REPORT – GIGANTIUM AQUATIC CENTER

Optimizing Ventilation Performance and Energy Consumption through installation of Nordicco® HVLS fans

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NORDICCO

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Summary

This technical report presents a test project carried out by Nordicco A/S, in which three HVLS (High Volume Low Speed) fans were installed in Gigantium Aquatic Center in Aalborg, Denmark. The purpose of the project was to improve energy efficiency and indoor climate by optimizing the operation of the ventilation system.

From August to December 2024, the ventilation system's power consumption was successfully reduced from 27 kW to 16.5 kW — a reduction of almost 39%. This improvement was achieved through careful monitoring, data collection, and step-by-step adjustments to the ventilation settings, including airflow, air pressure, and recirculation levels. The project's significance is supported by an economic analysis showing annual energy savings of 91,980 kWh, equivalent to a cost saving of EUR 24,644 (DKK 183,960).

With a payback period of approximately 1.9 years and an annual CO_2 reduction of 9,565 kg, the project demonstrates both economic and environmental sustainability. Feedback from the swimming facility's users also confirms an improvement in indoor climate.

This case project thus serves as a concrete example of how targeted energy optimization can play a critical role in sustainable building management and energy administration.

Introduction

Gigantium Aalborg and Nordicco A/S agreed to carry out a project involving the installation of three Northern Air® Aqua HVLS fans in the facility's swim hall: one above the water slide, one above the 25-meter pool, and one above the diving pool.

The HVLS fans were installed by Nordicco's partner Jysk Erhverv Klatring, while the electrical work was carried out by HETEK A/S. Installation took place on 29–30 August 2024, followed by a commissioning and adjustment phase. This report describes both the commissioning process and provides a detailed account of how the project's results were achieved.

As part of the project, the following Nordicco sensors were installed:

- 3 temperature, humidity, and CO_2 sensors placed in the occupancy zones.
- 3 temperature and humidity sensors mounted near the ceiling.
- 1 Northern Sky Power Meter measuring electricity consumption for Group 2F6 (ventilation system).

The project was carried out by the following team members:

Gigantium and Aalborg Municipality:

- Henrik Gøthgen
- Knud-Erik Rasmussen
- Dan Peter Pedersen

Nordicco A/S:

- Ole Bering Bang
- Mathias Thomsen

Regular project meetings were held every other week throughout the course of the project.

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Hypothesis

By optimizing the operation of the ventilation system through adjustments to airflow, air pressure, recirculation, and the speed of the HVLS fans, energy consumption can be reduced by at least 20%, while maintaining or improving the indoor climate in the Gigantium Aquatic Center.

Theoretical Explanation - HVLS

HVLS (High Volume Low Speed) fans are designed to move large volumes of air at low speed and with low energy consumption. Due to their low rotational speed, the airflow can travel over long distances in a predominantly laminar flow. This promotes more uniform air mixing in large spaces, ensuring consistent temperature and air quality throughout the entire room. As a result, HVLS systems can be particularly effective in large, open spaces such as sports facilities, swimming pools, and large industrial buildings, where it is important to maintain an even distribution of air to ensure comfort and energy efficiency.

HVLS Fan Dimensioning Process

At Nordicco, HVLS fan sizing is carried out using the following method:

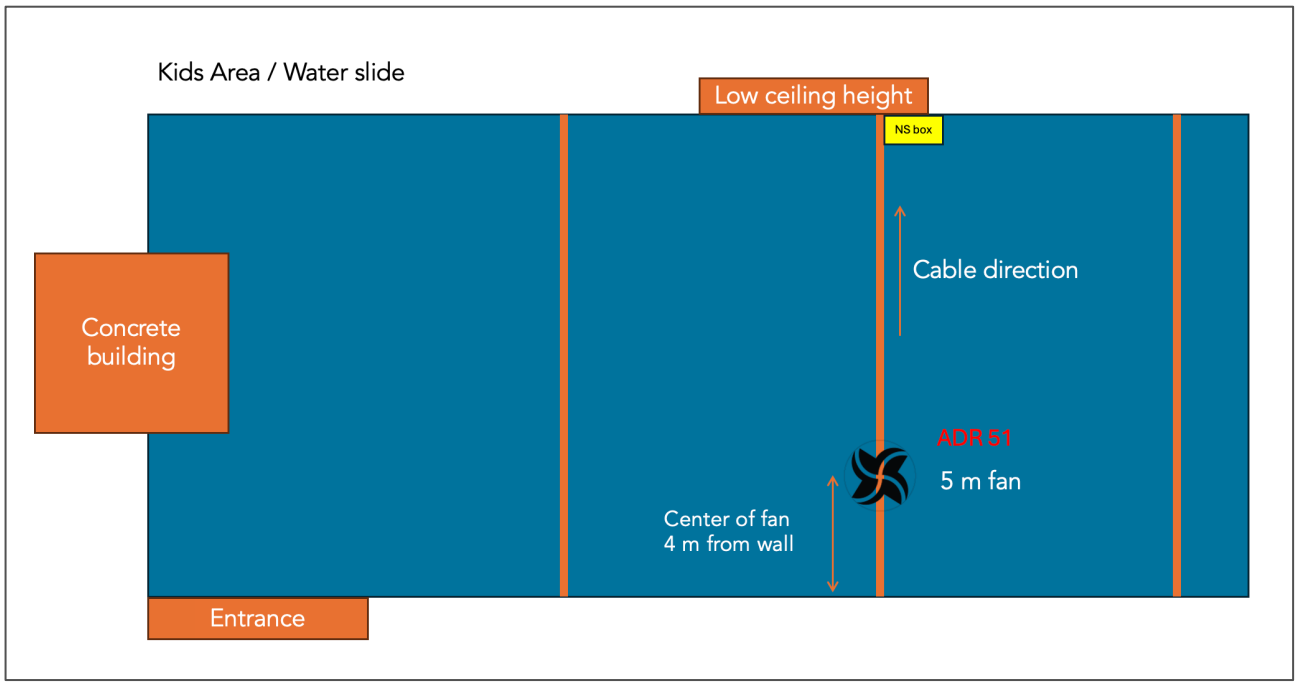
1. We select the largest possible fan that the space allows. This ensures optimal air mixing at the lowest speed, maximizing energy efficiency.
2. We recommend between 3 and 5 air changes per hour. For this specific swimming facility, our Air Movement Model determined that 3 HVLS fans, each with a diameter of 5 m, would be required.

