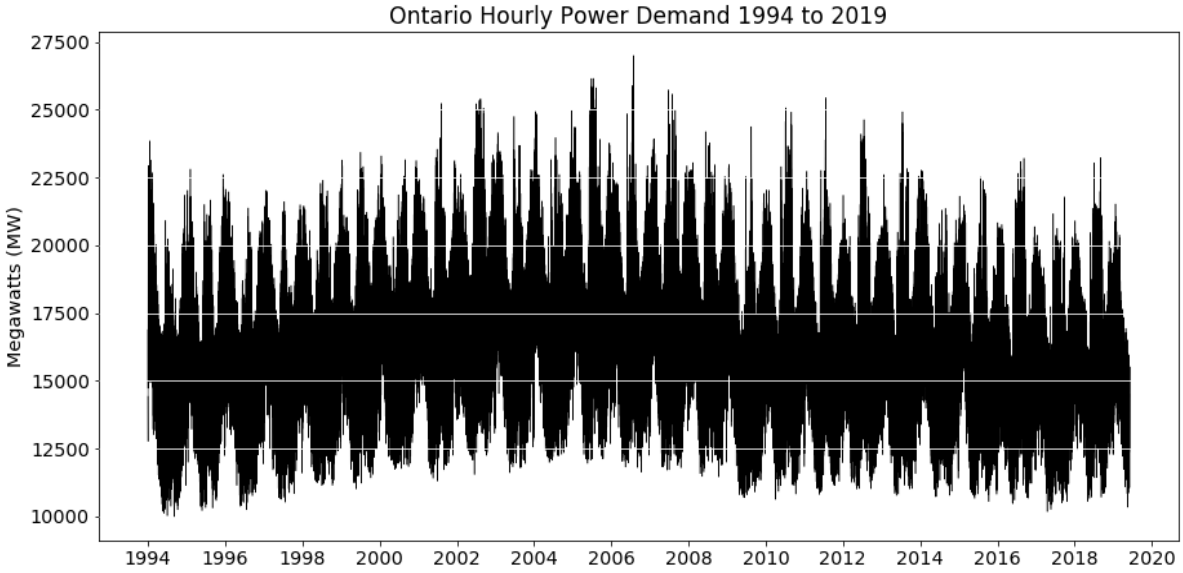
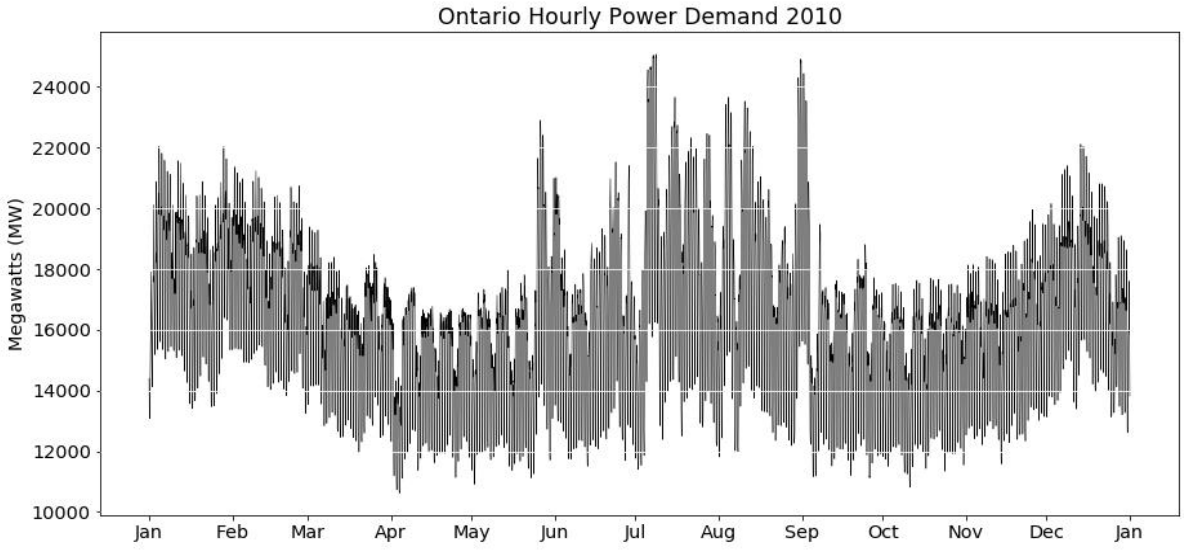
Analysis of Annual Electrical Power Demand in Ontario

