

industry: energy and environmental technologies

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Getting Started with Electrification:

Demand Flexibility,
Predictive Load
Management and
the Future of Plant
Efficiency



Summary:

- One of the first questions that must be answered at the start of an electrification project is whether the local utility grid can handle the increased load. This is not simply a question of power availability, but of balancing power demands and supply availability.
- Demand flexibility is the ability of industrial facilities to adjust their energy consumption in response to grid conditions. Demand flexibility not only helps local utilities, but it also can provide energy cost savings and valuable process data for the plants that implement the right technologies.
- **Predictive Load Management (PLM)** at the level of individual machines and at a network level enables demand flexibility without a loss of quality or throughput. It also helps to provide greater energy efficiency overall.
- Getting started does not need to be a cumbersome exercise; it can be enough to start with an electrical demand audit and a handful of modern controllers in a network. Watlow can help advise on a configuration that will work for your facility, whatever your industry.



Many industries are racing to electrify their processes and facilities to meet decarbonization goals, as well as to get a better understanding of their energy spend. The topic of electrification is no longer centered on why and when, but on how and what. Working within various industries, from semiconductor processing to production of construction materials, or heat treat in automotive and aerospace, our engineers frequently encounter the same questions:



- **How can we make electrification work for us?**
- **How do we get started?**
- **What challenges should we anticipate?**
- **What is the next step?**

As any engineer will understand, getting started with an electrification project is not as simple as swapping out a gas-fired process for an electric one. There are many questions that need to be addressed at the systems level to ensure the switch to electric helps achieve the stated benefits of greater safety, better control and reduced environmental impact—and that the implementation does not introduce unnecessary downtime or cost overruns.

Watlow is very familiar with these kinds of questions, having helped many plants switch over to electric process heating from older oil- and gas-fired technologies. And while many of these questions need to be answered on a plant-by-plant basis (reflecting the unique needs of the processes involved, the capacity of the local utility grid and so on), there are some general approaches that can help decision-makers get started, regardless of their particular industry.

This paper is meant to familiarize engineers, plant managers and sustainability leaders with some of the concepts at the core of these approaches: **Demand flexibility, Predictive Load Management (PLM) and networked PLM.**

The Initial Question: Can the Grid Meet a Plant’s Electrification Needs? Supply, Demand and Demand Flexibility

The biggest question that needs to be addressed right at the start of an electrification project is: Will there be enough power available to the plant to meet the needs of the processes to be electrified?

This question is trickier than first appears, because the amount of power supplied by the grid, and the amount of power demanded by the process in question, both fluctuate over time. Issues arise not because equipment exceeds what the grid can provide full-stop, but because equipment running at peak capacity can pass a threshold at a time when the grid cannot adequately support the demand.

The issue here is an economic one as well as an engineering one. Utility companies in Europe and the U.S.,



for example, will frequently impose heftier rates at certain peak hours, or be required to pay a tariff for drawing additional power beyond a certain threshold during peak periods. Thus, even though the grid could theoretically withstand the additional draw of power, the hit to the plant's energy bill makes tighter control of supplied power and demand a fiscal necessity.

The proliferation of electrification projects, and the increasing loads they place on the grid, have given rise to a call for better demand flexibility. **The American Council for an Energy-Efficient Economy (ACEEE)** defines demand flexibility as “the ability of industrial facilities to adjust their energy consumption in response to grid conditions.”¹ Demand flexibility is a win-win when it comes to electrification: On the one hand, utility companies can take a much more moderate approach when it comes to adding generation capacity or making expensive upgrades to the grid. On the other hand, facilities get the side benefits of better cost control and more in-depth data analysis.

This win-win scenario assumes that plants are willing to invest in the kinds of power control necessary to implement demand flexibility across processes, and throughout the plant as a whole. Specifically, it requires using modern power controllers that have **Predictive Load Management** capabilities across a network.

Predictive Load Management Enables Demand Flexibility

One of the key technologies for demand flexibility in process power control is **Predictive Load Management (PLM)**. **PLM** consists of two main functions: **Load balancing (or load sharing) and load shedding**. Load balancing involves equally distributing power of different loads to obtain an overall power consumption that is as stable and balanced as possible, eliminating peaks and “smoothing out” the power consumption curve. Load shedding involves limiting and shifting the overall energy consumption altogether (or within user-defined priorities).



Predictive Load Management is a feature of many of the SCR power controllers available through **Watlow**.² At the level of a single machine or device, a power controller with **PLM** can allow an operator to set a power threshold to ensure that the process will never draw power over that threshold. But the true benefit of **PLM** can be seen when multiple machines are in use, and multiple controllers are connected in a network. Then, **PLM**-equipped controllers can uniformly distribute power loads, ensuring that at any given moment, the overall power is as stable and balanced as possible.

