



Renewable energies in Paris. Situation. Objectives. Strategy

EXPRESS

March, the 09. 2024

N Richez – Head of Energy Department – Directorate of Ecological transition and Climate- city of Paris

nicolas.richez@paris.fr

01

Renewable in Paris - Situation

Reminder of Parisian objectives

In 2004 (starting point)

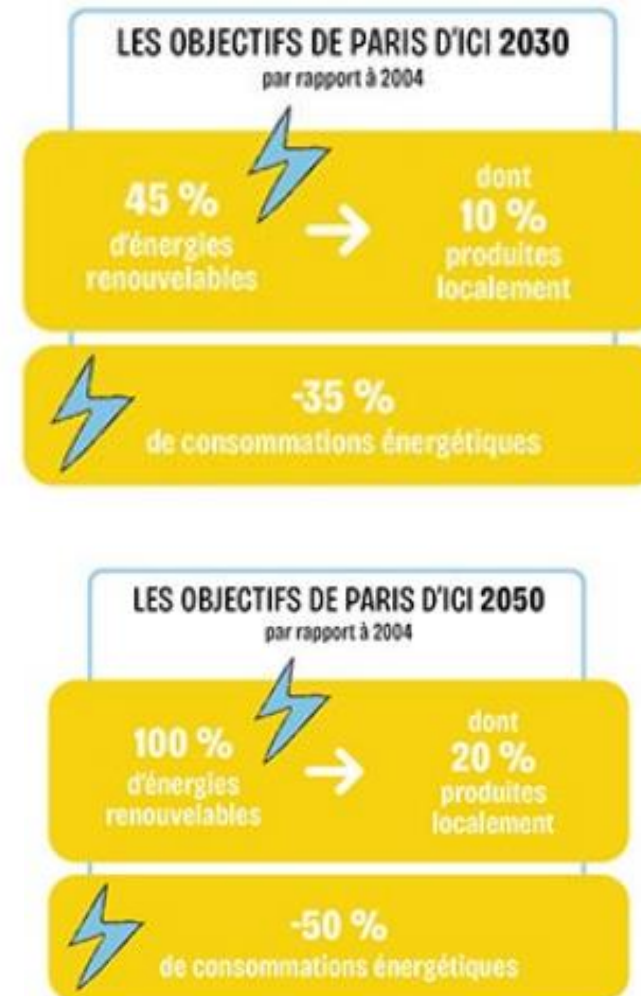
Energy consumption
40 TWh

Objective for 2030 (-35%):

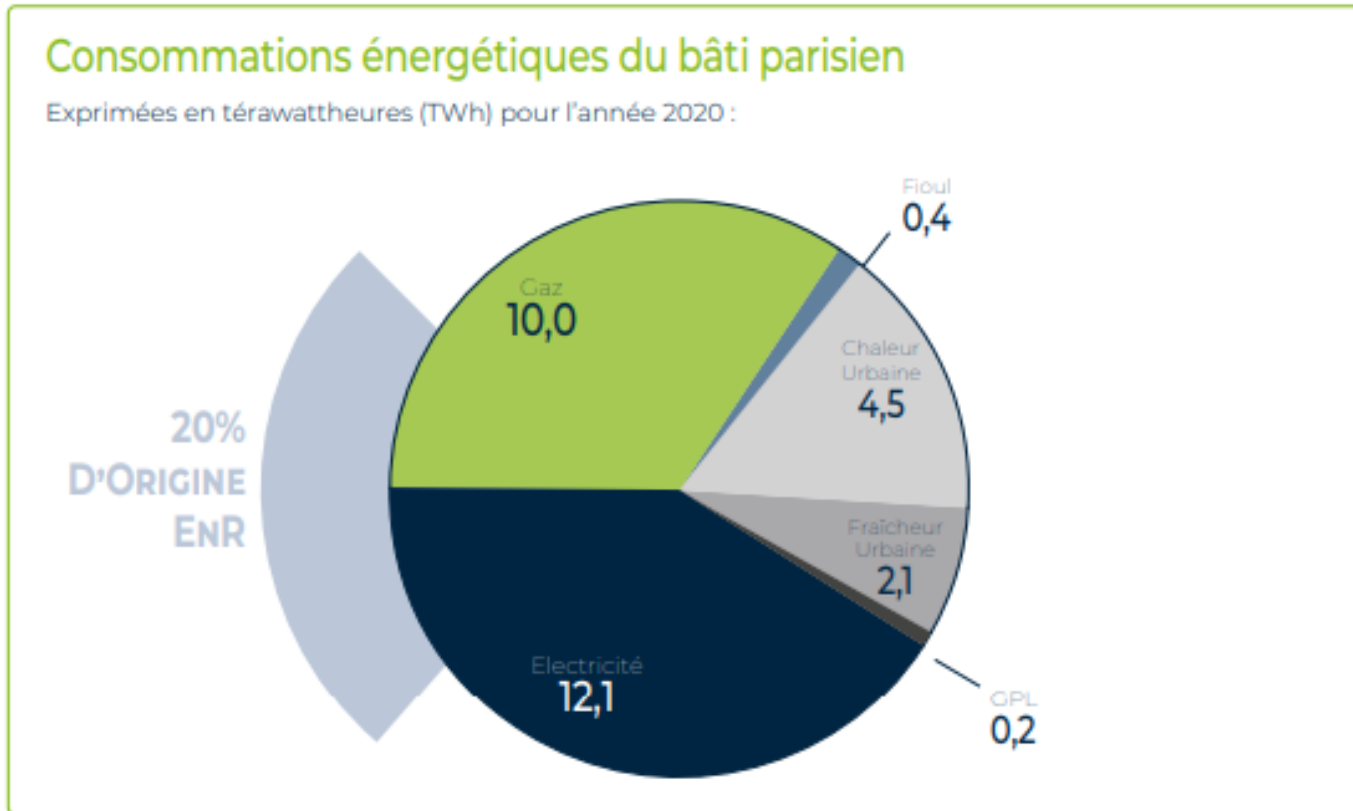
26 TWh consumed
Local renewables (10%)
2,6 TWh

Objective for 2050 (-50%):

18,66 TWh consumed
Local renewables (20%) : **3,7 TWh**



Energy Consumption in Paris in 2021



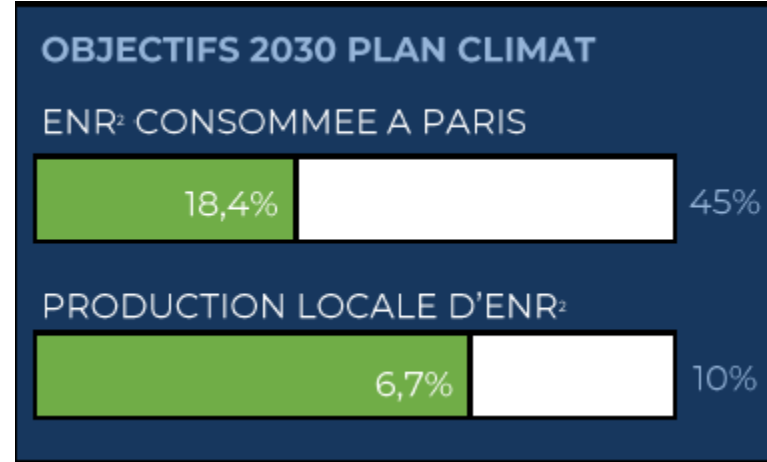
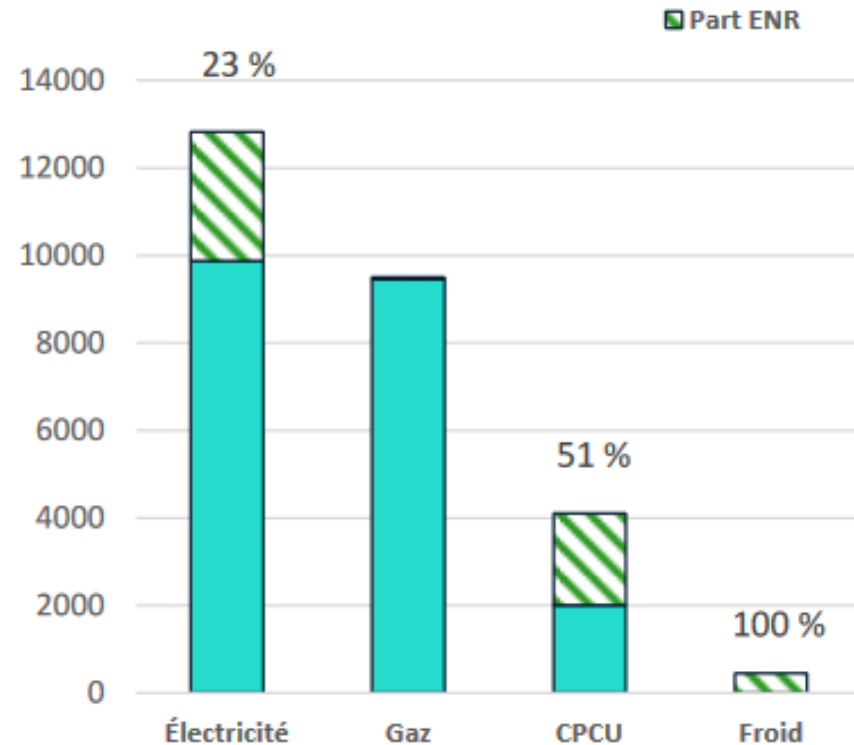
- ❑ 92% of energetic consumption is provided by 4 energy grids (électricité/gas/heat/cold)

All the estimates are climate adjusted (2020 was the warmest year before...2022)

These balances do not include the energy from gas stations (fossil fuel for mobilities, about 20%), except for electric and gas

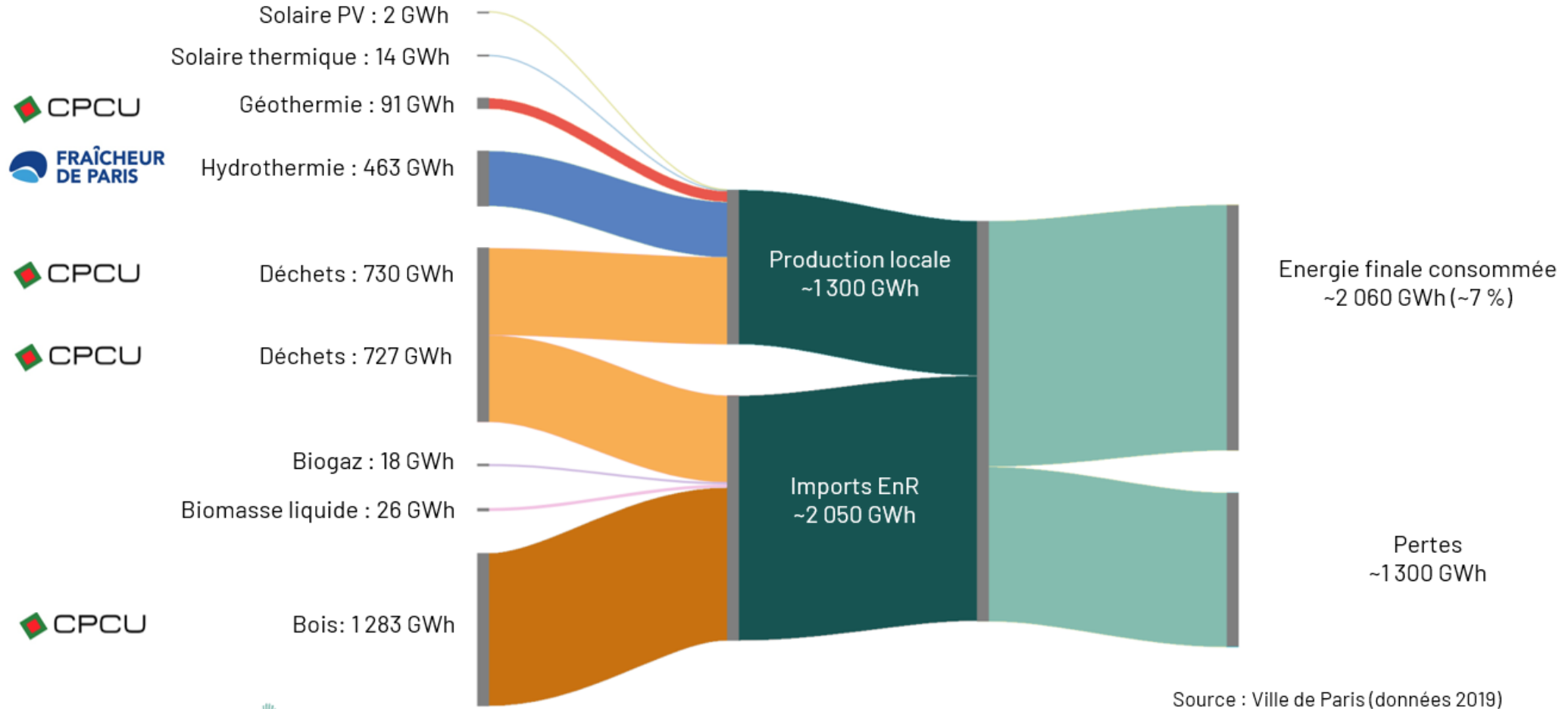
Current situation : energy supplies

ENERGIE DISTRIBUÉE À PARIS
(EN GWH PAR AN)



