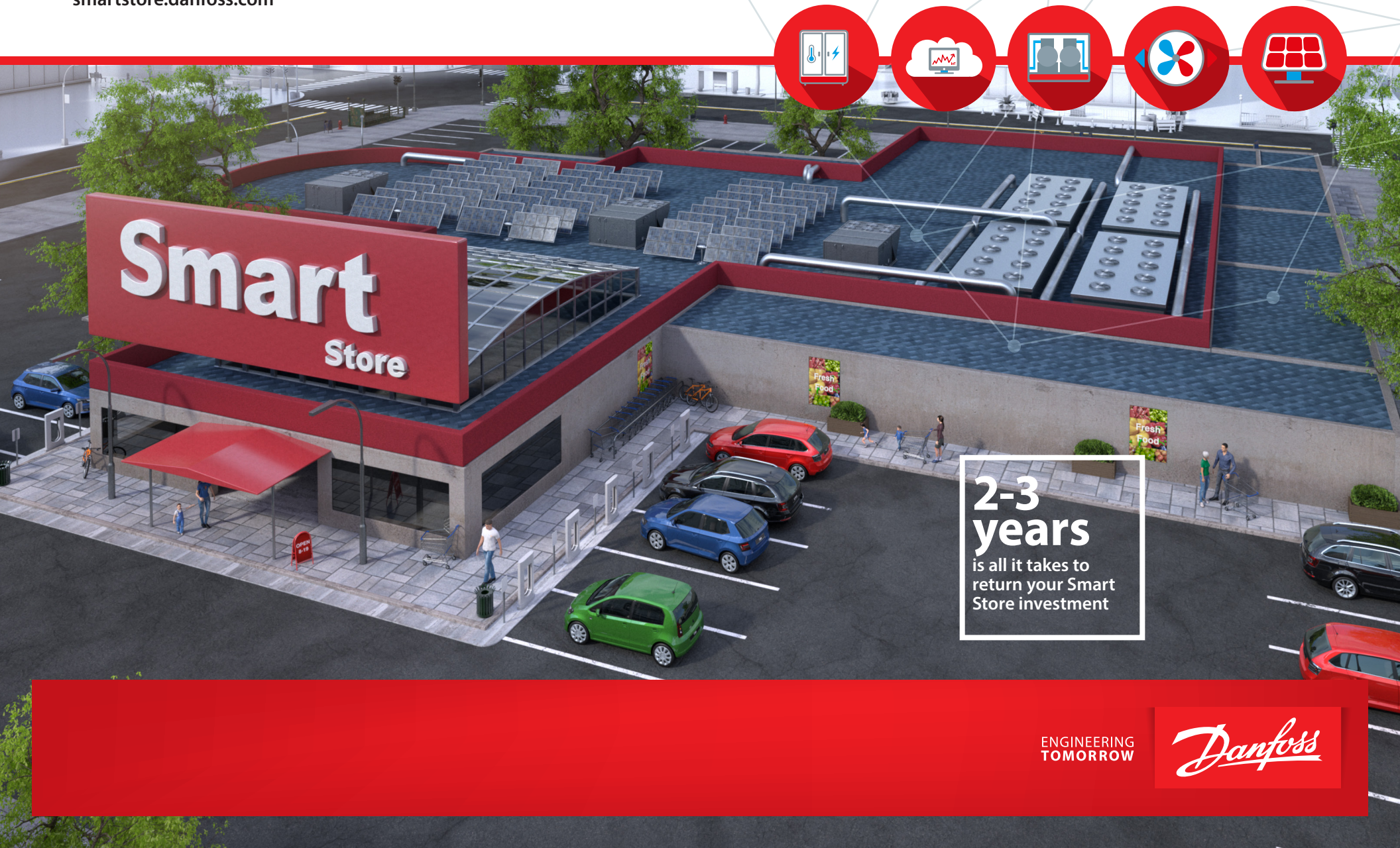
5 ways to **maximize efficiency** with Danfoss **Smart Store solutions**

smartstore.danfoss.com



ENGINEERING TOMORROW

Danfoss

Contents

Managing **operational efficiency** in food retail–**5 global trends** and how to respond

If you work in facilities or energy management for a food retailer, change is something you handle every day. When the way we live, work, or shop changes, new food retail technology is close behind.

Right now, all those things are changing like never before. Megatrends like electrification, digital communications, and the fight against climate change are creating both opportunities and challenges for the food sector, worldwide.

A robust **minimum stable superheat algorithm** — which ensures the evaporator is always fully utilized under all conditions — can **save 8-12% of energy use** at the system level.

At Danfoss, we see that first-hand, because we work with hundreds of food retail chains in more than 60 counties. In particular, we see five big, overlapping changes that are combining to shape today's workload for supermarkets' teams… and five key ways to respond.

Proven in more than 50.000 installations worldwide.

Intense pressure on operating margins makes cost savings essential

The average profit margin for a large food retailer currently stands at just 1.7%. This puts every operating cost under scrutiny—because it has a direct impact on competitiveness and profitability. ***What this means in practice:*** *supermarket teams need creative ways to save operating costs—including new technology and partnerships. They might also need to implement the technology for new revenue streams.*

Increasing food safety and reducing food loss are more important than ever

According the UN Food and Agriculture Organization (FAO), food wastage accounts for 3.3 gigatonnes of greenhouse gas emissions. Avoiding food loss has always been essential to limit costs; it's now part of sustainability too. ***What this means in practice:*** *retailers will need to keep their focus on maintaining safe refrigeration temperatures—and avoiding equipment breakdowns that waste time, money, and food.*

Climate change regulation makes refrigerant choice critical

Initiatives like Europe's F-gas regulations and US Climate Alliance are having a direct impact on refrigerant availability and cost world-wide. Choosing an alternative with low global warming potential has growing advantages. ***What this means in practice:*** *choosing the right refrigerant brings advantages in cost, regulation, availability, environmental impact, and sometimes tax.*

Utilizing waste heat as a resource

More than half the world's population now lives in cities, and the United Nations predicts that it will climb to 68% by 2050. This means urban neighborhoods will need new ways of meeting energy challenges—such as China's district heating systems. This can put retailers at the heart of the energy revolution. ***What this means in practice:*** *in some Nordic countries, retail stores divert around 30% of their excess capacity into heating homes in the surrounding area. This is a potential source of revenue.*

