Fostering diffusion of Heating & Cooling technologies using the seawater pump in the Adriatic-Ionian Region

Report on heat pump installation and industry in Adriatic-Ionian region

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Purpose of this document

The **scope** of the present document is to present the existing installations that use seawater heat pumps in buildings. In this Activity T1.1 each partner will collect and analyse data and information about:

- Existing installations of seawater heat pumps in buildings from different sectors located in the Adriatic-Ionian area;

The coordinator of the Action T1.1 “Mapping and current state situation” is CERTH, who prepared a common datasheet for collection of data regarding the existing seawater heat pump installations in the Adriatic – Ionian area. Each partner will collect data from national energy agencies, EU Commission, local administration, universities, research institutions and previous EU projects.

1 Introduction

The SEADRION project **aims** to support the development of a regional innovation system for the Adriatic-Ionian area with the installation of 3 renewable energy facilities in public buildings located in Greece and the western and southern part of Adriatic Croatia. These facilities are seawater heat pumps, an innovation system that uses the thermal energy contained in a reservoir (sea) to achieve the cooling and thermal energy in the buildings which are close to the sea.

The main **objective** of the SEADRION is to identify benefits and barriers associated with the use of this technology and to find a system solution designed to improve the use of the seawater heat pump technology and to make the building's energy self-sufficient and independent from fossil fuels.

The main **outputs** of the SEADRION project are a transnational seawater heat pump network

- to support sustainable development in the ADRION region, science and technology cooperation between research institutions and enterprises,
- to enhance innovation capacity of the heat pump sector with the aim to improve their innovation skills, capacities and competencies and common strategy to enhance the use of seawater heat pump based heating and cooling in the ADRION region.

Because of the diverse geographical features of MED countries, five countries were involved within the activity in order to present as good as possible the installed applications within each territory so as to obtain a comprehensive picture of already installed seawater heat pump applications. Within this activity the following partners were involved:

CROATIA – UNIZAG and DURA

GREECE - CERTH

ITALY - CORTEA

SLOVENIA - GOLEA

ALBANIA - AKBN

Information for the compilation of the data sheets as depicted in the annex, are collected by partners through questionnaires, from literature available on the internet and secondarily on invited expert advice, as indicated in each case description.

2 Existing heat pump installations in Adriatic – Ionian area

From the answers to the questionnaires, presented in the Annexes, we can see that sea water as a source is mainly used in medium and large-sized heat pump systems, such as small settlements of mixed use development (as described by CORTEA) and in many hotel complexes (as presented by CERTH, UNIZAG FSB and Dura). It is worth mentioning that in Slovenia, a SWHP system has been installed through an ESCO financial mechanism.

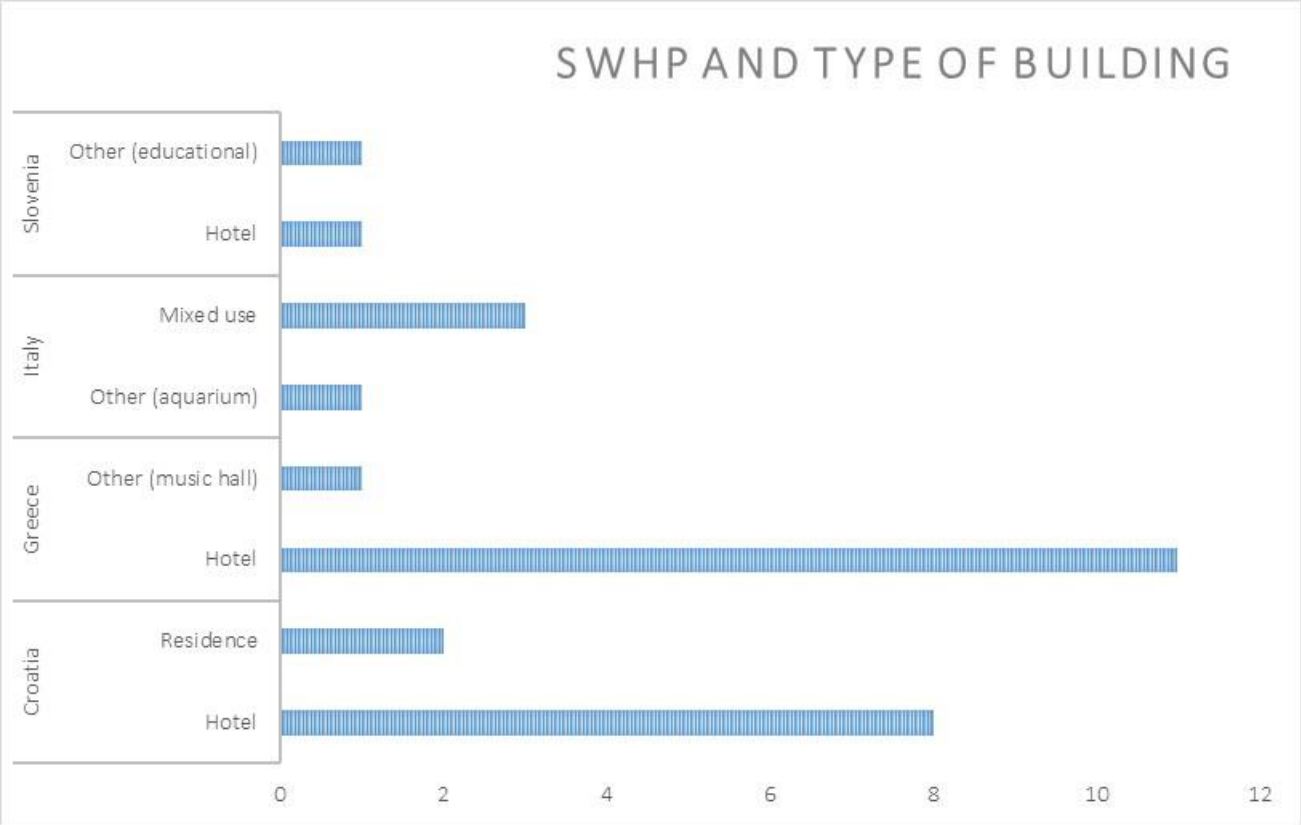

Figure 1: Type and amount of buildings having SWHPs in each country (no records are existing for Albania)

According to **GOLEA**, in Slovenia, one system that uses SWHP for heating and cooling is installed in the Faculty of Maritime Studies and Transport, in Portorož. The second installation is in a hotel also located on the coast in Portorož. In this case, high operational costs due to fossil fuel use led to the decision of refurbishment of the system, which was made through the ESCO financing model.

According to **CORTEA**, in Italy, Porto piccolo – Sistiana, is a small village set in the Gulf of Trieste. Great attention to the protection of the environment has been given in the design and implementation of the project and entire complex construction, which uses solar and geothermal energy. Sea water is used for covering of cooling and heating needs and also for DHW for the different buildings of the village (hotel, spa, residential units, commercial areas etc.). The village also uses solar energy for DHW needs with total 200 m^2 of solar panels. Also, Darsena of Savona has been restructured forming a complex of buildings with mixed use development: residential and commercial. In this case, water-to-water heat pumps are used for air conditioning and DHW. Due to

architectural constraints imposed by the buildings linear design there is no use of any other RES. Last but not least, there is a work in progress in Genova (Complesso San Benigno), which involves the construction of a low-enthalpy thermal and refrigeration energy distribution infrastructure, taken from sea water. The typology of the intervention will be able to serve the mixed use development blending residential, commercial, cultural, institutional, or entertainment uses. SWHP are also used in the Aquarium of Genova, providing heating and cooling of tropical fish and seal tanks.

The use of heat pumps for heating, cooling and DHW is widespread in the hotel sector in Greece. There are many installations using sea water as heat source and a few using open loop GSHPs exploiting saline water near the coast. According to **CERTH**, in Greece 10 hotels use geothermal systems for covering cooling needs during summer months. The total installed capacity is approximately 6.7 MW for heating and 9.4 MW for cooling. Some of these hotels, five in number, have also a supplemental renewable energy system installed in order to cover their energy needs. This system is mainly solar panels with a total area of 4.850 m^2 for the production of DHW.

According to **UNIZAG FSB and Dura**, two installations in private properties were found in Croatia which use geothermal heat pump systems. These systems were put in use in 2007-2008 and cover the energy needs of two apartment buildings with COP in the heating mode 5.5 and the energy efficiency ratio (EER) in passive cooling from 25 to 30. Also, eight hotels in the Adriatic coastal area of Croatia use SWHP for heating and cooling, and at the same time for the preparation of DHW, including heating of pools, where they exist. In one case, for the needs of DHW, solar collectors are used.

According to **AKBN** in Albania there are no seawater heat pump installations. Thus Albania has not been included in this report.

