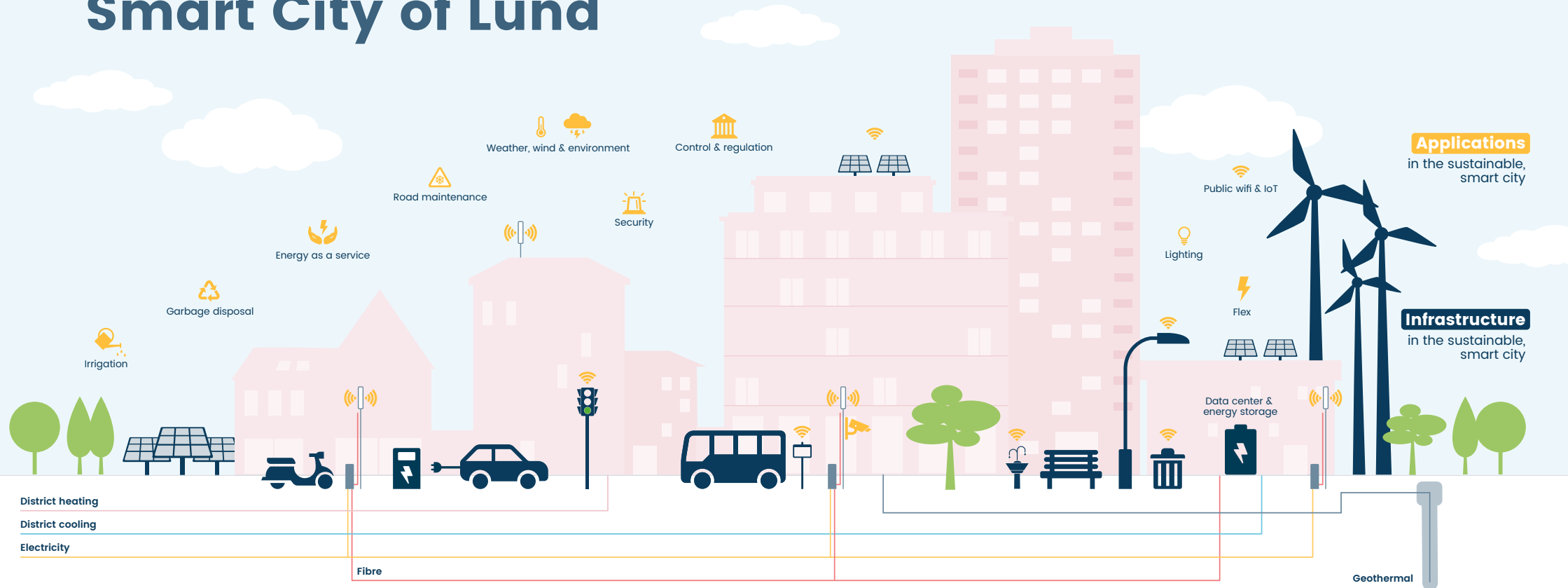




**Collaborations and partnerships
for sustainable and resilient
heating and cooling**

Smart City of Lund



Seven Swedish municipalities selected for the EU's mission climate-neutral cities

Gävle, Göteborg, Helsingborg, Lund, Malmö, Stockholm and Umeå. They are the Swedish cities who are chosen to take part in the EU mission on climate neutral cities 2030 – the Cities Mission. 100 EU cities, plus 12 cities from associated countries, out of 377 applicants were selected. In 2021, the European Commission asked all European cities who want to participate in the mission 100 climate neutral and smart cities by 2030 to express their interest. From Sweden, 13 cities applied, all of which are part of Viable Cities' initiative Climate Neutral Cities 2030. Seven of them were selected. The city of Lund is one of them.

Lund is one of Sweden's oldest cities with over 1,000 years of history. Located in the southern region of Sweden, the city is home to some 128,000 people, many of whom belong to the nearly 50,000 students enrolled at Lund University. The University is one of Sweden's oldest and largest, established in 1666 and it is also internationally acclaimed both for its science and social activities. In 2023 professor Anne L'Huillier at Lund University was one of the Nobel laureates in Physics. At the same time Lund was also awarded as the most sustainable cities in Sweden.

Kraftringen

Kraftringen is a regional energy company, owned by the municipalities of Lund, Eslöv, Hörby and Lomma, headquartered in Lund. The company's vision is "Energy for future generations". They strive to deliver electricity, heat, cooling, communications and other services with minimal impact on the environment. Work on a district heating grid in the city started in the early 1960's, replacing local boilers and thereby lowering overall emissions.

Over the years, a gradual move away from fossil fuels have meant that the citizens of Lund have kept warm in an ever more sustainable fashion. Electric boilers and heat pumps producing heat from sewage water are some examples. In 1985, a unique geothermal system was brought online, supplying 25 % of the overall heating need in the city. In 2018, the last fraction of fossil fuels was removed from the mix. Contributing to the fact that the City of Lund reached its climate goals for 2020 a full two years early.

