district energy
creating sustainable environments
District energy can include heating, cooling and electricity generation and is generated close to where it is required, rather than supplied through the national grid from large centralised plant. Local generation allows both heat and electricity to be used efficiently and helps reduce energy costs, lowers carbon emissions, and improves neighbourhood resilience.

District energy comprises three main elements:

- A local energy plant that produces thermal energy, and if a combined heat and power (CHP) plant generates electricity. In the summer months the surplus heat may be used to drive an absorption chiller to generate chilled water for cooling (tri-generation).
- A network of pre-insulated pipes to distribute the thermal energy from the local energy centre to buildings, and a private wire network to transfer electricity to customer sites.
- The customer interface with services at the building, to provide space heating, domestic hot water, cooling and electricity.

Optimisation of the pipe network, and control systems, along with thermal and electricity storage can assist in improving the management and overall efficiencies of the district energy networks.

The integration of renewable forms of heat from a range of heat pump applications, the use of biogas (or syngas) or recycling of heat from industry or connection to energy from waste plants can improve the low carbon supply mix for heat networks. In some cases an ambient temperature heat network can be designed, using heat pumps from ground, sewer or water sources.
d3associates specialises in the planning, optimisation and delivery of district energy schemes with a range of services that takes the system from initial concept design through detailed design, to construction and commissioning. With extensive project experience the team offers a broad range of skills across a range of technologies from CHP to large scale heat pumps, and battery storage.

Feasibility studies - energy masterplanning
Business case development
Detailed technical design
Hydraulic and thermal modelling
System optimisation
Installation and commissioning support
Metering and billing solutions
Project management
Principal designer - CDM 2015 regulations
Architectural design
meet the team

Paul Haverson  BSc (Hons) MICE CEng MICE  DIRECTOR
Paul has extensive experience within the energy, property and regeneration sectors and has been responsible as project director for the management and delivery of multi-disciplinary schemes across the UK.
He is responsible for client liaison and providing project direction, coordinating activities at both a strategic and project level to provide commercially and technically robust solutions.

Geoff Robinson  BSc MSc  SENIOR CONSULTANT
Geoff is a highly-qualified engineering design manager, with a Masters Degree in renewable energy.
He has a wide range of knowledge on energy generation, network distribution and metering. He has delivered energy efficiency projects for a variety of clients and leads the team assessing the condition of the communal and district heat networks for Social Housing Associations, preparing option appraisals, and identifying suitable metering and billing solutions.

Brad Murray  HND  SENIOR MECHANICAL DESIGN ENGINEER
Brad is an experienced Mechanical Design Engineer and M&E coordinator with extensive experience in district heating, including the design and construction of energy centres.
He has an in-depth technical knowledge of a broad range of mechanical and electrical services including HVAC systems, integrated CHP and renewable technologies, energy management, conservation and utilities, from feasibility modelling, design and assessment through to construction.

Craig White  BSc MSc  SENIOR TECHNICIAN
Craig is an experienced 3D CAD designer responsible for the preparation of designs and specifications for the installation of energy plant and pipework, coordinating and working with professional teams during the design development.
He has a sound technical understanding of a wide range of low carbon technologies associated with district heating projects as well as designing effective pipe routes and building interfaces.

Elisabeth Matuku-Nyambu  TECHNICIAN
Elisabeth is skilled in the preparation of engineering plans, drawings and schedules and in producing 3D AutoCAD models to allow schemes to be visualised.
She provides assistance with the preparation of specifications and tender documents and in the co-ordination of the works information.
She works closely within the team to ensure that the drawings convey the correct information and are error-free.

Lawrence Best  BSc MSc  SENIOR CONSULTANT
Lawrence has worked in the Power Industry since 1978; his expertise is based on an in-depth knowledge of district heating systems, and he has worked on several pioneering CHP schemes. He was Lead Engineer on the development of Northumbrian Water’s plant at Brier Sands.
A key team member experienced in the design, installation, commissioning of energy centres and distribution networks, his recent projects include a large scale biomass project, and the Gateshead District Energy Scheme.