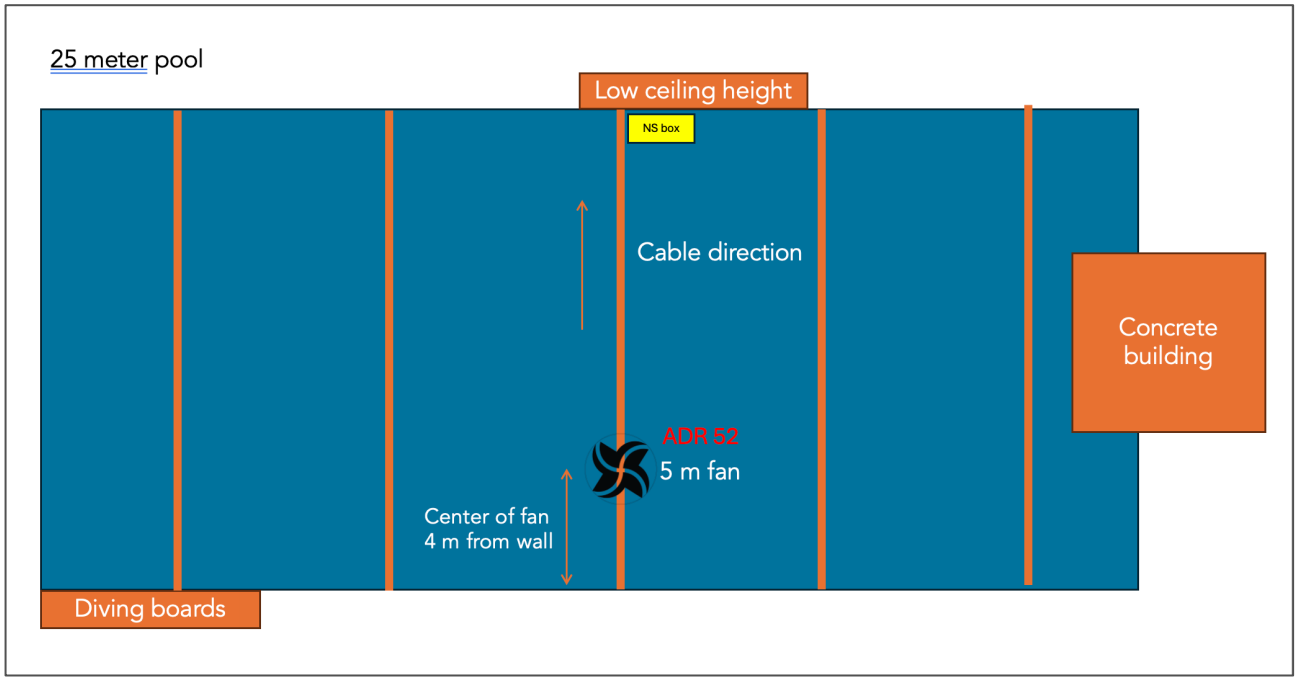
5-meter NORTHERN AIR® PRO					
Air Circulation		5	Times per Hour		
Area		Height		Total Building Volume	
2500	m^2	12	meter	30.000	m^3
Fan Load setting in %					40
Total Air Movement per Nordicco Fan				72.760	m^3/hr
Required Number of Nordicco HVLS Fans				3	Units
Total Air Movement				218.281	m^3/hr
Area Covered per Fan				833	m^2
Energy Efficiency				1819	m^3/Wh
Total Effect				120	W
Operating Hours per Day				24	hrs.
Total Daily Energy Consumption				2,88	kWh/day

