

SMART DISTRICT HEATING FROM FINLAND

The Coldest Country in Europe
The Best Country of District Heating

Internationalization Programme of Finnish DH Cluster

Background of Finnish Supply Potential:

- Finland: the coldest country in Europe
- Optimal DH & CHP system: low tariffs, high quality and availability
- World best experience in usage of renewable fuels
- Industrial and municipal co-operation is well-established
- Good examples in district cooling already
- Reliable reputation and high-quality products



Internationalization Programme of Finnish DH Cluster:

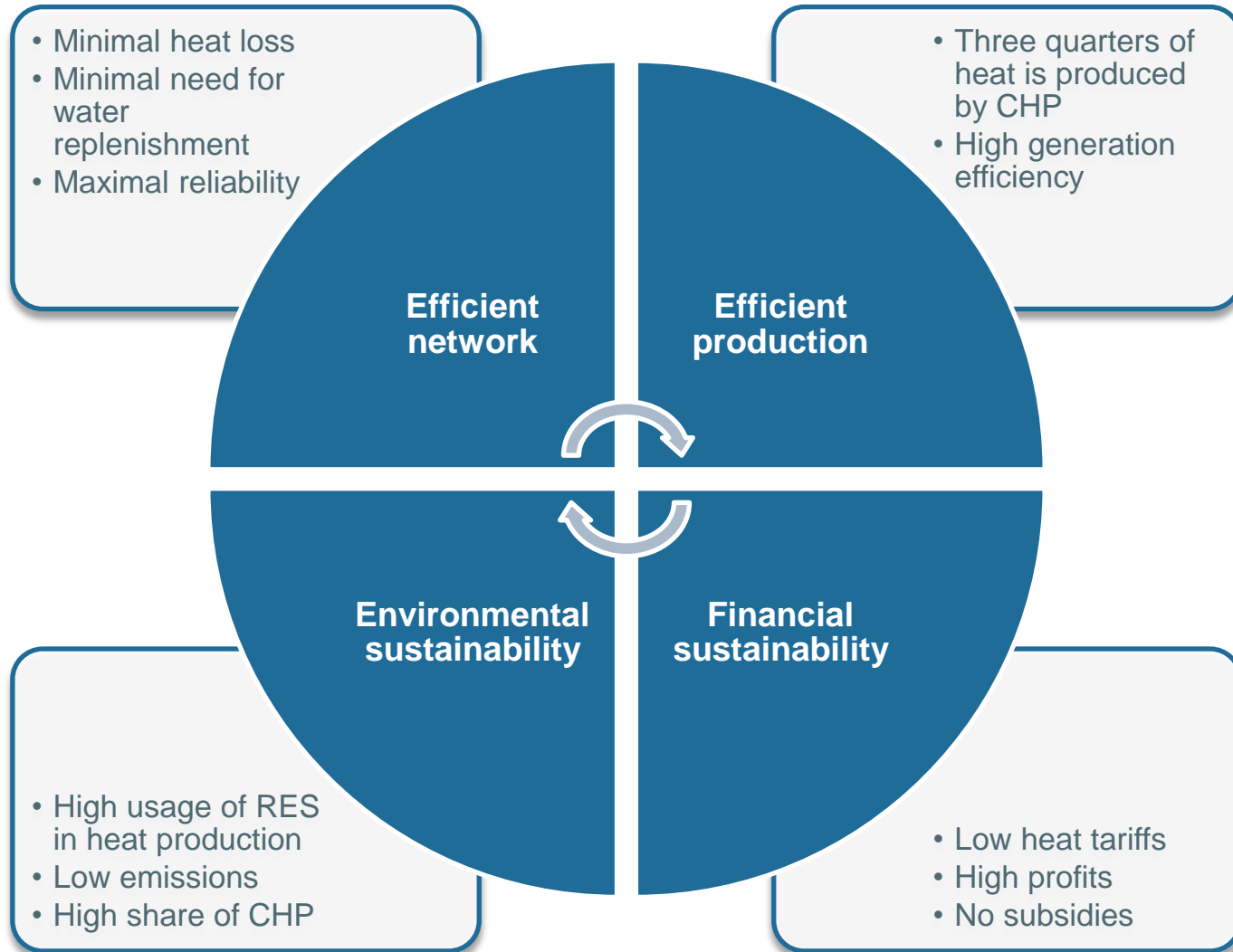
- Finnish Ministry of Employment and Economy has decided to finance internationalization programme of Finnish DH cluster through Finpro
- Thirteen Finnish companies are participating in the programme