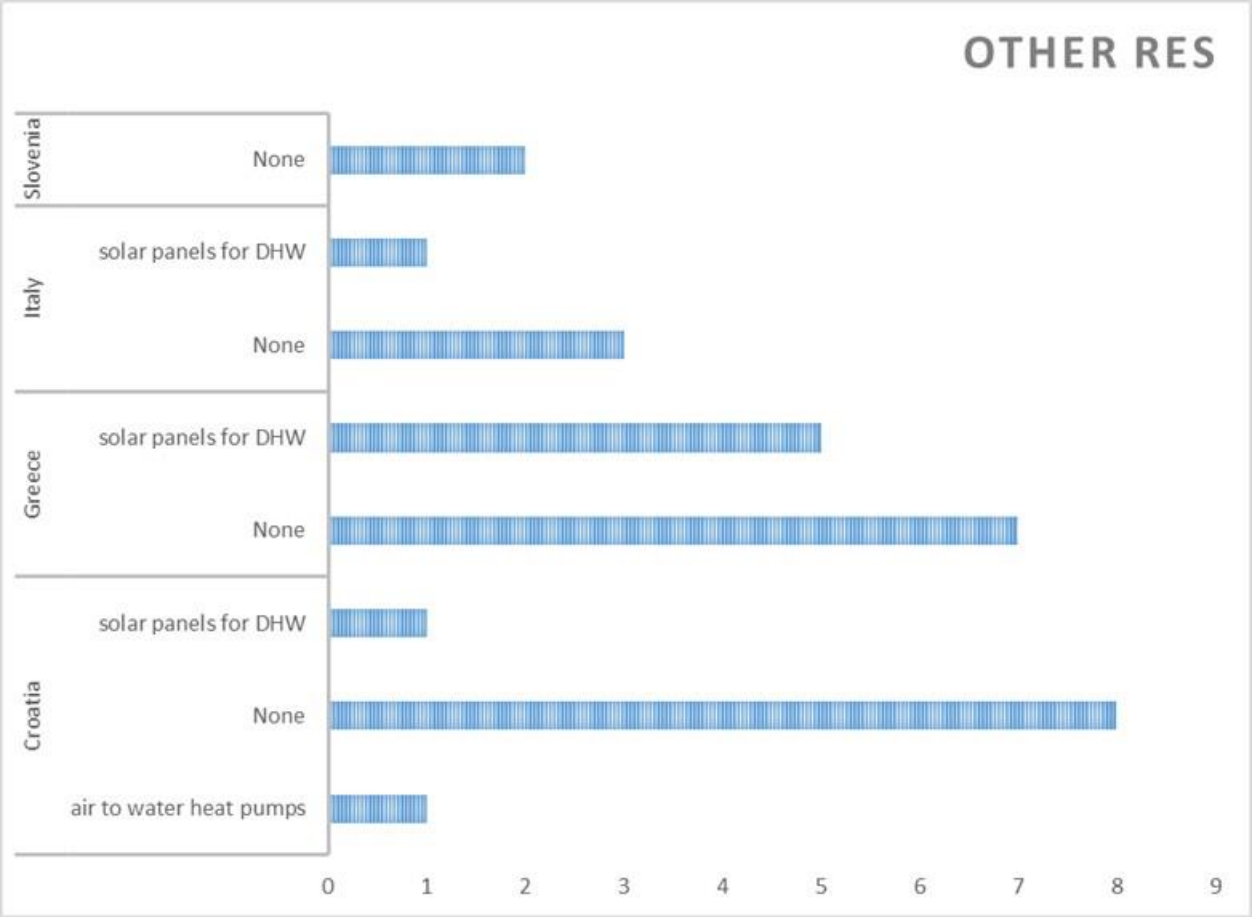

Figure 2: Other RES used in facilities

Regarding the water intake in the various applications, most partners are directly sourcing the water from the sea, apart from Greece, where it is more common to source water through drillings in order to avoid time consuming permission procedures (administrative reasons) for the water abstraction but also in order to avoid technical implications such as expensive filtering procedures to avoid clogged filters and a possible shut down of the facility (technical and economic reasons).

For the partners who are sourcing water directly from the sea, the distance is varying from approximately 5 until 500 meters.

3 References

As indicated in each case description.

Annex

1. Country/Region: **SLOVENIA**

1. Responsible contact person	
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e-mail	tomaz.lozej@golea.si
Position in institution/company	Project manager

2. Existing installations: Faculty of maritime studies and transport

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling		DHW

2.2. Description of the application

The selected case study is located in Portorož, Slovenia. The main purpose of the application is heating and cooling of the building – Faculty of Maritime Studies and Transport. System uses heat pump, which benefits on sea water temperatures, which are lower in the summer and higher in the winter in comparison with outside air temperatures. That makes the heat pump run on a higher efficiency which means more convenient costs of heating and cooling. Nominal heating power in winter time is 66 kW and nominal cooling power in summer time is 55 kW. Distance between machine room and seawater intake is about 60 m. The year of system's construction was 2004.
Regarding previous experience, it is similar with traditional heat pumps, except the maintenance works, that are related with the system for sea water.
Because heat pump system was constructed more than decade ago, there are no detailed data of investment costs. Similar system with available technology nowadays could be constructed for about 30,000€. In the planning phase payback period was calculated to be about 7 years. For smaller systems, a great share of investment costs can present construction of intake and discharge pipelines in case the heat pump is in distant onshore.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Faculty of Maritime Studies and Transport	13°34'39"E	45°30'58"N
Average air temperature (year)		13,4°C
Average seawater temperature (year)		15,8°C

Type of the building (domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Educational	**N.A.**	**N.A.**	**N.A.**

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
	66 kW / 55 kW	3.26 / 3.02
Other RES installed (technical data)	N.A.	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
91,000 / 75,000 kWh	3,195 / 3,195 h/a	60 m

2.3. General information

Location of the application

Pot pomorščakov 4

6320 Portorož

Owner:

Faculty of maritime studies and transport

Source: field visit and data collection

2. Existing installations: Grand Hotel Bernardin

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling		DHW

2.2. Description of the application

Grand Hotel Bernardin is located on the coast in Portorož, Slovenia it has 240 hotel rooms with more than 12,000 m^2 of hotel area in total. In 2014, new seawater heat pump system was launched in the hotel complex. Old boiler room was worn out with unreliable operation. Heating system operational costs were high and due to the fossil fuel use it was environmental unfriendly. The decision of renovation of the system was accepted and seawater heat pump system was chosen. To reduce investment costs, hotel owner chose model of ESCO financing with ESCO partner company Resalta d.o.o. (former GGE). All the investment costs (500,000€) were carried out by GGE, which is now paid to produce and supply energy to the Grand Hotel. Energy costs for the hotel owner were reduced from 300,000 € per year to approximately 200,000 € per year. Estimated payback period for ESCO partner GGE is less than 10 years. As seen by this case study, there is great potential in renovation of old worn out heating systems with installation of new heat pump systems. In this case study solution for financing is illustrated with ESCO model, where interested partner company invests and further manages energy.
Machine room is with pipelines connected to the seawater intake and discharge elements, which were designed as artificial marine reef. There are two heat pumps installed in the system, each with 500 kW thermal power. Heat pumps are used as heat source in winter as well as cold source in summer. In comparison with old system, CO_2 emissions are reduced for about 500 tons per year.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Grand Hotel Bernardin	13°34'08"E	45°31'03"N
Average air temperature (year)		13,5°C
Average seawater temperature (year)		16,8 °C

Type of the building (domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	**12,000 m^2**	**N.A.**	**N.A.**

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
	1000 kW	N.A.
Other RES installed (technical data)	N.A.	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
3,000,000 / N.A. kWh	N.A.	130 m

2.3. General information	
Location of the application Obala 2, 6320 Portorož Owner: Resalta d.o.o. Šlandrova ulica 4b 1231 Ljubljana - Črnuče	
Source: https://www.resalta.com/references/grand-hotel-bernardin-slovenia	

2. Country/Region: **Italy / Friuli Venezia Giulia**

1. Responsible contact person	
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Position in institution/company	Project manager

2. Existing installations: Porto piccolo – Sistiana

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling		DHW

2.2. Description of the application

Porto piccolo – Sistiana

This small village, set in the Gulf of Trieste, located directly on the Adriatic Sea, 460 residential units, public and private beaches, parks, bars and restaurants, hotel, marina with 124 berths and a large spa make Portopiccolo a real city. Born from a 245 million euro project lasted about 20 years for the environmental requalification of an abandoned stone quarry in Sistiana, PortoPiccolo has been nicknamed the "Little Monte Carlo" of the Italian Northeast.

Great attention to the protection of the environment has been given in the design and implementation of the project and entire complex construction, with uses solar and geothermal energy. For the project sea water is used as the source of the heat exchange. This renewable resource is stable all over the year and supplies water at favourable temperature to the loop serving the high efficiency Clivet Heat Pumps. These produce chilled and hot water plus domestic hot water for the different buildings (hotel, spa, residential units, commercial areas etc.).

The entire village boasts Class A energy efficiency, whose achievement has been made possible by using the sea as the thermal energy source for the heat pumps, with more than 600 Clivet air conditioning units.

The solution:

The plant engineering solution of PortoPiccolo is based on a water loop system that uses the sea water as an energy source. The plant has also the preparation for the exploitation of ground water, which emerges from the limestone which forms the floor of the quarry and then continues to the seabed. This renewable resource is stable all over the year and supplies water to the loop serving all the bay with 17 heating and cooling plants, which use the high efficiency packaged reversible Clivet heat pumps. These produce chilled,

hot water and domestic hot water for the different buildings: hotel, spa, residential units, commercial areas etc.