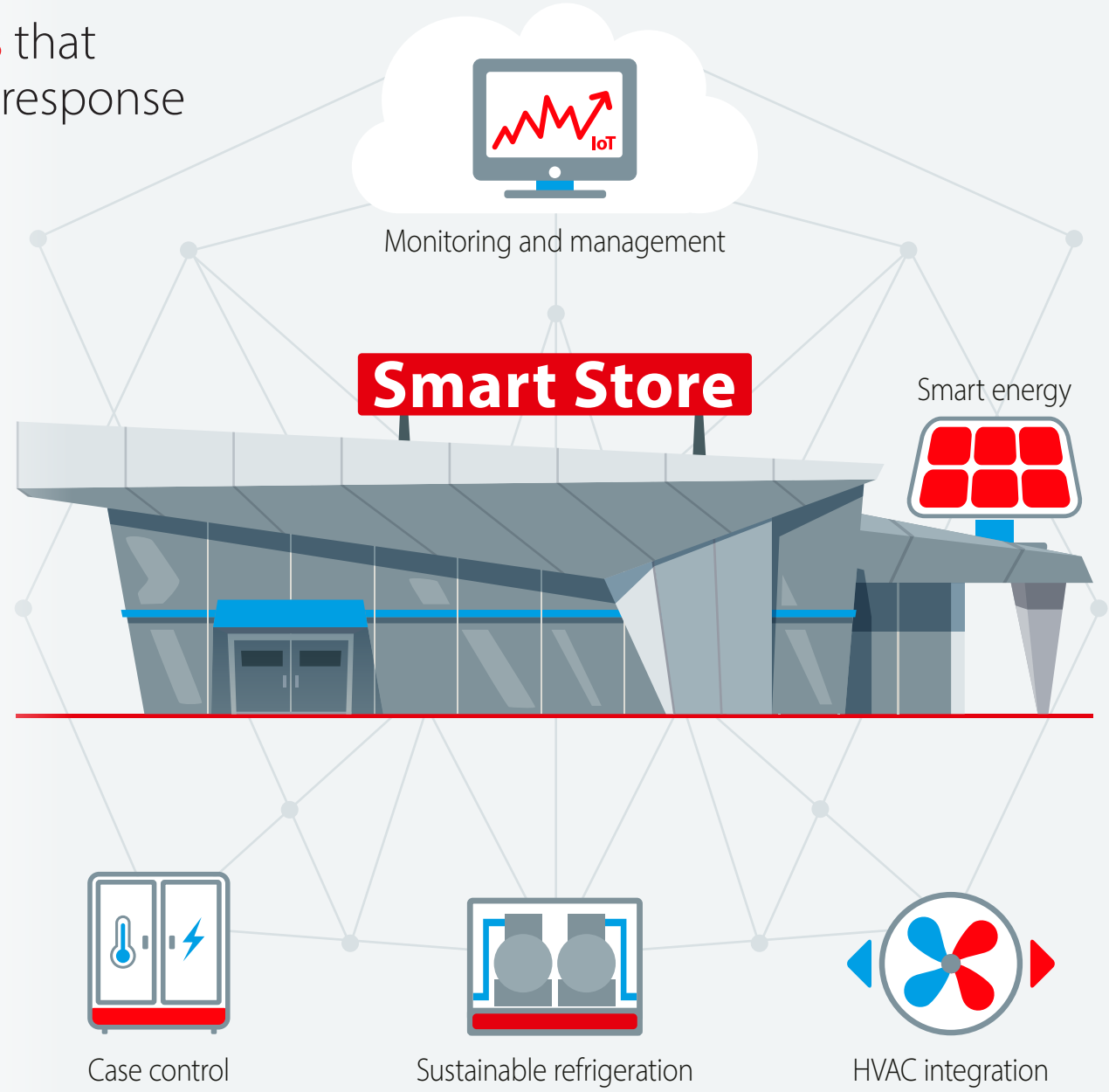
Electrification is a challenge…and an opportunity

Bloomberg estimates 57% of all new cars worldwide will be electric-powered within the next 20 years, and many retailers are already providing charging facilities. But there are also significant opportunities to benefit from energy arbitrage. ***What this means in practice:*** *as well as infrastructure, retailers need to find ways to prevent expensive short-term spikes in energy use as vehicles charge. But those who can find flexibility in their energy demand may be able to proactively cut costs.*

Overlapping **challenges** that demand a **coordinated** response

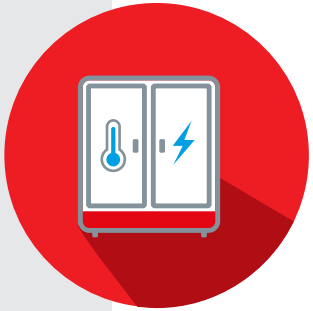
These five trends influence each other. For example, the opportunity to reduce energy tariffs by optimizing electricity demand is all the more compelling because of the need to find cost savings wherever possible.

In the same way, the changing food retail energy landscape needs a coordinated approach. We've identified five technical strategies which, when combined, will help supermarkets to stay ahead of—and in some cases benefit from—society's emerging demands.



1.

Use smart refrigeration case control to reduce operating costs



To optimize refrigeration efficiency, it's important to match capacity to demand. Too much cooling, and you waste energy; too little, and you risk system damage and food loss. An adaptive case controller, like the Danfoss ADAP-KOOL® series, can balance refrigeration performance to the load. And our Adaptive Superheat Control algorithm maintains the minimal stable superheat, so there's always just enough cooling.

The advanced controllers connect to the internet and the compressor pack controller via a system manager. They're also easy to use, simplifying the complexity of a modern refrigeration system, so you can focus on optimizing efficiency.

2.

Connect to the internet to eliminate food waste and cut service costs

Connecting your refrigeration system to the cloud is not just a trend. It offers a world of possibilities to save money and improve food safety. Remote monitoring and management make it easy to check and triage system alarms, giving priority to those with an immediate impact on costs or potential food loss. What's more, it's possible to fix some issues remotely—cutting unnecessary callouts by up to 30%.

There are also longer-term savings. Benchmarking performance data using an online dashboard can help optimize efficiency and save costs across a retail chain. Soon, it will be possible to use big data to predict exactly which equipment is at risk of failure, before it happens.

3.

