



ENGINEERING
TOMORROW



Case story | Danfoss Leanheat® Building
and Dynamic Hydronic Balancing & Control

Save energy and money with AI and dynamic balancing

Centrally heated apartment buildings often suffer from variations in room temperatures due to inefficient and unbalanced heating systems. This can lead to unhappy residents complaining about lack of comfort or high energy bills.

In Sweden, cooperative organization HSB aimed to use an intelligent monitoring and control solution to improve the energy efficiency and indoor comfort of a 12-apartment block that was connected to district heating.

Read more to discover how Danfoss Leanheat® Building and Dynamic Hydronic Balancing & Control solutions delivered a modern AI-driven and reliable heating solution that has enabled HSB to achieve comfortable indoor temperatures, save money, and reduce energy consumption by 20%.

**10.9%
+
10.2%**

energy savings
while improving
residents' comfort

STAGE 1

The challenge

HSB is a cooperative organization, owned by the members, operating in property development and property management. They currently operate in 34 regions in Sweden. HSB Södermanland has approximately 3,000 rental apartments and 200 tenant-owned properties (BRFs) in their area.

In the city of Eskilstuna, Sweden, HSB had a multi-family block facing significant heating challenges.

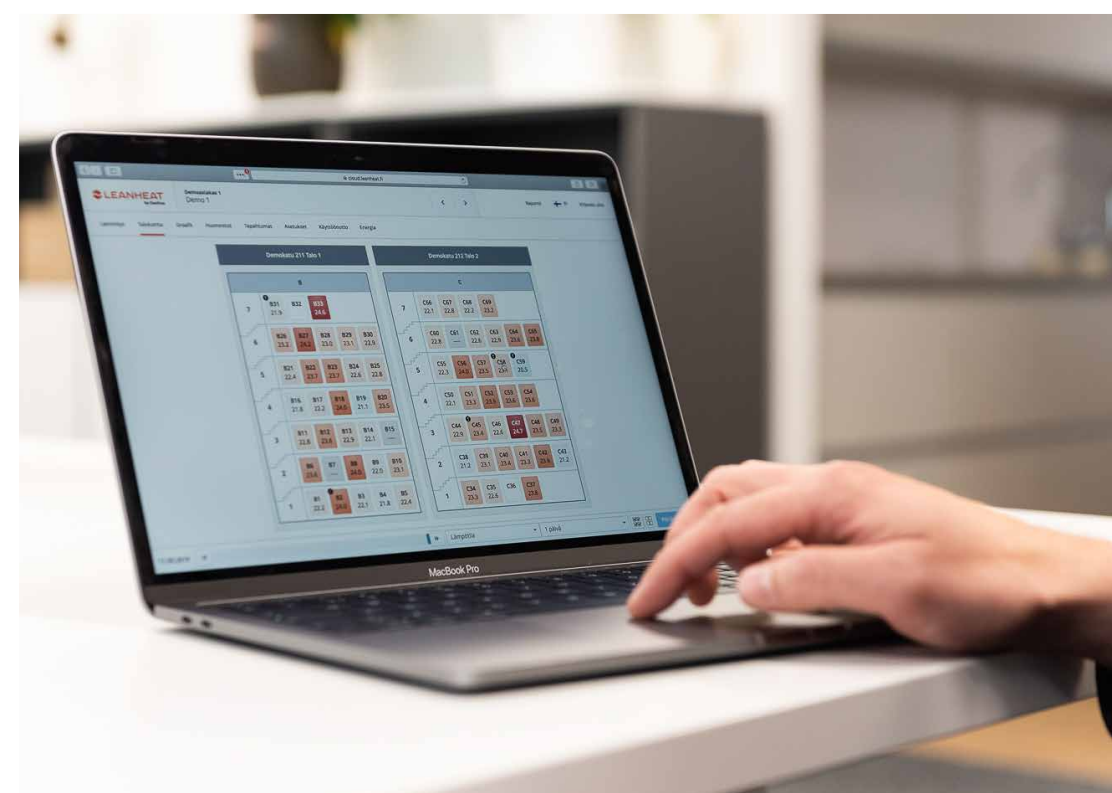
The Carlavägen block includes 12 apartments over 2 floors. Built in 1947, it has since been renovated with double glazed windows and is well insulated.

