

# District cooling

A cooling solution for climate challenges



## Helsinki has the fastest-growing district cooling network in Europe

- In 2000, district cooling was launched in a new district of central Helsinki.
- In 2011, district cooling covers Helsinki city centre, with about 200 customers and connected load of over 110 MW.
- In 2015, the cooling capacity will exceed 200 MW
- In 2020, cooling will have expanded to new residential areas.

Award-winning energy strategy

UNITED NATIONS ENVIRONMENT PROGRAMME



1990



Award of the EU Committee of the Regions

2008

# District cooling is an economic



IEA's recognition

2008



2009



2010



2011

## Efficiency ratio

The efficiency ratio shows how efficiently the fuel used in energy production can be utilised. A higher efficiency ratio means a more energy efficient production.

## Trigeneration

Whenever possible, Helsingin Energia produces district cooling in the same energy production process as heat and electricity.





In Helsinki, Finland's capital, location, urban structure, changing seasons and the sea mean that district cooling is the best solution in terms of its commercial value and eco-efficiency.



Heat is produced wherever there is activity: in data centres, business premises, and homes. Helsingin Energia has developed a solution where data centres are cooled with district cooling and the surplus heat produced by computers is utilised by conducting it to the district heating network to heat up the city's buildings and tap water.

# cal and environmental solution

**District cooling is a part of Helsingin Energia's trigeneration where electricity, heat and cooling are produced as eco-efficiently as possible, without wasting energy. Over 80 per cent of the cooling production is based on energy that would otherwise be unutilised, for example, cold sea water.**

District cooling is an efficient way to reduce carbon dioxide emissions in an urban environment. District cooling significantly reduces the amounts of greenhouse gases and other emissions, such as nitrogen oxides, sulphur dioxide and particulate emissions. District cooling can be used instead of individual mechanical cooling systems traditionally used in buildings.

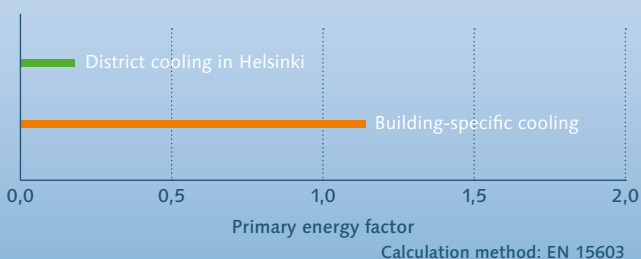
District cooling is suitable for cooling the ventilation air, in residential buildings, office and commercial properties, public administration buildings and data centres. Cooling is also suitable for different industrial processes, such as the food industry.

The individual cooling needs determine whether to choose district chill, district cooling or customised district cooling.

## International excellence

Helsingin Energia actively develops increasingly efficient and eco-friendly forms of energy production, and its expertise and new solutions have received international acclaim, winning them several awards and recognitions.

## Comparing primary energy factors of cooling systems



**Primary energy** is unused fuel.

**The primary energy factor of production** shows how many units of fuel are needed to produce one unit of energy. A lower production factor means better efficiency ratio and lower fuel consumption.



## Choosing district cooling is an environmental solution

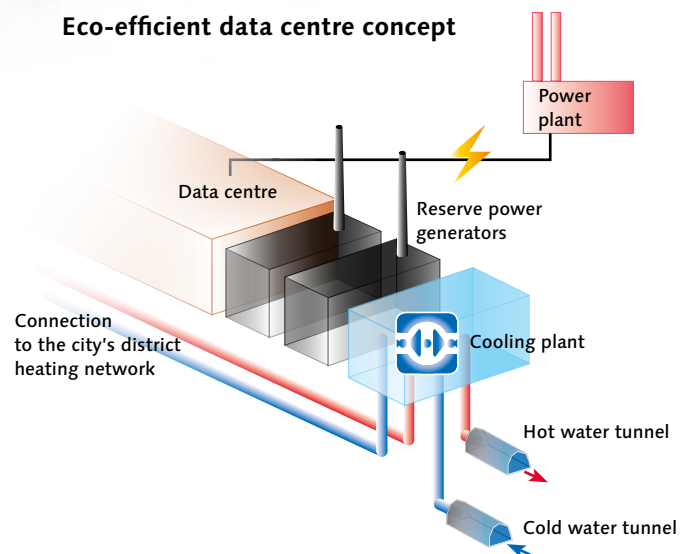
- Energy-efficient production
- Small space requirements in a building
- No harmful substances
- Inconspicuous and quiet
- Low maintenance and repair needs

# Use of urban energy at its

## District cooling is also an economically sensible choice

- Helsingin Energia takes care of district cooling production
- Security of supply
- Competitive prices
- Easy to estimate costs
- No need to invest in cooling equipment or condensers

### Eco-efficient data centre concept



The existing district cooling and heating network and underground facilities suitable for various sized data centres make it economical to relocate to central Helsinki.