Programme Objectives:

- To cluster Finnish offering of DH, CHP and renewable fuels
- To promote the Finnish expertise and know-how in CEE, CIS countries and China
- To establish strategic co-operation between the Finnish and local companies as well as high-level authorities

Finnish District Heating know-how is unique!

WOULD YOU LIKE TO HAVE THE **WORLD BEST** DHC SYSTEM?



WOULD YOU LIKE TO HAVE A DHC SYSTEM WITH EXCELLENT KEY PERFORMANCE INDICATORS?

Key Performance Indicators	Finland (200 companies on average)	Transition Economies
Network heat losses of production	6-9%	15-40%
Make-up water replenishment need per year	1	10-50
Reliability	99,98%	99% or lower
CHP share of DH production	76%	30-60%
DH generation efficiency	93%	60-90%
RES share of DH production	38%	0-10%
Staff productivity (GWh / employee)	20	1-4
Profitability % of turnover	10-20%	Low or negative

Highly **efficient** and **reliable** Finnish DHC Networks



- DH is available for customers 99,98% of the time (**breaks are less than 2 hours per year**, including planned breaks)
- Frequency of network damages is 0,1 damages/km, compared to 1-2 damage/km in transition economies
- Due to preventive maintenance practices, **damages are minimized** and if occurs, repaired immediately
- The efficiency of the DH networks is on average over 91%, in some cities reaching even 94%
- Network **water replenishment rate is only once a year** compared with 10-50 times in transition economies;
- Finnish DH pipelines are designed to last minimum 50 years and **expected to operate 100 years or even longer.**

Finnish DH systems are characterized by **reliability** and **ease of use**. Heat supply breaks are rare and the DH network requires **minimal maintenance**.

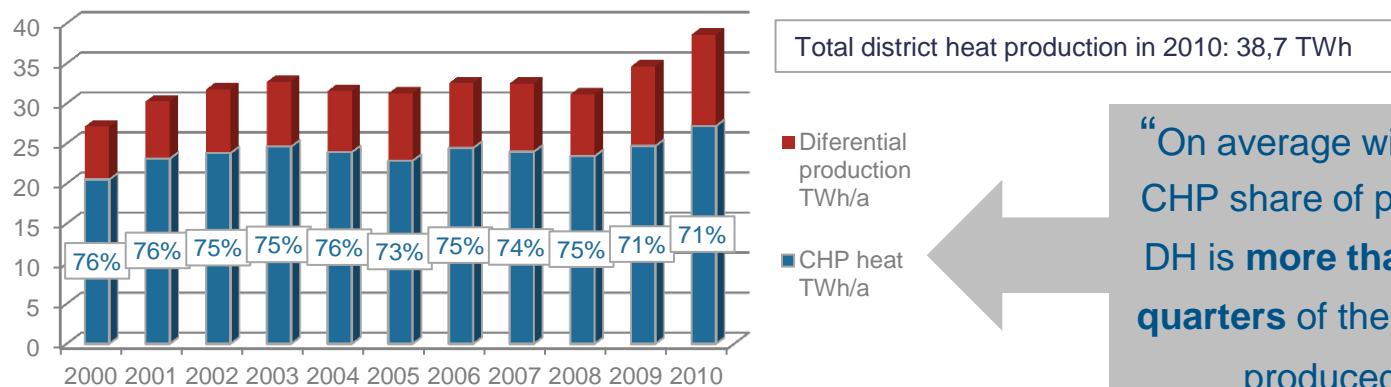
Finland: The World Leader in CHP / DH



CHP in District Heating is the Best Choice:

- Combined Heat and Power (CHP) is the **most efficient way** to produce heat and power from any fuel.
- CHP is largely used in both industry and district heating.
- In Finland, more than 70% of all district heating is generated by CHP whereas in many cities the share is more than 90%.
- In 2010, 20% of all electricity produced in Finland was based on CHP.
- Customers benefit from **low heat prices** in Finland.
- The reason to low prices lies on the optimized structure and size of the Finnish DH systems.
- Large scale use of CHP provides synergy benefits to DH as well.
- DH at low prices is competitive to any other heating modes.

Finnish District Heat production and the share of Cogenerated Heat

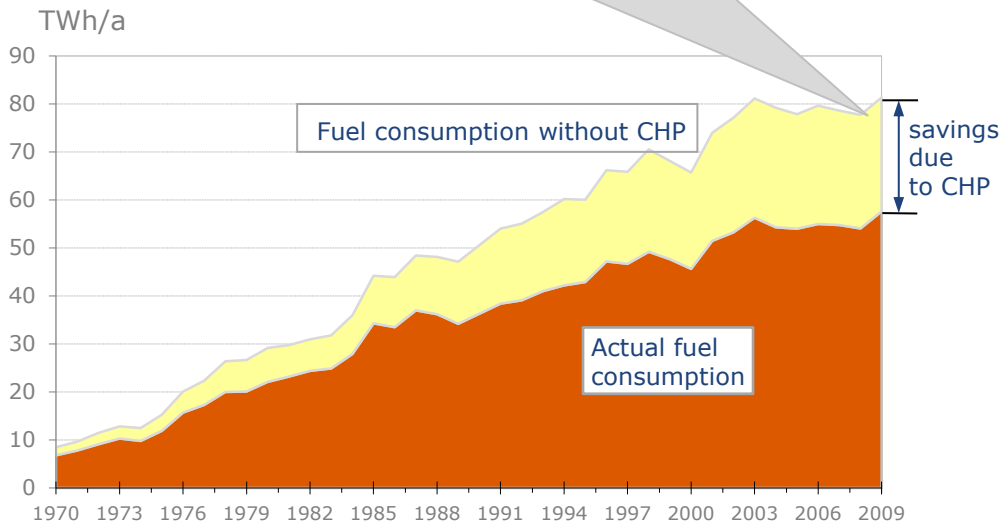


“On average winter, the CHP share of produced DH is **more than three quarters** of the total DH produced.”

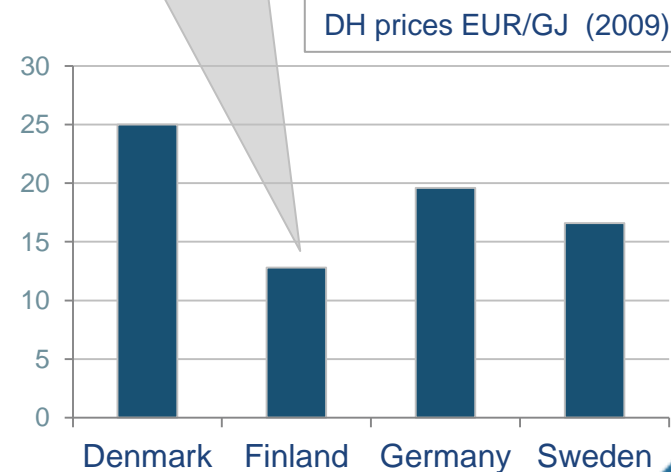
Comprehensive CHP and open energy markets led to lowest prices of heat!

“The fuel savings of about 22 TWh are equal to 3 million metric tonnes of hard coal. Such savings resulted in 600 kg of coal and 1400 kg of CO₂ equivalent saved per inhabitant in 2009.”

