watinyoo

| smart thermal grid |

TECHNICAL OVERVIEW

THERMAL SMARTGRID ON WATER LOOP

Creation of an intelligent heat network (Smartgrid) based on the principle of interconnected geothermal water loops modulated by control units

15/02/2018

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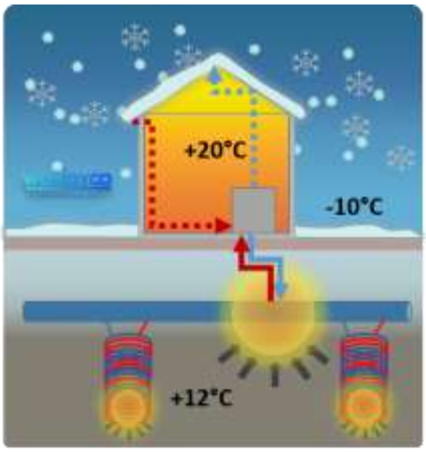
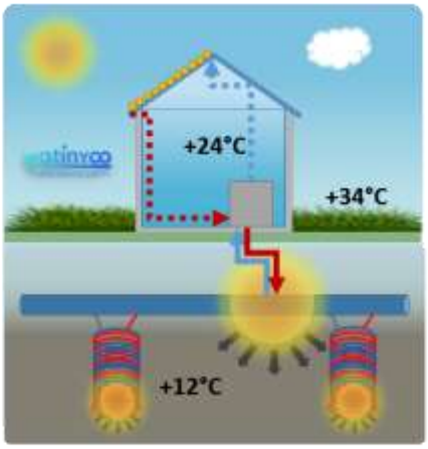
1. CONCEPT PRESENTATION

Designed like aeration systems that keep air at a temperature between 5 and 15 ° C like Canadian wells (for heat) or Provençal wells (for cooling), the system proposed by WATINYOO uses a hydraulic loop in which water is used as heat transfer fluid without any additives.





The soil temperature at the depth of 1.5 m (excluding frost), varies between 5 and 25 ° C (depending on the region). These naturally available degrees are picked up by the hydraulic network and reassembled (by plate heat exchanger) to the heat pumps connected to it.

Operating in a staggered manner with respect to the outside temperature, the soil thus restores stored temperatures in the cold season during the summer heat and allows, during the hot season, to benefit from a cooler temperature kept from the winter cold.

In case of need (strong climatic variations for example), the system can be associated with additional sensors or heat sources.

1.1. ASSOCIATION OF SURFACE GEOTHERMALITY AND SMARTGRIDS:

The concept is based on a set of buried water loops, interconnected by high efficiency plate heat exchangers, using natural soil isolation capabilities to produce and store heat and transport it over a long distance, without heat loss.

Buried at a depth of 1.5 m (frost-free), in the upper layers of the soil, the geothermal loop captures the natural heat of the soil (between 5 and 15 °) when it is higher than the water temperature of the soil. the loop or discharges heat into the soil when the temperature of the soil is higher than that of the soil.

The additional thermal energy is produced from renewable sources, non-polluting and available at very low economic cost (collection roof or facade, gray water recovery, geothermal exchange baskets).

Each subscriber is equipped with a control unit (WATeBOX ™) in charge of real-time monitoring of the state of available thermal resources (in the loop and at associated sensing points). The interconnection of the control units via the Cloud creates a smart grid (SmartGrid) for heat exchange.

The resource evaluation is compared to the current and future target temperatures (heating and DHW). In case of excess or deficit of resources, the control unit will interact with the other units of the network to provide additional resources.

The pooling of flows helps to considerably improve the efficiency of heat pumps (COP) connected to the network and used for the production of domestic hot water (DHW), heating or air conditioning..

1.2.ADDITIONAL ENERGY SOURCES :

1.2.1. COGENERATION

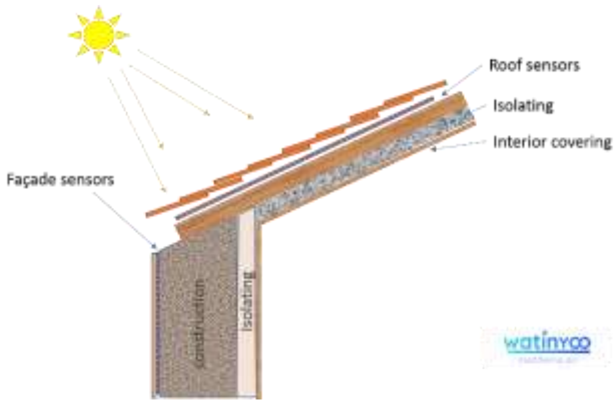
Power supply generation by cogeneration is designed in a flexible and poolable way to adapt to existing environments and structures.

