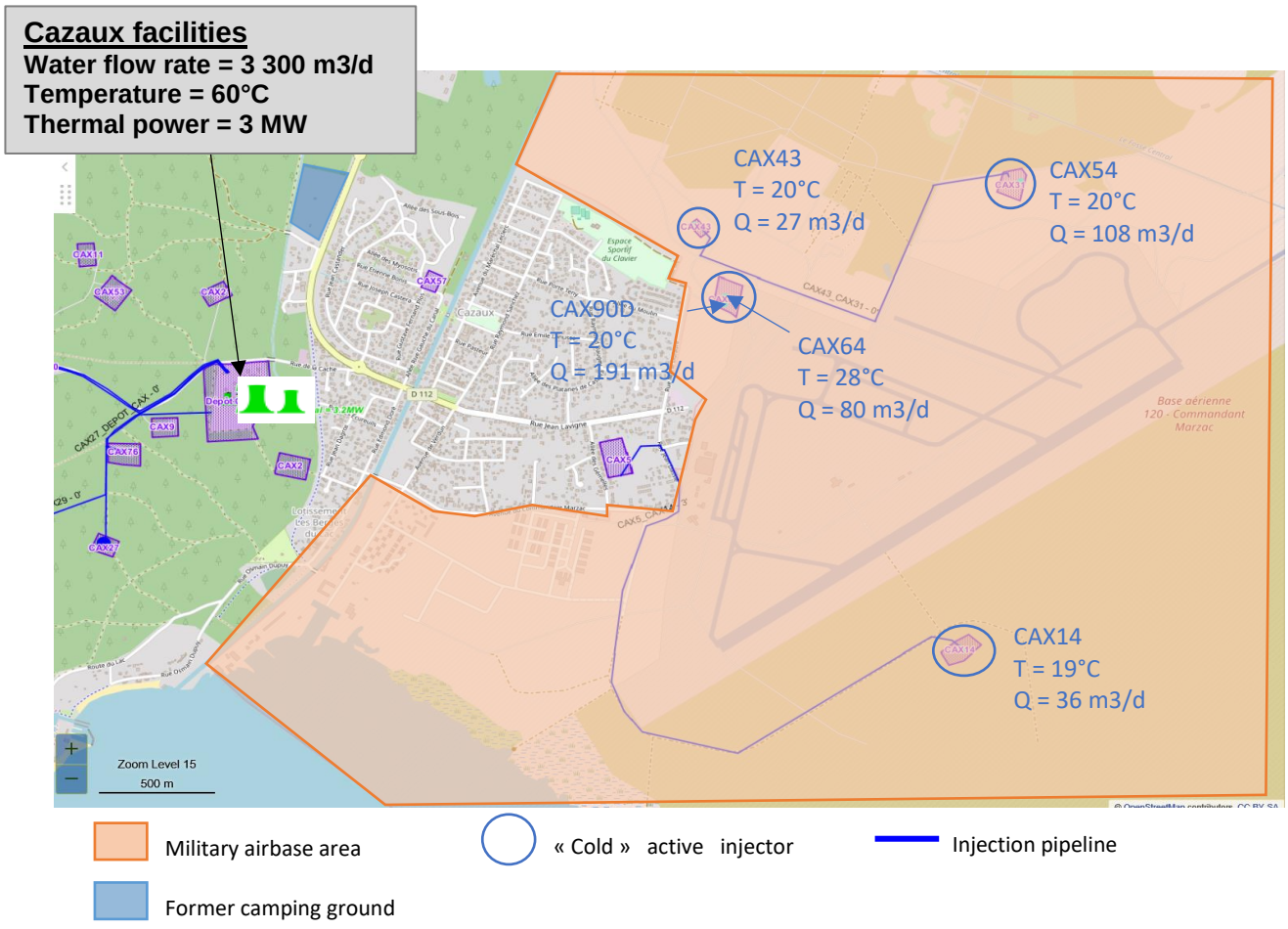

Figure 7: Position of the two potential users near Cazaux field

User 1 : Cazaux military airbase

The military base is 2 km away from the Cazaux facilities where the highest thermal resource is available. Some shallow water injectors (Vermilion wells) are located on the airbase but they have low temperature and quite flow rates (Figure 7). The military base energy needs are ~ 20 GWh/year for a heat capacity of 15 MW.

User 2: Potential housing project on a former camping ground

Until October 2018, a 57,000-square-meter municipal area was occupied by a camping activity, just 500 m north of the Cazaux facilities. Since then, the municipality has reclaimed the area and has submitted a new development plan to the state for housing development. The approval process is currently suspended. The plan is to build 150 housings within 3 years, and then 400 to

600 housings within 3 to 5 years. The city hall is very interested to study heat delivery by Cazaux facilities.

2.4.2.3 Vic Bilh

An algae farm project (Spirulina algae) is under confidentiality clause by the industrial partner. It is therefore out of MEET scope. If successful, the spirulina farm could be replicated at other Vermilion sites.

2.4.2.4 Summary table for Aquitaine basin

	LPS / LEA			CAZAUX	
PROJECT	**Condorcet high school**	**Eco-district extension**	**Real estate project**	**military airbase**	**Urban development**
Description	Heating system refurbishment	+500 housing	Housing	Heating system refurbishment	- 150 housing within 3 years - 400 to 600 housing within 3 to 5 years
Heat needs (if known)	810 MWh	~ 2.5 GWh [1]	-	20 GWh	~2 to 7 GWh[2]
Start date	Asap	2020	After 2021	-	within 3 to 5 years at earliest
Potential Blocker to investigate	LEA1 success	-	-	Connection cost (dense urban area)	Project blocked by state
Next meeting	May 2019	May 2019	-	June 2019	-

Table 10: Summary table on the potential projects identified in the Aquitaine basin.

[1] Estimations from data gathered during the operation feedback session (see section 3.2.2)

[2] For space heating, heat needs are estimated to be 12 MWh/year/equivalent residential unit (Source: ADEME/AMORCE, 2017).

2.5 CONCLUSION AND WAY FORWARD

This report highlights a keen interest by local stakeholders around Vermilion production sites. Further work needs to be done to check the feasibility by mid-2020, which is a blocker for some projects.

