districlima

22@. Sant Martí District. Barcelona
Public-private enterprise: 50,8% COFELY, 20% TERSA,
19,2% AGBAR, 5% IDAE, 5% ICAEN

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1. One page motivational letter specifying

1.1. Whether your system is a Municipal scheme with more than 10.000 users

DISTRICLIMA was set up in 2002 to implement, for the first time in Spain, a district heating and cooling network for use in heating, air conditioning and sanitary hot water, and it is operating since 2004. The project was initially located in an urban remodelled area of Barcelona that includes **the Cultures Forum 2004** (the Forum Area, at Besòs seafront). In 2005, after the awarding of a public tender, a second stage was started with the extension of the network to the **22@ technological district in Barcelona.** Nowadays, Districlima is the biggest urban network in Spain.

Regarding the current number of total users connected to the system, it is quite difficult to calculate it in terms of people, since most of the buildings are from the tertiary sector, such as hotels, office buildings and municipal equipments (civic centres, schools, universities, etc.), with fluctuations in its daily occupation. However, it is possible to speak in terms of number of buildings connected and its total constructed surface above the ground.

In the 22@ technological district, the system has currently 41 buildings connected, with a constructed surface of more than 390.000m^2, and with a prevision of 2.640.000m^2 of constructed surface at the end of the whole project. Therefore, it is possible to assume that the Districlima system currently has more than 10.000 users and it's expected to expand a lot more.

1.2. Which award category describes best your programme

Due to the impressive evolution of the demand and since the 22@ Barcelona project is still in development, with a potential of constructed surface above the ground connected to the system of 2.640.000 m^2 and a new power plant under construction, the category that describes the best this programme is the **"expansion of an existing scheme"**.

1.3. Why and how the programme was implemented? What has been achieved?

The 22@Barcelona project fills the city's need to recover both economic and social dynamism in the old industrial areas of Poblenou. At the time of the approval of the 22@Barcelona plan in 2000, the infrastructure network in the Poblenou industrial area was clearly insufficient. To amend this situation the project establishes a new **Special Infrastructure Plan (PEI)** to re-urbanise the 37km of streets in the 22@Barcelona district and provide them with highly competitive services and utility infrastructures.

The new infrastructure plan represents a total investment (mainly private) of over 180 million and provides the sector with a modern **power supply grid, district heating and cooling system** and **pneumatic refuse collection systems.** The design of such new grids and networks places the emphasis on energy efficiency and the responsible management of natural resources, while also providing for significant improvements to be made to the diverse urban services and utilities. (For further information see *"How has the programme improved the quality of life of your community"*).

2. A 250 words summary (text format) and logos (system owner/operator and municipality) in high resolution (jpg, gif, tiff) for the award web site: districtenergyaward.org

DISTRICLIMA was set up in 2002 to implement, for the first time in Spain, a district heating and cooling network for use in heating, air conditioning and sanitary hot water, and it is operating since 2004. The project was initially located in an urban remodelled area of Barcelona that includes **the Cultures Forum 2004**. In 2005, a second stage was started with the extension of the network to the **22@ technological district.** Nowadays, Districlima is the biggest urban network in Spain.

The main heating and cooling power plant, the **Forum Central,** uses residual steam from a municipal waste-to-energy plant to produce almost all the heating and, through absorption machines, a great part of the cooling. Currently, a new plant is being constructed, the **Tanger Central**, and it is conceived as a peak-up plant. This plant will also include some innovative solutions in order to improve the energy efficiency of the whole system, such as ice tanks.

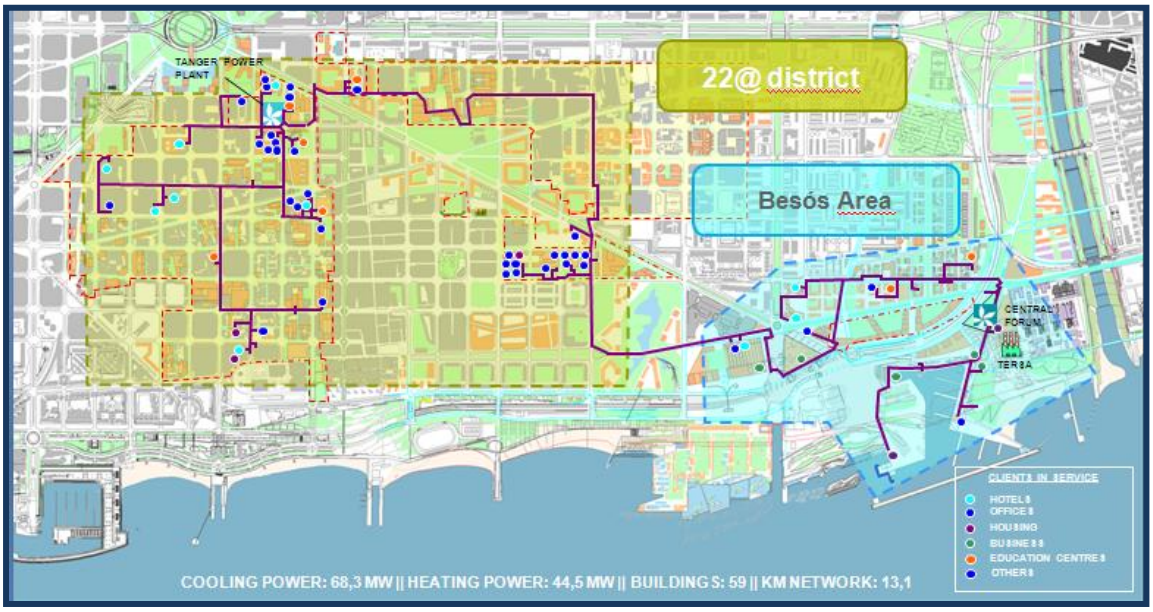
In the last 5 years, Districlima has expanded the network through Barcelona in order to serve heating and cooling to almost 400.000 m^2 of new buildings. Due to the high efficiency of the system, Barcelona is currently saving more than 50 GWh of primary energy and 10.000 Tn of CO_2 emissions every year. Since the 22@ Project is still developing, it's foreseen that the network is going to keep on increasing, contributing to higher savings of primary energy consumption and greenhouse gas emissions.

3. Written description (max. 10 pages) covering

3.1. System history, configuration of production units, distribution network, number or square footage of buildings/customer facilities served, average age of production and distribution system facilities.

Districlima network started working in 2004 in order to provide efficient heating and cooling to the exposition called **"**Forum de les Cultures**"** in the summer of 2004. In 2005, after the awarding of a public tender, a second stage was started with the expansion of the network to the **22@ technological district.**

Next picture shows the whole current state of the network and the two main areas served (Besós area and 22@ District) that are located at the north-east side of Barcelona and Sant Adrià de Besós.