To heat the apartments, the building is connected to the district heating system via a substation.

Like many other multi-family blocks, the building lacked enough apartment sensors to get good visibility of the indoor conditions. The heating curve had to be manually set depending on outdoor temperature, and this was resulting in unsatisfying indoor temperatures and energy consumption.

HSB therefore required new smart solutions that could:

- stabilize indoor temperatures for tenants
- optimize energy use and minimize excess heat
- digitalize heating systems to gain better data
- automate systems for less manual work
- enable more efficient, cost-effective property management
- provide better support to tenants



**Remote
monitoring
and control**

**was needed to avoid
manual adjustments
and physical site visits
to multiple buildings**

STAGE 1

The solution

The initial step was to optimize the heating in the building to stabilize apartment temperatures, save energy, and reduce peak power usage.

At the beginning of 2021, Leanheat® Building—a cloud-based AI solution—was integrated into the building’s existing substation controller, without the need for any extra hardware.

Leanheat® Building software monitors and controls the site remotely. It gathers accurate data that allows HSB to enhance property management, automate the heating system, and analyze performance.

HSB chose to partner with Danfoss for its Leanheat® Building AI software solution. Leanheat® Building has a renowned reputation for providing exceptional service, AI optimization, and good Return on Investment (ROI) by optimizing heating supply temperatures based on user behavior, building characteristics, weather forecast and room temperature sensors.

By the summer, additional temperature and humidity sensors had been installed in the apartments to increase visibility of indoor conditions, enable better control based on indoor temperature, and analyze imbalances and variations.



Find out more

Artificial Intelligence

learns how to heat efficiently and effectively



STAGE 1

The result

Leanheat® Building software optimized the heating system and reduced energy consumption by 10.9% between November 2021 and April 2022.

The total amount of energy saved was 11,136 kWh.

Additional savings were also made by Leanheat’s ability to lower peak power and the corresponding costs.

There was also good news for the residents. Because of more stable average temperatures, overall indoor comfort was improved.

These enhancements are possible due to smart software that can predict when and how heating is required, and learn from the measured results to optimize performance.

10.9%

average saving on heating bills with Leanheat® Building AI software

Energy consumption before and after Leanheat® Building AI software was implemented

Month	Energy consumption (kWh) <i>Heating season 20/21</i>	Leanheat Building energy consumption (kWh) <i>Heating season 21/22</i>	Savings (kWh)	Savings (%)
Nov	17,250	14,127	-3,123	-18.1%
Dec	20,411	17,740	-2,671	-13.1%
Jan	20,726	19,178	-1,548	-7.5%
Feb	17,870	16,298	-1,572	-8.8%
Mar	15,520	13,510	-2,010	-13.0%
Apr	10,072	9,860	-212	-2.1%
Total	101,849	90,713	-11,136	-10.9%

The table contains normalized (degree days corrected) energy consumption data from Eskilstuna Energi & Miljö for a fair comparison.



STAGE 2

The challenge

At the end of the 2021 heating season, Leanheat® Building data analysis showed that the building had a combination of temperature imbalance and a higher setpoint, which indicated greater energy savings could be made.

In its current state, the two-pipe heating system had static balancing valves on the branches and old Thermostatic Radiator Valves (TRVs) on all radiators.