The distribution of hot and cold fluid in the different buildings is through radiant panels, Clivet fan-coils and heated towel rails. The system uses different renewable energy sources such as sea and sun, with real energy saving and very low operating costs. All of the heat pumps are fuelled exclusively by electricity, as well as the induction cookers, completely eliminating the use of gas or oil.

In the village there are also 200 square meters of solar panels, positioned on the roofs of the modern buildings, contributing to the hot domestic water high efficiency heating.

The results:

The completely electric power supply of both the heat pumps and the various domestic users has made it possible to completely eliminate the emissions of combustion gas for a completely green city. Even the cars cannot circulate in the village and all the parking lots are underground.

The system:

17 reversible water-water heat pumps on the refrigeration circuit. 611 terminal units. Total cooling capacity 3 MW. 200 m2 thermal solar panels for the production of domestic hot water.

Cost:

Mechanical, electrical and sanitary facilities for a total of around € 25 million. The only air conditioning system for about 2.5 ÷ 3 M €, of which 1.6 M € only for the central sea and the ring with technical water.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Porto Piccolo – Sistiana	37.067	15.300
Average air temperature (year)		1 °C to 28 °C
Average seawater temperature (year)		13 °C to 22°C

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
460 residential units, parks, bars and restaurants and hotel		April 2014	

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
Cooling and heating	18 Clivet heat pump water-water (3 MW overall)	COP 4,4 - 4,9
Other RES installed (technical data)	200 m^2 of solar panels for the production of domestic hot water	

Yearly produced heat/cold	Hours of operation heating/cooling	Distance of seawater (intake)
(……kWh)		3,8 m

2.3. General information

The engineer Stefano Longhi of SGM Consulting comments: "All the houses of the village are in Class A and equipped with geothermal systems for heating and cooling, thermal-acoustic insulation at the highest levels, ventilation controlled mechanics, low emissive windows, green roofs, hanging gardens and underground parking. High technology is here applied to maximum comfort with minimal impact, so much so that PortoPiccolo has received an important certificate from the Ministry of the Environment that certifies the very low emissions in terms of polluting substances in the air and in the water.

"The engineer Masoli continues: the expected savings, based on the energy analysis done and on the high efficiency of the installed systems, they are between 30 and 40% compared to a traditional system. These forecasts will be subject to timely verification during the coming seasons thanks to a system of supervision and accounting that will provide the final energy parameters ".

Location of the application

Porto Piccolo Sistiana, Duino-Aurisina

Owner:

The team

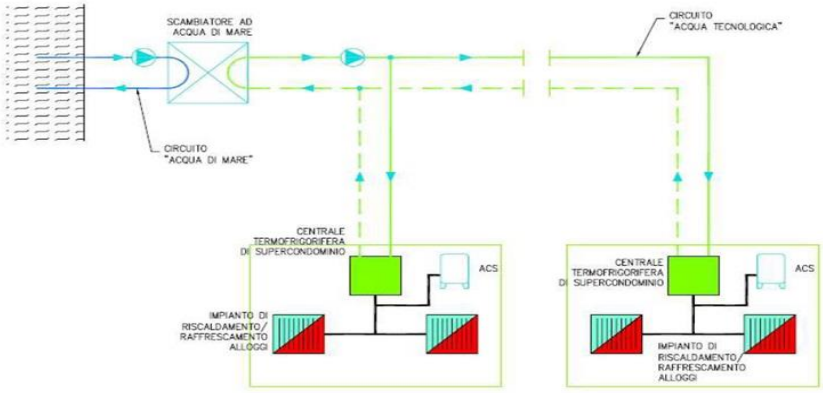
- Client: Serenissima SGR, Rilke.
- Architectural project: arch. Francesco Luparelli.
- Architectural and structural project development: Archest
- Plant design: SGM Consulting and SIMM engineering company Masoli Messi.
- Plant engineering companies: Fabbro Vanni, Ranzato Impianti, Buttro Hydrothermal, Tecnoterm.
- Management: Bovis Lendlease.

Photo of the application

Porto Piccolo – Sistiana

18 heat pump water-water (3 MW overall) produce hot and chilled fluids for indoor climate and hot water production, supported by solar thermal fields

Internal view of the power station, where the heat exchange takes place between the sea water and the heat transfer fluid (glycol water) that runs through the technical chain, allowing the heat pumps to work



The water circuit forms a loop that extends for about 2 km and, thanks to the operating temperature always below 35 ° C, was entirely made with polyethylene pipes.

Source: https://www.clivet.com/en/porto-piccolo-di-sistiana

2. Existing installations: Darsena of Savona

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling		DHW

2.2. Description of the application

Savona, renovation of the ex Darsena

The Darsena of Savona has been restructured forming a complex of buildings with mixed destination: residential, commercial and receptive, which directly overlooks the sea.

The solution:

After deep analysis, the air conditioning and domestic hot water production of the whole Complesso della Torre was entrusted to an ocean-thermal water-sea-heat-pump (WSHP) system based on heat pump technology.

Temperatures vary from 14°C in winter to 24°C in summer. Moreover, it is easily available, as the Complesso della Torre faces directly the sea. A concrete duct with an air intake grill and a shut-off damper that flows through a 60 m3 settling tank draws seawater.

By means of electric pumps, water is sent to filtering devices and then to three titanium steel exchangers with the same capacity. Water is finally returned to the source with 3°C difference in temperature. The exchanger utility side is represented by the WSHP water loop with reverse return circuiting, which supplies several water-to-water heat pumps serving the different users.

The hotel has a centralized solution with two heat pumps of 400 kW each for the production of cooled water, hot water and domestic hot water at 55°C. The distribution is committed to 190 ductable water terminal units. Air exchange is managed by four air-to-air heat pumps with thermodynamic heat recovery and by four hydronic air-handling units. 150 individual water-to-water heat pumps that supply more than 680 ductable water terminal units provide the air conditioning of residential and commercial users. The centralized domestic hot water production is realized by other heat pumps. Each residential and commercial unit is provided with its own ELFO Control device for its automatic air conditioning management. All devices are connected to the Clivet centralized control and management system.

The results:

Each user is independent respect to heating and cooling, throughout the year, with immediate accounting on its own electricity meter. The use of heat pumps for domestic hot water avoided the construction of heating plants with the associated bureaucracy and costs of installing gas pipes. Areas reserved for plant rooms were reduced to a minimum, consequently the commercialized surfaces, and the Complesso della Torre value, increased.

Thanks to the use of sea water as the heat pumps' energy source, design analysis over a one year period highlighted an average saving of 70% with respect to a traditional system that uses methane gas as an energy source for heating.

The system:

4 Clivet water-to-water heat pumps for the hotel air conditioning and domestic hot water production. 150 Clivet ELFOEnergy water-to-water heat pumps for the commercial and residential units air conditioning. 4 make-up units ELFOFresh Large and 4 air handling units by Clivet for the hotel common areas. More than 800 Clivet hydronic terminal units. 150 Clivet ELFOControl devices for the automatic management of each commercial and residential system. 2 storage tanks for domestic hot water. About 7,4 MW total thermal potential installed

Cost:

For a conventional plant life cycle, about 15 years, savings are equal to 2,5 million euros, including maintenance and energy costs. Environmental impact too has been drastically reduced, as direct CO_2 emissions have been thoroughly eliminated and indirect have been practically halved.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Vecchia Darsena – Savona	44° 14' 43'' N	8° 29' 33'' E
Average air temperature (year)		8 °C to 25°C
Average seawater temperature (year)		14°C to 24°C

Type of the building	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
NH Hotel with 96 rooms and conference centre, 103 flats, 20 offices and 31 shops	69.000 m^3	2007	

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
	7,4 MWt potential installed	
Other RES installed (technical data)	No	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
673.480 kWh - electricity		x

2.3. General information

The Spanish architect Ricardo Bofill has been inspired by naval architecture to design the new housing estate that overlooks Savona's dock, near Genoa. Comprising of two modern buildings, a nineteen-floor tower and a large pedestrian yard, the structure has a hotel, shops, offices and luxurious residences.

The Challenge. The main objectives of investors and town and port authorities was to provide a new image for the city of Savova, recovering and transforming radically the degraded area of the old dock. The programme idea: the new area would have high visibility structures for different types of end users, from tourists to traders and residents. The integration with the urban and maritime surroundings should be both architectural and environmental. The new buildings façades would be formed by large glass surfaces with different exposures to the sun: this could require simultaneous heating and cooling in different rooms.

This behaviour would be further amplified by the different uses and variable occupancy for each area. On the other hand external technical areas, such as roofs and balconies, would not be available because of architectural constraints imposed by the building linear design. Naturally the customer wanted all options to increase the value of the investment, both for energy savings and for installation and management

simplicity. The operation autonomy of all users and the ease in consumption accounting were in fact among the specific objectives.