Since the 22@ district tender was awarded in 2005, the system has experienced an important expansion through Barcelona in only 5 years.

In the 22@ technological district, the system has currently 41 buildings connected, with a constructed surface of more than 390.000m2, distributed as follows:

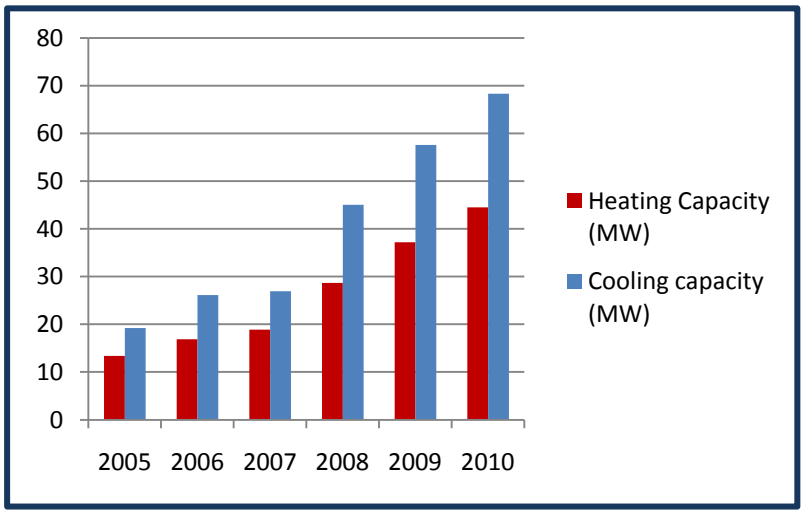
Type of building	Num. of buildings connected (2011)	Constructed surface above the ground (m^2)
Residential buildings	5	34.900
Office buildings and hotels	24	250.866
Equipments	12	105.543
TOTAL	**41**	**391.309**

There is a prevision of 2.650.000 m^2 of constructed surface connected to the system in the end of the whole 22@ district project. Distribution of the number of buildings connected and its constructed surface in the 22@ technological district are shown in the next table:

Type of building	Potential total GFS (m^2)	Potential of above ground surface (m^2) constructed connected to the system
Residential buildings	320.000	64.000
Office buildings and hotels	3.200.000	2.240.000
Equipments	480.000	336.000
TOTAL	**4.000.000**	**2.640.000**

Therefore, it is foreseen that the Districlima network is going to expand much more in the 22@ district area in Barcelona.

The evolution of the demanded capacity from year 2005 to 2010 has been as follows:



The network has 4 pipes and both heating and cooling are served 24 hours/365 days. The current length of the network is 13 km, and 59 buildings are connected.

The power plant called **Forum Central** was the first one to be installed and it is located in the north-east side, next to the TERSA waste-to-energy plant. This waste-to-energy plant treats 359,107 T/year of RSU and has an electric power of 23,76 MW and a production of 180,468MWh/year of electricity, in average.

The configuration of production units in the Forum Central is reported on Figure 2 from attachments. The **Forum Central** power plant has the following main **features**:

- Almost all heating and a great part of cooling are produced using the steam obtained from the urban waste incineration in TERSA.
- The rest of cooling is produced through industrial electric chillers, which are refrigerated using seawater. In this way, high performance is achieved and the installation of cooling towers is avoided.
- The system is completed with a cold water storage tank of 5.000 m^3.

The **equipment** of **Forum Central** is the following:

Cooling Production of Forum Central:

- 2 absorption equipments of 4,5 MW capacity each, indirectly refrigerated with sea water.
- 1 cold water storage tank of 5.000 m^3.
- 2 electric chillers of 4 MW capacity each, indirectly cooled with seawater.
- 2 electric chillers of 7 MW capacity each, directly refrigerated with sea water.

Heating production of Forum Central:

- 4 steam/water exchangers of 5 MW capacity each.
- 1 gas boiler of 20 MW capacity (back-up, operating only when there is no steam availability).

The **Tanger Central** power plant, which is located at the west side of the network and is currently under construction, will have the following **features**:

- Conceived, initially, as a peak-up plant. Its goal is to guarantee the energy supply in periods of high demand or in case of emergency.
- It will have an innovative system of cooling storage based on ice technology.The cooling production in periods of low demand is allowed using this system, as well as the cooling storage.
- The combustion gas from the boilers will be exhausted by the historical chimney of an ancient textile factory called Ca l'Arañó. In this way, the architectural heritage of this industrial neighbourhood is reused.

The **equipment** of **Tanger Central** is the following:

Cooling Production of Tanger Central:

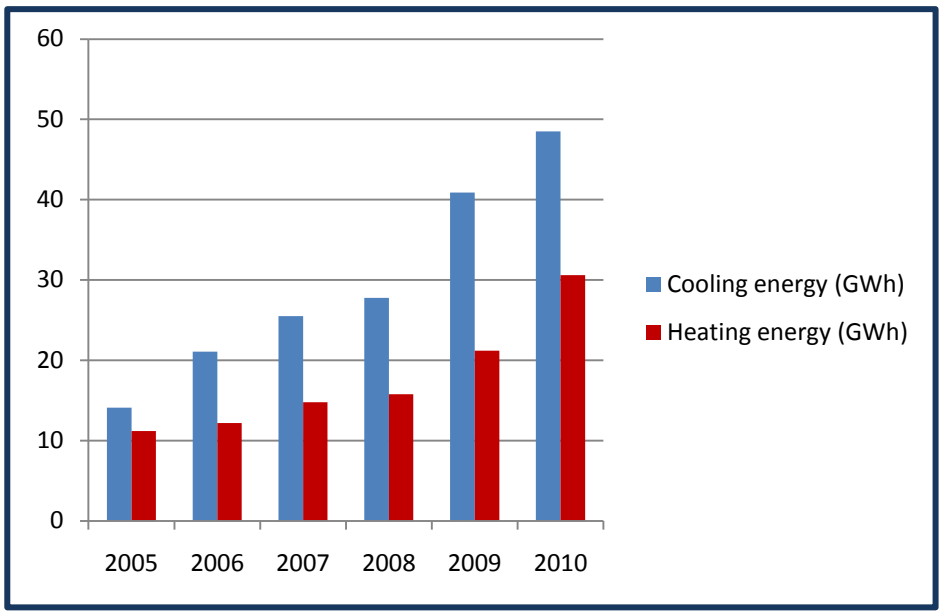
- 1st phase (2011)
  - 1 compression chiller of 6,7 MW producing glycoled water at negative temperature.
- 2nd Phase
  - 1 compression chiller of 6,7 MW producing glycoled water at negative temperature.
  - 1 compression chiller of 6,7 MW producing cold water at positive temperature.

