Climate Control Program: Case Study

ARoS Aarhus kunstmuseum Museum

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Resume:

The report concerns ARoS Art Museum's participation in the project "Getting Climate Control Under Control" and describes the implementation of sustainable initiatives in the museum's climate control. The museum aims to reduce energy consumption and CO_2 emissions while maintaining optimal preservation of the art collections.

Through the project, new strategies have been tested, such as reducing the pressure in the ventilation system and shutting down the system at night when the museum is closed. The results show an annual energy saving of up to 120,000 kWh, corresponding to a reduction of 8-10% of the total energy consumption. Additionally, changes in control strategies, such as the "closed operation" program, have reduced climatic fluctuations, ensuring a more stable environment for the art.

The project has also identified challenges, including the lack of in-house conservators and strict climate standards imposed by external loan agreements. To address these challenges, adjustments to loan procedures and a more flexible approach to climate requirements are proposed.

Moving forward, ARoS emphasizes placing climate-demanding exhibitions during winter months, optimizing the use of IoT sensors, and adapting ventilation systems for further efficiency improvements. The museum is working towards integrating Vision 2033 with a focus on sustainability and energy savings, which entails a comprehensive transformation in exhibition planning and operations.

The report concludes that small adjustments can achieve significant savings but emphasizes the importance of long-term strategic changes to maximize both economic and environmental benefits.

Introduction:

ARoS Aarhus Art Museum, constructed in 2004, stands as a 10-story square brick and concrete building, with 6 of the stories above ground. The building is surrounded by open grass areas, with no adjacent structures. The museum employs 130 permanent staff members and welcomes approximately half a million visitors annually. The building's total area is 19,083 square meters, of which 12,233 square meters are dedicated to art galleries.

Location and Seasonal Temperature Variations:

Aarhus, situated on the eastern coast of Jutland by the Kattegat, is classified as having a temperate oceanic climate (Köppen climate classification Cfb). This means the city experiences mild winters and cool summers, consistent rainfall throughout the year, and average summer temperatures below 22°C. Winter average temperatures hover around 0°C, with occasional light snowfall.

Aarhus' northern latitude significantly impacts daylight hours. In summer, the city can have up to approximately 17 hours of daylight, whereas winter days may be as short as 7 hours of daylight.

The museum's current climate control system is managed by ventilation units, which regulate relative humidity, temperature, and CO2 concentration within specified limits. These parameters are measured within the exhaust system.

Background for Participation in "Getting Climate Control Under Control"

A crucial aspect of participating in the project was to clarify and challenge our existing attitudes and assumptions with the latest knowledge in energy-efficient art preservation.

Through the project, ARoS aimed to gain a deeper understanding of how indoor climate conditions impact both the physical spaces and the preservation of the art collections, and, most importantly, how the museum can reduce its climate footprint while ensuring optimal care for art preservation.

Therefore, all energy efficiency initiatives were carried out in collaboration with the art department and the collection management team.

Selection of Team Members:

The project team consisted of members from the technical department, responsible for planning and executing exhibitions; the art department, in charge of the collection management and deciding on artwork selection and conditions in collaboration with external conservators; and the building operations team, which manages the building's BMS system and maintains and optimizes the air treatment process.

The project involved:

- Elizabeth Baadsgaard, Art Conservator, Kunstkonserveringen (Art Conservation Center)
- Adina Andersen, Technical Department, ARoS
- Anne Mette Thomasen, Collection Management, ARoS
- Søren Schmidt Pedersen, Building Operations, ARoS
- Jakob Hvam, Building Operations, ARoS

Prerequisite for Calculation:

To calculate the expected savings, it was necessary to make general assumptions about the energy consumption under various climatic loads on the building and to scale actual energy reductions from specific systems to other systems of the same type but different sizes, without further consideration of differences in system efficiency, etc.

All calculations were made by comparing a similar baseline period with the period in which the technical change was implemented, while attempting to account for the building's varying usage patterns.