## Significant reductions in emissions

- Greenhouse gases (CO<sub>2</sub>, etc.)
- Nitrogen oxides (NO<sub>x</sub>)
- Sulphur dioxide (SO<sub>2</sub>)
- Particulate emissions



A well planned and implemented facility excavated in the bedrock offers the highest possible level of physical safety. Automatic surveillance, alarm and fire fighting systems also operate in the facilities.

The Finnish bedrock is almost two billion years old. It is hard and stable, and it is located close to the earth's surface. The majority of pipes in Helsinki's district cooling and heating network are located deep within the bedrock.

# best

It is easy to see the unique qualities of district cooling. The customer receives reliable energy-efficiently produced cooling ventilation at a reasonable price.

In Helsinki, district-cooling energy is produced with several economical methods at any given time. This energy-efficient production method saves costs and the environment.

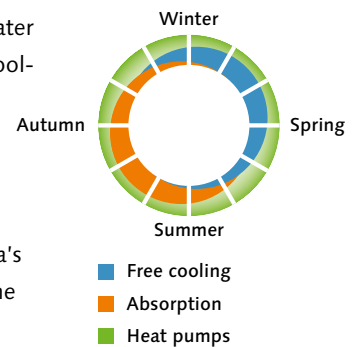
Helsinki Energia's cogeneration has an extremely high efficiency ratio. The primary energy is utilised out 90% of the fuel used, compared to the 50% in modern condensing power plants commonly used throughout the world.

Security of supply is improved by the storage of district cooling energy. In Helsinki, cold is stored in large underground tanks with a capacity that equals the water volume of an average lake.

## Three ways to produce economical cooling:

### Free cooling

Free cooling is produced from cold sea water whenever possible. Cold sea water provides an inexhaustible source of cooling energy for Helsinki.



