ENGINEERING
TOMORROW

Whitepaper

Renovate to Innovate

Resilient buildings fit for the future.

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Resilience (sometimes referred to as "resiliency") has been defined broadly as "the ability to resist being affected by an event or the ability to return to an acceptable level of performance in an acceptable period of time after being affected by an event closing."

In the event of a disaster or extreme event, the benefits of energy efficient buildings can extend far beyond cost savings. Buildings designed to be energy efficient and/or store or produce energy onsite offer a greater level of protection to the people and operations they house.

Energy efficiency measures contribute to resilience in a number of ways.

- Energy efficiency increases the passive survivability of buildings—the ability of buildings to maintain habitable conditions in the event of a heating/cooling system loss or with rising energy costs.
- Energy efficiency measures are a powerful complement to onsite energy generation and storage, as they can significantly reduce the necessary size and cost of power systems and can increase the reliability of existing backup power in serving critical loads. This is of particular relevance for commercial, industrial and public building owners, for whom the economic impacts of a loss of power (electricity, colling or heat) tend to be significantly greater than for residential customers.
- Most energy efficiency active solutions make the building able to adapt to changing user profile and behavior.
- Staged renovation is made easier with efficient technical building systems, that make the building able to adapt to new heat sources and improved envelope.

A resilient building requires lower costs for total energy while providing greater comfort and higher indoor air quality. Efficient buildings reduce the energy consumption impact of event-driven (e.g., heatwave, cold snap or war…) price spikes on power and heating fuel.

In social and low income owned buildings this means that energy bills will still be covered, safeguarding occupants' ability to pay rentals or mortgages. It enables provision of grid services (e.g., demand response, ancillary services).

Decreased demand may decrease the likelihood of electricity grid failures or natural gas transmission constraints during extreme events (e.g., heat waves or winter storms or supply unavailability) that drive peak demand beyond system capacity.

Resilience

- Multiple Energy Sources
- Multiple Water Sources
- Disaster Fortitude Design
- Emphasis on passive systems
- Reduced Environmental Effects
- Flood Plain evaluation of building location

- Energy Independence
- Water Independence
- Renewable Resources
- Resource Storage
- Environmental Effects
- Community Support

Sustainability

- Energy Reduction
- Renewable Energy Production
- Recycled/Reclaimed Water
- Locally Sourced Material
- Community Responsibility
- Acces to Transportation
- Indoor Environmental Quality
- Brownfield Restoration

I. We need to renovate our buildings – **for our planet**

a. Today's buildings consume massive amounts of energy

- **i.** 28% of global CO_2 emissions and 30% of global energy consumption are caused by HVAC and lighting in buildings
- **ii.** 12% of water use is consumed by building construction and operation
- **iii.** We spend 90% of our time indoors

b. Now is the time to boost energy savings by improving our buildings.

- **i.** 9 out of 17 of the UN SDGs in the Paris Agreement apply to buildings
- **ii.** 2030 is the year we can achieve 40% fewer carbon emissions in the building construction sector
- **iii.** 2050 is the year we can achieve net zero carbon emissions in the building construction sector
- **iv.** 30% average energy savings potential by optimizing technical building systems

c. Making buildings more energy efficient is the only way to tackle the global energy crisis

- **i.** Monthly inflation rate in 2022 for gas was 51.4%; liquid fuels – 45.2%; energy – 41.1%; and electricity – 29.7%.
- **ii.** 70 million European homes are without thermostats. The IEA estimates that Europe can save 10 BM of gas every time a private home reduces its temperature by 1 degree. To make this happen, residents need to be able to efficiently control room temperature.
- **iii.** Upgrading Europe's 500 million inefficient radiators with thermostats will save 130 TWh – two times Germany's net electricity generation from nuclear power in 2021.

