

The background of the entire page is a photograph of a winter landscape. A snow-covered road with visible tire tracks leads from the bottom center towards the horizon. On the right side of the road, there is a dense line of evergreen trees heavily laden with white snow and frost. The sky is a clear, bright blue. The overall scene is bright and crisp, suggesting a cold, sunny day.

aggreko

# Prepare for the chill

Tackling temperature and  
humidity challenges in Nordic  
data centre construction

# Why the Nordics?

The Nordic region is widely regarded as one of the best locations for data centre construction. Global design and consultancy business Acadis puts four Nordic countries in the top 10 of its data centre location index, with Sweden and Norway only beaten to the top spots by Singapore, Japan and the United States.<sup>1</sup> Others, like Investment Monitor, believe Denmark outranks them all, emphasised by the opening of Google's \$730 million Fredericia facility in late 2020.<sup>2</sup>

The reasons why the biggest names in tech continue to house infrastructure in the region are clear. There is room to build, connection speeds are among the fastest in the world and cybersecurity standards are considered superior to those found in other key markets. Surpluses of grid power, like those found in Norway, also help to keep operating costs low and allow businesses to expand their digital capabilities more easily.<sup>3</sup> Arguably the most important features, however, are the freely available natural cooling and a well-established renewable energy mix that puts the region's data centres on course to be zero carbon by 2030.<sup>4</sup> This final point is vital, not

least because the sector accounts for a significant percentage of global energy consumption.<sup>5</sup>

## Regional Challenges

That said, the Nordics are not completely free of challenges. With all countries being situated in northern Europe, harsh winter weather can make management of environmental conditions difficult, especially as those responsible for construction are usually tasked with storing and maintaining IT equipment as a facility is being built.

Consistently low temperatures and high humidity can wreak havoc with equipment, not only jeopardising a build project

<sup>1</sup>The Arcadis Data Centre Location Index 2021

<sup>2</sup><https://techmonitor.ai/techonology/data-centre/best-place-data-centre-denmark-google>

<sup>3</sup><https://techhq.com/2021/04/low-cost-power-and-green-energy-in-norways-well-connected-data-centers/>

<sup>4</sup><https://www.prnewswire.co.uk/news-releases/western-europe-and-nordic-data-center-market-size-to-reach-revenues-of-around-usd-45-billion-by-2026-arizton-878329341.html>

<sup>5</sup><https://www.nature.com/articles/d41586-018-06610-y>

**“The Uptime Institute recommends some businesses factor fines into construction contracts before work even begins”**

but also raising the possibility of incurring penalties for missed deadlines. This is such a common problem that the Uptime Institute recommends some businesses factor fines into construction contracts before work even begins.<sup>6</sup>

Environmental management in the Nordics is only made harder by the distance some contractors have to travel. As one article points out, businesses in the UK and Ireland are now sought after for their knowledge and experience, having worked on many of the first European hyperscale facilities built for blue-chip companies like Microsoft, Amazon and Facebook.<sup>7</sup>

Working in this way, however, also means that plant equipment critical for temperature control can take days to arrive, leaving delicate parts at risk of damage.

This is a problem that needs addressing. The Nordic data centre market continues to grow at pace, keeping contractors in high demand, yet planning for freezing conditions still remains a reactive issue for most. Those working on data centres now need to consider a proactive strategy that protects both IT equipment and the reputations of businesses in the region. This guide examines that process.

<sup>6</sup> <https://journal.uptimeinstitute.com/avoiding-data-center-construction-problems/>

<sup>7</sup> <https://irishadvantage.com/collen-construction-the-irish-firm-helping-sweden-in-its-data-centre-industry-transformation/>

# Expert Opinion



We are seeing a lot of investment in the Nordics region, and the signs suggest that we have only scratched the surface. Google's investment into Finland – and Facebook moving to Luleå – were seen as real gamechangers for the region. Since then, Apple, Google and Facebook have all invested into Denmark, and Google, Amazon Web Services and Microsoft have all committed to facilities in Sweden.

It's clear that the region is an attractive proposition for operators, Co-lo providers and investors, thanks largely to the Nordics' cooler climate and access to green energy. There's also a lot of excess land in the region, with an investment in Swedish countryside increasing.

While there is no doubting that this is an exciting time for the region, it doesn't come without its challenges. There is still a reliance on overseas builders, thanks to a local skills shortage, coupled with a desire to work with contractors that the investors have worked with previously.

Those builders and contractors still have to follow local laws and building standards, as well as prepare for a climate which can be particularly harsh in the winter months. As such, it is important that the whole industry works together. From local consultants, to overseas contractors, collaboration is essential.

The opportunity in the Nordics is here to stay, and we can expect the region to continue becoming a major player in the data centres market.