Kraftringen's main heating grid today is one of Sweden's largest, connecting the cities of Lomma, Lund and Eslöv into one large grid. It has a total yearly demand of about 1 TWh, half of which is met by the combined heat and power plant in Örtofta, which has been in operation since 2014. The district heating grid is also connected to the grids in the cities Landskrona and Helsingborg, providing possibilities to optimise production further with our partners Landskrona Energi and Öresundskraft.

2009 was a very important year for the city of Lund. Within one month decisions were taken to fund two large research facilities to be placed here. European research ministers awarded Lund the opportunity to host the European Spallation Source (ESS) and the Swedish Ministry of Education decided to fund the MAX IV Laboratory.

The European Spallation Source is nearing its final phase of construction and will be fully operational at the end of 2027. MAX IV was inaugurated in June of 2016 and is regarded as the world's premiere source of synchrotron light. Both facilities will be of huge importance for future science and industrial developments within fields such as material and life sciences. Between the two research complexes, Science Village is in development and will act as a meeting place for research, education and business.

MAX IV, ESS and Science Village are located in close proximity and also form the basis of an entirely new city district called Brunnshög. Lund Municipality have since made plans for Brunnshög to be a leading example of sustainable city development. Over a period of 40 years, Brunnshög will grow and reach 40,000 people living and working within its limits.





Brunnsjön - science heats the city

The district heating grid owned and operated by Kraftingen is one of Sweden's largest. As such, the possibility to use it as a cooling system for the European Spallation Source was an important factor in the facility's plan to be as environmentally efficient as possible. This was a key factor in the decision to place ESS in Lund, since it is going to use a great deal of energy and a responsible way to make use of residual heat minimises overall energy losses.

The technical prerequisites at the MAX IV Laboratory are slightly different and it does not generate as much high-grade residual heat as its neighbour ESS. Kraftingen, in cooperation with the City of Lund, therefore committed to building a next-generation low temperature district heating (LTDH) grid in Brunnsjön. Making sure that the residual heat from MAX IV came to good use.

The LTDH system, the world's largest of its kind, is used to heat an entire city district through innovative technical solutions as well as novel business models. "Science heats the city" is a tagline for the project, illustrating both a scientific approach as well as indicating the actual energy sources supplying heat for Brunnsjön. The backbone of the grid was inaugurated in the fall of 2019. The first client was connected at the same time and has been heated by LTDH since then. As Brunnsjön grows, more and more clients are connected and new and innovative uses of heat have been implemented. A tramway connects Brunnsjön to the center of Lund and all tram stops will have shelters that will be heated by the LTDH system. Bike ways and sidewalks will be heated to make them free of snow and ice in the winter, amongst many other ideas and plans.

Extremely low primary energy usage

Since Brunnsjön is a completely new district, all construction in the district are being built according to current building codes and using state of the art building techniques, meaning that they meet very high standards of insulation and have low heating needs. Nevertheless, there is a heating requirement during the winter season, and year-round need for hot tap water. Given that there are heat sources available which can supply residual heat for the entire district at zero primary energy use, there was a need for technology that transfers heat as effectively as possible to ensure as low climate impact as possible.

The system temperature of 65 °C was chosen to eliminate the need for extra equipment to handle growth of legionella bacteria. The lower temperature also means plastic pipes, specially developed for the COOL DH project, could be used. These can be laid closer to the surface, meaning shallower digging and thereby narrower working area and less intrusion on the surroundings. The new pipes are delivered on 100 meter rolls which can be rolled out very effectively compared to previous technology, where 16 meter sections needed to be lifted into the ground. This also means that the LTDH grid needs far fewer joints, leading to further reduction in costs.

The MAX IV energy central is also connected to the high temperature district heating grid, meaning that there is a redundant heat supply with extremely low primary energy usage (primary energy factor of 0.04) in periods when there is no production at the MAX IV Laboratory.

Developing sustainable district cooling

As climate change keeps affecting temperatures, leading to ever warmer summers, modern buildings with very high insulation levels face a new problem; how to maintain cool indoor temperatures during the summer months.

Demand for sustainable cooling solutions is increasing and one such solution is district cooling, a stable and sustainable way of lowering indoor temperatures. Kraftringen are building a district cooling grid in Brunshög. Initially this is a local grid for the upcoming Space and The Loop buildings in Science Village, but the plan is to cover the entire city district in the long term. The grid started serving its first customers during September of 2023.

An important advantage of district heating and district cooling networks is that they can serve as a basis for efficient management of society's waste heat. Kraftringen already recycles large parts of this residual heat and distributes it as district heating. In the near future, it is expected that there will be a large surplus of residual heat in Brunshög during the warmer months of the year. In order to use the residual heat efficiently, Kraftringen plans to convert it into cooling.

This can be done through so-called absorption cooling machines. It is a well-proven technology that we have used in central Lund for many years. This way, research in Brunshög will provide both heating and cooling to the city. Above all, this will be important in a very electricity-intensive area like

Brunshög, as the alternative for the properties is to produce cooling with electric cooling machines or heat pumps.