Heating production of Tanger Central:

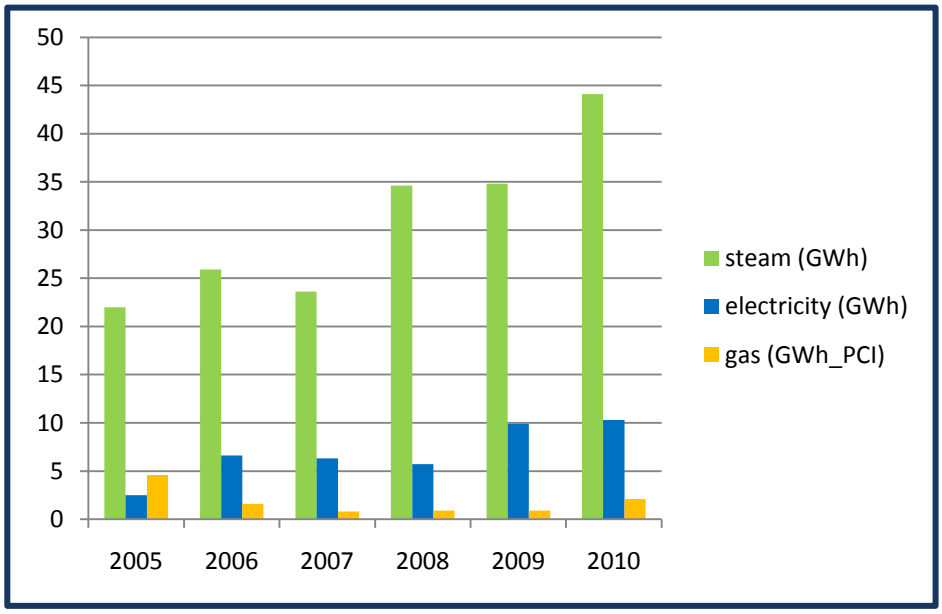
- 1st phase (2011)
  - 2 gas boilers of 13,4 MW each.
- 2nd Phase
  - 1 gas boiler of 13.4 MW.

3.2. Data supporting the systems overall energy efficiency in terms of useful energy delivered to end use customers divided by fossil primary energy input to production/distribution process, specification of fuel/energy input mix.

The amount of useful energy delivered to end users from 2005 to 2010 has increased as follows:



The total amount of energy input to production and distribution process has the following evolution:



Heating is produced mainly with steam. Gas is only used when the TERSA waste-to-energy plant stops providing steam because of maintenance works.

Cooling is produced either with steam or electricity and using one or another depends on the availability of absorption chillers, electricity price, etc.

Figure 3 from attachments shows the primary energy savings of Districlima system in 2010 compared to a conventional system composed of boilers and air-cooled chillers. **The amount of primary energy saved in 2010 is 56,5 GWh_{PCI} (57% of reduction).**

Since Districlima network is still expanding, energy savings will keep on increasing.

3.3. How has the programme reduced greenhouse gas emissions and/or other emissions in your community? Environmental benefits which the system provides over other available energy options (trends in CO2, NOx, SO2, particle emissions). Please describe fuel and water conservation achieved.

Figure 4 from attachments shows the CO_2 emission savings of Districlima system compared to a conventional system composed of boilers and air-cooled chillers. **The amount of CO_2 emissions saved in 2010 is 10.119 Tn (63% of reduction).**

Since Districlima network is still expanding, CO_2 emission savings will keep on increasing, as seen in Figure 5 from attachments.

3.4. What makes your programme outstanding and innovative?

- **District heating and cooling network development in a Mediterranean climate.** Consequently, Districlima is the first European urban network with a high cooling demand, actually, higher than the heating demand. Therefore, the priority is cooling production and this particularity has effects on the business scheme.

- **Close collaboration and cooperation between Districlima operators and City Council,** especially during the network construction, in order to work together to improve the Barcelona infrastructures, such as the telecommunications ones, the energy production and distribution, the waste collection and treatment, etc.

- **Use of residual heating from a waste-to-energy plant** making profit of a low enthalpy energy that, without Districlima, would be wasted.

- **Use of sea water to refrigerate the chillers**, achieving high efficiency and avoiding cooling towers installation.

- **Back-up plant**. In 2011, Districlima is going to be the first District Heating and Cooling with two power plants in Spain. The second power plant is going to increase reliability of the system.

- **Use of Ice Tanks.** The new power plant is going to have an innovative system of cooling storage based on ice technology, which allows storing much more energy not only for storing the water at lowest temperatures but also because latent energy is used.

- **Piping system accessible through subterranean galleries.** Since the Special Infrastructure Plan of 22@ District proposes a new organization of land, all the utilities such as phone exchange plants, electrical substations, district heating plants and pipes, etc., are located underground and all of them are accessible through subterranean galleries, reducing this way the maintenance costs. A photo is reported on Fig. 6 from the attachments.

- **Building energy efficiency qualification improvement.** The Royal Decree 47/2007, 19 January 2007, approving the *Basic procedure for the energy certification of newly constructed buildings,* asks to property to provide buyers or users of buildings with an Energy Efficiency Certificate. This certificate assigns an energy class to each building in the form of an energy efficiency label ranging from class A, for the most efficient, to class G, for the least efficient. Usually, all new buildings connected to the Districlima heating and cooling district system gets, at least, a B class, under the considerations of this Royal Decree.

- **Demonstration project.** Since the Districlima network was the first district heating and cooling scheme in Spain, where this kind of technologies are rare, this system has an additional value as it is a demonstration project in our country.

3.5. How has the programme improved the quality of life of your community?

URBAN, ECONOMICAL AND SOCIAL REVITALIZACION OF THE POBLENOU AREA

The 22@ technological district is the result of the 22@Barcelona project. This project was approved by the Barcelona City Council in 2001 with the aim of transforming an old industrial area in the centre of Barcelona, the **Poblenou** district.

This area is 198,26 hectares in size (equivalent to 115 blocks of the Ensanche) and its transformation is creating new economic zones for production activity in the centre of the city, in addition to areas for facilities, subsidized housing and green spaces, making former industrial zones a high-quality urban and environmental area. Thus, 22@Barcelona provides a new, high quality, diverse, ecologically efficient and economically strong urban model that strikes a balance between production and neighborhood life.

As an **urban refurbishment**, it answers to the need to restore the economic and social dynamism of the Poblenou Quarter, creating a diverse, balanced environment with production centres, social housing, facilities and green space aimed at improving both the quality of life and of the workplace.

As an **economic revitalization**, it offers a unique opportunity to turn the Poblenou District into an important scientific, technological and cultural platform, making Barcelona one of the most dynamic and innovative cities in the world.

As a **social revitalization**, it favours the networking of the different professionals working in the district and encourages and supports innovative projects that foster collaboration among companies, institutions and residents as well as social, educational and cultural organizations.

