

WHITEPAPER

# Challenges & Opportunities for Energy-efficient Climate Control

How to create a sustainable and comfortable climate within your production facility



World leader in adiabatic cooling



# Introduction

A common challenge faced by production facilities today is how to create an indoor climate that is beneficial to their employees and production machinery, processes and products. Heat is an essential cause of complications in production processes. It not only results in employees to be demotivated, less productive and make more mistakes but also causes machine downtime. Other influences, such as dust or released vapors can also have a negative effect on the comfort and well-being of employees. Therefore, cooling and optimal ventilation are fundamental to your production facility. At the same time, production facilities need to reduce their energy costs.

In the winter months, underfloor heating is often used for heating. But is this really the most sustainable solution? And what about ventilation?

Production facilities need to rethink the way they can achieve optimal cooling, heating and ventilation. Mechanical air conditioning, for instance, proves to be highly unsustainable and unaffordable. The goal of production facilities is thus to implement an energy-efficient climate system that maximizes production output, at minimal energy costs.

In this whitepaper, we describe what factors you need to take into consideration and how you can achieve energy-efficient climate control within your production facility.

# 1. Factors that influence the indoor climate of a production facility

When looking to create a climate within your production facility that is beneficial to the production process and energy-efficient as well, it is crucial to consider the factors that influence the indoor environment. In this chapter, we explore these factors further.

## 1.1 External Factors

External influences largely determine the temperature within a building. This includes the outside temperature, the position of the sun and the amount of sunlight or sun hours. Furthermore, the geographical location of the building plays a role as well, as this will determine the overall influence of wind and relative humidity. These factors need to be taken into account when looking to create a comfortable and sustainable climate within the production facility as these determine the design of your climate control solution.

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“Due to temperatures rising globally, it has become a challenge for many production facilities to maintain an indoor climate that is both healthy and sustainable”





## 1.2 Internal Factors

There are many fixed characteristics of the building itself that will influence the indoor climate. For example, the year the production facility was built, and with what type of insulation material influences the levels of insulation within the building. If a building is well insulated, the internal heat cannot easily escape, which is beneficial during the colder periods of the year, but less optimal during summer. The amount and type of windows also influence the indoor climate. Skylights provide an aesthetically pleasing and convenient natural lighting solution, but also let a lot of sun heat pass through. The same goes for single glazed windows. Besides, the presence of a natural ventilation system or ventilation hatches will also influence the indoor environment. Throughout the year, these ventilation options provide the facility with fresh outside air. Yet, the outside air that is ventilated in during summer isn't cooled down, and will only heat the facility even further. Furthermore, the type of electrical lighting in place will influence the internal heat load as some light bulbs give off a lot of extra heat.



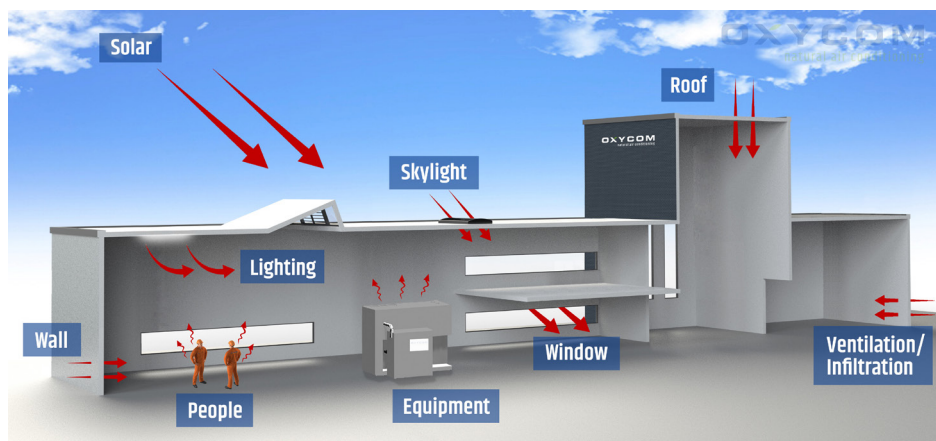
### 1.2.1 Production process

The temperature in a production facility also depends on the production process itself. The machines used in production give off a lot of heat during their running time and warm up the indoor environment. Compressors and process cooling machines also influence the indoor climate if they are placed indoors, as these generate a lot of heat as well. Furthermore, if there is any process extraction in place, it is essential to consider whether this extraction blows the heated air back into the production hall, as this heavily influences the indoor temperature. Last but not least, the number of people and their activities will further impact the indoor environment due to their body heat.



## 2. Opportunities & solutions for energy-efficient climate control in a production facility

As described above, many factors influence the indoor climate of a production facility. Once these factors have been taken into account and are analyzed, you can start looking at the opportunities and solutions for energy-efficient climate control within your production facility. The first step in this process is to determine what climate you want or rather need in your production facility and if this can be achieved using an energy-efficient solution.