The next steps are

- Ranking of projects that are feasible by mid-2020
- Decision to proceed to detailed feasibility, by Vermilion and end-user: milestone MS3, by August 2019.
- Surface engineering study : design , cost , planning. By end 2019
- Economic study to determine a “win-win” heat price. By end 2019
- Regulatory application. By Q1 2020
- Subsurface engineering study: long-term thermal resource. By Q1 2020
- Formal commercial agreement between Vermilion and end-user. By Q1 2020
- Purchasing equipment, connexion work and heat exchanger commissioning. By Q2 2020
- Heat production to start by milestone MS4: august 2020

3 ANNEXES

3.1 ANNEX 1: TABLE LISTING POTENTIAL HEAT END-USERS BASED ON A GIS SEARCH

3.1.1 In the Parisian Basin

Data site Vermilion	Critères:	Itteville K1	Bac Charmotte	Bac Charmotte (la	Donnemarie	St Méry Chaunoy	VLG : dépôt	Malnoue	Vulaines	Champotran	Trigueres
	Puissance thermique (MW)	0,8	0,4	0,5	0,2	5,9	3,3	1,8	1,5	8	
	KWh/an	700800	350400	438000	175200	5168400	2890800	1576800	1314000	7008000	
	Equivalence logement de 100m²	54	27	34	13	398	222	121	101	539	
	Température eau (°C)	60	50	50	70	70	70	70	65	60	23
	Débit eau										

Utilisateurs potentiels	Critères:	Ecole maternelle Elsa Triolet	Mairie de Fontains	Mairie Chapelle Rablais	Ecole élémentaire de Mons en Montois	Mairie de Saint Méry	Groupe Scolaire Ecole Maternelle Croix	Ecole élémentaire de Marolles en Brie	Ecole primaire de St Loup de Naud	Ecole de Vaudoy-en-Brie	Elevage escargot JPS
	Localisation	Chemin du Lanscanet, 91760 Itteville	2 Rue de la Grelotterie, 77370 Fontains	Place de l'Église, 77370 La Chapelle-Rablais	24 grande Rue, 77520 Mons en Montois	22 Rue de l'Église, 77720 Saint-Méry	27 Rue de la Poste, 91810 Vert-le-Grand	Place de la mairie, 77120 Marolles en Brie	2 rue des écoles, 77650 St Loup de Naud	13 rue du Tour de l'Eglise, 77141 Vaudoy en Brie	
	Type de bâtiment		Public	Public	public	Public			public		
	Existant/ projet	Existant	Existant	Existant	existant	Existant	Existant	Existant	existant	existant	
	Type de chauffage actuel										
	Obstacles entre site VRM et utilisateur	Champs	route	Petite route	ville	routes et forêt	traverse la ville		routes		
	Rural/ résidentielle	rural et residentielle	village	village	residentielle	village	résidentielle		village		
	Distance entre site VRM et utilisateur	750m	1118m	715m	1800m	859m	1200m	1800m	1400m	3300m du dépôt / 1300m de injection	
	Besoin de chauffe										
	contribution par VRM (%)										
	Impact social										
	Impact environnemental (CO2...)										
	Note		A rajouter sur le SIG			A rajouter sur le SIG					
	Contact		mairie.de.fontains@wanadoo.fr	mairiechapellerablais@orange.fr	mairiemonsenmontois@wanadoo.fr	mairie@saintmery.fr	commune-vert-le-grand@wanadoo.fr		mairie.saint.loup.de.naud@wanadoo.fr	vaudoy-en-brie@wanadoo.fr	
	Infos		mail mairie envoyé 12/03	mail envoyé 12/03	mail envoyé 12/03	mail envoyé 12/03	mail envoyé 12/03	Incohérence adresse, erreur SIG? école existante?	mail envoyé 12/03	mail envoyé 12/03	
	Critères:	**Ecole élémentaire Jean Jaurès**	**Ecurie et Elevage de Courtenain**	**Ecole élémentaire les Montils**	**Collège du Montois**	**Mairie de Champeaux**	**Ecole élémentaire le Tilleul**	**Plateau EPS / multisports**	**Ecole primaire Armand Francois**	**Ecole primaire Jehan de Brie**	
	Localisation	25 rue Jean Jaurès, 91760 Itteville	12 Route de Fontainebleau, 77370 Nangis	place de l'Eglise, 77370 La chappelle Rablais	34 route de Provins, 77520 Donnemarie Dontilly	5 Rue du Cloître, 77720 Champeaux	Grande rue, 91630 Leudeville	Lieu-dit la Cressonnière, Marolles en Brie	7 chemin du Marias, 77650 Ste Colombe	11 rue DES FOSSES, 77970 Jouy-le-Châtel	
	Type de bâtiment	public	entreprise	public	public	Public	Public		public		
	Existant/ projet	existant		existant	existant	existant	existant	existant	existant	Existant	
	Type de chauffage actuel					Chauffage central gaz ECS gaz 350 m2					
	Obstacles entre site VRM et	champs + rue		champs et départementale	ville		departementale et village	routes	champs et 1 départementale		
	Rural/ résidentielle	résidentielle		rural et village	résidentielle		village	rural	village		
	Distance entre site VRM et utilisateur	600m	500m	750m	2100m	1400m	1500m	2300m	2500m	900m de injection	
	Besoin de chauffe					Conso au 18/03 : 80000 kWh (année pose compteur > 10 ans)					
	contribution par VRM (%)										
	Impact social										
	Impact environnemental (CO2...)										
	Note			Inexistant sur Google Maps							
	Contact				mairie-donnemarie@wanadoo.fr	http://champeaux-77.fr/index.php	mairie@leudeville.fr		mairie.ste.colombe@gmail.com	mairiejouylechatel@wanadoo.fr	
	Infos	A noter que les deux sites de Itteville sont proches donc les deux peuvent fonctionner pour ces deux écoles.		mail envoyé mairie 12/03	mail envoyé 12/03	formulaire contact 12/03	mail envoyé 12/03	Incohérence adresse, erreur SIG? école existante?	mail envoyé 12/03	mail envoyé 12/03	

Data site Vermilion	Critères:	Itteville K1	Bac Charmotte	Bac Charmotte (la	Donnemarie	St Méry Chaunoy	VLG : dépôt	Malnoue	Vulaines	Champotran	Trigueres
	Puissance thermique (MW)	0,8	0,4	0,5	0,2	5,9	3,3	1,8	1,5	8	
	KWh/an	700800	350400	438000	175200	5168400	2890800	1576800	1314000	7008000	
	Equivalence logement de 100m²	54	27	34	13	398	222	121	101	539	
	Température eau (°C)	60	50	50	70	70	70	70	65	60	23
	Débit eau										