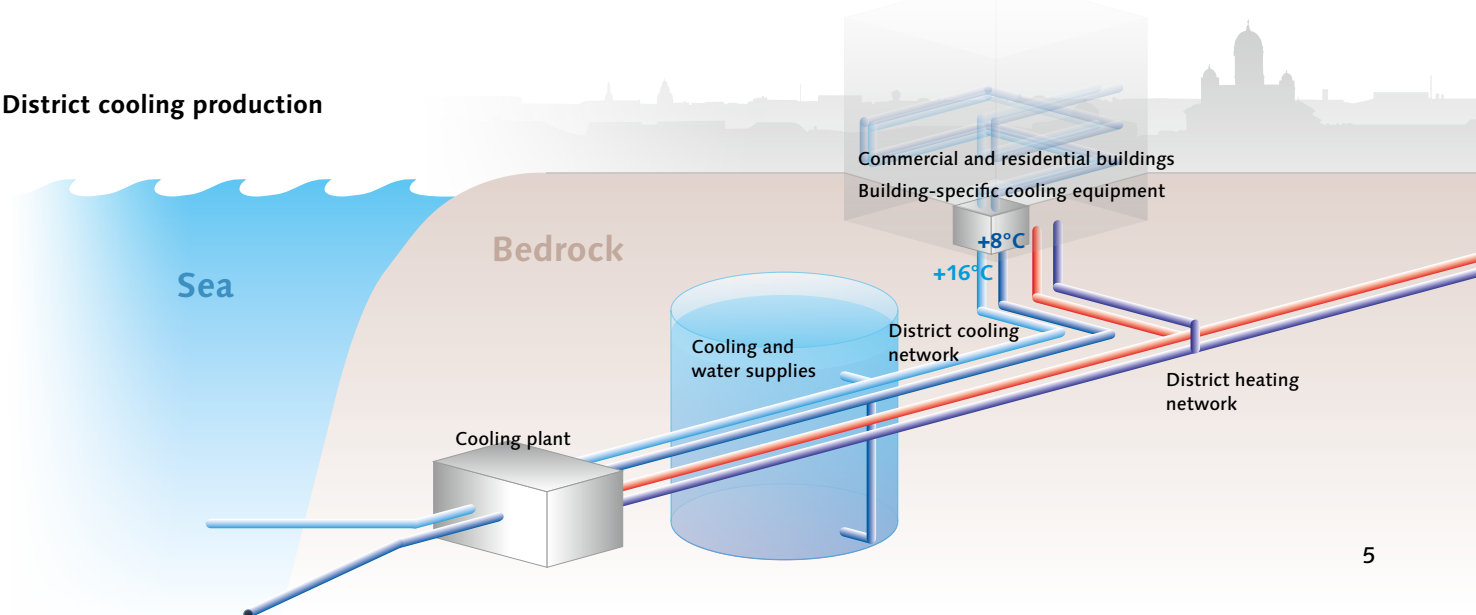
### Absorption cooling equipment

In the short summer season, surplus thermal energy from Helsingin Energia's cogeneration plants is also used for the production of district cooling.

### Heat pumps

Purified wastewater is utilised in a heat pump plant. Both district cooling and heating are produced with the aid of heat pumps in the same process.

## District cooling production





# Helsinki is a global forerunner

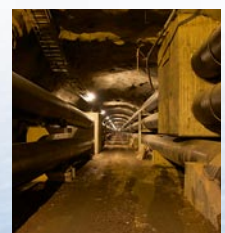
\* International District Energy Climate Award 2011



## Production and distribution of district cooling in 2011

- Extent of network: 50 km
- The number of cooling plants: 3  
The number of production units: 15
- The capacity of cold water storage: 11 mill. litres

**In both urban and suburban areas, district cooling is a superior eco-efficient cooling method. In Helsinki, district cooling covers the downtown area. In the city centre's new construction sites district cooling is the principal cooling solution.**





# anner in district cooling\*








3D image: Artesa Studio

The network sections located close to the surface.

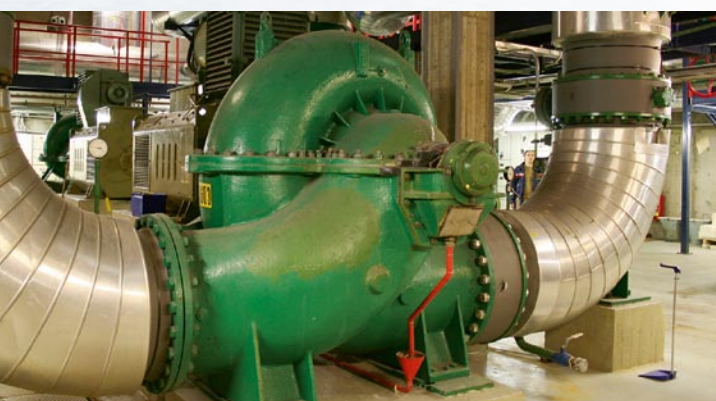
## Advantages of centralised cooling production

Centralising the cooling production into larger units increases the efficiency of energy use and improves the efficiency ratio of processes compared to separate cooling systems for each building. A centralised cooling system uses the most advantageous source of cold and the most appropriate technology for each situation.

-  District cooling
-  Free cooling/Cold water storage
-  Absorption cooling
-  Heat pump
-  Energy production

The cooling network covers the downtown area of Helsinki. In the next few years, the distribution network will be expanded to new districts.

Helsingin Energia has a network of tunnels extending to almost 60 km in Helsinki. The underground routes guarantee uninterrupted delivery, and the distribution networks are not affected by changing weather conditions or damage caused by roadworks.







The network of tunnels extend to 300 kilometres in the Helsinki region. Some sewerage plants, heating plants, substations, base stations, depots, and coal and oil storage facilities are also located underground. In 1994, a sewage water treatment plant was also excavated inside the bedrock. Since the 1960s, Helsinki has systematically utilised the possibilities of underground construction. The facilities and tunnels built under the city now total almost 10 million cubic metres.



# District cooling is the cool for a developing capital

**Helsinki and its surroundings form one of the most rapidly growing metropolitan areas in Europe. Helsinki is currently undergoing the most significant efficiency drive and change in its urban structure in a hundred years.**

## The city also grows underground

The community management safeguarding Helsinki's vital functions operates in the shelter of underground rock facilities without disturbing overground activities. Helsinki's multi-utility tunnels house the major transmission lines of the district heating and cooling systems, and the power and telecommunications networks.





# ooling solution

## The district cooling network of Helsinki is growing

With district cooling, the ventilation and cooling needs of the city will be covered in an eco-efficient way as part of the City of Helsinki's sustainable development strategy.