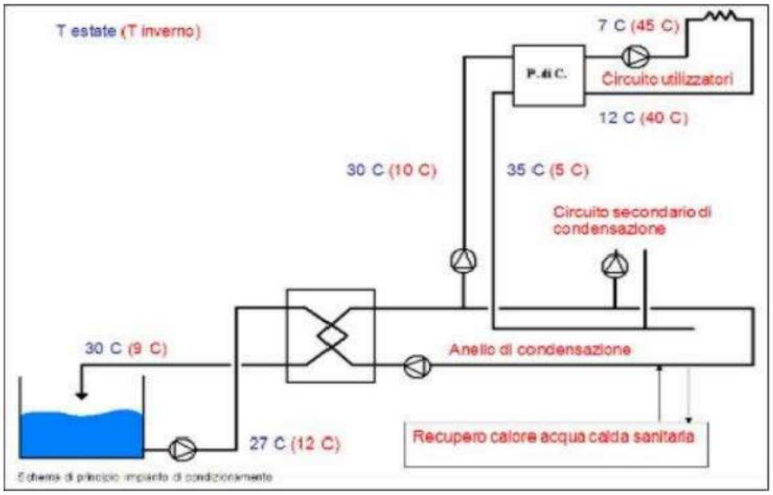
Location of the application

Darsena di Savona, Savona.

The team:

- Investor GF Group, Italy.
- Architectural project Ricardo Bofill Studio, Spain.
- Plant project Ing. Marco Gaminara, Italy.
- Exec. project and architectural project management.
- Arch. Armellino and Poggio, Ital

Photo of the application



Simplified description of the Savona plant

Oceanothermal heat exchangers and heat pumps

Source: http://www.repowermap.org/installations/563587126/it/Pompa-di-calore-Savona

http://www.clivet.lt/wp-content/uploads/2012/03/12_1-COMPLESSO-DELLA-TORRE-Multipurpose-complex.pdf

2. Existing installations: Aquarium of Genova

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

Aquarium of Genova

The Genoa Aquarium, built by the architects Renzo Piano and Peter Chermayeff, is one of the most visited places in the world. It has been realized in 1992 on the occasion of Expo '92 for the celebration of the fifth centenary of the discovery of the New World by Christopher Columbus with the goal of restructuring the

Port area. In 2007 the technological systems of the aquarium have been totally renovated in order to improve its functionality and efficiency.

The solution:

The three Carrier 30HXC 375 refrigeration units (freshwater- or seawater-cooled chillers) that control the air conditioning of the rooms and provide heating and cooling of tropical fish and seal tanks, are located in an underground room at level -2.

The plant consists of three refrigeration units that produce chilled water at a temperature of 6-7 ° C for cooling the common areas and seal tanks.

The tempered water, disposed during the condensation, is instead used for the air conditioning of the tropical fish tank at a temperature of 45-50 ° C.

Heat exchangers are installed to guarantee the correct functioning of the refrigeration units ensure dissipation and complete the cooling cycle, while water distribution is entrusted to suitable circulators. An interesting technical note of the system is that the cooling units use water from sea for the disposal of unused energy. In the face of this, special arrangements have been made in the plant plate exchangers designed for this particular operation.

The system:

Gross yield 1.181 kW. Group absorption 388.00 kW. Power Compressor 388.00 kW. C.O.P 3,04 . Minimum capacity 10.00%. Refrigerant R-134a.

Cost:

The plant has guaranteed to the customer the saving of about 800 euros a day of methane gas, being the boilers replaced most of the time by heat pumps. The saving for the production of cold water is also sensitive due to the greater efficiency of the refrigeration units, but on this we do not have a comparison data due to the continuous application changes (number and parameters of the tanks).

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Aquarium of Genova	44° 24' 22.22" N	8° 55' 21.33" E
Average air temperature (year)		6°C to 28°C
Average seawater temperature (year)		13°C to 23°C

Type of the building	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Aquarium	Cooling common areas and seal tanks	2007	

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
	1,1 MW	3,04

Other RES installed (technical data)		
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)		

2.3. General information

On 23 July 2010 a technical visit was organized to the Aquarium of Genoa entitled "The high efficiency of seawater heat pumps", a meeting dedicated to designers and professionals in the sector in order to present prestigious Carrier case histories. The event, planned in collaboration with the Territorial Delegate AICARR and with the on-site coordination of the Labella agency, saw the participation of 25 designers and allowed the large group of professionals to confront one of our most important plant designs.

Location of the application

Ponte Spinola, Genova

Owner:

Photo of the application

Aquarium of Genoa

Installation of the Aquarium

Source: file:///C:/Users/Utente/Downloads/Carrier_on_air_Acquario_di_Genova%20(1).pdf

2. Existing installations: Complesso San Benigno – Genova

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

Complesso San Benigno – Genova (work in progress)

The project involves the construction of a low-enthalpy thermal and refrigeration energy distribution infrastructure, taken from sea water, implemented with a fresh water ring with a flow rate suitable to supply thermal energy to the main centralized users of the district.

The typology of the intervention will be able to serve directional centers, shopping centers, hotels, condominiums, tertiary sector in general, but also residential areas. The service provides for the distribution of fresh water through a circuit that receives heat by drawing from the sea in the port basin of Genoa. The infrastructure provides for a seacock in the port area. The intake at sea consists of two communicating tanks, the first used for the antibiofouling and pumping treatment, the second for heat exchange with the fresh water circuit that implements the distribution.

The primary energy consumption of the complex (considering the national yield indicated by AEEG 0.46) ad today it is 15,272 MWht. After the intervention it is estimated that consumption will be reduced to 9.202 kWht with an expected savings of 39.7% and a reduction in emissions of 1,274 tons of CO2 / year.

Furthermore, substantial reductions in greenhouse gases, fine dust and other pollutants are expected.

Cost:

In economic terms, the estimated savings are almost € 400,000 / year.

The total amount of expenditure calculated is around 3 and a half million euros.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Complesso San Benigno Genova	44.40678	8.93391
Average air temperature (year)		6°C to 28°C
Average seawater temperature (year)		13°C to 23°C

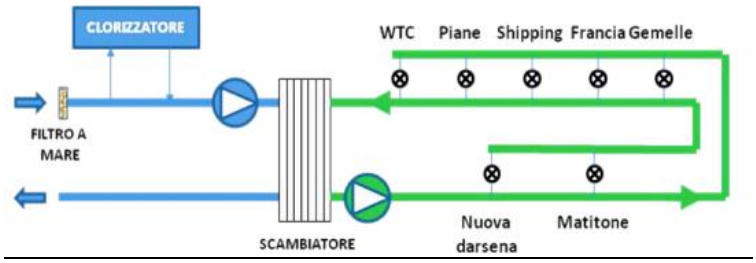
Type of the building	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Mixed use development (residential, commercial,		work in progress	

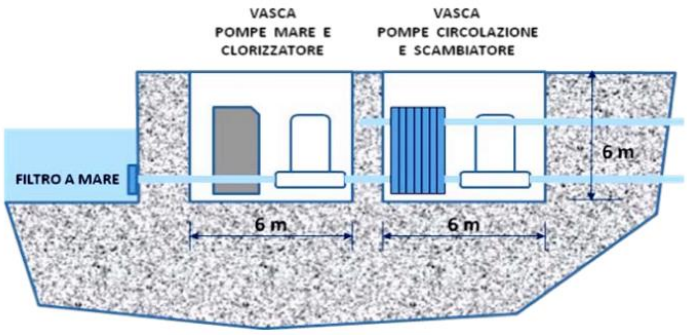
cultural, entertainment etc. uses)			

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
Heating and cooling		4,50 / 2,90
Other RES installed (technical data)		
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)		

2.3. General information

Domenico Carmosino, manages San Benigno from a condominium point of view and is the creator of the project with the engineer Avanzini, who is one of the theorists in Italy of marine climatization. Domenico Carmosino, explains that "The biggest obstacle is obviously the bureaucratic part. In itself the infrastructure to be done is not complex and the actual work to be carried out is estimated in just over a year. Genoa is part of the Smart Cities project that promotes technological projects aimed at improving the level of Eco sustainability of the city. To this is added the interest in the project by private individuals, who could invest on this idea".

Location of the application	**Photo of the application**
Complesso San Benigno, Genova **Owner:** - Domenico Carmosino manages San Benigno. - Ing. Avanzini creator of the project	 *General scheme of operation Complex San Benigno*

<table>
<tr><td></td><td> 

Tanks at sea</td></tr>
<tr><td colspan="2">https://www.ligurianautica.com/mercato-nautica/climatizzazione-marina-il-progetto-ecosotenibile-per-il-complesso-san-benigno/13286/</td></tr>
</table>

3. Country/Region: **Greece**

1. Responsible contact person	
Name	V. Ketikidis, E. Mylona
Institution/company	CERTH/CPERI
Address	4th km Ptolemais - Bodossakio Hospital
Phone	+30 2463055300
e-mail	ketikidis@lignite.gr, mylona@lignite.gr
Position in institution/company	Research associates

2. Existing installations: Hotel Amalia in Nafplio

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

Use of heat pumps for heating, cooling and sanitary hot water is widespread in the hotel sector in Greece. There are many installations using sea water as heat source and a few using open loop GSHPs exploiting saline water near the coast. One such example is the Amalia hotel in Nafplio, a building with around 9000 m² air-conditioned spaces. Hotel heating and cooling needs are covered by 4 GSHPs supplying 740 kW heating and 566 kW of cooling with fan-coils.

