BUILDINGS

Linde Haven, a new sustainable city area

The challenge:

Source: IEA (2021). Greenhouse Gas Emissions from Energy

Buildings

28%

of all global energy-related CO_2 emissions come from buildings

Industry

39%

of all global energy-related CO_2 emissions come from industry

Transport

27%

of all global energy-related CO2 emissions come from transport

Sector integration

Over the next 40 years, the world is expected to build 230 billion square meters in new construction – adding the equivalent of Paris to the planet every single week.[1]

It is therefore vital that new city areas are built to be highly energy efficient and with an energy supply that can be decarbonized.

1. UN Environment, GBA & IEA (2017). Global Status Report 2017, p. 2.

The solution: Zero-carbon-ready city areas

As the world grows, new city areas are added all over the world. How they are constructed is an important factor in the green transition. The new city area of Linde Haven in Sønderborg is built to meet the highest sustainability standards, not least regarding energy efficiency. Energy efficient design of the buildings allows Linde Haven to be supplied by low-temperature district heating.

Linde Haven will operate at low temperature, which has the potential to reduce distribution heat loss by an estimated 31% compared to similar buildings operating at normal temperatures.

Towards zero-carbon-ready buildings

Most of the world's building stock must be zero-carbon-ready by 2050. Zero-carbon-ready buildings are highly energy efficient and supplied with energy directly from renewable sources or from energy sources with the potential to be fully decarbonized, such as district heating.[2] This means that a zero-carbon-ready building will become a zero-carbon building by 2050, without any further changes to the building or its equipment.

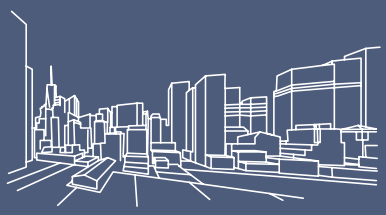
According to the International Energy Agency's (IEA) Net Zero Emissions by 2050 Scenario, all new buildings must be zero-carbon-ready by 2030. And 20% of all existing buildings must be retrofitted to be zero-carbon ready by 2030.[3]

Both passive and active energy efficiency measures are central to meet the net zero scenario. Passive measures aim at reducing energy demand by increasing the use of natural heating and cooling, and by reducing energy losses through the building envelope. Passive measures include wall insulation, loft space insulation, skylights, roof windows, and designs that account for sunshine, shading and ventilation.

Active measures aim at reducing energy demand by measuring, monitoring, and controlling energy usage in both new and existing buildings. Active measures include everything from simple thermostats to artificial intelligence. At both a room, building and local level there is a large potential to reduce emission and to save energy and money.

2. IEA (2021). Net Zero by 2050, p. 148
3. IEA (2021). Net Zero by 2050, p. 147

Examples of the potential in active energy efficiency measures



Heat supply at local level

Lower temperature heat supply through a district energy system: Every 1 EUR spent in buildings for obtaining lower temperatures will reduce future supply costs with approx. 4 EUR.[4]

Heat control of buildings

Control heating systems with **model-predictive control systems** that combine artificial intelligence and building, weather and user data to adjust temperatures.

In an apartment building, model-predictive control systems can **reduce heating consumption by 11%.**[5]

Heat distribution and room control

Electronic thermostatic radiator valves retain a specific room temperature digitally and enable lower temperatures at night or over a holiday period for further energy savings. In a multi-family building, electronic thermostatic radiator valves **save 11% on final energy with a payback time of 1 year.**[6]

Manual thermostatic radiator valves automatically retain a specific room temperature level. In a multi-family building, thermostatic radiator valves **save 7% on final energy with a payback time of 1 year.**[6]

Automatic hydronic balancing can optimize the water distribution in a building's waterbased heating or cooling system. In a multi-family building, an automated hydronic balancing system can **save 10% on final energy with a payback time of 1 year.**[6]

4. Lund et al. (2018). The Status of 4th Generation District Heating: Research and Results, p. 157.
5. EA Energianalyse (2021). ACTIVE ENERGY EFFICIENCY, p. 18.
6. Ecofys (2017). Optimising the energy use of technical building systems – unleashing the power of the EPBD's Article 8, p. 55 & 60.