Collection of Energy Data:

All indoor climate data is collected via the museum's BMS system and newly acquired IoT sensors. Energy consumption data is gathered through Energinet's DataHub portal and subsequently analyzed using ENTO, an AI-enhanced Energy Management System (EMS).

The EMS system analyzes both baseline and peak load consumption, taking variables such as weather, weekdays, holidays, etc., into account, and adjusts accordingly, thereby creating a highly accurate basis for comparison.

As part of the project, all participating museums were offered a free package of IoT-fabrikken's 'RoomAlyzer' sensors along with a two-year all-inclusive framework agreement. ARoS chose to utilize this offer as the sensors were easy to implement, scalable, and featured a simple and intuitive interface for data logging.

Selection of Test Galleries:

ARoS has a total of six galleries. The basement gallery hosts permanent multimedia works, while the galleries on levels 1, 5, and 6 feature rotating exhibitions with loaned artworks twice a year. It was therefore decided to use the gallery on level 8 as the basis for the project, as it houses a permanent exhibition, and the artworks in this gallery are part of ARoS's own art collection. The gallery is 1,031 m^2 in size and has a maximum occupancy of 200 people.

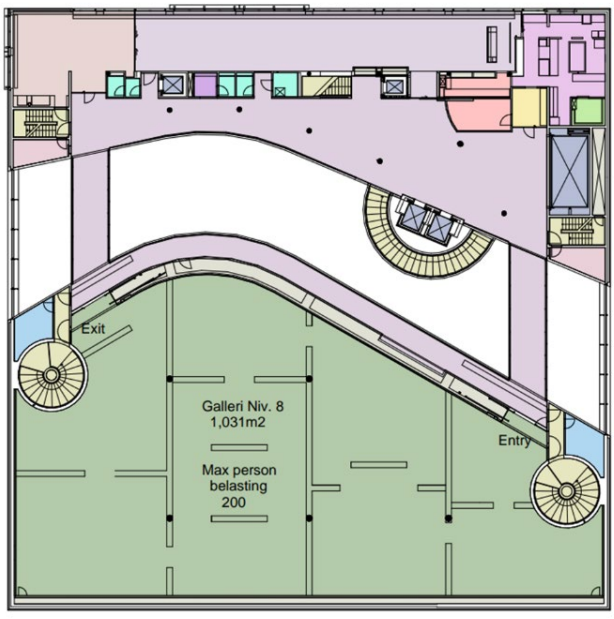
Since the gallery is located relatively high in the building, it is also expected to be the most affected by the external climate.

From the collection pieces installed in the gallery on level 8, four works were selected for close monitoring, as the Art Conservation Center assessed them to be potentially "sensitive" to fluctuations in relative humidity. The selection criteria included widespread cracking (with slight tendencies toward flaking) and the fact that the works had previously undergone conservation, which indicates a general structural weakening, likely caused by prior storage under significant climatic fluctuations.

It was not possible to select suitable works made from other (fragile) materials, such as wood or panel, in the chosen gallery, leaving oil on canvas as the only material type available for the project.

Selected Works:

- Janus la Cour, Fra Moesgård Strand (Title listed as Risskov, Århus, Skrænten), 1892 (inv. 155) This was particularly suitable for the project as it has numerous cracks and is mounted on the gallery's only exterior wall, where a microclimate can be expected behind the painting, potentially influenced by changes in temperature and relative humidity (RH).
- P.S.Krøyer, Fiskekutterne skal lette, 1894 (inv. 976)
- Vilhelm Lundstrøm, Nature Morte, 1920 (inv. 484)
- Asger Jorn, Spansk drama, 1952-53 (Inv. 670)



Selection of Control Parameters:

We aimed to investigate whether adjusting the indoor temperature at ARoS according to the current season could result in significant energy savings without compromising the preservation of the artwork, indoor comfort, and thus the visitor experience. What would it mean for energy consumption to raise the temperature by 1-3 degrees during the summer months and similarly lower it in the winter months? How would these changes impact the indoor climate and the condition of the artworks? What strategies can be implemented to ensure an optimal balance between energy efficiency, visitor experience, and the preservation of artworks?