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A key part of our strategy is to strengthen our position as an innovative consultancy, and enhance our skills to effectively meet our client’s requirements. To meet this aim we recognise the need to work collaboratively with experts in their field, and adopt new and beneficial technologies, which will enable us to deliver broader, smarter and more efficient outcomes.

The combination of our in-house knowledge and skills, and working closely with other commercial and technical specialists within the energy sector allows us to offer a wealth of experience in developing smarter energy networks, and the adoption of new technologies and business models.

In future a mix of technologies will have a role to play, whether this is the deployment of large scale heat pumps, battery or thermal storage, hydrogen networks, increased electric heating or the use of sustainably grown biomass - hybrid systems will provide opportunities to provide lower cost energy and reduce carbon emissions.

We have worked closely with d3associates, using their in-depth technical knowledge of heat networks to help optimise systems and provide cost effective design solutions.

Glyn Addicott Operations Director, HAL

Siemens

We work closely with Siemens Plc, a market leader in developing services, platforms and outcomes for smart energy systems. Siemens are a significant energy infrastructure delivery partner with direct practical consulting experience in energy and low carbon studies, planning and strategy. d3associates support Siemens on the technical design and optimisation of heat networks including thermal and hydraulic modeling to assess the system’s operational efficiency and resilience to change.

Hydraulic Analysis Ltd

Hydraulic Analysis Limited is a worldwide leader in surge analysis, flow assurance and dynamic simulation having completed over 7000 projects in the past 40 years. They are highly experienced in modelling district heating systems to optimise the piping design, confirm pump selection, calculate the range of system pressure and temperature losses, determine the maximum surge pressures and pipe loads. A district heating hydraulic study will provide an assessment of the control system and operation to ensure that a continuous supply of flow to the users is maintained and heat transfer obligations are met whilst maximising efficiency and reducing controller instabilities.

d3associates can provide a systematic approach to problem solving, working closely with Hydraulic Analysis Ltd to optimise existing networks, utilising accurate hydraulic and thermal modelling, coupled with our in-depth knowledge and understanding of energy generation, network design and operation.

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**case study**

GATESHEAD DISTRICT ENERGY SCHEME – DISTRIBUTION NETWORK DESIGN

district energy

d3associates was commissioned by Clancy Docwra Ltd to undertake the design of the Gateshead District Energy Scheme heating network as part of a design build project for Gateshead Council. The pipe network stretches over 7km, from the south bank of the Tyne into central Gateshead to serve public buildings, businesses and social housing tower blocks. The overall project represents a £14M energy scheme; the Energy Centre includes two 2MW gas fired CHP units to provide electricity and heat for customers in the district.

d3associates provided advice regarding the design requirements, the programme and the key technical project risks. The ‘pre construction’ activities included the detailed design of the 3D pipe network route utilising Ground Probing Radar and Trial Hole survey data, preparation of the network P&ID’s and development of the commissioning and testing plan. This work also included establishing a ‘proved route’ for a major road crossing near to the Tyne Bridge.

The 3D pipe route design together with the P&ID’s enabled the network to be thermally and hydraulically modelled to confirm the suitability of the design and to assess the pipe stress and surge conditions, which determine the design requirements for pipe movement and thermal expansion. The route for the heat distribution system required careful consideration to ensure the network design met the required energy demand at the customer buildings. The network design optimises the velocities within the pipeline and temperature profiles to ensure the availability of sufficient energy for the end users. Excessive velocities are avoided in the network as these increase the required operating pressures, energy consumption and consequently operating cost.

The project programme was developed establishing clear milestones and periods for client review of design proposals. Other design management plans produced for the project include the Project Quality Plan and the Project Execution Plan. d3associates also undertook the role of Principal Designer for the project in accordance with the CDM (2015) Regulations.