Utilisateurs potentiels	Critères:	Ecole Jacques Prevert	SARL François et Fils	Plateau EPS / multisports	Ecole élémentaire de l'Auxence	Ecole élémentaire de Champeaux	Ecole maternelle Chant du Coq	Salle polyvalente		Ecole primaire les 2 Tilleuls	
	Localisation	Chemin de Paris, 91760 Itteville	Rue Trévois; 77370 Fontains	Route de Coutençon, 77370 La Chapelle Rablais	2 rue Radepont, 77520 Donnemarie Dontilly	Place du Cloître, 77720 Champeaux	rue du chant du coq, 91630 leudeville	7 rue Creuse, 77120 Marolles-en-Brie		Rue du Prieuré, 77370 Pécy	
	Type de bâtiment				public	Public	public				
	Existant/ projet	Existant	entreprise	existant	existant	Existant	existant			Existant	
	Type de chauffage actuel					Chauffage central gaz ECS gaz 350 m2					
	Obstacles entre site VRM et utilisateur	2 départemnetales		possibilité de ne couper que des champs	ville	route	départementale, village				
	Rural/ résidentielle	résidentielle // rural (possibilité de passer par champs		rural	résidentielle		village				
	Distance entre site VRM et	1300m	500m	1200m	2100m	500m	1500m			1900m injection	
	Besoin de chauffe					cf. valeur mairie (conso commune)					
	contribution par VRM (%)										
	Impact social										
	Impact environnemental (CO2...)										
	Note			Inexistant sur Google Maps							
	Contact				mairie-	formulaire contact 12/03	mairie@leudeville.fr			commune-de-pecy35@orange.fr	
	Infos		Construction de matériel professionnel pour l'entretien des espaces verts et de voirie => besoin de chaleur pour chauffer locaux ?	mail envoyé mairie 12/03	mail envoyé 12/03	école de 23 élèves sans cantine	mail envoyé 12/03			mail envoyé 12/03	
	Critères:	**Collège Robert Doisneau**			**Ecole maternelle la Butte st Pierre**	**Ecole maternelle de Champeaux**	**Collège st Exupéry/ et gymnase a coté**			**Salle d'arts martiaux**	
	Localisation	Rue du Bouchet, 91760 Itteville			butte saint pierre, 77520 Donnemarie Dontilly	rue Sarazin Desmarayse, 77720 Champeaux	Chemin de paris 91630 marolle en hurepoix				
	Type de bâtiment	public			Public	Public	public				
	Existant/ projet	existant			Existant	Existant	existant				
	Type de chauffage actuel					Chauffage central gaz ECS gaz 200 m2 Conso au 18/03 : 140000 kWh (année pose compteur > 10					
	Obstacles entre site VRM et	route départementale, village			ville	départementale					
	Rural/ résidentielle	résidentielle			résidentielle						
	Distance entre site VRM et utilisateur	1500m			2200m	600m	2km de canalisation injection				
	Besoin de chauffe										
	contribution par VRM (%)										
	Impact social										
	Impact environnemental (CO2...)										
	Note	salle de danse juste à coté									
	Contact				mairie-	formulaire contact 12/03	mairie@marolles-en-				
	Infos				mail envoyé 12/03	45 élèves avec cantine	mail envoyé 12/03				

Data site Vermilion	Critères:	Itteville K1	Bac Charmotte	Bac Charmotte (la	Donnemarie	St Méry Chaunoy	VLG : dépôt	Malnoue	Vulaines	Champotran	Trigueres
	Puissance thermique (MW)	0,8	0,4	0,5	0,2	5,9	3,3	1,8	1,5	8	
	KWh/an	700800	350400	438000	175200	5168400	2890800	1576800	1314000	7008000	
	Equivalence logement de 100m²	54	27	34	13	398	222	121	101	539	
	Température eau (°C)	60	50	50	70	70	70	70	65	60	23
	Débit eau										

Utilisateurs potentiels	Critères:					ZAC des Bordes (nouvelles serres)	Médiathèque municipale			Mairie Pécy ?	
	Localisation					Crisenoy (entre autourte et ligne TGV)	27 rue de la poste, 91810 Vert-le-Grand				
	Type de bâtiment						Public				
	Existant/ projet					Non existant	Existant				
	Type de chauffage actuel										
	Obstacles entre site VRM et						Route				
	Rural/ résidentielle						Résidentiel				
	Distance entre site VRM et utilisateur					6100m	1700m				
	Besoin de chauffe										
	contribution par VRM (%)										
	Impact social										
	Impact environnemental (CO2...)										
	Note						Juxtaposé à l'école La Croix Boissée				
	Contact						commune-vert-le-grand@wanadoo.fr				
	Infos					La CCBRC très intéressée	Infos à demander quand retour mail de la mairie (omis dans le 1er mail car site identifié après envoi)				
	Critères:						**Nouveau quartier**			**Sapeurs pompiers**	
	Localisation						Plessy Paté (rond-point / route de Borbeil)			rue de Parie, 77970	
	Type de bâtiment						Privé				
	Existant/ projet						Non existant				
	Type de chauffage actuel										
	Obstacles entre site VRM et utilisateur										
	Rural/ résidentielle										
	Distance entre site VRM et utilisateur						5000m			350m	
	Besoin de chauffe										
	contribution par VRM (%)										
	Impact social										
	Impact environnemental (CO2...)										
	Note										
	Contact						Olivier GOSSET (contact par JPS)				
	Infos						RDV prévu le 6/05/19				

	Critères:	Itteville K1	Bac Charmotte	Bac Charmotte (la	Donnemarie	St Méry Chaunoy	VLG : dépôt	Malnoue	Vulaines	Champotran	Trigueres
Data site Vermilion	Puissance thermique (MW)	0,8	0,4	0,5	0,2	5,9	3,3	1,8	1,5	8	
	KWh/an	700800	350400	438000	175200	5168400	2890800	1576800	1314000	7008000	
	Equivalence logement de 100m²	54	27	34	13	398	222	121	101	539	
	Température eau (°C)	60	50	50	70	70	70	70	65	60	23
	Débit eau										

	Critères:									Gendarmerie	
Utilisateurs potentiels	Localisation									42 rue de Provins, 77970 Jouy-le-Châtel	
	Type de bâtiment										
	Existant/ projet										
	Type de chauffage actuel										
	Obstacles entre site VRM et										
	Rural/ résidentielle										
	Distance entre site VRM et utilisateur									1400m	
	Besoin de chauffe										
	contribution par VRM (%)										
	Impact social										
	Impact environnemental (CO2...)										
	Note										
	Contact										
	Infos										
	Critères:									Mairie Jouy le Châtel	
	Localisation									Place de l'Eglise, 77970 Jouy-le-Châtel	
	Type de bâtiment										
	Existant/ projet										
	Type de chauffage actuel										
	Obstacles entre site VRM et										
	Rural/ résidentielle										
	Distance entre site VRM et utilisateur									1000m	
	Besoin de chauffe										
	contribution par VRM (%)										
	Impact social										
	Impact environnemental (CO2...)										
	Note										
	Contact										
	Infos										
	Critères:									Collège Jouy le Châtel	
	Localisation									Intersection entre rue de Paris et rue de la Belle Idée	
	Type de bâtiment									Public	
	Existant/ projet									Non existant (prévu pour sept. 2022)	
	Type de chauffage actuel										
	Obstacles entre site VRM et										
	Rural/ résidentielle										
	Distance entre site VRM et									5300m	
	Besoin de chauffe										
	contribution par VRM (%)										
	Impact social										
	Impact environnemental (CO2...)										
	Note										
	Contact										
	Infos									Projet par la CCBRC	

Table 11: Table listing potential heat end-users based on a GIS search (Parisian basin).

