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All applications

In alphabetical order of the name of the scheme/system.

Name & location of the system + Logo(s)	Short Description
Aberdeen Heat & Power District Energy Aberdeen, North East Scotland, **Aberdeen, UK** ABERDEEN CITY COUNCIL Aberdeen Heat & Power PDF Summary	Aberdeen Heat & Power Ltd (AHP) is a 'not for profit' company that was set up by Aberdeen City Council in 2002 to develop and operate district heating and CHP systems in the city. The network has grown through implementation of three principal projects and now supplies around 1750 flats in multi story blocks and 9 public buildings. Carbon emissions from these buildings have reduced by 45% and typical fuel costs to tenants have been reduced by 50% over the previous heating systems. Customer satisfaction surveys have indicated that tenants are very satisfied. The schemes have received three high profile awards within Scotland and the UK. AHP continues to develop their District Heating network and has recently completed installing a £1m extension of underground mains towards the City Centre with the aim of providing heat to the Council's Town House and other public buildings en-route including a health campus. AHP's not-for-profit community-based governance structure is unique within the UK. AHP is exploring opportunities for greater fuel diversity from renewable sources including biomass. Furthermore, AHP and the Council have entered (14 May 2013) a partnership to install a fuel cell fed by bio-gas from a landfill site. The fuel cell will provide heat into the network, electricity and hydrogen for the Council's vehicle fleet.
Bio-oil production connected to existing DH and CHP **Joensuu, Finland** JOENSUU Fortum PDF Summary	Bio-oil production in city of Joensuu is new type of trigeneration concept that is added to existing district heating and CHP. It is a great example of expansion of district energy business to new markets and areas beyond traditional district energy scheme. Bio-oil production create another way to utilize and capitalize local biomass that otherwise would be unused. It provides profitable business opportunity for local district energy company as well as reduces fossil supply, cut CO2 emissions and decrease imported fuel dependency. It also increases utilization of existing district energy system and CHP plant. PRF of district heating in Joensuu is equal to zero. District heat production is dominated by CHP (94 %) that is primarily fuelled by local biomass and also by local peat. Share of local fuels in Joensuu district energy system is 95 % and it will be 100 % next year. Current renewable share is 65 %. Current CO2 emission factor (2012) is 103 g/kWh and current yearly CO2 reduction by DH is about 120 000 tons. Bio-oil will lower CO2 emission factor close to zero by cutting yearly greenhouse gas emissions about 60 000 tons. Overall yearly CO2 reduction by trigeneration and entire district energy system in Joensuu will be 180 000 tons. SO2 emissions will be reduced more than 300 tons by bio-oil. The productivity of DH and CHP is enhanced but bio-oil production has even larger positive impact on other local business like forestry and harvesting. Biomass chain for bio-oil production employs about 50 people. Alternative for bio-oil would be imported fuels when money would go out of the area and country. District energy system with new type of trigeneration provides the best heating option for DH customers, profitable business for Fortum and a lot of jobs around the area as well as enables to keep fuel expenditures in own county. Joensuu is a great example how district energy enables sustainable energy solution and generate welfare for entire area. Joensuu plant is the first industrial scale bio-oil production that is integrated to CHP in the world. However, this type of bio-oil production can be executed anywhere in the world. New trigeneration concept enables expansion of district energy to new sectors, markets and areas.

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Bromölla district heating **Bromölla, Sweden** Bromölla kommun Bromölla Energi & Vatten PDF Summary	By an ambitious environmental plan and a cooperation between local industries and the municipality we have created a win-win district heating scheme. We have substituted fossil oil equivalent to 50GWh by local surplus heat from a local pulp and paper industry. As our back-up we use renewable biodiesel. We provide secure, inexpensive and climate friendly heating to half the population of Bromölla. We have replaced import of fossil oil by local energy and this way created new local jobs. Bromölla is a small, low density populated town, quite similar to an American small town, without a dense town center.
CHP for Medias Hospital Medias city Sibiu County **Medias, Romania** TAI HospMed Project s.r.l. PDF Summary	The Microturbine produces in cogeneration system high-efficiency power (0.4/50 Hz) and heat from exhaust gas using natural gas as fuel. In the case of natural gas supplied from the distribution networks, it is necessary to mount a compressor downstream of the microturbine to ensure the minimum required pressure of 5.2 bar. Natural gas supply installation consists of o sectioning valve (with sphere, slide pinion valve, or butterfly) # 8.01 which separates the gas supply installation of the microturbine, of the main supply column of the existing central heating boilers. As a safety feature in the case of exceeding certain parameters of installations downstream of the microturbine (SRH- exhaust gas heat exchanger/water), an electromagnetic valve is being mounted #8.17, which is controlled by a PLC (Programmable Logic Controller). The gases are filtered by filter # 8.06. and their pressure adjusted by the locking device regulator and overpressure device # 8.00. Flow metering is made via turbine meter # 8.07 and of PTZ volume corrector # 8.08. Natural gas are thus vacuumed into the gas compressor # 8.09 at a pressure of 100 mbar input up to 110 mbar, and are repressed at a pressure of 5.2 bar. As a safety element downstream of the compressor is mounted a purge valve # 8.19 to eliminate overpressures that may arise from sequences of stop / start (pick shaving). The gases resulting from the combustion of the microturbine #CHP-MT, are discharged through the exhaust duct, damper sense # 1.01, and through the by-pass equipped with butterfly valve #1.03 to be directly in the air on the chimney # 1.08 (in the case that is desired the exclusive production of electricity, in certain sequences of stop/start, and when temperature and /or the pressure of the SRH heat exchangers exceed the set parameteres), to be passed through the heat exchanger #1.04 thus ceding the heat of the water flowing through it. The water's temperature for flow/return, in the heat exchanger is 90/70 degrees Celsius.