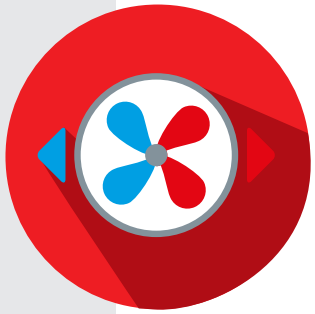
Treat refrigerant selection as a long-term decision

The refrigerant you choose has a significant impact on your costs—not just at installation, but for the life of a store. For example, CO_2 was once seen as an expensive option, best used in cold ambient temperatures. But now it's growing in popularity as new technology like the Danfoss Multi Ejector Solution™ makes it a viable option for all climates and store sizes.

The shifting legislation around refrigerants means options with high global warming potential (hundreds or even thousands of times higher than CO_2) can quickly become expensive, highly taxed, and difficult to obtain. In this context, a natural, low-GWP alternative could be a good long-term choice.

4.

Integrate each store's systems to gain economies of scale



Every cost saving is valuable, and yet most retailers pay to run a heating and hot water system, while a separate refrigeration system releases heat into the atmosphere. Treating these facilities as an integrated solution can reduce a store's carbon footprint, while reducing installation and operating costs. When integrated, a store's refrigeration system can usually supply all its heat too—even eliminating the need for a boiler.

This integration was once difficult to achieve. However, the rising popularity of CO_2 is making it more common —while Danfoss's purpose-built Heat Recovery Unit helps to eliminate the technical challenge.

It can also be a good idea to build air conditioning and ventilation into the refrigeration system—that way, you can get the additional cooling load almost free of charge.

5.

Reduce energy prices by optimizing demand

As supermarkets get better at energy efficiency, the fastest cost reductions are increasingly found in managing demand patterns. Reducing moments of the highest load can help cut a store's energy price for the rest of the year, as well as enabling infrastructure savings, such as using a smaller transformer.

In some cases, this flexibility can enable a retailer to receive incentives from their energy provider. Utilities companies are increasingly seeking help to match energy production to demand—discounting off-peak energy or seeking a temporary reduction in power use to manage short-term "demand response" events.

There are several ways to achieve this—for example by using a battery bank, changing maintenance schedules, or storing the energy thermally. This could include pre-cooling freezers or using an ice-making unit to load up with excess renewable energy.

This isn't the future. It's happening right now.

Between them, these five approaches can help retailers to cut costs, minimize environmental impact, and find a competitive advantage, while safeguarding food safety.

They're best used in combination; for example, heat recovery is much easier with a CO_2 system, and smart case controllers maximize the benefit of monitoring online.

At Danfoss, we call this joined-up approach Smart Store. Food retailers around the world are already using it to improve efficiency, find new opportunities, and meet the sector's current challenges head on.

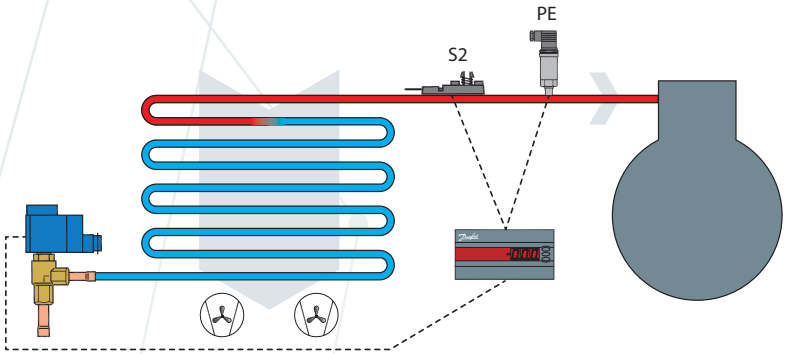
We've compiled five articles to show you how each part works and introduce you to some of the real supermarkets who are taking the lead. You can also reach out to a Danfoss expert to discuss your store's own individual needs.

How smart refrigeration **case control** makes **energy saving** simple

As food retailers look to reduce energy bills, every incremental savings counts. Increasing price competition means operating costs have an immediate impact on competitiveness and profitability—and, after staff, energy is the biggest bill most supermarkets have.

In food retail, most of that energy is spent on refrigeration, so efficient new components, like the AKVP electric expansion valve and high-end case controllers, are usually a good investment.

For example, a robust minimum stable superheat algorithm — which ensures the evaporator is always fully utilized under all conditions — can save 8-12% of energy use at the system level.



But this method requires several components to work together perfectly. And this introduces a broader challenge: each new advance in technology also makes a system more complex. This can mean it's harder to install, service, and configure…unless you have help.

This is where today's smart case controllers (also called control solutions) make the difference. As refrigeration technology gets more sophisticated, the best modern case controllers handle that complexity for you, optimizing efficiency and helping you make good decisions.

Why the best case controllers emphasize simplicity

Think of a good case controller as the brain of your display case. It analyzes and optimizes performance, and coordinates the various components to maximize energy savings, while prioritizing food safety.

But for the best results, you need to understand how to use your controller effectively. And as technology advances, that becomes increasingly difficult.

So, while your controller's specifications and algorithms are important, it's also vital that it has an interface that's easy to use. This will help your technician to work quickly and with more flexibility…whether they're installing a new system, or responding to a food safety alert, without technical support, in the middle of the night.

The natural next step in this process is smartphone apps, which communicate with the case controller and provide a graphic interface to make it even easier for the technician to install, configure, diagnose, and fix.

Case controllers need to be connected

Up to
12%
energy savings compared to other EEV technologies.

Safe, efficient refrigeration is a delicate balance—you have to match capacity to demand. Retailers can't afford to waste energy on unnecessary cooling, but food and system safety must not be compromised. Even though load conditions change rapidly, case temperatures need to stay within safe limits, and the compressor must be protected from liquid in the suction line.

As a result, static refrigeration setpoints usually include a margin of error. This feels safe for the retailer but wastes energy; around 2-3% for every 1K of superheat.

This is where the ADAP-KOOL® system can make a difference. By monitoring sensors in real time, the controllers can detect system changes and react accordingly to match performance to the load. Typically, this adaptive approach can produce energy savings of up to 33% compared to basic systems with TXV controls.

One popular way to do this is using Danfoss' Adaptive Superheat Control algorithm, which allows HFC and CO_2 systems to maintain the minimal stable superheat under any load condition. This ensures the evaporator is always at its most efficient—but without the risk of returning liquid to the suction line.