3.1.2 In the Aquitaine Basin

	Critères:	Vic Bilh (dépôt)	Lugos (dépôt)	Cazaux	Les pins
Data site Vermilion	Puissance thermique (MW)	2,4	1,6	3,3	1
	KWh/an	2102400	1401600	2890800	876000
	Equivalence logement de 100m²	162	108	222	67
	Température eau (°C)	65	50	60	65
	Débit eau				

	Critères:	Vic Bilh (dépôt)	Lugos (dépôt)	Cazaux	Les pins
Data site Vermilion	Puissance thermique (MW)	2,4	1,6	3,3	1
	KWh/an	2102400	1401600	2890800	876000
	Equivalence logement de 100m²	162	108	222	67
	Température eau (°C)	65	50	60	65
	Débit eau				

	Critères:	Pas de lieu public	Mairie de Lugos	(projet à la place du	Lycée Condorcet
Utilisateurs potentiels	Localisation		2 Rue de la Mairie, 33830 Lugos		1 Avenue Roland Dorgeles, 33311 Arcachon
	Type de bâtiment		Public		
	Existant/ projet		Existant	non existant	Existant
	Type de chauffage actuel				
	Obstacles entre site VRM et		Route + departementale		coupe 1 route (petite)
	Rural/ résidentielle		residentielle		rural
	Distance entre site VRM et		1100m		140 m
	Besoin de chauffe				
	contribution par VRM (%)				
	Impact social				
	Impact environnemental (CO2...)				
	Note				
	Contact		lugos.fr		
	Infos		mail envoyé 12/03		contact mr pujos
	Critères:		**Ecole primaire du Brana**	**Mairie annexe de Cazaux**	**Salle omnisports**
	Localisation		20 rue des Ecoles, 33830 Lugos	1 Rue des Fusillés, 33260 La Teste-de-Buch	Avenue du Dr Lorentz Monod, 33120 Arcachon
	Type de bâtiment		public	Public	
	Existant/ projet		existant	Existant	Existant
	Type de chauffage actuel		Chaudière au fioul		
	Obstacles entre site VRM et utilisateur		départementale, rue, habitations	route, forêt	coupe 2 routes (petites)
	Rural/ résidentielle		résidentielle	résidentielle	rural (quartier pas loin)
	Distance entre site VRM et		1275m	690m	280 m
	Besoin de chauffe				
	contribution par VRM (%)				
	Impact social				
	Impact environnemental (CO2...)				
	Note				
	Contact		commune@commune-lugos.fr		
	Infos		mail envoyé 12/03	L'architecte Jean Dubrous a conçu une résidence à loyers modérés, La Dune blanche qui s'inscrit dans le concept actuel et qui s'intègre à l'environnement, apportant une vision plus élargie du carrefour..La mairie annexe qui fait partie intégrante de la résidence, occupe une superficie de 240 mètres carrés abritant trois bureaux, une salle des mariages, deux	

	Critères:	Vic Bilh (dépôt)	Lugos (dépôt)	Cazaux	Les pins
Data site Vermilion	Puissance thermique (MW)	2,4	1,6	3,3	1
	KWh/an	2102400	1401600	2890800	876000
	Equivalence logement de 100m²	162	108	222	67
	Température eau (°C)	65	50	60	65
	Débit eau				

	Critères:			Ecole élémentaire Cazaux Lafon	Collège Marie Bartette
Utilisateurs potentiels	Localisation			Place du General De Gaulle, 33260 La Teste de Buch	9 Avenue Roland Dorgeles, 33120 Arcachon
	Type de bâtiment			public	
	Existant/ projet			existant	Existant
	Type de chauffage actuel				
	Obstacles entre site VRM et			ville	coupe 2 routes (petites)
	Rural/ résidentielle			résidentielle	rural (quartier pas loin)
	Distance entre site VRM et			900m	390 m
	Besoin de chauffe				
	contribution par VRM (%)				
	Impact social				
	Impact environnemental (CO2...)				
	Note				
	Contact				
	Infos				
	Critères:			Ecole maternelle Cazaux le Farandole	Planète 9 (salle de muscu et cardio)
	Localisation			18 av du Maréchal Leclerc, 33260 La teste de Buche	Rue lagrua la teste
	Type de bâtiment			public	
	Existant/ projet			existant	
	Type de chauffage actuel				
	Obstacles entre site VRM et			ville	
	Rural/ résidentielle			résidentielle	
	Distance entre site VRM et			920m	proche canalisation
	Besoin de chauffe				
	contribution par VRM (%)				
	Impact social				
	Impact environnemental (CO2...)				
	Note				
	Contact				
	Infos				
	Critères:			Base aérienne	
	Localisation				
	Type de bâtiment				
	Existant/ projet				
	Type de chauffage actuel			Puissance des chaufferies : 8 MW centrale base + 7,5 MW chauffage central DGA	
	Obstacles entre site VRM et				
	Rural/ résidentielle				
	Distance entre site VRM et				
	Besoin de chauffe			19 GWh/an	
	contribution par VRM (%)				
	Impact social				
	Impact environnemental (CO2...)				
	Note				
	Contact				
	Infos				

Table 12: Table listing potential heat end-users based on a GIS search (Aquitaine basin).

3.2 ANNEX 2

3.2.1 Annex 2.1: Tom d'Aqui

Tom d'Aqui is tomato greenhouse grower located next to Vermilion's Parentis site. They have developed their activity with the Vermilion's help as heat is supplied for free since 2008. Today, their activity covers 15 hectares.

3.2.1.1 Vermilion's thermal heat resource's characteristics

At Parentis Depot, a huge volume of water is reinjected: 10,500 m3/d at an average temperature of 55°C, which is equivalent to a theoretical thermal power equal to 8 MW.

This geothermal heat is extracted through a 800 kW-titanium plate heat exchanger.

3.2.1.2 Tom d'Aqui's heat needs

As Tom d'Aqui is a tomato greenhouse grower, their energy needs are different depending on the seasons:

- During winter, the geothermal heat supplied by Vermilion heats the greenhouses to ensure good growing conditions.
- During summer, the energy needs decrease and geothermal heat is less exploited but the greenhouses still have to be heated to prevent from condensation risks and fungus. Indeed, this condensation phenomenon can heavily affect the tomato plants as high humidity favors the plants to develop diseases.