By 2011, about 200 customers will have joined Helsingin Energia's district cooling system.

## World's first underground master plan

As far as it is known, Helsinki has drawn up the only master plan in the world for systematic utilisation of its valuable resources in the bedrock. The plan is used for managing the location, reservation and co-ordination of significant bedrock facilities and transport tunnels and for safeguarding the stability and operations of already built facilities. New bedrock facilities will be planned for multiple uses for several concurrent activities. To an increasing extent transport, parking, maintenance and storage can be moved underground.



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## Developing the urban structure and cityscape is a multidimensional challenge

Helsinki wants to regenerate itself as an attractive urban living environment by densifying and developing its urban structure while honouring the city's heritage.

At the same time, the locations of businesses and industry, the possibilities for diversifying urban living, and boosting transport efficiency will also be taken into account. The target is to reduce the volume of traffic, to develop a well-functioning public transport system and to increase the number of safe pedestrian and cycling paths.

## New innovations in building and housing types

New implementation methods are being created in addition to the construction of apartment blocks. Areas are reserved for denser construction than before, as well as for the development of detached housing areas. The development possibilities, standard of living and pleasant environment in the suburbs are improved through complementary construction and urban space development.



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- In 2008, moving the operations of two goods harbours to a new location released extensive areas in the city centre for the construction of residential and service buildings.
- In 2009, some areas of neighbouring municipalities were incorporated into Helsinki.

Background image, images 2 & 6:  
Helsinki City Planning Department / Tietoa Finland Oy  
Images 1 & 5:  
Helsinki City Planning Department / Helin & Co Architects  
Images 3 & 4:  
Helsinki City Planning Department / Jarmo Roiko-Jokela





# Helsingin Energia is a forerunner in the utilisation of new technologies

In line with the targets agreed with the EU, Finland and the City of Helsinki, Helsingin Energia has launched its development programme towards a carbon-neutral future, aiming for an increase in the use of renewable energy in order to mitigate climate change. The Helsinki City Council approved the programme in late 2010.

## Towards a smart power grid

Helsingin Energia, ABB and Nokia Siemens Network have joined together to develop a model smart power grid in the urban area released from one of the two goods harbours. By the early 2030s, the area will employ 10,000 people and provide housing for about 18,000 Helsinki residents.

## Working towards carbon neutral production

Helsingin Energia aims to achieve carbon neutral production by 2050. The security of the energy supply is based on several production forms: natural gas, coal and oil, renewable bio-, hydro- and wind energy, and nuclear power. As part of the development programme to increase renewable energy, power plants will gradually introduce pellets or other biomass to be used as co-fuel with coal. Helsingin Energia will also research the possibilities of increasing the use of wood-based fuels, biogas and biocoal.

## Significant achievements



### Storing coal underground

The world's first underground coal storage facility was completed in Helsinki in 2004. The upright storage, excavated into the bedrock, is fully automated with a holding capacity for some 250,000 tonnes of coal. The deepest parts of the storage are located 120 metres below sea level. The construction of the storage improved the city-scape, as the mounds of coal could be removed, and the valuable land could be used for construction purposes.



### World's largest heat pump plant

The world's largest heat pump plant has carbon dioxide emissions 80% lower producing district heat and cooling in the same process than those of the most commonly used production solutions. The remotely operated heating plant produces district heat from the heat of purified sewage water. In the winter, the cooling energy is obtained from seawater, and in the summer from the return water of district cooling. The heat pump plant is hidden in a cave close to the seashore at a depth of 25 metres below sea level.





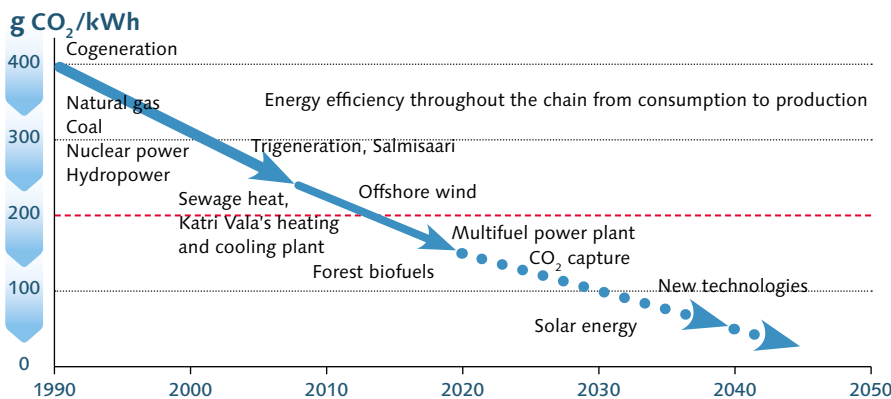
### Electric vehicles in Helsinki

In 2010, Helsingin Energia implemented Finland's first public on-street recharging point for electric vehicles utilising mobile technology in the city centre of Helsinki. A more extensive recharging system is being designed on the basis of experience gained from the project.