This is one example of how your case controller and your compressor pack control can work together via a system manager. The two sides of your system work in harmony to achieve the balance you need.

Your controllers don't only need to be connected to each other. Connecting your case controller to the internet offers further opportunities to generate savings. If you can diagnose issues and control the case remotely, service engineers needn't be called out to simple situations like starting a defrost. And being able to compare performance and efficiency across an entire estate of stores makes it easy to spot patterns and make incremental efficiency gains.

Simplicity is vital in expansion valves too

If the controller is your refrigeration case's brain, the expansion valve is its heart. Just like a heart, it regulates flow to match the required performance.

As in other parts of the system, keeping things as simple as possible can help retailers make the most of new technology and achieve efficiency savings.

For example, Danfoss' world-leading AKVP expansion valve removes the need for a separate solenoid valve or battery pack to protect the system in the event of a power failure, as you might find in a stepper valve. The resulting design is safe, cost-effective, and simple to maintain.

Indeed, the new evolution of this design—the AKVP—takes this principle a step further by covering both HFC and CO_2 systems with one model, reducing the number of variants and thereby the complexity throughout the supply chain and service stocks.

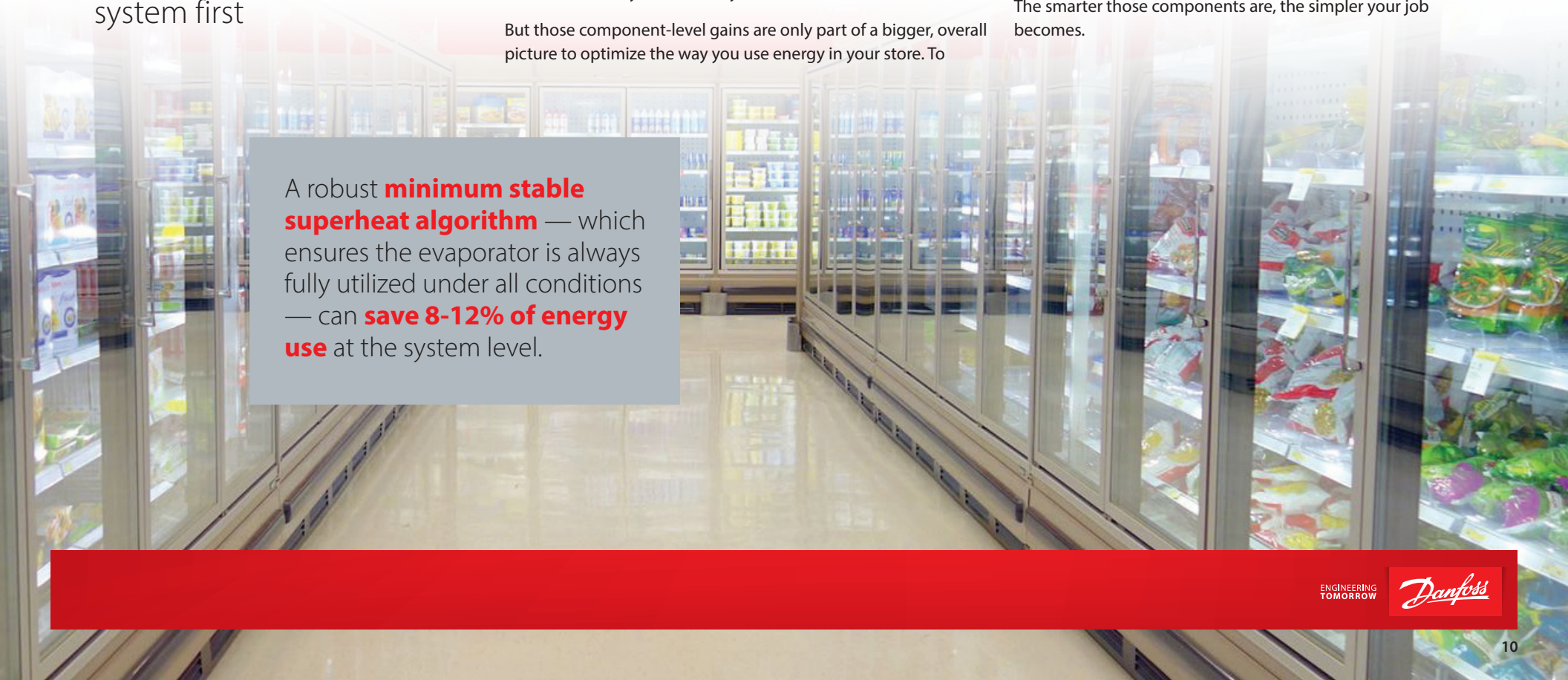
To keep things simpler still, the valve is designed to work with the ADAP-KOOL® case controller to ensure the most efficient heat transfer and safely use the evaporator to its full capacity at all times. It also acts as an accurate flow meter, making it easy to diagnose and solve problems—so the retailer saves energy and service costs.

Need energy savings? Look at the refrigeration system first

Your refrigeration system is the natural place to look for energy efficiency gains. There are dozens of technologies that can tune your performance and efficiency to your exact requirements—if you haven't seen the capabilities of our new sensors and transmitters lately, it's definitely worth a look.

But those component-level gains are only part of a bigger, overall picture to optimize the way you use energy in your store. To unlock that potential, you need a controller, expansion valve, and high-accuracy sensors that are smart enough to make the technology work together—and a system manager that can help you see and control the bigger picture.

The smarter those components are, the simpler your job becomes.



A robust **minimum stable superheat algorithm** — which ensures the evaporator is always fully utilized under all conditions — can **save 8-12% of energy use** at the system level.

5 ways **connected monitoring** and **management systems** can **save** food retailers money right now

It's a challenging time to work on a supermarket's technical team. Competitive pressure has brought an even greater need to reduce running costs—and often to do it with a reduced headcount.

Many new kinds of store facility technologies promise to help. Big data, automation, and the Internet of Things (IoT) all have the potential to save food retailers time, money, and energy, while preventing food waste.

This article will share **five ways** major food retailers around the world—and their refrigeration contractors—are realizing **real-world benefits**, right now. And they're doing it by connecting their in-store systems to the internet.

1. Saving time responding to technical alarms

Most stores protect food safety and the customer experience by using alarm functions to alert a technician if something is not working or a sensor reading is outside a set parameter. These can cover everything from the temperature rising because a cooler door was left open to a broken light or fan.

