

Using Data Visualization to Better Understand Electric Load and End-Use Data

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H:1. SYNOPSIS

This paper briefly describes new data visualization techniques that enhance knowledge about industrial customers.

H:2. ABSTRACT

In the more competitive utility market, detailed understanding of the way industrial customers use energy, especially for electro technologies, will be an essential component to retaining these important customers. This poster presentation will show how new data visualization techniques can be used to glean information from end-use and total load metered data.

We have worked with a number of utilities, helping them to better understand specific technologies used by their industrial customers. Visualization of their end use data has provided valuable information about a technologies usage schedule and patterns of use.

This poster presentation will show data visualization images developed for a number of industrial users, including metal and paper processing.

H:3. INTRODUCTION

Data visualization is the graphic representation of numeric data. Bar charts, pie charts and load profiles are all examples of data visualization. So are EKGs, x-rays and satellite photos. Eyesight is the most highly developed of the human senses; it gives us the ability to process incredible amounts of data. So we turn to graphic representation of data to help us understand large amounts of data that might otherwise be overwhelming. This is especially useful in understanding metered end-use and total load data.

End-use and total load data is dynamic. It changes over time, has characteristic patterns and is influenced by a variety of variables. Understanding these patterns and the effect of external stimuli allows the utility planner, rate maker, load researcher, and customer service representative a more complete understanding of the customer. As the utility industry is deregulated, understanding the customer becomes more important. Data visualization has always added to the understanding of the customer, and as that

Data visualization has always added to the understanding of the customer, and as that knowledge of the customer becomes more important so do the visualization tools that the utility uses to add to that understanding.

H:4. THE ENERGYPRINT

The load profile is familiar to most people involved in the electric utility industry. It has been very useful in understanding how energy is being used. Load shapes are limited though. They don't readily show the change in a system over time. This is a problem of how to view three dimensions of data. A new method for displaying these three dimensions (usually measurement interval, day, and demand) has been developed that uses color to represent the third dimension (the metered demand). We call the new images energyprints.

An example of an energyprint for the aggregate load for the SIC 33 class (metals) for a midwestern utility is displayed in Figure 1. In this example we are limited to black and white, but the posters and computer examples demonstrate the full effect of using color. The energyprint is developed by taking data, in this case fifteen minute metered data, and assigning one of 255 colors to the metered demand for each interval. We use lighter colors to represent higher metered demand, and darker colors to show lower demand. The energyprint is then displayed with the metered interval as the Y axis, the date on the X axis and the color coded demand is shown at each corresponding X and Y coordinate. Another way to think about the energyprint is to think of the whole dataset that you are interested in. Find the minimum and maximum data points, and gave them the colors black and white respectively. Then assign the other 253 colors to the rest of the data values. Take all of the now color coded daily load shapes and stack them next to each other. Now rotate the whole set so that you see it from the top. In this energyprint we can see the reduced use on weekends, the hours of use (it appears that there are multiple shifts at this site), and the effect of the two weeks vacation that their primary customer takes.