Ventilation System, Adjustment in Pressure Setpoint

The ventilation system was originally calibrated to a supply air pressure of 200 Pa, which ensured the desired airflow and indoor climate in the museum's exhibition spaces. However, after a series of tests, we found that we could lower the pressure to 100 Pa without negatively impacting the indoor climate, as both temperature and relative humidity remained within the desired limits. This adjustment resulted in energy savings without compromising comfort or climate conditions.

The table below shows the energy consumption during the respective periods when the adjustments were implemented:

Start Date End Date Average Daily Consumption (kWh)

- 24-08-2023 18-09-2023 130.67
- 20-09-2023 26-11-2023 63.15
- 27-11-2023 07-04-2024 48.74
- 28-05-2024 11-11-2024 37.00

Note that the reduced average daily consumption during the period from 28-05-2024 to 11-11-2024 is due to the implementation of a “night shutdown” of the ventilation system, as described elsewhere in the report. This further reduction in energy consumption was achieved by turning off the ventilation system during nighttime hours when ventilation demand is lower, contributing to significant savings without compromising the indoor climate during the daytime.

Ventilation System, Change in Control Strategy

This experiment aims to improve energy consumption in the gallery on Level 8 by minimizing the influence of outdoor air. The experiment involves implementing a "closed operation" program, causing the ventilation system to run in full recirculation mode, thus only reconditioning the indoor air.

Implementation of the "Closed Operation" Program

The experiment included a new program that blocks outdoor air intake outside the museum's opening hours. This initiative aims to reduce the energy costs associated with heating, cooling, or treating outdoor air, which would otherwise affect the gallery's indoor climate, as the need for fresh air supply is reduced when there are few or no people in the galleries.

2024 Estimates

Closed Operation	**Night Shutdown**
Level 8	**13,500 kWh**
Level 6	**13,500 kWh**
Level 5	**18,300 kWh**
Level 1	**18,300 kWh**
Storage Area	**11,000 kWh**

It should be noted that the "closed operation" program results in energy savings in kWh but not necessarily in monetary savings if electricity is billed based on spot prices. In such cases, implementing the closed operation program during morning and evening hours might be more advantageous.

Implications for the Humidity Curve

As a result of these changes, a significant improvement in the stability of the humidity curve was observed: fluctuations in the humidity curve were reduced from +/- 2% to +/- 1%, indicating a much more stable relative humidity in the gallery.

Impact on Humidification and Dehumidification Systems

One consequence of this experiment is an increased activity of both humidifiers and dehumidifiers in the gallery. This indicates that the systems need to work harder to maintain a stable climate, which could potentially offset the energy savings achieved through reduced ventilation speed.

Sensor Placement

To ensure the most accurate results for the study, it was found necessary to position the measuring equipment at the same height as the artworks. Measurements taken from an exhaust duct do not provide a representative picture of the actual climate surrounding the artworks.

Additionally, climate studies near the entrance and exit doors revealed no significant differences, as a slight overpressure is maintained in the gallery.

Finally, we examined the microclimate behind artworks mounted on exterior walls. During the winter months, a temperature difference of approximately 1 degree was recorded between the front and back of the artworks. This has not raised any further concerns.

Planning:

After defining the scope of the study (gallery and artworks) and desired test parameters, the project was presented to the museum's curatorial management, director, and board for approval. The project was deemed to have a high degree of professional foundation and relevance to the museum's Vision2033, which led to approval to proceed with detailed planning and execution.

In collaboration with the Art Conservation Center, condition reports were prepared, and high-resolution photographs of the four selected paintings were taken to document their state prior to the project's start. Visual inspections of the artworks were subsequently conducted every 2–4 weeks by the same conservator from the Art Conservation Center. New condition reports were only required in the event of documented changes. At the end of the project, a concluding condition report and final summary report were made (appendix to the case study).