“ Finnish DH tariffs are the lowest in Western Europe and lowest in the world compared to the purchasing power.”



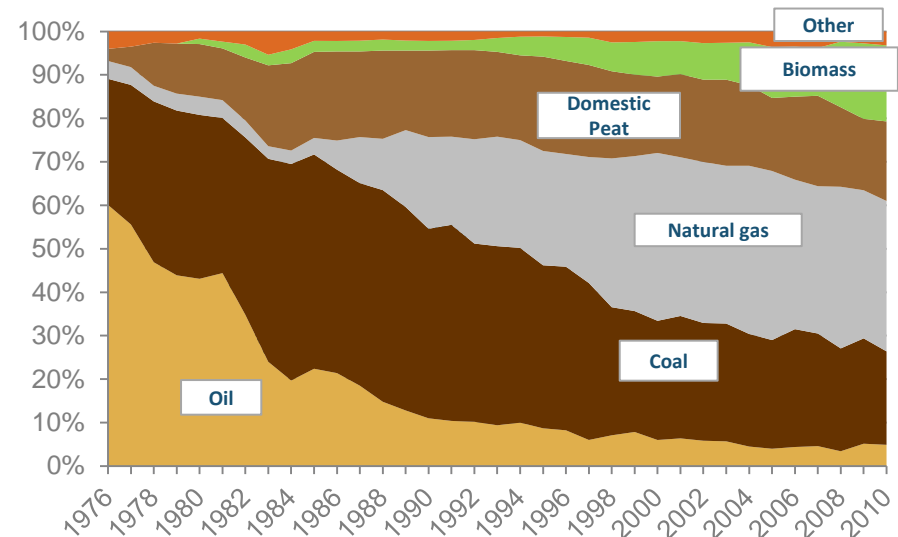
Source: Finnish Energy Industries,



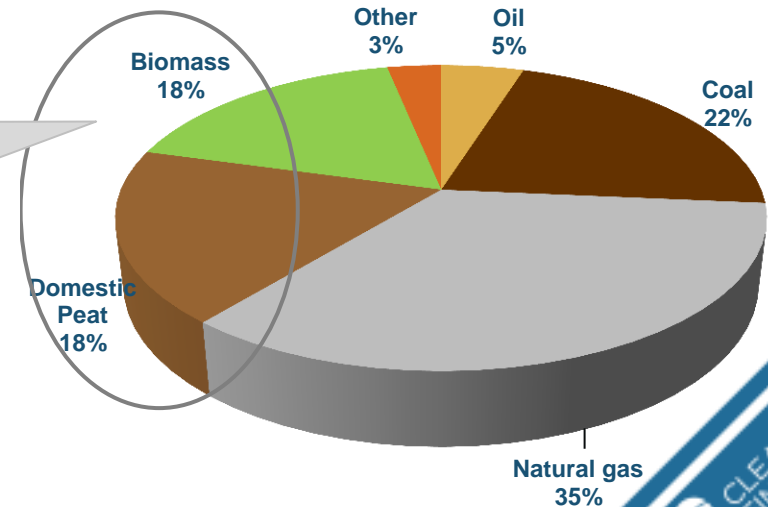
Source: Euroheat&Power: Country by country/2011 Survey

Leading Expertise in Usage of RES

- Finnish companies have decades of experience and strong position in exporting bio energy technology
- 36% of DH production is based on biomass and domestic peat
- 31% of electricity production is based on RES.
- DH in Finland has its roots in the CHP of the wood processing industry
- The increase of biomass use is even higher in CHP than in separate heat production
- The national target is to have DH and CHP free from fossil fuels by 2050