The co-generators, organized into micro-proximity plants, ensure the production of electrical energy in the area, thus allowing the supply of heat pumps but also the supply of electrical energy for the subscribers.

The heat of the co-generators (fatal heat) is recovered and transmitted to the hydraulic network (by heat exchangers with high efficiency plates).

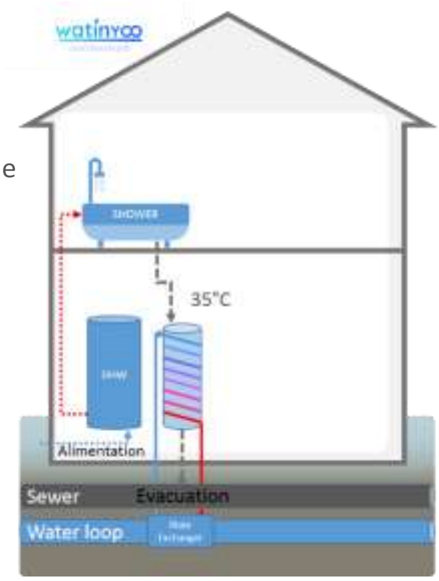
1.2.2. ROOF OR FACADE CAPTATION

An additional system of solar heat recovery on the roof and / or on the facade, makes it possible to create an additional source of heat if necessary.



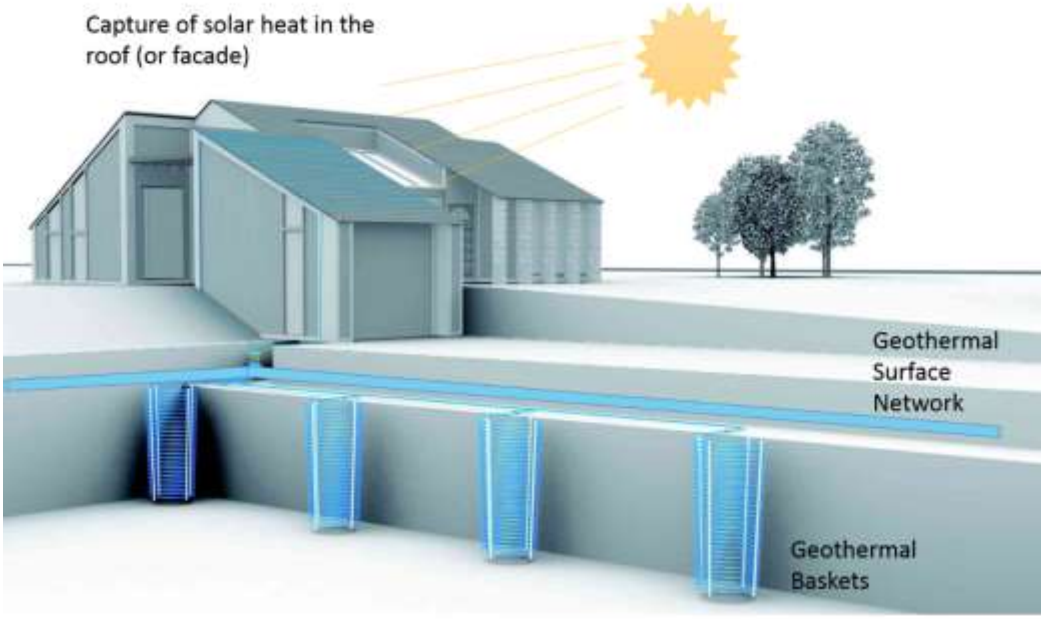
1.2.3. GREY WATER RECOVERY

A pre-evacuation tank for the domestic hot water of a building allows the recovery of additional heat added to the geothermal loop.



1.2.4. GEOTHERMAL BASKETS

If necessary, the network can be supported by geothermal baskets. They consist of conical spiral tubes about 1.5 m high, buried 4 to 5 m deep in the ground, and recovering an additional 5 to 15 ° C (or removing excessive heat) by increasing the area and volume of heat exchange.