- 18,4% (2 059 GWh) of the general consumption comes from renewables
- 53% of renewable in the heating system
- A study conducted in 2020 shows that we can achieve up to 11% of local renewable energy consumption

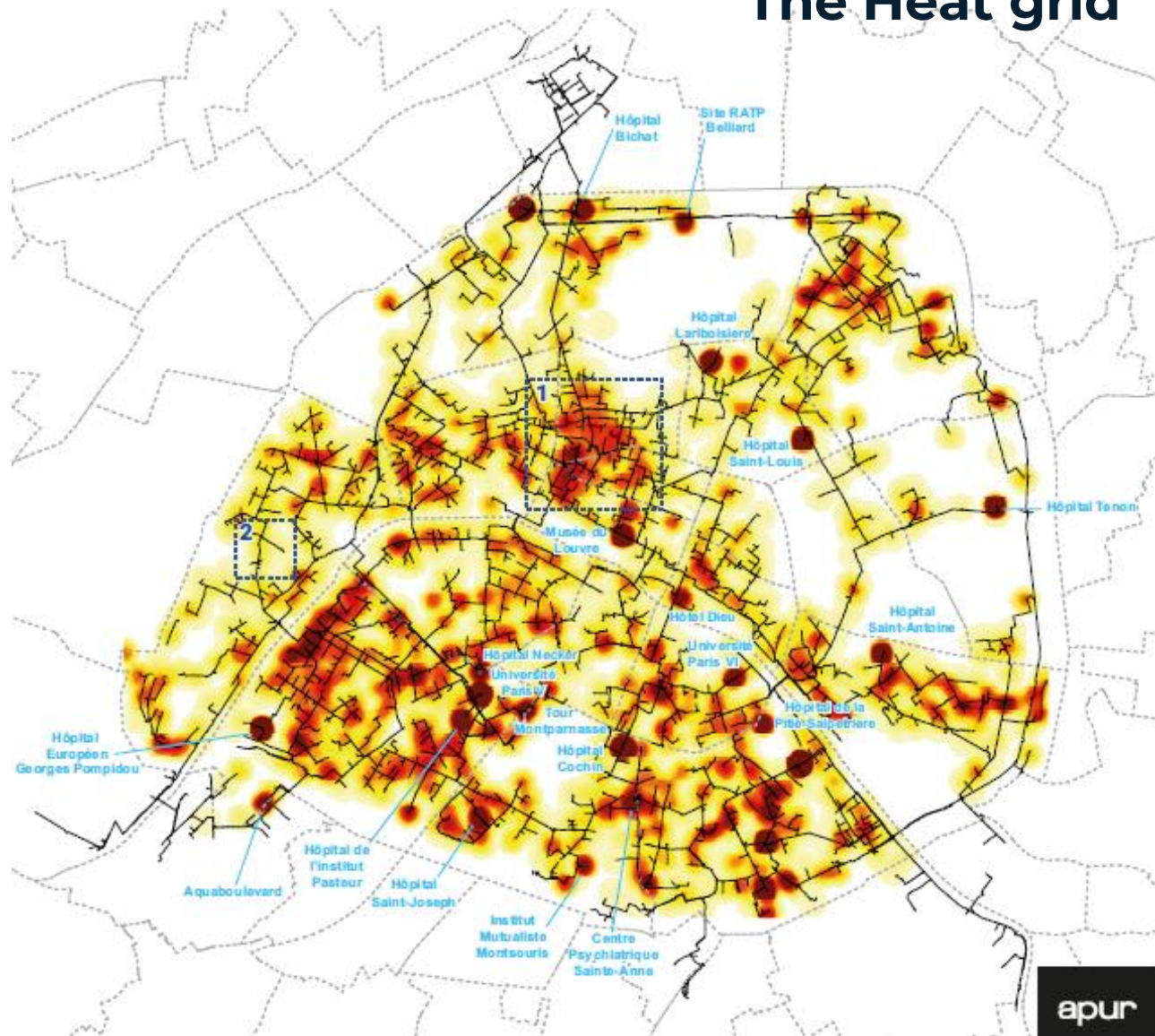
Most Renewable Energies Come From the 4 grids...



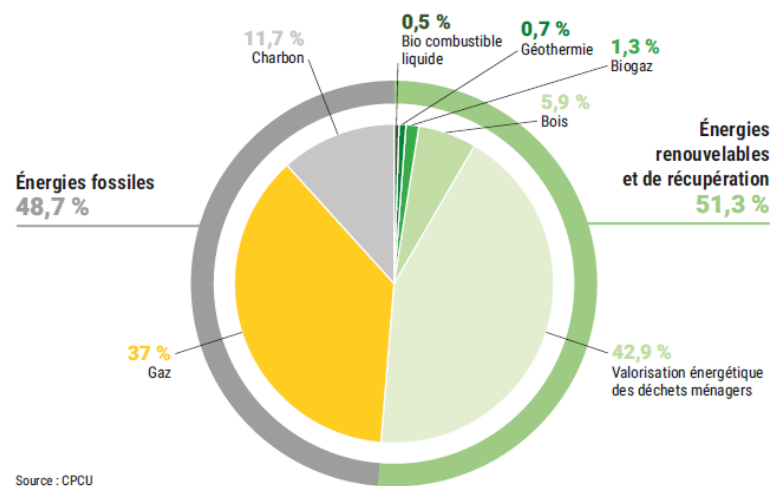
02

Parisian Strategy to increase Renewable energies

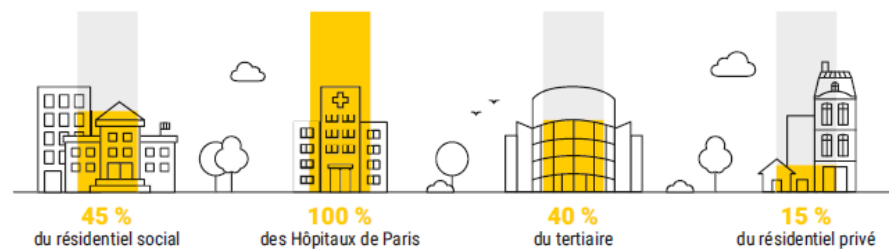
The Heat grid



MIX ÉNERGÉTIQUE DU RÉSEAU DE CHALEUR PARISIEN EN 2019



Source : CPCU



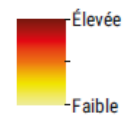
Source : CPCU 2019

DENSITÉ DES CONSOMMATIONS ANNUELLES DES CLIENTS CPCU - 2018

Réseau et densité de consommation

— Réseau CPCU

Densité de consommation CPCU annuelle (MWh/an)



Renewable Energy (EnR) assessment of the territory

Heat :

- Paris heating grid : Delivery of 5 TWh of heat (2021 data)

Rate of renewable energy in the grid: 54.1% (CPCU data, November 2023)

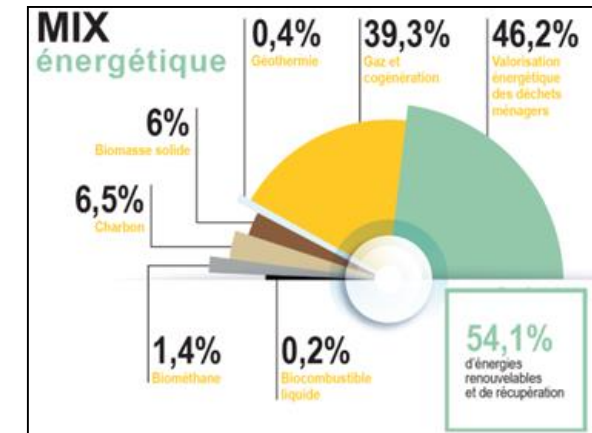
- Geothermal power :

3 deep geothermal installations

Around a hundred individual surface geothermal installations

91 GWh currently produced

The objectives of the PCAE theoretically require doubling this production capacity by 2030



Wastewater heat recovery:

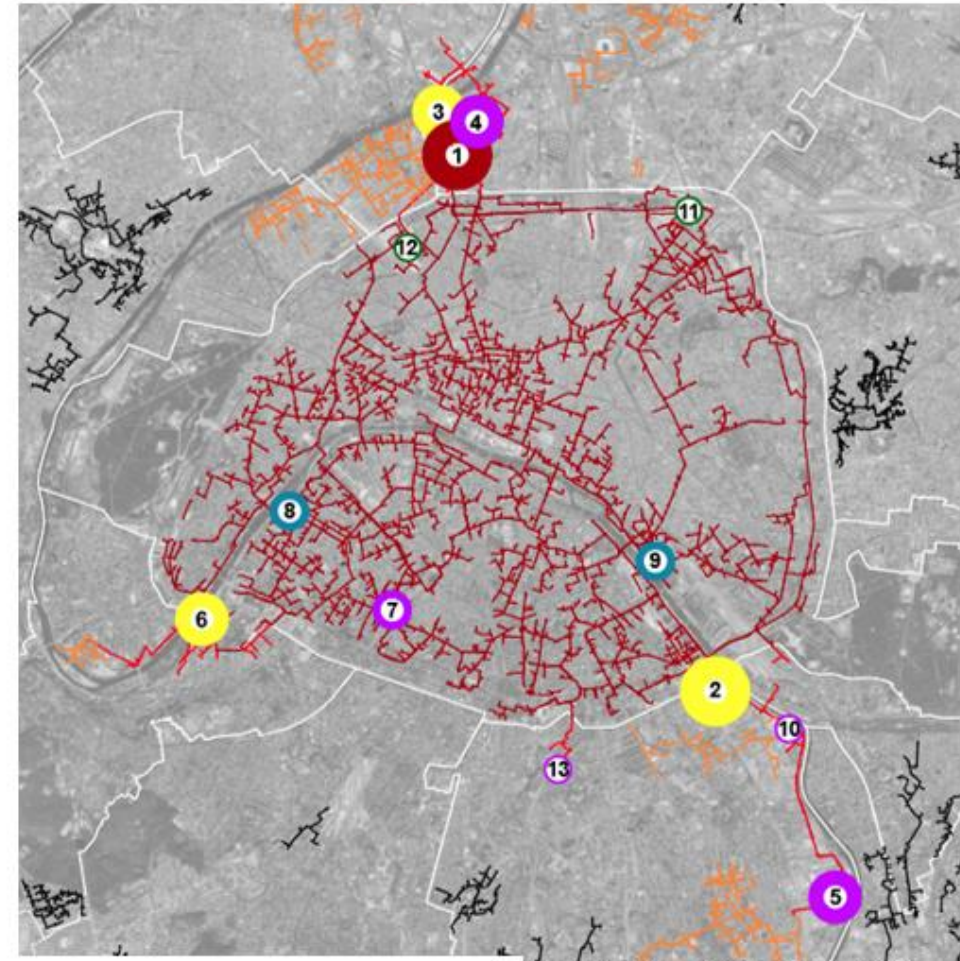
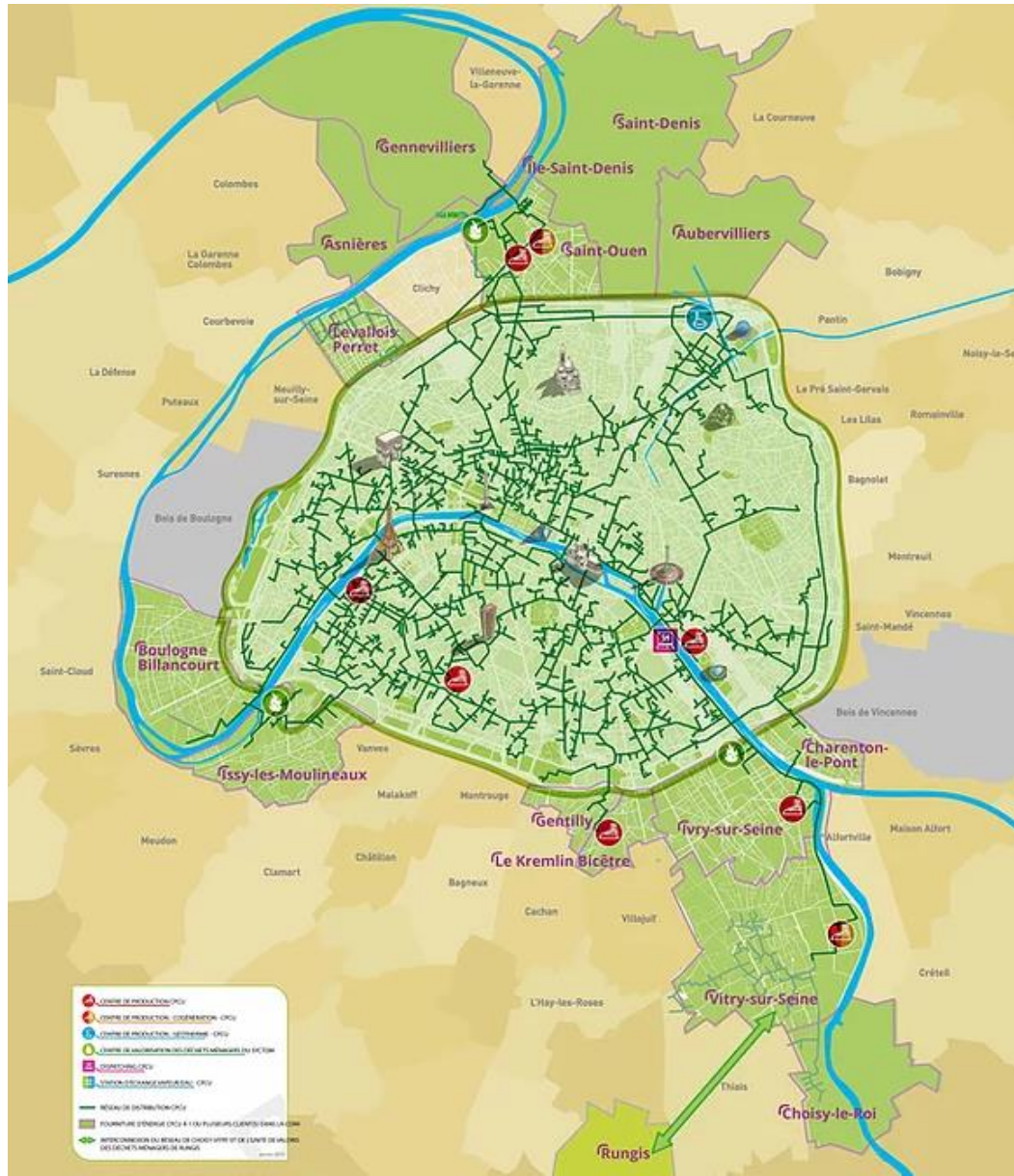
4 installations in service on municipal sites (total of 500 kW)

Currently, around 11 GWh is generated locally

The goals of the PCAE theoretically require a 10-fold increase in this production capacity by 2030, including 10 GWh recovered from Parisian sewers.

- Thermal solar:

500 installations in Paris. Real difficulty in developing this type of production in Paris, including on the City's heritage sites.



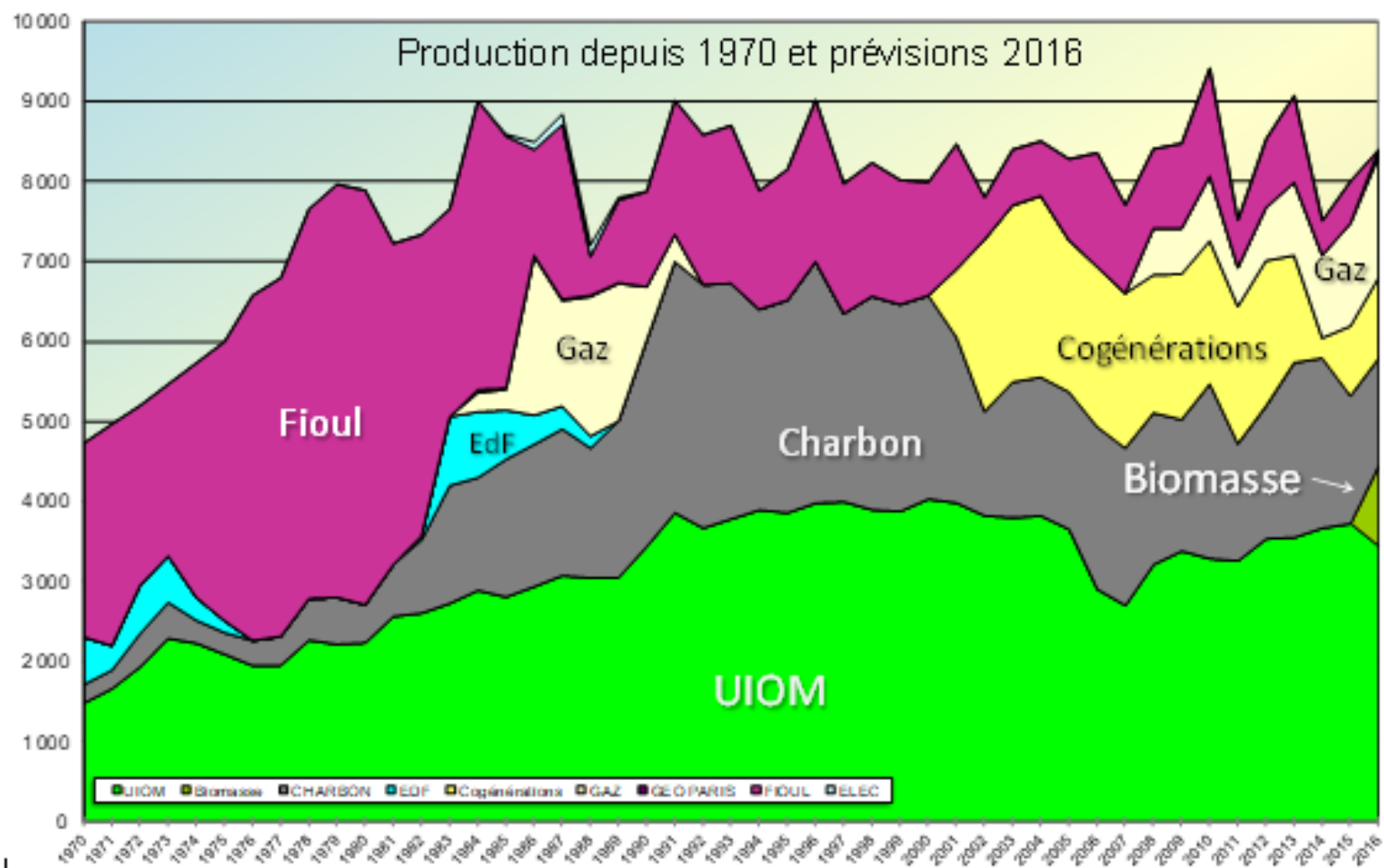
Sites de production alimentant le réseau CPCU

- Unités d'incinération des déchets non dangereux (UIDND) - Sycotom
- Centrale biomasse
- Centrale géothermique
- Centrale biocombustible/gaz
- Centrale gaz

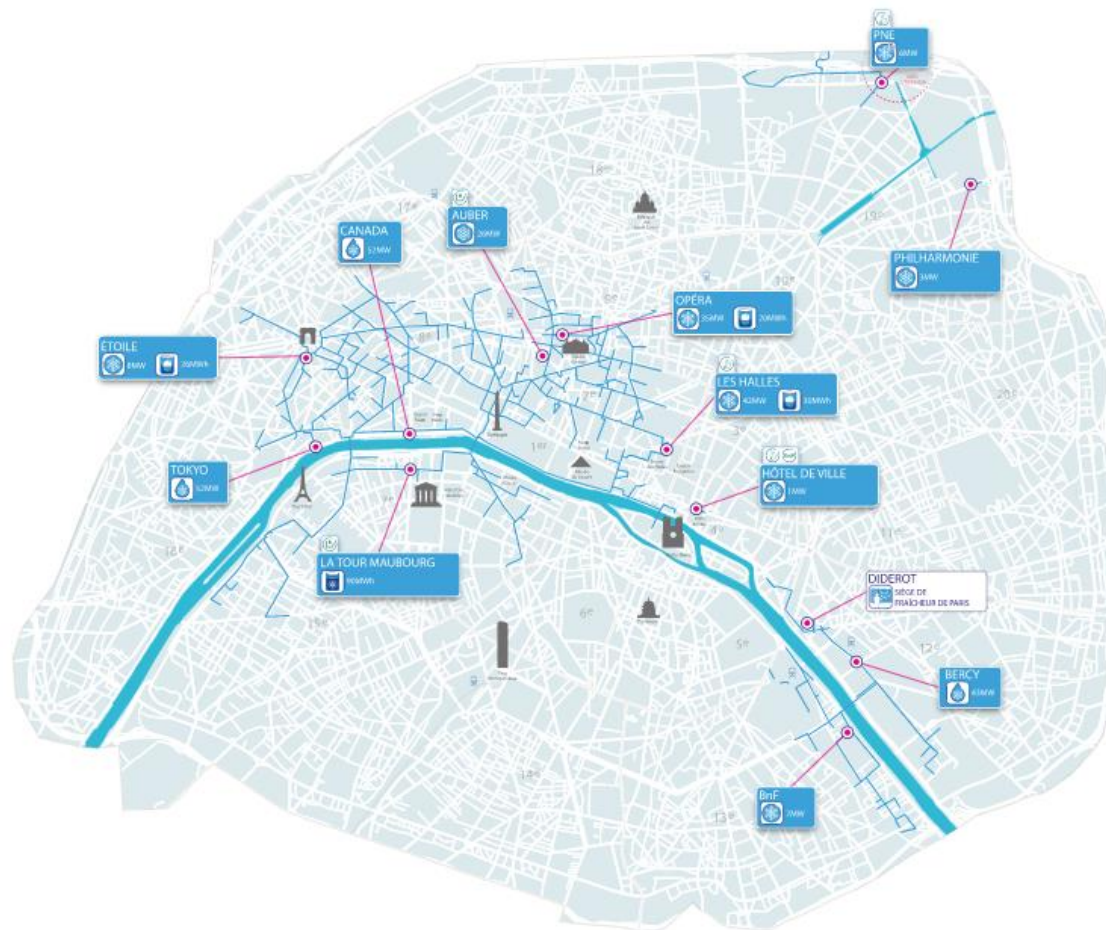
Energie livrée au réseau CPCU en GWh/an (2019)