Following are some noteworthy figures regarding the scope of the project:

- Potential total GFS: 4.000.000 m^2.
  - Production Activity: 3.200.000 m^2.
  - Other uses (facilities, housing …): 800.000 m^2.
- Housing:
  - Regularisation of 4.614 existing homes
  - Creation of 4.000 new social housing units (at least 25% rented)
- New green space: 114.000 m^2 land.
- New facilities: 145.000 m^2 land.
- New jobs: 150.000. (Estimated)
- Investment in infrastructure plan: 180 million €

Moreover, the new infrastructure plan, the **Special Infrastructure Plan (PEI)**, provides significant improvements in the diverse urban services and utilities, such as:

- A system of **subterranean service galleries** interconnecting the city blocks allows the utility networks to be improved or repaired without the need for street-level work.
- **New telecommunications networks**, including dark fiber optics, that allows companies to choose from different service providers and create point-to-point connections within the district. Moreover, companies can also install antennas and radio transmission systems.
- The **new district heating and cooling system (DH&C),** which involves savings at both the economic level and in CO2 emissions. This system has allowed an energy efficient than the traditional mechanisms for more than 40% and reduced substantially CO2 emissions into the atmosphere.
- A **selective pneumatic waste collection system**, which separates organic, non-organic and paper waste.
- The **new power grid** guarantees the quality of the electricity supply, offering five times more power than the current system, as well as more powerful gas and water supply systems.
- The **new mobility plan** for the sector aims to ensure that as of 2010, over 70% of the journeys made by people in the 22@Barcelona district will be by public transport, on foot or by bicycle. To such ends it proposes significant improvements to the public transport network, establishes an extensive network of cycle lanes (29 km) and streamlines the flow of vehicles. It also guarantees the availability of parking spaces for both workers and visitors throughout the sector, and introduces new mechanisms to reduce noise and environmental pollution.

ENVIRONMENTAL IMPROVEMENTS

In addition to the advantages mentioned before, that were the consequence of the 22@Barcelona project, the Districlima system has some specific environmental improvements, such as:

- Residual energy sources are generally used (urban solid waste or others) in high performance energy equipment, thus **minimizing fossil origin primary energy consumption.**
- **Reduction of greenhouse effect gas emission** as it is a more efficient energy solution.
- Significant **reduction of refrigerant losses** into the atmosphere compared to conventional systems.
- **Noise and vibration reduction** in buildings connected to the system.
- **Null visual impact** as the system ensures that roofs and façades remain completely unobstructed.

ECONOMIC IMPROVEMENTS

Districlima system has also some economic advantages. For example:

- Notable **reduction** of **contracted electrical power**.
- **Savings in user energy bills.**
- **Reduction in maintenance costs** and fewer technical specialization requirements.
- **No need to purchase or replace own production equipment**.
- Aids energy expenditure forecasting.
- **More space** available for business or other uses.
- Cutting-edge buildings with a high added value.

3.6. What were the challenges you faced and how were they overcome?

CONSTRUCTION OF THE SYSTEM IN AN URBANIZED AREA

Working in an already urbanized area was the main challenge faced by this project. As said, the 22@ technological district is the result of the 22@Barcelona project. This project has the aim of transforming an old industrial area in the centre of Barcelona, with about 200 hectares, into an innovative productive district.

As any old area, the 22@ district had serious lacks of infrastructures. It was necessary to reorganize all the area services, from the sewer system to the telecommunications one, as well as gas and electricity connections. It was in that moment that the Barcelona City Council chose an innovative way of serving heat and cool to the buildings, including this possibility in the main objectives of the 22@Barcelona Project.

However, the problems of working in an already urbanized area are important:

- The works are more difficult, since it's needed to deconstruct and rebuilt the street pavement.
- Consequently, it is usually more expensive than the same project in a new urbanization.
- Then, the network expansion did not always follow logical decisions (or the most economical ones), since usually the district heating and cooling network construction works needed to take advantage from the streets urbanization promoted by the city Council. In other words, the extension of the network was sometimes determined by the streets that were being rebuilt at that moment, not because they were really needed for the system itself.
- In conclusion, as the opportunity of executing expansion works and the need of this energetic infrastructure were not matching in time, some of the needed investments had to be done earlier. Therefore, the global budget has been penalized by these early network investments.

The only way to face this problem was to work closely and always coordinated. The future operators were required to follow the Barcelona City Council instructions in every single movement since they had to take into account the main work planning (in time and in streets works priorities) in order to plan their own works.

ATOMIZATION OF POTENTIAL USERS

In addition to the previous problem, the other big challenge was the atomization of potential users. Since the development of the whole district was made in phases, often the potential users were not exactly located near the existent or planned pipes.

However, the only way to convince them to connect the building was to assure the heating and cooling service at the same moment they started their activity. Therefore, some works were made maybe not in the most convenient time, but when they were needed.

The problem was solved in different manners: some investments were advanced in time, network extension was rethought with the purpose of being able to connect some important users in time, temporal dedicated equipment was needed in order to give users the required services and ensure the thermal energy supply, etc.

DEMONSTRATION PROJECT: LITTLE KNOWLEDGE ABOUT THE TECHNOLOGY

As said before, the Districlima heating and cooling network system was the first DH&C in Spain. Thus, it was not easy for the network operator to convince potential users about the advantages of these systems. Fortunately, the operators and the Barcelona City Council worked together to face this challenge.

On the one hand, the Barcelona City Council is doing a really good communication plan and, additionally, requires to all new public buildings located in the 22@ technological district to be

connected to the system, as an example for private owners. On the other hand, the operators were really active in looking for clients and explaining the system virtues.

WORLD ECONOMICAL CRYSIS

Nowadays the biggest challenge is the world economical crisis: fewer investments and less building construction. However, it is right now that the Districlima operators have begun with the construction of the new plant, the Tanger Central.

It is not still clear what will happen...

3.7. How was the programme financed?

The construction of the main heating and cooling power plant and the first 3 kilometres of network were financed by the municipality. The capital returns depends on the demand connected to this part of the network. This was the first public concession established between the Barcelona City Council and the Districlima society.

The expansion of the network through 22@ district was the second public concession. In this case, the network construction is fully financed by Districlima. It is also his duty, as a result of the concession, to build the back-up plant, the Tanger Central. This new heating and cooling power plant is going to increase the reliability of the system.

As explained previously, the Barcelona City Council helps Districlima in the current stage of expansion by including the DH&C network when new streets are rebuild and allowing a differed return of capital depending on the demand. Moreover, the Barcelona City Council will also pay the electrical connection to the Tanger Central, as a non-recoverable contribution.

In order not to be too much indebted to the bank, Districlima increased its capital from 4 M€ to 19 M€ in 2010.