Some alarms are genuinely urgent and could lead to lost stock or sales. Others can wait to be batched as part of a technician's task list, making servicing more efficient. But a large store can have dozens of alarm events a day; just interpreting all the error codes can be a full-time job.

When your refrigeration system controller is online, you can outsource this triage task—saving time and money and giving you 24/7 coverage all year round.

For example, Danfoss Enterprise Services' (DES) international teams handle 2.8 million alarm events every month. There's an online dashboard, so it's easy to see, triage, and prioritize system alarms, all at once, at both a store and chain level.

This saves technician time and makes maintenance more efficient. And a centralized monitoring center like DES can learn from worldwide alarm data to help interpret every alarm quickly, understand where risk lies, and improve diagnostic problem solving.

2. Cutting service callouts by up to 30% by using remote maintenance

For a food retailer, triaging system alarms in this way can help you to batch and plan your maintenance, saving technical workload without compromising food safety, shopper experience, or system reliability.

But it's possible to go further and intervene remotely to solve refrigeration issues, without a technician visiting the store at all.

A connected system manager, like the Danfoss AK-SM800, lets a monitoring service do more than simply notify technicians of alarms. They can diagnose the problem, and often fix it remotely —for example, by updating refrigeration setpoints and alarm thresholds, or by triggering a defrost —without setting foot in the store.

At DES, we have seen that this approach typically results in a 15-30% reduction in unnecessary service truck rolls.

3. Avoiding food waste, and saving time satisfying HACCP

Centrally monitoring your alarms means service technicians can immediately prioritize emergencies when they come through. But that's only one way a connected system can help retailers avoid food waste.

Accurate sensors in the refrigeration case can track and measure cooling performance to a high degree of accuracy.

This—and the fact setpoints can be adjusted remotely—means supermarkets can move away from the wasteful practice of including a wide margin of error around refrigeration temperature settings without risking food safety. More accurate temperature control makes cooling safer and often more efficient.

And because the system manager is connected online, the temperatures are all logged automatically at regular intervals. This means you have detailed evidence that every item of food has been kept in optimum conditions throughout. You can satisfy HACCP without requiring staff to manually record temperatures up to four times a day per cabinet.

4. Analyzing data trends to identify chain-wide savings

For years, supermarkets have looked closely at sales data trends to optimize the performance of individual stores—even individual displays. But fewer retailers realize it's possible to do exactly the same thing with in-store technical systems to reduce operating costs. It's enabled by a connected system manager.

First, an in-store system manager like the AK-SM800 collates energy usage and performance data from all connected systems—refrigeration, air conditioning, lighting, and more. Then it uploads it to the cloud, where the DES dashboard makes it easy to create an accurate baseline for each store—normalized to account for variables like size and ambient temperature, so the comparisons are fair.

This is powerful information. You can use it to make targeted and informed cost savings—identifying common trends among poorly-performing stores and making incremental improvements across the entire estate.

The data can point to potential compressor pack and defrost cycle optimizations, proactive ways to manage refrigerant setpoints, and refinements to a store's HVAC and lighting schedules.

If you're busy, you can ask DES to perform this analysis for you. We can make proactive suggestions to cut energy costs based on actual data and benchmarked against industry norms.

5. Adapting your energy use to benefit from utility incentives

A growing number of supermarkets are engaging in energy arbitrage —adapting their energy consumption to respond to discounted off-peak energy or moments of peak demand.

For example, utility companies will often offer bonuses to companies who help them balance supply and demand in the grid. And supermarkets are ideally placed to benefit.

A simple change, like temporarily reducing sales floor lighting or allowing air conditioning temperature to drift slightly, can produce energy tariff savings with minimal impact on the shopping experience.

But in most stores, refrigeration uses more energy than anything else—and holds the greatest savings potential. Harnessing this without risking food safety is possible but takes significant food refrigeration experience.

This trend is so important that we've written a separate article about it. But it's also worth knowing that a connected system manager makes the process much easier—the energy saving measures can be triggered remotely, using careful scrutiny to ensure temperatures stay in line. And DES can collect the evidence to claim the benefit from the energy provider.

What's next? Moving from **preventative** to **predictive** maintenance

These measures are all possible now, with today's technology. At DES we're managing them for tens of thousands of food retailers worldwide.

But the future is even more exciting. As more supermarket systems are connected, more retailers can all benefit from the resulting data.

For example, supermarkets understandably err on the side of caution when it comes to the preventative maintenance of their food refrigeration units. The cost of an unscheduled breakdown—food waste, emergency callouts, and lost sales opportunities—is often extremely high.

But this extra safety measure also means planned refrigeration downtime and servicing costs are higher than they need to be. If they had a clearer idea of which units were likely to break down, when, and under what conditions, they could save money accordingly.

By analyzing performance data, it's possible to get an accurate prediction of the risk that an asset will fail. Then, retailers can focus their maintenance spend and catch small problems before they become expensive emergencies. We're using analytics to see if that data can tell us whether a unit will break down. If it can, we'll be able to help retailers and maintenance contractors focus tight maintenance budgets where it reduces their risk the most.

To balance these current and potential benefits, it's important to have a system that delivers savings today but is also ready for the future. For example, at Danfoss, our philosophy is to use open protocols, so customers can decide for themselves what happens to their data and how it's used. It makes collaboration and updates easy.

And that means there's no reason to wait for future developments—retailers can start saving money, protecting their margins, and saving time right now.

Why are so many **supermarkets** now **choosing CO_2** refrigeration?

Around the world, there is little doubt that CO_2 is fast becoming food retailers' refrigerant of choice.

At Danfoss alone, we're currently seeing supermarkets switching to CO_2 refrigeration systems at a rate of around 10,000 a year—and that number is growing fast. Meanwhile, alongside the traditional large applications, CO_2 is being used in a broader range of settings than ever, including very small systems like remote condensing units.

There are several reasons for this. Partly, it's being driven by the global push to move away from HFCs in favor of natural refrigerants. Many HFCs have a global warming potential (GWP) more than 1,000 times higher than CO_2, and increasing regulation is creating refrigerant cost and availability issues.

But it's also because many of the traditional obstacles that once prevented people choosing CO_2 no longer apply—making it easier to use its unique properties to increase efficiency and cut heating costs.