The GSHPs are fed through a heat exchanger by an open loop geothermal doublet comprising one production and one reinjection well 60 m deep each, supplying 60 m³/h of groundwater at 18 °C. System SPF values are 4.77 in heating and 3.65 in cooling mode.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Hotel Amalia, Nafplio	37°35'19.08"N	22°47'54.58"E
Average air temperature (year) *		17 °C (year 2017)
Average seawater temperature (year) **		20 °C (year 2017)

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	9000 m2	n/a	Renovation of the entire building during 2007-2008

Type of appliance	Nominal power heating/cooling	COP / EER heating/cooling
Geothermal Heat Pump System with vertical open loop exchanger (boreholes)	740 kW heating and 566 kW cooling	4.77 / 3.65
Other RES installed (technical data)	n/a	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)	n/a	n/a

2.3. General information

Location of the application

Amalias str., N. Tiryns, 21 100,

Nafplio, Greece

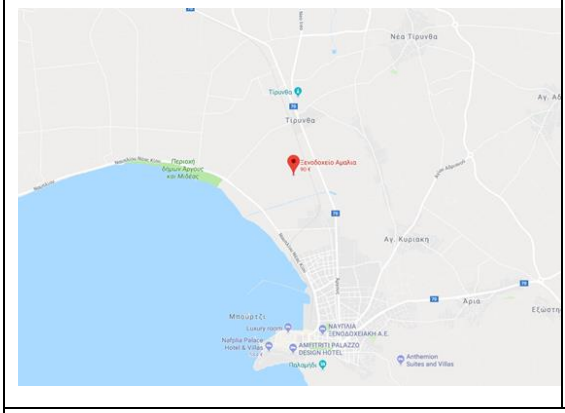


Photo of the application

Information from the official site of the company Climaveneta (http://www.climaveneta-hotels.gr/)

2. Existing installations: Thessaloniki Concert Hall

2.1. Sea Water Heat Pump for (select appropriate):

	Heating	X	Cooling		DHW

2.2. Description of the application

The Thessaloniki concert hall is a building of 27.000 m² with a capacity for 1500 persons, located at the port of Thessaloniki. What is important about this building, is that it is cooled by water source chillers, fed by seawater during the summer. The system includes 3 water source chillers, plate heat exchangers, and provides 1800 kW of cooling through 214 fan-coils, 40 central air-handling units and a piping network of 15

kilometres. Although not used for heating, a very similar system with heat pumps instead of chillers could provide low temperature heating as well.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Thessaloniki concert hall	40.598152	22.948594
Average air temperature (year) *		16 °C (year 2017)
Average seawater temperature (year) **		19 °C (2017)

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Public	27000 m2	n/a	n/a

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
3 water source chillers, plate heat exchangers	1800 kW cooling	n/a
Other RES installed (technical data)	n/a	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)	n/a	n/a

2.3. General information

Location of the application

25 Martiou str., Thessaloniki

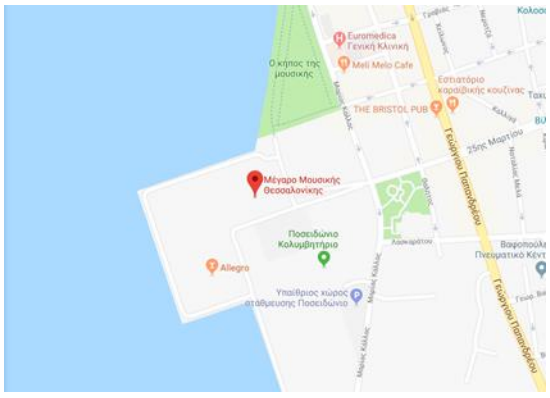


Photo of the application

Information from “Use of geothermal heat pumps for heating of buildings in Greece” by Dimitrios Mendrinos, Dr Michalis Karagiorgas, Dr Kostantin Karytsas, Presented during the LowExx workshop

"Low Temperature Systems in Existing/Historical Buildings", 7 March 2002, Maastricht, Netherlands.

2. Existing installations: Mirragio Thermal Spa Resort

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

The hotel has an accommodation capacity of 1.000 beds and a 32.500 m² total built-up area.

The installation received the first gold award in the category «Green City – Utilization of 'green' and renewable energy", where Yfantis Engineering LTD (SYCHEM group) did the electromechanical application studies and planning. SYCHEM constructed the innovative combined sea water geothermal, heating recovery and desalination system. An advanced BMS / electronic management system has been installed at the hotel, that was also designed and constructed by SYCHEM. This combined system saves annually 1,680,000 kWh electricity, 64 tons of gas, reducing carbon dioxide emissions by 632 tn/year.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Mirragio thermal spa resort	39.927795	23.707848
Average air temperature (year) *		16 °C (year 2017)
Average seawater temperature (year) **		19 °C (2017)

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	32.500 m2 (total build-up area)	2013-2016	-

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
n/a	Cooling capacity →2.400kW Heating capacity →1.300kW	n/a
Other RES installed (technical data)	-	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**

(……kWh)	n/a	Not available. Probably through drillings.

2.3. General information

Location of the application

Kanistro, Paliouri, 630 85

Halkidiki, Greece

Photo of the application

Information from the official site of the company Sychem (https://www.sychem.gr/en/)

2. Existing installations: Elounda Porto De Lux Resort

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

The hotel has an accommodation capacity of 620 beds or 29.594 m2 of build-up area.

Construction of combined Sea water geo-exchange system

- Central HVAC system
- Central DHW system
- BMS system

- Thermal Solar Field

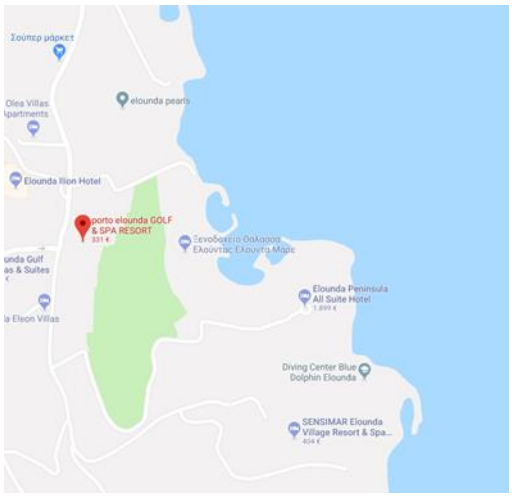
In addition, 3 drillings for the sea water intake are used.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Elounda Porto De Lux Resort	35.241891	25.729876
Average air temperature (year) *		19 °C (year 2017)
Average seawater temperature (year) **		20 °C (2017)

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	29.594 m2 (total build up area)	2004	2015

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
n/a	Cooling capacity → 1.265kW Heating Capacity → 170kW	n/a
Other RES installed (technical data)	Solar panels → 950m²	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)	n/a	No direct seawater intake. Water intake through drillings (3 in total).

2.3. General information

Location of the application Sxisma, Elounda, 720 53, Crete  	**Photo of the application**  
Information from the official site of the company Sychem (https://www.sychem.gr/en/)	

2. Existing installations: MarBella Corfu Resort

2.1. Sea Water Heat Pump for (select appropriate):

	Heating		Cooling	X	DHW

2.2. Description of the application

The hotel was built in 1971 and renovated in 2017, after five years of refurbishment works. **It has an accommodation capacity of 730 beds.** Total build up area is 25.602,68 m2.

Construction of combined Sea water geo-exchange system**:**

- Installation of new high efficiency water cooled Chiller, 365kW
- Construction of sea water geo-exchange DHW system
- BMS system

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude

MarBella Corfu Resort	39.507937		19.921735
Average air temperature (year) *			18 °C (year 2017)
Average seawater temperature (year) **			20 °C (2017)
Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	25.602,68 m2 (total build up area)	1971	2012-2017
Type of appliance	**Nominal power heating/cooling**		**COP / EER heating/cooling**
n/a	Cooling capacity → 1.265kW Heating capacity → 1.164kW DWH Heating Capacity → 170kW		n/a
Other RES installed (technical data)	Solar panels → 327m²		
Yearly produced heat/cold	**Hours of operation heating/cooling**		**Distance of seawater (intake)**
(……kWh)	n/a		Not available. Probably through drillings.

2.3. General information

Location of the application

Ag. Ioannis, Peristerion, Corfu, Greece

Photo of the application

Information from the official site of the company Sychem (https://www.sychem.gr/en/)

2. Existing installations: Belvedere Royal and Imperial Belvedere Hotels

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

The hotels have an accommodation capacity 1.340 beds on 20.400m² total built-up area.

ROYAL BELVEDERE HOTEL has 330 rooms and IMPERIAL BELVEDERE HOTEL has 341 rooms.

Construction of combined Sea water geo-exchange system including:

- Central HVAC system
- Central DHW system
- Design of central Thermal Solar Field.
- Design and construction of two additional High Temperature heat pumps and BMS extensions.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Belvedere Royal Hotel Imperial Belvedere Hotel	35.304270 35.305671	25.401765 25.402055
Average air temperature (year) *		19 °C (year 2017)
Average seawater temperature (year) **		20 °C (2017)

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	20.400m² (total built-up area)	2006	2012

Type of appliance	**Nominal power**	**COP / EER**

	heating/cooling	**heating/cooling**
n/a	Cooling capacity → 1.130kW Heating capacity → 360kW	n/a
Other RES installed (technical data)	Solar panels → 2.470m²	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)	n/a	Not available. Probably through drillings.