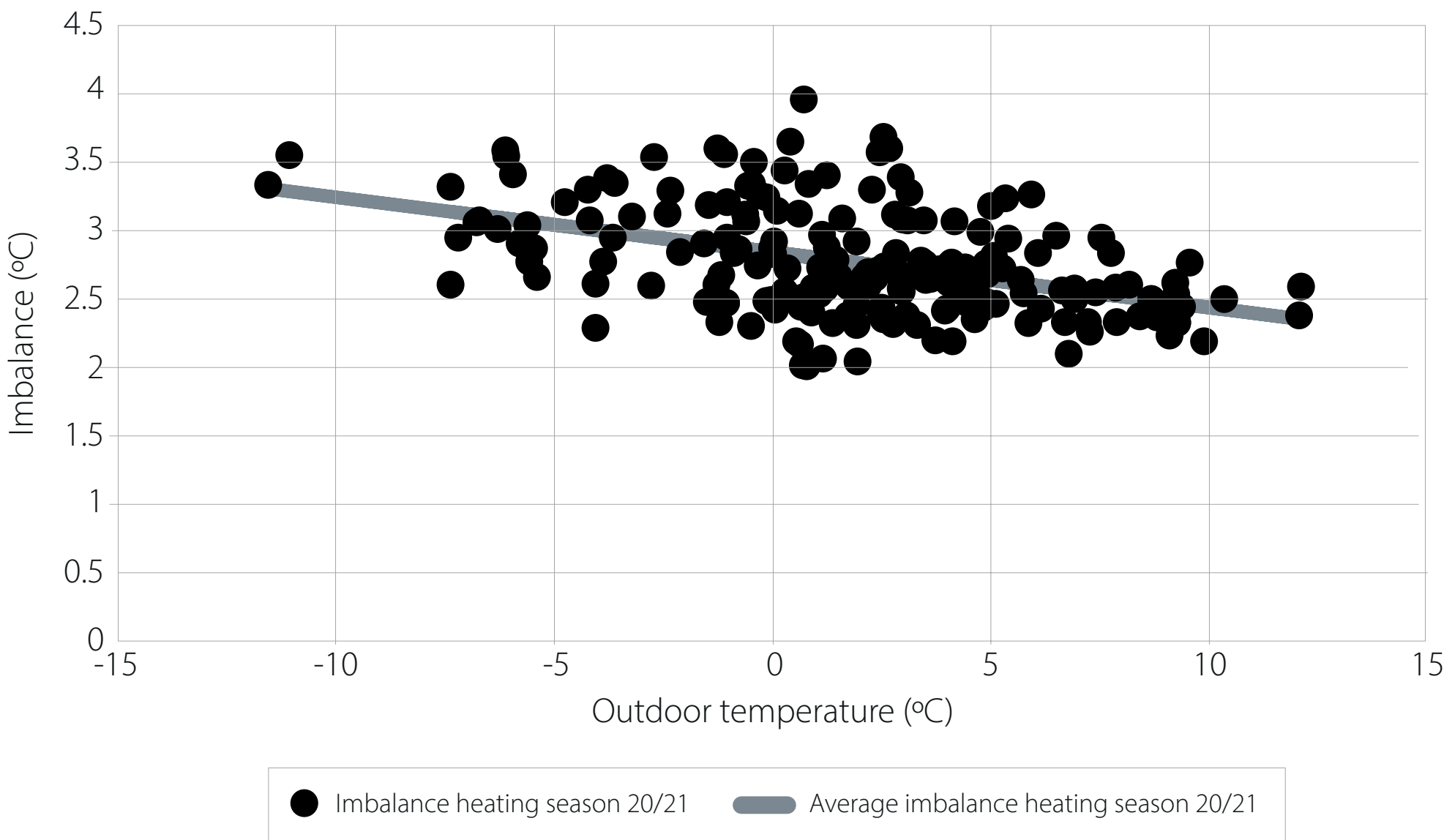
Static hydronic balancing solutions typically work quite well in full-load conditions. Yet, when the system gets to work in partial load conditions (when multiple rooms reach their desired temperature and TRVs close), this solution doesn't perform well. The remaining radiators will receive flows that are too high and experience increased differential pressure which can cause rushing sounds in the system. It also consumes unnecessary energy.

HSB wanted to optimize the system even more, so it runs perfectly in both full load and partial load situations.

Danfoss recommended that new pre-setting radiator valves and thermostats be installed, along with dynamic balancing valves, to ensure optimal flow and pressure control in the heating system.

The renovation would contribute to continuous system optimization and results would be monitored and visualized using Leanheat® Building software as shown on this graph.