**Pär Åberg**

Chairman, Swedish Datacentre Industry Association

[www.sdia.se](http://www.sdia.se)

# Key data centre sites in the Nordics

You only need to look at the climate in key Nordic regions over winter to see the challenges that contractors face. In Fredericia the temperature ranges from 14°C in September and plunges to just above freezing during January and February. Meanwhile humidity consistently sits above 80% during the coldest months. Other areas, especially those further north, can see more extreme conditions for an extended period of time. The temperature in Oslo, for example, remains far below 0°C from December and only begins to thaw in April. Humidity is also consistently high, peaking at 90% in November.

These figures are brought into focus when comparing them against the ideal operating conditions for data centres. The American Society for Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) recommends that server inlet temperatures sit between 18-27°C, with relative humidity ideally near 50%. The Uptime Institute is more cautious, suggesting an upper limit of 25°C.



This map indicates the average temperatures in the key data centre locations in the Nordics. Hover over each location to see average temperature and humidity ranges.



Note: Figures taken from September 2020 – March 2021 period. Data from <https://en.climate-data.org/>

# Prepare for the chill

**Humidity is fairly easy to maintain once a facility is complete but is far more difficult to control during the construction phase, leaving switchgears, uninterruptible power supplies and transformers at risk.**

It's important to note that relative humidity can be high at any temperature though the warmer months tend to carry more moisture. However, very cold dry air can also see an electrostatic charge build up inside a facility. This can cause serious problems for IT equipment, with airflow needing to be stabilised before anything is installed. In turn, parts can be left stored in less-than-ideal conditions for long periods, raising the possibility of damage from water ingress.

## **Ideal data centre conditions and why they matter**

- Newer equipment means data centres can now operate at a warmer ambient temperature than before, ideally sitting between 18-27°C
- Ideal humidity was once given at between 45% and 55%, though revised guidance now states a minimum humidity of 20% and a maximum of 80%
- According to research from Gartner, data centre downtime costs \$300,000 per hour. Good environmental conditions will not only ensure maximum uptime but improve the lifespan of hardware<sup>9</sup>

**"Very cold dry air can also see an electrostatic charge build up inside a facility."**

<sup>8</sup> <https://www.digitalrealty.co.uk/data-center-cooling>

<sup>9</sup> <https://blogs.gartner.com/andrew-lerner/2014/07/16/the-cost-of-downtime/>

<sup>10</sup> <https://www.capacitymedia.com/articles/3828097/european-data-centre-demand-rises-by-a-third-in-2021>



# Key construction challenges in the Nordics

Aggreko has identified three key challenges for contractors through its work providing temporary power, temperature and humidity control in the Nordics. Left unchecked these issues can cause significant disruption during construction, putting the ability to complete projects without late penalties at risk. Keeping to schedule is important in any sector but it's critical for data centre operators as they rely on ready infrastructure to keep pace with market demand, which in some regions is rising by as much as a third each year.<sup>10</sup>

## Challenge one: Preparing to fail

There is a tendency for builds to progress without adequate risk management. This reactive approach makes it harder to manage adverse conditions found in the region, which are known to change quickly with little warning. Should the weather suddenly get much colder, companies will need to bring in extra heaters fast to protect critical parts from exposure.

Contractors, for example, may take delivery of switchgear worth millions of pounds. If there are delays on site, this equipment has to be stored securely away from the elements. If left to the environment without adequate protection for long enough, moisture can easily find its way into components and render parts unfit for installation. The potential cost of an oversight like this could make an entire project unprofitable.

This issue is only made worse by the distances between depots and some data centre locations. Luleå, a popular data centre site in northern Sweden, is over 560 miles from Stockholm, for example. If power equipment were to fail or temperatures plunged, it would take roughly 10 hours for generators and heaters to arrive from Stockholm, and even longer if travelling from overseas.

## Solution one: Contingency planning

Contractors with a contingency plan in place will inevitably fare better than those without. It minimises the chances of extended downtime by having the right equipment ready should the worst occur. It also eliminates the difficulties around transportation and accessibility.

### Key considerations include:

- Past experiences – have there been more problems at certain times of the year?
- Identification of weaknesses – is the site prone to grid shortages, risk of flooding or temperature challenges? Are there accessibility issues? Will cabling and connections be compatible with replacement items?
- Determining what is needed – is additional power needed, or are heaters and dehumidification the main concern?
- Detailed plans – what needs to be done and when to get the site back online? Are there any other third parties the site depends on that might affect the contingency plan?

### Challenge two: **Insufficient heating**

Most contractors will have sufficient outdoor heating in place to limit the effects of exposure. However, far less attention is given to indoor heating where important assets are held. This puts equipment at risk of being stored beyond the required temperature to remain in warranty. Indirect diesel-fired heaters (IDF) are often used in this scenario but the amount of heat required inside some facilities can see huge amounts of energy used inefficiently. For hyperscale operators, this can have a significant impact on the sustainability of their data centres, challenging their pledges to become carbon neutral.<sup>11</sup>

### Solution two: **Alternative Heating**

Alternative heating solutions are readily available for those working in the region. Electric heaters, for example, are great for localised heat in smaller areas, such as switchgear or UPS rooms. If IDF heaters are a requirement, contractors can take advantage of ones running on hydrotreated vegetable oil (HVO). HVO offers a readily available green solution in the region, and you can read more about its benefits later in this guide. Finally, 500KW-1500KW wood chip boilers (sometimes referred to as pellet boilers) are also an option worth considering for data centre projects. All of these solutions will cover the worst of the Nordic winter, keeping parts safe from harm, but without having to use high amounts of fuel.