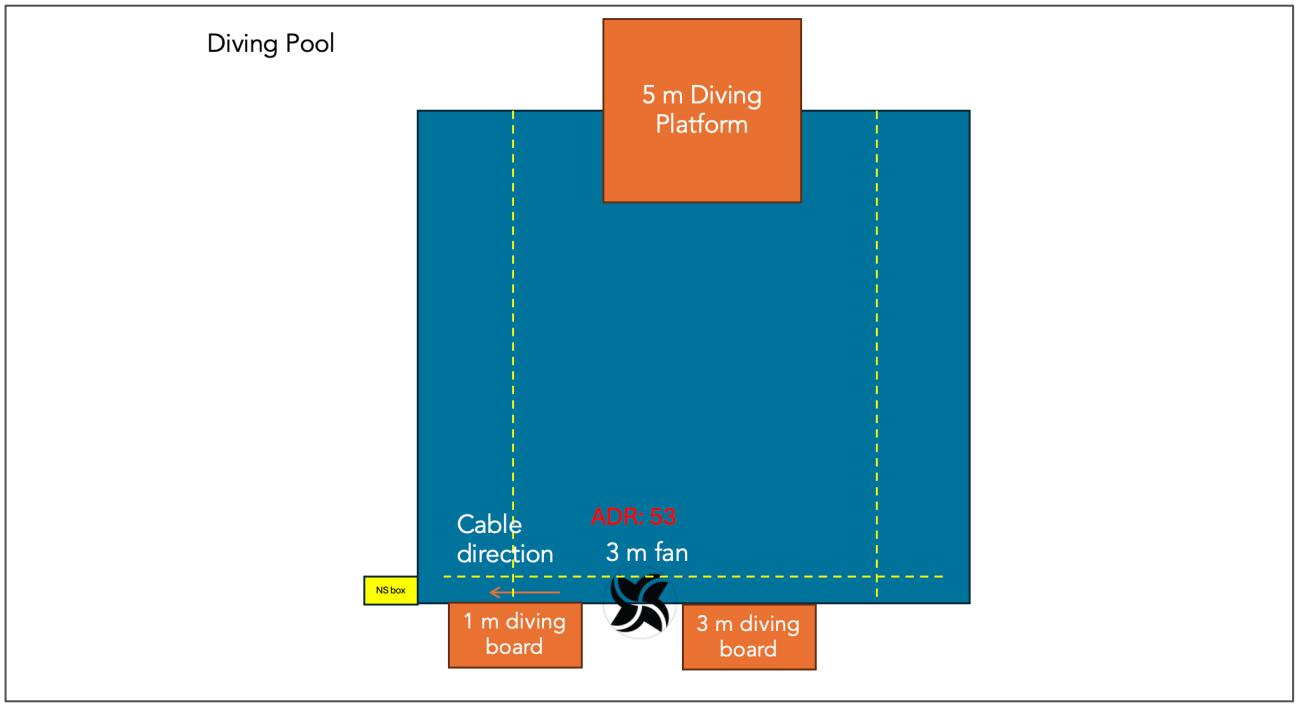
3. Our physical inspection of the facility determines the final placement of the fans. We aim to position the fans as high and as centrally as possible within the constraints of the space. In this specific case, the fans are placed on one side due to the sloping roof.

Placement of Three Northern Air® Aqua fans

The following three diagrams show the placement of the fans in the children's area and water slide, above the swimming pool, and above the diving pool. The location above the diving pool was chosen because access with a lift was required; climbing in the roof structure was not possible.




25 meter pool
Low ceiling height
NS box
Cable direction
Concrete building
ADR 52
5 m fan
Center of fan
4 m from wall
Diving boards


Diving Pool
5 m Diving Platform
Cable direction
ADR: 53
3 m fan
NS box
1 m diving board
3 m diving board

Adjustment and Balancing of the Ventilation System

Focus Areas

- Recirculation damper level (fresh air)
- Pressure (Pa) in the ventilation system (ventilation rate)
- Humidity control (RH%)
- Humidity levels in the swimming hall (RH%)
- Temperature levels in the swimming hall (°Celsius)
- HVLS-fan speed (%)
- Feedback from users and staff

Procedure

The optimization of the ventilation system at Gigantium followed a structured process that included installation, adjustments, and continuous monitoring to ensure optimal operation and energy savings.

1. Installation of Northern Air® Aqua fans

On 29 August 2024, three Nordicco fans of the type of *Northern Air® Aqua* (*previously called Aggressive Environment)* were installed in the Gigantium swimming facility.