### 2.1 An energy-efficient climate beneficial to the production process

Some production facilities are dead set on a stable climate of 20°C within their production facility, all year round. However, during the warmer periods of the year when outside temperatures quickly rise to 40°C, this can only be achieved with heavy mechanical cooling that uses a lot of energy. The question is then if this large discrepancy in temperature is necessary. Of course, some industries such as the medical industry and the food industry absolutely require their indoor temperature to stay below 25°C. Yet, for many other industries, this is not the case. Therefore it is essential to consider the temperature that you need to achieve within your production facility, and in

the lesser what you want to achieve. Furthermore, the humidity requirements need to be considered, as well as the levels of fresh air and ventilation. For instance, are toxic fumes or dust present in the production facility, one would have to opt for a climate solution that offers fresh air ventilation instead of recirculatory ventilation. All these factors need to be taken into account when looking for the right climate control solution. In the sections below we will describe a few opportunities and solutions for energy-efficient climate control.

## 2.2 Straightforward and sustainable adjustments

As described in chapter 1.2, many internal factors influence the indoor climate of a production facility. Many of these can be changed by a few sustainable and straightforward adjustments to create a more comfortable work environment.

### Windows and skylights

Are your windows or skylights single glazed? Change them to solar control (double glazed) windows and/or apply a sun reflective coating or foil. The coating allows the sunlight to pass through the glass while reflecting away a significant degree of the sun's heat. Other options include installing sunblinds, coating the glass panes with sun reflective chalk or paint, or covering the windows with a sun reflective fabric. The latter options do, of course, affect the amount of light that passes through.

### Roof

Most of the heat that builds up underneath the building's roofing can be reduced by painting the roof white or a lighter shade of grey. Placing solar panels on the roof will have a similar effect.





### Lighting

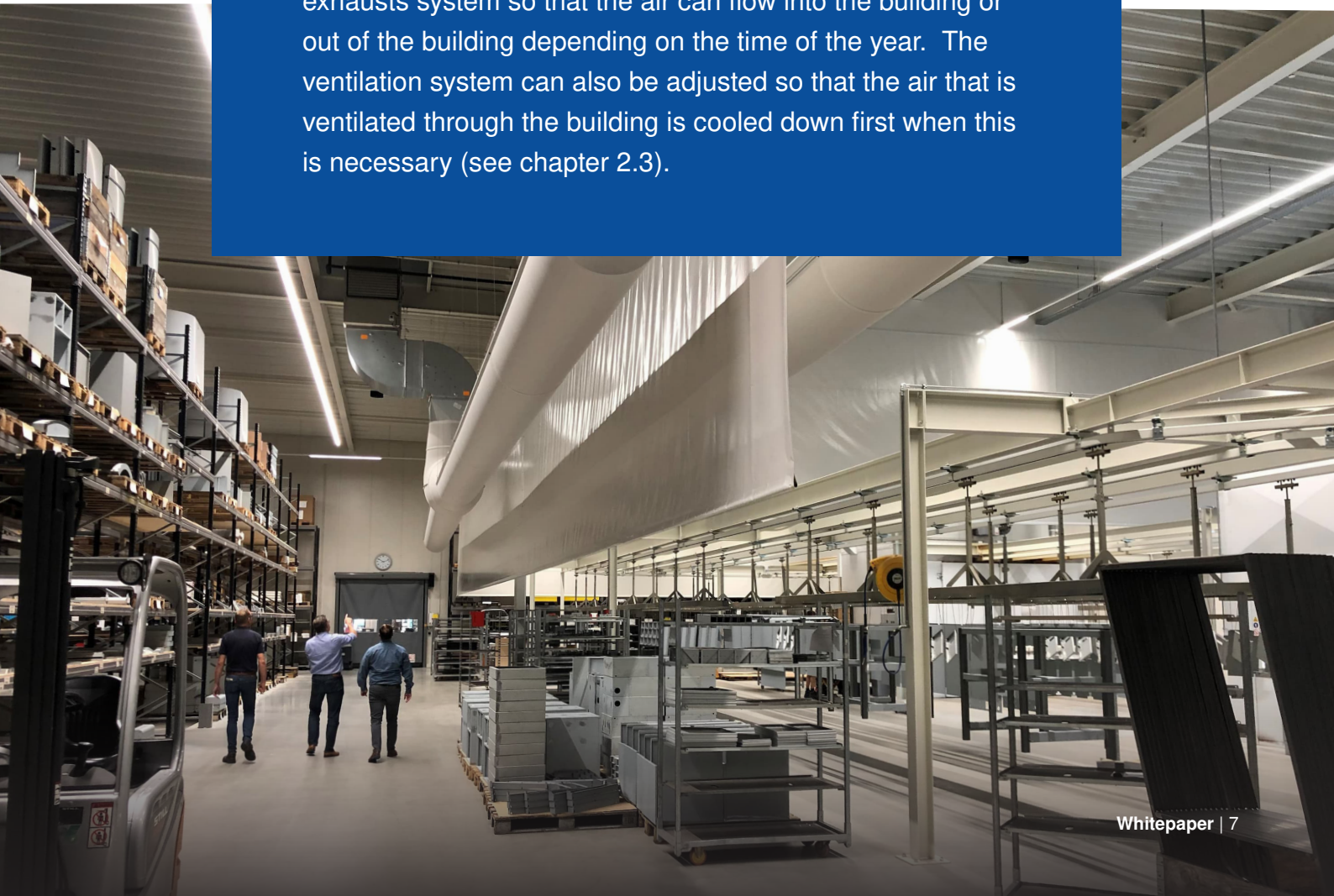
If possible, consider using LED-lighting instead of other light bulbs. LED-lights produce minimal heat and use considerably less energy than regular lighting.