By preventing the greenhouses from condensation, Tom d'Aqui limits plant treatments, and guarantee pesticide residue free products.

According to Mr. C's expertise, the Energy Manager at Tom d'Aqui, a minimum temperature of 55°C ensures good operating and growing conditions.

3.2.1.3 Tom d'Aqui's energy mix and needs

At the beginning of their activity, the 8 MW available on the Parentis site were sufficient to cover the heat needs of the first 6.5-hectare greenhouse built. Then, as Tom d'Aqui have extended their activity, now representing a total surface of 10 hectares, Vermilion's geothermal heat needs to be assisted by another source of energy: gas is the solution chosen by Tom d'Aqui.

Tom d'Aqui declared that they cannot be fully dependent on geothermal energy only. Indeed, if Vermilion's oil production has to be stopped for any reason or if the temperature fluctuates, they need a backup solution. Their energy mix is as followed:

- Greenhouses' heat needs are mainly supplied by Vermilion's geothermal heat
- Gas produced by co-generation activity constitutes their backup solution

- A wood-fired boiler is also on site, but is currently not in operation: this installation is the gas' backup solution.

For economical and operational reasons, the biomass-fired boiler solution is less competitive:

- High purchase price of wood
- Operational costs
- Thermal inertia takes longer to be reached
- Complex thermal regulation
- Treatment of ashes

With this energy mix, two buffer tanks are needed to avoid thermal disturbances as hot water produced by Vermilion or by co-generation is at two different temperatures:

- 1 low temperature buffer tank: storage of water heated by Vermilion's geothermal resource (55°C)
- 1 high temperature buffer tank: storage of water heated by co-generated gas (90°C)

Hot water buffer tank is an essential element for any greenhouse activity. As for Tom d'Aqui's activity, 2000 to 3000 cubic meter of hot water have to be stored on site to supplier their 10 hectares of crop for one day.

3.2.1.4 Energy consumption

The greenhouse needs about 60 GWh / year , covered at 80% by geothermal resource.

3.2.1.5 Heat exchanger installation

The heat exchanger is located on Vermilion Parentis surface site

Figure 8: Heat exchanger installation.

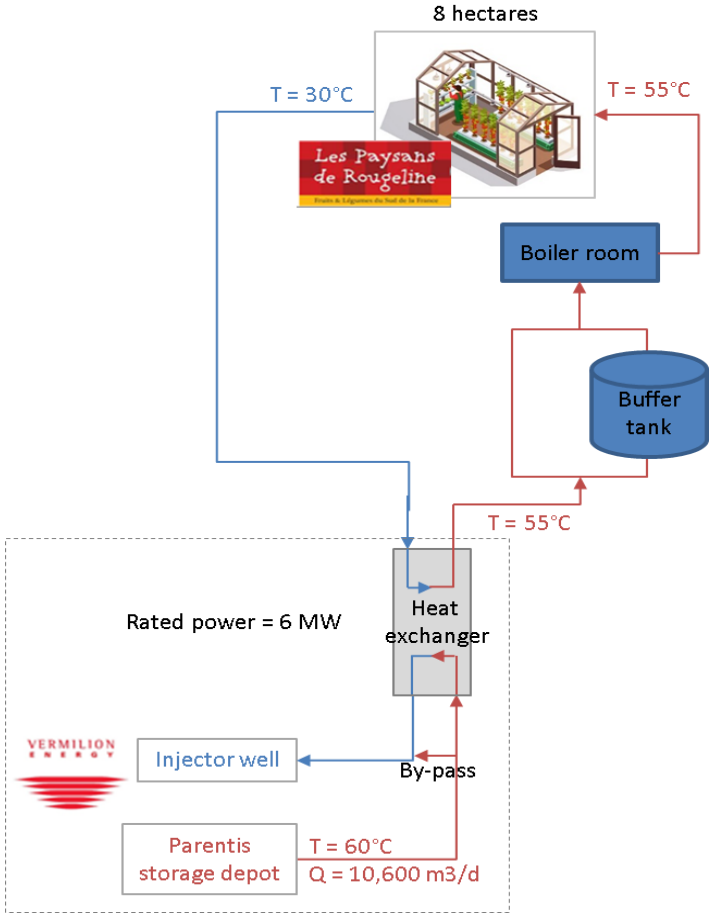

Figure 9: Heat network connecting Vermilion Parentis depot and Tom d'Aqui.

3.2.1.6 Vermilion's contribution to the Tom d'Aqui concern

By using Vermilion's heat, Tom d'Aqui has achieved significant cost savings: the 25-years contract guaranteeing heat supply at no cost offers Tom d'Aqui the opportunity to grow pesticide residue free products, making them competitive in the sector.

Vermilion has also contributed in local job creation: 250 jobs have been created since 2008, enhancing local development and economy.

3.2.1.7 Tom d'Aqui's feedback on their operational difficulties

- The first heat exchanger installed was in alloy 316 and was deteriorated as the water produced by Vermilion is corrosive and carries (triggers) oil depositions. Corrosion and leaks were observed less than 6 months after the heat exchanger's installation. A titanium heat exchanger has since been installed. The water properties directly depend on the efficiency of the oil to water separation.
- Vermilion's geothermal resource's temperature fluctuations can affect the growing conditions of the tomato plants. Indeed, the optimal temperature is 55°C and Vermilion supplies a resource which sometimes shows a temperature that can be under this threshold. Depending on which well is used (choice between 60 oil production wells in Parentis), the water income can have a variable flow and temperature depending on the daily fluctuating oil production.

3.2.1.8 Prospects and opportunities

Up to now, only 50% of the French tomato consumption is produced in France. This is an opportunity for Vermilion to supply geothermal heat to replicate this activity near their other sites.

3.2.2 Annex 2.2: Eco-district

Among the different concessions owned by Vermilion in France, the one located in La Teste produces hot water which is used since July 2017 to supply heat for the Eco-district Les Portes du Pyla, in La Teste-de-Buch. That energy is exploited through a win-win partnership with ENGIE Cofely, which is a French leader company in heating networks and renewable energy services for districts and municipalities.

3.2.2.1 Vermilion's thermal heat resource's characteristics

Water is separated from the oil and gas is characterized by a temperature of 70°C and a volumetric flow of 850 m^3/d. Considering a temperature of 50°C at the injector well, the theoretical thermal power available at this site is estimated at 800 to 900 kW.

To extract the thermal heat from the geothermal resource, a counter-flow plate heat exchanger was installed at LEA N site. This 79-titanium-plate heat exchanger was designed for a thermal power equal to 800 kW.