2. Initial Settings and Observations

Following installation, the ventilation system had the following settings: fresh air damper minimum at 60%, constant air pressure at 45–55 Pa, and HVLS fans set to 70% speed (recirculation, i.e., reverse rotation). The ventilation system had a power demand of 27 kW.

During nighttime operation, humidity levels were observed to drop too low (see figure 6).

3. The First Adjustments

At the first follow-up project meeting, several adjustments were made to improve system performance:

- The fresh air damper minimum setting was reduced from 60% to 50%.
- Air pressure (Pa) was reduced by 10%.

These measures reduced the ventilation system's power demand to 24 kW.

4. Ongoing Optimizations

Over the following months, the system was fine-tuned to balance energy savings with maintaining a comfortable indoor climate. Key changes included:

- Further reduction of the fresh air damper minimum setting to 45%.
- Adjustment of air pressure to a range of 30–40 Pa.

- The HVLS fan speed was reduced to 60%. By the end of November 2024, the ventilation system's power demand had been reduced to 19.9 kW.

5. Monitoring and Feedback

Continuous monitoring was carried out to ensure the system was operating optimally. Data from the online control platform, Northern Sky®, was analysed, and adjustments were made as needed. User feedback from lifeguards and other staff indicated satisfaction with the indoor climate, confirming the effectiveness of the implemented changes.

6. Results

At the conclusion of the optimization process in December 2024, the ventilation system's power consumption had been reduced to 16.5 kW (see Figure 1). This was achieved without compromising the indoor climate or the user comfort.

Graph of Ventilation System Power Demand over Time

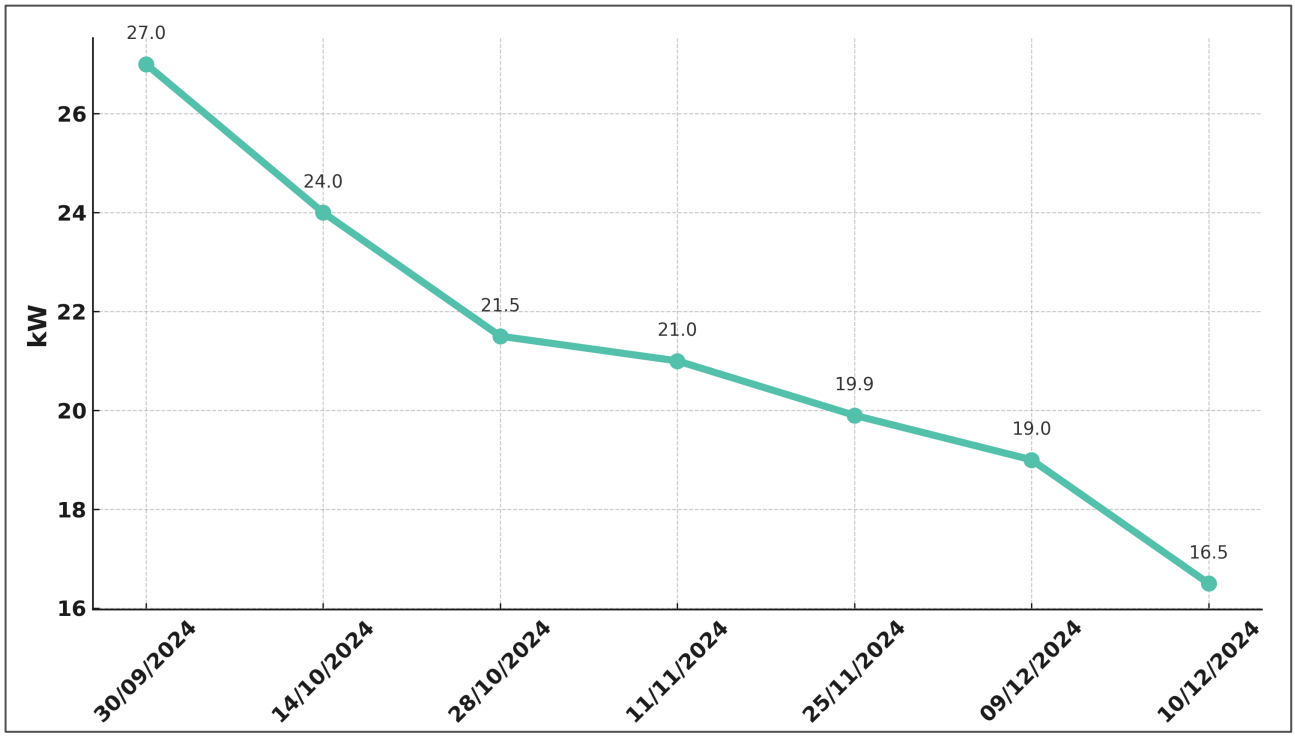


Figure 1

Figure 1 shows the ventilation system's power consumption during the project's adjustment period.