Based on data from electricity meters and the energy consumption of cooling systems, estimated calculations can be made regarding the costs of climate control in a gallery, both in terms of temperature and humidity control as well as temperature control alone. These figures are estimates, as the actual cooling demand cannot be separated by gallery, even though electricity consumption is accurately recorded from the individual meters. However, the figures in the attached table are sufficiently precise to serve as a guiding reference for the costs of opting in or out of climate control in a gallery at ARoS.

2024 estimater	Summer (3-month consumption)		Mid-season (3-month consumption)		Winter (3-month consumption)	
	With Climate	Without Climate	With Climate	Without Climate	With Climate	Without Climate
Niv. 8	35.800kW	18.300kW	12.000kWh	3.400kWh	3.400kWh	3.400kWh
Niv. 6	48.400kW	24.800kW	16.200kWh	4.600kWh	4.600kWh	4.600kWh
Niv. 5	35.800kW	18.300kW	12.000kWh	3.400kWh	3.400kWh	3.400kWh
Niv. 1	48.400kW	24.800kW	16.200kWh	4.600kWh	4.600kWh	4.600kWh
TNL		2.000kWh		2.000kW		2.000kWh
Total	122.000kWh	88.200kWh	58.400kWh	18.000kWh	18.000kWh	18.000kWh

Table – Calculations based on estimates from Appendix

Technical Implementation

At present, it is assessed that no major technical investments are required to optimize the climate in the galleries, apart from resources to work with the data generated as a consequence of the changes.

Challenges:

From an art conservation perspective, the main challenges in carrying out the project have been the lack of in-house conservators who could participate in the project on equal terms with other participants during the testing phase, as well as act as professional collaborators in implementing updated knowledge about the sensitivity of various materials to changes in temperature and humidity throughout the (relevant parts of the) organization. This includes both the knowledge that initiated the project and the knowledge gained through participation in it.

In connection with borrowing artworks for the museum's six annual temporary exhibitions, curators and coordinators still face a high degree of conservatism and unsupported caution in loan agreements. These agreements require specialized knowledge and insight—not to mention time and diplomacy—to negotiate towards more sustainable resource management.

Although ARoS has a clear and declared goal to make sustainable choices in all aspects of museum operations, including exhibition production, the museum's curatorial activities are largely subject to the goodwill of other museums, artists, galleries, and others who temporarily entrust ARoS with their artworks. These works can be irreplaceable, fragile, and of high economic value. Despite ICOM's recognition of protocols like the Bizot Green Protocol and the general acknowledgment of the climate parameters recommended therein at international registrar conferences such as ERC, a widespread "Zero-Risk policy" and "better safe than sorry" approach to temperature and humidity parameters still prevail, which will take time to overcome.

Achieved Results:

Modified Pressure Settings and Introduction of "Night Shutdown":

The potential of fully implementing night shutdown and reduced pressure settings in the galleries is significant in terms of both energy savings and operational efficiency. By applying night shutdown and pressure reduction across the entire museum, the total annual energy savings are estimated to be approximately 120,000 kWh, equivalent to a reduction of 8-10% of the museum's total energy consumption. This will not only reduce costs but also lower CO_2 emissions, supporting the museum's sustainability goals.

Additionally, this strategy can improve the lifespan of the ventilation system and other climate control installations, as the systems will experience less wear and tear due to reduced operation outside opening hours. Over time, these savings could enable further investments in energy-saving technologies, further optimizing the museum's climate control.

New Resources for Building Operations:

The building operations team at ARoS has been strengthened with the addition of an energy optimization project manager. This position has been established to ensure efficient management and maintenance of technical systems, including the optimization of climate and lighting controls in the galleries, which is expected to reduce electricity consumption by 5-10%. The position will also take over tasks previously handled by external suppliers, saving the museum expenses and ensuring in-house expertise in building management systems (BMS). Additionally, the project manager will contribute to energy management, CO_2 accounting, and sustainability analyses, supporting the museum’s long-term vision.