Besides the Brunshög example, there are two other district cooling grids in use in Lund today. Production is adapted to needs and seasons. During the cold season heat pumps are the main means of production, where the excess heat from the pumps is used in the district heating network. Conversely, excess capacity in the district heating system is used during the summer to produce cooling via absorption chillers.

Traditionally, Kraftringen's clients have been business customers who, for example, want to cool server rooms.

We also see an increased interest among property owners, as both enterprises and citizens want access to sustainable solutions to cool homes and premises during the summer months.

The long-term goal of district cooling is to keep the electricity consumption down, and this is made possible by the fact that we plan to use residual heat for district cooling through absorption cooling. It is sustainable, timely and important, especially here in the south of Sweden where the deficit in electricity production is high.





Benjamin Walfridzon

Environmental product declaration

Kraftringen focuses greatly on the transition to a more sustainable energy landscape. In 2018, the goal of 100 % fossil fuel-free production was reached. In 2022 Kraftringen took the next step and launched an environmental product declaration for the entire district heating supply in Lund, Lomma and Eslöv. The result indicates that the climate impact from Kraftringen's district heating is significantly lower than the Swedish national average.

The environmental product declaration (EPD) is based on an analysis of the environmental impact of the complete district heating system during its entire life cycle, including every kilowatt hour of heat delivered. The life cycle includes everything from extraction of raw materials and transport of fuel to construction and decommissioning of facilities as well as the district heating grid itself. The EPD provides a transparent picture of the total emissions and has been prepared according to the ISO 14025 standard, as well as being third-party audited.

The EPD allows us to take sustainability work to the next level, as we can identify where in the life cycle our main emissions occur and take targeted measures to reduce them even further.

The climate impact is presented as carbon dioxide equivalents and for Kraftringen's large district heating network, which covers the municipalities of Lomma, Lund and Eslöv, the value for non-biogenic carbon dioxide emissions is 10.7 g CO₂e/kWh. For Kraftringen's

low-temperature district heating network at Brunns-
hög, the value is slightly higher, among other things due to high distribution losses as few properties are currently connected. However, the theoretical potential for Brunns-
hög shows a significantly lower emission when the district is fully developed, reducing the distribution losses.

Kraftringen's results can be compared to the Swedish average for district heating, which in 2020 amounted to 54 g CO₂e/kWh. That value is calculated according to the Swedish Heating Market Committee's method, which differs from the method in the EPD, but gives an indication of how Kraftringen's district heating compares.

We are very proud that we can now clearly show how good our district heating is from a climate point of view. It is a quality stamp for our many years of work with continuous improvements, where, among other things, the construction of our biofuel-fired cogeneration plant in Örtofta and the low-temperature network in Brunns-
hög are two contributing factors to this fine result.

Shows the way for more sustainable energy use

With the EPD in place, Kraftringen can now provide reliable and comparable decision-making information on environmental impact, which can help customers when evaluating different energy solutions.

Since the EPD was launched, Krafringen has offered a new product called climate neutral heating. This means that Krafringen calculates and compensates for district heating's total emissions of greenhouse gases over the entire life cycle. For the customer, this means district heating which, overall, contributes net-zero emissions of greenhouse gases to the atmosphere.

We choose to offset the carbon footprint of our district heating through projects that can demonstrate emission reductions. As the market matures around climate compensation for negative emissions, i.e. carbon storage measures, we will also evaluate this possibility. The sustainability work we do before we finally compensate for the climate is always in focus, and with our EPD we have received a receipt that we are at the forefront. However, we will never be completely satisfied, but always work to further reduce our climate impact.

Impact for the future

Krafringen's prognosis for the future states that Brunnshög as a whole is going to need 23 GWh of heat energy in the year 2035. The same year, heat output from the MAX IV Laboratory is thought to be around 28 GWh, more than covering the needs of the entire city district.

What potential impact can these projects have on a European level? According to Heat Roadmap Europe there are currently around 6 000 utilities that presently

serve 13 % of the heating demand in the EU. The amount of unexploited waste heat exceeds the amount of heat needed to heat up all the buildings in the EU. If we were to build district heating systems utilising waste heat, it could cover 50 % of the heat demand for buildings, saving 30 to 50 billion euro per year in purchase of fossil fuels alone and replacing 100 % of the present use of natural gas used for heating buildings.

Global District Energy Climate Awards

At a virtual ceremony on November 11, 2021, the Brunnshög LTDH grid was awarded an award of excellence in the category "New scheme". The Global District Energy Climate Awards were held at the Asia Urban Energy Assembly and in cooperation with the International Energy Agency (IEA) and their Technology Collaboration Programme on District Heating and Cooling, the UN environment cities initiative and the representative organizations of the district energy sector.

In Brunnshög, we want to show how cooperation and sustainable urban planning become a reality today. The award sheds further light on the project and place Lund on the world map as an example in creating circular energy flows in an urban environment.



Contacts



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