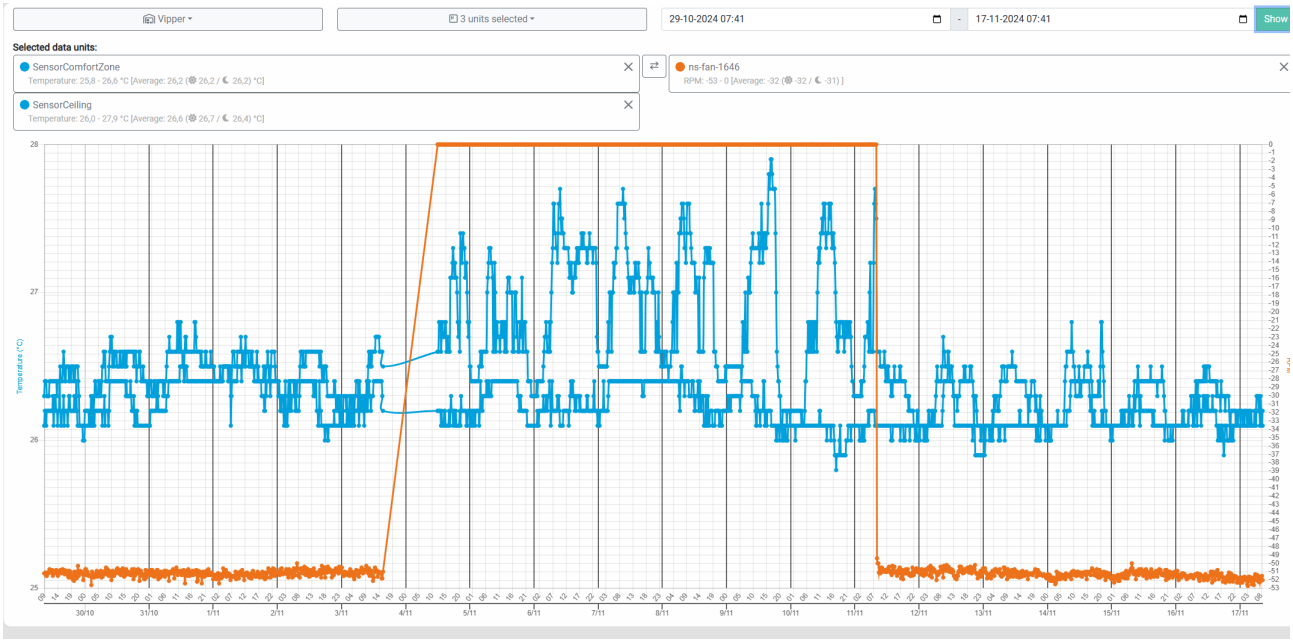


Figure 2

Figure 2 shows the floor and ceiling temperatures at the diving area in the blue curves. The orange curve represents the RPM (revolutions per minute) of the HVLS fan. In the middle of the graph, there is a one-week period where the fans were turned off (orange curve at RPM = 0), during which the temperature difference between the floor and ceiling shows greater fluctuations (blue temperature curves).

This clearly demonstrates that a more uniform room temperature is achieved when the fans are operating.