Presentation of water pipe network concept associated with geotermal baskets

1.3. HEAT TRANSPORTATION

Several loops (of variable size) can be connected to one another by means of heat exchangers in order to constitute an urban heat network with a particularly low cost of implementation and operation.

A surface geothermal loop of 1000 linear meters may represent (depending on the geological and meteorological conditions) a thermal energy power greater than one megawatt (1.16 MW).

The network can accommodate a number of high-performance heat pumps (COP> to 5) which, in turn, provide heating, domestic hot water (DHW) and the necessary air conditioning for users.

Each subscriber is equipped with a control box (WATeBOX™) operating on the principle of Internet access boxes and responsible for providing, permanently, the energy demanded by the user.

Like Internet Boxes which allow to reach media offers (films, Web sites, TV channels, etc.), the WATeBOX™ allows access to heat sources (geothermal network, capture roofing, heat fatality, etc.) proximity to optimize the operation of PAC. WATeBOX™ uses the Cloud to exchange information and pool thermal resources available on the different loops on which they are connected.

The transfer of energies between the sources and the loops of the network is done by means of plate heat exchangers. It takes approximately 20 to 30 minutes to transfer 1 kW over a distance of 1000 m.

1.4. HEAT PUMP COP IMPROVING

Classe d'efficacité énergétique de l'unité en mode réfrigération		Classe d'efficacité énergétique de l'unité en mode chauffage	
A	3.20 < EER	A	3.60 < COP
B	3.20 ≥ EER > 3.00	B	3.60 ≥ COP > 3.40
C	3.00 ≥ EER > 2.80	C	3.40 ≥ COP > 3.20
D	2.80 ≥ EER > 2.60	D	3.20 ≥ COP > 2.80
E	2.60 ≥ EER > 2.40	E	2.80 ≥ COP > 2.60
F	2.40 ≥ EER > 2.20	F	2.60 ≥ COP > 2.40
G	2.20 ≥ EER	G	2.40 ≥ COP

The energy performance of an air conditioner or a heat pump results in the ratio between the amount of heat produced by it and the electrical energy consumed by the compressor.

This ratio is the coefficient of performance (COP) of the heat pump. The higher the number, the better the system. The ceiling is currently 7.

For the heating of buildings (CH) a COP of more than 3.60 corresponds to a class "A" of energy efficiency.

For heating (CH) the operating temperature is allowed at 35 ° C for low temperature heating. For a variation of the field heat source of between +5 and +15 ° C, the coefficient of performance varies from 4.83 to 6.25, ie 1kWh of electricity consumed globally produces 4.83 to 6.25 kWh of heat.

température		+5.0	+ 10.0	+15.0
20.00		6.86		
25.00		6.14	6.88	
30.00		5.45	6.18	6.92
35.00	CH	4.83	5.52	6.25
40.00		4.27	4.91	5.59
45.00	ECS	3.76	4.34	4.96
50.00		3.32	3.82	4.38
55.00		2.93	3.36	3.86
60.00		2.58	2.96	3.38
65.00		2.29	2.61	2.97
70.00		2.03	2.29	2.61
75.00		1.80	2.02	2.28
80.00			1.78	2.01

For domestic hot water (DHW) production this coefficient of performance is usually even lower considering the elevated temperature rise between that of the supplied water (around 15 ° C) and the service temperature (around 60 ° C). C). The performance coefficient calculations for domestic hot water production estimate this average and necessary rise in temperature (from 15 to 60 ° C) to 45 ° C.

Heating with heat distribution by radiators at elevated temperature is comparable to the production of domestic hot water in terms of coefficient of performance.

For a variation of the field heat source between +5 and + 15 ° C, the coefficient of performance varies from 3.76 to 4.96, i.e. 1 kWh of electricity consumed produces 3.76 to 4.96 kWh of heat overall.