- Moins de 100 GWh
- de 100 à 500 GWh
- de 500 à 1 000 GWh
- Plus de 1 000 GWh

Les années 2006 À 2017



The Cold grid



RÉSEAU DE FROID URBAIN >

Carte du réseau de froid urbain

Centrale de production



Centrale de production



Centrale de production (eau de Seine)

Réservoir de stockage



Réservoir de stockage d'eau glacée



Réservoir de stockage de glace

Solar energy in Paris today

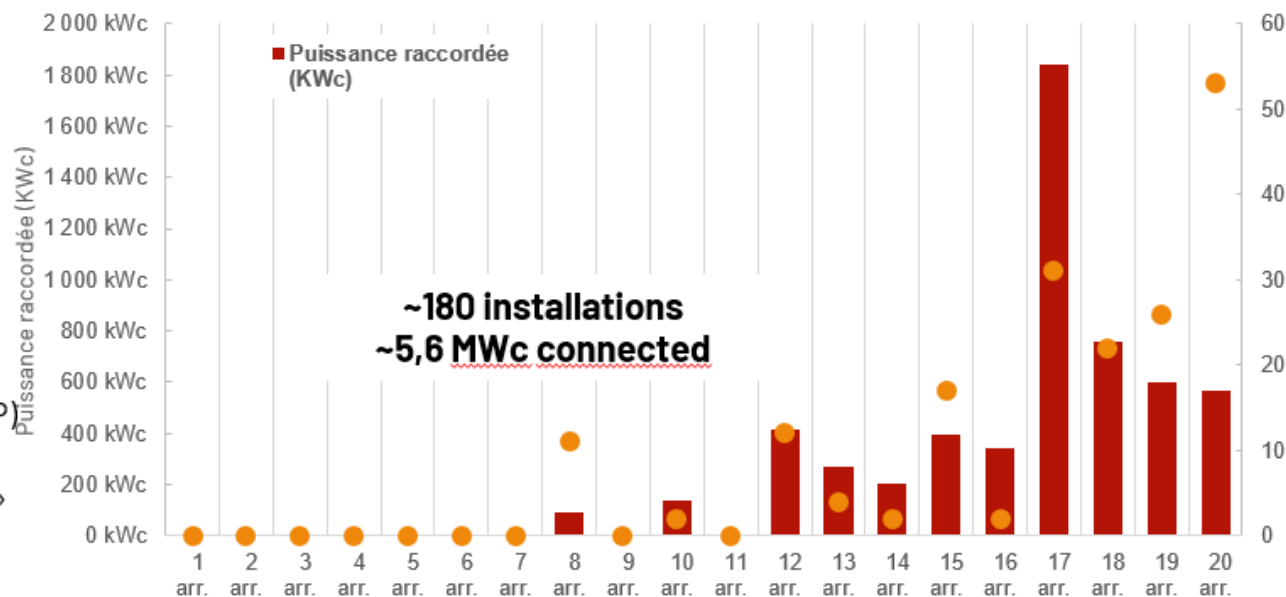
2 GWh
(2019)

Photovoltaic solar

Project « working-class neighbourhoods with positiv energies » elected by citizen votes (participatory budget) « working-class neighbourhoods with positiv energies »: **15 installations built by a citizen association, Enercit'iF**

- 9 on public buildings
- 6 avec les bailleurs (RIVP, Paris Habitat, SIEMP)

Coming soon : call for projects « EnergiCulteurs » : **15 sites with self-consumption (3 with public management et 12 with private delegation) for the 1st season**

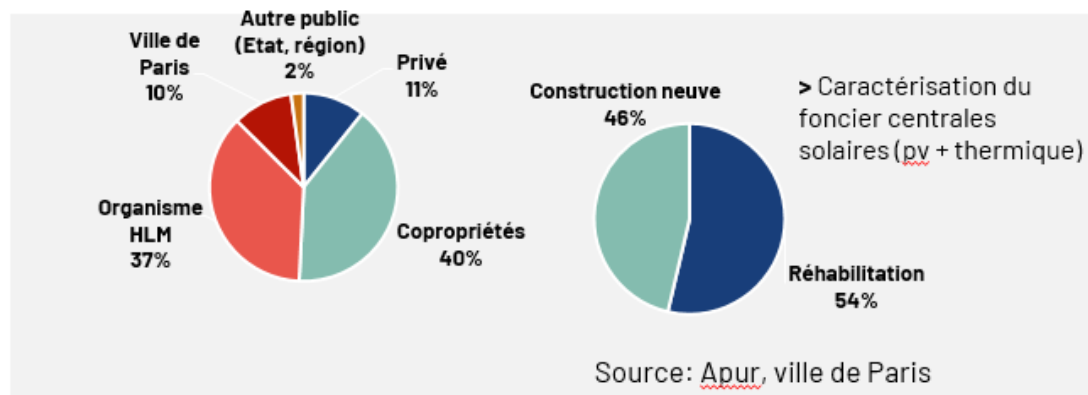


Source: National Register of electricity installations of production and storage (at 08/31/2022)

14 GWh
(2019)

Thermic Solar

About 470 toitures installed in Paris



Solar Energy: Potential

1 500 GWh

The issues:

A very high theoric potential (1,5 TWh)

The local urbanism regulation required installations of solar pannels for new buildings for areas bigger than 1500 m2 but only a few new constructions in Paris

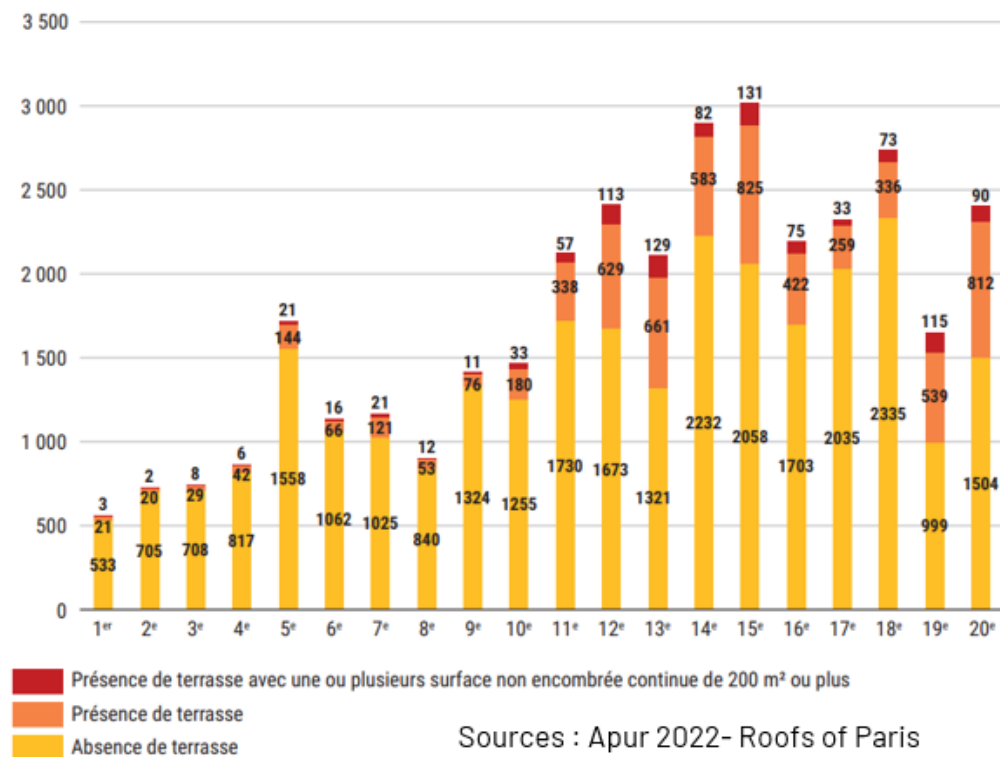
A favourable economic context for self consumption according with regards to the high prices of electricity in Europe but a vulnerable business model

Invest costs usually higher in Paris than in the rest of the national territory (and a situation of inflation)

Significant structural and architectural insertion constraints (which improve the operating costs)

Competition with green roofs (but possibilities of mix green-solar roof)

TOITURES RECEVANT UN ENSOLEILLEMENT ANNUEL MOYEN SUPÉRIEUR OU ÉGAL À 800 kWh/m²/an (et sans installations existantes)



Sources : Apur 2022- Roofs of Paris

actors:

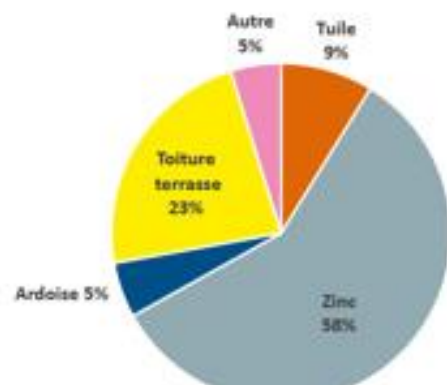


Les toitures parisiennes en chiffres :

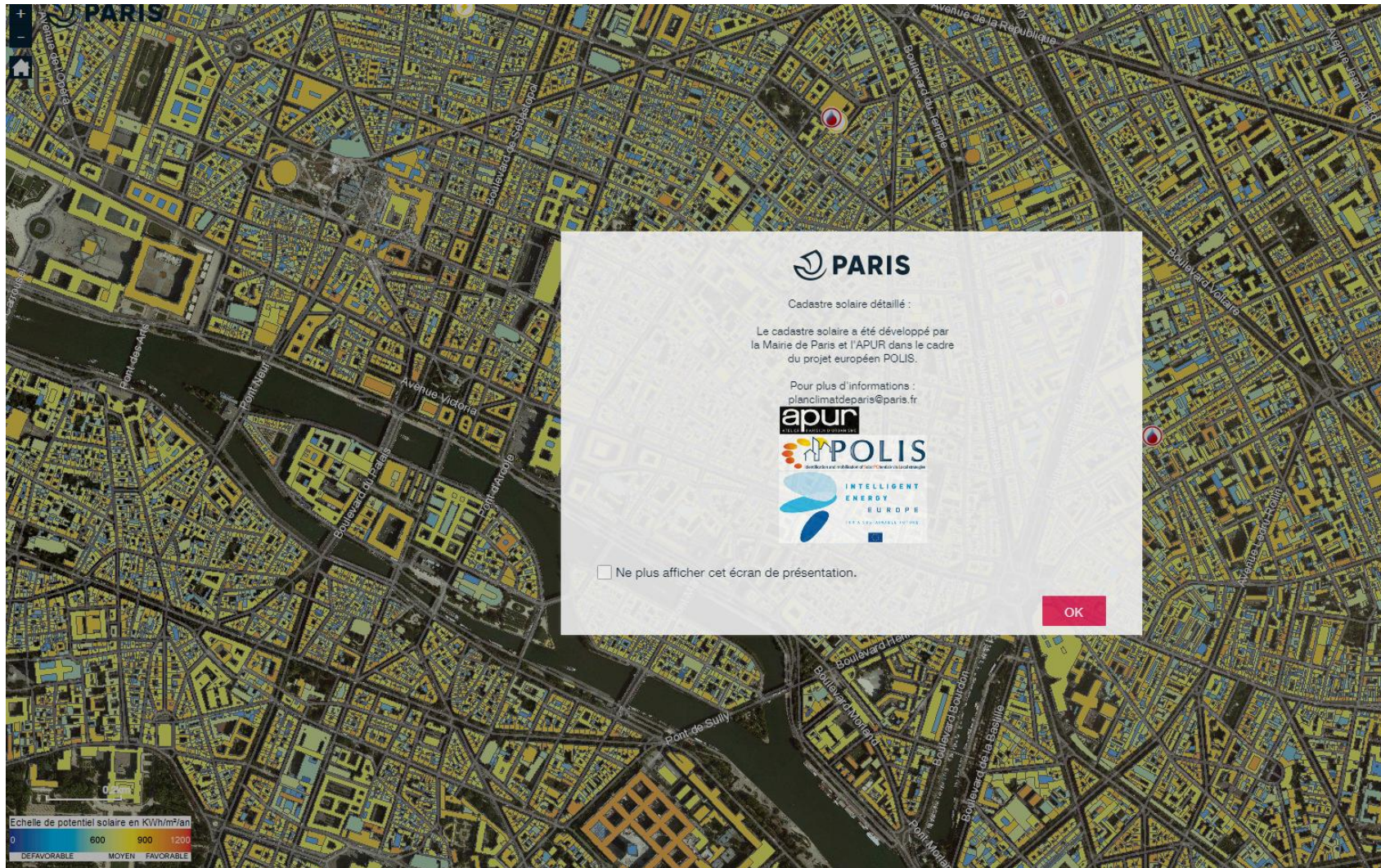
128 000 bâtiments

3 220 ha de toitures, dont :