4. Attachments

4.1. Districlima Shareholders

Distrclima is a public-private enterprise who has the concession for 30 years to develop network through 198,26 hectares in size. Their shareholders are:

Cofely (50,8%)	Europe's leader in energy and environmental services, designing and implementing solutions to help business and public authorities make better use of energy, whilst reducing environmental impacts.
TERSA(20%)	Municipal corporation specialized in treatment, control, management and valuation of urban solid wastes. TERSA produces steam in their stage of energetic valuation, which is provided to Districlima. Therefore, TERSA is not only a shareholder but also a supplier of Districlima.
AGBAR (19,2%)	The Agbar group is a world leader both in the fields which constitute the core of its activities related to the water cycle and in the business lines demanded by the new society, particularly in the services of health.
IDAE (5%)	IDAE (Institute for Diversifications and Saving of Energy) is a state-owned business entity that reports to the Ministry of Industry, Tourism and Trade through the State Secretary for Energy.
ICAEN (5%)	ICAEN (Catalan Institute of Energy) has the aim to promote research and support developments in the field of energetic technologies.

Figure 1: Districlima Shareholders.

4.2. Configuration of production units in Forum Central

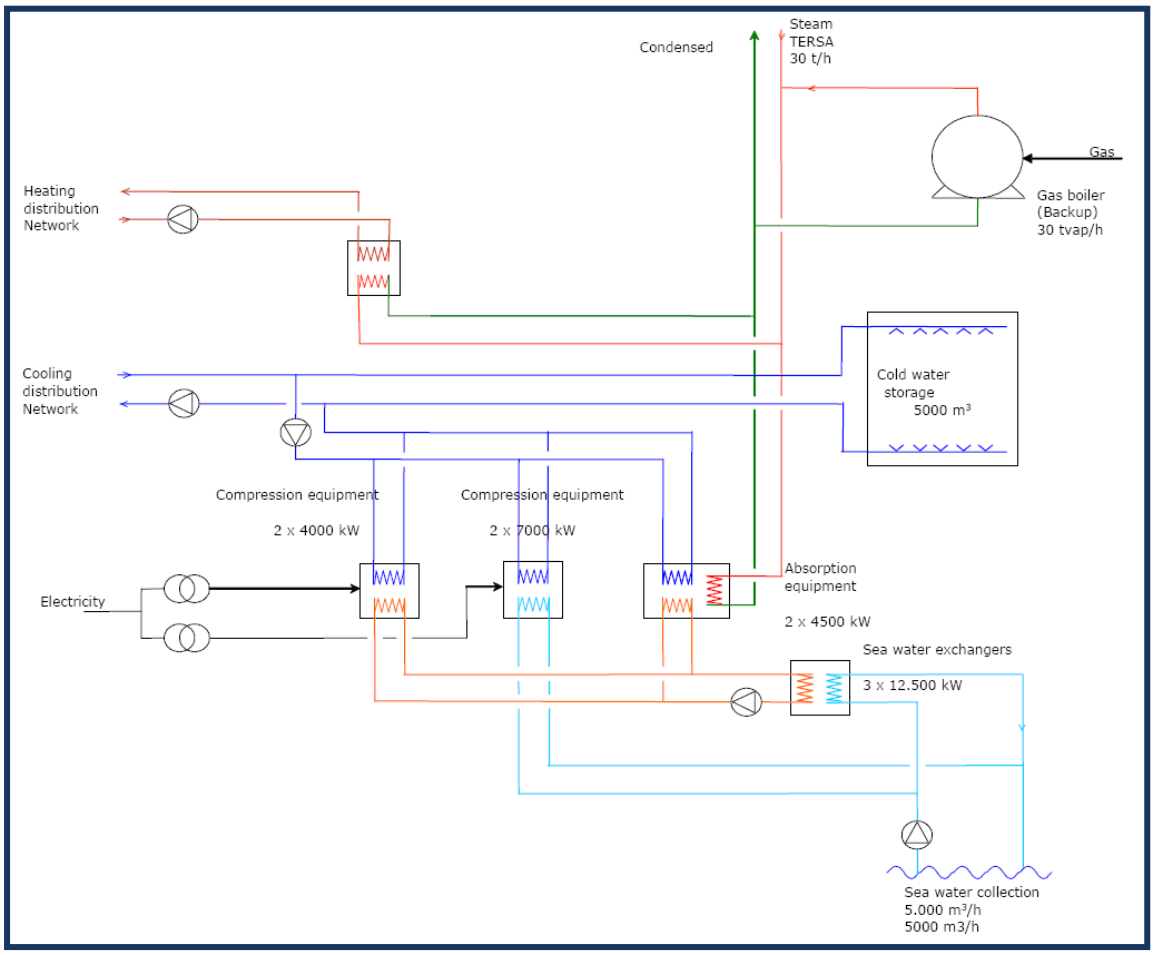


Figure 2: Configuration of production units in Forum Central.

4.3. Primary energy savings in 2010

Energy provided to customers						
Heating useful energy delivered to customers	MWh_t	30.574				
Cooling useful energy delivered to customers	MWh_f	48.557				
Conventional installations			**DHC - DISTRICLIMA**			
Conventional installation EER		2,3	Electrical consumption (b)	MWh_e	10.284	
Compressor electric consumption	MWh_e	21.112	TERSA steam consumption	MWh_t	44.143	
Electrical consumption of conventional installation (a)	MWh_e	21.112	Performance that TERSA could have if produce		10,0%	
Performance electrical production with fossil fuel		35,9%	Electricity not produced (c)	MWh_e	4.414	
Equivalent primary energy	MWh_{PCI}	58.817	Performance electrical production with fossil f		35,9%	
Boilers performance		75%	Equivalent primary energy consump	MWh_{PCI}	40.949	
Convenctional gas consumption	MWh_{PCI}	40.765	Natural gas consumption	MWh_{PCI}	2.108	
Total primary energy consumption	**MWh_{PCI}**	**99.583**	**Total consumption**	**MWh_{PCI}**	**43.057**	
Energy savings						
Electricity savings (a - (b + c))				MWh	6.413	
Performance electrical production with fossil fuel					35,9%	
Primary energy savings related to electricity				MWh_{PCI}	17.868	
Primary energy savings related to gas				MWh_{PCI}	38.657	
Total primary energy savings				**MWh_{PCI}**	**56.525**	**57%**

Figure 3: Primary energy savings in 2010.

4.4. CO_2 savings

Conventional installations				DHC - DISTRICLIMA			
Electricity							
Production mix emission Endesa Energía SAU 2008	g/kWh	370			g/kWh	370	
Emissions due to Electricity consumption	t	7.811			t	5.438	
Gas							
Specific emission	g/kWh	200,4			g/kWh	200,4	
Emissions due to natural gas consumption	t	8.168			t	422	
Total emissions	t	15.979			t	5.861	
CO_2 emission savings					**t**	**10.119**	**63%**

Figure 4: CO_2 savings.