GATESHEAD DISTRICT ENERGY SCHEME

Integrating heat, and power generation with energy storage and national grid services, the 4MW gas-fired CHP scheme will help to underpin the future redevelopment of Gateshead Town Centre.
The Birley Field campus consists of accommodation blocks for 1000 students and academic facilities. The site is served by a LTHW district heating system generated from an energy centre with 3000 kW of gas fired boiler plant with an additional 400kW generated by the rejected heat from a Combined Heat and Power unit with thermal storage.

d3associates was commissioned to conduct conditional surveys of the Energy Centre, satellite plant rooms within the student accommodation and academic blocks. The purpose of this survey was to review the control and hydraulic arrangements of the existing heat interface units and district heating network. A hydraulic model was developed and recommendations provided to optimise the LTHW systems flow rate with supply and return temperatures, whilst optimising the usage of the CHP plant and thermal storage and effectively utilising the rejected heat into the district heating system.

New heat metering devices were installed and this data when input into the hydraulic model will be used to fine tune the controls to deliver the most economic operation of the CHP, thermal storage and gas fired boilers.

d3associates and Hydraulic Analysis Ltd provided initial advice to Manchester Metropolitan University with regard to confirming the suitability of the existing district heating primary pumps to meet the varying loads throughout the year. Further analysis was undertaken of the heating demand profiles for space heating, mechanical ventilation and domestic hot water usage attributed to the accommodation blocks and academic building.

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A regular dialog between the survey team and the University Estates Department helped develop a clearer understanding of the control systems and has supported the improved operation of plant.

district energy
case study

GENTOO GROUP LTD
COMMUNAL HEATING OPTIONS APPRAISALS

Gentoo is a housing association that owns and manages more than 29,000 homes in Sunderland. They appointed d3associates to report on the condition of their communal and district heat networks, prepare options appraisals and to identify a uniform metering and billing solution that offers value for money to end users across all district heating sites.

The project was divided into three phases: the first to investigate the condition of the 40 year old boiler houses and pipework that form the district heat networks in Washington and prepare a fully costed options appraisal, reporting on alternative solutions for heat provision.

The second phase was an options appraisal for seven tower blocks in the Northside area of Sunderland where the flats are currently heated by individual combi-boilers. The final phase was to report on ten other Gentoo properties, a mix of terraced housing, supported living care facilities and sheltered housing. For all the Gentoo properties on communal or district heat networks, options for a uniform metering and billing solution were identified to replace current installations. A financial assessment of the networks carried out and comments made on the end user heat charges.

For Phase 1, d3associates prepared a comprehensive report, detailing the current condition of the boiler houses and district heat networks, externally and internally to the properties, and assessed the costs of operating the systems against the income received through heat metering. In addition, d3associates produced a fully costed options appraisal on alternative solutions for the heat provision in Washington. All of which allowed Gentoo to determine their preferred option which provides best value to the housing association and residents.

The reports for Northside Towers considered fossil fuel and renewable energy options for replacing the existing gas combi boilers. Capital and operating and maintenance costs were provided along with the income available from Government incentive schemes. Gentoo are now progressing with their preferred option.

Gentoo currently have several methods for metering and billing which were assessed and options put forward for a new system which meets all their requirements, to be used on all their properties on communal or district heat networks.

case study

AMPLEFORTH

The review includes consideration of the adopted design principles, heat load profiles, wood fuel options and construction issues. d3associates were also requested to undertake a financial analysis of the proposed scheme, including potential payback under the Renewable Heat Incentive and hold a workshop to inform the Community.

Feasibility work for the scheme is was undertaken, along with energy surveys of the existing buildings to consider the potential to reduce the existing heat demand. d3associates provided a strong team and worked closely with the Estates Department and other consultants to ensure that the proposed solutions were technically sound and commercially viable.
As a specialist design consultancy, our aim is to offer a holistic design solution, using a range of energy generation technologies to help reduce costs and lower carbon emissions. Our in-house design team, supported by our partners, can provide the detailed design solutions for generation plant and ancillary equipment, to develop an efficient energy centre. This includes the specification of boilers, CHP units, Low NOx Selective Catalytic Reduction Systems, Absorption Chillers, Air Cooled Condensers, heat recovery steam generators, Organic Rankine Cycle, Biomass Boilers & Handling systems, BMS and SCADA Control.