- 740 ha de toitures terrasses
- 73,4 ha de toitures végétalisées ornementales
- 11,3 ha d'agriculture en toiture
- ~ 500 installations solaires recensées à partir des autorisations d'urbanisme (donnée à consolider)



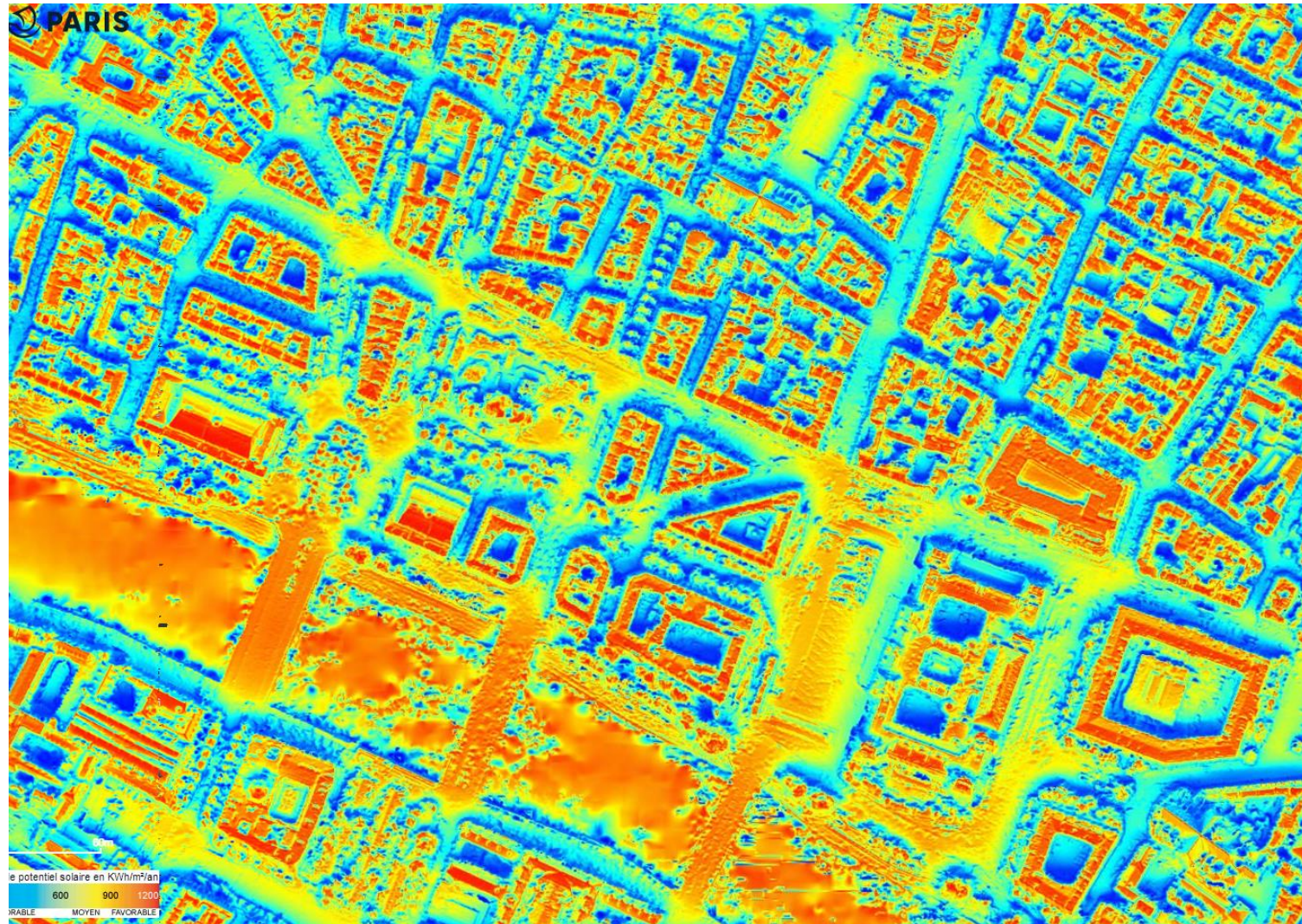
The Interactive Registry of Solar Potential



The Interactive Registry of Solar Potential



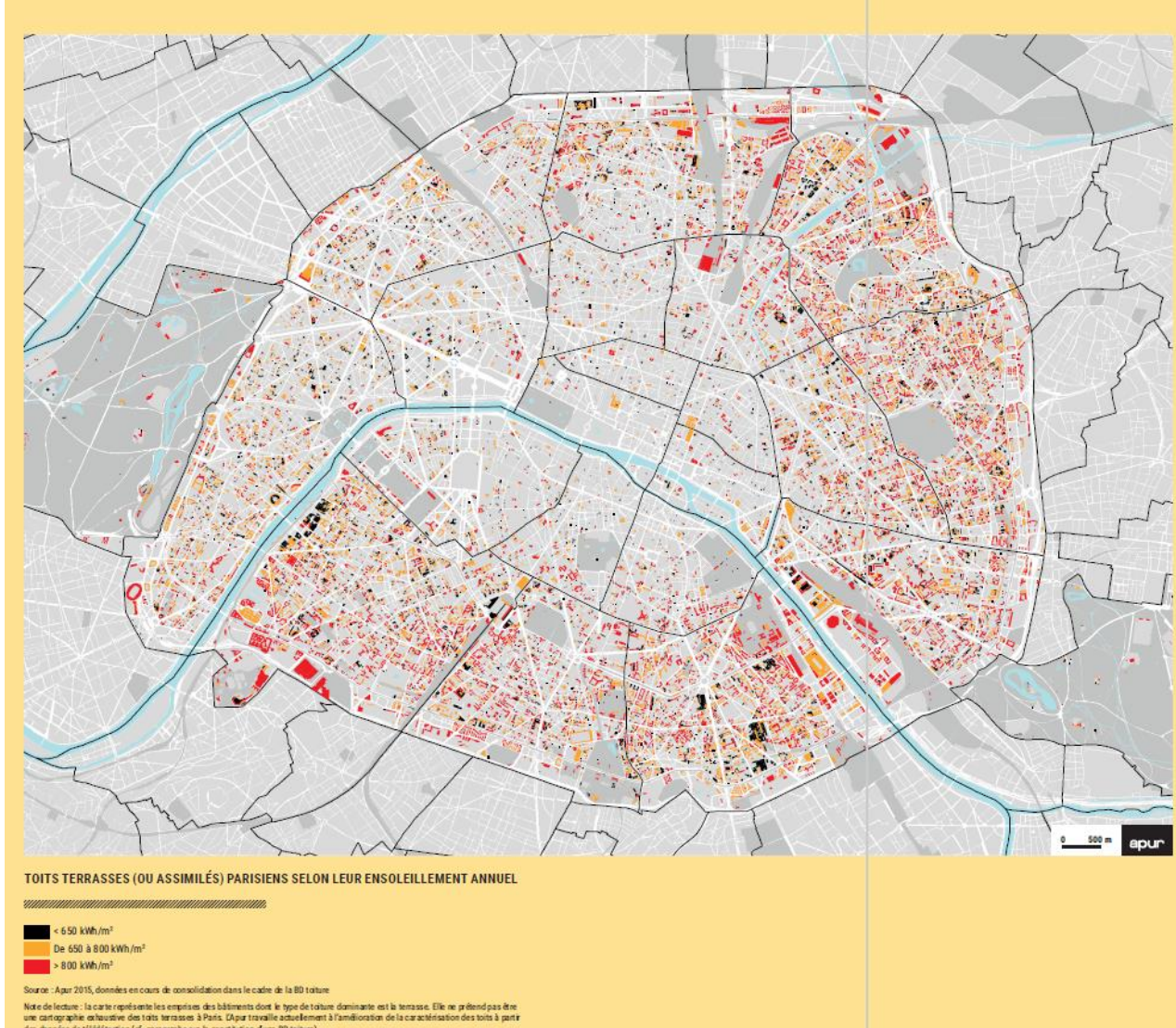
The Interactive Registry of Solar Potential



The Interactive Registry of Solar Potential



In progress: Creation of a rooftop database and App



Data:

- Owners' data
- Areas of the roofs
- Types of roofs
- Albedo
- Technical characteristics: access, bearing capacity, sealing capability
- Sunshine
- Presence of solar installations
- Urban agriculture or vegetation

Goals:

- Sharing knowledge
- Ease the usage of roofs

Program « Energy farms »

Photovoltaïc program

Season 1, 15 municipal rooftops:

- 3 sites managed in 2023
- 12 indirectly managed by a private operator
=> selection of private operator 1st semester 2024

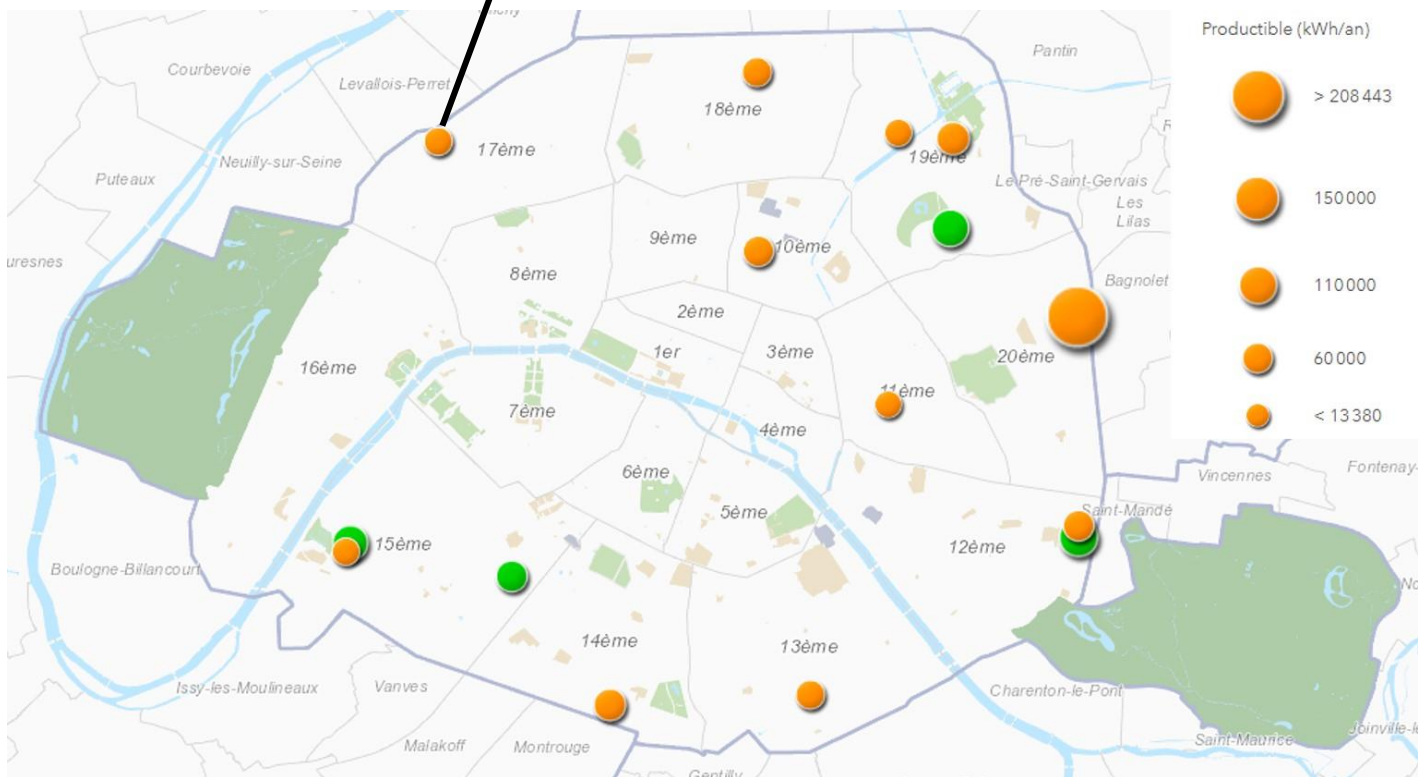
Key numbers

- 4 200 m² solar pannels
- 825 kWc power
- 750 MWh/year renewable electricity produced