4.5. CO_2 savings evolution

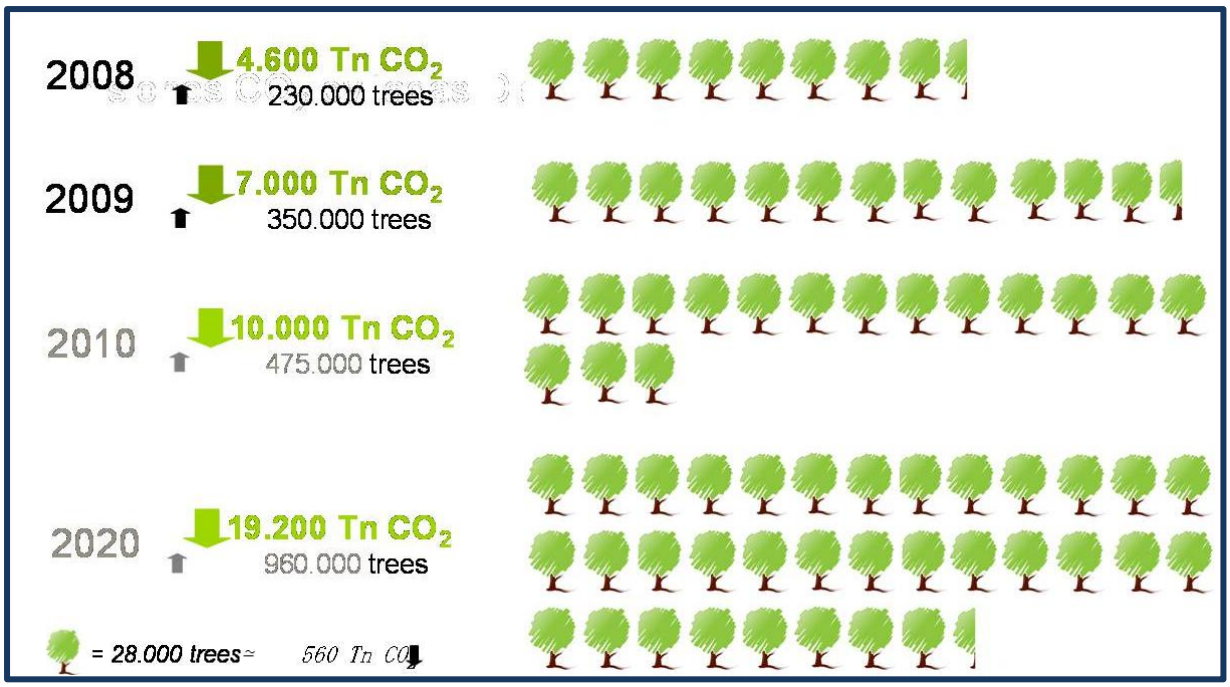


Figure 5: CO_2 savings evolution from 2008 to 2010 and expected savings for 2020.

4.6. Subterranean galleries

Figure 6: Image of the subterranean galleries in the 22@ Technological District.

4.7. Network evolution from 2005 to 2010

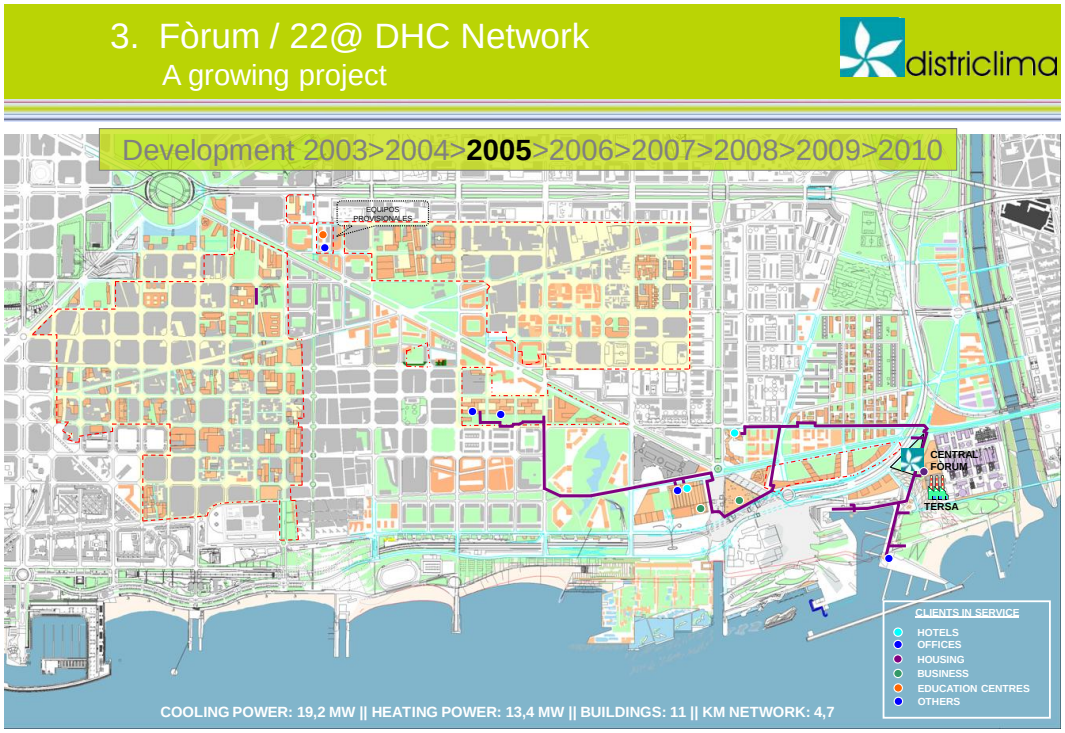


Figure 7: Network development in 2005.