2.3. General information

Location of the application

Hersonisos, 700 14, Crete

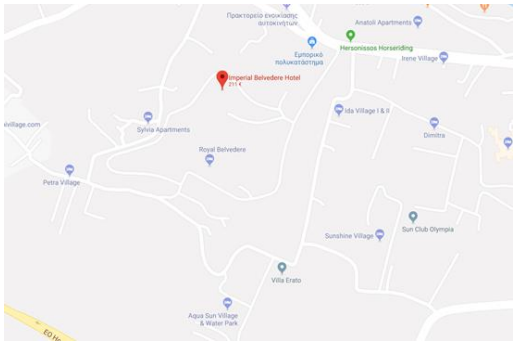


Photo of the application

Information from the official site of the company Sychem (https://www.sychem.gr/en/)

2. Existing installations: Elounda Diamond Residences

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

Complex of 21 villas with a build-up area of 85 – 440 m2 each.

Yfantis Engineering LTD (SYCHEM group) did the complete design of MEP installations. Consulting services and site inspection of MEP installations. Sea water distributed geothermal system. Separate water source heat pump for each residence on common geothermal water network. Central heat pumps for pools heating.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Elounda Diamond Residences	35.241051	25.733533
Average air temperature (year) *		19 °C (year 2017)
Average seawater temperature (year) **		20 °C (2017)

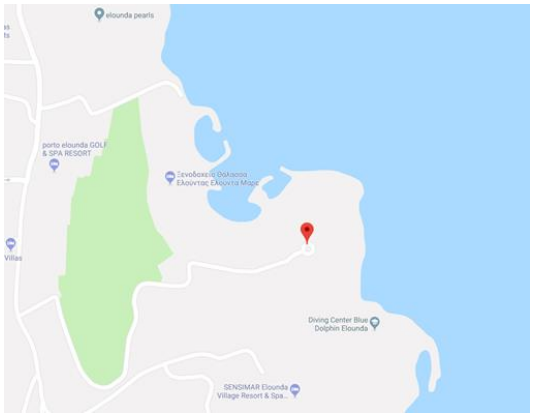
Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Residences	21 villas with a build-up area of 85 – 440 m2 each.	2009-2014	-

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
n/a	Cooling capacity → 275kW Heating capacity → 300kW	n/a
Other RES installed (technical data)	-	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)	n/a	n/a

2.3. General information

Location of the application	**Photo of the application**

Elounda, Crete, Greece



Information from the official site of the company Sychem (https://www.sychem.gr/en/)

2. Existing installations: Ikaros Beach Resort & Spa

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

Hotel has an accommodation capacity of 245 rooms or 855 beds.

Construction of combined Sea water geo-exchange system including:

- Complete MEP design for SPA (2008)
- Consulting services and site inspection of MEP installations (2008)
- Design & construction of Sea water geo-exchange HVAC, DHW & BMS System (2016)

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Ikaros Beach resort and spa	35.291600	25.448718
Average air temperature (year) *		19 °C (year 2017)
Average seawater temperature (year) **		20 °C (2017)

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)

Hotel and spa	245 rooms or 855 beds	1971	2010

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
n/a	Cooling capacity (Hotel) → 330kW Cooling capacity (SPA) → 348kW Cooling capacity (Hotel 2016 addition) → 348kW DHW heating capacity (Hotel 2016 addition) → 127kW	n/a
Other RES installed (technical data)	-	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)	n/a	n/a

2.3. General information

Location of the application

Malia, 700 07, Crete

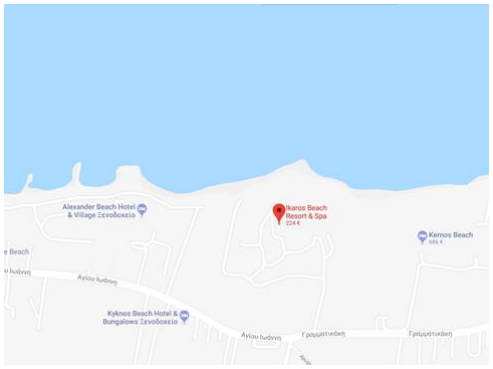


Photo of the application

	
Information from the official site of the company Sychem (https://www.sychem.gr/en/)	

2. Existing installations: Elounda Mare

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

Hotel complex consisting of 74 rooms with an accommodation capacity of 160 beds.

Construction of combined Sea water geo-exchange system including:

- Complete design of MEP installations for extensions.
- Consulting services and supervision of MEP installations.
- Construction of Sea Water geothermal HVAC, DHW, pools heating and BMS plants.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Elounda mare	35.246563	25.730191
Average air temperature (year) *		19 °C (year 2017)
Average seawater temperature (year) **		20 °C (2017)

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel complex	n/a	2003	-

Type of appliance	**Nominal power**	**COP / EER**

	heating/cooling	**heating/cooling**
n/a	Cooling capacity → 290 kW Heating capacity → 385 kW	n/a
Other RES installed (technical data)	Solar panels → 550 m²	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)	n/a	n/a

2.3. General information

Location of the application

Elounda, Crete, Greece

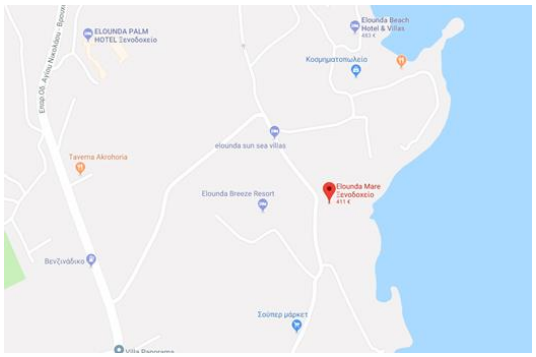


Photo of the application

Information from the official site of the company Sychem (https://www.sychem.gr/en/)

2. Existing installations: Star Beach Village

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

Hotel complex consisting of 1.200 beds.

Construction of combined Sea water geo-exchange system including:

- Complete design of MEP installations for extensions.
- Consulting services and supervision of MEP installations.
- Construction of Sea Water geothermal HVAC, DHW, pools heating and BMS plants.

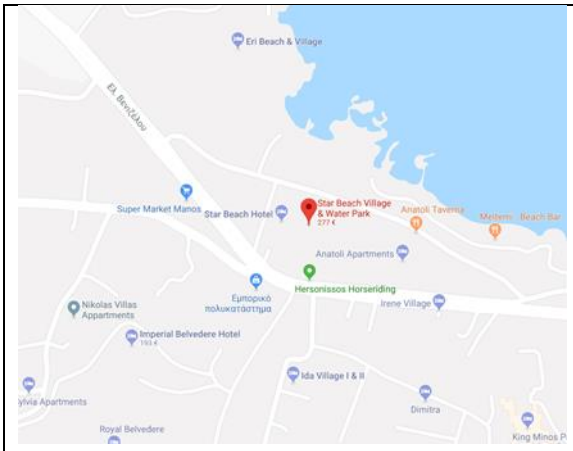
Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Star Beach Village	35.307292	25.404972
Average air temperature (year) *		19 °C (year 2017)
Average seawater temperature (year) **		20 °C (2017)

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	n/a	2009	2016

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
n/a	Cooling capacity → 290 kW Heating capacity → 385 kW	n/a
Other RES installed (technical data)	Solar panels → 550 m²	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)	n/a	n/a

2.3. General information

Location of the application	
Hersonissos, Crete, Greece	**Photo of the application**



Information from the official site of the company Sychem (https://www.sychem.gr/en/)

2. Existing installations: Atlantica Sensatori Resorts

2.1. Sea Water Heat Pump for (select appropriate):

	Heating		Cooling		DHW

2.2. Description of the application

Hotel complex consisting of 330 rooms.

Construction of combined Sea water geo-exchange system including:

- Re-design and of main HVAC and DHW plantroom and BMS system.
- Construction of Sea water geo-exchange HVAC & DHW system.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Atlantica Sensatory Resort	35.335219	25.349177
Average air temperature (year) *		19 °C (year 2017)
Average seawater temperature (year) **		20 °C (2017)

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
n/a	n/a	n/a	-

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
n/a	Cooling capacity → 976kW Heating capacity → 1280kW DHW heating capacity → 587kW	n/a
Other RES installed (technical data)	-	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)	n/a	n/a

2.3. General information

Location of the application

Hersonissos, Crete, Greece

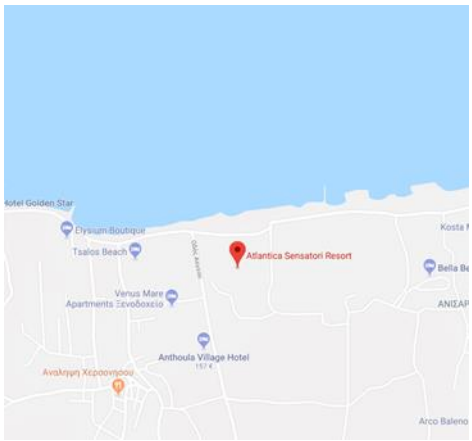


Photo of the application

	
Information from the official site of the company Sychem (https://www.sychem.gr/en/)	

2. Existing installations: Kontokali Bay Resort & Spa

2.1. Sea Water Heat Pump for (select appropriate):

X	Heating	X	Cooling	X	DHW

2.2. Description of the application

The hotel has an accommodation capacity of 260 rooms.