A new sustainable city

Linde Haven is an entire new area in the city of Sønderborg complete with 92 flats, 34 terraced houses, 16 single-family houses and a school.

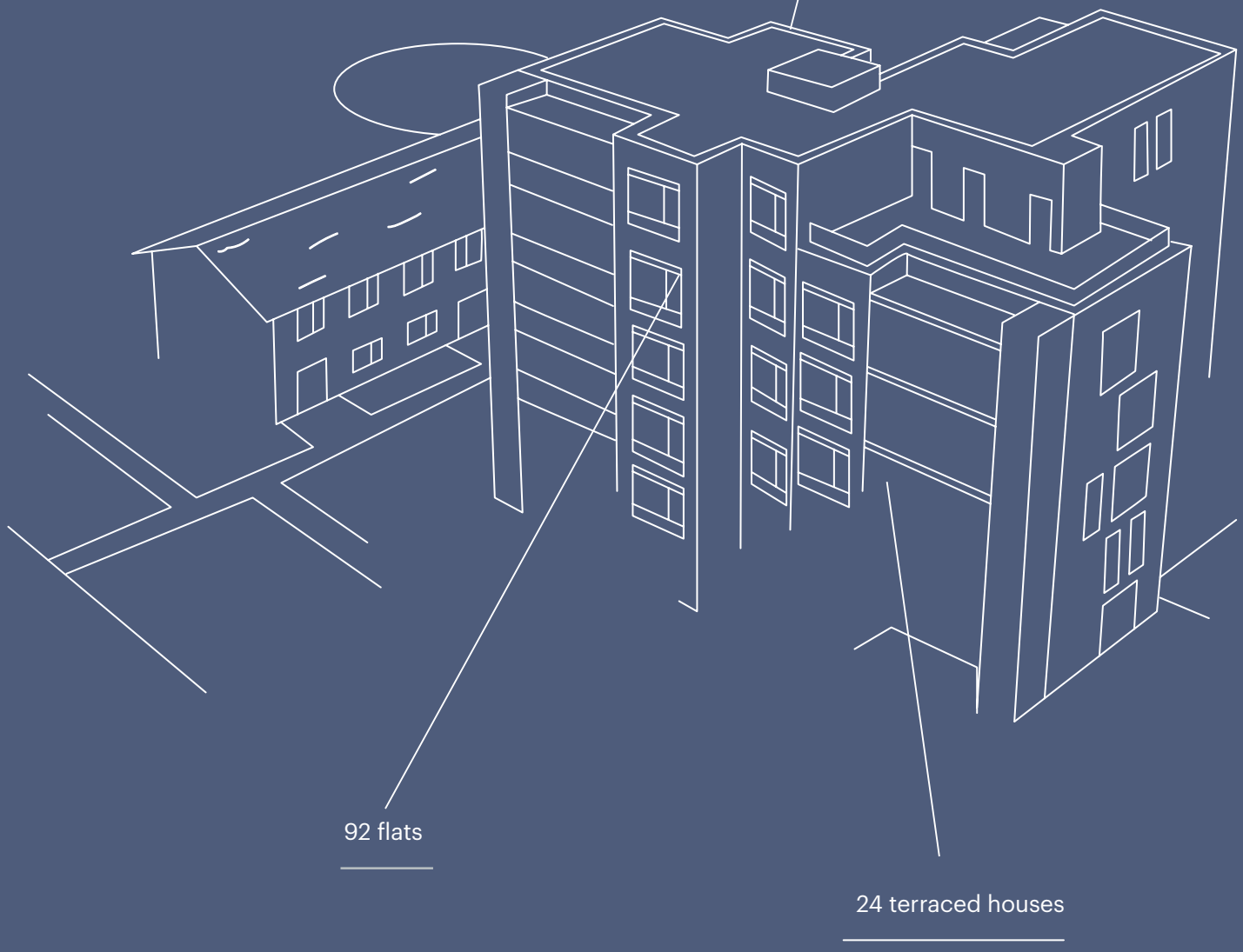
When the housing association 'B42' was tasked with constructing Linde Haven, they decided to make an extra effort to tap into the municipality's ambition to have a carbon neutral energy system in 2029 by adopting a sustainable approach both in the construction phase and in operations.