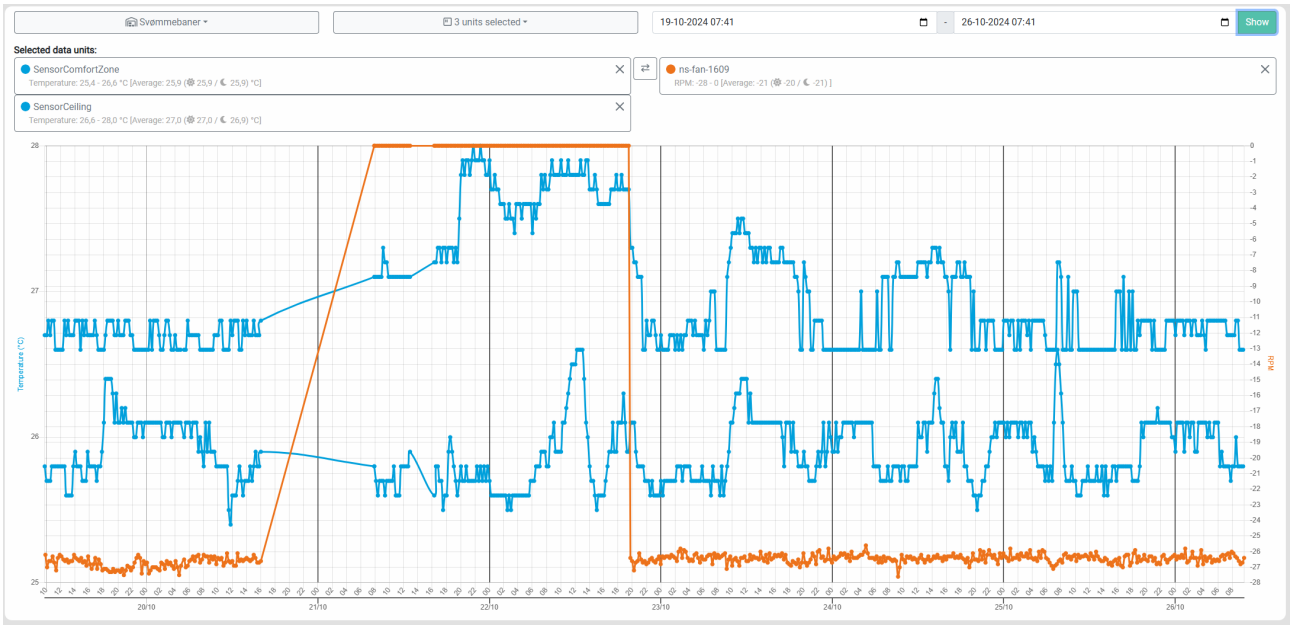


Figure 3

The same pattern as the one observed at the diving area in Figure 2 is also seen at the swimming lanes, shown in Figure 3.

Conclusion

The project at Gigantium Aquatic Center, involving the installation of 3 HVLS fans and the optimization of the ventilation system, demonstrates clear benefits in terms of both energy efficiency and indoor climate.

Over the course of the project, from August to December 2024, it was documented that the ventilation system's power consumption could be significantly reduced from 27 kW to 16.5 kW — a reduction of nearly 39%.

This reduction was achieved through a series of step-by-step adjustments, including lowering the fresh air intake, reducing HVLS fan speed, and fine-tuning air pressure settings.

The results support the hypothesis that careful fine-tuning of various ventilation system components can deliver substantial energy savings without compromising comfort or air quality in the swim hall. Feedback from users, including lifeguards and other staff, confirmed that the indoor climate was maintained — and even improved — underscoring the positive impact of the HVLS systems.

The figures in this report illustrate the tangible improvements in energy efficiency and air quality, showing a more uniform temperature distribution and a reduction in energy consumption.

The project's success underscores the significant potential for improving energy efficiency in existing swimming facilities, while maintaining a healthy indoor climate and minimizing operating costs. It is therefore recommended to consider this type of hybrid system — combining existing HVAC installations with HVLS fans — as part of efforts to achieve greater sustainability in building operations and improved economic efficiency in large facilities.

Economic Conclusion

The energy optimizations implemented in the Gigantium project correspond to an annual energy saving of 91,980 kWh, resulting in a cost saving of EUR 24,644 based on an electricity price of EUR 0.268 per kWh, assuming the current system settings are maintained. With an initial investment of EUR 46,890, this results in a payback period of approximately 1.9 years.

This calculation does not account for additional savings from reduced heating consumption, which could further improve the financial outcome. This underscores that the project is economically attractive and delivers substantial savings in the short to medium term.

In addition, these energy savings correspond to an annual CO_2 reduction of 9,565 kg. (https://energinet.dk/data-om-energi/co2-pr-kwh-el-kommune/)

Appendix

Logbook Gigantium and Nibe

Logbook: Ventilation Control and Energy Consumption in Gigantium and Nibe Swimming Facilities

Date: 30 September 2024

- **Event:** Meeting on 30 September 2024
- **Current Settings in Gigantium:**
    - Minimum fresh air: 60%
    - Constant air pressure: 45-55 Pa
    - Recirculation: Two 5-metre fans running at 50% during daytime, one 3-metre fan running at 50% during daytime
- **Observed Issues:**
    - Low humidity in the swimming facility, increasing evaporation and heat loss
    - Constant high airflow results in higher-than-necessary energy consumption
- **Recommended Changes After Meeting:**
    - Reduce minimum fresh air to 50%
    - Reduce constant airflow by 10%
    - Set all fans to 70% recirculation
    - Energy consumption: 27 kW
- **Important Notes:**
    - Important to maintain negative pressure in the swimming facility during system balancing

Tasks:

- Ole to maintain the logbook.
- Mathias to schedule a meeting on Monday, 14 October at 08:00 and every 14 days thereafter.
- Gigantium to adjust the system following discussions with Nordicco and collect relevant data.

- Gigantium to gather comfort data.

Date: 14 October 2024

- **Update:**
    - Gigantium is working on stabilizing the BMS (Building Management System).
    - The goal is to reduce fresh air to 15% and control airflow to lower energy consumption.
    - Energy consumption: 24 kW
- **Agenda Questions:**
    - Should indoor climate be prioritized in upcoming meetings?

Date: 28 October 2024

- **Update:**
    - Energy consumption: 21,5 kW
    - Minimum pressure: 32 Pa
    - Maximum pressure: 42 Pa
    - Minimum fresh air: 45 %
    - Dan is working on implementing the same approach in Nibe.
    - 20% savings so far.