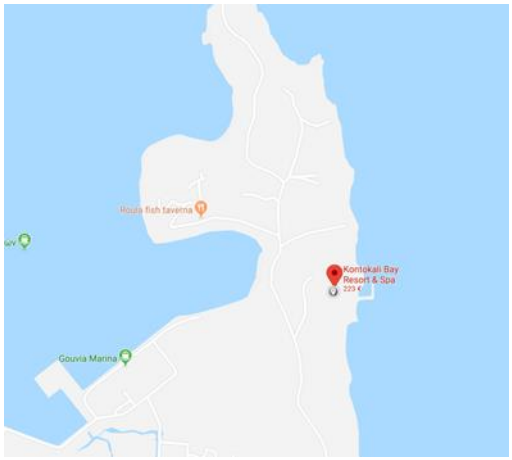
Construction of combined Sea water geo-exchange system including:

- Design and construction of sea water geothermal HVAC and hot water system.
- BMS system.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Kontokali Bay	39.649354	19.860312
Average air temperature (year) *		18 °C (year 2017)
Average seawater temperature (year) **		20 °C (2017)

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
n/a	n/a	n/a	-

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
n/a	Cooling Capacity → 910kW Heating Capacity → 105kW	n/a

<table>
<tr><td>Other RES installed
(technical data)</td><td colspan="2">-</td></tr>
<tr><td>Yearly produced heat/cold</td><td>Hours of operation heating/cooling</td><td>Distance of seawater (intake)</td></tr>
<tr><td>(……kWh)</td><td>n/a</td><td>n/a</td></tr>
<tr><td colspan="3">2.3. General information</td></tr>
<tr><td colspan="2">Location of the application
Kontokali, Corfu 491 00
 
</td><td>Photo of the application
 
  </td></tr>
<tr><td colspan="3">Information from the official site of the company Sychem (https://www.sychem.gr/en/)</td></tr>
</table>

*, ** All information about air and seawater temperature are from:

- Air temperature information are from http://www.greece.climatemps.com/
- Seawater temperature information are from www.seatemperature.info

4. Country/Region: **Croatia**

1. Responsible contact person	
Name	Tena Maruševac
Institution/company	UNIZAG FSB
Address	Ivana Lučića 5, 10002 Zagreb
Phone	003851 6168 555
e-mail	tena.marusevac@fsb.hr
Position in institution/company	Expert Associate

2. Existing installations: Apartment building, Pazdigradska ulica, Split

2.1. Sea Water Heat Pump for (select appropriate):

x	Heating	x	Cooling	x	DHW

2.2. Description of the application

It was the owners wish to apply a solution which takes advantage of nearby sea to improve his DWH and HVAC systems. The project was even more effective thanks to the excellent qualities of the low energy building. The system was put in use in September 2008.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Apartment building, Pazdigradska ulica, Split	43.505941	16.494036
Average air temperature (year)		16.5 °C
Average seawater temperature (year)		13 °C

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Domestic	520 m^2		

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
Geothermal - geoTHERM VWS 171/2		5.5/25-30
Other RES installed		

(technical data)		
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)		

2.3. General information

Location of the application

Pazdigradska ulica 44

21000, Split

Owner:

…….

Photo of the application

http://www.hupg.hr/file/DPG2011/Dan%202/DPG2011_09_Simunovic.pdf

2. Existing installations: Novi Vinodolski

2.1. Sea Water Heat Pump for (select appropriate):

x	Heating	x	Cooling	X	DHW

2.2. Description of the application

It was the owners wish to apply a solution which takes advantage of nearby sea to improve his DWH and HVAC systems. The project was even more effective thanks to the excellent qualities of the low energy building. The system was put in use in September 2007.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Novi Vinodolski	45.126061	14.788777
Average air temperature (year)		15.5 °C
Average seawater temperature (year)		16.5 °C

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Domestic	260 m^2		

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
Geothermal geoTHERM VWS 101/2		5.5/25-30
Other RES installed (technical data)		
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)		

2.3. General information

Location of the application	Photo of the application

Novi Vinodolski

Owner:

…….

http://www.hupg.hr/file/DPG2011/Dan%202/DPG2011_09_Simunovic.pdf

2. Existing installations: Falkensteiner Family Hotels

2.1. Sea Water Heat Pump for (select appropriate):

x	Heating	x	Cooling	X	DHW

2.2. Description of the application

The Falkensteiner Family Hotels have worked with international experts to implement a comprehensive system that helps to minimise its long-term ecological footprint. Choosing an ecologically sound construction method was at the core of the design process.

The sustainable seawater treatment plant provides the water that is required for everyday use and also generates energy for heating and cooling. Heat pumps are the only source of heating and cooling energy. Seawater intake is 300 m from the coast, at the depth of 15 m.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Falkensteiner Family Hotels	44.194181	15.150174
Average air temperature (year)		16 °C

Average seawater temperature (year)				16.5 °C
Type of the building (public, domestic, commercial, industrial)		**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	Aparthotel Senia	18,278.27 m2	2009	No
	Hotel Diadora	20,519.04 m2	2009	
	Hotel Iadera	48,928 m2	2011	

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
YORK, Water to water	3x1.2 MW	4/6.9
Other RES installed (technical data)		
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
	7,000	300 m from the coastline, 550 m from the heat pump

2.3. General information

Location of the application

Hotels & Residences Punta Skala Zadar, 23231, Zadar

Owner:

FALKENSTEINER HOTELS & RESIDENCES

Photo of the application

Source: https://www.falkensteiner.com/en/hotel/iadera/the-hotel/your-hosts/sustainable-resort and directly from the hotel

2. Existing installations: Hotel Le Méridien Lav, Split

2.1. Sea Water Heat Pump for (select appropriate):

x	Heating	X	Cooling	x	DHW

2.2. Description of the application

Hotel Le Méridien Lav, Split wanted a heating and cooling system that would help them to minimise its long-term ecological footprint. Since the hotel is located on the coast, the logical choice was to try and use seawater. Seawater heat pump is not only used for heating and cooling of the hotel, but also for the preparation of domestic hot water, including heating of two pools.

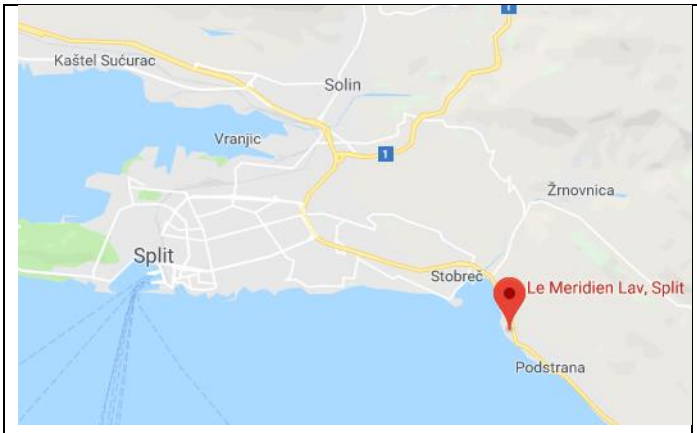
Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Hotel Le Méridien Lav, Split	43.492622	16.538337
Average air temperature (year)		16.5 °C
Average seawater temperature (year)		18.7 °C

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	Area of 30,000 m^2 and 2 pools of together 650 m^3	2006	No

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
McQuay Water to water	4 x 1 MW	4/3
Other RES installed (technical data)		
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
Altogether 8,000,000 kWh	3,000 per heat pump	300 m

2.3. General information

Location of the application	Photo of the application



Grljevacka, 2A, Podstrana, 21312, Split

Owner:

Le Meridien

Source: https://www.menea.hr/wp-content/uploads/2013/12/Dizalice-topline-CK_Soldo.pdf and directly from the hotel

2. Existing installations: Hotel Pinija, Petrčane

2.1. Sea Water Heat Pump for (select appropriate):

	Heating	x	Cooling		DHW

2.2. Description of the application

In the hope to reduce their carbon impact, and due to their location near the coast, Hotel Pinija decided to use seawater heat pumps for cooling of 260 twin rooms. A heat pump is used only for cooling, while for preparation of domestic hot water, solar collectors are used, adding to the reduction of carbon impact.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Hotel Pinija, Petrčane	44.179568	15.158783
Average air temperature (year)		16.5 °C
Average seawater temperature (year)		20-28 °C during the cooling period

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)

Domestic	260 twin rooms	1970	A complete renovation in 2001, and partial renovation, only for rooms, in 2015

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
Daikin	60 kW	-
Other RES installed (technical data)	Solar collectors for preparation of domestic hot water	
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
(……kWh)	2,000	100 m

2.3. General information

Location of the application

Ul. Maka Dizdara 1 |23231 Petrčane

Owner:

Intermod Ltd.

Photo of the application

Information directly from the hotel

2. Existing installations: Hotel PARK, Makarska

2.1. Sea Water Heat Pump for (select appropriate):

x	Heating	X	Cooling	x	DHW

2.2. Description of the application

The Hotel Park in Makarska decided upon using a seawater heat pump in their hotel in order to reduce energy consumption. Next to the heat pump, the hotel possesses a 345 kW boiler which is used during the low outside temperatures and once per week for reheating of domestic hot water. Seawater intake is performed on the coast, at the depth of 3.5 m and the output is 15 m from the intake. **The heat pump has problems with seawater intake which was made with lack of care**, which caused clogged filters in a much higher rate than usual. For cleaning the filters, the heat pump needs to be shot off, which is unpleasant for the guests.