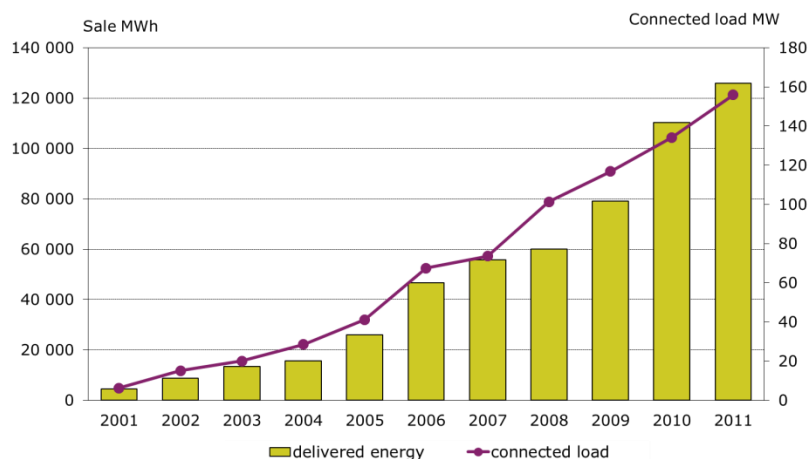
“ The price of district heating has increased moderately compared to rising prices of oil and gas, because alternative fuels - such as coal, domestic peat, waste wood, municipal and industrial waste - have been used instead.”



Finland: among the Leading Countries on District Cooling in Europe



- In Helsinki, despite of the cold climate, a high demand for cooling prevails.
- In 2008, Helsinki had the third largest and most rapidly growing cooling system in Europe. (90 MW).
- The growth is based on customers' own willingness to connect district cooling in the free market.
- Sea water, conventional heat pumps and absorption chillers, covering 1/3 each, are used as sources for cooling.
- More than 80 % of the district cooling production is based on resources that otherwise would be wasted.
- The share of renewable sources amounts to 60%.



District Cooling Key Figures in Finland, 2011

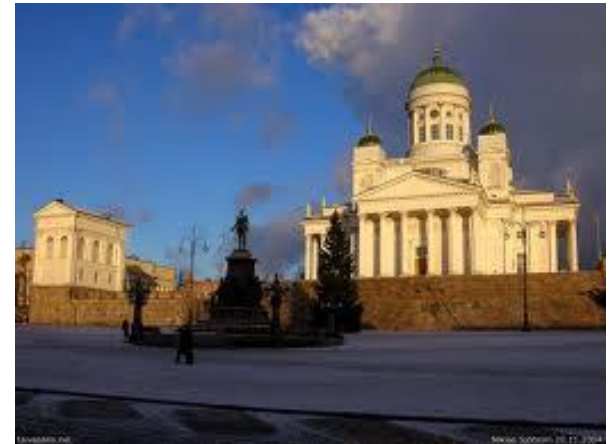
- Total DC sales: 120 MWh
- DC trench length for transport and distribution network (one way): 76 km
- Available DC storage: 38.6 MW
- Cities offering DC: Helsinki, Turku, Heinola, Lahti
- Tampere is planning to offer DC
- DC is competitive in densely built areas where high demand for cooling exists.

Integration of district heating and cooling provides synergy in CHP operation and in overall energy efficiency.

Case Helsinki, Finland

In the city of Helsinki, DHC and electricity are produced in CHP processes on a large scale. The emissions have decreased and the air quality in Helsinki has improved considerably since 1990s – despite the fact that energy production has increased by more than 60%!

- **District heating** covers **93%** of the total heating energy demand in Helsinki
- **More than 90% of DH** energy is produced by **CHP**
- The energy efficiency of CHP exceeds 90%, which is one of the highest in the world
- Despite of **low prices of DH**, Helsinki Energy is highly profitable.
- Helsinki is the third biggest and fastest growing district cooling operation in Europe.
- Data server centers are connected to DHC system to create world's most eco-efficient computer halls.