### Challenge three: **Humidity**

As figures in this report show, the Nordics experience among the highest levels of relative humidity in Europe. This can compound problems as condensation builds up on heat pumps and freezes during the coldest periods. Further delays will then follow to defrost the equipment needed for temperature control. Worse still, extended periods of cold dry air can cause electrostatic discharge that has the potential to corrupt data, meaning further interrupting while the environment is brought under control.

### Solution three: **Effective dehumidification**

Humidity is often an afterthought during construction, yet it can have a huge impact on the success of a data centre project if IT equipment is unable to be installed to schedule. It's important to note that rapid heating will not control moisture effectively, nor will it deal with static. Once this heat is removed, it only takes around 48 hours for equilibrium to be restored as moisture returns from the air back into the building's fabric. It's therefore essential for contractors to have sufficient dehumidification on site, particularly during the winter months when risks from condensation are highest.

<sup>11</sup> <https://www.theguardian.com/environment/2020/sep/15/facebook-and-google-announce-plans-become-carbon-neutral>

## Importance of testing

Nordic data centre construction cannot rely on predictable weather patterns during the winter months. With the site and equipment facing pressure from such volatile weather patterns, it's essential for contractors to conduct load testing, particularly on the electrical infrastructure.

Loadbanks are used to test electrical power supplies, simulating variable electrical load conditions in a way that can be accurately controlled, measured and recorded. It's vital to test systems, particularly when commissioning new generators. It's also important to run backup generators regularly to burn off any unburned fuel, oil, or condensation.

Aggreko carefully plans its load testing so it doesn't affect a build and can assess a range of different equipment commonly used during data centre construction, including generators, turbines, uninterruptible power systems and electrical distribution. It can also simulate heat loads to determine how temperature control will affect power demand on site. Predicting the weather is impossible but covering all eventualities is not.



## Sustainable practices in data centre construction

The overall environmental impact of data centres remains an ongoing focus in the Nordics, as it does throughout the world. Yet with the region enjoying an abundance of renewable energy sources and society trending toward more of a greener future, all stages of a data centre's lifetime are expected to be as sustainable as possible, including construction.

As part of its broader strategy to help contractors reduce their environmental impact, Aggreko has taken a number of steps to ensure data centre construction sites can be more eco-friendly. These include:

### Stage V compliant generators

Aggreko is the first hire company to design and manufacture Stage V engines compliant with the Medium Combustion Plant Directive (MCPD). This directive forms part of the European Commission's Clean Air Policy Package to limit emissions of certain airborne pollutants from Medium Combustion Plants.

These new 600 kVA generators can provide temporary power to construction sites with extremely low emissions. This is achieved via mandatory installation of a Diesel Particulate Filter to reduce soot emissions in line with the MCPD. The units' selective catalytic reduction systems also utilise diesel emission fluid to reduce nitrogen oxide emissions to levels required by the directive. Additionally, these Aggreko generators use diesel oxidation catalysts, reducing the amount of carbon dioxide emitted via an oxidation process.

### HVO

Aggreko's generators are also compatible with hydrotreated vegetable oil (HVO), a greener drop-in fuel that can completely replace diesel in existing units without adjustments or modifications. Unlike regular biodiesel or its synthetic, gas-to-liquid counterpart, HVO does not contain dilutions of fossil fuels, instead being sourced from vegetable oils and fats treated with hydrogen.

Depending on sourcing, HVO produces markedly less carbon emissions than traditional fossil fuels, as well as lower amounts of particulate, carbon monoxide, hydrocarbon and nitrogen oxide emissions. The fact all oxygen is removed from HVO during the creation process means it can be stored far longer than previous drop-in fuels without the risk of contamination.

### Load-on-demand power solutions

Aggreko's load-on-demand power solutions replace a single, large, constantly operating generator with two or more smaller hybrid generator systems that power up or down automatically, depending on the site's fluctuating power usage. By using smaller single generators that power down when not required (instead of a single large unit constantly operating at low load), construction sites can save on fuel costs, and emissions.

As well as allowing for more sustainable and efficient practices, load-on-demand systems also ensure there is an uninterrupted, reliable power supply for the whole construction site no matter how the power demand changes.

# Conclusion

UK and Irish contractors are recognised for their skill in data centre construction, having worked on some of the world's most ambitious data centre builds over the last 20 years. These opportunities, however, rest on an ability to complete builds safely and to schedule without any losses. It's vital for businesses to move from a reactive approach that fails to account for volatile weather and instead prepare for challenges in the summer months before ground is broken. This includes sufficient heating and dehumidification but also back-up generators and load testing to guarantee the site remains operational no matter how cold it gets.

**For more information, visit: [aggreko.com](https://aggreko.com)**

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