The chart below shows the electrical power demand in Ontario for every hour of every day between January 1st 1994, and June 11th 2019.

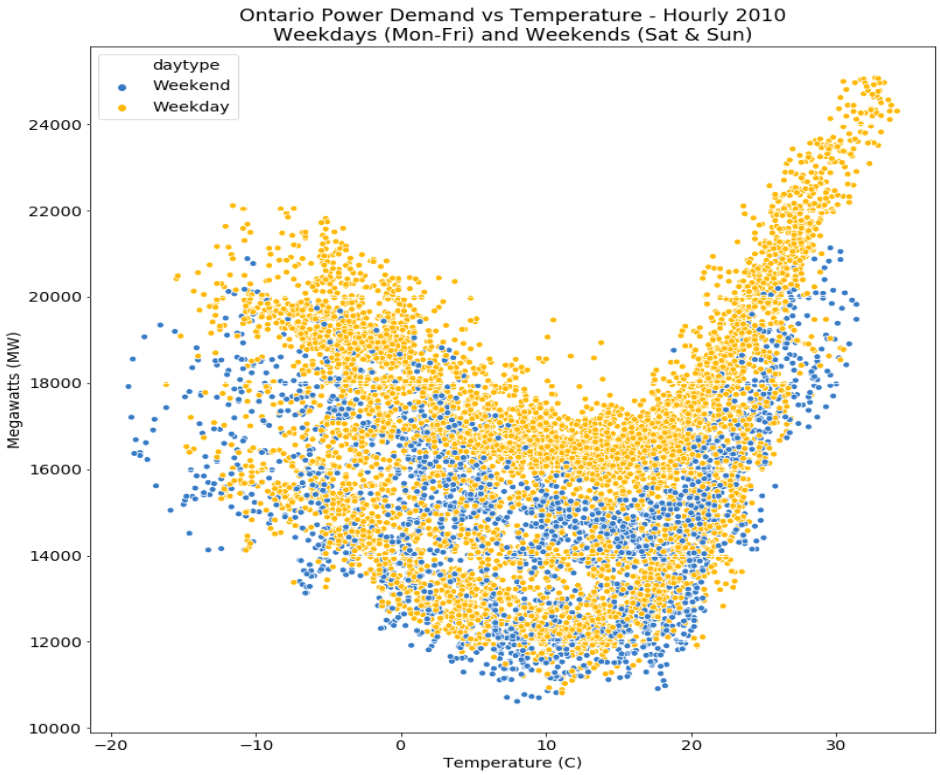


Impact of Temperature

Making sense of the valleys and troughs in the above chart feels a bit overwhelming, so let's choose a random year, say 2010, and zoom into the details of that year.