Température distribuée	-15.0	-10.0	-05.0	0.0	+5.0	+10.0	+15.0	+20	+25	+30	+35
20.00	3.99	4.65	5.36	6.12	6.86						
25.00	3.45	4.05	4.68	5.39	6.14	6.88					
30.00	3.01	3.52	4.10	4.75	5.45	6.18	6.92				
35.00	2.65	3.09	3.61	4.18	4.83	5.52	6.25				
40.00	2.35	2.74	3.18	3.69	4.27	4.91	5.59	6.31			
45.00	2.11	2.45	2.82	3.25	3.76	4.34	4.98	5.64	6.35		
50.00		2.18	2.50	2.88	3.32	3.82	4.38	5.01	5.67	6.36	
55.00		1.95	2.23	2.55	2.93	3.36	3.86	4.42	5.02	5.68	6.36
60.00			1.99	2.27	2.58	2.96	3.38	3.88	4.42	5.02	5.66
65.00			1.78	2.02	2.29	2.61	2.97	3.39	3.87	4.41	4.99
70.00				1.80	2.03	2.29	2.61	2.96	3.38	3.85	4.37
75.00					1.80	2.02	2.28	2.58	2.94	3.35	3.80
80.00						1.78	2.01	2.26	2.55	2.90	3.29
85.00								1.97	2.22	2.51	2.84

For a coefficient of performance of 5.0, the renewable energy share of the system is 80%

2. AN INNOVATION THAT GOES BEYOND TECHNOLOGY

For WATINYOO, the current energy market and the different tensions that characterize it are the result of a linear vision of business.

Indeed, players in the energy market share the same business model based on the control of primary energy sources (wells, mines, power stations, dams, etc.), the control of production tools (refineries, power plants, etc.), the control of distribution networks (tankers, service stations, electrical networks, etc.) and, lastly, the control of end-user subscribers.

The result is a superposition of operational margins throughout the value chain which ultimately results in access to the service at a high price. This elevated level of cost of service is, moreover, necessary for the profitability of researching new sources of primary energy. The increasing cost of finding new sources, which in turn contributes to increased operating margins and the ultimate cost of service. The inflation trend of the model is thus self-powered.

Our concept is based on a 360 ° vision. Human activity and nature produce waste (biomass, sludge from wastewater treatment plants, industrial waste, household waste, etc.) or (solar) energy sources that represent primary energy sources. The treatment of this waste by pyrolysis or capture (solar energy) allows the creation of renewable energies (and products) immediately usable by human activity (heat, water, electricity). New waste (dead heat, DHW) is, in turn, reused for energy production.

The available energies are pooled across the network (geothermal loop) to serve where they are needed.

This circular approach, unlike linear vision, allows to create a virtuous spiral limiting energy loss (through recovery) while reducing their cost of exploitation (by pooling). This approach is of the win / win type. The operator develops its network by increasing the energy sources for a lower and lower cost. The subscriber benefits from the multiplication of energy sources and has a quality service at a lower cost.

3. APPLICATION TO MOUNTAIN HOSPITALITY BUILDINGS

3.1. PROJECT CONSTRAINTS

3.1.1. GENERAL CONSTRAINTS

- The use of renewable energy for heating and domestic hot water production for residences in alpine regions is still subject to a multitude of problems such as the profitability compared to fossil resources and the difficulty of geothermal drilling.
- Solar capture is not very profitable because energy needs are low in the period of strong sunlight.
- The use of air-water heat pump is also unreasonable because of winter temperatures that can reach -20 ° C and the power consumption becomes important.
- The use of wood as primary energy is well adapted in these regions (local and CO2 neutral) but the use of one boiler per building poses operational problems when used in the offseason due to a demand sporadic which implies the use of storage tank.
- The use of wood with too high humidity is another problem because it causes microparticle pollution and rapid corrosion of the plant with high maintenance costs.
- The use of a elevated temperature remote heating is well adapted, but the profitability is bad because of the costs of implementation and the losses related to the ground which is cold.

3.1.2. SPECIFIC CONSTRAINTS

The altitude of the project (approximately 1,600 meters) makes the task extremely difficult or impossible for the application of a heat pump-based installation if it was not associated with a geothermal network such as that proposed by WATINYOO.

The main specific constraints to the project are as follows:

- Consumption of massive domestic hot water in the middle of winter at the time of maximum heating consumption.
- The contributions of solar energy are reduced by a lack of exposure, especially 3 months without sun.
- Several buildings are distributed in a disorganized manner, which undermines the importance of heat supply facilities.

3.1.3. PROJECT CONFIGURATION

A residence with a capacity of 500 beds is spread over 6 buildings. The site plans of the project and the installations relating to the concept are appended to this report.

3.2.PROJECT STUDY

3.2.1. CONSUMPTION DATA

The energy consumption data for heating and domestic hot water have been calculated precisely according to the rules of the art.