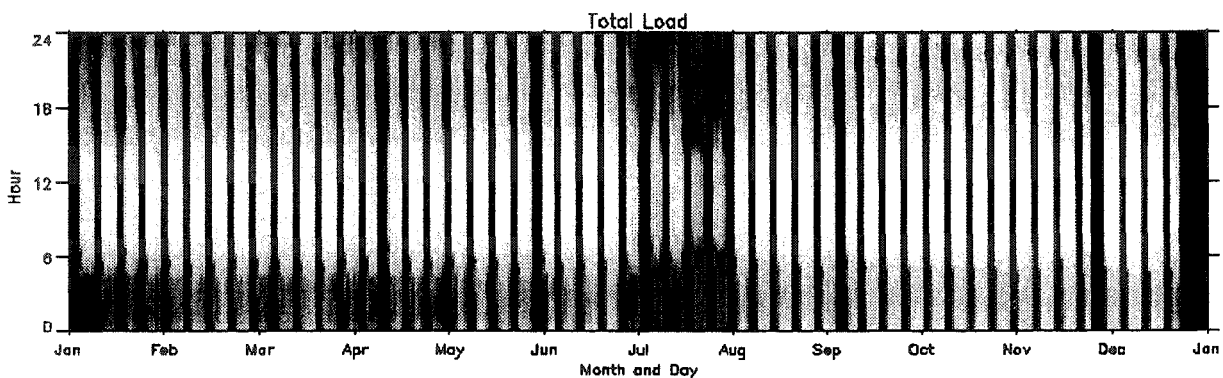


Figure 1: Energyprint

Now that you know what an energyprint is, the rest of this paper will be energyprints of aggregations of different industrial class customers, and some electro-technologies, with brief discussions about each.

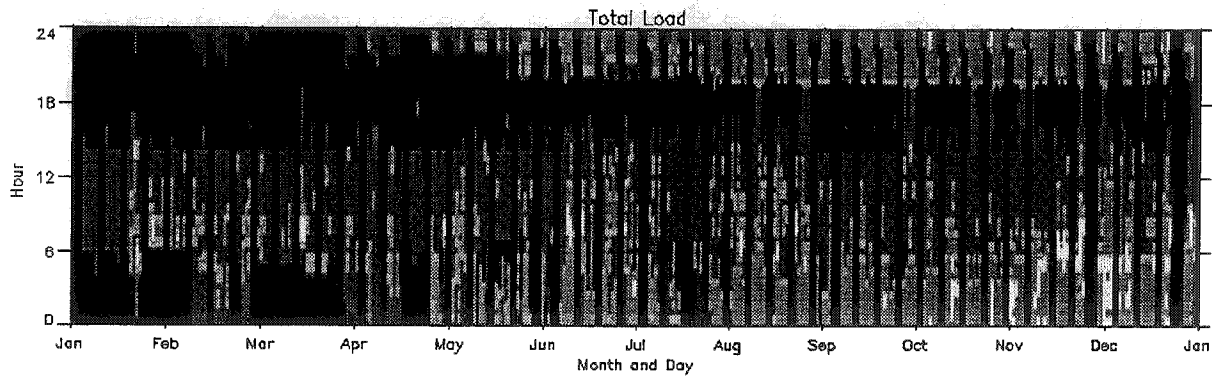


Figure 2: SIC Class 22 - Textiles

Note the regular shifts, and the addition of load (added shifts?) in May.

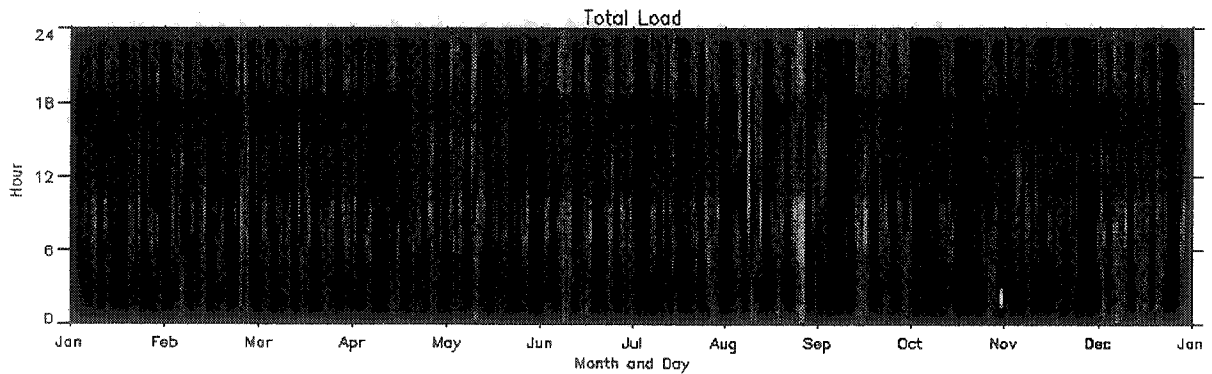


Figure 3: SIC Class 26 - Paper

Note the very steady, non weather dependent, 24 hour load.

