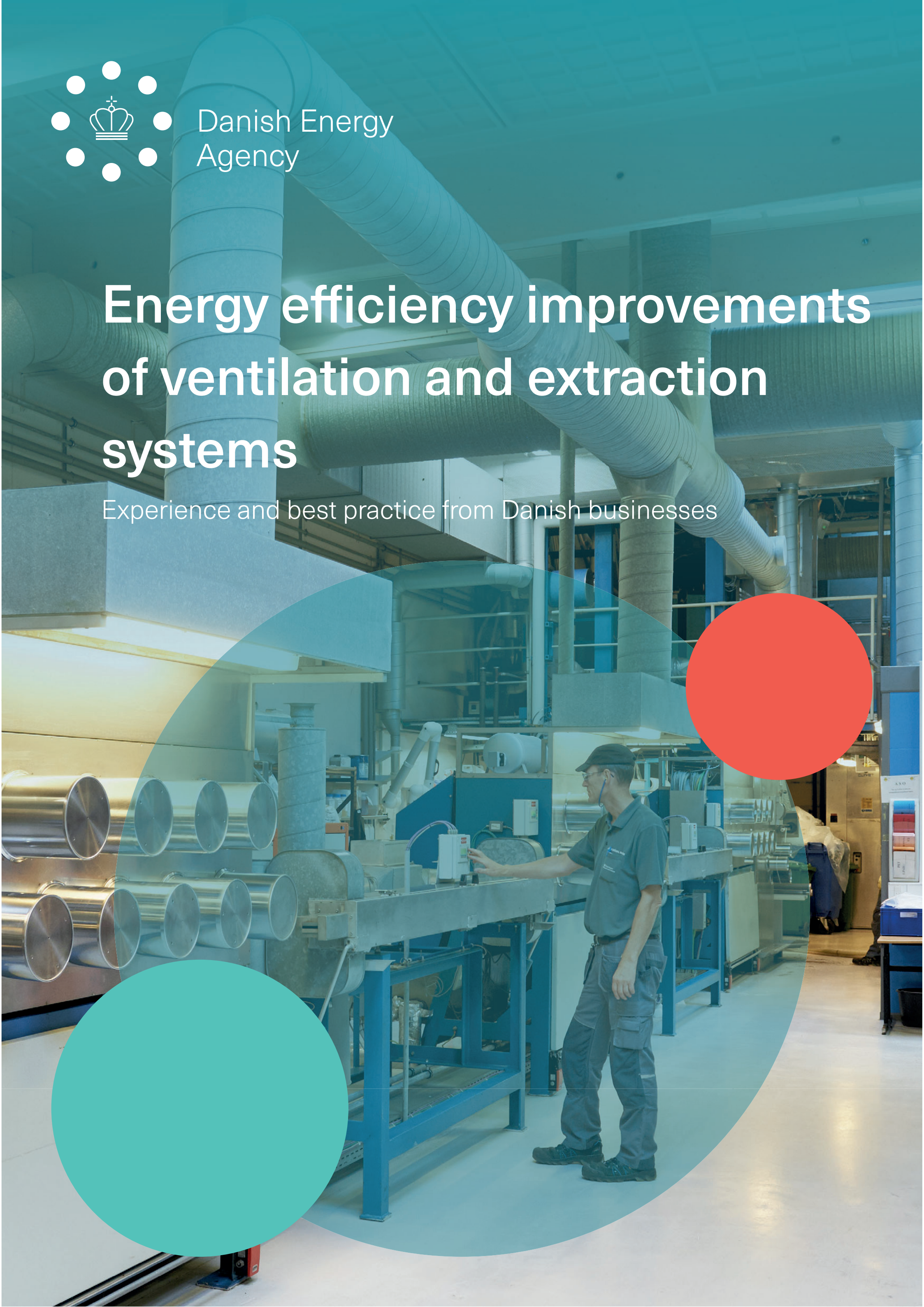
Danish Energy Agency

Energy efficiency improvements of ventilation and extraction systems

Experience and best practice from Danish businesses



Ventilation systems consume considerable amounts of energy

- and are used extensively by Danish businesses

Ventilation and extraction systems have many different functions. They remove carbon, add fresh air, control the air pressure and remove airborne gasses and particles. In addition, ventilation is used to control temperatures and air humidity in production areas, for example. This is why most Danish businesses have ventilation and extraction systems that often use considerable amounts of energy.

Did you know that…

- An optimised ventilation system often improves health and safety at work?
- Energy efficiency improvements can improve the market position of a business?

Ventilation and extraction systems account for 15% of electricity consumption

In 2016, ventilation and extraction systems in Danish businesses consumed 2,386 GWh (8.59 PJ) of electricity. This corresponds to 15% of total electricity consumption by businesses/ industry and almost 10% of total energy costs. This does not include energy consumption for space heating generated by the systems.

