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WHITE PAPER

SMART CONTROL OF RADIATOR THERMOSTATS

How you can use smart radiator thermostats to save energy, CO_2 and costs.

#bettertogether

Content

Introduction

Energy efficiency is a key issue for building owners and occupants. The use of IoT technologies such as LoRaWAN® offers numerous opportunities to reduce energy consumption as well as intelligently optimize consumption profiles.

The key to this are smart buildings. These are equipped with a variety of networked devices that independently communicate with each other and automatically perform actions.

In order to reduce energy consumption, energy costs and emissions, the legislator in Germany also sets corresponding guard rails such as the Buildings Energy Act (GEG) or the Heating Cost Ordinance (HKVO).

In the property of the future, digitalisation and sustainability go hand in hand. The goal is to make the building stock climate-neutral by 2045. Especially in view of the currently rising energy costs, it is also in the interest of landlords, building occupants or other building users to use energy as efficiently as possible. In this way, economic interests and environmental goals can be combined.

This white paper examines the opportunities that exist, particularly when retrofitting existing buildings, and why smart radiator thermostats in particular are an excellent solution for energy savings in buildings and networked neighborhoods.

INFO: LORAWAN®

LoRaWAN® is a communication protocol specifically designed to meet the requirements of IoT applications that rely on long battery runtimes in addition to range. With its special radio modulation, this bidirectional, wireless transmission method enables data transmission over long distances while consuming little energy.

Potential Savings

IoT in buildings and quarters

In the future, the Internet of Things (IoT) will play an even more important role in saving energy at the building and neighborhood level by enabling more efficient monitoring, control and automation of energy systems.

FUNDAMENTALS AND POTENTIALS

An evaluation by the German Energy Agency (dena)[1] shows that buildings account for about 35 percent of Germany‘s total final energy consumption.

Around 63 percent of residential buildings in Germany were built before the first Thermal Insulation Ordinance came into force in 1979. Consequently, the efficiency potential of older houses is particularly high, according to dena.

For these buildings, controllable thermostats, such as via LoRaWAN®, offer a simple and effective way to save energy. In order to develop accessible solutions for the operation of large properties and quarters, heating control via smart thermostats in particular presents itself as the most promising solution. In this case, the investment costs and the operating expenses are equally low.

A study of the Karlsruhe Institute of Technology (KIT)[2] also proves: „Comparing the relative heat consumption of households with Smart Thermostats and the twin building households without Smart Thermostats, the equipped households have an average of 31.5 percent lower relative heat consumption.“

According to the KIT case study, the use of smart radiator thermostats saved up to 31.5 percent in relative heat consumption.

CHARACTERISTICS AND ADVANTAGES OF LORAWAN® THERMOSTATS

Conventional thermostats basically require manual adjustment in order to regulate the temperature in the room. In contrast, smart thermostats are able to control the room temperature automatically using LoRaWAN® .

Networked thermostats with LoRaWAN® offer the following advantages:

- Energy efficiency: Heating and cooling systems already accounted for a good two-thirds of a building’s energy costs in 2018. Smart thermostats can directly reduce these costs by improving energy efficiency through targeted control and reduce energy consumption.
- Higher comfort for building users: Smart thermostats allow building occupants to independently set and adjust their heating and cooling preferences.
- Intelligent energy saving: By connecting smart thermostats with other smart building systems, such as lighting and ventilation, the building’s overall energy consumption can be optimized.

- High potential savings: The use of LoRaWAN® thermostats can save energy costs, especially in large building complexes or entire quarters.
- Remote control via mobile devices: LoRaWAN® thermostats can be controlled remotely via tablets or smartphones.
- Sustainable: In the first step smart thermostats often serve as the most economically sustainable solution to reduce the CO_2 footprint of buildings.

CHALLENGES

- Compatibility: It should be ensured in advance that the selected smart thermostat is compatible with the existing radiator valve.
- Data access: Smart thermostats often collect data about temperature and system usage. Data protection concerns must always be taken into account in this context. Appropriate rights management in the IoT platform can counteract these concerns. Since LoRaWAN® is end-to-end encrypted, it is particularly well suited and secure for this application.
- Connectivity: In addition to the assembly, connectivity to the platform and full system integration must also be ensured. The chosen solution should have full end-to-end process integration, relieving the user of system setup and configuration activities.
- Connection quality: When smart thermostats are used particularly in apartment buildings or utility buildings, the data connection of the devices must be guaranteed over the appropriate distances and through the building structure. Conventional wireless technologies such as WLAN or Bluetooth® quickly reach their limits here.
- Dependence on technology: Problems may occur in the event of connectivity and functional faults. Here, especially in heating periods, a fallback solution on the part of manual thermostat operability must be ensured.
- Costs: The initial costs are significantly lower compared to other measures in unrenovated buildings. Thus, smart thermostats often represent the most efficient measure for decarbonizing the real estate stock.
- Rollout: Care must be taken to ensure proper insertion into the field of networked sensors - especially at high volumes. Here, IoT rollout solutions and integrated processes are essential to ensure long-term economic operation.