Association and benefits :

- 4 bio-solar rooftops (greening/solar)
- cooling roof coatings

Les premiers panneaux solaires
Energiculteurs à l'école 38 Reims 17e



New project : EnergiCultors « energy farms »

SAISON 1 : 15 TOITURES D'EQUIPEMENTS PUBLICS IDENTIFIES (Surface cumulée : 11 780 m²)



EM Mouffetard (5^e) – 480 m²



Gymnase Paradis (10^e) – 550 m²



EM Popincourt (11^e) – 230 m²



Collège G. Tillion (12^e) – 370 m²



CISP M. Ravel (12^e) – 1 850 m²



CV C. Bertheau (13^e) – 640 m²



CS Elisabeth (14^e) – 2 000 m²



EM Procession (15^e) – 600 m²



EM Jongkind (15^e) – 320 m²



GS Saint-Charles/Varet (15^e) – 1 300 m²



EP Reims (17^e) – 700 m²



EP Poissonniers (18^e) – 500 m²



EM Émelie (19^e) – 400 m²



Collège E. Varèse (19^e)
– 1 000 m²



Collège P. Mendès France (20^e)
– 840 m²

En vert : les toitures prévues biosolaires



© Christophe Jacquet - Ville de Paris

Panneaux solaires – Parc Clichy-Batignolles - Martin Luther-King (17^e)



© Christophe Jacquet - Ville de Paris

Logements Caserne de Reuilly Lot B



ENVIRONNEMENT

Tout Paris

S'adapter aux effets du réchauffement climatique à Paris

f t

Le projet

✓ Budget Participatif 2021
Projet lauréat avec 43 637 votes !

23% 6% 63% 8%

5 000 000 €

Les questions du handicap et de l'accessibilité sont prises en compte dans le cadre de ce projet.



© MyLight Systems

Autoconsommation d'électricité solaire – Rue Lecourbe (15^e)

New project: « the renewable heat contract » : surveying potential renewable heat project developers in Paris

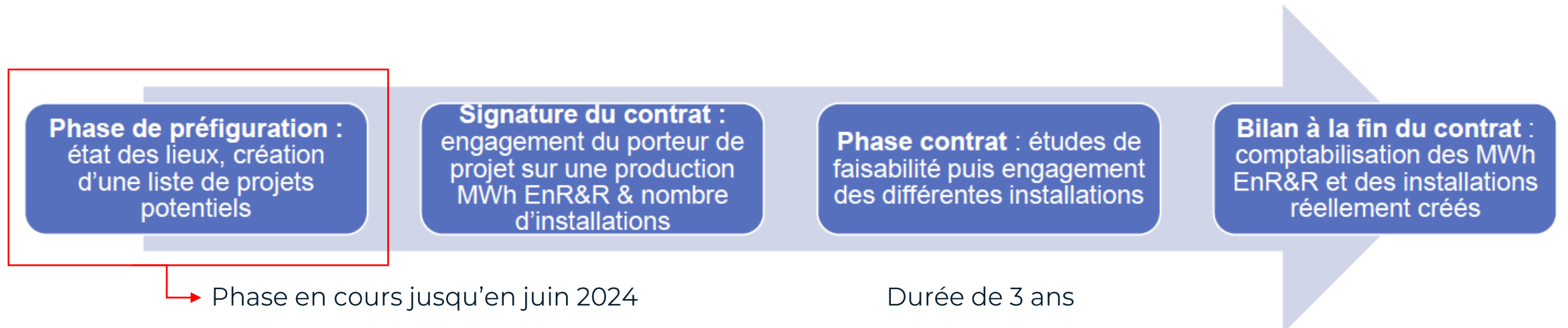
A scheme under ADEME's Heat Fund to locally promote the production of renewable heat:

- All project developers (public/private)
- Financial assistance for studies and investment
- Support throughout the project

For Paris, a tool to accelerate the development of:
Surface geothermal energy

- Recovery of waste heat (wastewater, data centers, etc.)

Current survey of projects until Spring 2024



Geothermal energy

90 GWh

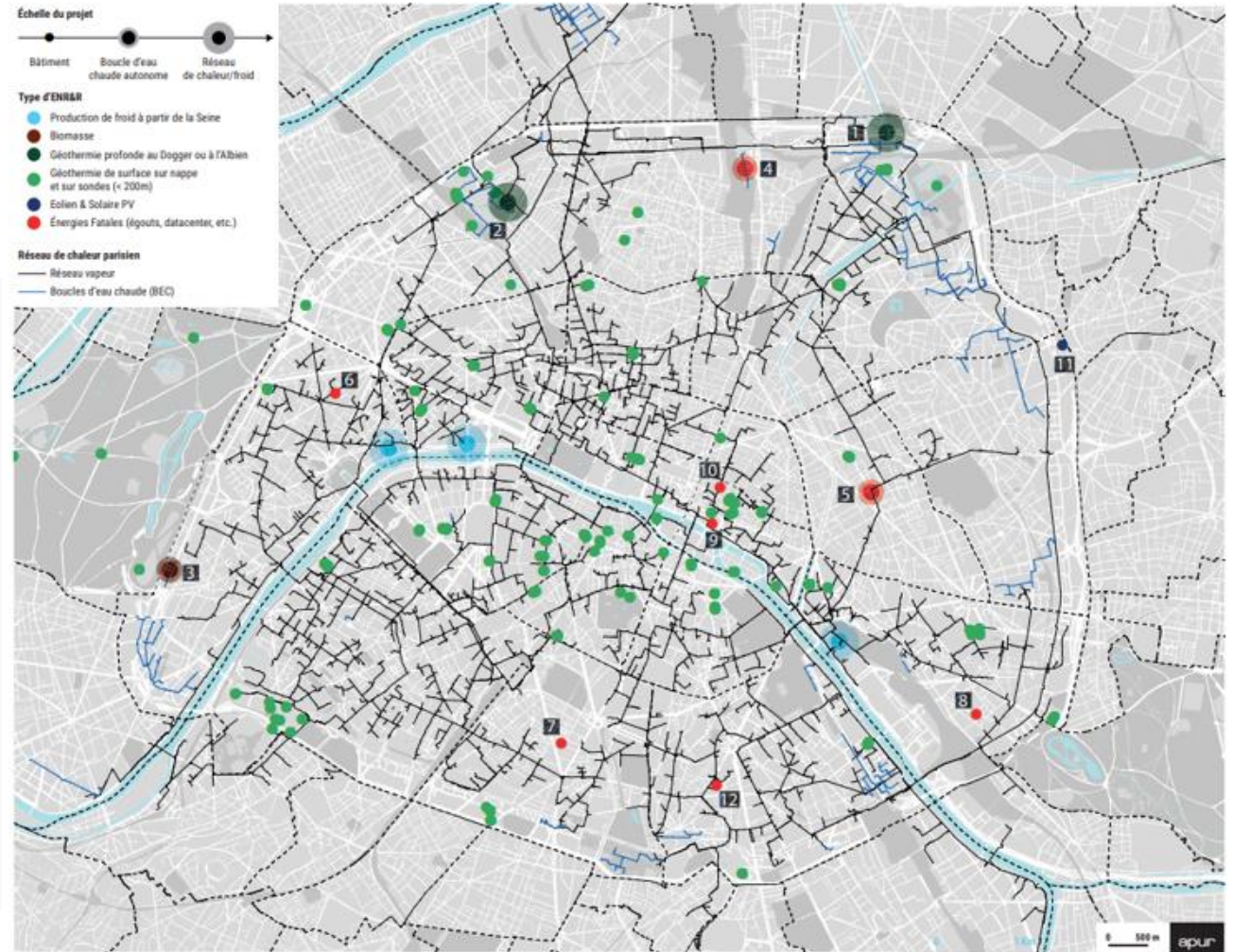
2 Main boreholes valued on the heat network (~60 GWh)

~70 geothermal surface installations (on aquifers or probe)



Surface geothermal aquifers, or open systems, involve taking water through a first borehole in an aquifer (groundwater), in order to extract calories from them and use them in a heat pump (PAC), which requires electricity. The water thus cooled is discharged to the same aquifer via a second drill, and the calories

Surface geothermal on vertical probes, or in a closed system, consists of taking heat from the subsurface by heat exchange between the subsurface and a heat transfer fluid circulating in a closed circuit, consisting of a multitude of vertical probes. The fluid recovers calories from the basement, which are then exploited via a heat pump



Geothermal energy- potential

6 200 GWh*

Issues :