Con Edison Steam System County of Manhattan **New York, USA**	For 130 years, Con Edison has had the privilege of being the energy service of choice to many of New York's most prominent and unique properties. The Company's plan is to continue to provide Steam Service to customers by maintaining the current high reliability and operational excellence on production and distribution, incorporating technological advancements into the system, optimizing system efficiency, pursuing new opportunities for productivity, performance improvements, and cost reductions, and by bringing additional value to the customer base.

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conEdison PDF Summary	The Con Edison Steam System has earned several prestigious awards and recognition in recent years which include the USEPA Energy Star Combined Heat and Power award for East River Stations' Units 1&2 for significant energy savings (2009) and two IDEA Awards for "Best System of the Year" in 2000 and 2007. In addition, the Company has received recognition for carbon disclosure and reduction. The Con Edison Steam System, being the producer of steam and electric in the Company, was a major contributor to these reductions. In 2011, Con Edison placed first among utilities in the S&P 500 Carbon Disclosure Leadership Index, was the only utility listed in the S&P 500 Carbon Performance Leadership Index, and was #1 Utility in Newsweek Green Rankings. Con Edison's steam facilities are operated and actively monitored to reduce regulated pollutant emissions. A significant district energy benefit of this remote and controlled emission is the removal of any air quality issues for development or renovation. Situating a stack and accounting for dispersion of flue gases for onsite boilers can restrict both the property served and any surrounding development. In Manhattan, this is a significant concern. By using steam, customers benefit from better building aesthetics (e.g. no flues, cleaner facades), there's more rentable space for building owners, there are no stationary engineers or licensed boiler operators required for high-pressure operations, and building owners avoid boiler operating expenses (labor, service contracts, chemical costs, water treatment, and maintenance). Funds that would be diverted to these functions can be directed toward tenant service instead. In 2012, 64% of steam supplied by Con Edison was produced using cogeneration technology, which resulted in the avoidance of 430,000 tons of CO2 that would have been otherwise produced from conventional electric generation and non-cogenerated steam generation.
Co-Op City CHP Plant Bronx, New York, USA RIVERBAY AT CO-OP CITY PDF Summary	The Co-Op City complex is a housing cooperative located in Bronx, NY, originally constructed in 1973. The complex includes 15,372 units located in over 35 buildings, and houses approximately 60,000 residents. In 2007, the cooperative board began the process of upgrading the site's outdated central heating plant to a combined heat and power plant meeting the facility's electrical and thermal needs, and allowing for operation independent of the local utility system. The result was a flexible, 40 MW design utilizing a high pressure boiler and two combustion turbines with heat recovery steam generators to supply steam to a turbine generator whose exhaust would meet the site's thermal load requirements. The inclusion of steam turbine-driven chillers in the design would allow the system to operate with a high annual capacity factor. This system, which was built leveraging a $2 million incentive from the New York State Energy Research and Development Authority (NYSERDA), is one of the pioneer micro grid applications in the New York City Metro Area. The CHP plant provides much needed energy generation reliability to the residents, and allowed the complex to recently weather Hurricane Sandy with minimal disruption. In addition to improving energy efficiency and system reliability, the Co-Op City CHP plant has reduced the cooperative's greenhouse gas emissions from purchased electricity and fuel oil consumption by 143,105 metric tons per year, or over 50%.
Combined Heat & Power (CHP) System College Station, **Texas, USA** TEXAS A&M UNIVERSITY UTILITIES & ENERGY SERVICES	The Texas A&M University (TAMU) Utilities & Energy Services (UES) Department produces, delivers, and manages utilities and energy serving close to 24 million GSF on the Texas A&M University campus. UES determines purchased energy requirements, manages extensive utility production and delivery systems for electricity, cooling, heating, water, and other services, manages automation systems to reliably and efficiently regulate building conditions, meters and recovers all cost for utilities and energy services, while ensuring customer needs are effectively met. Other services provided include solid waste and recycling management, domestic water production and delivery, and operation of two wastewater treatment facilities. Texas A&M University (TAMU) is planning for significant campus growth and conducted an evaluation of existing systems and

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PDF Summary	expansion requirements. This study reviewed campus utility infrastructure including chilled water, heating hot water, steam, power generation, electric distribution, domestic hot water, wastewater, water, and storm drainage. TAMU recently implemented a CHP upgrade stemming from this study that included a 32.5 MW gas turbine coupled to a 210klb/hr high pressure heat recovery steam generator. The HRSG sends steam to a new 11 MW extraction/back pressure steam turbine whose extraction steam is used for domestic hot water and campus heating. This $70M project was funded partially by a $10M grant from the US Department of Energy. TAMU was targeting $500,000 in monthly savings. Actual savings in the first month of operation exceeded $1M, and is able to go toward teaching, research, and other functions on campus. The TAMU CHP System was recently awarded a 2013 ENERGY STAR® CHP Award by the US Environmental Protection Agency. These upgrades are coupled with a 40% demand side reduction in energy consumption per gross square foot since 2002 and result in $140M in savings which has provided measurable improvement in safety, reliability, efficiency and customer service to the 50,000 students on the TAMU campus. Texas A&M UES is clearly at the forefront of energy efficiency from demand and supply sides.