¹ Fraser, Archibold and Johnson, Anna (2024). “To Electrify Industry at Scale, Flexible Demand Is Essential.” The American Council for an Energy-Efficient Economy (ACEEE). <https://www.aceee.org/blog-post/2024/02/electrify-industry-scale-flexible-demand-essential> accessed 2/28/2024.

² See especially the Eurotherm® EPower™ Controller, <https://www.watlow.com/Products/Controllers/Eurotherm/epower-controller>

An Illustration of PLM Over a Network

Suppose that a given plant has 10 process lines, each of which has a thermal array that draws power. Any individual machine has a power draw limit of, say, 200 kw. However, the plant will receive some hefty charges from the utility company if it exceeds 100 kw during its peak period. Without any sort of networking or demand management, one would have to assume that, in the worst-case scenario, all 10 lines could run simultaneously and draw peak power. To be safe, each machine would thus need to be limited to 100 kw.

Alternatively, consider an additional power controller with **PLM** attached to a network of devices. This controller can now set an overall network threshold—in this case, 100 kw. Now, the individual controllers will synchronize and communicate amongst each other, providing a level of demand management at the plant level. Any individual piece of equipment could exceed the 100 kw average, if the demands of the process call for it, as long as other pieces of equipment could compensate.

Such **PLM** networks (at least, those that Watlow frequently installs) can be quite expansive, controlling dozens of pieces of equipment. The equipment in question does not need to be uniform either; different pieces of equipment with different needs and thresholds can be connected and synchronized, making the benefits truly plant-level. Additionally, such equipment does not need to be networked all at once; a couple of machines can be networked and assessed for stability, adding in others later as processes are tested.

Without this kind of network capability, engineers and users are forced to make very cautious and conservative guesses as to what the peak power demands of each machine is separately, and this can effectively hobble what the plant is capable of overall. But with networking, it is possible to measure power supply and demand dynamically, allocating power in the most efficient way possible. This helps to achieve the demand flexibility needed, resolving the issue of whether the grid can sustain electrification without decreasing throughput or creating downtime.



Watlow's Eurotherm line of SCR smart controllers

Setting Variable Demand Thresholds for Peak Grid Times

Again, the supply of power over the grid is not static; it fluctuates over time. Thus, a key part of demand flexibility is the ability to set different thresholds at different times to reflect what is available from the grid.

To take an example: Suppose a plant runs a number of power-intensive furnaces. That plant might be informed by the local utility that, given the demand of the equipment, the plant would have a much-reduced level of electricity that they could consume during certain hours over the summer; otherwise, operating that equipment could risk triggering brownouts in the local area.

With networked **PLM**, this plant could schedule what the various demand thresholds would be so that the power draw can adjust automatically throughout



the day. Instead of shutting down process lines altogether to accommodate the decreased supply, they can run all of the lines and allow the system to manage power use given the lower demand threshold. Instead of physically scheduling downtimes for each process line, the system adjusts automatically—and brings machines back to full capacity as soon as they are able.

This is an especially good strategy for avoiding the tariffs briefly mentioned above. If plant managers know that a given level of demand will trigger an additional tariff, they can use SCR with PLM to avoid going over that threshold, potentially saving a noticeable amount on their energy bills. (In one case, a Watlow customer discovered that they had exceeded their demand threshold in just the first 10 minutes of their first week of the month, triggering a kilowatt hour surcharge that doubled for the remainder of their power draw for the rest of the month. The savings afforded to this customer by monitoring and managing power accurately were thus substantial.)

Additional Benefits: Energy Efficiency

Above, better demand flexibility was touted as a “win-win” that helped both local utilities and manufacturers. Investing in modern power control means migrating away from other methods of power control that might be older and less efficient. Better energy efficiency means lower energy costs, even when peak rates and additional traffic are not in play.

Modern power controllers, as well as modern process heaters, also allow for faster, better data collection. Not only is such data collection quickly becoming a requirement imposed by both governments and investors, but it also affords the opportunity for more in-depth analysis of the industrial processes in question. Thus, electrification and the use of modern controllers can also be the beginning of an Industry 4.0 move toward real-time analysis and improvement on and around the factory floor.

Takeaways

Electrification of processes, and process heating in particular, requires a change in power management. This isn't just a matter of implementing an SCR power controller that can handle higher amperage requirements, but of taking advantage of advanced power management capabilities, such as **PLM** across networked power controllers.

That said, change does not have to be wholesale. Simply networking a few pieces of equipment to start can often demonstrate savings and prove that quality and throughput are not impacted in any way.

Most plants, unbeknownst to their management team, are leaving money on the table when it comes to power consumption. Let's discuss your energy demands to see if better power management and demand flexibility can improve your bottom line.

Further information is available at: www.watlow.com