CO_2 is no longer the expensive option

CO_2 was once considered expensive to use. As a high-pressure refrigerant, it requires more specialized components than other refrigerants. This additional installation cost was often unattractive.

However, that picture has changed.

Although CO_2 still needs special components, the recent dramatic changes in refrigerant availability and cost mean the refrigerant itself is now much less expensive than most alternatives.

Meanwhile, the volumetric refrigeration capacity of CO_2 is 5-10 times higher than conventional refrigerants. It therefore needs a far smaller charge—further reducing refrigerant cost—as well as smaller components and pipe dimensions, which saves money on copper and insulation materials.

These savings often cancel out the cost of the additional components—so the initial installation cost for a CO_2 system compares favorably with a conventional alternative. Installers tell us cost parity is very common.

And when you consider the potential energy savings—as well as the growing number of areas that tax refrigerant charge based on its GWP—the total cost of ownership is typically far lower with CO_2.

CO_2 is now efficient in all ambient temperatures and load conditions

More than
30%
reduction of carbon footprint on store level.

Until recently, CO_2 was best used in areas with cooler climates. But now, new technology makes it a realistic and efficient option everywhere—even in regions with high ambient temperatures.

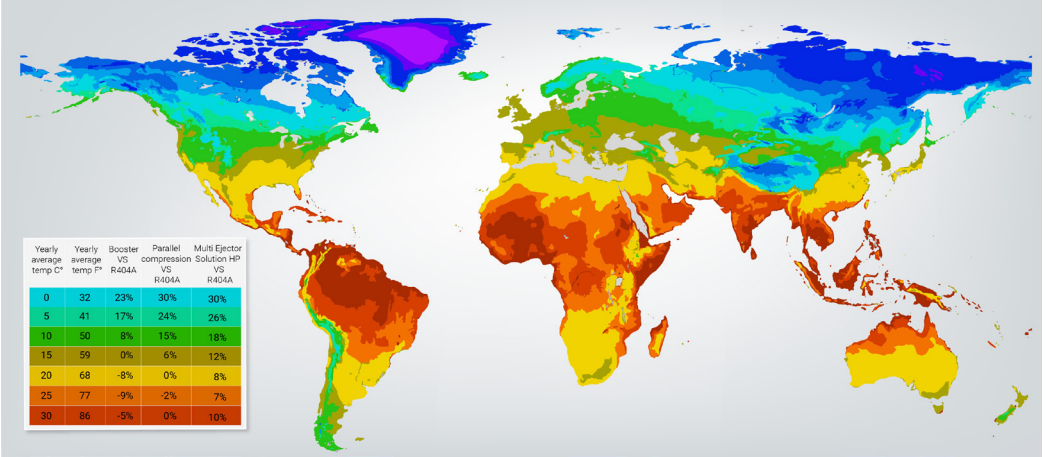
We have successful transcritical CO_2 systems in stores all over the world—including Africa, Asia, and the Middle East. Recently, we worked to bring CO_2 to Italy's largest hypermarket, where ambient temperatures can reach 38˚C.

This is possible because technology like the Danfoss Multi Ejector Solution™ significantly increases energy efficiency during transcritical operation in hot ambient conditions. It offers a 10% energy savings annualized over the year and, at peak times, is around 30% more efficient than a traditional CO_2 booster system.

Importantly, the Multi Ejector solution™ improves efficiency in part-load conditions, which is where refrigeration systems do the vast majority of their work.

Similarly, our CO_2 Adaptive Liquid Management (CALM) solution—which combines our new Liquid Ejector with our Adaptive Liquid Control algorithm—optimizes efficiency in all conditions. This solution allows superheat to fall to zero, while the Liquid Ejector pumps any liquid leaving the evaporator back into the receiver. This maximizes efficiency, while safeguarding the compressors.

Savings on CO_2 systems VS R404A



Yearly average temp C°	Yearly average temp F°	Booster VS R404A	Parallel compression VS R404A	Multi Ejector Solution HP VS R404A
0	32	23%	30%	30%
5	41	17%	24%	26%
10	50	8%	15%	18%
15	59	0%	6%	12%
20	68	-8%	0%	8%
25	77	-9%	-2%	7%
30	86	-5%	0%	10%

Supermarkets are taking a wider view of costs

CO_2 also brings the potential for cost savings outside the refrigeration system itself, because it's perfect for heat recovery.

Used as a refrigerant, CO_2 has a high discharge temperature and a non-condensing nature. This makes it relatively easy to reclaim and re-use this energy—even under sub-critical conditions—and use it to heat a store's water and space with minimal additional equipment.

This is an extremely cost-effective way to heat the store, effectively reducing heating costs to zero. And there is often no need for a boiler, further reducing the initial installation costs across two systems.

CO_2 skills and components are becoming easier to find

In most countries, CO_2 is still a growing technology. It therefore requires engineers to learn some new skills. However, once these are acquired, many refrigeration professionals find they prefer working with CO_2.

Where CO_2 is well established, it's considered a core refrigeration skill—and its growing popularity elsewhere means other countries are catching up.

The skill base outside supermarket refrigeration is growing too.

CO_2 is increasingly used in other store formats, industrial refrigeration, heat pumps, rooftop chiller units, air conditioning, and even efficient data center cooling.

At Danfoss, we're also working hard to help our customers give their skills a boost. Our CO_2 Champions program enables experts to share best practices and advice, while our Mobile CO_2 Training Unit has been on the road for the last three years, training refrigeration professionals all over the world.

After ten years of hard work, change is coming

At Danfoss, we're delighted food retailers around the world have seen that CO_2 is a winning refrigerant. We have spent more than ten years refining the technology to make it easy and efficient to use everywhere.

Russia now has its first transcritical CO_2 hypermarket, while Al Salaam supermarket in Jordan recovers waste heat from its CO_2 refrigeration system to heat its water supply.

That transition is excellent news for everyone. If all the world's supermarkets switched to natural refrigerants like CO_2 instead of HFCs, the impact on climate change would be equivalent to taking tens of millions of cars off the road.

We want to make that transition easier. That's why we're creating an ever-growing portfolio of CO_2-ready valves, electronics, and line components—so installers, contractors, and engineers can bring this technology to more applications, and more retailers, than ever.

Supermarkets are choosing CO_2 because it's cost-effective, it's good for the environment, and it's efficient in any climate. If you're making that same choice, we'll make sure you have all the components, training, and support you need.