Considerable theoretical potential

An articulation to be found with the heat network

Decoupling the cost of heat from fossil fuels

Significant implementation constraints

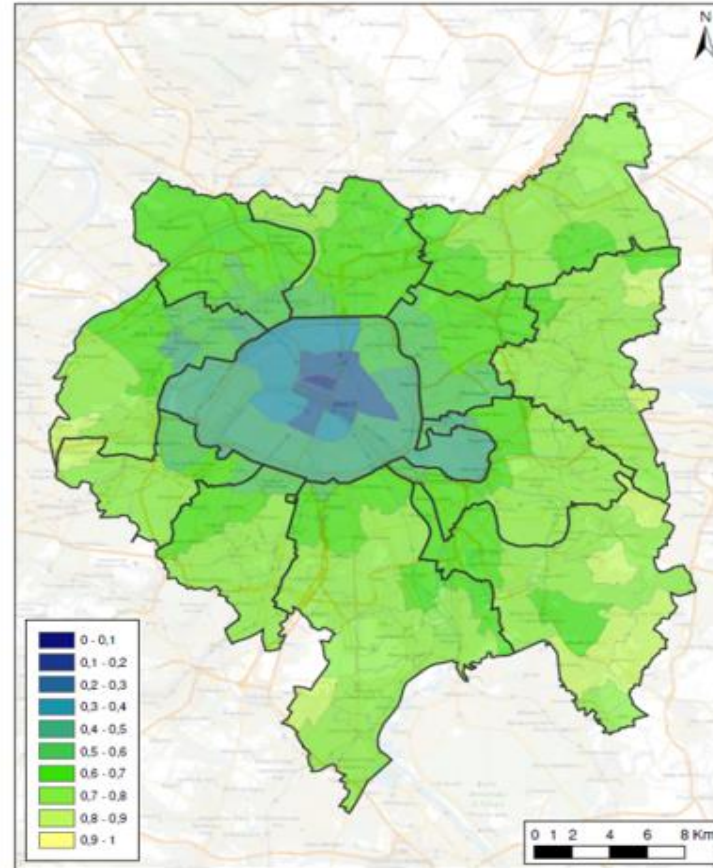
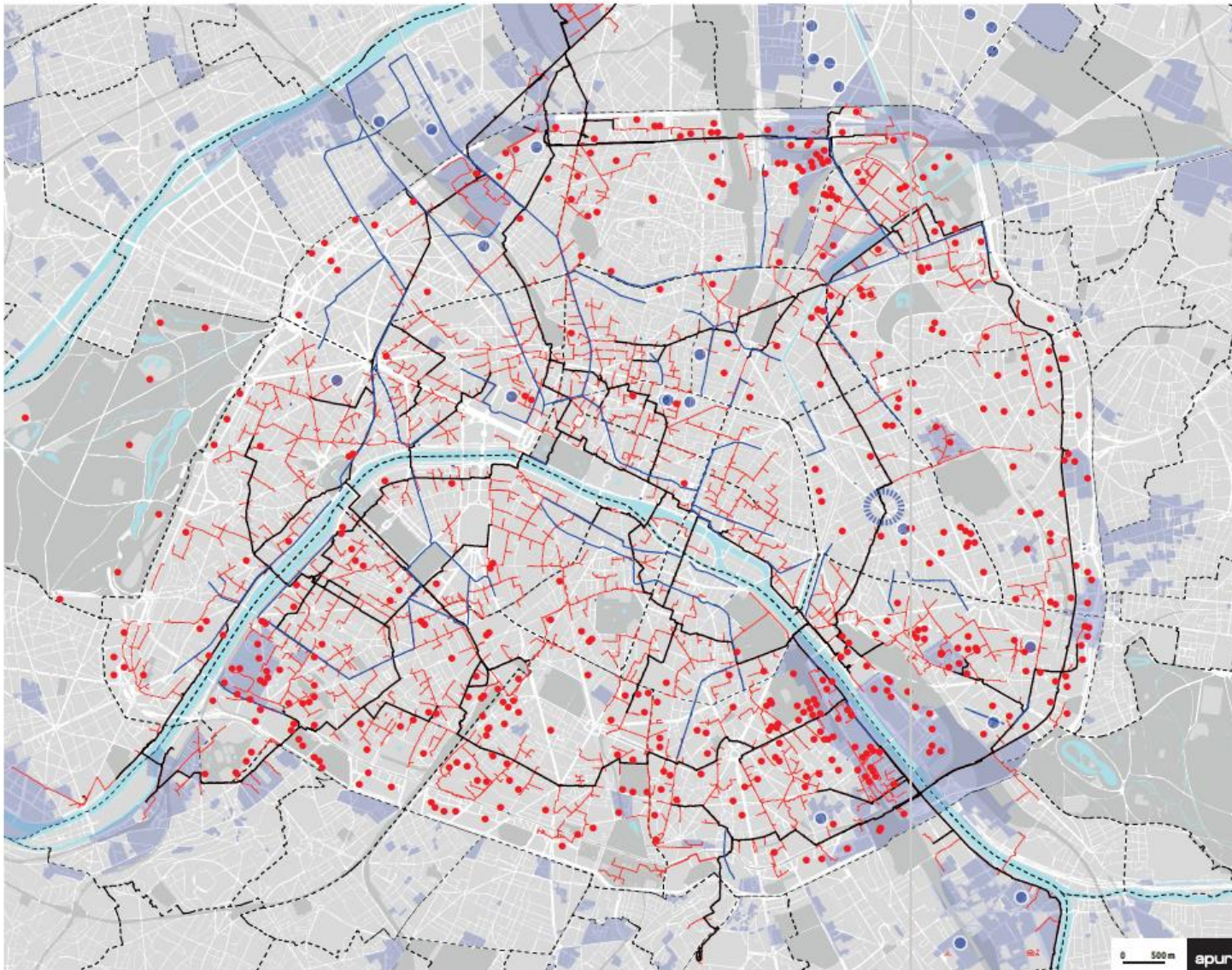


Figure 69 : Taux de couverture des besoins de chauffage par géothermie, sur chaque commune normalisé entre 0 et 1. Pas de prise en compte de la priorité à donner aux réseaux de chaleur.

Source : Mapping the potential of surface geothermal energy in the territory of the Metropole of Greater Paris- BRGM

Cross-referencing grids and renewable energy potential



VALORISER LES RÉSEAUX EXISTANTS POUR DÉVELOPPER LES ENR&R

LES RESSOURCES ENR

Les ENR moyenne température

Solaire thermique : bâtiments d'après 1914 avec plus de 500 m² de toiture terrasse et avec un ensoleillement > 800 kW/m²/an

Les ENR basse température

Réseau du SAP - tronçons > 0,80m

Datacenters

Projets urbains // opportunités de développement des ENR&R et de boucles d'eau chaude BT

Boucle d'eau chaude réalisée par la DCPA avec récupération de chaleur sur égout

Le réseau de chaleur parisien

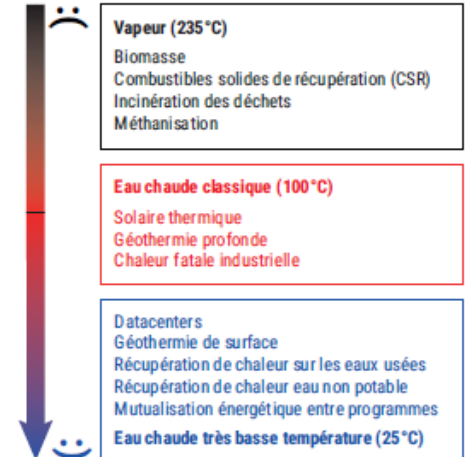
Réseau de transport vapeur

Réseau de distribution eau chaude

Vers la création d'un réseau eau chaude basse température en complément du réseau existant

Sources : CPCU, DGFRP, Ademe, SAP, DCPA - 2018

CAPACITÉ À CAPTER LES ENR&R SELON LE NIVEAU DE TEMPÉRATURE DU RÉSEAU

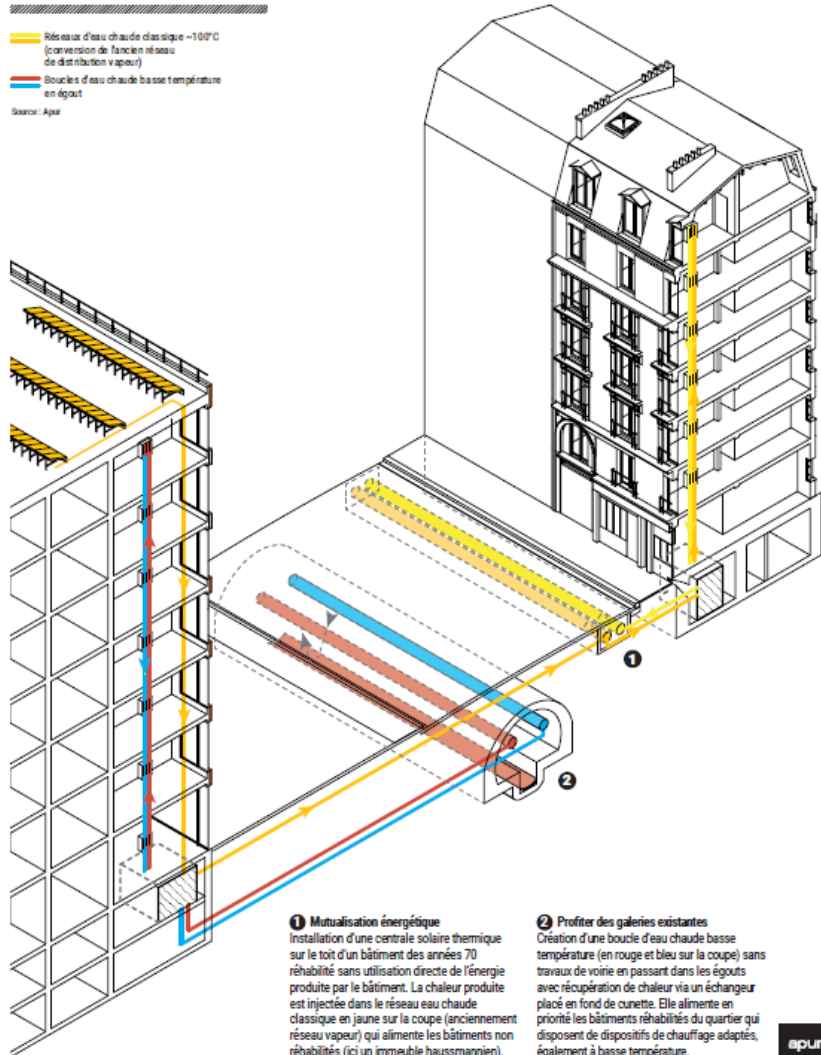


Example of heat recovery potential from sewers

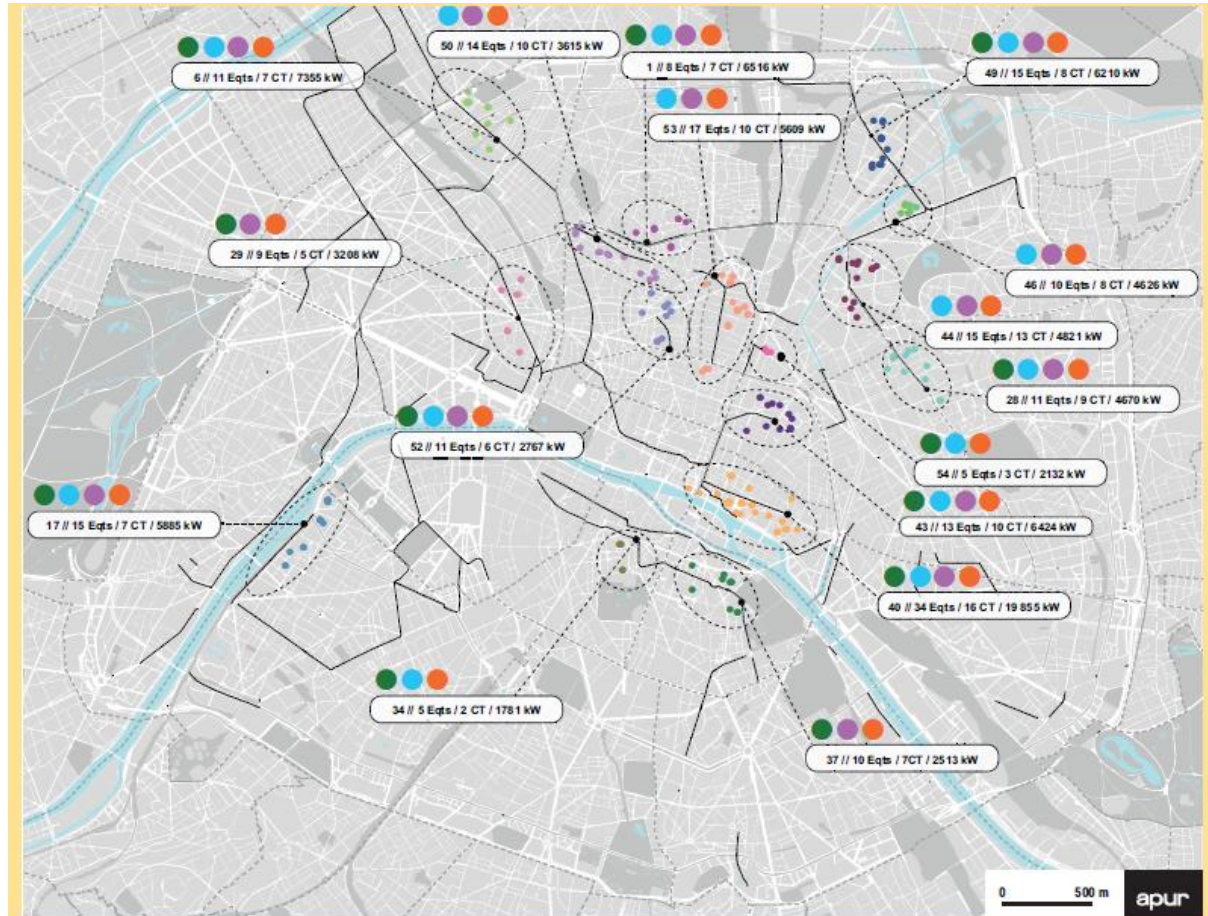
COUPE DE PRINCIPE D'UN RÉSEAU DE CHALEUR AVEC DIFFÉRENTS NIVEAUX DE TEMPÉRATURE

- Réseau d'eau chaude classique ~101°C (conversion de l'ancien réseau de distribution vapeur)
- Boucles d'eau chaude basse température en égout