'B42' has prioritized sustainable materials and proximity of contractors in the tender process. Bricks, concrete elements, floors and other materials were chosen based on sustainability criteria and supplied by local manufacturers to reduce emissions from transport.

Energy efficiency has been a central focus in all aspects of the building's design and to provide comfortable living conditions inside the dwelling with the least possible amount of energy consumption. The building enclosure is designed with a series of passive energy efficiency measures such as insulation, energy efficient windows, doors and ventilation systems that reduce energy needs. Similarly, active energy efficiency measures add to the overall efficiency. Smart systems allow tenants to control everything from lighting, heating, air conditioning, underfloor heating and other forms of energy use as efficiently as possible.

Hot water is produced at an apartment level instead of in the basement, which minimizes the waste of heat and, together with highly efficient heat exchangers, allows the buildings to operate at lower temperatures. Lower temperatures offer great potential for lowering energy bills and reducing emissions.

Linde Haven


16 single-family houses and a school
92 flats
24 terraced houses

District energy provides a path to decarbonizing the heating and cooling sector

When buildings operate at lower temperatures, it supports a more efficient use of heat from heat pumps or district energy systems. Linde Haven will serve as a great example of that once the city area is complete.

In many parts of the world, district energy systems supply homes and companies with heating as well as cooling. District energy systems tap heat from processes, such as at power plants, and distribute it through pipelines to end users in the form of water.

Today, the majority of global district heat production relies on fossil fuels.[7] According to the International Energy Agency (IEA), the world needs to increase the share of green sources in district heating from 8% today to about 35% in 2030 to reach net zero. If we succeed, this will help to slash carbon emissions from heat generation by more than one-third.[8] The solutions are there to meet that goal and more.

In Sønderborg Municipality, Denmark, carbon emissions from space heating and domestic hot water have dropped by 73% since 2007 and the local district energy systems have been key drivers.[9]

7. IEA (2021). District Heating.
8. IEA (2021). District Heating.
9. ProjectZero (2021), Monitoring report 2020 Sonderborg Municipality, p. 38-39.

One of the main strengths of district energy systems is their capacity to integrate different heat sources that can push fossil fuels out of the heating and cooling mix. As a result of improved energy efficiency, temperatures in the district energy systems have been lowered over time, which allows for even more green sources to be introduced into the system.[10]

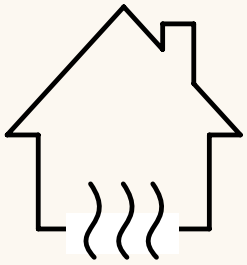
That includes excess heat. A laptop generates heat to operate, and a data center does the same in large scale. Excess heat from data centers can be reused through the district energy system to supply heat to buildings and industries. The same goes for supermarkets, biogas production, wastewater management and many other daily processes. Heat is generated as a waste product, and it can be reused or sold, instead of being simply released into the atmosphere.
The binding link is the district energy system.

Linde Haven is at the forefront of low-temperature green district heating and aims at operating at a temperature of 57°C when installations are complete, compared to the typical supply temperature of 70°C. When complete, Linde Haven will demonstrate the full potential of the link between modern, low energy buildings and energy efficient district heating.

10. Thorsen, J. E., Lund, H., & Mathiesen, B. V. (2018). Progression of District Heating – 1st to 4th generation.

The potential in energy efficient buildings and green district heating

The energy efficiency of buildings defines their operational temperatures. Operational temperatures at Linde Haven are low, and therefore the district heating temperatures can be lowered as well. Low district heating temperatures result in lower distribution heat losses. And better insulated distribution pipes reduces the heat loss further. It is estimated that the lower temperatures in the network have the potential to save 81 MWh a year – equal to a reduction of distribution heat loss of 31% compared to a similar building operating at normal temperatures.



31%

reduction in heat distribution loss compared to similar buildings operating on normal temperatures.

Energy savings can be found in buildings all over the world

Active energy measures can drive energy consumption down in both new and existing buildings all over the world.

