

US food producers waste approximately 40% of product before it reaches the end consumer, equal to approximately 36 billion pounds of food. Poor environmental conditions that cause inventory to spoil or degrade are a primary driver of product loss. Monitoring the temperature of food and other perishable products is necessary to avoid food safety incidents and needless product loss. Nevertheless, many restaurants, manufacturers, and distributors conduct manual temperature checks, which are labor-intensive, inaccurate, and easily fabricated.

However, product loss is now optional, thanks to devices that remote temperature monitoring devices. In turn, organizations increase profits, reduce manual labor, and guarantee food quality and safety.

What is remote monitoring?

The optimal way to perform temperature checks in cold storage areas is to utilize remote monitoring devices like Therma. While remote temperature monitoring devices differ, they generally include three components:

1. The **sensors** detect and measure temperature, humidity, and other variables within the monitored area and transmit this data to a centrally located hub.
2. The **hub** receives this data and sends it to the cloud, which connects to traditional IT systems.
3. Advanced data analytics **software** records and displays the information so users can take actionable steps to safeguard their inventory and equipment.

Why remote monitoring matters

Remote monitoring offers many benefits that can help optimize your cold storage facility. It provides the prospect of safe and efficient storage in freezer rooms, cold rooms, quarantine areas, and receiving/loading bays. However, it is most adept at notifying operators when the conditions in their storage facilities have become incompatible with their inventory.

While many of these locations within a cold storage facility have climate set points, the actual temperature can vary. This phenomenon is known as “temperature drift.” Temperature drift is to be expected. However, once it exceeds established thresholds and enters the [cold storage danger zone](#) for longer than an hour, the inventory may spoil or become unusable.

Traditional pen and paper temperature monitoring protocols make these incidents hard to spot. The CDC recommends cold storage inspections twice a day. However, in reality, these inspections create a host of problems:

- Inaccuracy: Manual temperature checks are often conducted using traditional thermometers. These devices must be calibrated frequently to provide accurate data, but this task is frequently neglected.
- Redundancy: When thermometers are defective, they may continually show identical readings. Over time, staff may assume that the checks are unnecessary, especially when they have a large workload on top of that.

- **Pencil Whipping:** Pencil whipping occurs when staff logs fake data without checking the area's conditions. This is often a byproduct of the two points raised above.

Remote monitoring prevents these situations by automatically informing operators when their inventory has entered the danger zone. Therefore, teams can take actionable steps to create loss events.

The Role of Analytics in Cold Chain Management

Advanced analytics is a crucial component of remote monitoring systems, which enhances operational efficiency and risk mitigation. In cold storage and manufacturing, analytics primarily drives impact in two key areas:

1. **Detection of Temperature Cyclicity**
2. **Predictive Maintenance and Equipment Downtime Forecasting**

Temperature Cyclicity Detection

Cold storage environments often experience cyclical temperature fluctuations driven by operational workflows, such as scheduled loading and unloading activities. These fluctuations can cause transient temperature spikes that, if unaddressed, increase the likelihood of spoilage events.

Advanced analytics platforms leverage historical temperature data to identify recurring patterns, allowing for preemptive corrective measures. For example, suppose data trends indicate that a freezer room consistently breaches its upper threshold during peak delivery hours. In that case, facilities can implement pre-cooling strategies or adjust schedules to mitigate thermal excursions.

Predictive Maintenance and Downtime Mitigation

Machine learning and predictive analytics enable proactive detection of refrigeration system degradation. By utilizing supervised learning algorithms trained on historical temperature deviations and maintenance records, modern analytics platforms can forecast potential equipment failures before they occur.

Neural networks analyze sensor data streams to detect anomalies, such as gradual temperature drift or sudden thermal instability—both leading indicators of impending mechanical failure. By identifying these precursors early, operators can execute condition-based maintenance, reducing unplanned downtime and minimizing the risk of catastrophic refrigeration failures.

Remote monitoring in food manufacturing

Remote temperature monitoring plays a critical role in food manufacturing because it automates environmental standards that are important for product quality.

For example, temperature and humidity must be continuously monitored in high-end chocolate production to provide a high-quality output. During the production process, the chocolate cools from 113°F to 82.4° before heating up to 86°F. After manufacturing, the chocolate must be held between 55-68°F, at 55% humidity, and without natural light exposure. Read on to learn more about the remote temperature monitoring processes that a high-end chocolatier uses to protect their products.

How Moonstruck Chocolates uses Therma° temperature sensors

To optimize environmental conditions in the production processes, Moonstruck Chocolates in Portland, Oregon, implemented Therma° remote monitoring throughout its manufacturing process.

Beginning with storing their raw materials, Moonstruck deployed wireless sensors in locations close to the entryways where they store chocolates. Entryways tend to be where warm air permeates, such as in the event of loading/unloading of inventory. Timely alerts allow operators to monitor conditions and ensure their products don't deteriorate in substandard conditions.