3.2.2.2 The eco-district project and Vermilion's involvement

The eco-district Les Portes du Pyla, located in La Teste-de-Buch, covers over 11 hectares and represents 500 equivalent residential units. 80% of its energy mix is covered by geothermal heat supplied by Vermilion. The 20% left are from gas based origins and supplied by ENGIE Cofely.

Thanks to this free heat supplied by Vermilion, ENGIE Cofely is in a position to offer heat to end consumers at a competitive cost: 50% savings have been achieved and geothermal resource covers almost 80% of the needs.

The figure below represents the geographic location of the area.

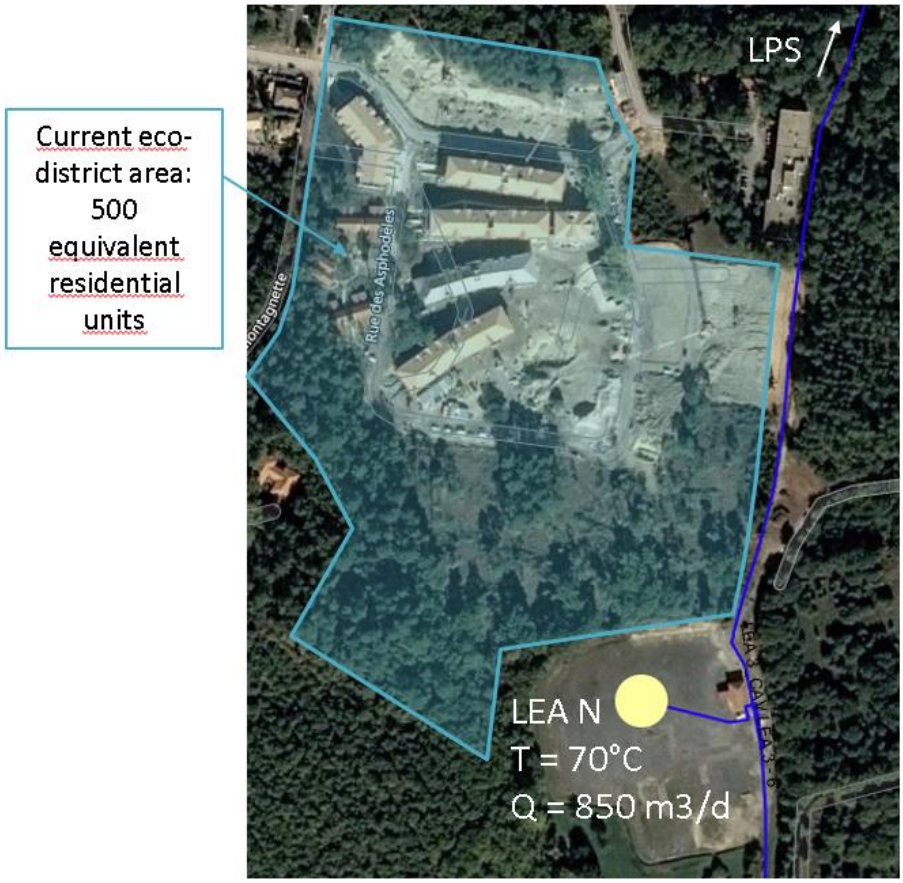

Figure 10: Geographic location of the eco-district project.

That thermal power is delivered to the eco-district's heat network, but also supplies heat to a nursing home. Figure below represents a simplified flow diagram of the heat network.

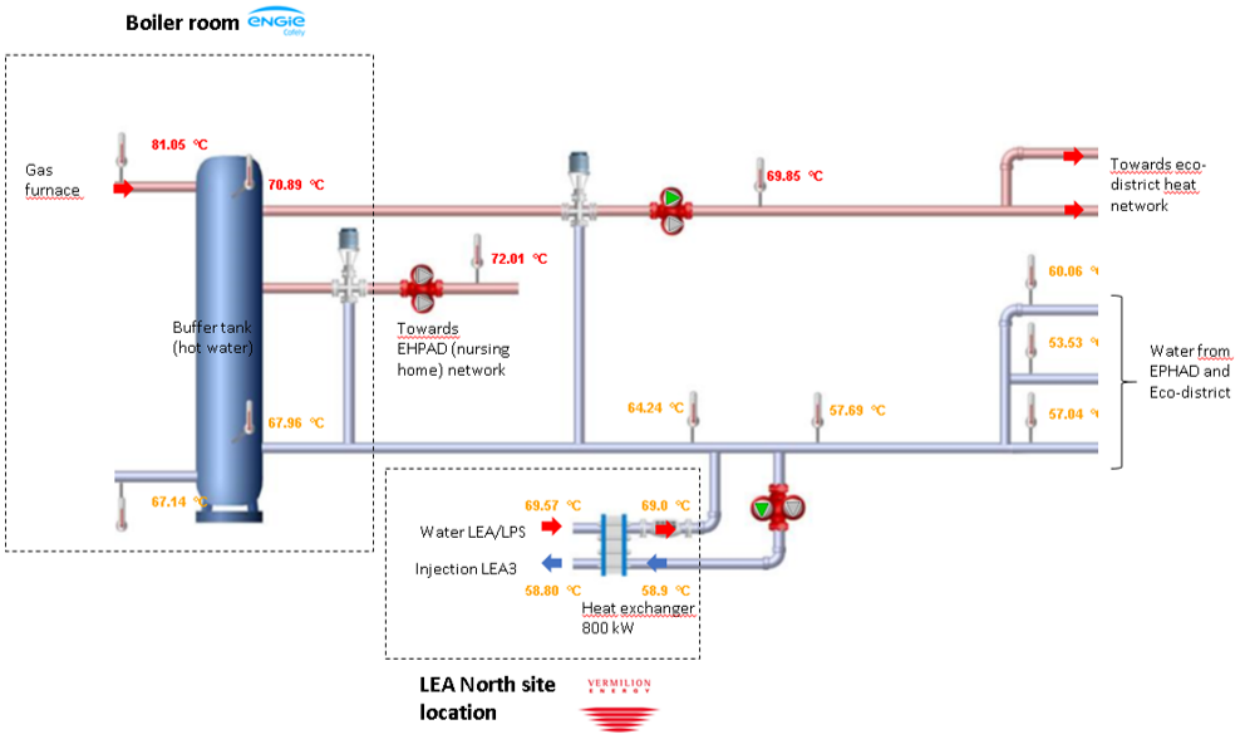

Figure 11: Flow diagram of the heat network.

3.2.2.3 Eco-district's heat needs and energy consumption

Instantaneous effective power demand:

- During winter period: 700 to 800 kW, mainly a consumption peak in the morning and in the evening. This peak can reach 1000 kW when all housing will be delivered. 900-kW peaks were occasionally measured.
- During summer period: 250 to 300 kW for hot sanitary water (morning and evening only).