Suggestions for Improvements:

ARoS has developed a range of optimization proposals as part of the "Getting Climate Control Under Control" project to reduce energy consumption and CO_2 footprint. By scheduling climate-intensive exhibitions in winter, relaxing climate requirements for certain artworks, expanding the RoomAlyzer sensor system, introducing variable temperature setpoints, and implementing night operations and pressure reduction in the galleries, the museum can achieve significant energy savings. Economic incentives such as fixed electricity budgets and a spot price agreement with V2G utilization should promote sustainable energy use. Furthermore, the purchase of green certificates and a PPA agreement for green electricity is proposed. Together, these measures will reduce energy consumption, preserve artworks, and strengthen the museum's sustainable profile.

Future Plans and Strategy

As part of the museum's future sustainability strategy, the collection presentations in the galleries on levels 6 and 8 will play a central role in upcoming sustainability initiatives and experiments. These will focus not only on climate control but also on material choices, recycling, lighting, and flexible exhibition architecture. A working group has been established, consisting of the Head of the Technical Department and the Head of Collection Management, supplemented by other professionals, to develop potential initiatives for the coming years.

Regarding the loan of artworks, ARoS has reformulated its climate requirements to make them "open" in loan agreements: "Room temperature, humidity, lighting, and placement of the loan during the loan period must not cause unnatural changes in the condition of the loan." Facility reports indicating that the borrowing institution adheres to the Bizot Green Protocol are accepted.

For incoming loans, ARoS' future facility report, sent as part of loan requests, will state the museum's goal of climate control in the galleries within the parameters of the Bizot Green Protocol, rather than Thomson's Class 1 standards. A document will be prepared for the curatorial department to support, streamline, and facilitate communication with lenders. This document will clearly explain and substantiate the museum's practices and objectives regarding climate control in exhibition galleries.

Optimization Proposals

To promote more sustainable operations and reduce energy consumption, ARoS has developed several strategic initiatives and proposals for optimizing the museum's climate control:

1. Scheduling Climate-Intensive Exhibitions During Winter Months:
   By shifting climate-intensive exhibitions to the winter months, the museum can take advantage of the lower energy requirements for heating and humidifying cold, dry winter air compared to dehumidifying and cooling warm summer air. This can reduce the museum's energy consumption by an estimated 60,000–70,000 kWh annually, equivalent to approximately 5% of its total energy needs.

2. Excluding Climate-Intensive Works in Exhibitions Without Climate-Sensitive Requirements:
   By excluding climate-intensive works from exhibitions where the majority of artworks do not require climate control, the museum avoids unnecessary climate regulation for entire galleries. This optimizes resources and significantly reduces operational costs.

3. Reassessing Climate Requirements in the Facility Report:
   Adjusting the allowable variations in temperature and relative humidity for exhibition galleries can reduce the precision demands on climate control systems. This change provides greater flexibility in climate settings and could potentially lower energy consumption.

4. Expanding the Roomalyzer Sensor System:
   Adding more sensors and increasing access to climate data for relevant staff will ensure that artworks are constantly monitored and preserved under optimal conditions. Although this investment may not directly lead to energy savings, it will enhance the reliability of climate control.

5. Variable Temperature Setpoints Year-Round:
   By allowing gallery temperatures to follow outdoor seasonal variations, the museum can reduce energy consumption for heating and cooling. Temperature setpoints would be lowered to 19°C in winter and raised to 22°C in summer, potentially leading to significant energy savings depending on annual outdoor temperatures.

6. Night Operation of Ventilation Systems:
   Following a successful test on level 8, it is recommended to implement night operation in all galleries and storage areas. This could result in annual savings of approximately 20,000–25,000 kWh, equivalent to 2% of the museum's energy consumption.

7. Reducing HVAC-systems pressure in Galleries:
   Lowering HVAC systems' working pressure from 200 Pascal to 100 Pascal would reduce energy consumption while still maintaining galleries climate requirements. The risk of reduction is that peaks become larger and take longer to adjust. This adjustment could save approximately 100,000 kWh annually, equivalent to about 7% of total energy consumption.

8. Fixed Electricity Budget for Exhibitions:
   Allocating a fixed electricity budget for exhibition planning would incentivize curators to optimize climate requirements, as savings could be redirected toward other exhibition purposes. This financial incentive could encourage more sustainable exhibition planning.