Supermarket refrigeration, heating, air conditioning, and ventilation **work best** as an **integrated solution**. Here's why.

When you stop and think about it, it's a little strange that supermarkets usually pay to heat their premises and water while their refrigeration system works overtime to move heat energy outside.

Once, this might have seemed sensible: having discrete, isolated systems can give retailers' technical teams a sense of control. There's also less risk that a major fault might incapacitate the whole system.

Conventional HFC refrigerants also lacked the discharge temperature necessary to drive a heating system without several additional components. This added to installation costs and complexity and made payback relatively slow.

Now, it's time to look again. Energy costs are rising, and margins are low. Retailers are fighting to reduce their carbon footprint—and to find energy savings wherever possible.

In that context, and with the growing popularity of CO_2 as a refrigerant, integrating HVAC and refrigeration systems has become a serious option supermarkets can no longer ignore.

Integrating heating and AC into a CO_2 refrigeration system

For a supermarket with a parallel compressor CO_2 refrigeration system, incorporating heat recovery and air conditioning load is relatively straightforward—and extremely cost-effective. In the UK, a single Sainsbury's supermarket saved one million kWh in a year with heat recovery from its CO_2 refrigeration system.

Running refrigeration, freezing, air conditioning, hot water, and in-store heating from a single compressor pack improves efficiency and the store's carbon footprint, and can significantly reduce initial installation costs.

Space and water are heated by including one or more additional heat exchangers in front of the gas cooler, taking advantage of the high discharge temperature of CO_2.

Meanwhile, an air conditioning evaporator or chilled water system can be fitted at the system's separator. Compared to the refrigeration load, this almost provides air conditioning for free.

As well as saving the running costs and carbon footprints of the separate systems, this approach can eliminate the need to install and maintain those components. For example, the store may not require a boiler or gas furnace at all.

It's also possible to go further and sell excess heat to neighboring buildings. This is easiest where a store has an adjacent fitness center or shopping mall, but there are other approaches. For example, a SuperBrugsen supermarket in Denmark is one of many to supply their local district heating system.

Unlocking the potential of supermarket heat recovery

While the theory is simple, supermarkets have historically faced a number of challenges with implementing heat recovery successfully.

Usually, systems were created, modified, or retrofitted on a bespoke basis. This limited servicing options. And in some systems, large temperature fluctuations in the heat exchanger led to CO_2 leakage into the water—creating carbolic acid that damaged water lines.

At Danfoss, we wanted to prevent these kinds of problems, simplify the process, and bring supermarket heat recovery into the mainstream.

We've therefore combined our heating and refrigeration expertise to create a purpose-built Heat Recovery Unit (HRU), perfect for supermarkets. It's now proving its worth in supermarkets across Northern Europe, where CO_2 is well established, and we look forward to seeing it deliver results worldwide.

The HRU solves many of the traditional issues with heat recovery—notably by giving engineers a well-defined design, common components, and clear service requirements. It includes an extra heat exchanger set to prevent breakdowns and leakage and temperature buffer tanks to prevent stress in moments of peak demand.

The result is an easy, self-contained way for supermarkets to harness the heat recovery potential of CO_2 refrigeration systems, using a system built by one of Europe's leading manufacturers of heating systems.

It also opens the possibility of selling excess heat to neighbors in a controlled way, using approved heat meters—which can increase the benefit of using the store's compressors as a heat pump.

It adds up to a rapid cost savings. If you have a CO_2 system, payback is typically within 1-2 years—sometimes sooner.

90%
reduction in your heating costs.

Integrating other kinds of AC systems

It's also possible to integrate several approaches within a non-CO_2 air conditioning (AC) system to improve efficiency and reduce GWP.

For example, in large, hypermarket-scale applications—or where there's a large AC load—an oil-free centrifugal Danfoss Turbocor® compressor can run chillers in combination with air-handling units (AHUs).

This integrated solution makes both services extremely energy efficient and opens the possibility of using ultra-low GWP, HFO refrigerants like R1234ze. In China, a Suguo hypermarket cut its AC energy costs by 50% by using exactly this solution.

Reacting to changing load conditions is also important. So, for standard rooftop chiller scenarios, using a variable-speed compressor gives an immediate way to improve year-round energy efficiency across every part of the system. This can be further integrated with an extra coil and rooftop ice bank to even out peaks in load and make the best use of cheap energy when it's available.

Integrated solutions need smart controls

However, there is no such thing as a standard configuration. Each individual store faces different challenges.

An integrated solution may need to include measures to manage humidity, account for ambient temperature changes, or combat frosting and fogging. The system might incorporate a plug-in hydronic system with balancing valves, or fan speed control.

That means the central part of any integrated system must be a smart controller—with the right algorithms to make the best use of all the technology in your solution.

For example, the Danfoss MCX controller lets you take a modular approach, building in expansion and accessory modules to suit your system's exact needs. It also lets you program your system graphically through its own design app.

Connecting your controller to an in-store system manager like the Danfoss AK-SM800 makes it smarter still. Now, you can link in other building management systems and tune performance across the whole store through a single interface—so you can trade off different aspects to achieve the best energy profile overall.

An integrated system is a better system

Ultimately, the closer you align your heating, ventilation, air conditioning, and refrigeration systems, the easier it will be to save money, safeguard stock, and reduce your environmental impact.

As an added benefit, an integrated solution reduces the chance of separate system suppliers disputing the cause of issues, delaying fixes, and jeopardizing food safety.

Quite simply, **it makes excellent business sense.**

Supermarket energy **optimization**: why **efficiency** is only half the story

In the last few years, supermarkets have made great advances in energy efficiency—reducing both overhead and their environmental impact.

Reducing energy use is valuable, and always will be. But there's another side to reducing energy costs. Increasingly, the biggest potential saving isn't only in using less energy; it's in optimizing how it's used, and when.

Worldwide, there's a growing need to manage fluctuations in energy generation—caused by the unpredictable nature of renewable energy—and times of peak demand.

As a result, utility companies and grid operators are increasingly offering incentives to energy users who can help them balance this equation. This gives supermarkets the potential to take advantage of low off-peak energy prices, or to avoid short-term spikes in energy use that increase the cost for the rest of the year.