II. **New legislation** is driving the **need for renovations**

a. The European Commission's Energy Performance of Buildings Directive is designed to boost the energy performance of buildings to help reach the goals defined in the European Green Deal. When it comes to renovations, there are key guidelines to focus on.

i. Self-regulating devices

1. In new buildings, self-regulating devices should always be the starting point.
2. They offer fast ROI of 1–3 years with a low upfront cost of €1.50/m2.
3. They can considerably improve tenants' health and comfort while tackling energy poverty
4. The installation of self-regulating devices will be systematically required in all existing buildings where heat and cold generators should be replaced by 2027.

ii. Dynamic balancing – Article 11

1. Hydronic imbalances and the lack of individual room temperature controls cause energy waste, unnecessary heating/cooling costs, complaints, and the performance gap between expected and actual energy consumption after a renovation.
2. Ensuring optimal energy performance at all heat load conditions is essential to consistent living comfort and low operating costs.
3. Dynamic balancing ensures the best 'low-temperature heating' necessary for elevated heat pump performance (COP).
4. The total potential savings from optimizing hydronic distribution in domestic EU heating systems would amount to 2.6 Mtoe.

iii. Indoor Environmental Quality (IEQ)

1. IEQ should be promoted at a unit level—not just the building level
2. The monitoring of IEQ should be made visible to tenants to inform them about deviations between actual and target values to incentivize optimization
3. Each unit should be able to measure the IEQ to properly identify failures, localize inefficiencies and streamline follow-up

III. Why **investing in energy efficiency** is good for business

a. It's an investment in your tenants. Tenants' demand/expectations for cost-saving, energy-efficient and reliably comfortable heating in their homes is only rising. They want:

- **i.** Affordable rent and utilities
- **ii.** Hygienic hot water
- **iii.** Individual temperature zones
- **iv.** Quiet and fully-functioning radiators
- **v.** Modern, energy-efficient heating technology

b. It's an investment in your business. That gives you:

- **i.** Stable costs during renovation and new-builds
- **ii.** Lowest possible investment with rapid ROI
- **iii.** Long-term value retention (easy to rent or sell)
- **iv.** No need for legionella testing
- **v.** Fewer complaints
- **vi.** Reliable heating technology that's easy to bill

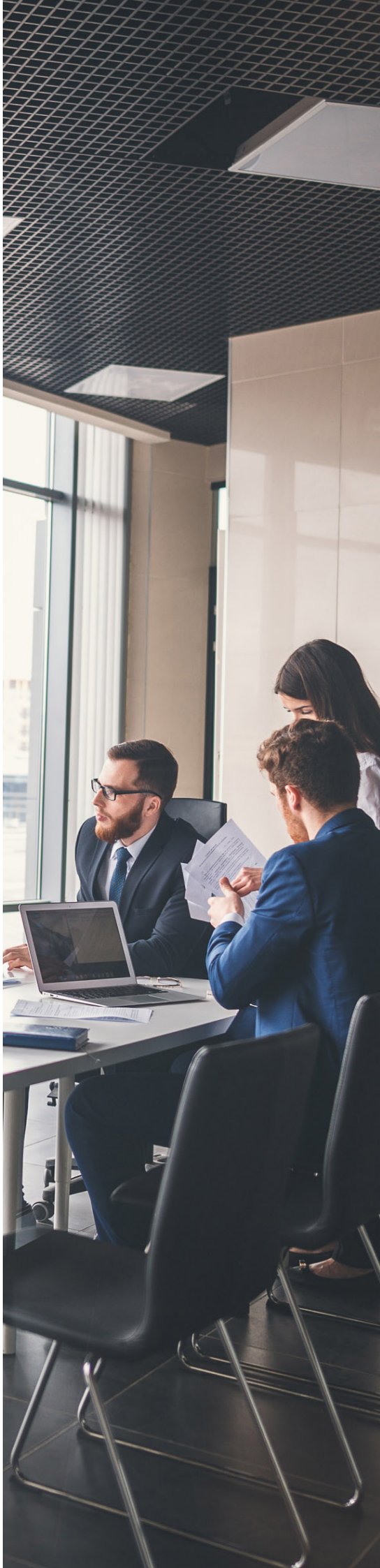
IV. Make a **big impact** with a **minimal investment**