Practical Example

Control of smart thermostats with BuildingLink

To make the temperature control of entire buildings efficient from an operational point of view, special applications are used, such as ZENNER BuildingLink. These assist in controlling the individual radiator thermostats.

Faulty radiator valves can be identified via the functions of the smart thermostats and applications, as can upcoming battery changes. This professional device management enables facility managers to initiate maintenance processes when needed.

The data from sensors, actuators, and information about the building and the heating system must be available without errors and without media breaks, from installation to use in the application. This is the only way to achieve the highest level of automation and end-to-end digitisation in processes.

With ZENNER BuildingLink, the heating behavior of entire buildings or building areas can be adjusted with just one click. The integrated target/actual comparison supports building owners, managers and users alike in targeted energy saving. In addition, BuildingLink contributes to preventive protection of the building fabric with temperature curves and dew point calculations. By controlling target temperatures, energy is immediately saved and CO_2 emissions are reduced.

View of the ZENNER BuildingLink application with display of the target and actual temperature as well as the option for central temperature control and viewing of historical measured values.

Example economic efficiency

View of a large office complex

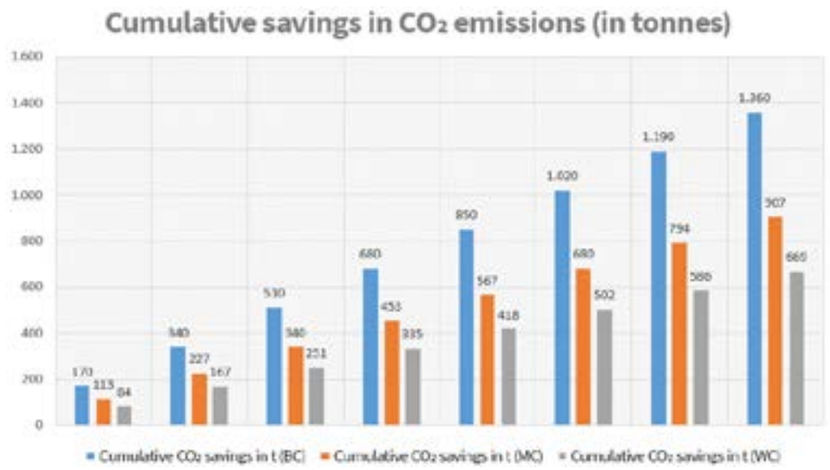
BuildingLink is to be used in an exemplary office complex. The economics for deployment in this example are calculated and projected over an eight-year period.

The office complex has a total area of 27,000 m2. The heating costs per year amount to approximately 374,447 euros. To determine this, the primary energy demand of the building class[2] was approximated and average prices from the German Federal Statistical Office were used.[3]

There are a total of 1,400 radiators in use. A total investment of around 259,487 euros is expected for the retrofitting of the building.

Based on these factors, three scenarios with different energy savings potentials[1] were considered - a best, middle, and worst case.

Depending on user behavior and building insulation, energy savings potentials of 31.5 percent are possible in the best case. Over an eight-year period, this corresponds to cost savings of 943,606 euros and a reduction in CO_2 emissions of 1,360 tons[4]. The amortization here takes place in about 20 months.



SOURCES AND BASICS

[1] Energy savings potential (heat sector) for tenants through the use of smart radiator thermostats: Case Study, Institute for Technology and Management in Building Operations (TMB), Karlsruhe Institute of Technology (KIT).
[2] Source: Study Wohnen und Sanieren, Umweltbundesamt, S.13. https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2019-06-03-barrierefrei--broschuere_wohnenundsanieren.pdf
[3] Federal Statistical Office (Destatis), 2023 | Status: 05.07.2023 / 14:28:21
[4] Source: Act to Standardize Energy Conservation Law for Buildings and to amend other laws, page 1789, For district heating, the average emission factor of all fuels was used, Status: 13.08.2020