There are several reasons why ventilation and extraction systems consume considerable amounts of energy. For example

- The systems are often in operation for 24 hours a day, and not only during working hours
- The systems often have to heat large quantities of air
- The systems do not usually have efficient heat recovery units
- The dampers, filters and silencers of the systems as well as heating and cooling surfaces lead to major pressure losses
- Older buildings often consume additional heat because of poor insulation and leaks
- Many of the systems have not been updated with the most recent and most energy efficient components and controls

Capitalise on the energy efficiency experience of other businesses

Through voluntary energy efficiency agreements with the Danish Energy Agency, Danish businesses have implemented numerous energy saving projects and have performed analyses of energy intensive processes and supply facilities, etc.

The Danish Energy Agency has compiled the most important experience from businesses into a number of feature articles targeted at businesses with energy efficiency potentials.

This feature article presents some of the results of energy saving efforts and provides guidance on work with ventilation and extraction systems.

CASE • **Fibervision**

Fibervision installed a heat recovery unit and adjusted ventilation to their production needs. This saved Fibervision approx. DKK 437,000 (EUR 60,000) a year.

Payback period after subsidies: Approx. 1.3 years

Small changes, large savings
- and stronger competitiveness in the green transition

The large energy consumption for ventilation and extraction systems means that even small steps often generate huge savings on energy bills. For example, your company can optimise its systems to align with current operations or adjust ventilation to the specific needs of different work areas. When you reduce the amount of air to be replaced by the ventilation system, less air needs to be heated. This will reduce your heating bill, and give you in-depth knowledge about the operation and performance of your facilities. In some cases, you will also be able to increase your production capacity without significant investments, as well as save money on maintenance.

Did you know that…

- You can save up to 28% of the electricity used for ventilation and extraction systems with a payback period of four years?
- Danish manufacturing businesses usually save 5-15% on system energy costs when they optimise their ventilation systems?
- Research shows that a better indoor climate results in fewer sick days and higher productivity?

Energy efficiency is a competition parameter

When you optimise and improve your energy consumption, you immediately reduce your costs. Moreover, you become part of the green transition and help Denmark reduce its carbon footprint and strengthen its position as one the most energy efficient countries in the world.

Did you know that…

- Danish businesses are among the most energy efficient businesses in the world?
- A strong green profile attracts more skilled employees and encourages them to stay longer?

When you make optimal use of your energy resources, you also improve your competitiveness and prepare the ground for new business opportunities, increased exports and growth. This is good for Danish exports and it is good for your bottom line.

CASE • Fertin Pharma A/S saved almost DKK 1 million (EUR 130,000) a year by making ventilation and heat recovery systems more efficient

Fertin Pharma, which produces nicotine chewing gum, uses considerable amounts of energy on ventilation, because the company must comply with requirements for air humidity and room temperature in production areas.

Fertin Pharma wanted to reduce space heating costs, for example by recirculating air and reusing heat, thereby saving energy. The company analysed all its rooms to assess whether the air could be recirculated, or the rooms had to be ventilated using fresh air. The solution was to establish a new ventilation system with a heat recovery function and convert several existing systems to recirculate the air.