Our in-house architectural team can also design the energy centre building using Revit building information modelling software, working closely with our energy team to optimise the layout. Early design work should include developing an outline commissioning plan, considering the location of valves, air vents, drains and network flushing requirements; designing the pipe leak detection system, and pipe entry locations into customer’s buildings.

Network design

d3associates have gained significant practical district heating network design experience, based on the design and installation of Gateshead District Energy Scheme and through working closely with the appointed Contractor during the installation and commissioning. From interpreting the Ground Penetrating Radar and utility information and developing technically feasible routes avoiding services and other linear obstructions, to optimising the network design and installation programme to reduce the number of bends, minimising the depth of excavation, traffic disruption, and use of special pipe sections.

Detailed network design follows with the creation of a 3D network model, P&ID’s, valve schedules, general arrangement and long section drawings. Through our technical knowledge and hands-on experience of designing large scale DH networks, and working closely with Hydraulic Analysis Ltd, we can provide sound practical advice ensuring the design is robust and complies with Heat Networks Code of Practice.
We provide independent advice to support housing associations to manage their systems, provide more efficient energy services and comply with The Heat Network (Metering and Billing) Regulations 2014 which implements some of the requirements of the EU’s 2012 Energy Efficiency Directive, and apply to anybody who is a ‘heat supplier’. The regulations apply to many multi-let buildings where the landlord recharges the cost of heating, cooling or hot water supplied through a District Heating Network (DHN) or communal heating (CH) system to at least two final customers. The aim of the regulations is to allow users of heating, cooling and hot water supplies to be aware of the level of their consumption and as a result be incentivised to reduce that consumption. The largest share of CO₂ emissions from UK buildings come from space heating and water heating.

d3associates services include:
• Condition surveys; customer sites, boiler houses and distribution network.
• Review current maintenance requirements across housing portfolio.
• Identify flexible metering and billing solution (ideally an open protocol system).
• Identify alternative solutions for heat provision to ensure long-term sustainability.
• Consider energy generation from renewable or low carbon energy sources.
• Evaluation and options appraisals – based on our building services and district heating design experience.
• Concept / detailed design of the preferred solutions, cost, risk and programme management.
• Additional funding and funding options.

Ensuring the system is modelled accurately from the outset is key to developing a heat network that will closely reflect reality and perform according to expectations. Complex systems can be accurately modelled including any component of a system that can affect the fluid behaviour within a pipeline. This includes accurately simulating all pumps, valves, pipe work, long transmission lines, variable flow regimes, telemetry effects, surge suppression equipment, and control systems. Surge pressures and the associated out of balance loads can be rapidly applied and simulated using specialist hydraulic computer modelling techniques resulting in exceptional accuracy when compared to as-built systems.

By combining over 40 years of extensive hydraulic and thermal engineering experience in both the energy and oil/gas industries, Hydraulic Analysis have successfully pioneered, developed, and deployed a dynamic simulator for district heating systems, able to address the challenges listed above. The simulators are proven to generate results consistent with real-time operation and accurately model the system pressure and temperature losses. The simulators incorporate the full Energy Centre and HIU control systems to ensure an accurate reflection of the true system operation.

Many heat networks in the UK are failing to deliver their promised performance due to inefficient operation and over engineering. Thermal store use must be improved and this can only be achieved with a thorough understanding of the system control and operation. Designing for high demands reduces the system efficiencies and demand diversity needs to be assessed using an accurate simulator. The cause of high secondary return temperatures varies between systems and must be addressed to achieve viable economic returns. A comprehensive understanding of the system operation and performance is essential to locate areas of high temperature loss.

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