Temperature imbalance between apartments during the heating season 2020/2021 indicated more energy could be saved and indoor comfort could be further improved



STAGE 2

The solution

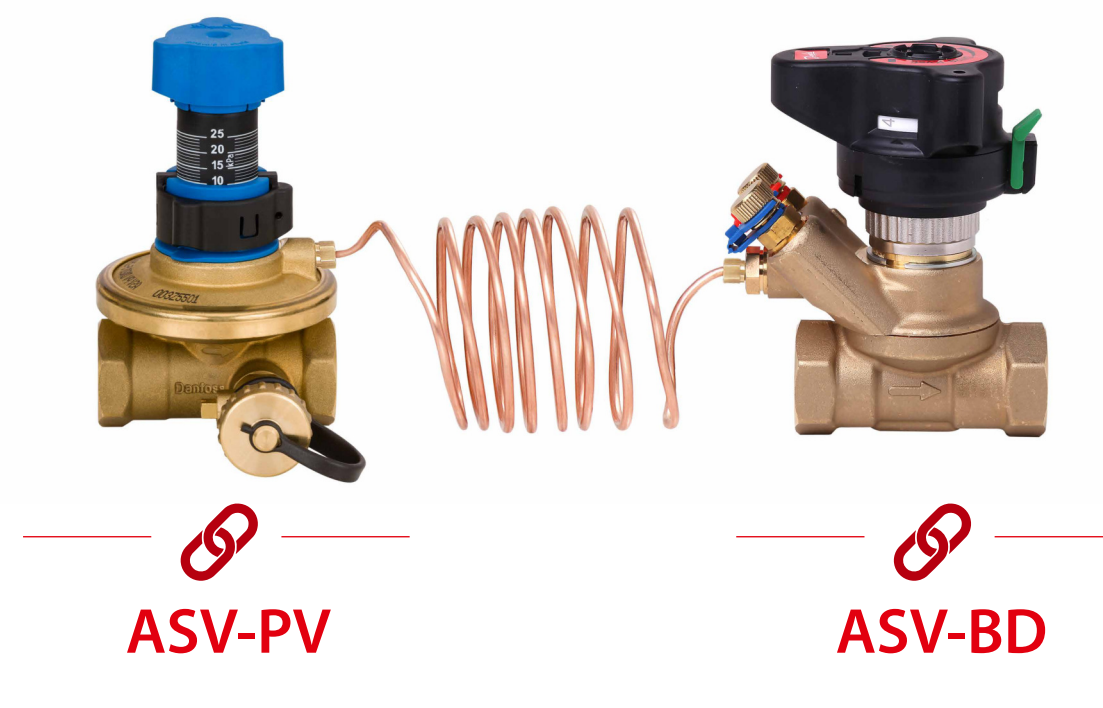
In July 2022, work began to replace the old valves and balance the two-pipe radiator heating system.

Danfoss ASV-PV return-pipe mounted differential pressure control valves and ASV-BD partner valves were installed to control the differential pressure over the branches. Danfoss RA-N valves were installed on each radiator and were pre-set to ensure optimum distribution of the water in the heating system.

RA-2000 thermostats were also installed on each radiator to enable residents to maintain desired room temperatures and lower energy consumption.

Together these components created a dynamic, well-balanced system that optimized heating and eliminated noise and energy waste.

For the installation and commissioning of the valves, HBS involved the experts from Mälardalens VVS. The engineers followed the easy-to-use Optimal 2 method for installation, which provides guidance on the correct sizing, setting and commissioning of the heating system.



“Working with the Danfoss Optimal2 method was a joy! We have never done an adjustment so quickly with such good results before. The valves work superbly. Spending time on planning at an early stage is important for things to run smoothly in the workplace. Here, too, we received a helping hand from Danfoss to get started.”

Carl Hedbäck, Installer, Mälardalens VVS

STAGE 2

The result

After the installation of the Dynamic Balancing and Control solution, the imbalances in the apartments were significantly reduced. HSB could even decrease the setpoint by 1.5°C without changing the comfort levels or increasing the temperature imbalance.

Energy consumption was reduced by a further 10.2% (compared to Leanheat® Building implementation alone in 2021).

The additional amount of energy saved was 9,223 kWh.

Importantly, tenants now have a comfortable home environment with stable temperatures and reliable heating.