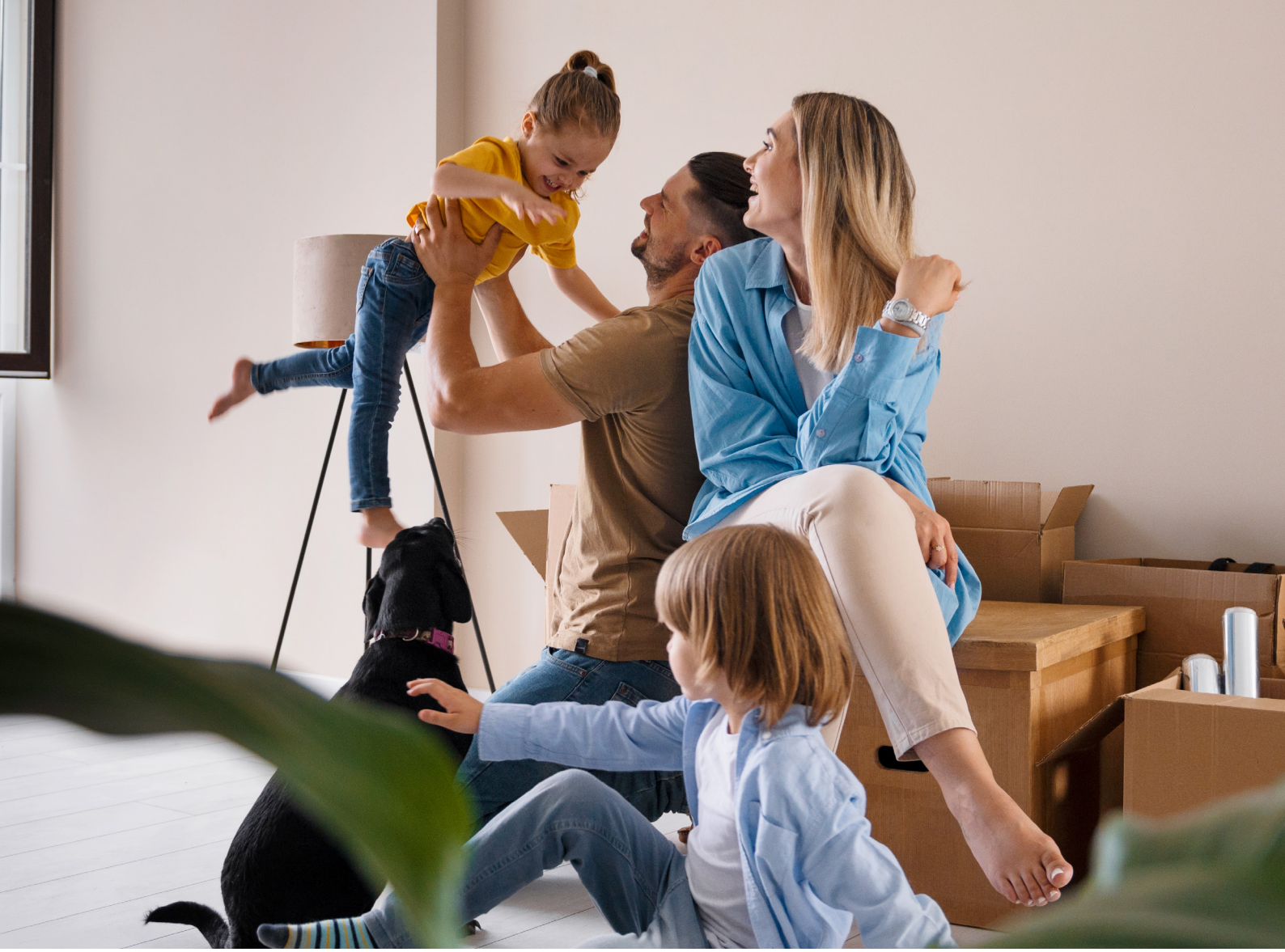
a. Traditional heating systems are often inefficient

- **i.** Traditional heating systems—usually those built prior to 1990—have an inefficient, single boiler design or district heating connection that often leads to inconsistent hot water supply to radiators throughout the building.
- **ii.** These system imbalances make it extremely difficult for tenants to achieve the comfort level they want. Plus, they experience noisy radiators, excessive or inadequate heating, and varying heating times. All of which leads to energy loss and high heating costs.

