Case Study
Efficient Controls Alignment at Manufacturing Plant

Key Opportunity

There is an opportunity to reduce spot overtime on weekends to avoid any inefficiencies related to partial production capacity.

Savings potential: 360,000 kWh/year

Expected cost: $0

Applicability: This measure is applicable anywhere manufacturers operate at partial capacity. If possible, manufacturers should only operate at full capacity to reduce their overhead costs per production unit. Otherwise, the energy costs of common systems such as lighting, cooling, and ventilation will inflate the total costs per production unit.

Introduction

This metal fabrication plant takes flat steel blanks and produces various end products through a process of forming, welding, annealing, and finishing. The plant has a variety of machine production lines and the number of end products it manufactures varies based on order flow. The plant normally operates 24 hours a day during the week and adds spot overtime on most weekends to ensure customer orders are delivered on time.

The Energy Pathfinder Research Initiative installed sub-meters at a manufacturing plant to monitor the energy consumption of the following systems:

- Rolling Mills (3 sub-meters)
- Annealing Lines (3 sub-meters)
- Cooling Tower System (1 sub-meter)
- Electrical Distribution Systems (7 sub-meters)

Energy Analysis

The overall load profile for this metal fabrication plant is influenced by the number of machines running simultaneously. Customer orders arrive sporadically and consist of components of various sizes, which leads to different combinations of machines running at any given time. As shown in Exhibit 1, the load profile of the plant is fairly steady during the week since the various machines are used to capacity as much as possible. On weekends, however, only components that could not be filled during the week continue along the production line, resulting in a reduced load profile. For holiday weekends, production is completely shut down and only a few overhead loads remain such as lighting and ventilation.

Exhibit 1 Overall Plant Load (kWh/hour)

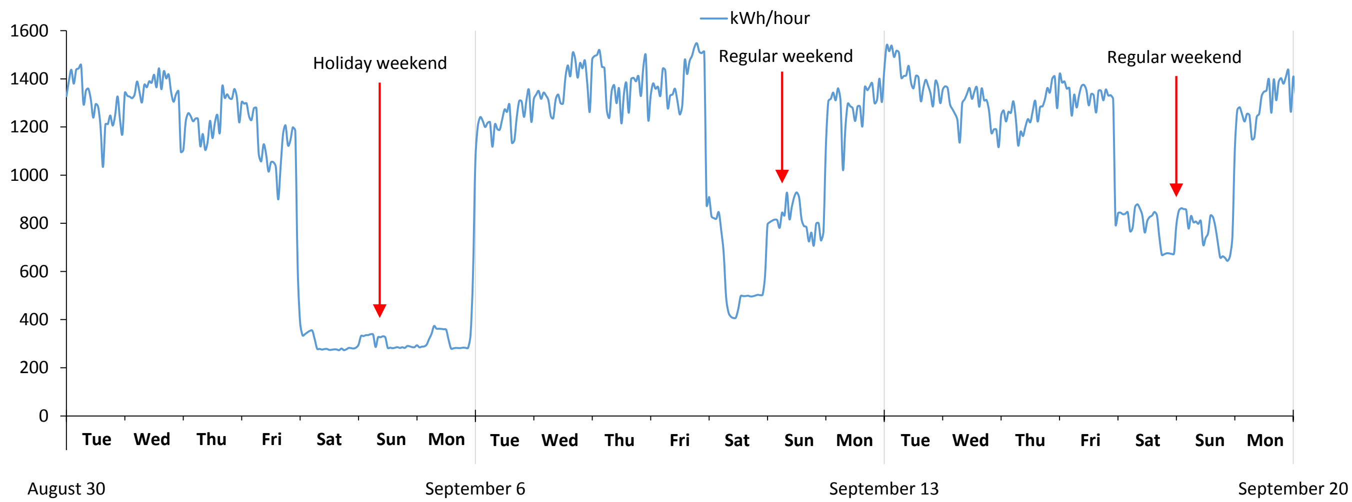
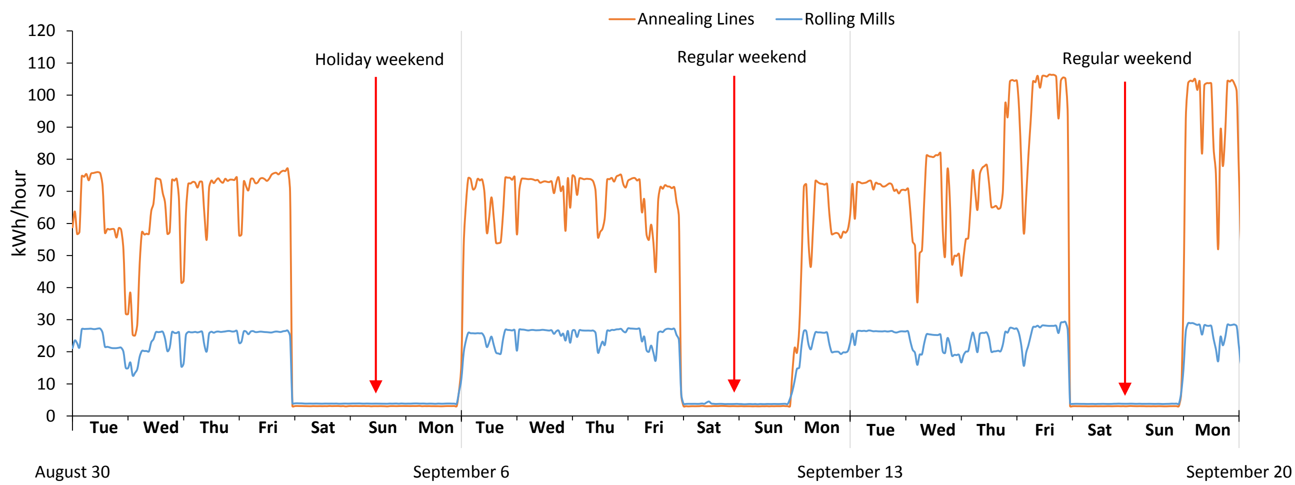