CONSOMMATION [kWh] ECS/CHAUFFAGE SUR L'ANNÉE

Consommation [kWh]	janv.2	févr.2	mars2	avr.2	mai2
ECS [65 degrés celsius)	7 700	7 450	5 470	5 300	5 470
Chauffage (35 degrés cel)	11 010	8 670	6 080	4 550	470
Total consommation	**18 710**	**16 120**	**11 550**	**9 850**	**5 940**

juin2	juil.2	août2	sept.2	oct.2	nov.2	déc.2
5 300	5 470	5 470	5 300	5 470	5 300	8 020
-	-	-	100	2 960	8 460	10 580
5 300	**5 470**	**5 470**	**5 400**	**8 430**	**13 760**	**18 600**

3.2.2. CALCULATION OF MONTHLY PERFORMANCE AND WEIGHTED PERFORMANCE COEFFICIENTS

The calculations were carried out in detail per month to produce heating and hot water. The various calculation parameters include:

- Monthly DHW consumptions / heating

- The temperatures of the ground (storage) month by month

- Summer solar energy inputs,

- Monthly temperature of water loop collectors and baskets

- The calculation of the weighted annual coefficient of performance (4.64).

CALCUL DU COP

Coefficient de performance	janvier	février	mars	avril	mai	juin	juillet	août
COP ECS	4.05	4.05	4.05	4.05	4.05	4.34	4.65	4.65
COP Chauffage	5.18	5.18	5.18	5.18	5.18	5.52	5.88	5.88
COP moyen pondéré	4.71	4.66	4.64	4.57	4.14	4.34	4.65	4.65
COP ANNUEL PONDÉRÉ	4.64							

3.2.3. MAIN CALCULATION INPUTS

CONSOMMATION [kWh] ECS/CHAUFFAGE SUR L'ANNÉE

Consommation [kWh]	janv.2	févr.2	mars2	avr.2	mai2	juin2	juil.2	août2	sept.2	oct.2	nov.2	déc.2
ECS [65 degrés celsius]	7 700	7 450	5 470	5 300	5 470	5 300	5 470	5 470	5 300	5 470	5 300	8 020
Chauffage (35 degrés cel)	11 010	8 670	6 080	4 550	470	-	-	-	100	2 960	8 460	10 580
Total consommation [kWh]	**18 710**	**16 120**	**11 550**	**9 850**	**5 940**	**5 300**	**5 470**	**5 470**	**5 400**	**8 430**	**13 760**	**18 600**

APPORTS SOLAIRES ET TEMPÉRATURE DES OBJETS

Consommation [kWh]	janvier	février	mars	avril	mai	juin	juillet	août	septembre	octobre	novembre	décembre
Tempér. surface [1m]	2.3	0.3	-	2.1	3.6	5.9	7.9	9.9	10.5	9.6	7.3	5.4
Tempér. collect. énergie	7.5	7.5	7.5	7.5	7.5	10.0	12.5	12.5	12.5	10.0	[illegible]	[illegible]
Apport solaire [deg Celsius]				0.8	1.8	1.9	2.1	2.5	1.8	0.8		
Tempér. corbeille [2m]	7.2	7.3	7.4	7.5	7.4	10.0	10.4	10.4	10.2	8.8	8.3	7.7