Cornell Combined Heat and Power Project Ithaca **New York, USA** PDF Summary	In 2009, Cornell University released the Climate Action Plan, which sets a goal of reducing campus net greenhouse gas emissions to zero by 2050. One of the biggest roadblocks to climate neutrality is coal. Historically, Cornell University burned nearly 60,000 metric tons of coal for campus heating. Cornell's Beyond Coal Initiative was launched in 2010. The key component in the success of this initiative is the new Combined Heat and Power Plant, which achieved a total operational efficiency of supplied heat and power to the campus of nearly 80% for fiscal year 2012. The results of integrating CHP and eliminating coal are (1) an overall reduction in greenhouse gas emissions of 55,000 metric tons/year; (2) Kyoto Protocol commitments are exceeded, and (3) significant pollutant reductions are achieved by no longer combusting 60,000 metric tons per year of coal. The easier and cheaper way would have been to install conventional natural gas boilers, continue using coal, and buy most of our electricity from the grid. However, Cornell decided that the cost premium over standard practices was the right thing to do and demonstrates a real commitment to promoting sustainability. Combined heat and power (CHP) is the simultaneous production of electricity and the utilization of "waste" heat for heating requirements. The project is based on two new dual fuel Gas Turbine Generators and natural gas duct fired Heat Recovery Steam Generators for the purpose of supplying the Cornell University (Ithaca, New York) campus with electricity and heating steam. The electrical production displaces electricity previously purchased from the local utility company and the heating steam production displaces steam produced by existing boilers. The project is wholly owned, and operated by Cornell. The project produces 80% of campus electrical power. The project was more complex than installing some new equipment. A dedicated (Cornell owned) 3.2 mile long gas line was constructed to meet natural gas needs. In addition, a major renewal of the electrical substation was needed, increasing the capacity of the substation from 50 MVA to 78 MVA. The Central Energy Plant provides all the centrally produced power and district energy services such as steam and chilled water. The plant serves approximately 150 buildings (13 million sqft) of the central campus and annually produces 215,000,000 killowatt-hrs of electricity, 1,000,000 thousand pounds of steam, and 45,000,000 ton-hrs of chilled water.
Decentralized District Heating and Cooling system (DHC) **Helsinki, Finland** HELSINKI	Helsingin Energia's DHC smart city- solution combines CHP, district heating and district cooling in the most energy-efficient way in the world. Helsingin Energia is business based and profitable energy company not subsidized by the municipality. We promote end-use energy efficiency by monitoring, reporting and providing customer guidance, and help them to make cost- and energy-efficient choices and use energy wisely. During the year 2012, we updated our strategy and action plan towards a CO2- neutral energy production. Helsinki Energy's DHC and CHP infrastructure consists of four CHP plants. The system is supported and diversified by harnessing waste heat accumulated along the energy chain. The DHC system enables the production of electricity corresponding double the amount of the need of Helsinki and

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HELSINGIN ENERGIA PDF Summary	simultaneously Helsingin Energia can supply over 90 % of the need of heat and produce cooling. Helsingin Energia manages an efficient district energy supply with energy storage and by optimising the energy use of our customers. We also aim to maximise the use of our system wherever there is need for heating or cooling. Our DHC system enables our customer to gain a LEED certified way of housing and living. The operational reliability and guarantee of delivery of the DHC system in Helsinki is high. The energy production of Helsingin Energia is increasing while carbon dioxide emissions are falling. Future energy solutions are constantly being planned and tested. Interaction with our customers and energy end-users is one of the key elements of our operational principles.
District cooling system in Šaleška Valley Velenje, Saleska, Slovenia PDF Summary	The subject of our application is a district cooling system in the city of Velenje, Slovenia. There the cooling energy is produced in absorption chillers. The heat for their operation is supplied from an existing district heating system. In it the supply temperatures are sufficient to power the absorption chillers through the whole year, due to industry consumers. The heat source for the district heating system is surplus heat from a power plant. The system is facing problems with low energy and economic performance in the summer months due to relative low heat demands by consumers. As a consequence an opportunity was recognized to use the heat from the distribution network to power the absorption chillers and by doing so improving the distribution network performance, as well as producing cooling energy from surplus energy, instead of using the electric energy for the electro-compressor technology. Thus there are several direct and indirect benefits to the community in the area where the system is in operation.