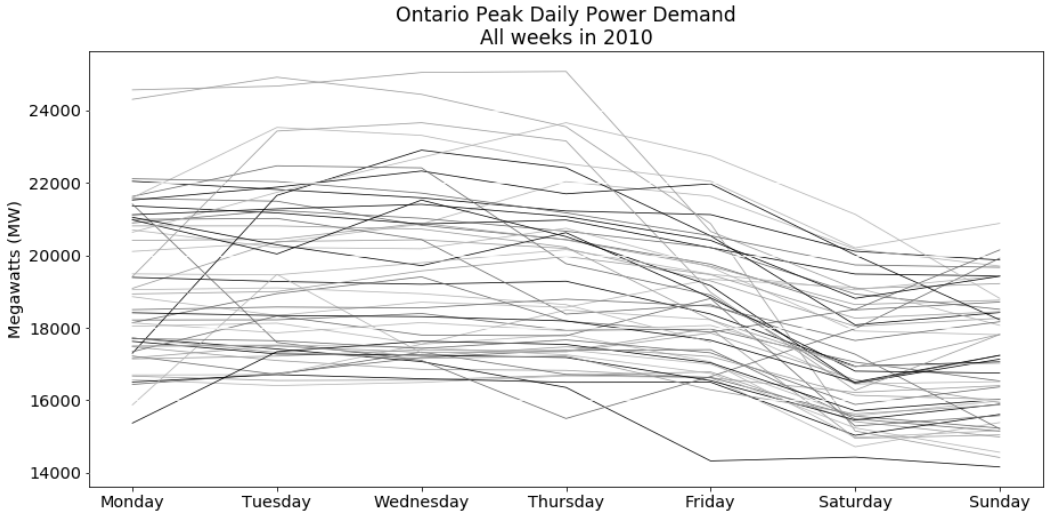
This is a bit easier to read. It looks like power demand is high in the winters, low in spring and fall, and very high in summer. We could reasonably guess that high power usage is related to both cold and hot weather. We can review this relationship by plotting temperature against power demand.



The plot shows that as temperature goes to extreme highs or lows, power demand goes up accordingly. This makes sense when we realize our heating and cooling systems use electricity, and these systems tend to get more usage when temperatures are more extreme. Another factor that seems to make a difference is the day of the week, with higher power demands occurring during the working week.

So, let's look the pattern of daily power usage over a week. We can do this by plotting all 52 weeks of the year 2010 on the same chart. If there is a weekly pattern, the lines will tend to have a similar shape.

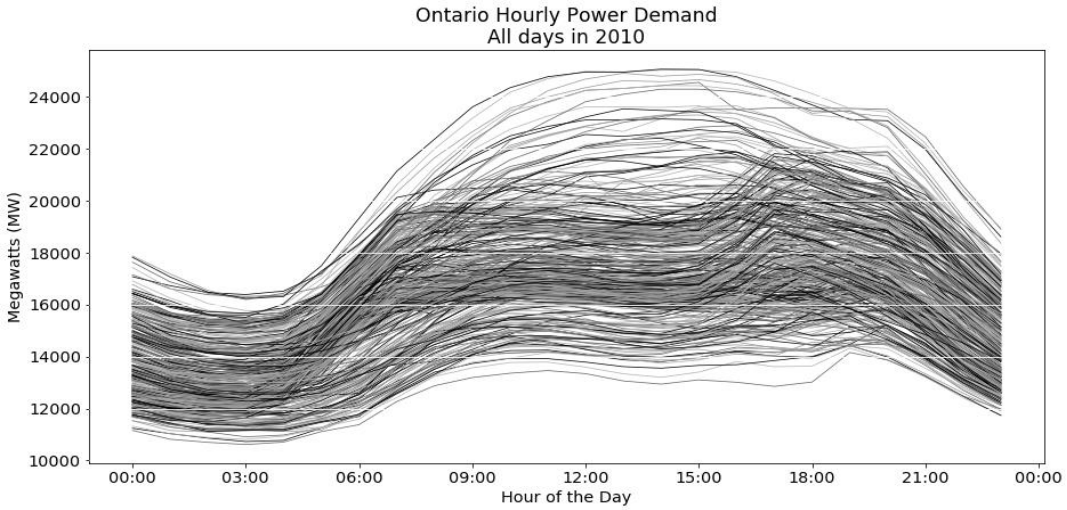
Impact of Day of the Week



Typically, power usage tends to be higher from Monday to Thursday. It drops slightly on Friday, and then drops further on Saturday and Sunday. Therefore, it is a reasonable assumption that as people's activities increase, so does their power usage. And the main activity for a high proportion of people is their work.