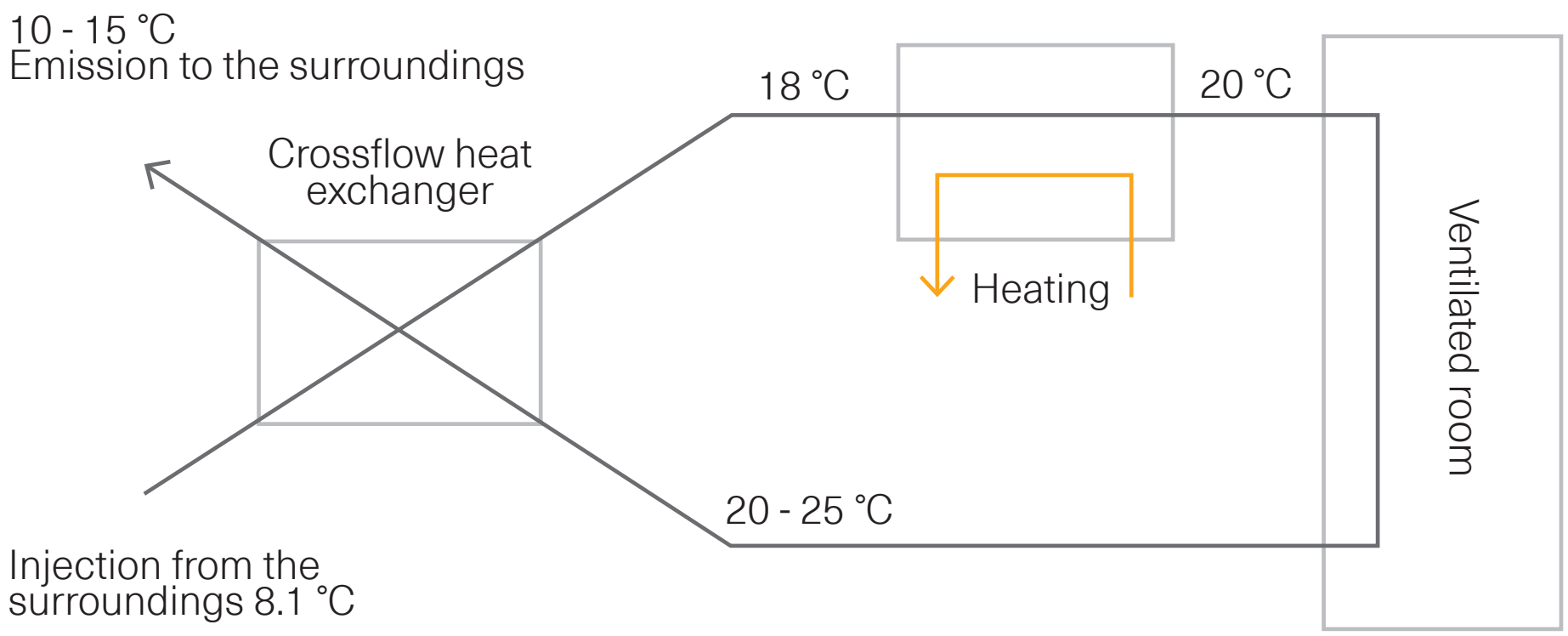
The investment

DKK 2.8 million (EUR 370,000) for a new ventilation system and refurbishment of existing systems. The new ventilation system has an expected lifetime of at least 20 years.

The result

- Annual energy and heat savings of DKK 890,000 (EUR 120,000)
- Total savings over the system's life expectancy of approx. DKK 19.5 million (EUR 2.6 million)
- Simple payback period after subsidies: approx. 2.4 years

Current ventilation systems with heat recovery at Fertin Pharma A/S



Energy savings were achieved by establishing crossflow heat exchangers in some ventilation systems at Fertin Pharma A/S. However, the largest percentage of heating savings was achieved by recirculating ventilation air, as traditional heat exchange is typically less efficient.

CASE • Needs reduction and increased system efficiencies saved Novo Nordisk A/S DKK 500,000 (EUR 70,000) a year

Novo Nordisk wanted to optimise their ventilation and save energy in one of their filling factories at Bagsværd north of Copenhagen.

Analyses showed that it was possible to reduce both electricity consumption and clean steam production without impairing production conditions.