District Energy St. Paul **Saint Paul, USA** CELEBRATING 30 YEARS DISTRICT ENERGY ST. PAUL™ PDF Summary	Integration is the hallmark of District Energy St. Paul's system. From its inception, District Energy St. Paul envisioned a future that used district heating and cooling infrastructure to integrate a variety of local, renewable energy sources and technologies. District Energy has doubled the amount of buildings served from 1985, yet is producing less carbon thanks to the incorporation of biomass, CHP, and solar. Our customers benefit from a modern, integrated system offering fuel flexibility, advantages for green certifications, and renewable energy and energy conservation technologies. The heating system serves more than 32 million square feet of building space and operates at twice the efficiency of the former steam district heating system while using the same amount of fuel. Our system has achieved notable reductions of greenhouse gas and other criteria pollutants resulting from our drive to maximize renewable fuels, increase fuel flexibility and fully integrate efficiency. The carbon footprint from our high-performance solar thermal installation resulted in carbon emission reductions of approximately 460,000 pounds in 2012. Our combined heat and power plant has reduced sulfur dioxide and particulate emissions, carbon dioxide emissions, and the use of oil, natural gas and coal. Beginning in 1993, the integration of district cooling significantly reduced the use of chlorofluorocarbon (CFC) refrigerants in customer buildings. We are proud that we offer environmental benefits in addition to fuels and technologies providing a platform to achieve rate stability. District Energy has fully integrated our own large-scale solar thermal installation into the district heating system, integrated a customer's solar thermal installation into the heating system loop, enhanced the data collection and metering components of the system, installed fiber optic lines in much of the distribution system and developed a Delta T program for customers to manage

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	efficiency. Modernization has not been limited to the pursuit of system enhancements and energy efficiency improvements. Communication and community engagement has changed deepen the conversation with customers, community members and stakeholders about global climate change and the ways we can minimize our energy footprint. Without resting on our laurels, we continue to evaluate opportunities including seasonal storage of hot and chilled water, flue gas capture and reuse, and the integration of energy islands.
Drammen Fjernvarme District Heating **Drammen, Norway** PDF Summary	UK firm Star Refrigeration has launched a groundbreaking renewable energy heating system, which will heat homes and businesses across an entire city in Norway. The Glasgow-based cooling solutions specialist, with Norwegian refrigeration partner Norsk Kulde, has just sold its first Neatpump to the city of Drammen. The system will supply hot water pumped through a network of underground pipes for heating over 6,000 homes and businesses in the city. Star's Neatpump will provide up to 15MegaWatts of heat for Drammen, a community of 60,000 on the Drammen Fjord near Oslo. Due to be completed in January 2011, it will be the world's largest district-wide natural heat pump system. It also marks the largest export order in Stars 40-year history as one of the UK's leading industrial refrigeration engineering companies. Star's Neatpump is a renewable energy heat pump that extracts heat from seawater, air or any industrial waste stream, such as air conditioning or large scale cooling processes. This waste heat is captures, compressed, boosted and recycled to provide hot water at up to 90?C for heating buildings on a massive scale. Heat pumps are becoming increasingly popular across Europe as the heat they deliver far exceeds the energy they consume. District heating sees heat generated in a centralised location distributed for residential and commercial heating. Star's Neatpump in Drammen, Norway District heat pumps already exist in Scandinavia and across Eastern and Central Europe, providing higher efficiencies than traditional localised boilers. However, many of these first generation systems rely on Hydro Fluorocarbon (HFC) refrigerants, which are thousands of times more potent as global warming gases than carbon dioxide when emitted to the atmosphere. Unlike its forerunners, Star's Neatpump system does not require any synthetic global warming gases (HFCs). It operates using ammonia, a naturally occurring refrigerant that has zero ozone depletion potential. Ammonia has never been used in a high temperature heat pump allocation of this type. Electricity for the Drammen system is provided by hydropower, making the Neatpump's carbon emissions virtually zero.
Dubai Healthcare City Treated Sewage Effluent-Reverse Osmosis Plant EMPOWER –District Cooling Plant **Dubai, UAE**	The major challenges that face any district cooling provider are to operate the chiller systems with the highest achievable efficiency, minimize water wastage and reduce the cost of operation. This documentation was prepared to demonstrate how the conversion from the usage of potable or domestic water in district cooling plants into alternative water sources (specifically Treated Sewage Effluent) can be achieved and showcases this accomplishment with the integration of reverse osmosis technology. The financial savings incurred from this approach are also demonstrated. It is important to define that "domestic water" is the potable water produced by the local governmental utility DEWA (Dubai Electricity and water authority) using the process of sea water desalination. This water is distributed throughout the city of Dubai for the domestic use. On the other hand, "TSE", treated sewage effluent is the sewage water recycled by the local Municipality

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PDF Summary	DM (Dubai Municipality) through a Sewage Treatment Plant. TSE water is primarily used by the local municipality for irrigation. The key concern involving the use of alternative water sources other than domestic water such as grey water or treated sewage effluent is that it is not advised to be used directly in the District Cooling System unless it is treated due to the high risk associated with using it in the raw form. The risk arises from the fact that this type of water contains high concentration of contaminants and high biological fouling potential which would degrade the performance of the heat exchange equipment. Several simulation calculations were done to provide a range of alternatives to the use of domestic water in the cooling towers of a district cooling plant. These calculations helped to narrow down the options and provided a guide to select the optimum combination of Treated sewage effluent water mixed with treated TSE through reverse osmosis technology. As a result of this analysis, the optimum approach was chosen which uses the permeate water from the reverse osmosis plant and blended it with enough quantity of pre-filtered treated sewage effluent to make it equivalent to domestic water in chemical properties. By following this approach, several goals were achieved. - Eliminated the use of valuable domestic water from the district cooling plant. - Reduced the risk potential of the treated sewage effluent. - Implemented an economically viable solution.
