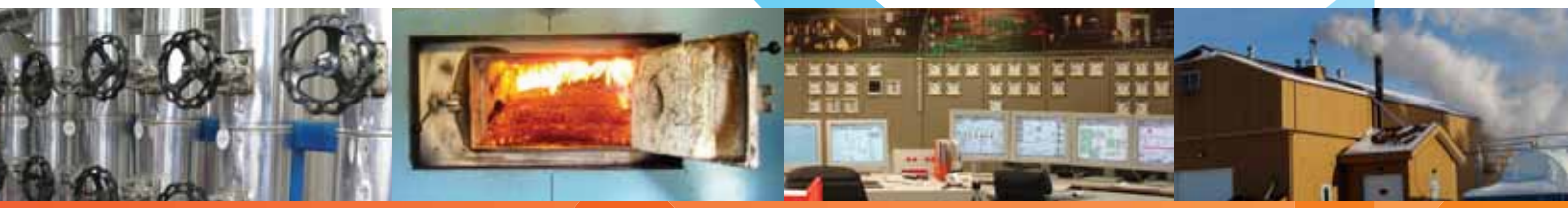
IEA DHC|CHP

International Energy Agency

Implementing Agreement of District Heating and Cooling, including the integration of CHP

Annex IX | 2008-2011



BRINGING COUNTRIES TOGETHER

TO RESEARCH, INNOVATE AND GROW DISTRICT HEATING AND COOLING – INCLUDING CHP

RESEARCH, INNOVATE AND GROW

Countries around the world are looking for ways to reduce greenhouse gases and increase energy security. District heating and cooling (DHC) and combined heat and power (CHP) are energy-efficient, environmentally responsible technologies that make these goals possible.

DHC is especially effective in areas of high building density, making it invaluable in this era of growing urbanisation and increased energy and environmental challenges. As a result, many countries are establishing or renewing their commitment to DHC and CHP and the potential they hold.

DHC/CHP systems worldwide already avoid about half the CO_2 reduction presumed in the Kyoto Protocol.

That is why it is more important than ever for the world's nations to share best practices of DHC and CHP and continue to conduct research that will further improve system operations, efficiencies and resulting benefits. A major international research programme operating under the auspices of the International Energy Agency (IEA) does just that.

Established in 1983, the 'IEA Implementing Agreement on District Heating & Cooling including the integration of CHP' (IEA-DHC) brings countries together to research, innovate and grow district heating and cooling and CHP.[1]

Countries that participate in the IEA-DHC research programme leverage their resources to conduct studies that they may not be able to accomplish on their own. The result is that they gain leading-edge knowledge and insight they can put to work in their communities and cities, supporting their efforts to increase energy efficiency and address climate change.

HOW THE RESEARCH PROJECTS WORK

The IEA-DHC research programme addresses technical as well as policy issues aimed at low environmental impact. We select, manage and publish collaborative co-funded projects, collating and exchanging information on R&D projects between participating countries.

Every three years – a time period we call an Annex – IEA-DHC participant countries can propose research projects, and the programme's Executive Committee decides which of these research projects should be undertaken during the upcoming three-year period.

The selected project teams usually represent at least two countries and are headed by a project manager who coordinates project meetings, conference calls, etc. Each project team also arrange two to three meetings with experts nominated from each country, further sharing knowledge and optimising research results. These experts report progress to their country's Executive Committee representative, and the results of each project are presented at an End-of-Annex seminar. The participant countries also have direct access to all research results. After one year the reports are made available to the public via the IEA-DHC web site.

This brochure provides information about the projects of Annex IX. Just as in past annexes, these projects address issues of current relevance within the DHC/CHP industry. Over the years, we have researched a variety of issues related to distribution systems, operations, customers and benefits of DHC and CHP. [See "DHC/CHP Research Accomplishments (1983-2008)."] More information also is available at www.iea-dhc.org.

WHO PARTICIPATES IN THE IEA-DHC PROGRAMME

IEA-DHC programme control is vested in its Executive Committee, which comprises one official representative from each participating country. Each country can also assign an alternate committee member. The Executive Committee meets twice a year, normally in May and November. We maintain close links with Euroheat & Power and the International District Energy Association.

Our meetings enable us to continue coordinating our research programme as a whole, dealing with technical, financial and organisational issues. We also compare the status of the DHC industry in our respective countries, discuss project progress, prepare for new projects and plan upcoming workshops for sharing information.

The Executive Committee closely cooperates with other IEA programmes. In particular the IEA-DHC is a member of the IEA's Building Coordination Group, resulting in more knowledge sharing and planning of joint activities.

