IEA DHC|CHP

International Energy Agency

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

Annex X | 2011-2014

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 X. 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 (1983-2011)."] 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 X PROJECTS

IMPROVED MAINTENANCE STRATEGIES FOR DISTRICT HEATING PIPE-LINES

Lead Country: Sweden

The main goals of this project are to increase the service life of district heating pipes, reduce costs for operation and network installation, and enable networks to be more easily managed and optimised. Both district heating suppliers and network owners can benefit from the project outcomes.

It is planned to develop tools which determine the current condition of pre-insulated pipes already in operation and allow a forecast to be made of their remaining technical life and likely degradation. It is envisaged that this will bring about a marked improvement in risk management for DH companies connected to the distribution network.

Information that will be collected and used during the course of this project to determine further courses of action includes forecast operating parameters of the network (e.g. transport fluid temperatures and energy demands), requirements of robustness and redundancy, as well as costs for energy loss, maintenance and reconstruction.

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ECONOMIC AND DESIGN OPTIMIZATION IN INTEGRATING RENEWABLE ENERGY AND WASTE HEAT WITH DISTRICT ENERGY SYSTEMS

Lead Country: USA

The objective of this project is to facilitate an increased use of renewable energy and waste heat in district energy systems.

The project will provide a framework for evaluating options for combining renewable and waste heat sources with existing or potential new district energy systems. Economic, design and operational issues will be included in this framework.

For example, key design issues that will need to be addressed include the impact of supply and return temperatures on the ability to access available energy sources.

To achieve the project goal the current state-of-the-art for relevant components and software will be assessed and recommendations for improvements will be developed.

By using the results from this project, customers and businesses will be able to devise strategies concerning renewable energy and waste heat in district heating networks.

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TOWARDS 4TH GENERATION DH: EXPERIENCES WITH AND POTENTIAL OF LOW TEMPERATURE DH

Lead Country: Denmark

Fourth Generation District Heating (4GDH) implies very low temperature heating systems. The impact of such systems is to extend locally available sources of useful energy, including renewable and waste heat sources. This project will therefore have a natural synergy with the above project concerning integration of renewables.

The overall goal is to bring experience, knowledge and solutions for Fourth Generation District Heating (4GDH) to a level where they are ready to be implemented widely.

The main objective of the project is to analyse lessons learned from early examples of low temperature (50°-55°C) district heating schemes already serving new-build high-energy-performance buildings. Such lessons include how effective comfort levels have been maintained and how the legionella risk has been addressed. This will enable potential for replication, in-country and internationally, to be assessed.

The practicality of extending the scope of 4GDH to existing buildings by lowering the supply temperature of more conventional district heating systems will be examined.

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DEVELOPMENT OF UNIVERSAL CALCULATION MODEL AND CALCULATION TOOL FOR PRIMARY ENERGY FACTORS AND CO EQUIVALENTS IN DISTRICT HEATING AND COOLING INCLUDING CHP

Lead Country: Norway

The objective of this project is to develop a universal, well documented and transparent method and calculation tool to determine the renewable and non-renewable Primary Energy Factors (PEF) and the greenhouse gas (GHG) emissions factors for district heating and cooling (DHC) including combined heat and power (CHP).

The method will be applied by calculating the primary energy factors and greenhouse gas emissions as CO2 equivalents for selected case studies. The case studies will include both low temperature district heating and areas with low heating/cooling demand.

The method will be implemented in a calculation tool for International Energy Agency (IEA) DHC members that could be made available on the internet.

The overall aim is to illustrate the environmental benefits of DHC in terms of PEF and GHG reductions in a transparent and understandable way. The tool should provide a useful means for a quick and precise assessment of PEF and GHG indicators for specific DHC systems.

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DHC/CHP RESEARCH ACCOMPLISHMENTS (1983-2011)

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.

IEA DHC|CHP

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