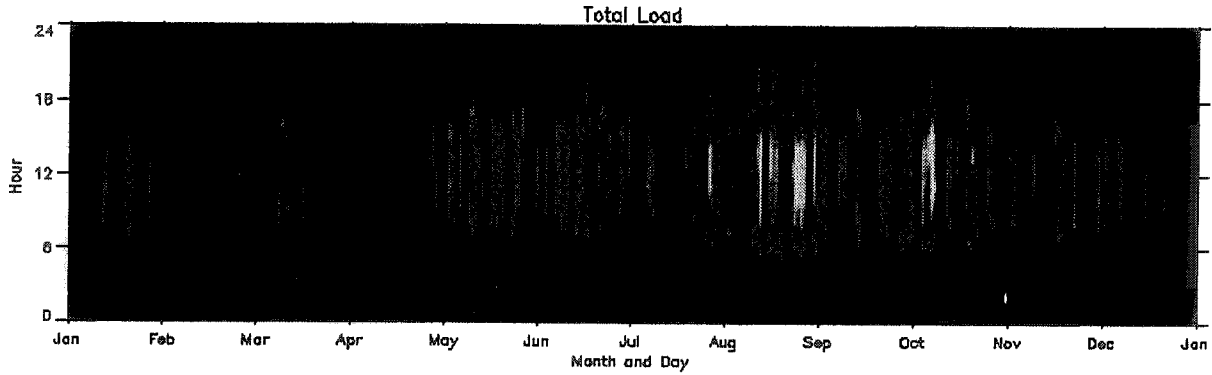


Figure 4: SIC Class 28 - Chemical

This class seems to have monthly cycles of production.

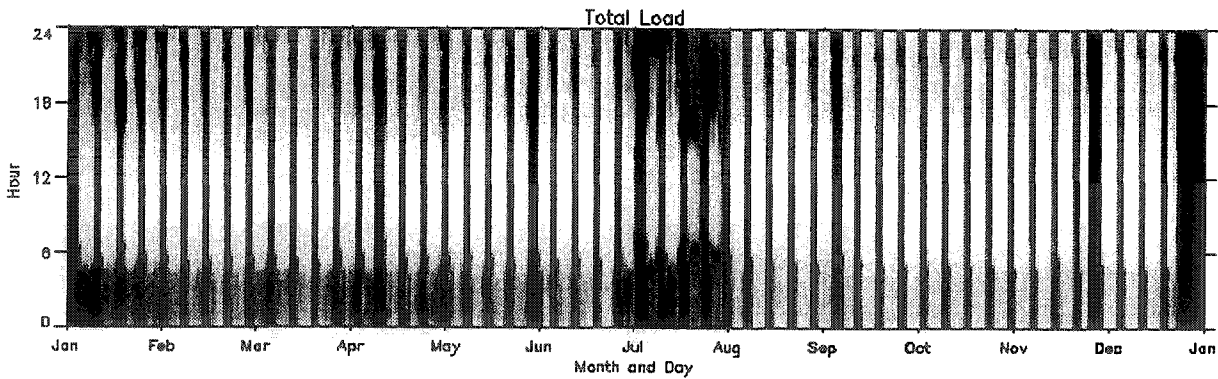


Figure 5: SIC Class 30 - Rubber

Note the two shift production schedule.