b. To fully optimize the heating system, you need to:

- **i. Ensure risers are properly balanced.** This ensures hydronic balancing of the entire system under all conditions and outside temperatures.
- **ii. Properly balance all radiators.** By installing pre-setting TRVs, you can ensure an even water flow through the system.
- **iii. Ensure easy and effective temperature control by adding sensors to TRVs.** This enables automatic temperature regulation to provide tenants with an optimal indoor climate and maximum energy savings





V. Decentralized vs centralized **heating systems**

a. Decentralized systems for heating and domestic hot water bring many advantages, including lower energy consumption, more revenue-generating space in apartments and multi-family housing, and reduced heat waste.

b. Renovating your building for decentralized heating can be time-consuming and come with expensive initial costs. However, the benefits are worth the investment of time and resources:

- **i.** Reduced heat losses and heating costs
- **ii.** Increased comfort, convenience, and hygiene
- **iii.** Transparency and control over heating and hot water bills

c. According to a 2008 study*, a decentralized heating solution reduced heat loss from pipes by more than 40% compared to modern centralized domestic hot water solutions—and as much as 80% compared to traditional one-pipe solutions.

d. A study* comparing the initial investment costs for a traditional central heating system versus modern decentralized systems for the renovation of 50 apartments shows that while initial costs for traditional central heating systems are lower than for decentralized systems, the 30% higher investment cost for a decentralized system with decentralized DHW products has an **ROI of about 9 years** due to **70% lower energy consumption costs**

VI. **Green renovation** in action

a. Reducing energy usage by 14% in a multi-tenant building in Italy

i. Five 9-story apartment buildings in Milan, Italy had radiators equipped with thermostatic radiator valves for years.

ii. By fitting the system with automatic balancing valves, they were able to:

1. Reduce energy usage by 14%
2. Reduce radiator noise
3. Lower maintenance costs
4. Improve indoor comfort

b. Reducing energy usage by 20% in a multi-tenant building in Sweden

i. Residents on the 10th floor of an apartment building in Sweden complained about insufficient heating. The problem: the heating system wasn't balanced properly.

ii. Using the simple Optimal 2 tool, they balanced the existing 2-pipe radiator system and replaced existing radiator valves with lockable thermostatic valves.

iii. Achieved:

1. ROI in 3 years
2. 20% energy savings annually
3. Improved indoor comfort
4. Eliminated complaints

iv. "We're very pleased with the solution and plan to use this energy renovation method in several other buildings." Marcus Nejdel, Energy Manager Bostadsbolaget AB in Mjölby, Sweden

c. Reducing energy usage by 25% in a multi-tenant building in Estonia

i. Residents in a 9-storey apartment building in Tallinn, Estonia, dealt with inconsistent temperatures in individual apartments. The housing association wanted to provide better comfort for residents, increase the heating system's efficiency, and save on annual energy costs.

ii. By replacing the old one-pipe system with a two-pipe system equipped with Danfoss automatic balancing valves and thermostatic radiator valves, residents enjoyed equal heat distribution with individual heat control all year round – with fair allocation of heating costs.

iii. Achieved:

1. 25% annual energy savings
2. individual room control
3. easy commissioning
4. year-long comfort

iv. "We are pleased to see how improved user comfort and energy savings go hand-in-hand." – Anatoly Utjemov, Housing Association Manager

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VII. **Let's work together** to make our buildings **more energy efficient** (Conclusion)

