# OLD TECHNOLOGY, NEW POTENTIAL
# GREEN DISTRICT HEATING AND COOLING

In Denmark, 62% citizens are served by DH, for example, this number reaches 97% in Copenhagen where fuel composition is recycled heat, renewables and other.

There is an extensive district-heating systems due to significant geothermal energy. About 85% of all houses in Iceland are heated with geothermal energy.

Today, the Scandinavian countries pioneer utilizing renewable energy sources for district heating systems. For instance, DH corresponds 55% of heat demand among all and 51% fuel source of CHPs is coming from renewables. One of socio-economic benefit is 5000 employment in Sweden.

Finland has a total population of 5.3 Million inhabitants, of which 49% are served by District Heating. By 2050, the country aims decreasing emissions from 220 g/kWh to 25 g/kWh from district heat [1].

Russia is a major user of CHP in industry, and by far the world's largest user of district heating but the market has decreasing trend in production and fuel is based on natural gas and coal [2]. The investment needs of rehabilitating the district heating systems are estimated at US$ 70 billion by year 2030 [3].

District Cooling System utilizes the water of Lake Ontario to cool downtown buildings. The process has become known as 'Deep Lake Water Cooling (DLWC)'. It provides for over 140 MW of cooling.

First commercial district heating system, New York 1877: Central boiler, a loop of steam pipes, radiators and condensate return lines, created by Birdsill Holly.

In China, most of generation plants are coal based. In 2007, 1st concession agreement is signed in the heating sector of China where the company supplies heating to 14.5 million m2 which represents 75% of the current heating surface of the city of Jiamusi [4].

- During Middle Ages, district heating concept is seen in Chaudes-Aigues Cantal, France as distributing warm water through wooden pipes. This long-lived asset has been using even today.
- Largest District Cooling System in Europe: Utilizing River Seine Water for free cooling in Paris where network length is 140 km that serves 500 clients with annual reduction in electricity consumption 42% and 48% CO2 emission [6].

Market share of DH in Germany is 14% based on recovery sources, to increase use of direct renewable sources, German government to take decision to subsidize up to 500 million € per year [5].

Austria is is promising state of EU which has been operating Solar District Heating (SDH) in Graz that is consist of 4700 square meters solar collectors and future investment will lead to avoid 10.000 tones of CO2 over 5 years.

The Integrated District Cooling Plant (IDCP) is the largest district cooling plant in the world that supplies the entire cooling demand of the island with a network 90 km length and saves 250 million kg of CO2 emissions annually. Additionally, noise pollution at the end user is significantly reduced by DC.

Geothermal power in New Zealand is a small but takes significant part of the energy generation; it is seen as the most reliable renewable energy source. The sources between 70-140°C are utilized for space and domestic water heating.

DHC Service provider in Emilia-Romagna Region has an integrated system with 83% of fuel coming from green resources such as geothermal and WtE in Ferrara, that results 15.000 TOE in primary energy savings.

<u>District Heating and Cooling Fuel Resource</u>
- Green Systems (Renewable+Recovery>80%)
- Mixture of Fossil Fuels and Green Sources
- Fossil Fuel Dominant
- District Cooling

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## What is District Heating and Cooling ?

District Heating and Cooling (DHC) is a method which utilizes various types' energy sources in a centralized plant to provide services such as hot sanitary water, space heating and/or cooling via insulated pipes to where demand is, particularly in residential areas. District Heating (DH) is also called as 'teleheating' where origin of 'tele' word comes from Ancient Greek that means such as 'at a distance, far away, far from'.

## Green DHC Concept

To minimize environmental impact generated by heating/cooling plants; to maximize socio-economic benefits of a DHC system for the community. Therefore, Green DHC utilizes two kinds of fuel sources as follows;

Green District Heating System

| <u>Direct Utilization of Renewables</u> | <u>Recovery Sources</u> |
|---|---|
| Geothermal | Incineration Plants (WtE) |
| Biomass | Industrial Plants |
| Solar | |

On the other hand, green district cooling supports free cooling which exploits lake/sea water directly for cooling purpose, and absorption chillers which consumes less electricity by using wasted heat (i.e. surplus heat from any type of plant) , compare to conventional chillers, those bring cost effectiveness to the method.

The key aspect to of DHC is to bring fuel shift from fossil fuel through local renewable energy sources. Since the system utilizes available energy sources in the region, DHC is a significant example for acting local concept from sustainability view of the issue.

## System Components

### i. Production Plants

Biomass boilers are the most common district heating systems that are mostly seen as two categories; direct combustion and combined power and heat (CHP) plants which generates electricity and heat at the same time. Since fuel is from renewable sources, CHPs are considered as parts of green district heating system within the boundaries of the concept. Solar thermal systems capture solar energy in the form of heat by use solar collectors (evacuated tube or flat plate), and move that heat with circulated water through them that can be used for domestic hot water (showers, faucets, etc.) or heating purposes. Medium to low temperature geothermal resources are utilized for direct heating; in addition, heat pumps provide individual energy-efficient alternative heating and cooling solution for residents.

In an integrated district heating and cooling system heat only boilers take place as a back-up station to compensate peak heat loads, during maintenance of major system, in case of emergency and also to improve DHC service quality.

### ii. Heat Exchangers

A heat exchanger is a equipment which transfers heat from production plant to heat carrier, usually water, circulates in network.

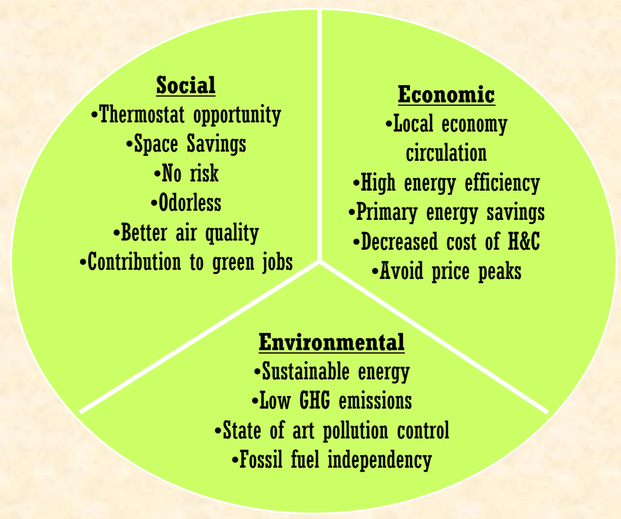
### iii. Network

Highly insulated pipes are used in DHC networks in order to decrease heat loss.

### iv. Substations

The place where consumers purchase heat and/or cool from the network directly (rather than gas or electricity), is substations that connects the main network to an internal building heating systems, such as radiator heating systems. It includes heat exchangers in consumer side, pumps, valves, temperature sensors and heat meters. Substations mostly belongs to the service company so this lets households avoid the cost of installing and maintaining boilers within their own buildings.

## Benefits




## Conclusion

District Heating and Cooling (DHC) is summarized well in the Danish slogan "Old technology, new potential" regarding to long history of it and favorable conditions of today. DHC represents green future nowadays that has potential to contribute robust sustainable expansion in different levels either national or global. To go a step further, generation of energy secure nations is likely in the future by these kinds of technologies.

*Irem Aksulu (依仁), 25, Turkish*
*MSc Environmental Assessment & Integrated Management in Urban Areas, IUSS Pavia-Tongji University, Shanghai*
*BEng Geophysical Engineering, Dokuz Eylul University, Izmir*

***Research Interests:*** *Integrated District Heating, Renewable Energy particularly geothermal and its utilization in power generation.*

***Contact:*** *irem.aksulu@gmail.com*

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