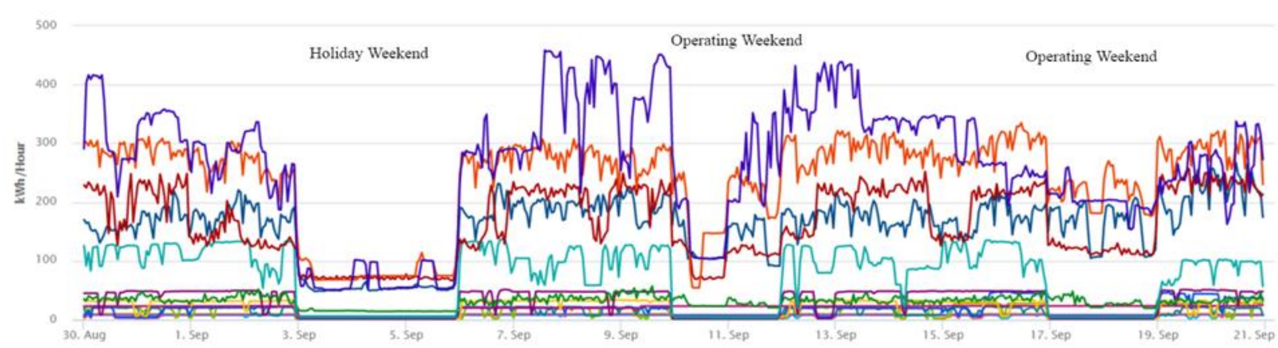
Exhibit 2 shows the total consumption of the rolling mills and annealing lines over the same 3 week period, and reveals that these machines are only in use during the week. Furthermore, the steady load provided by the rolling mills and annealing lines throughout the week indicates that the energy consumption of these particular machines is governed by an on/off driver. This is fairly typical for operations where the plant runs at a “sweet spot” to maintain the best quality of product at the highest rate of production. Once identified, the operators do not tend to deviate from this “sweet spot”, which leads to a steady consumption rate.

Exhibit 2 Energy Consumption of Rolling Mills and Annealing Lines (kWh/hour)