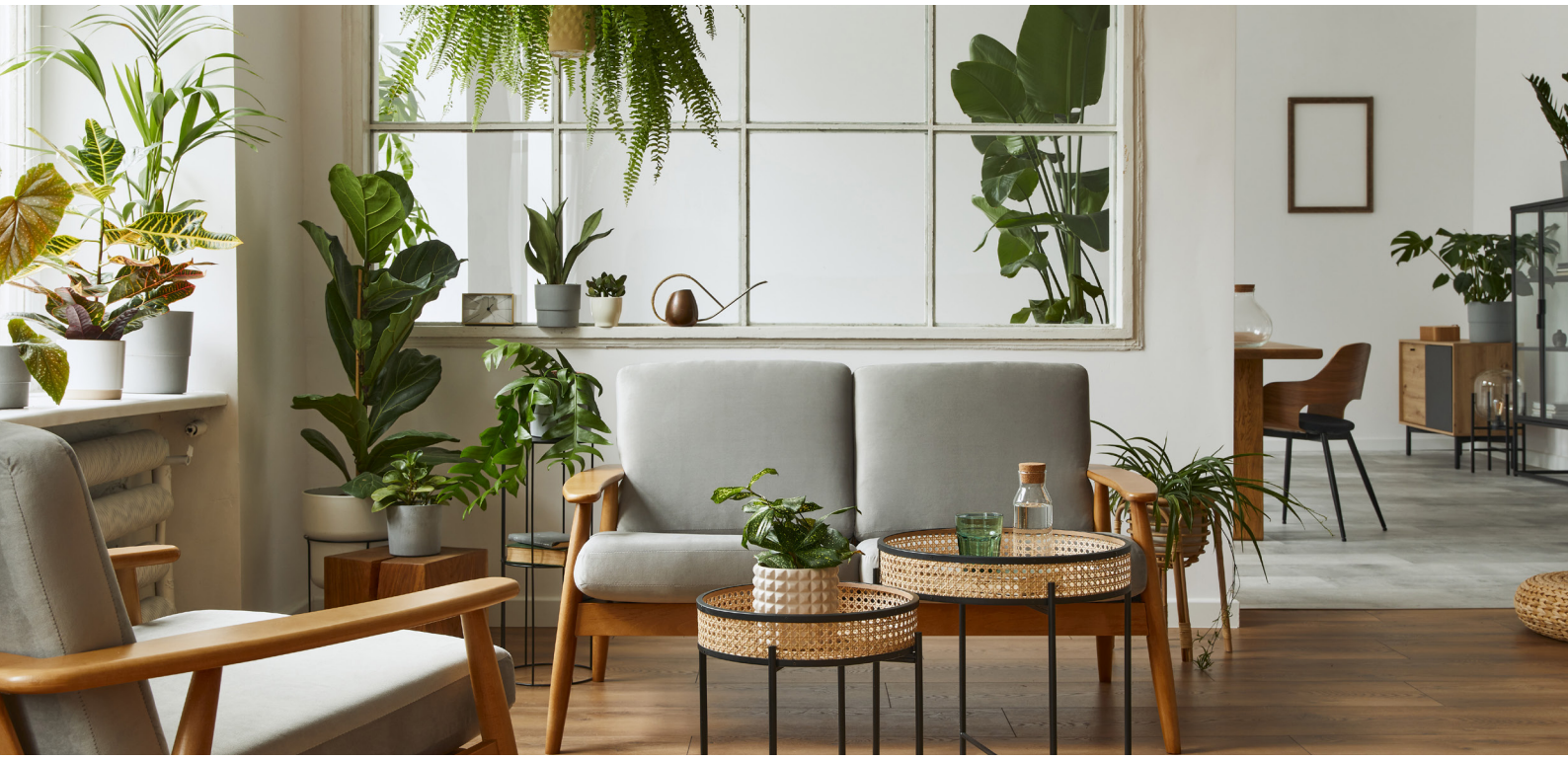
a. Danfoss has over 80 years of expertise in creating energy-efficient heating and cooling solutions for buildings.

b. We invented the radiator thermostat and the automatic differential pressure controller – the two main components in our automatic balancing solutions for two-pipe heating systems in multi-family buildings.

c. We offer a wide range of affordable, innovative solutions and products for renovating multi-family buildings, including:

- **i.** Automatic balancing solutions for one-pipe heating systems
- **ii.** Domestic hot water system optimization with Danfoss MTCV circulation valves
- **iii.** Decentralized heating system and instant domestic hot water production with EvoFlat™ stations
- **iv.** Substations and control components for buildings connected to district heating networks

d. Let's find the right solution for your business. Contact us today.



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