The efficient airport in Istanbul, Turkey

Once complete, Istanbul's new airport will have an annual passenger capacity of up to 200 million, making it the world's busiest airport. The vast airport is built with energy efficiency in mind. The main terminal building of Istanbul Airport, its state guest house, mosque and ATC tower were designed according to LEED (Leadership in Energy and Environmental Design) certification, which promotes energy efficiency in design and operations. With the help of control valves, the indoor climate is kept comfortable using the lowest amount of energy, while heating installations prevent snow and ice from gathering on the enormous roof of the terminal building.

Keppel Bay Tower in Singapore

Keppel Bay Tower in Singapore is an exceptional commercial building with an unparalleled location. The 18-story building, owned by Keppel REIT and managed by Keppel Land, has been certified as a Green Mark Platinum Zero Energy building by the Building and Construction Authority (BCA), making it the first commercial building in Singapore to achieve this distinction.

Retrofitting the tower with energy efficiency solutions has been key to Keppel Bay Tower's certification achievement. This includes retrofitting existing air handling units with new and emerging energy efficiency technologies to improve the energy efficiency of air ventilation in the building, which significantly reduced energy consumption in the Keppel Bay Tower.

Denmark's energy lab in Nordhavn, Denmark

Nordhavn, Scandinavia's largest urban development project, is underway in Copenhagen. The project EnergyLab Nordhavn showcases the latest energy solutions and is a living laboratory that shows how electricity and heating, energy efficient buildings and electric transport can be integrated into an intelligent, flexible, and optimized energy system, supplied by a large share of renewable energy as well as reused excess energy.