# erunner in hology

In the near future, the smart energy grid will enable the increase of local renewable energy production, efficient control of consumption and energy saving, and the use of electric vehicles. Longer-term development includes the utilisation of solar energy, carbon capture, and completely new technologies.

### Development steps towards a carbon neutral future



### An eco-efficient data centre concept

Helsingin Energia developed a solution where data centres are cooled with district cooling and the surplus heat produced by computers is utilised by conducting it to the district heating network to heat up the city's buildings and tap water. The carbon footprint is a fraction of the ordinary solution. If all of Finland's data centres worked on this principle, it would save up to 500 MWh of energy every day, equivalent of the heating needs of an average-sized town.

- Finland's first data centre to utilise this world leading energy efficient concept, was implemented in 2010 in co-operation with the ICT service company Academia Oy.

### International awards

#### 1990 UN Environmental Award

The grounds for granting the 1990 UN Environmental Award were that, on an international scale, Helsinki uses an exceptionally large amount of cogeneration of electricity and heat. Helsingin Energia produces district heat and electricity with a high efficiency ratio. The expanding desulphurisation technology of Helsingin Energia's power plants was also commended. Dr Noel J. Brown, Director of the United Nations Environment Programme UNEP, called the award the Nobel Prize of the UN Environment Programme.

#### 2008 Regional Award

In 2008, Helsingin Energia received the Regional Award of the EU Committee of the Regions for its district heat and district cooling operations.

#### 2008 IEA recognition

In 2008, IEA awarded Helsingin Energia a recognition for energy efficiency.

#### 2009 Certificate of Merit

In 2009, IEA awarded Helsingin Energia a Certificate of Merit for its superior solutions for climate change mitigation.

#### 2010 Uptime Institute Green Enterprise IT Awards

Helsingin Energia created a technology, where the heat produced by computers is utilised in a new way in the heating of buildings and tap water. This won the first prize in the 'Beyond the Data Centre' category of the 2010 Uptime Institute Green Enterprise IT (GEIT) Awards. The competition was organised by the Uptime Institute, the world's leading IT think tank and research unit ([uptimeinstitute.org](http://uptimeinstitute.org)).

#### 2011 Global Energy Award

Helsingin Energia won the environmental award of the International District Energy Climate Awards competition for its best international district heating and cooling solutions. According to Richard H. Jones, Deputy Executive Director of IEA, district cooling is an outstanding example of a market-based system that benefits the climate, the customer, the energy company and the entire society. District cooling provides energy savings of almost 100,000 megawatt-hours. Helsingin Energia's district cooling system is the most innovative, diverse and environmentally friendly of all district cooling systems.

The competition is organised by the leading international and impartial expert organisation IEA (International Energy Agency) together with expert organisations representing the industry, Euroheat & Power and IDEA, the International District Energy Association.





# Helsingin Energia

Established in 1909, Helsingin Energia is today one of Finland's oldest energy companies that sells electric energy to approx. 400,000 customers in Finland and covers over 90 per cent of the heating needs of Helsinki with district heating. Its district cooling operations are expanding rapidly in the Helsinki region. The company also offers project and maintenance services in energy production and distribution systems and is responsible for the outdoor lighting of Helsinki.

Heat, electricity and cooling are produced mainly in

power plants and heating plants located in Helsinki. Helsingin Energia also procures energy through its associated companies outside Helsinki and from the electricity exchange.

The security of energy supply is based on several production forms, including natural gas, coal and oil, and the renewables, wood, hydro and wind power, as well as nuclear power.

Helsingin Energia is involved in programmes that promote energy saving in accordance with the EU Energy Services Directive.

**Helsingin Energia is constantly improving its own energy efficiency, introducing services promoting energy saving and increasing the use of renewable energy sources.**

[www.helen.fi/kaukojaahdytys\\_eng](http://www.helen.fi/kaukojaahdytys_eng)

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