Outlook

Saving energy in buildings and neighborhoods

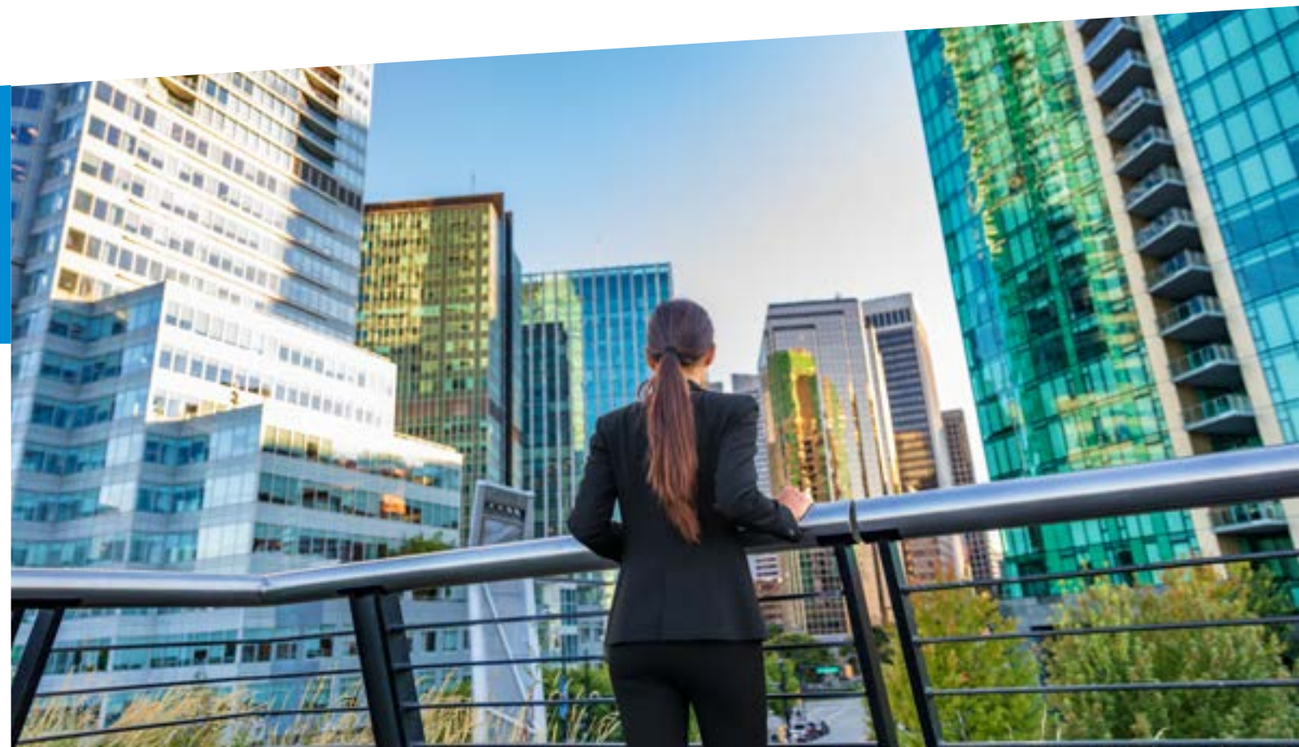
Smart thermostats are a targeted choice for energy savings in the smart building and allow easy scaling from the individual building to the building complex to the smart neighborhood. In this context, the advantages of IoT technologies in energy saving in buildings can be played out extensively.

From a technical point of view, smart thermostats are the most effective and, in terms of installation effort, the most accessible measure for initial heating energy savings.

From an operational point of view, connectivity via LoRaWAN® plays out its advantages in that cross-scale and demand-driven integration is possible, from building control systems to energy district concepts. Integrated end-to-end processes for the deployment of IoT technology are the foundation for this. Especially for public utilities, municipal representatives and property managers in general, this circumstance offers a lot of development potential, especially if they have already rolled out LoRaWAN®, for example. This means that duplicate infrastructures do not have to be set up.

Smart thermostats have gained popularity in recent years as they increase the comfort and energy efficiency of heating systems while offering a good price-performance ratio at the same time.

In the future, smart thermostats will be further developed and improved in terms of hardware and software.



The following developments are to be expected:

- Integration of further IoT devices: Smart thermostats may be integrated into the IoT network in the future to facilitate interaction with other devices in the home and improve automation. In addition, it is possible to integrate other operationally relevant technologies of the property, such as smoke detectors, into the architecture.
- Improved energy efficiency: Future smart thermostats are likely to be even more efficient at saving energy by automatically optimizing energy consumption and giving users tips on how to improve energy efficiency.
- More functionality: Smart thermostats are expected to offer even more functions beyond simply controlling radiators. As a result, they will provide an even better user experience and allow for increased personalization.
- Advanced Artificial Intelligence (AI) and Machine Learning: Smart thermostats will be able to understand heating and cooling needs of users even better through data collection and analysis and adapt accordingly. As machine learning continues to develop, this will be possible locally and without transferring the data to a cloud.

SOURCES

(1) German Energy Agency (dena) „Designing buildings for energy efficiency“ (https://www.dena.de/themen-projekte/energieeffizienz/gebaeude/)
(2) Karlsruhe Institute of Technology (KIT, 2023) „Energy savings potential (heat sector) for tenants through the use of smart radiator thermostats, case study“ (https://publikationen.bibliothek.kit.edu/1000157856)

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