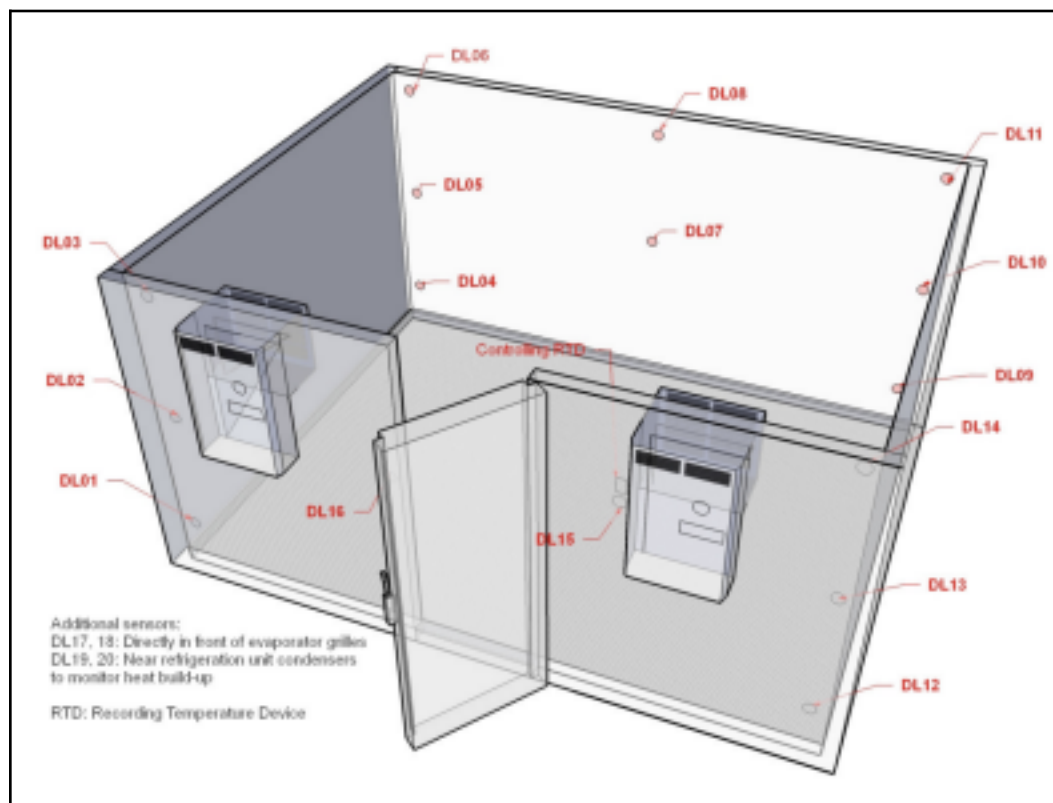
During production, Moonstruck leverages remote monitoring to precisely control ambient conditions along the production line. Four strategically placed sensors at each entryway continuously track environmental variables, ensuring optimal conditions. Maintaining strict oversight is critical, as transforming precursors—from solid to liquid and back to solid—requires exact thermal regulation to preserve product integrity and consistency.

In their retail sites, Moonstruck monitors the conditions of their display cases and reach-in refrigerators. This is important because the presentation of their chocolate is almost as important as quality assurance in their production process. If customers receive a degraded product due to temperature variation, it could damage the reputation of their business, lead to a health inspection, fines, or even a closure.

Remote monitoring in industrial warehousing

There are multiple strategic placement methods for sensors in an industrial warehouse to maximize efficacy. According to a technical report by the World Health Organization (WHO), operators should deploy sensors in a grid configuration spanning the width and length of the facility. This layout ensures comprehensive coverage, with sensors positioned approximately every 15 feet to maintain accurate environmental monitoring and consistency across the space.

Another effective strategy is deploying sensors in a grid formation to map air temperature profiles throughout the warehouse. This approach helps identify cooling inconsistencies and pinpoint unsafe storage zones for temperature-sensitive products. Additionally, it enables differentiation between pallet-racking storage areas and walk-in cold rooms. To ensure seamless data transmission, operators must also position a centrally located hub within range of these sensors, allowing real-time temperature data to be relayed to a cloud-based dashboard.



This map shows suggested locations for sensors within a cold room.

Energy Savings Potential Through Remote Temperature Monitoring

Conventional HVAC and refrigeration systems are inherently energy-intensive and often operate inefficiently, leading to unnecessary costs. According to the United Nations Environmental Program (UNEP), optimizing refrigeration and control systems could yield 30–70% energy savings. One major culprit of inefficiency is overcooling to compensate for temperature drift.

By leveraging real-time temperature data, remote monitoring enables operators to identify hot spots, detect overcooled areas, and implement energy-efficient control strategies within industrial facilities. One such approach is capacity-limiting, where factory control systems adjust cooling output based on actual demand rather than pre-set assumptions.

For instance, an optimized evaporator coil fan speed strategy can prevent unnecessary energy consumption. When a sensor detects an overcooled zone, it triggers an alert to the building management system, prompting a reduction in fan speed for evaporator coils equipped with variable-speed controls.

Another energy-saving tactic is defrost termination, which defers the defrost cycle in overcooled zones. Since these areas already maintain low temperatures, defrosting the evaporator coils prematurely wastes energy without improving storage conditions.

Research from the University of California, Berkeley, highlights that commercial buildings in the US waste an estimated 8% of energy due to overcooling. The study further demonstrates that reducing airflow to 90% of peak capacity can achieve 10–30% energy savings while maintaining stable temperatures. Remote temperature monitoring automates these optimizations, integrating IoT-enabled sensors and predictive analytics to drive smarter, more efficient climate control—significantly cutting costs while ensuring product integrity.

Why try Therma?

Higher-quality temperature data and analytics via remote monitoring systems, such as Therma, offer the following benefits to operators:

- Decreased food waste
- Compliance with legal ordinances
- Reduced workload for staff
- Equipment repair savings

The market today offers a range of options to enhance warehouse storage management, with remote temperature monitoring emerging as a key solution. However, the critical question remains: which technology delivers the best performance? Given the competitive demands of the warehouse and manufacturing sectors, minimizing errors, avoiding overcooling, and preventing spoilage are non-negotiable priorities.

To achieve these objectives, selecting highly efficient technology is paramount. In this regard, Therma's LoRaWAN-powered devices are the optimal choice. Their superior range, combined with their integration into an intelligent, adaptable software suite, enables operators to extract maximum value from their remote monitoring systems, ensuring energy savings and the protection of valuable inventory.