Date: 11 November 2024

- **Update:**
    - Energy consumption: 21 kW
    - Minimum pressure: 30 Pa
    - Maximum pressure: 40 Pa
    - Minimum fresh air: 40%
- No complaints in Gigantium. Lifeguards are satisfied.
- Power outage occurred; therefore, systems were shut down. A lifeguard used a damp cable.
    - Dan is working on implementing the same approach in Nibe.
    - No progress has been made in Nibe yet. Awaiting the ventilation technicians.

Date: 25 November 2024

- Update:
    - Energy consumption: 19.9 kW
- HVLS reduced to 60%
- Ole is creating a calendar so they can start operations themselves.
    - Minimum pressure: 30 Pa _ Unchanged
    - Maximum pressure: 40 Pa _ Unchanged
    - Minimum fresh air: 40% _ Unchanged
- Everyone is satisfied.
- There was a power outage, so the systems have been off.
- They are reviewing the control system for Gigantium's swimming pool to assess how humidity is regulated, as humidity levels fluctuate significantly.
    - Dan is working on implementing the same approach in Nibe. Knud will speak with Benjamin.
    - No progress has been made in Nibe yet. Awaiting the ventilation technicians.

Date: 09 December 2024

- Update:
    - Energy consumption: 19 kW
- HVLS reduced to 60%
    - Minimum pressure: 30 Pa _ Unchanged
    - Maximum pressure: 40 Pa _ Unchanged
    - Minimum fresh air: 40% _ Unchanged
- Everyone is satisfied
- They are reviewing the control system for Gigantium's swimming pool to assess how humidity is regulated, as humidity levels fluctuate significantly.
    - Dan is working on implementing the same approach in Nibe. Henrik will speak with Benjamin.
    - No progress has been made in Nibe yet. Awaiting the ventilation technicians.
- 1.2°C temperature gradient in the cafeteria.

Date: 10 December 2024

- **Update:**
    - Energy consumption: 16,5 kW

Ventilation System - Energy Graphs

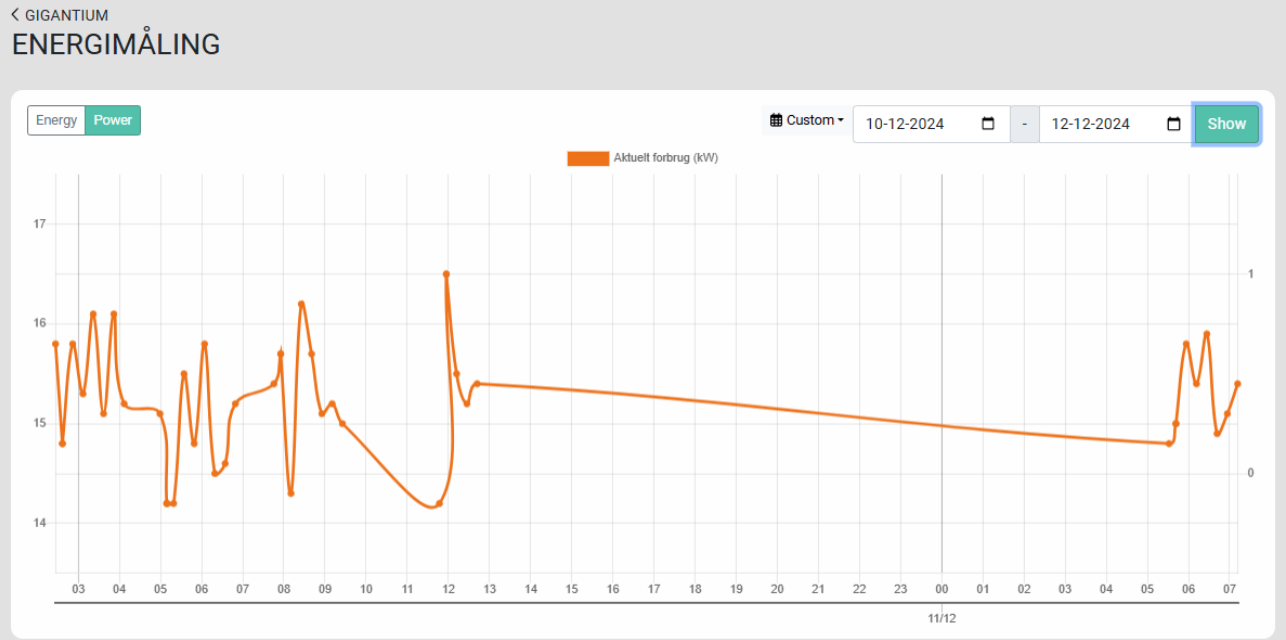


Figure 4 Actual power consumption on 10/12 - 12/12/2024 (kW)