ENERGICENTRALEN **Bjerringbro, Viborg Kommune** **Bjerringbro, Denmark** PDF Summary	Energicentralen: a jointly owned district energy plant to the benefit of citizens and industry See video: https://www.youtube.com/watch?v=P6E_D3hBnj0&feature=youtu.be Improvements of the local environment and a positive effect on the climate due to reduced CO2 emissions are two important results of this project created by an equal partnership between Grundfos and Bjerringbro Varmeværk (DH Company). A third result is a reduction of the annual fuel costs. Energicentralen is the jointly owned energy station hosting five compressors to co-generate heating and cooling. It is linked to a nearby Aquifer Thermal Energy Storage (ATES) used as a seasonal storage. Energicentralen is also connected to Grundfos' machinery via a new cooling network and to the CHP-plant and the DH-station via an existing heat transmission line. The two partners have shared - one to one - the total investment of 4.48 mill. €. Also the savings achieved are equally shared so that each partner will save 200,000 € annually. The pay back period will be less than 15 years and the annual reduction of CO2 emission will be about 3,700 tons. The plant performs as follows: • 3,500 MWh of cooling based on 9° C groundwater will during four months in the summer be supplied by from the ATES and will cover the full demand in the machinery connected. • 10,500 MWh of cooling will during 8 months be supplied by the cooling machinery in Energicentralen, which will cover the full cooling demand and the re-cooling of the groundwater. • 13,400 MWh of district heating will be produced yearly by heat from the cooling machines. Bjerringbro Varmeværk was founded in 1959 and today has 2,100 consumers (buildings) with an annual production of 90,000 MWh. The new plant will cover some 15% of the annual demand. The original boiler station from 1959 was designed for operation on oil but has later on been converted to operate on natural gas. In 1994 a CHP-plant based on natural gas engines was added, and in order to achieve flexibility between power and heat generation, a heat storage tank was installed. In recent years, heat pumps were installed to cool and condense the water in the flue gases in order to increase the heat production. The project demonstrates that the innovative solution was created by virtue of the open and equal cooperation between the two partners. It turned out quite early in the planning process that each of them alone was not able to realise savings to the same extent as achieved

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EnergyPLAN - Advanced Energy System Analysis Model **www.EnergyPLAN.eu** PDF Summary	The EnergyPLAN model is an advanced energy systems analysis model, which allows for the analysis of complete energy systems of a town, a country or the whole of Europe including future sustainable energy systems. The model has been used to identify the role of district heating and cooling in present and future energy systems showing the benefits of including district energy. The EnergyPLAN model has among others been used to make the following studies: Heat Road Map Europe (Pre-study-I) (2012) showing how Europe would benefit from increasing the share of District heating from the current level of 12% to 50%. Decrease in CO2 emission and annual cost and at the same time create 120.000 jobs. Heat Plan Denmark (2008 & 2020) showing how district heating plays a major role not only in the current energy supply but also in a sustainable energy future in which the space heating of the buildings have been decrease by 75%. Heat startegies for Towns/municiplaties (E.g. Aalborg and Frederikshavn) showing the inportance of district heating in the transformation towards sustainable energy systems. Towns like Aalborg and Fredeikshavn has made policital decisions on expanding district heating and such palns are being implemented. Heat Plan Denmark has been adopted into the official strategies of the implementation of the Danish Energy future. Heat Road Map Europe is being used to influence the European strategies on district heating and cooling The EnergyPLAN model is a freeware which can be acessed from: www. EnergyPLAN.eu
Integrated District Cooling Plant (IDCP) The Pearl Qatar **Doha, Qatar** قطر كوول QATAR COOL PDF Summary	Qatar District Cooling Company "Qatar Cool" was incorporated in November 2003 as a Qatari Closed Stock Company. The company was set up with the intention of providing district-cooling services to the public, commercial and industrial sectors of Qatar. The company's first plant in West Bay has a capacity of 30,000 Ton of Refrigeration, began operations in September 2006, the second plant in West Bay, with a capacity of 37,000 Ton of Refrigeration started operations in October 2009. Both Plants are providing cooling service to almost 50% of existing towers in West Bay of Doha. Qatar Cool's Integrated District Cooling Plant on The Pearl-Qatar was inaugurated in November 2010 with a capacity of 130,000 Tons of Refrigeration, which made it the main eco-friendly technology on the island and the largest district cooling plant in the world. The Plant has 52 centrifugal chillers arranged in 26 models in series counter flow arrangement forming a 5,000 Ton of Refrigeration train. It has 26 horizontal double suction condenser water pumps (Constant Flow) with a rate of 7,500 US gallons per minute. The primary power system is supplied with an 11kV multi – feeder supply, 11kV-3.3kV step- down transformers to serve the chillers. The remainder of the system is supplied with 415 volts. IDCP is operated, controlled and monitored by a SCADA system. Also, in addition to the usage of the fresh water the plant is equipped to use the Treated Sewage Effluent (TSE) water. Moreover, IDCP cooling towers blow down water could be discharged to the sea or the sewer system or used for irrigation purposes. The total area served is more than 3.9 million square meters (41 million square feet), occupied by 45,000 residents more than 100 towers that include approximately 15,000 apartments and 1,500 villas.