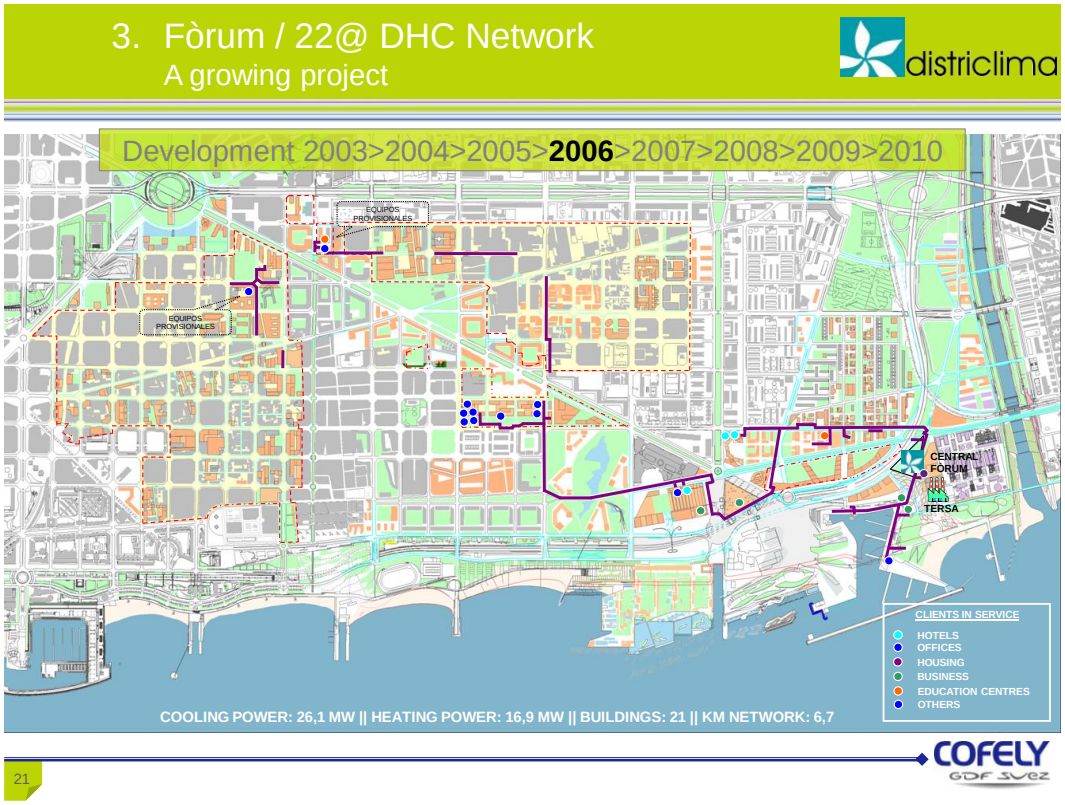


Figure 8: Network development in 2006

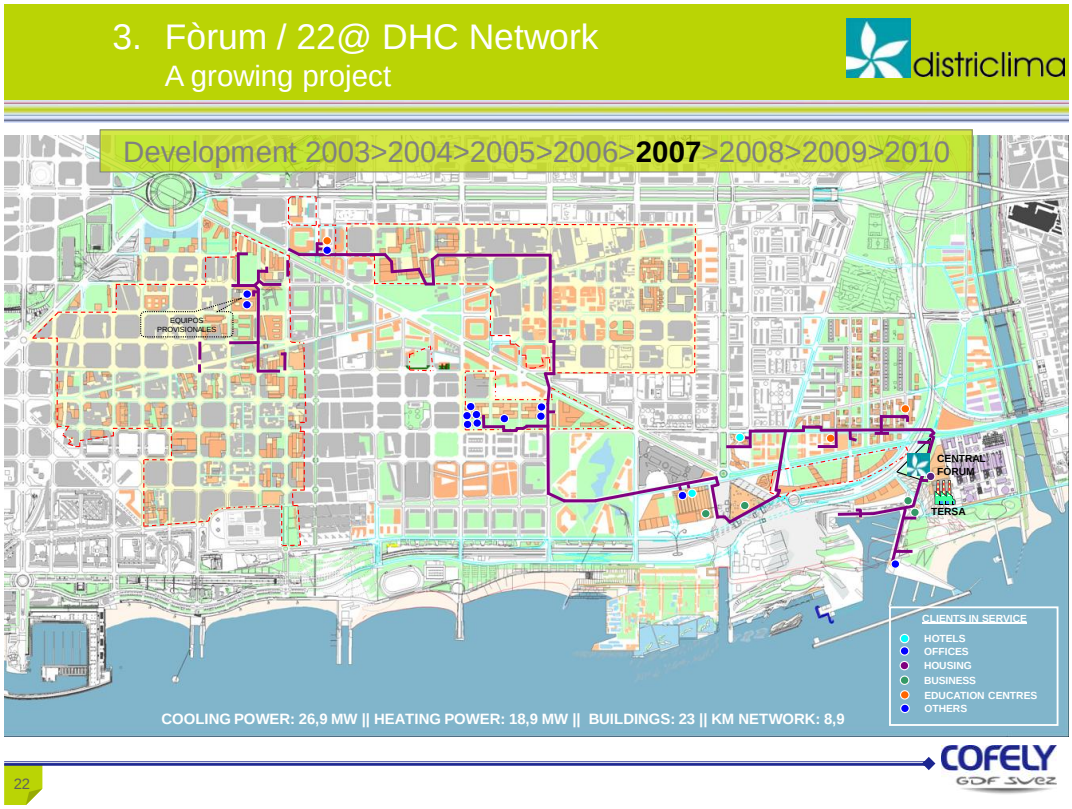


Figure 9: Network development in 2007.

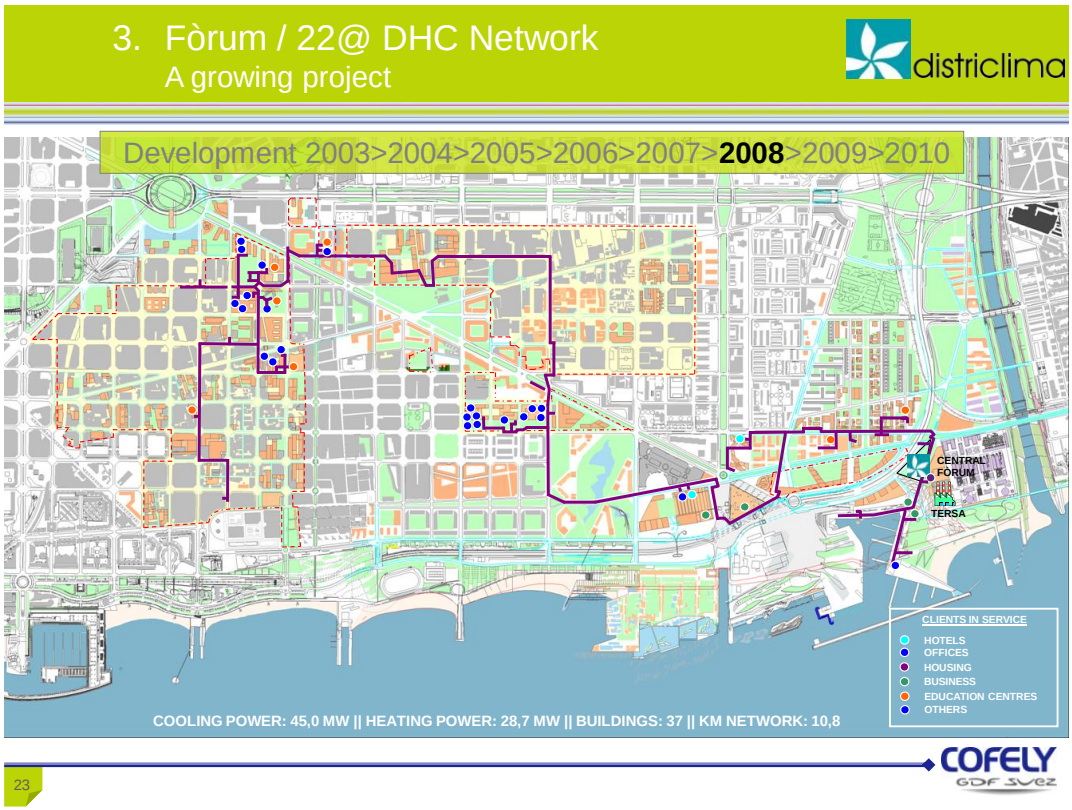


Figure 10: Network development in 2008.

