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.

Take the step towards a zero energy store.

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"

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.

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