The boiler room was visited, and the heat meter indicated on 13/02/2019 the following data:
Cumulative energy used since July 2017: 3,974 MWh
Including geothermal cumulative energy: 2,250 MWh (57%)
Including cumulative energy from gas: 1,724 MWh (43%)

Time (years)	Cumulative energy used (MWh)	Equivalent residential unit
1.75 (from 07/2017 to 02/2019)	3,974	500
1	2,271	500
1	4.54 [1]	1

[1] To estimate the energy consumption for a single equivalent residential unit, it has been considered that the cumulative energy used corresponds to the entire eco-district. It is a first approximation as to this day, all the housing (500) have not been delivered yet.
The **geothermal energy use** (ratio between effective heat used and theoretical heat available over a given period of time, equivalent to the capacity factor in the electricity sector) can be estimated to be about 20% (period of time considered: 18 months).

3.2.2.4 ENGIE Cofely's feedback on operational difficulties

Several operational issues have occurred since the commissioning of the heat network.

- Since the automation of the heat network, if the value of the outlet temperature from Vermilion's heat exchanger is under the set point temperature defined by ENGIE Cofely, the pump stops automatically. Then, the pump has to be manually put back into operation. To optimize the installation, ENGIE Cofely has equipped the heat network with contact temperature sensors and the pump command has been automatized. The operating company unsuccessfully tried to equip the pump with a frequency converter which would have prevented the pump shaft to break during stopping and restarting operations.
- A "water hammer" occurred in the heat network when Vermilion interrupted production operations. That incident created an overpressure in the heat exchanger which resulted in salted water leaking into the heat network. To prevent from future "water hammer" incidents, check valves have since been installed.
- In end of February 2019, a maintenance operation on the heat exchanger has shown oil deposition along the plates. Figure below highlights thick petroleum crustings on the inside plates, requiring regular maintenance operations, even chemical washing.

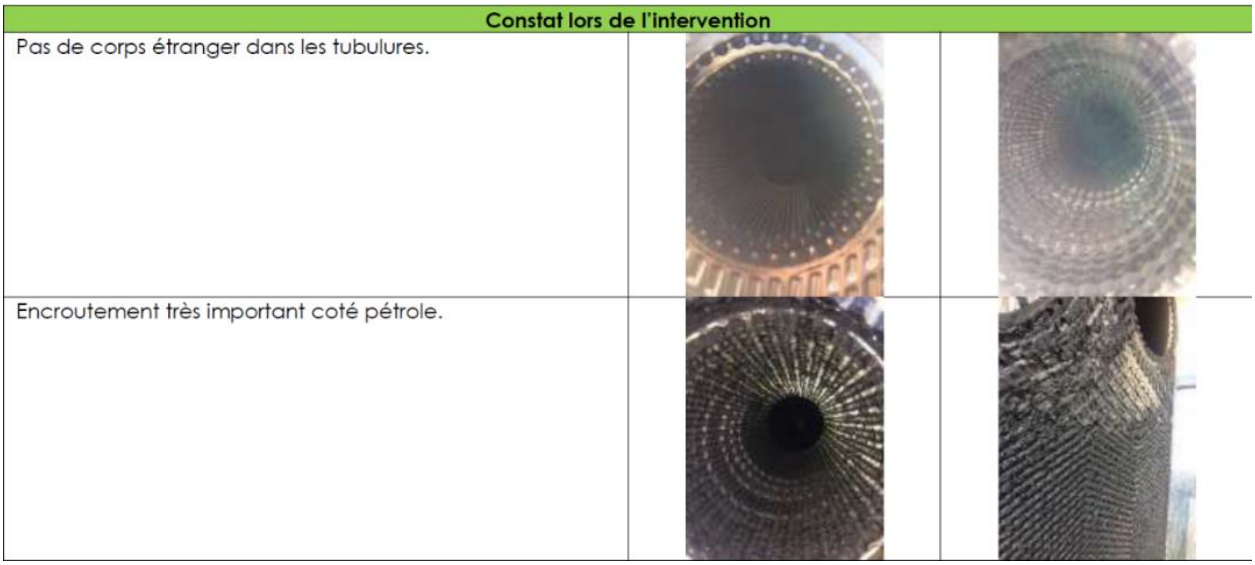

Figure 12: Thick petroleum crustings on the inside plates.

- Inlet temperature fluctuations can influence the thermal power available. These fluctuations depend on the chosen active well but they can also be a consequence of an oil production interruption. Figure below shows these temperature variations.

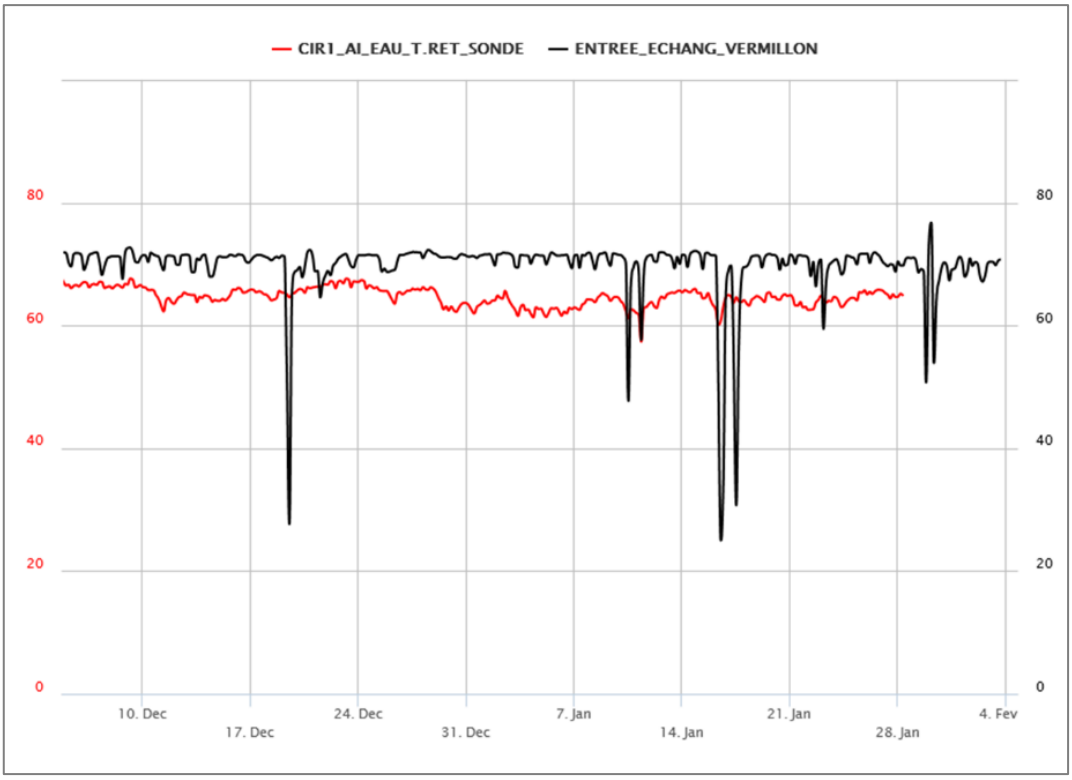

Figure 13: Inlet temperature fluctuations.