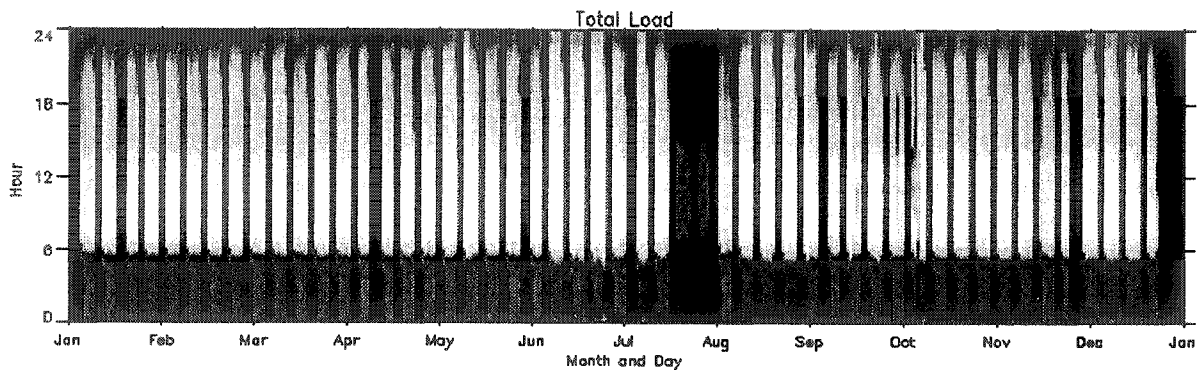


Figure 6: SIC Class 37 - Transportation

Note the similarities between Figures 1, 5, and 6. Which drives the other two?

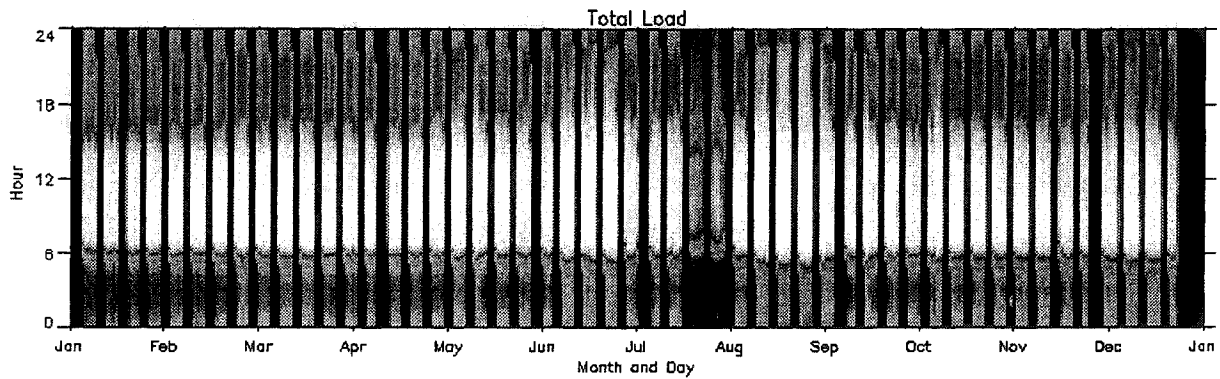


Figure 7: All Industrial Classes

Notice the influence Figures 1,5 and 6 have on the total industrial load.

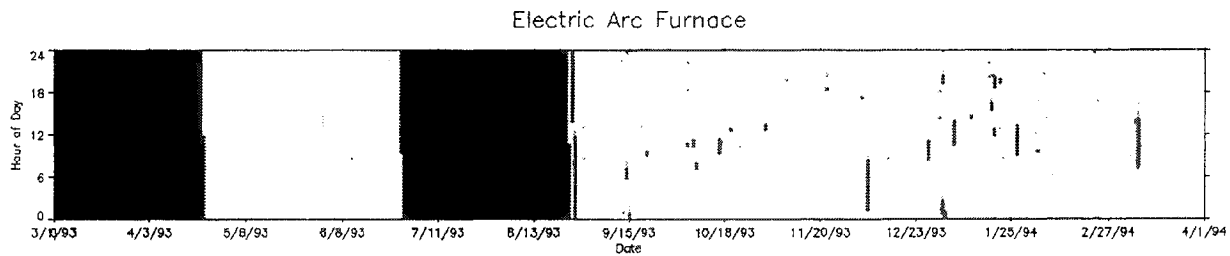


Figure 8: Electric Arc Furnace

Notice the full time production.