Impact of Hour of the Day

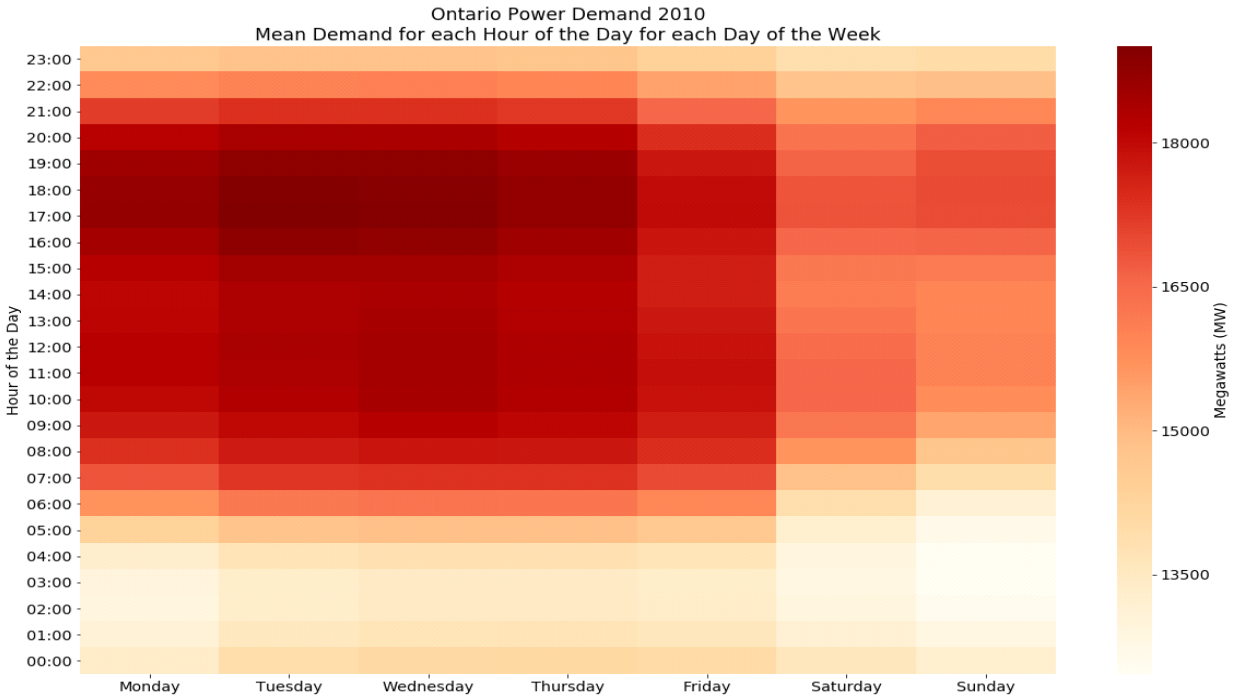
For many people, their work day starts in the morning and ends in the evening. Thus, we could hypothesize that if we plotted every day's power usage for 2010 on the same chart, we would see a pattern in line with most people's working hours.



The chart shows a pattern where power demand starts increasing at around 6:00 AM. It levels off, and stays level until about 4:00 PM. It kicks upwards at around 5:00 or 6:00 PM, before declining to a low at 3:00 AM

Power Demand over a Typical Week

We can combine our data for weekdays and hours of the day by plotting a heat map of the 168 hours in a week, where higher average power demand shows as a higher intensity red.



The heat map helps visualize the weekly and hourly demand cycles. Clearly, weekdays between 4:00 PM and 8:00 PM tend to demand peak power, whereas the very early morning hours are low energy.

Summary

Power demand is related to temperature, but not linearly. As the temperature gets above 15C, demand goes up. As the temperature goes lower than about 10C, demand also goes up. Demand seems to be more sharply associated with hotter temperatures.

Over a week, power demand is higher on week days than weekends. This is probably due to commercial activities driving higher demand.

Over a day, power demand hits a trough at around 3:00 AM, and increases during the day. It reaches higher levels between 9:00 AM and 8:00 PM, with peak demand between 4:00PM and 8:00 PM.