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JKP 'Beogradske elektrane' **Belgrade, Serbia** Beogradske elektrane PUBLIC UTILITY COMPANY OF BELGRADE PDF Summary	Before heating season 2009/10. PUC "Beogradske elektrane" burns up to 10.000 tons of coal per year. Besides high emissions of SO2, CO, NOx and particulates there is a serious problem of ground contamination with coal and ash during transport, handling and storage. This is another important reason for introduction biomass in coal fuelled boilers and thus further decreasing the consumption of coal and introduction of renewable. The JKP "Beogradske elektrane" has performed investigations on possible utilization of solid biomass in existing boilers, originally fuelled with coal. The main goal of these investigations was to analyze possibilities of utilization of biomass without modifying the existing boilers. The extensive results obtained during the research proved to be very useful for better understanding of performance and operation of coal fuelled boilers when using solid biomass and confirm that the change from coal to briquettes and pellets can be done the way the Utility Company of Belgrade planned. Following the current heating technology concepts and the high price of fossil fuels, the JKP "Beogradske elektrane" has paid particular attention to energy efficiency increase and the environmental protection and global warming issues by investigating possibilities to introduce renewable for heat production in Belgrade. During the last 30 years period JKP "Beogradske elektrane" has closed over 1000 coal or oil fuelled local heating units and connected the consumers to district heating systems operating on natural gas, thus substantially improving quality of life in Belgrade by reduction of emissions of pollutants and CO2 emissions. Four year experience resulted in following important findings: • Wood briquettes and pellets can be utilized as a substitute for coal for some types of boilers and continuous fuel feeding systems without modifications of boiler sub-systems, except possible minor adjustments for control and operation of boiler. • The achieved thermal powers when using either coal or biomass do not differ. • There are substantial improvements when using biomass in what concerns emissions of gaseous pollutants, ash, particulates and CO2. • Dimensions of briquettes and pellets to be used depend on boiler and grate types and their geometry. • Storage and handling of briquettes and pellets is much simpler and environmentally friendlier than storage and handling of coal. • No investment is needed!
Lambda Test System **Vienna, Austria** TU WIEN FGW	Test system design and measurements of the thermal conductivity for composite pipes A significant fraction of human energy consumption is used for heating purposes thus efficient and durable insulation is a necessity. Although different materials have been used to insulate district heating pipes over the last decades only few studies have been conducted on the long-term aging effects. This study has two main objectives: First, the development of a cost efficient and reliable measurement system to determine the thermal conductivity of insulation layers in compound pipes. Secondly, to analyze unused and used plastic jacket pipes in order to study the change of thermal conductivity due to aging effects in the insulation material for PUR closed-cell foams. A variety of factors have to be considered in the design of a measurement system (e.g. the most suitable time constant, amount of available funds, sensor type, means of measuring surface temperatures, data acquisition layout and operation). The guidelines for such measurements given in appendix F of the European standard EN 253 and general literature have been researched and implemented as far as possible. The measurement system uses thermal equilibrium of the sample pipe with an ambient air volume and heating power monitoring to calculate the thermal conductivity of the insulation layer. The setup consists of a specimen housing where the samples

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PDF Summary	are mounted on two support posts in a temperature controlled environment, a control unit which regulates the heating and cooling elements and a data acquisition unit which converts the electric sensor signals into a digtial data stream accessible via a virtual serial port. A small number of samples was chosen and more than 200 measurement runs conducted. The results indicate a smaller deterioration of the insulation properties than former studies with artificially aged pipes stated. The used sample pipes showed that even after prolonged operation of more than 20 years at usual temperatures in the range of 80°C to 90°C only small relative increases in thermal conductivity smaller than 10% can be detected. Furthermore this project has highlighted the possibilities for low-cost testing systems for plastic jacket pipes.