Source: Apur



apur



POTENTIEL DE RÉCUPÉRATION DE CHALEUR EN ÉGOUT

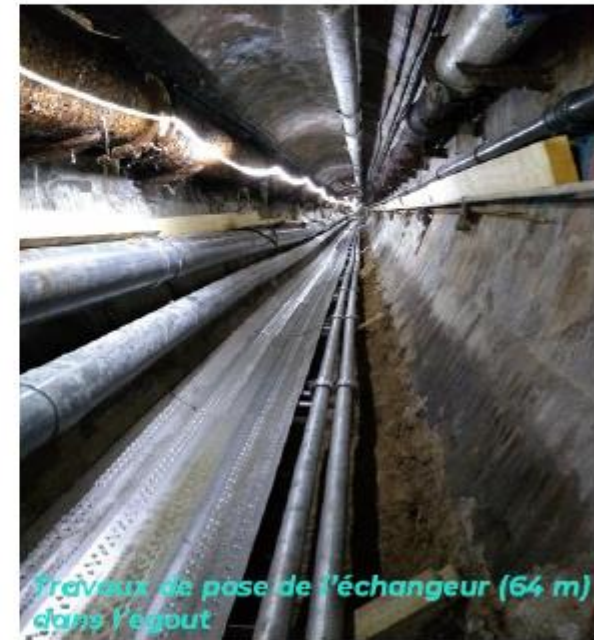
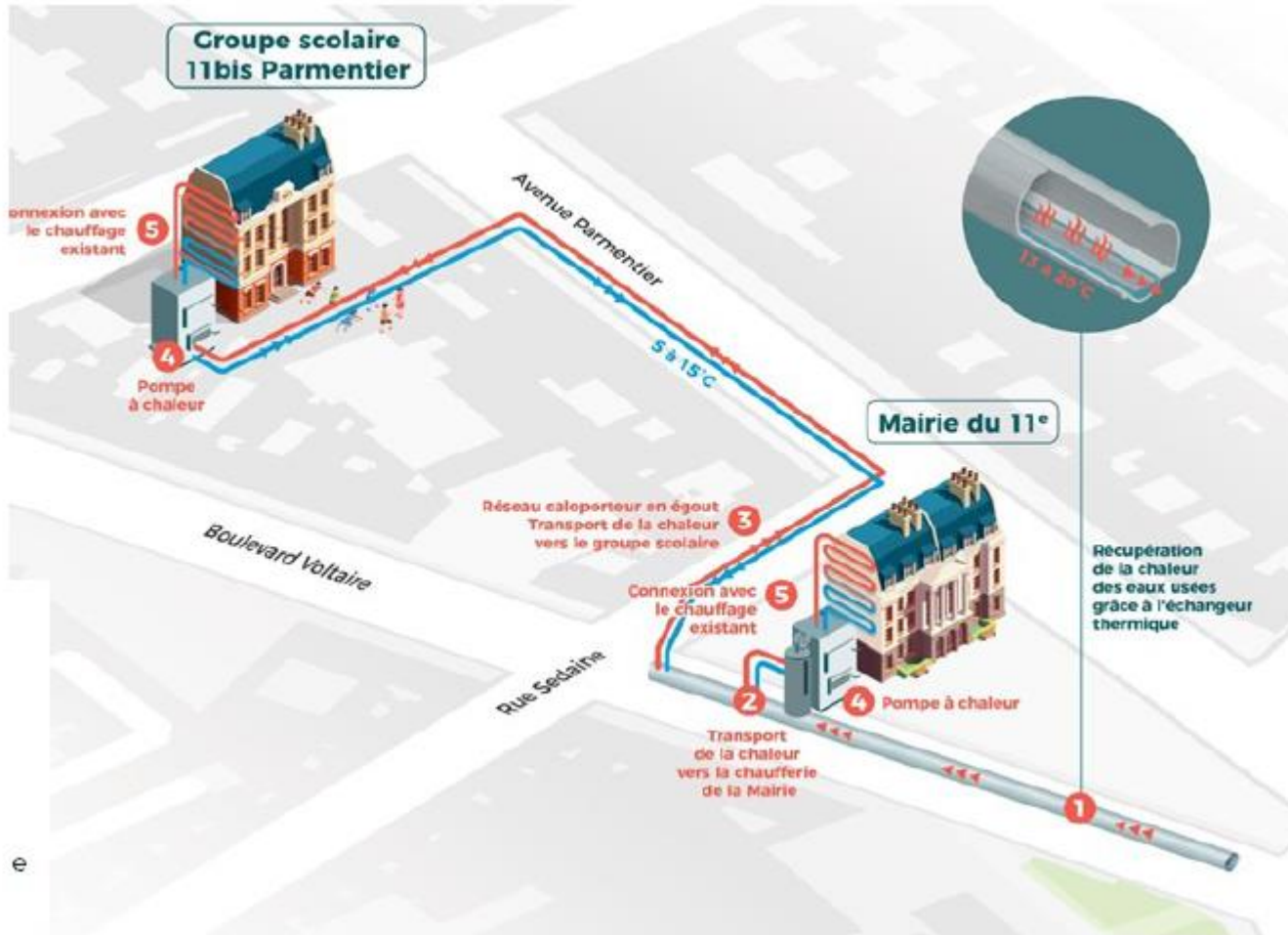
Principaux groupes d'équipements favorables à la récupération de chaleur sur égouts

Identifiant du groupe // nb d'équipements / nb de centres thermiques / Puissance installée (en kW)

- Présence d'une ou plusieurs piscines et/ou d'une mairie d'arrondissement
- Présence d'au moins un gros consommateur avec une puissance > 1 000 kW
- Présence de 4 centres thermiques ou plus ayant une puissance > 200 kW
- Présence d'un ou plusieurs équipements ayant une conso annuelle > 250 MWh/an
- Potentielle création de boucle d'eau chaude à avec récupération de chaleur sur égout pour alimenter un groupe d'équipements publics

Sources : DCPA, DGFIP, DPE, Apur - 2020

Example of heat recovery potential from sewers

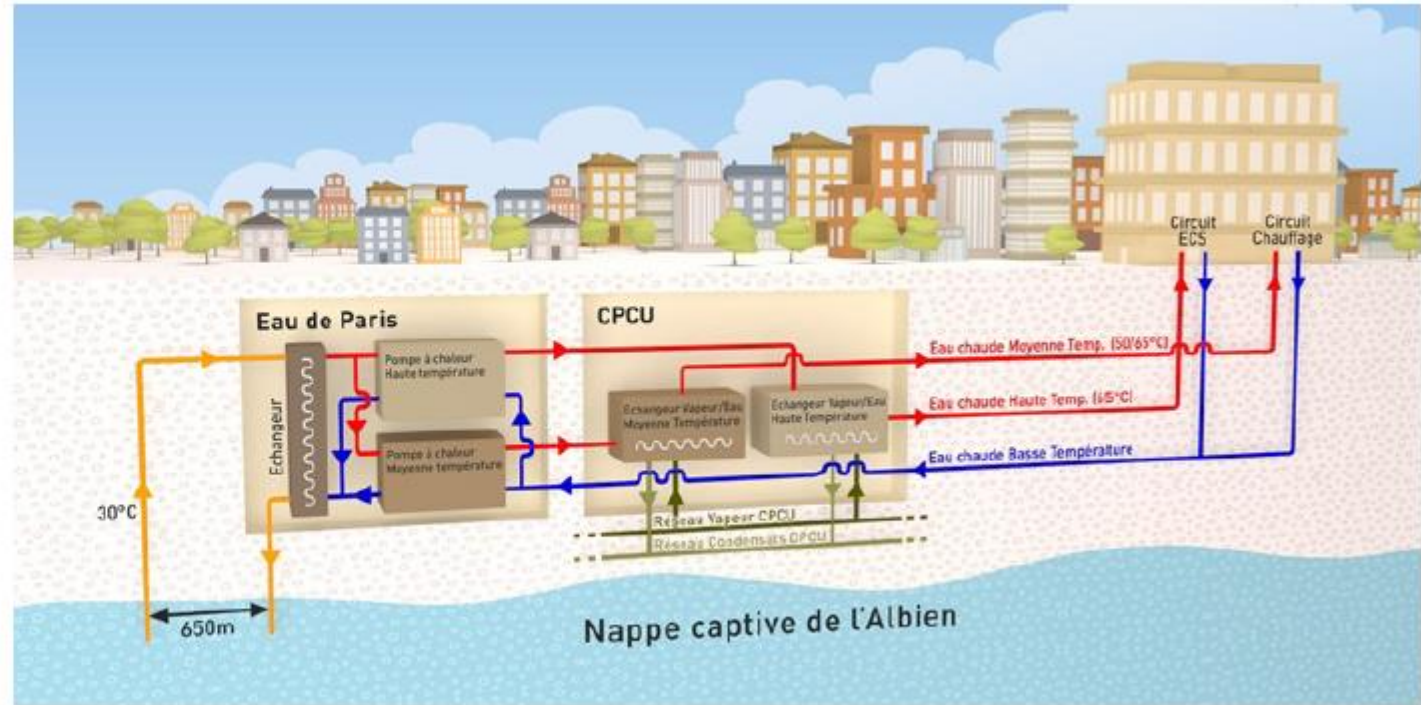
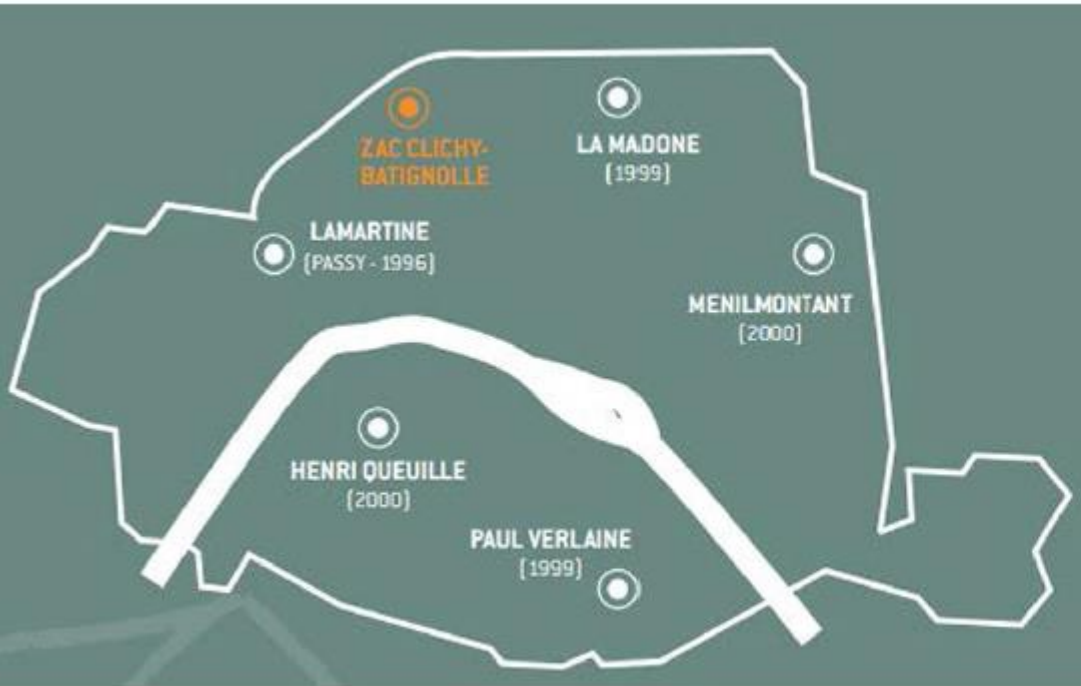


Example of Geothermal Energy



L'éco-quartier Clichy-Batignolles (17e)

Using Acquifer at a depth of 600 m





L'éco-quartier Clichy-Batignolles (17e)

On the surface...



Station de géothermie dans l'éco-quartier Clichy-Batignolles (17e)

...underground



Thank you for your attention