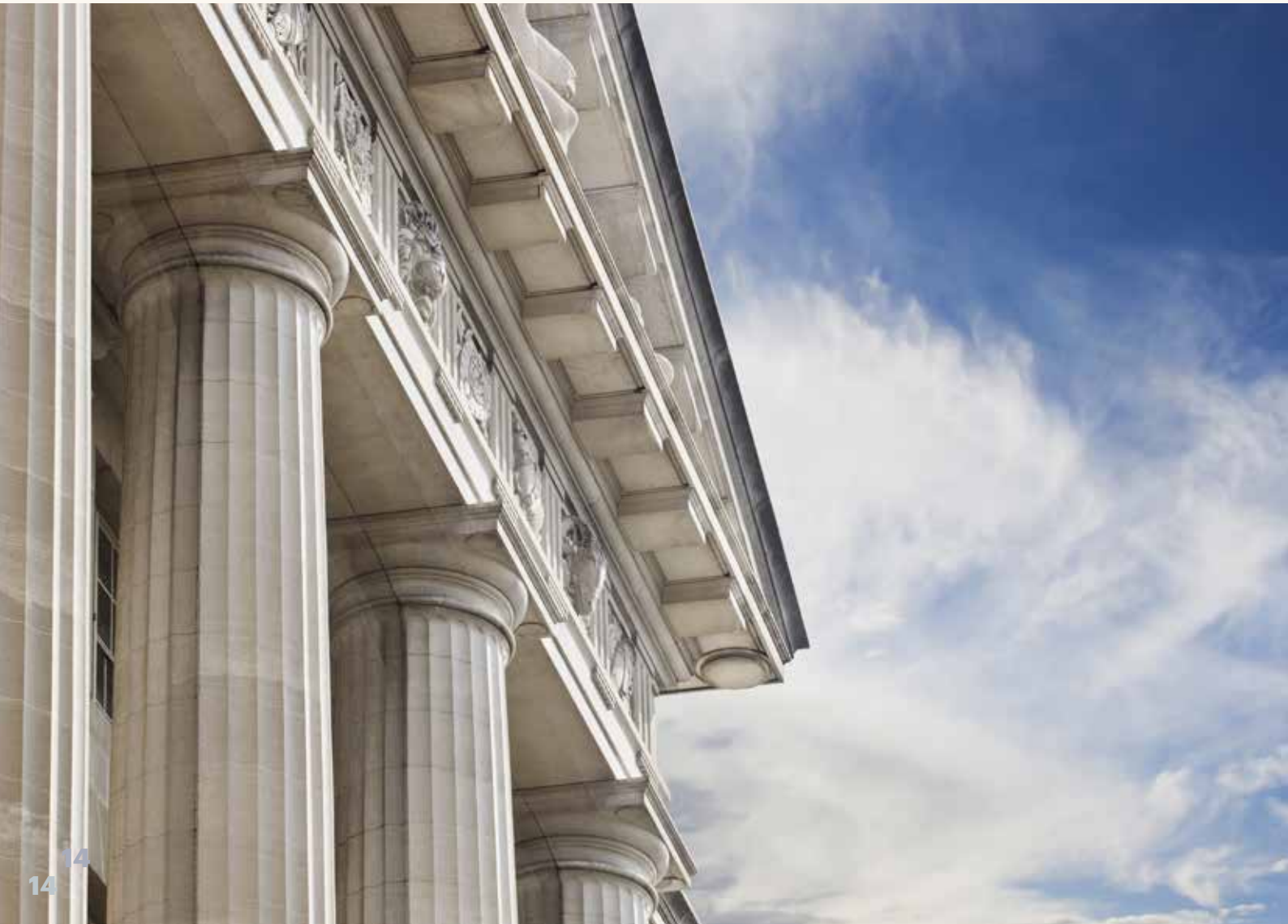
Affordable heating in Brooklyn, USA

In recent years, the average rent for a one-bedroom apartment in Brooklyn's Bushwick neighborhood has skyrocketed to more than $3,000 a month, excluding utilities. That is why New York City's Department of Housing Preservation and Development (HPD) and Ridgewood Bushwick Senior Citizens Council (RBSCC) came together to develop Knickerbocker Commons, a six-story, 24-unit, affordable multifamily building.

RBSCC wanted to cut tenant utility costs radically without compromising comfort, so they asked architects and engineers to design an ultra-low-energy building. Knickerbocker Commons features continuous exterior insulation, energy recovery ventilators, sealed combustion boilers, and individual room thermostat controls. It was the first mid-sized apartment building in the US to be certified to the Passive House Standard and was recognized in former New York City Mayor Bill de Blasio's One City: Built to Last program as an innovative approach to reducing the city's carbon footprint.

Stakeholder toolkit

Buildings have a long lifetime. Poor energy efficiency in new buildings locks consumption and operating costs in at a needlessly high level for decades to come. Even today, most new buildings are still being built with no effective mandatory efficiency codes. According to the IEA Net Zero Scenario, all new buildings must be zero-carbon ready in 2030. To meet this milestone, the following measures can be considered.



14

Set minimum requirements

Improve energy efficiency in new buildings by setting minimum requirements for specific areas, i.e., energy efficient cooling (in warm climates), energy efficient ventilation, energy efficient pumps and fans, and energy efficient appliances (IT equipment, fridges, freezers, washing machines, etc.). Furthermore, set building energy codes with minimum requirements for overall building energy performance, low-carbon materials and integration of onsite renewables or waste heat sources. If the new buildings are to become more energy efficient, it is essential to develop requirements for all new buildings, both residential and non-residential, public and private, and make sure to update the requirements regularly.

Address economic incentives

Make sure that taxes and fiscal policy support the construction of zero-emission buildings and address or alleviate barriers. Federal and local governments can reward green building construction and provide incentives to the different phases of green building construction, all the way from the planning phase throughout the operation of the building. For instance, governments can address the taxes on energy to make sure that there is an incentive to integrate heat sources such as excess heat. Furthermore, consider providing rebate incentives to stakeholders to offset the cost of procuring energy efficiency building features, and promote green mortgages and performance-based preferential loans to lessen the financial burden for stakeholders to construct and operate green buildings.

Establish partnerships

Initiatives like Linde Haven are possible through partnerships, and voluntary cooperation between different authorities and stakeholders is essential in any case. In order to promote energy performance certificates, passports and energy performance disclosure should be provided at the point of sale or lease. Meanwhile, partnerships and voluntary cooperation between different authorities are crucial for the provision of technical, financial and legal guides for the construction industry and other stakeholders. Furthermore, partnerships are also needed to provide training and education for craftsmen, architects, and engineers.

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Buildings account for 28% of all global energy-related emissions. We need to ramp up improvements in the energy efficiency of buildings.

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