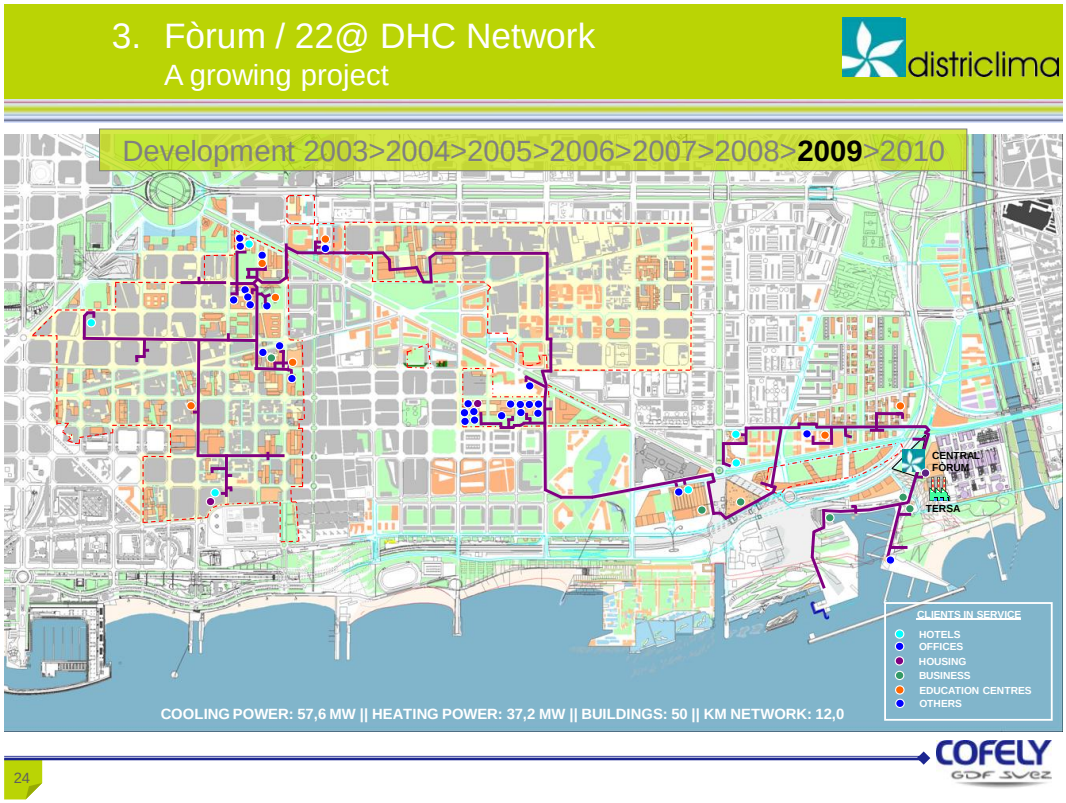


Figure 11: Network development in 2009.

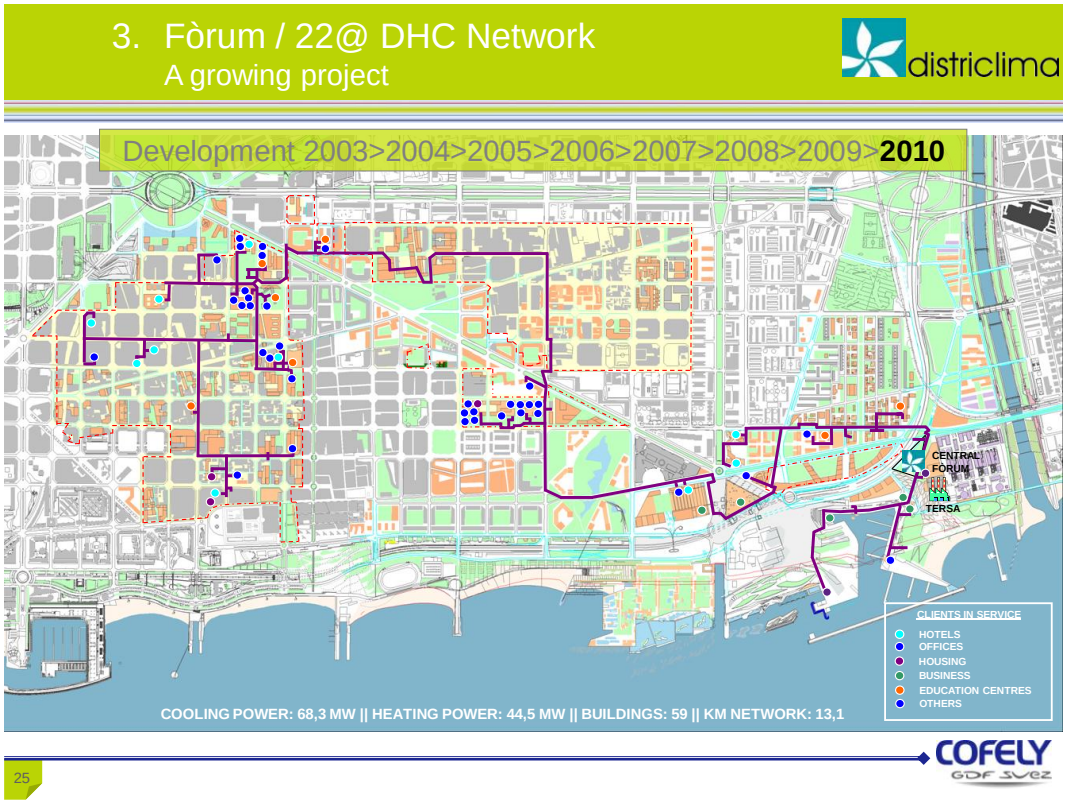


Figure 12: Network development in 2010.

4.8. Construction of the Tanger Central

Fig. 13: Construction of the Tanger Central.

Fig. 14: Ice tank construction.