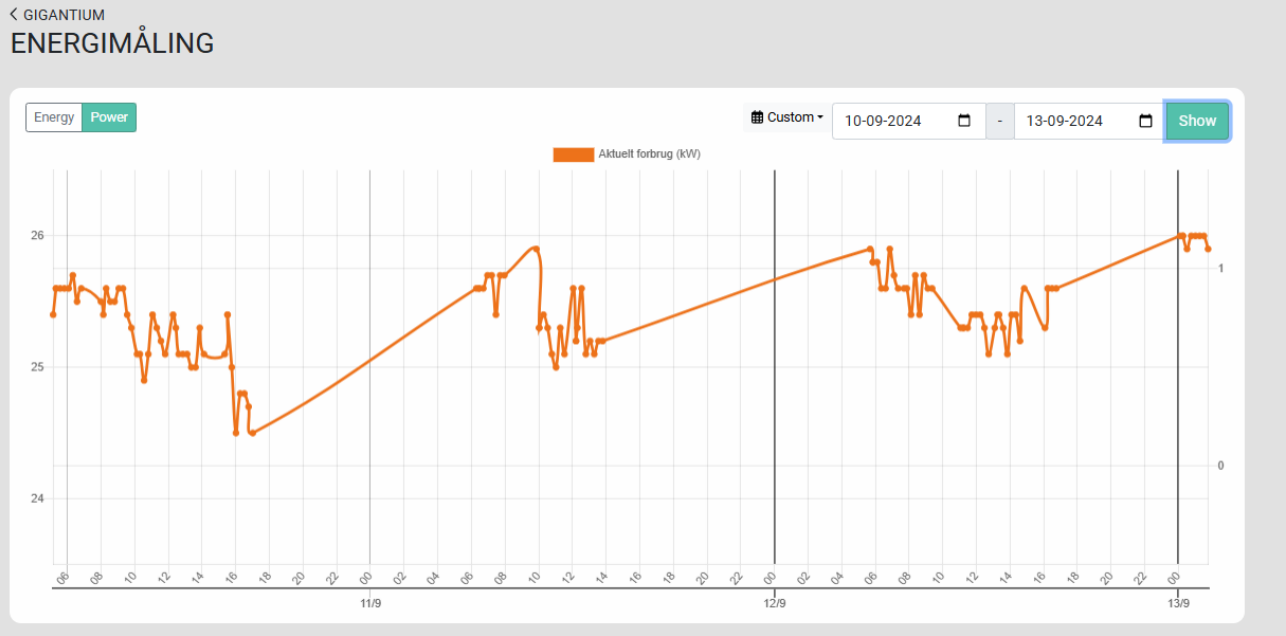


Figure 5 Actual power consumption 10/9 - 13/09/2024 (kW)

Humidity

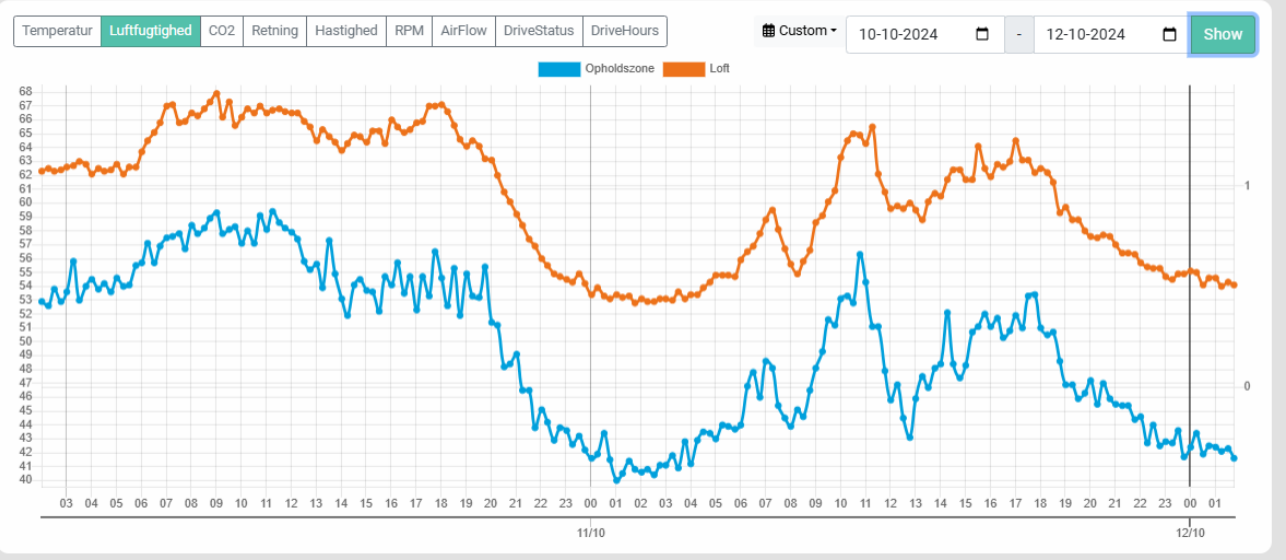


Figure 6 Humidity overnight, 10/10 - 12/10/2024