3.2.2.5 Prospects and opportunities

Additional heat should be available by mid-2019 in the sector: 0.8 MW will be available which will double the thermal power currently produced:

- On site LPS2: up to now, a water flow characterized by 350 m^3/d at 70°C is reinjected without extracting its potential power, estimated around 0.4 MW.
- Rehabilitation of site LEA1: 400 m^3/d of water at 70°C will be available, representing 0.4 MW.

Several projects are planned to be developed which could give Vermilion the opportunity to supply geothermal heat:

- A project on the extension of the eco-district aims to deliver another 500 equivalent residential units by 2020.

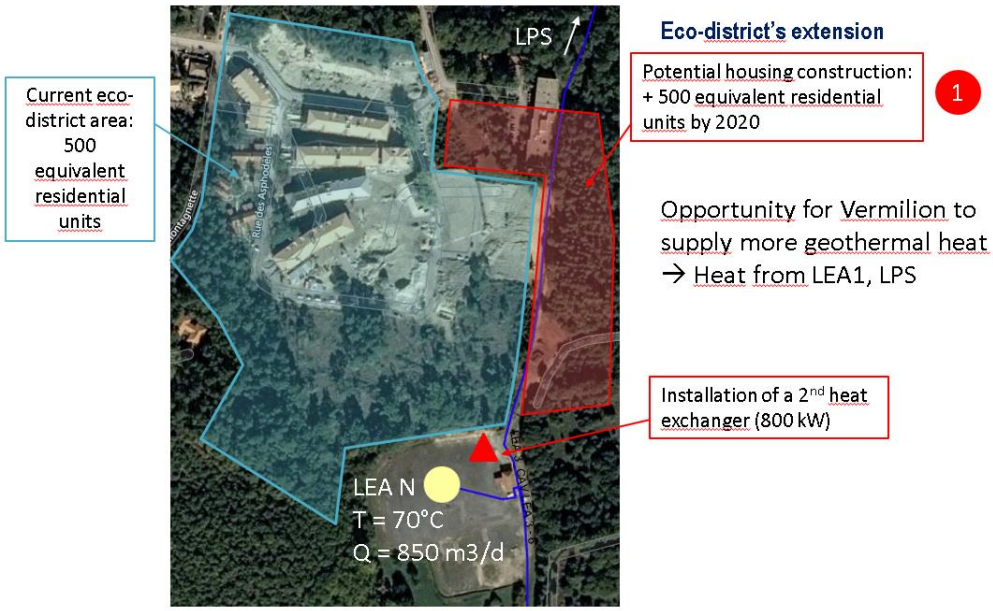

Figure 14: Potential projects at LEA / LPS site (1/2).

- Grand Air high school: this building is also located near LPS and is characterized by 0.5 MW of installed capacity. Its heat network is supplied by a groundwater heat pump with backup heat from gas furnace. Vermilion's heat could be their backup solution.
- Condorcet high school: this public building is close by LPS and a call for tenders is in process to rehabilitate its heat network (500 to 600 kW). ENGIE Cofely is currently tendering it and will mention Vermilion as one of the potential heat supplier. Another partnership with ENGIE Cofely could be signed.
- Public works project: a roundabout is planned to be constructed, which would make room to build housings. Figure below illustrates its close proximity to Vermilion's sites. Vermilion could be their heat supplier.

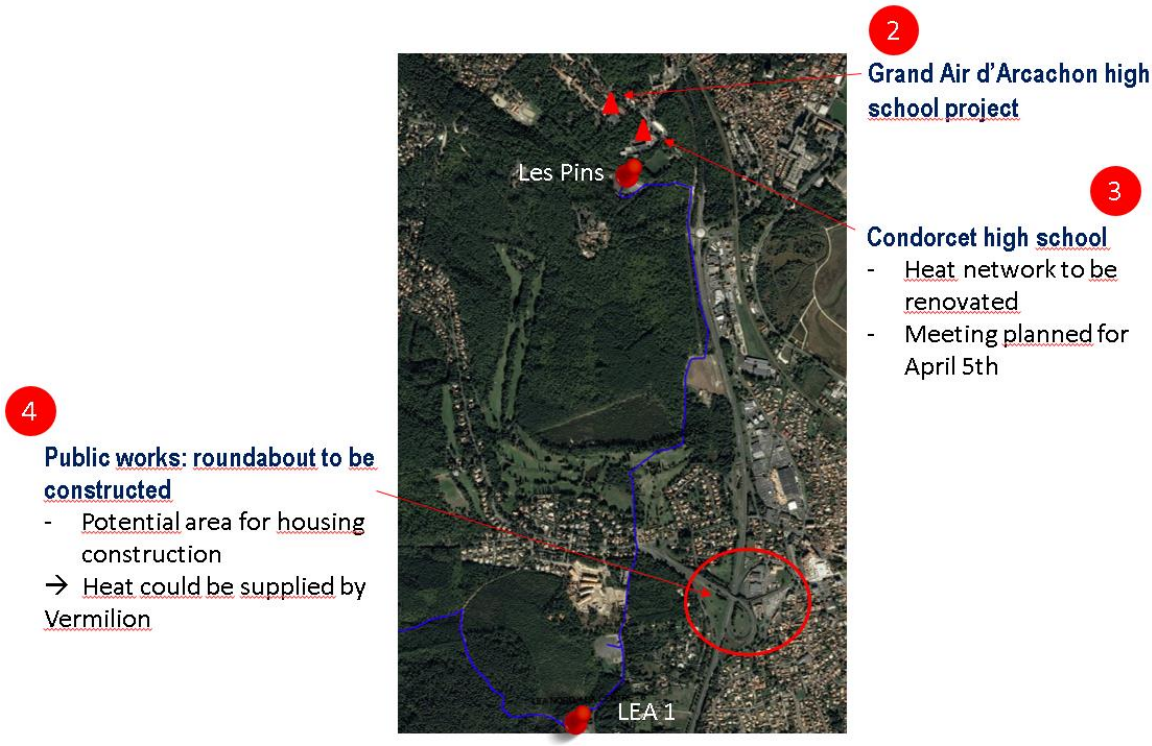

Figure 15: Potential projects at LEA / LPS site (2/2).