10.2%

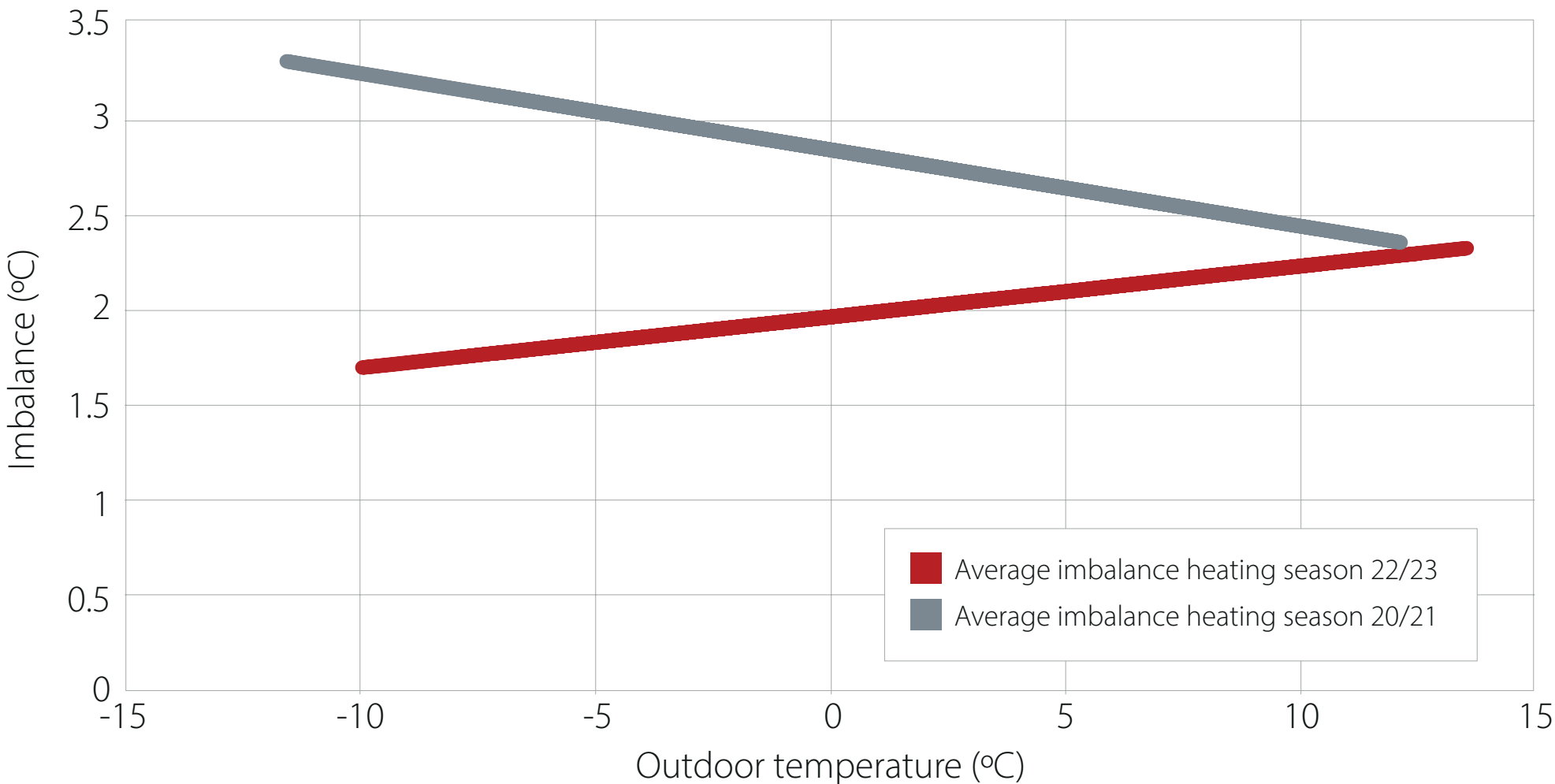
**additional savings
with Dynamic
Hydronic Balancing
and Control**

Energy consumption before and after expansion of Leanheat® Building software with dynamic balancing and control solution

Month	Leanheat Building® energy consumption (kWh) <i>Heating season 21/22</i>	Leanheat Building® Dynamic Balancing energy consumption (kWh) <i>Heating season 22/23</i>	Savings (kWh)	Savings (%)
Nov	14,127	11,706	-2,421	-17.1%
Dec	17,740	15,819	-1,921	-10.8%
Jan	19,178	16,834	-2,344	-12.2%
Feb	16,298	14,379	-1,919	-11.8%
Mar	13,510	13,767	257	1.9%
Apr	9,860	8,985	-875	-8.9%
Total	90,713	81,489	-9,223	-10.2%

The table contains normalized (degree days corrected) energy consumption data from Eskilstuna Energi & Miljö for a fair comparison.