Countries may become a part of the IEA-DHC research programme by paying an annual subscription fee based on the country's gross domestic product. Benefits include

- being a part of the international research program for DHC;
- accessing research valued at US$1 million for each annex, for a fraction of that cost;
- sharing knowledge and networking with countries with diverse DHC/CHP markets and industry maturities;
- related involvement in other international energy groups;
- gaining knowledge from IEA's other building-related programs;
- participation in end-of-annex seminars usually integrated with major DHC conferences; and
- having a global policy voice through the International Energy Agency.

The world may be challenged by climate change, but countries can make district heating and cooling and CHP part of an integrated energy and environmental solution.

The IEA's DHC Implementing Agreement has played a significant role in the DHC/CHP industry's history and will play a vital role in its even brighter future. We encourage you to join us as we bring countries together to research, innovate and grow district heating and cooling – including CHP.

JOIN US!

Please contact the Operating Agent at iea-dhc@senternovem.nl for further information on joining.

[1] The IEA-DHC is one of 42 international collaborative Implementing Agreements. For further information about the IEA Implementing Agreements, consult www.iea.org/techagr.

DHC/CHP

The fundamentals of district heating and cooling are simple but powerful: connect multiple buildings through a hot water, steam and/or chilled-water piping network to environmentally optimal – and often local – energy sources. These can include CHP, municipal or industrial waste heat and renewable energy sources such as biomass, geothermal and solar. Customer buildings use the energy for space heating, domestic hot water and/or air conditioning.

As highlighted in our policy paper, the IEA-DHC programme asserts the following:

- **DHC is competitive with individual building systems.**
- **Modern DHC systems are one of the most potent ways to reduce carbon emissions.**
- **DHC networks create opportunities to increase CHP.**
- **CHP enables power demands to be met efficiently.**
- **Linking buildings with DHC opens up technology options.**
- **DHC provides a flexible infrastructure for transition to renewable fuels.**
- **DHC confers energy security benefits.**

These findings and more are included in our policy paper on DHC and CHP that is available as a pdf download at ***www.iea-dhc.org/0503.html****.*

To view a video about DHC technology and its benefits, visit ***http://tinyurl.com/DHCvideo****.*

ANNEX IX PROJECTS

THE POTENTIAL FOR INCREASED PRIMARY ENERGY EFFICIENCY AND REDUCED CO_2 EMISSIONS BY DHC

Lead Country: Sweden

This project aims to develop a method for calculating and illustrating the environmental and energy-saving benefits of DHC/CHP systems and their customer buildings in a way that can be easily understood by the energy sector and general public. Such a method will be helpful to European Union (EU) member states as they implement the EU's Energy Performance of Buildings Directive (EPBD) requiring them to introduce certificates indicating a building's energy performance.

According to the building standards set forth by the EU, the two main measures of a building's energy performance are to be primary energy usage and levels of carbon dioxide produced. Therefore, this project will develop a calculation method that assesses CO_2 emissions and primary energy usage of DHC and/or CHP systems for the whole actual energy chain, from energy producer to energy consumer. This project will also compile processes and efficiencies of DHC systems, including an analysis of the actual CHP plants. It will also produce a number of case studies showing the potential of DHC compared to the selected reference alternative and the effect further improved systems might have on CO_2 emissions and primary energy usage.

Project Contact:

Mrs. Monica Axell
SP Technical Research Institute of Sweden
Department of Energy Technology
P.O. Box 857, 501 15 Borås
Sweden
monica.axell@sp.se
Tel +46 10 516 55 19

DISTRICT HEATING FOR ENERGY-EFFICIENT BUILDING AREAS

Lead Country: Finland

The objective of this project is to develop strategies for operating district heating systems in residential areas where the homes have improved energy efficiencies and/or are connected to renewable energy sources, either individually or through the network. The project will also study the potential for extending service into new areas previously not considered feasible to supply with district heating, i.e., areas where individual or local heating sources have traditionally been preferred for economical, technical or environmental reasons.

This research is needed to respond to two major challenges facing the district heating industry: (1) the increasing energy efficiency of buildings, which decreases customer heat demand – resulting in higher heat distribution costs and reduced system efficiency; and (2) customers' use of their own renewable heat sources, such as solar energy or heat pumps, which exacerbate the difference between summer and winter loads. In conjunction with this, the project will also evaluate the border line between new district heating and individual building heating schemes and propose design criteria for expanding into new areas.