9. Spot Price Agreement for Electricity and V2G Utilization:
   By entering into a spot price agreement and utilizing peak hours through a Vehicle-to-Grid (V2G) system, the museum can align energy consumption with periods of lower electricity prices and CO_2 concentration, reducing operational costs and supporting sustainable energy use.

10. Power Purchase Agreement (PPA) for Green Electricity:
    A PPA agreement with a renewable energy provider would ensure the museum a stable supply of green electricity and significantly reduce the CO_2 footprint associated with its energy consumption.

11. Purchasing Green Certificates:
    By purchasing green certificates equivalent to the museum's electricity consumption, ARoS can document that an equivalent amount of electricity is sourced from renewable energy. This supports the museum's sustainability goals and strengthens its green profile.

Conclusion:

The project has demonstrated significant savings in the climate control of the art areas at ARoS. The study identified several minor adjustments that have now been integrated into the museum's BMS system and are recommended for implementation across other art areas if there is support for this.

As with other optimizations, ongoing discussions should evaluate whether the existing climate requirements are necessary. In short, while small adjustments can yield savings, the greatest benefit will be achieved if climate control requirements are significantly reduced.

To meet ARoS' ambitions and Vision 2033, the museum should more critically assess whether all exhibitions need to be climate-controlled. If climate requirements could be entirely removed from the museum (although this is not feasible due to collection presentation and storage requirements), the total savings could potentially amount to approximately 350.000 DKK and reduce energy consumption by approximately 200.000 kWh.

On a smaller scale, the museum should prioritize scheduling climate-intensive exhibitions during the winter months, while exhibitions without climate requirements (such as video, sound, installations, etc.) should be scheduled in the summer, when the load is highest. With long-term and focused planning, the museum could achieve savings of approximately 60-70.000 kWh yearly.

Furthermore, the museum should consider excluding certain works requiring climate control if the majority of the exhibition does not have such requirements. An economic incentive could be offered to curators to exclude or replace works with climate costs, helping the museum achieve its Vision 2033 ambitions. This can be supported by adjusting standard procedures in facility reports so that the museum does not automatically offer climate control with Thomson's Class 1 for loans.

Among the less strategic decisions, it should be accepted that the gallery climate mirrors external conditions as much as possible, ventilation is turned off during nighttime hours, sensors are placed near artworks, and facility reports work with a much wider range of parameters.

The report presents several proposals that the management group should consider advancing this work. None of the proposals conflict with conservation recommendations for art preservation or visitor experience. Common to all proposals is that they change the museum's approach to exhibition planning, incorporating climate and environmental considerations as key parameters on par with preservation.

Appendix 1:

The electricity consumption of the cooling units at ARoS is primarily driven by the building's need for dehumidification, which is required for approximately 8 months of the year. This analysis aims to accurately determine the energy consumption associated with both dehumidification and "climate cooling" for the galleries.

Key Assumptions and Methodology:

1. Baseline for Dehumidification:
    - The electricity consumption of the cooling units in October 2023 was used as a baseline, as there was no cooling required for comfort purposes during this period.
    - October 2023 recorded an average temperature of 9.3°C (minimum: 0.5°C, maximum: 18.4°C), ensuring that cooling requirements were primarily driven by dehumidification.
    - Electricity consumption for October 2023 was 32,547 kWh.

2. Summer Months Comparison:
    - During the summer months (June–September), electricity consumption fluctuated between 52,000 kWh and 65,800 kWh per month due to combined cooling and dehumidification demands.
    - The cooling effect attributed to dehumidification was calculated as a fixed percentage of total electricity consumption, based on the ratio of October consumption to the average summer consumption for both 2023 and 2024.

3. Dehumidification Electricity Consumption:
    - The electricity consumption attributed to "climate cooling" was calculated as 54% of the total cooling effect.
    - The average electricity consumption for climate cooling during the summer months was determined to be 44 kWh/h.