Princess Noura University for Women **Riyadh, Saudi Arabia** MILLENNIUM ENERGY INDUSTRIES MINISTRY OF FINANCE PDF Summary	Implementation of a large scale solar thermal district application to provide for space heating and hot water needs of the Princess Nora University for Women in Saudi Arabia (PNUW). The University Campus has to supply 40.000 students, 13 faculties, lecturers and university personnel, dormitories, research facilities and a gymnasium. The area supplied with hot water and space heating even comprises a hospital and hotel along with all other necessary infrastructure for living, working and studying. The implementation of the solar system should lower the capital cost, lower operational and maintenance cost, support the saving of conventional fuels and provide safer operation. The Challenges of this actual case study are the arid desert conditions with possible severe sandstorms generating fine dust and the desert climate where it can be very hot during the day and very cold, sometimes freezing during the night. The sandstorms generating fine dust require the system to be built sealed and in addition the cleaning process should be easy and not altogether time consuming. The complexity of excess heat has to be resolved since in summer there is no need of space heating and during vacation periods the demand of hot is much lower. Because of a freezing probability during the cold desert nights the system and solutions will have to be tested to withstand low ambient temperature. The size of the project causes challenges in space allocation and uncertainty of solar input because of weather conditions. Integration with sophisticated Building Management Systems (BMS) has to be implemented. Easy and simple transfer of technology to the customer should be achieved. Saving of carbon emission gained by saving on fuel consumption. With a solid background and engineering experience, identification of the customer needs for the project and the analysis of the given facts for the supply of domestic hot water and space heating during the 40 heating days in Riyadh, are conducted and a solar supported district heating network is installed. The demand of heat is covered by oil fired boilers with a peak load capacity of 70 MWth together with a 25 MWth generated from 36.305m2 of flat plate collectors especially designed to withstand harsh desert conditions with low maintenance needs. The collectors are placed on the rooftop of a 60.000m2 warehouse. During the summer period the thermal load of the district heating network is calculated to be 30MWth. While the prevailing share of t
Stanford University District Energy System Stanford University, California Stanford, USA Stanford University PDF Summary	The Stanford Energy System Innovations (SESI) project is a $438 million major transformation of the campus district energy system. The transformation is from gas fired combined heat and power with steam distribution to electrically powered combined heat and cooling with hot water distribution. When completed in April 2015, the new heat recovery system will be 52% more efficient than the existing cogeneration system; immediately cut Stanford's Category I and II GHG emissions in half; save 20% of Stanford's drinking water supply; and save $303 million (20%) over the next 35 years compared to the existing system. The heart of SESI is heat recovery- approximately 70% of waste heat from the campus chilled water system (currently being discharged out evaporative cooling towers) will be reused to meet 80% of campus heating loads through the use of industrial heat recovery chillers and conversion of the campus heat distribution system from steam to hot water. SESI includes: • installation of a new electrically powered central energy facility built around heat recovery; • demolition of the existing cogeneration plant;

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	• installation of 20 miles of new hot water distribution piping to replace the campus steam system; • conversion of 155 building connections from steam to hot water; • installation of a new campus high voltage substation. SESI is unique and innovative in design, implementation and impact. SESI advances heat recovery in district energy to scales heretofore unseen. It is achieving direct and immediate environmental improvements and cost savings at a dramatic scale, while opening a flexible and lasting path for Stanford to continually achieve sustainability. SESI combines cutting edge technology from both North American and European district energy systems; its development has led to the creation of new state of the art district energy plant operating software and spawned a startup company; and it is expected to be amongst the most efficient trigeneration district energy systems in the world.
Sunstore4 **Marstal, Denmark**   PDF Summary	The city of Marstal, in the Danish island of Aero, has adopted in summer 2012 the Sunstore4 model, a 100% renewable district heating system integrating several different technologies: solar thermal, biomass boiler and heat pump. The plant also include ORC electricity production and a 75,000 m3 seasonal heat storage. This innovative and flexible solution also shows an affordable heat production cost, between 40 and 60 €/MWh. The company managing the district heating system is owned by the heat consumers themselves, which founded a cooperative company with two main goals: producing heat from local energy sources and assure a negligible impact on the environment. At the same time, by assuring a long term stability of the heat cost, being independent from the price oscillations of conventional fossil fuels, it provides the citizens with a clear view of their economic future. The heat supply is about 32 GWh/year, 55% of which is provided by solar thermal, 40% by biomass and only 5% by the heat pump. It should be noted also that solar thermal shows no polluting emissions at all in its operation phase and that biomass is CO2 neutral. The Sunstore4 project has been developed and implemented by a large international research group, in the framework of a FP7 funded European project.
The brilliance of a district energy system Falun **Falun, Sweden** Falu Energi & Vatten FALUN PDF Summary	History Falu Energi & Vatten (Falu Energy & Water) is taking responsibility by developing the community of Falun, county Dalarna. Our cooling & heating plant is situated on the brink of the world heritage, Falu copper mine, which for many centuries was one of Sweden´s foremost business activities. That is a tradition we are carrying on. Climate impact Falun´s investment in climate neutral production of heating, cooling and electricity has globally reduced CO2 emissions by 145 000 tonnes/year. This is equal to emissions from 47 000 cars! Large investments have been made to replace fossil energy and reduce the global CO2 emissions with renewable power production. Since 2007 the annual production has doubled. The system Over the past five years Västermalmsverket has evolved from being solely a combined heat and power plant. By investing in an absorption cooling machine we have reduced the use of electricity for conventional cooling installations. At the same time we are able to increase the production of electricity at Västermalmsverket. We have built a wood pellet factory which helps us to produce more renewable energy during the warmer period when the need for heat is at its lowest. By doing so we have increased our electricity production and we get wood pellets to use in our district heating production during the

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	winter. These four ingredients make our plant a combined bioenergy plant - it is unique due to simultaneous production of heat, cooling, electricity and wood pellets. And by the end of summer 2014 the system will include district heating being transported through a line between the cities of Falun and Borlänge. This increases our possibility to maintain district heating as a competitive product. Opportunities for the future In order to develop a sustainable district heating industry there is a need to spread knowledge about district heating´s minimal environmental impact. This knowledge needs to be transferred not only to customers and the public. It is also important that politicians, policy makers, officials and industry understand total systems and the large picture.