Project Contact:

Dr. Kari Sipilä
VTT Energy and Pulp & Paper
Energy Systems/Energy Economics
P.O. Box 1000
Fin-02044 VTT
Finland
Kari.Sipila@vtt.fi
Tel +358 20 722 6550

INTERACTION BETWEEN DISTRICT ENERGY AND FUTURE BUILDINGS THAT HAVE STORAGE AND INTERMITTENT SURPLUS ENERGY

Lead Country: Canada

This project will address the question of how district energy can be integrated cost-effectively with low-energy buildings for a net reduction in energy use and greenhouse gas emissions. Methodologies will be developed for estimating the optimum percentage and configurations of low-energy buildings to maintain utility cost-effectiveness in areas remote from a central district energy plant. Research will be conducted in two low-energy-use houses to evaluate control system interactions and establish guidelines for efficient system operation.

The topic is an important one for the future of the district energy industry, as future buildings will consume less energy – due to reduced heat loss, recovery of heat and renewable energy use. With their improved energy costs and performance, more and more of these buildings will be constructed and mixed with conventional buildings. The result will be the creation of areas similar to low-density housing.

Project Contact:

Mr. Tom Onno, President
Gagest Inc.
62 Harold Street
Almonte, ON Canada K0A 1A0
Tel +1 613 256 7966
gagest@sympatico.ca

DISTRIBUTED SOLAR SYSTEMS INTERFACED TO A DISTRICT HEATING SYSTEM THAT HAS SEASONAL STORAGE

Lead Country: Canada

This project will focus on developing design guidelines and methodologies for cost-effectively supplying district energy services to privately funded, small- and medium-scale solar thermal systems, while minimising fossil fuel consumption and peak loads on the network. Experimental data from a house with a high-temperature solar system will be used to establish net consumption and billing for a solar house connected to district energy.

The results of this project will be useful as technology evolves and privately constructed solar thermal buildings become more common. These types of buildings will be constructed in the same areas as conventional buildings, giving the effect of lower density to a district energy utility.

Project Contact:

Mr. Tom Onno, President
Gagest Inc.
62 Harold Street
Almonte, ON Canada K0A 1A0
Tel +1 613 256 7966
gagest@sympatico.ca

POLICIES AND BARRIERS FOR DISTRICT HEATING AND COOLING OUTSIDE EU COUNTRIES

Lead Country: Finland

The project's overall objective is to identify and review barriers to and best practices for the sustainable development of DHC systems. It is hoped that this will provide useful information to facilitate the wider global adoption of DHC that will help increase energy efficiency, mitigate climate change from CO_2 emissions and increase national security of supply. With similar work already being carried out for EU countries, this project will review lessons learned about institutional factors affecting DHC in countries including China, Russia, United States, Canada and selected European countries outside the EU.

The key institutional barriers of DHC development will be identified, with clear examples presented from the various countries. Best practices useful for sustainable DHC development will be established by giving a brief analysis and individual examples from the countries examined.

Project Contact:

Mr. Arto Nuorkivi, D.Sc.
Energy-AN Consulting (EAC)
Asessorintie 9
FI-00690 Helsinki
Finland
Tel +358 41 4568893
energy@nuorkivi.fi

CURRENT PARTICIPATING COUNTRIES AND THEIR REPRESENTATIVES

CANADA
Dr. Chris Snoek
Natural Resources Canada
CANMET Energy Technology Centre
1 Haanel Drive
Ottawa, ON K1A 1M1
CANADA
Tel +1 613 992 1832
csnoek@nrcan.gc.ca

DENMARK
Mr. Lars Gullev (Vice Chairman)
West Copenhagen Heating Transmission Company - VEKS
Roskildevej 175DK 2620 Albertslund
DENMARK
Tel +45 43 66 03 66
lg@veks.dk

FINLAND
Mr. Heikki Kotila
Tekes, Finnish Funding Agency for
Technology and Innovation
P.O. Box 69
FI-00101 Helsinki
FINLAND
Tel +358 106055673
Mobile: +358 505577673
Heikki.Kotila@Tekes.fi

KOREA
Mr. Lee, Hoon
Korea District Heating Corp.
District Heating Technology Research Institute
732, Suseo-dong, Gangnam-gu
Seoul 135-886
SOUTH KOREA
Tel +82 2 2040 1200
leehoon@kdhc.co.kr

THE NETHERLANDS
Mr. Arno Sijben
NUON District Heating
PO BOX 9039
6800 EZ Arnhem
THE NETHERLANDS
Tel +31 26 844 2117
Mobile: +31 6 4205 6099
ajw.sijben@home.nl

NORWAY
Prof. Rolf Ulseth
Norwegian University of Science and Technology
Department of Energy and Process Engineering
Kolbjorn Hejes vei 1b
N-7491 Trondheim
NORWAY
Tel +47 73 593862
rolf.ulseth@ntnu.no

SWEDEN
Mr. Anders Johansson
Swedish Energy Agency
Box 310
631 04 Eskilstuna
SWEDEN
Tel +4616 544 22 86
anders.johansson@energimyndigheten.se