### Heat producing equipment

If feasible, consider placing a screen around heat-generating equipment to reduce the amount of heat they radiate into the production facility. Some heat-generating machinery, such as internal cooling machines could even be placed outside of the production hall to eliminate their influence on the internal heat load.

### Ventilation and process exhausts

A smart way to improve the indoor climate of your production facility is to rethink the ventilation system that is in place, as well as the process exhaustion. If the process exhausts blows the air back into the facility, consider adjusting the exhausts system so that the air can flow into the building or out of the building depending on the time of the year. The ventilation system can also be adjusted so that the air that is ventilated through the building is cooled down first when this is necessary (see chapter 2.3).





## 2.3 IntrCooll: Energy efficient and sustainable two-stage adiabatic climate control

If the adjustments listed above are insufficient to create a comfortable and productive environment inside the production facility, an additional climate control system will have to be put in place. Traditional air conditioning can be a solution. However, these systems use a lot of energy to achieve the desired temperature. Two-stage adiabatic climate control, on the other hand, can cool up to 15°C below the outside temperature while using 90% less energy than traditional air conditioning. Furthermore, two-stage adiabatic climate control systems allow you to create a sustainable and productive climate throughout the whole year.

Oxycom's two-stage adiabatic climate control system, IntrCooll, uses 100% fresh outside air during free cooling and cooling. During spring, winter or fall, the system uses the outdoor air smartly to ventilate and cool without using any energy at all. When the outside temperatures increase beyond a temperature of 18-22°C, the IntrCooll system switches to two-stage adiabatic cooling; the outside air is cooled in the first stage using cold recirculation water and further cooled down by direct evaporation in the second stage. Only 1 kW of electricity is needed to provide up to 40 kW of cooling power. This so-called EER (Energy Efficiency Ratio) is a factor 10 lower with traditional cooling systems.



## 2.4 Energy-efficient four-season climate control system

In comparison with other climate systems, IntrCooll system is modular and can be easily adapted to different requirements, which makes installation a piece of cake. The parts can be put on top of each other like Lego blocks and lifted together.

During winter, the IntrCooll system can be enhanced using a natural ventilator box (no extraction fans needed) and the Heat Reclaim module. This module reuses the residual heat that is generated from machines, processes, heating, lighting and people, mixes it with fresh outside air and thus supplies the production hall with preheated ventilation. In this process, the horizontal temperature layers in the production area are breached (anti-stratification), and the difference in temperature of the roof (between inside and outside) is minimized. This results in less heat loss and therefore provides significant savings.

A carbon dioxide (CO<sub>2</sub>) measuring device can be connected to our system to deliver the required amount of fresh air in winter or shut off the outdoors completely at night and/or on weekends when no fresh air is needed. Additional heating can be provided by connecting the Heat Reclaim Module with a heat pump.





# Benefits of energy-efficient climate control



Happy and healthy employees



Zero machinery downtime



Energy (costs) reduction



Low running costs



Less production errors



Low carbon footprint

## Chapter 4: Recap and key takeaways

The climate within a production facility greatly influences the production process—insufficient cooling and ventilation of the workplace results in machine downtime as well as unmotivated and unproductive staff. Achieving the right climate within the workspace will, therefore, maximize your output. Because production facilities need to lower their energy consumption, it is crucial to look for energy-efficient ways to create an optimal indoor climate. Many sustainable adjustments can be made to minimize the internal heat load of a production facility. In addition, a two-stage adiabatic climate control system can be implemented to assure cooling, heating and maximal ventilation and to provide a healthy, productive and energy-efficient indoor climate all year round.

- The indoor climate is influenced by external and internal factors, as well as the production process
- Straightforward and sustainable adjustments can reduce internal influences
- Two-stage adiabatic climate control further provides an energy-efficient solution
- Cooling, heating and ventilation can be provided into one with our innovative two-stage adiabatic climate control



### Want to know more on the benefits of an energy-efficient climate control solution?

During the heatwaves of August in the USA, the temperature rose around 44 °C (112 °F). After the installation of our sustainable and innovative two-stage adiabatic cooling solution, IntrCool, the indoor temperature at the MilliporeSigma site remained around 23.3 °C (74 °F), due to average supply temperatures around 13 - 14 °C (55.4 - 57.2 °F) and all with 90% energy savings and no harmful cooling agents, but water.

[Download case study →](#)





## About Oxycom

At Oxycom, we are pioneers. We design our highly innovative 'natural cooling systems' with one goal: reduce the global ecological footprint required for cooling, ventilating and heating buildings. Founded in the Netherlands, we have been developing innovative adiabatic climate solutions since 2002. Oxycom has years of experience with countless applications worldwide. Our broad expertise enables us to complete every project successfully together with our partners / installers.

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