Twence: A Top Supplier of Sustainable Energy **Hengelo, Netherlands** AkzoNobel Gemeente Enschede essent Gemeente Hengelo Twence® PDF Summary	For years, the public debate on how to achieve a more sustainable supply of energy had focused on electricity. Waste processor Twence realised that using residual heat from the production of electricity and even replacing the production of electricity by supplying heat and steam (especially to replace natural gas) would have greater positive effects, both for the environment and for a more efficient use of the energy generated from waste (WtE) and biomass. First of all, the source of energy not only had to be sustainable but above all also reliable. Ensuring a reliability of supply of over 99% would require at least two different production sources. To that end, and to enable better economies of scale in the production of energy from waste, Twence invested in a new WtE line and a dedicated biomass power plant. The main challenge was to forge partnerships with contracts that would enable investments to last 20 years. We succeeded in doing so with the two main potential customers: AkzoNobel for steam (to evaporate brine in their salt-production plant) and Essent for heat (for district heating), in both cases to replace their gas-fired boilers and CHP plants. In 2009 and 2010 we invested over €15 million to connect our power plants to Enschede's municipal district-heating system. This involved technical in-plant modifications to enable the sourcing of steam and heat as well as long-distance transport pipelines connecting our plants to the main system in Enschede. This was done in close cooperation with energy company Essent, which operates that system to provide heat to end-users. In close cooperation, Twence and AkzoNobel invested over €10 million in technical plants and a pipeline for transporting steam to AkzoNobel's salt production plant in Hengelo. In 2011 and 2012, using steam from Twence, AkzoNobel already managed to reduce its natural gas consumption by some 90 million Nm3 and to avoid emitting more than 165,000 tonnes of CO2. This led the AkzoNobel board of management to recognise the Hengelo site as one of the company's most sustainable plants. In two years, starting in 2011, both projects saved a total of over 120 million Nm3 of natural gas, and some 220,000 tonnes of CO2 emissions were avoided. The setup was further expanded in late 2012 with a major increase in the supply of steam to AkzoNobel. Studies are investigating the possibility of extending the system to supply the district-heating networks in Hengelo and other communities in Twente.
Veolia Energy Philadelphia Philadelphia, USA	Veolia Energy Philadelphia's Green Steam Conversion reflects extensive infrastructure upgrades at the Philadelphia district network, which simultaneously increased our operating efficiency and reduced our environmental impact, benefiting the 500+ buildings (100 million sq. ft. of space) on Philadelphia's 41 miles of district energy network. In 2008, the University of Pennsylvania (Penn), our largest US customer, was up for contract renewal. As one of the original signatories of the American College & University Presidents'

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PDF Summary	Climate Commitment, Penn is an environmental leader, including energy generation and procurement. Veolia Energy and Penn sought to overcome the challenge of the high cost and environmental impact of burning #6 and #2 fuel oil in Veolia Energy's generating assets. In addition to fuel sourcing and pricing transparency, Penn also sought to maintain reliability by reducing the time to power back-up systems. After an extensive technology, efficiency and operational review, Veolia Energy determined that it could accomplish Penn's goals through a change in equipment dispatch, which relied upon two significant capital investments: $30 million investment in two 250,000 pph rapid-response boilers; $30 million investment in the expansion of a lateral in the TETCO natural gas pipeline that eliminated a restriction on firm gas supply. This project is not only an innovative solution to Penn's current energy needs, but also incorporates the flexibility for expansion. Other major institutional users are driving growth with highly specialized medical and R&D uses that require the multiple levels of redundancy that Veolia provides. These institutions now constitute 30% of Philadelphia's local employment, increasing 20% over the past decade. These innovative Green Steam upgrades literally fuel the City of Philadelphia's growth sectors. The benefits are not only economic and environmental, but also increased reliability for our customers. Firm gas supply provides sufficient natural gas for 100% of capacity during peak thermal demand in the winter months, enabling increased loading of the CHP so that 100% of district energy can be fueled using our 163 MW cogeneration plant. The primary role of the rapid-response boilers is to reduce the need to idle to maintain standby steam pressure. Veolia's $60M investment achieved environmental savings of 1.4 million MT GHG and energy savings of 4.9 million MMBTU over the project life.
Whistler Athletes Village Whistler, British Columbia Whistler, Canada PDF Summary	We have found a tremendous interest in our District Energy Sharing System (DESS) from around the world. So far we have accumulated Awards from organizations such as the Canadian Association of Consulting Engineers (ACEC), the Non-Oil and Gas Energy Infrastructure Project Canada, the Community Energy Association (CEA), the #1 Non-Oil and Gas Infrastructure Project Canada, and been written up in The ACEC Magazine, The ASHRAE Building Operation Award, the ASHRAE Journal, Short-Listed by both The Chartered Institution of Building Services Engineers and the American Waterworks Association. We have had interest from Countries such as France, Russia and Australia. The DESS is Unique, there are no systems like it worldwide. Our studies and the results from the connected systems have shown the same energy saving results that we found with the Whistler installation. We are able to provide references from users testifying to the results from the existing systems. The District Energy Saving System (DESS) not only saves Energy but there are huge savings in Greenhouse Gas Production.