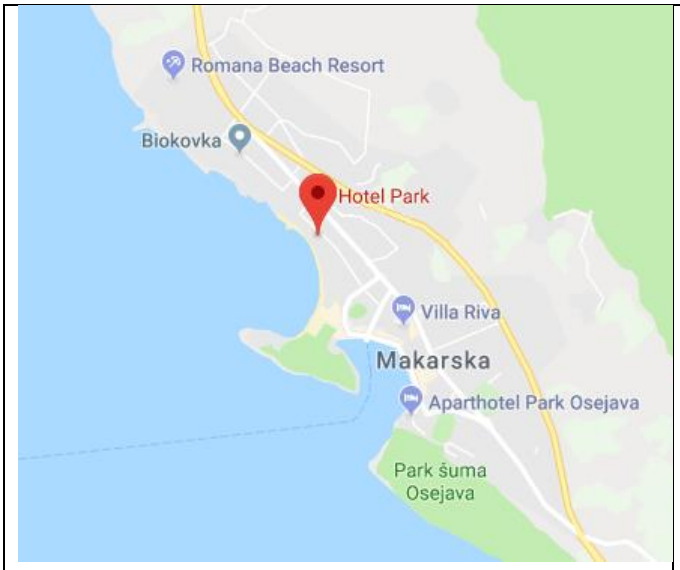
Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude
Hotel PARK, Makarska	43.299687	17.013707
Average air temperature (year)		16.5 °C
Average seawater temperature (year)		18.3 °C

Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	6,639.97 m^2	2007	No

Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**
AERMEC NW 1802 LD8	624 kW	Above 3
Other RES installed (technical data)		
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**
		Around 100 m

2.3. General information

Location of the application	Photo of the application



Kralja Petra Krešimira IV 23

21300 Makarska

Owner:

PARK HOTEL Ltd.

Information directly from the hotel

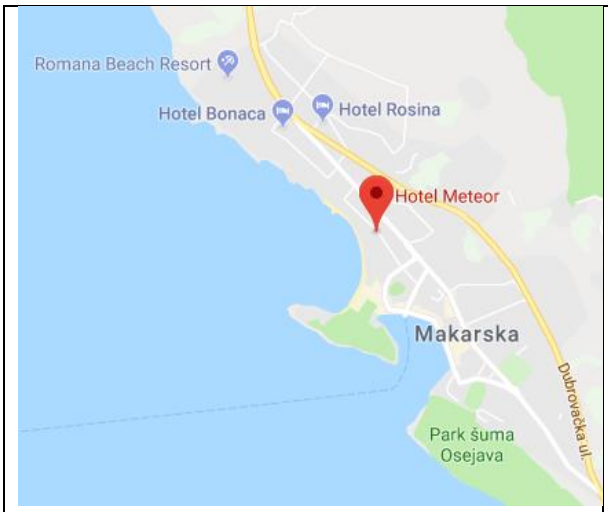
2. Existing installations: Hotel Meteor, Makarska

2.1. Sea Water Heat Pump for (select appropriate):

x	Heating	x	Cooling	x	DHW

2.2. Description of the application

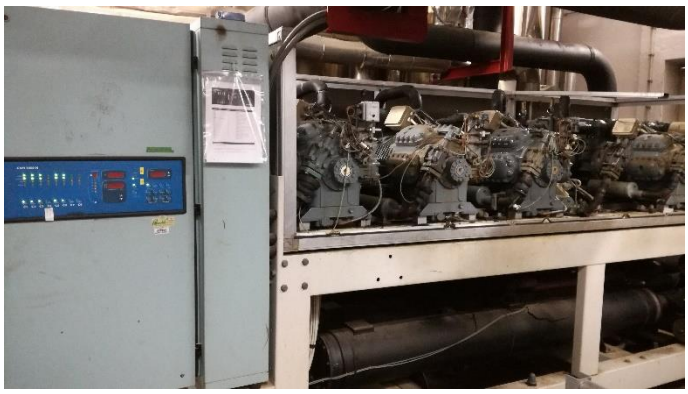
In Hotel Meteor, seawater heat pump is being used for heating, cooling and domestic hot water preparation since 1985. The hotel also has a replacement air to water heat pump which starts to operate in case that the main seawater heat pump is malfunctioning. The heat pump consists of 3 circles, and each circle has 2 compressors. At the moment heat pump is still operating with R22 as a refrigerant, but the hotel is in the process of purchasing a new heat pump which would use refrigerant R32.			
Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude	
Hotel Meteor, Makarska	43.299021	17.014667	
Average air temperature (year)		16.5 °C	
Average seawater temperature (year)		18.3 °C	
Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	23,391 m^2	1985	No
Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**	
Climaveneta water to water	300 kW	Unknown	
Other RES installed (technical data)	Air to water heat pump		
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**	
	From February to December 24 hours a day – around 8,000 hours	Around 100 m	
2.3. General information			
Location of the application	Photo of the application		



Kralja Petra Krešimira IV 19 21300 Makarska

Owner:

Hoteli Makarska



Information directly from the hotel

2. Existing installations: Hotel Royal Blue, Dubrovnik

2.1. Sea Water Heat Pump for (select appropriate):

x	Heating	x	Cooling	x	DHW

2.2. Description of the application

The heat pumps implemented in the Hotel Royal Blue were designed to simultaneously produce heating and cooling energy, with priority for cold water in summer, and hot water in the winter season.

During the summer season, the priority is given to the cooling regime, using waste heat from the condenser to heat the water. During the winter season, the priority is given to heating regime using heat from the condenser, while the cold water can be used for eventual cooling needs of the hotel.

Next to the mentioned heat pump, another heat pump that is used for preheating of domestic hot water is installed.

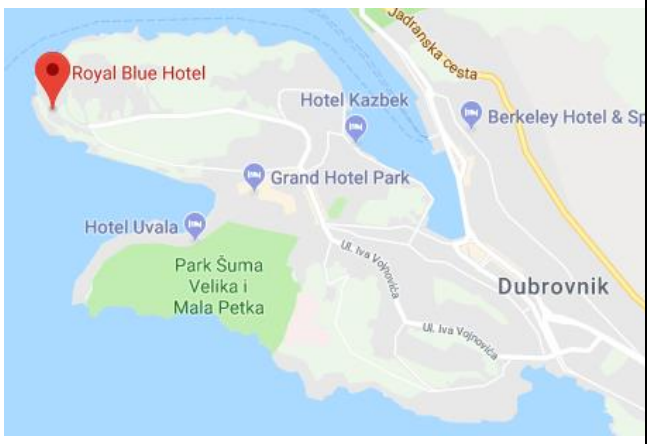
The heat pumps implemented in the Hotel Royal Blue were designed to also supply thermal and cooling needs to the already existing Hotel Neptune.

Name of the building (where technology is installed)	**Location**: Latitude	**Location**: Longitude

Hotel Royal Blue, Dubrovnik	42.659797		18.058318
Average air temperature (year)			17.0 °C
Average seawater temperature (year)			18.3 °C
Type of the building (public, domestic, commercial, industrial)	**Heated area of the building**	**Year of construction of the building**	**Renovation** (Yes/No, what type, year)
Hotel	4,125 m^2	2016	No
Type of appliance	**Nominal power heating/cooling**	**COP / EER heating/cooling**	
2 x Daikin EWWD330J-SS008	417/333 kW	4.9/3.9	
Daikin EWWD210J-SS032	258/207	5.11/4.11	
Other RES installed (technical data)			
Yearly produced heat/cold	**Hours of operation heating/cooling**	**Distance of seawater (intake)**	
		Well intake, 52 m deep	

2.3. General information

Location of the application



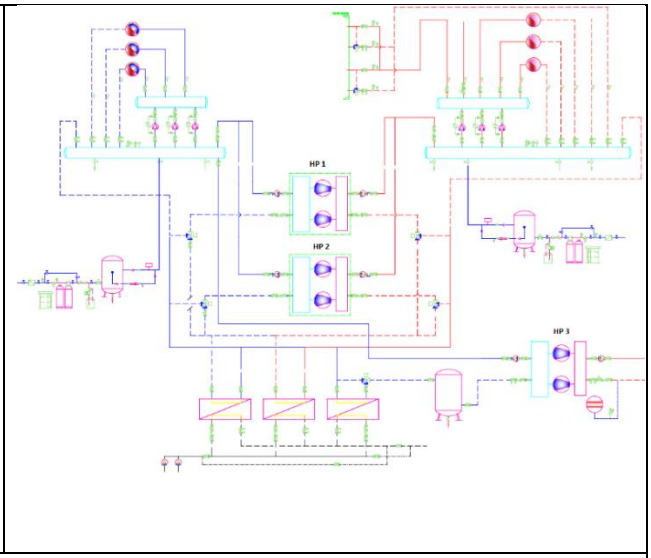
Ul. Kardinala Stepinca 31

20000, Dubrovnik

Owner:

Importanne Hotels&Resort

Photo of the application

	
Information directly from the hotel	