UNITED KINGDOM
Dr. Robin Wiltshire (Chairman)
BRE
Garston, Watford
WD25 9XX
UNITED KINGDOM
Tel +44 1923 664534
WiltshireR@bre.co.uk

UNITED STATES OF AMERICA
Mr. Douglas Kaempf
U.S. Department of Energy
Technologies MS: EE-2f
1000 Independence Ave. S.W.
Washington, DC 20585
UNITED STATES
Tel +1 202 586 5264
douglas.kaempf@ee.doe.gov

IEA SECRETARIAT
Ms. Carrie Pottinger
Program Manager Energy
Technology R&D Networks
9, rue de la Federation
75739 Paris, Cedex 15
FRANCE
Tel +33 1 40 57 67 61
carrie.pottinger@iea.org

OPERATING AGENT
Ms. Inge Kraft
SenterNovem
Swentiboldstraat 21
P.O. Box 17
6137 AE Sittard
THE NETHERLANDS
Tel +31 46 420 2299
iea-dhc@senternovem.nl

Please contact the Operating Agent for more information.

DHC/CHP RESEARCH ACCOMPLISHMENTS (1983-2008)

DISTRIBUTION

- New materials and construction techniques to improve quality and life of district heating pipes
- District heating distribution in areas with low heat demand density
- Cost benefits and long-term behavior of new all-plastic piping systems
- Handbook on plastic pipe systems for district heating
- Cost-effective and low-cost district heating networks
- Fatigue analysis of district heating systems
- Advanced transmission fluids
- CFC-free plastic jacket pipes for district heating
- Horizontal drilling and district heating network operation
- How cellular gases influence insulation of district heating pipes and competitiveness of district energy
- Strategies to manage heat losses

OPERATIONS

- Optimisation of district heating operating temperatures
- Appraisal of benefits of low-temperature district heating
- Monitoring and analysing temperature variations in district heating systems
- Managing hydraulic system in district heating
- Efficient substation installations
- Review of European and North American water treatment practices
- Biofouling and microbiologically influenced corrosion in district heating networks
- Design and operation of ice slurry-based district cooling systems
- Supervision of district heating networks
- Advanced district heating production technologies
- Thermal energy from refuse analysis computer program
- Low-temperature heat sources
- Optimising cool thermal storage and distribution
- Absorption refrigeration with ice thermal storage
- Two-step decision and optimisation model for centralised or decentralised thermal storage in district cooling systems
- Dynamic heat storage optimisation and demand-size management
- Improvement of operational differences in district heating systems

COMBINED HEAT AND POWER

- Improved cogeneration and heat utilisation techniques in district heating networks
- Balancing production and demand of combined heat and power
- Design guide for integrating district cooling and combined heat and power
- Comparing distributed CHP/DH and large-scale CHP/DH

CUSTOMERS

- Assessing actual annual energy efficiency of building-scale cooling systems
- Consumer heating system simulation (CHESS)
- Optimising district heating system by maximising building system temperature differences
- Potential telemetry technology for district heating

HEAT METERS

- Guidelines for converting building heating systems for hot water district heating
- District heating and cooling building connection handbooks

BENEFITS

- Environmental benefits of district heating and cooling
- Promotion and recognition of district heating and cooling and combined heat and power benefits in greenhouse gas policy and trading programs
- Promotional manual for district energy systems

ABOUT THE INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA) is an intergovernmental organisation that serves as energy policy advisor to 28 member countries in their effort to ensure reliable, affordable and clean energy for their citizens. Founded during the oil crisis of 1973-1974, the IEA was initially established to coordinate measures in times of oil supply emergencies.

As energy markets have changed, so has the IEA. Its mandate has broadened to incorporate the "Three E's" of balanced energy policy making: energy security, economic development and environmental protection. Current work focuses on climate change policies, market reform, energy technology collaboration and outreach to the rest of the world, especially major consumers and producers of energy like China, India, Russia and the OPEC countries.

With a staff of nearly 200 who are mainly energy experts and statisticians from its 28 member countries, the IEA conducts a broad program of energy research, data compilation, publications and public dissemination of the latest energy policy analysis and recommendations on good practices.

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International Energy Agency
9, rue de la Federation
75739 Paris, Cedex 15
FRANCE
Tel +33 1 40 57 67 61
www.iea-dhc.org

The IEA-DHC, also known as the Implementing Agreement on District Heating and Cooling, Including the Integration of Combined Heat and Power, functions within a framework created by the International Energy Agency (IEA). Views, findings and publications of the IEA-DHC do not necessarily represent the views or policies of the IEA Secretariat or of all its individual member countries.

IEA-DHC thanks and acknowledges the following individuals and organisations for the use of these photographs:
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2009.08