Average temperature imbalance before and after expansion of Leanheat® Building software with ASV dynamic balancing and RA-N/RA 2000 control solution



The imbalance reduced significantly, especially at lower outside temperatures, resulting in more stable indoor temperatures for higher comfort and lower energy consumption.

“The project to replace the balancing valves and thermostatic radiator valves and sensors at Carlavägen 72-74 went beyond expectations and without major disturbances. We are able to keep a stable temperature between 20° to 21°C in all apartments.”

Patrik Granholm,
Project Leader, HSB

The conclusion

HSB now has a fully optimized, energy efficient heating system that can be monitored remotely, saves money, and keeps apartments at a comfortable temperature.

The total savings established by the combination of Leanheat® Building and Dynamic Hydronic Balancing & Control reach around **20%**.

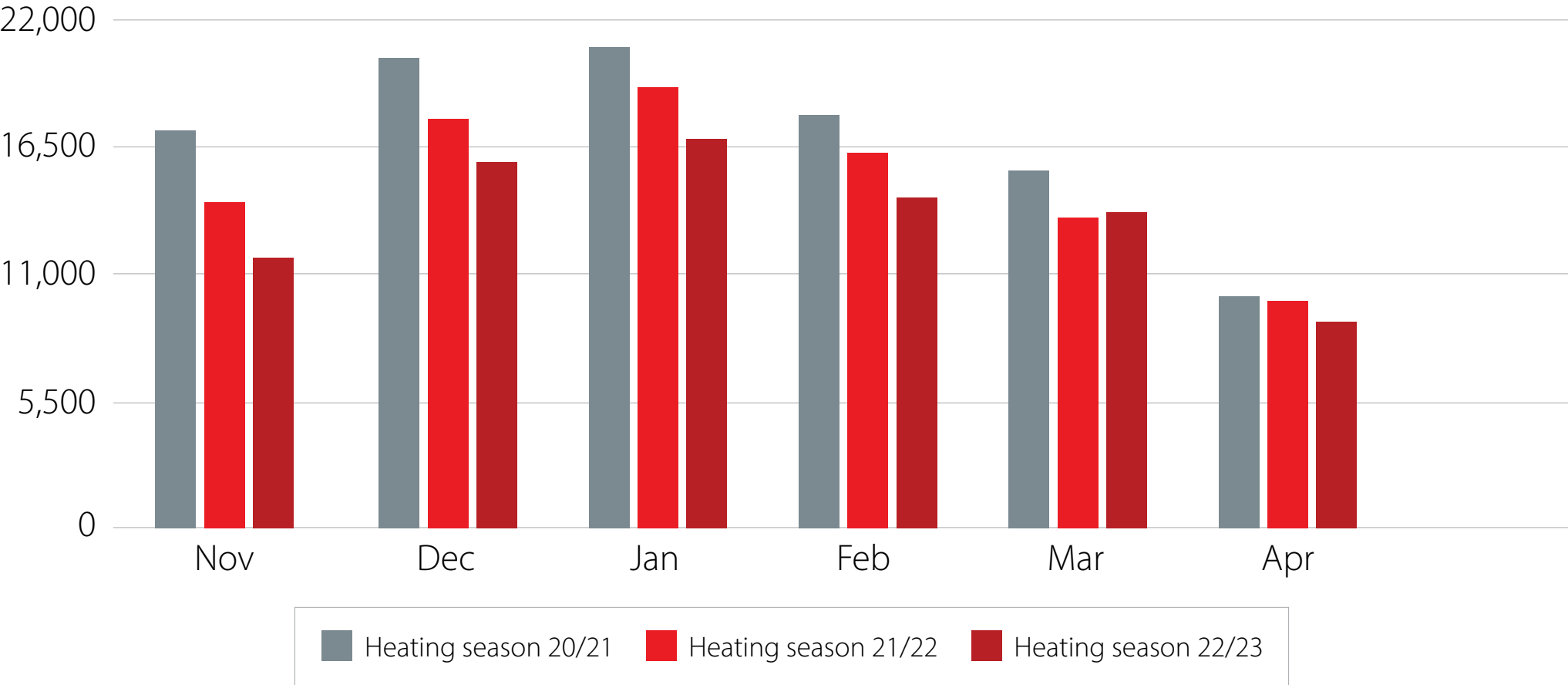
The total energy savings over 2 heating seasons was 20,359 kWh.