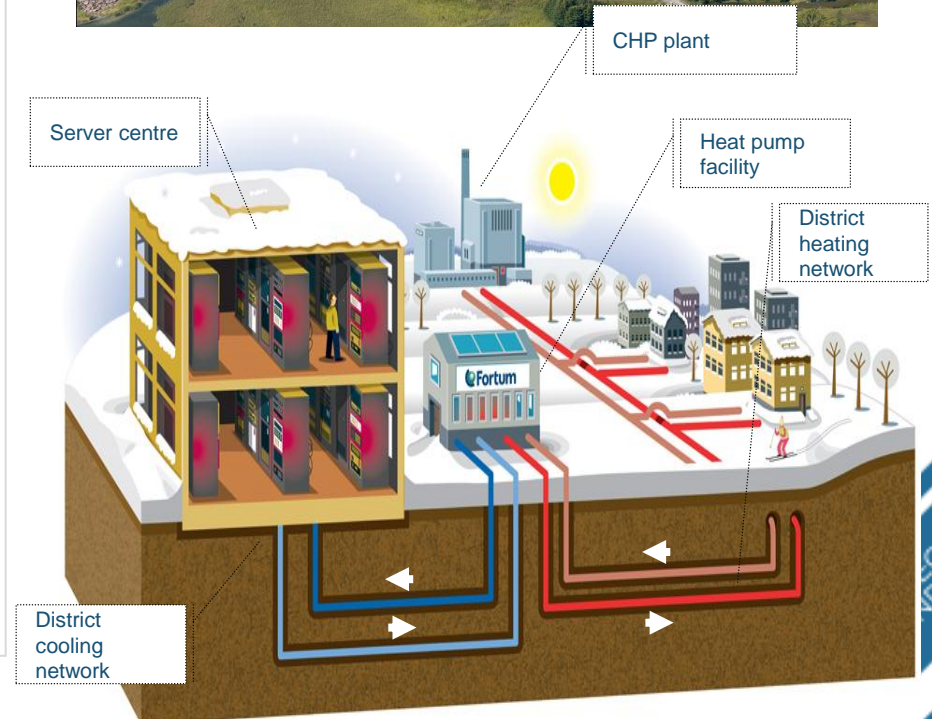
Awards:

- The EU has ranked DHC and CHP in Helsinki as **Best Available Technology** in 2008.
- International Energy Agency IEA has awarded Helsinki for **superior solutions for climate change mitigation** in 2009.
- Euroheat&Power and IEA has awarded Helsinki the **Best District Cooling System** in 2011.

DISTRICT HEATING AND CHP PRODUCTION IN ESPOO, FINLAND (FORTUM CASE)

CO₂ emissions (g CO₂/kWh) per produced district heat reduced by 30% between 1980-2010.

- Additional power generation from Suomenoja CHP (2009)
- New CCGT-plant (Combined Cycle Gas Turbine) as a base load unit
- Substantial decrease in coal (about 30%) and oil usage
- Efficiency in energy production: 90%
- Decrease in CO₂ emissions per produced energy unit: 14%
- Expansion of district heating network
- 2nd longest DH network in Finland: 800 km
- Network efficiency: 93%
- Innovation in cooling to utilize the heat pumps and the waste heat from data server centers (2011)
- CO₂ reduction by 3% in total



Finnish DHC: The **Benchmark** worldwide!



Finnish DHC in 2012

Heat sales (incl. taxes)	2,250 mill €
Sold heat energy	33.6 TWh
Average price of DH (incl. taxes and domestic hot water)	67 €/MWh
Inhabitants in DH apartments	2.7 mill
Market share of district heat	47%
Sold district cooling energy	124 GWh

*The International Energy Agency (IEA 2009) has stated that **Finland is the 'model for the world' in CHP and DHC** with high efficiency and environmental performance.*

Finnish DHC business and expertise is provided by:

- Both private and public DH companies that independently operate in the non-regulated market, which drives them for high operational efficiency and financial sustainability
- Investments made based on the long-term least cost solution
- Several world-class energy consulting companies
- Full range of equipment manufacturers both for energy production and distribution
- Several universities, research institutes and energy companies who invest in R&D activities for CHP and DHC.