But in the name of food safety, retailers have largely avoided making changes to refrigeration and limited themselves to managing air conditioning and lighting. Unfortunately, this dramatically reduces their ability to make any meaningful difference to peak energy use.

Now Danfoss is working with supermarkets on both sides of the Atlantic to help them access bigger savings by shifting refrigeration patterns—while still providing ideal conditions for their food.

Peak demand has a disproportionate impact on energy cost

In many countries, reducing peak electricity demand is now the fastest way to significantly reduce a supermarket's energy bill.

Energy tariff structures vary around the world. But everywhere, power grids experience moments of peak demand which threaten safety and reliability. At other times there's excess supply.

For a large energy user like a supermarket chain, this has several key impacts. Often, the price per unit a store pays will be influenced by its highest energy demand—even if this was only for a few minutes. Retailers who manage this one moment better can achieve a significant, year-round savings.

Reducing the peak demand level can also bring savings into a store's own energy infrastructure. For example, downsizing the transformer will have a noticeable impact on initial installation costs.

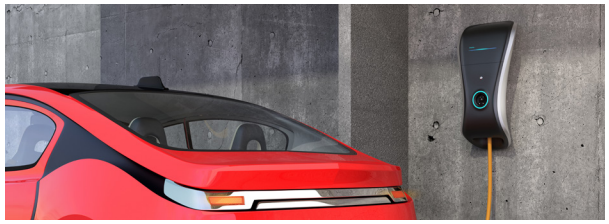
And that's only the start. As grids use more renewable energy, their need to balance excess demand and supply grows. In many countries, utility companies offer financial bonuses to customers who temporarily reduce their energy consumption to help manage short-term "demand response" events.

For example, the Giant Eagle supermarket chain in North America now uses peak shaving and demand response to achieve significant energy tariff reductions.

Other companies shift energy prices by time of day. Prices at peak times can be up to 500% higher than when demand is lower.

Food retailers—especially those who run their own renewable energy or have a chain of stores—are well placed to make significant tariff savings, over and above the strong business case for renewable generation itself. But to maximize this, they need to make changes to their refrigeration arrangements.

Electric vehicles will make managing demand more challenging



Every supermarket technical team needs a plan to cope with electric vehicle (EV) charging—because if your store does not already provide this, it will soon need to.

Wherever you are, most cars will soon be electric-powered. Bloomberg predicts 57% of all new cars worldwide will be electric by 2040—and in places like Europe, the transition is happening far more quickly.

To meet this demand, the European Union's directive on the energy performance of buildings compels member states to set a statutory minimum number of EV charging points for any non-residential building with more than 20 parking spaces.

Meanwhile, several major supermarket chains are already offering customers free EV charging to gain a competitive edge.

This is a commercial opportunity, but for a chain's energy manager, it poses a problem. Depending on the type of vehicle and charging station, too many EVs charging at once could temporarily double the store's energy use—setting an artificially high peak and inflating its energy price.

Cooling capacity: the supermarket's in-built "battery"

Take the step towards a zero energy store.

Thankfully, supermarkets are especially well-placed to reduce peak loads and respond to demand events, and energy managers have several good options. A growing number are generating their own renewable energy by using battery banks to store excess energy for when it can be used most profitably.

Until recently, however, supermarkets struggled to dynamically optimize their own energy consumption patterns. Up to 60% of a store's energy is used on refrigeration, so if this cannot be changed, only minor savings can be made. And efficient technology like LEDs—while saving power—also mean there's less opportunity to use lighting systems to influence demand.

It's time we changed that. At Danfoss, we have a long history in food refrigeration, which means we will never compromise food quality. And we've found several ways to adjust when a refrigeration system uses energy while always keeping the temperature well within safe limits.

The simplest way to optimize energy consumption is to ensure that any energy-intensive maintenance—like defrosting and rail heating —is carried out away from peak energy times.

This gives an immediate, but relatively small improvement. For larger results, you can also use your system like a battery, effectively storing or borrowing cooling capacity.

For instance, a supermarket expecting a peak in energy demand can lower its freezer temperature while energy is cheap, then temporarily switch off the compressors until the peak has passed. This is also a good way to prepare in advance for a demand response event.

Conversely, it's possible to reduce refrigeration compressor power by as much 30% for a short time when there's peak demand. The system must then be run more intensively to compensate and ensure the temperature remains within safe limits.

These approaches may seem counter-intuitive, because running the refrigeration system this way will use more energy overall; it's called the "rebound effect". But used properly, the unit price savings often far outweigh the increase in use—and balancing demand is an essential part of low-carbon power generation, so the method is also environmentally sound.

Supermarkets will lead the energy revolution

Renewable energy sources are increasingly important, but they can be unpredictable. Tomorrow's energy market will therefore need more than just energy efficiency; it will need far more flexibility to match changing supply and demand.

Supermarkets are ideally placed to benefit from this. Between them, food retail chains consume a great deal of energy, so they can take a prominent role in the community and ensure flexibility within the local grid.

This is especially true with renewable energy generation: large roof spaces create opportunities for solar photovoltaic panels—while a supermarket's energy demand profile neatly matches the times when solar generation is most productive.

For example, the aktiv & irma supermarket in Oldenburg, Germany now collects and stores its own renewable electricity. It uses a Danfoss AK-SM 800 System Manager, and an ennexOS unit from our sister company SMA Solar Technology, to create a smart, two-way connection to the energy grid.

Depending on the weather, the store often generates more electricity than it needs. It can then sell some energy back to the grid, or reduce the temperature of the supermarket's chilled counters, ready to offset demand when the weather changes. The system's own algorithm calculates which approach is most profitable at any given time.

And activ & irma's team can manage the whole process remotely, because the system manager is connected to the internet. The Danfoss Enterprise Service dashboard allows them to see and optimize the store's many energy features—not just refrigeration, but solar, wind, EV charger, and battery status too.

What's more, because the store uses CO_2 refrigerant, the system's heat is reclaimed and reused. More than two years after opening, the store has yet to use its heater.

The need for low-carbon energy means that one day, this kind of energy arbitrage will be completely normal—everywhere, not just in food retail.

Until then, cost pressures mean supermarkets will maximize every opportunity to save energy costs. And that means energy managers in food retail will continue to lead the way for the rest of us to follow.

ENGINEERING
TOMORROW

Every day, we are dedicated to making your store just a bit smarter.

Learn more at **smartstore.danfoss.com.**

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