Danfoss continues to provide HSB with product expertise while Leanheat® Building offers data analysis and AI optimization support. Plans are currently in place to equip more HSB facilities with Danfoss Leanheat® Building and Dynamic Hydronic Balancing & Control solutions.

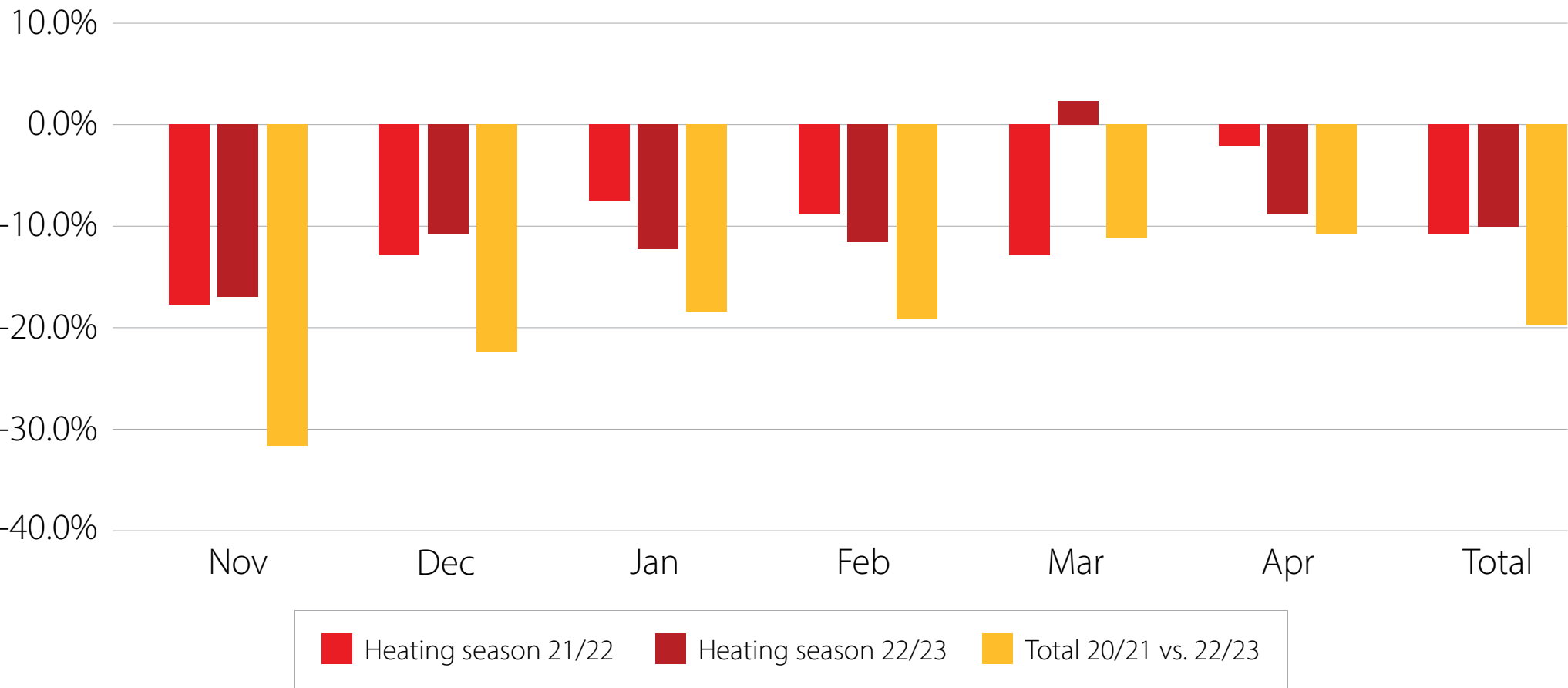
20%

total energy saving
with Leanheat®
Building and
Dynamic Balancing
& Control

Energy consumption (kWh)



Energy savings (%)



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