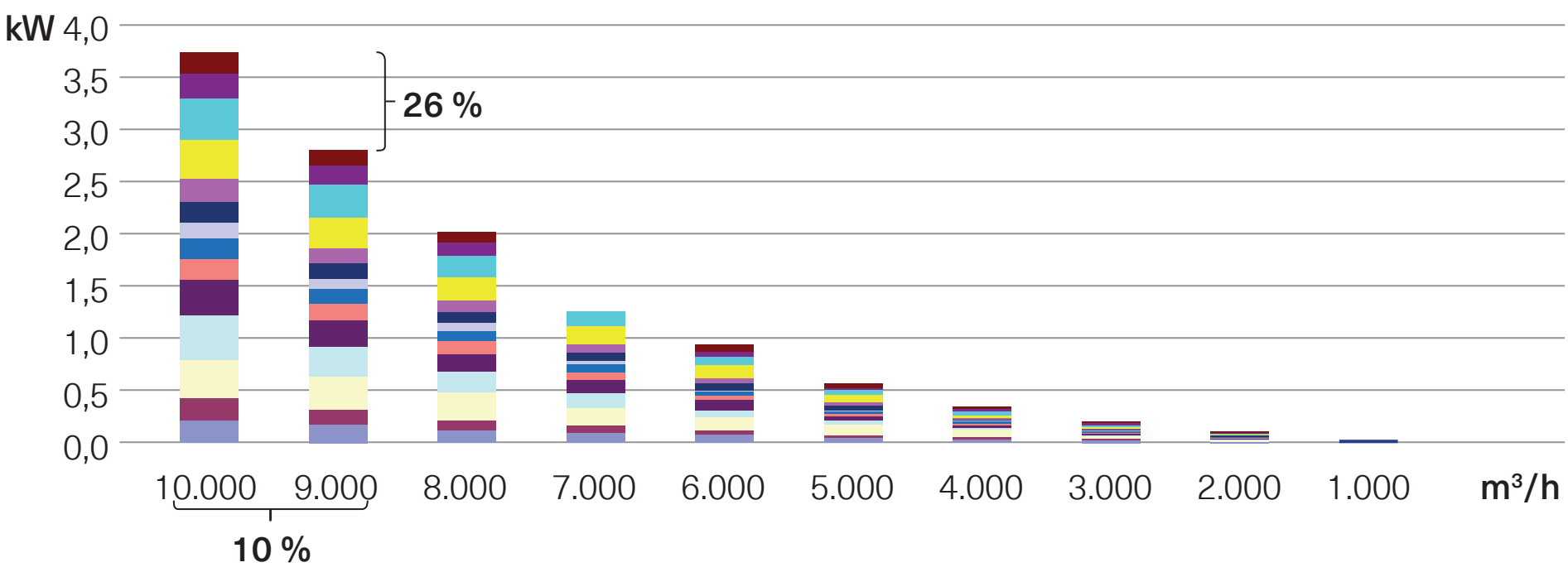
The investment

Investments were made in connection with other refurbishments and are likely to be recouped in less than 3 years.

The result

- Annual energy savings of 848 MWh, corresponding to DKK 500,000 (EUR 70,000)
- New knowledge and insights into system operations and energy consumption

Ventilator power absorption as a function of volume flow



The figure shows energy savings from lowering the air change by 10%, for example, in one of the four ventilation systems in the factory. Novo Nordisk will thereby reduce electricity consumption by 26%. The different bar colours show the calculated pressure loss for the individual components of the ventilation systems, such as filters, heating/cooling coils, etc. The figure also shows where Novo Nordisk loses most energy in the system. This makes it clear where it is worth acting.

How to save energy in your ventilation systems
- experience and *best practice* from other businesses

Experience from other businesses shows that the best results are achieved if you systematically analyse your energy needs and the efficiency and operation of your system. You can do this by considering three overall topics:

1. **Needs reduction:** For example, can you accept less air change or larger temperature and humidity fluctuations?

2. **System efficiency:**For example, can you reduce pressure loss, establish more efficient ventilators or install heat recovery?

3. **Optimisation of operations:** For example, can you adjust air change to variations in your demand across the day, week or year?

Adjust to demand

Your business will achieve much greater savings by adjusting the ventilation system as required. Even small adjustments in the operation of systems can generate large savings, because the energy consumption of the systems increases exponentially with the quantities of air ventilated.

CASE • **Vald. Birn A/S**

The Vald. Birn A/S foundry reduced the air change of their extraction system by almost 10% and installed new belt drives. Injection fittings and operating times were also optimised.

This reduced energy consumption at Vald. Birn by 15%, corresponding to 1,878,000 kWh a year.

Payback period after subsidies: Less than six months

Remember...

Place demands on your supplier!

The specification of requirements may help make the right demands of your supplier when converting or establishing your new system.

How to get started
– and achieve the best results

Use this approach to make sure you consider all relevant aspects of your systems and your needs. This will give you the best work process and the best results.

Remember...

... to apply for subsidies before you start!

You can apply for subsidies from an energy company, but you have to do so before launching your project - otherwise this possibility will no longer exist.

1. Identify the original design basis

- What is your need for air change, for example in relation to health and safety requirements?
- What temperature and humidity requirements exist for the ventilated area?
- Have your needs changed since the system was established?

2. Analyse your current needs and existing operations

- How does demand for air change etc. in the ventilated area vary across the day, week, year?
- Can you reduce your air change needs?
- Can you establish local zones and/or local exhaust ventilation in some areas?
- Can your system's operation be adjusted according your needs?

3. Assess your system efficiency

- What is the SEL value and pressure loss in ventilation ducts and components?
- How do electric motors, drives and transmissions work?
- How efficient is your heat recovery system?
- Can you reduce pressure losses in your ventilation ducts and components?

4. Optimise your system operating parameters

- Can you use a broader range when adjusting temperature and humidity?
- Can you reduce or adjust the operational needs of the system outside working hours?
- Can you exploit waste heat from processes better?

5. Optimise your system maintenance procedures

- Do you have fixed routines for replacing/cleaning your filters?
- Do you regularly clean ventilation ducts and heating/cooling surfaces etc.?
- Do you have fixed procedures for controlling and adjusting belt drives?

6. Define your key operating indicators

- Can you set an operating target for electricity consumption for ventilators?
- Can you measure air change across the day, week and year?

Learn more

You will find six remaining feature articles in this series:

- **Evaporation, drying and distillation**
- **Waste heat recovery and waste heat utilisation**
- **Cooling, compressed air and vacuum systems**
- **Kilns and melting processes**
- **Energy management and employee involvement**
- **LEAN and productivity**

Furthermore the Danish Energy Agency have elaborated checklists (in Danish) for efficiency improvement initiatives, specification requirements for equipment, and analyses of efficiency potentials in the Danish Industry.

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