4. Airflow and Ventilation Systems:
    - Dehumidification is managed by four ventilation systems with a combined output of 81,000 m^3/h.
    - Electricity consumption per ventilated cubic meter of air for climate cooling was calculated as 0.00055 kWh/m^3.
    - After dehumidification, reheating requires a heating demand of 7°C.

5. Final Calculations:
    - Cooling Demand:
        - 1 m^3/h of treated air requires 0.00055 kWh of electricity to produce climate cooling.
    - Heating Demand:
        - 1 m^3/h of treated air requires 0.00274 kWh of electricity for reheating after dehumidification.

Final Report

Climate Control Pilot - Danish Cohort – ARoS Kunstmuseum, Level 8
The Conservator's Role in the Project

As part of the agreement between Kunstkonserveringen and ARoS Kunstmuseum for the 'Climate Control Pilot' project, a selection of artworks on Level 8 were identified by the conservator as 'suitable' for inclusion. These works, in a relatively fragile state of preservation, were deemed particularly sensitive to changes in climate conditions. The primary task was to monitor the condition of these selected works throughout the project.

The conservation status of each of the four selected paintings on Level 8 was documented through individual condition reports. Specific areas of concern were identified for each painting to be closely monitored. The selected paintings include:

- **Janus la Cour, *Risskov, Århus, Skrænten*, 1863:** This painting was chosen due to extensive cracking and the beginning stages of delamination. It is hung on the gallery's only exterior wall, where a microclimate behind the painting may be influenced by fluctuations in temperature and relative humidity.
- **P.S. Krøyer, *Fiskekutterne skal lette*, 1894:** The paint layer on this work exhibits significant old losses and 'tenting' caused by severe moisture exposure in the past, rendering it particularly vulnerable to substantial climate variations.
- **Vilhelm Lundstrøm, *Nature Morte*, 1920:** This painting has areas of severe cracking in the paint layer and has undergone extensive conservation treatments in the past.
- **Asger Jorn, *Spansk drama*, 1952-53:** The paint layer on this work has localized severe cracking and is currently experiencing flaking. Asger Jorn's paintings are particularly sensitive to large fluctuations in relative humidity and temperature due to the artist's materials and techniques.

Condition reports were prepared in June/July 2023, November/December 2024, and finally by the end of August 2024. During each assessment, selected areas with cracking and early signs of paint layer flaking on the four paintings were photographed in detail. These photographs served as documentation and reference for subsequent assessments and the final evaluation.

The reports were compiled in digital format using the program 'Art-i-check,' a commercial software introduced by the Green Academy (ODM, DK) at the project's onset and included in the Climate Control Pilot.

In addition to the project, conservators from Kunstkonserveringen have regularly monitored the conservation state of the paintings on Level 8, per an ongoing agreement with ARoS.

Conclusion

A visual assessment revealed no changes in the condition of the four paintings during the period of climate control adjustments in the exhibition rooms on Level 8. The cracks did not appear to have

widened, and the areas of tenting in the paint layers showed no further lifting or detachment from the support.

Notes to the conclusion

- **Duration of Climate Control Adjustments:** It is important to note that the climate control adjustments were implemented over a relatively short period and did not span all seasons. Continuation of these adjustments across all seasons is recommended to fully assess their impact on relative humidity (RH) and temperature (T) on Level 8.
- **Specificity of Findings:** The conclusions drawn from the condition assessments apply exclusively to the four selected works, all of which are oil paintings on canvas. Therefore, it cannot be inferred that all types of objects and artworks would tolerate the climate changes recorded by the installed data loggers.
- **Challenges with Documentation:** The digital documentation of the preservation state was conducted using the Art-i-check program. However, difficulties arose as the program was installed on the conservator's laptop and a Surface Pro tablet, yet it was later discovered that its full functionality required an iPad, which was not disclosed at the start of the project. Consequently, the documentation lacks consistency and uniformity. Future use of this program would necessitate investment in iPads, appropriate licenses, and dedicated time and resources for training.

Report written by Elizabeth Baadsgaard, Painting conservator, Kunstkonserveringen, August 30, 2024