COP ANNUEL MOYEN PONDÉRÉ
4,64
CH ECS

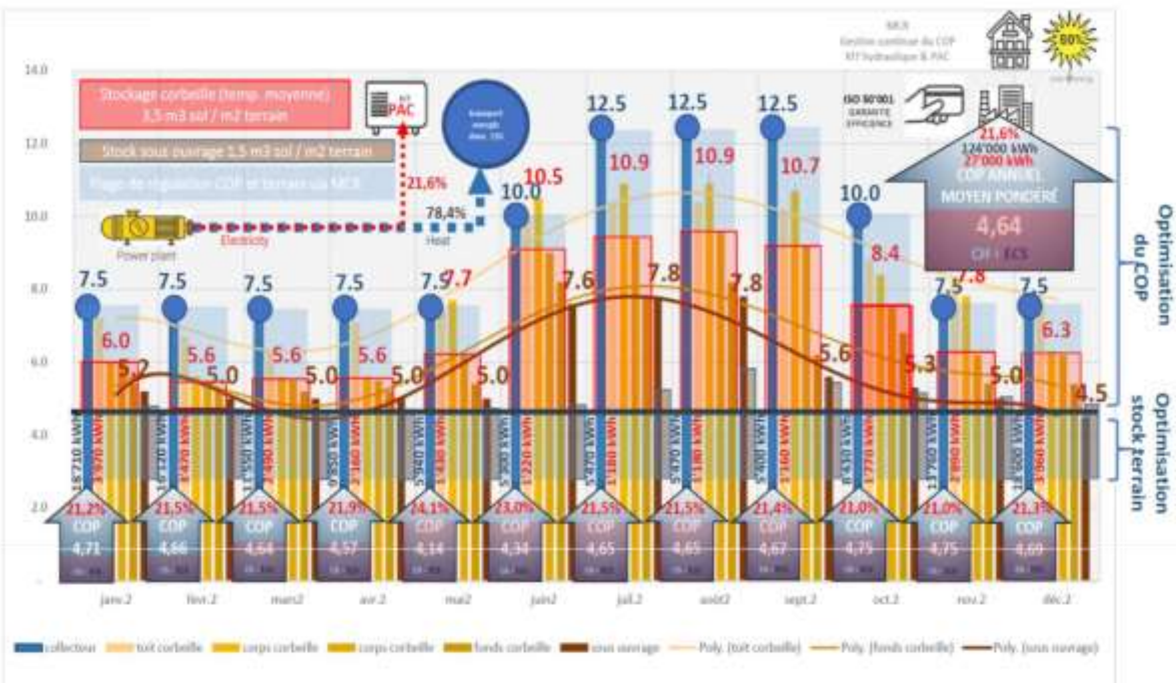
CALCUL DU COP

Coefficient de performance	janvier	février	mars	avril	mai	juin	juillet	août	septembre	octobre	novembre	décembre
COP ECS	4.05	4.05	4.05	4.05	4.05	4.34	4.65	4.65	4.65	4.34	4.05	4.05
COP Chauffage	5.18	5.18	5.18	5.18	5.18	5.52	5.88	5.88	5.88	5.52	5.18	5.18
COP moyen pondéré	4.71	4.66	4.64	4.57	4.14	4.34	4.65	4.65	4.67	4.75	4.74	4.69
COP ANNUEL PONDÉRÉ	4.64											

ÉCARTS TMPÉRATURE (POUR ÉVALUATION DES PERTES THERMIQES SOL & CORBEILLES)

Ecart température (celsius)	janvier	février	mars	avril	mai	juin	juillet	août	septembre	octobre	novembre	décembre
Ecart tuyau-surface [1m]	5.2	7.2	7.5	5.4	3.9	4.1	4.6	2.6	2.0	0.4	0.2	2.1
Ecart corbeille(2m)-tuyau	- 0.3	- 0.2	- 0.1	-	- 0.1	-	- 2.1	- 2.1	- 2.3	- 1.2	0.8	0.2
Apport solaire [deg Celsius]				0.8	1.8	1.9	2.1	2.5	1.8	0.8		

3.2.4. GEOTHERMAL LOOP OUTPUTS



3.3. STUDY CONCLUSIONS

The calculated results and conclusions are as follows:

- The hot / cold and domestic hot water needs are fully covered by the energy production system,

- The electricity needs of the heat pump installations are fully covered,

- 78.4% of useful energy is produced without CO_2 and 21.6% is CO_2 neutral,

- No fossil energy is needed, the share of solar renewable energy is about 80% and the share of renewable energy from waste represents the balance of 20%,

- Investment costs are comparable to a traditional system, but operating and energy consumption costs are much lower by a factor of 2,

- The storage room for wood chips (or solid fuel) is about 45 m3 and the full is to be done 6 times a year for all residences.

- The proposed security measures are the installation of a traditional remote heating system on standby and linking the cogeneration plant to the buildings as well as the reservation in place for the future installation (during the extension of the geothermal network to village) of a second cogeneration plant.

smart thermal grid

WATINYOO IS A MEMBER OF THE SMARTGRIDS COTE-D'AZUR CLUB ASSOCIATION

WATINYOO IS MEMBER OF CAPENERGIES ASSOCIATION

INNOVATION AWARD ON CLIMAT-ENERGY PLAN FRENCH RIVIERA 2017

WATINYOO HAS BEEN SELECTED TO INTEGRATE THE FIRST PROMOTION OF SOPHIA-ANTIPOLIS VILLAGE-BY-CA

WATINYOO IS PARTNER OF ETIA-COGEBIO GROUP