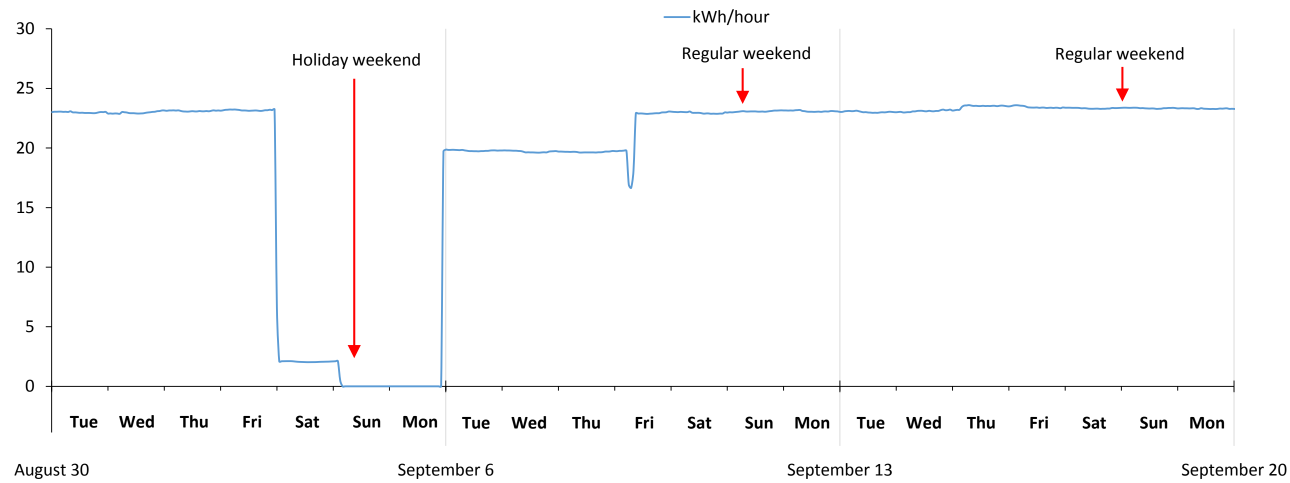
While consumption from the rolling mills and annealing lines in the above exhibit shows efficient weekend reductions, Exhibit 1 showed overall plant loads between 300 kW and 800 kW on regular weekends. To better understand the loads present during weekends, Exhibit 3 compares each of the sub-meters. It is important to note however that, due to the size of the facility, 7 of the sub-meters are at the electrical distribution system level. These readings capture multiple end uses from a section of the plant under a single sub-meter, complicating the identification of opportunities. From Exhibit 3 it can be observed that on the holiday weekend the loads are fairly steady and represent overhead loads such as security lighting and ventilation loads. The variable loads on the other weekends are the machines that are running extra shifts to fill orders. The same overhead loads are on as when the plant is running. General lighting and ventilation must also run while the building is occupied.

Exhibit 3 Individual Plant Loads Showing Three Weekends (kWh/hour)



While the distribution system level sub-meter readings are not granular enough to point out all of the individual overhead loads, the cooling tower sub-meter captures the trend for weekends. Shared systems such as the cooling water system must run even if only one production line is running. Exhibit 3 demonstrates that the cooling system is running whenever any operations are taking place, and is only shut off during weekends that don't have any production. Of note is the fact that load profile of the cooling system does not diminish during operational weekends, despite diminished production rates.

Exhibit 4 Cooling Water System (kWh/hour)



Opportunities for Energy Cost Reduction

Reduce Spot Overtime on Weekends to Minimize Overhead Loads

The plant shuts down its production lines as well as many common systems when not in use, and is generally running at its best operating point for energy consumption. By operating three shifts per day during the week, the energy costs of overhead loads are spread over the largest possible number of production units. However, the cost per production unit increases on the weekend since the plant is not operating at full capacity.

Given that the plant is already doing a good job of eliminating overhead loads during normal operating periods (aligning consumption to their actual process requirements), the main opportunity to save in the future would be if the plant decides to cease or minimize weekend production. Avoiding weekend production would allow the facility to reduce lighting and ventilation consumption by shutting down more systems. This could result in 10% energy savings on weekends, which would save the plant approximately $50,000 annually. Alternatively, achieving a full shutdown for one of two weekend days could achieve half of this level of overhead load savings.

Exhibit 5 Summary of Energy Saving Opportunity

Opportunity	Capital Costs	Energy Savings (kWh/year)	Annual Energy Cost Reduction	Payback Period
Reduce weekend overhead loads	$0	360,000	$50,000	-

Canadian Manufacturers & Exporters

How many energy efficiency best practices has your facility adopted?
Find out by downloading and completing the CME Pathfinder benchmarking survey (by clicking here). This Excel-based survey covers important best practices associated with process heating, process cooling, machine drives, HVAC systems, lighting, and compressed air. Completing the survey will provide your facility with insights into where it can focus its future efforts to improve energy efficiency.

CME Energy Pathfinder Research Initiative

The Energy Pathfinder Research Initiative is designed to explore, define, and quantify low cost opportunities to improve, control, or optimize specific end uses and energy intensive processes for selected industries within the Ontario industrial and manufacturing sector. The project is unique in that it ***focused on the identification of operational opportunities rather than upgrading inefficient assets*** and aims to identify new best practises for waste energy reduction, realigning energy consumption to correct drivers, and identifying opportunities for load shifting or shedding for lowering peak demand and demand response.

Prepared by **ICF** and
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