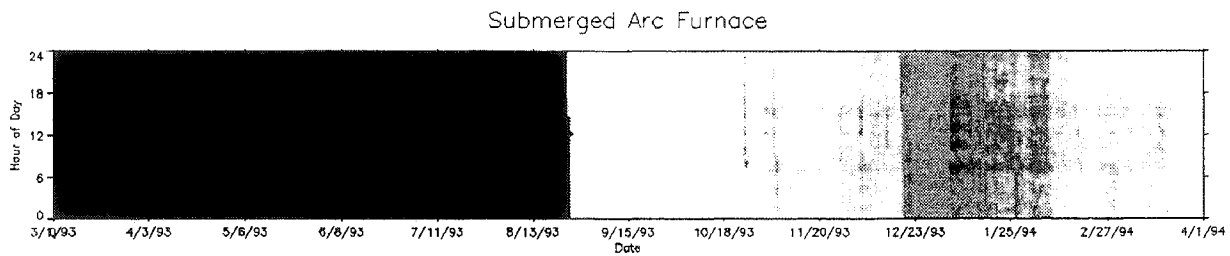


Figure 9: Submerged Arc Furnace

Submerging the furnace helps decrease the load a little.

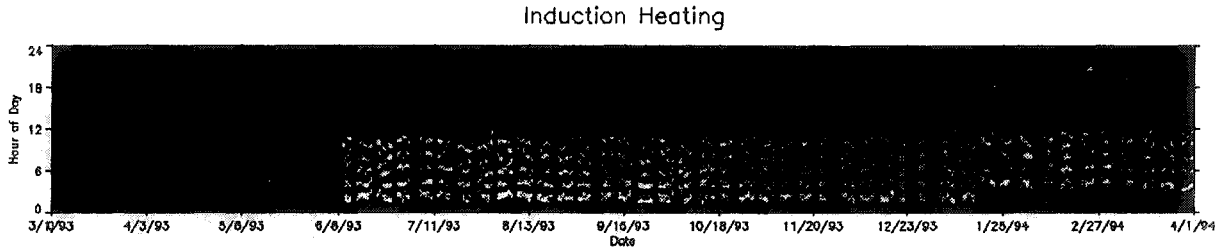


Figure 10: Induction Heating

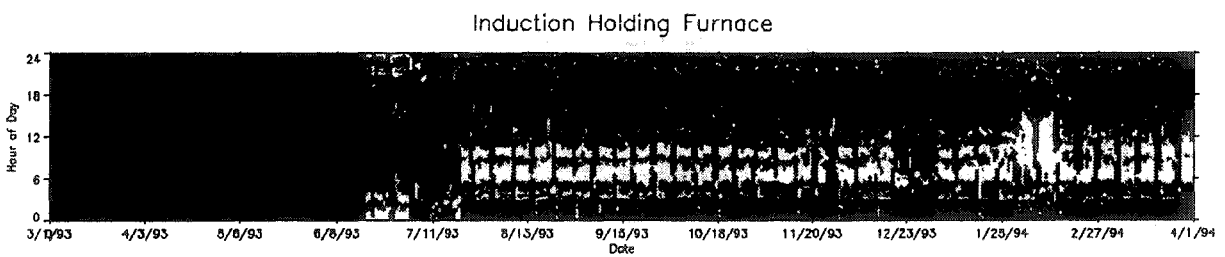


Figure 11: Induction Holding Furnace

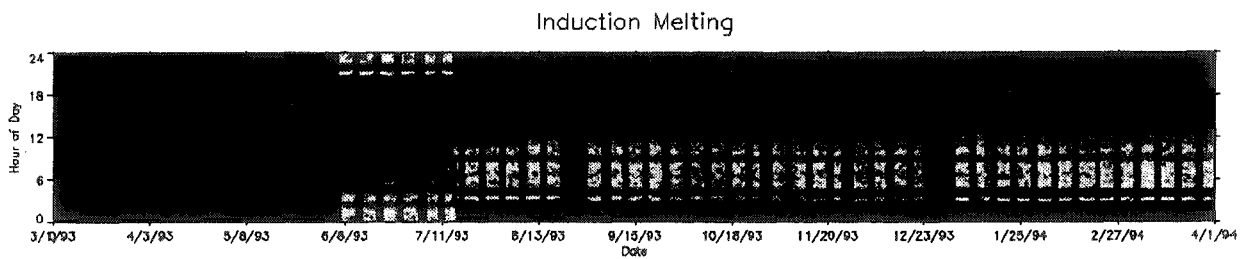


Figure 12: Induction Melting

Note the cycling of all the induction processes compared to the constant demand of the arc heating processes.