Utah FOUNDATION Executive Summary

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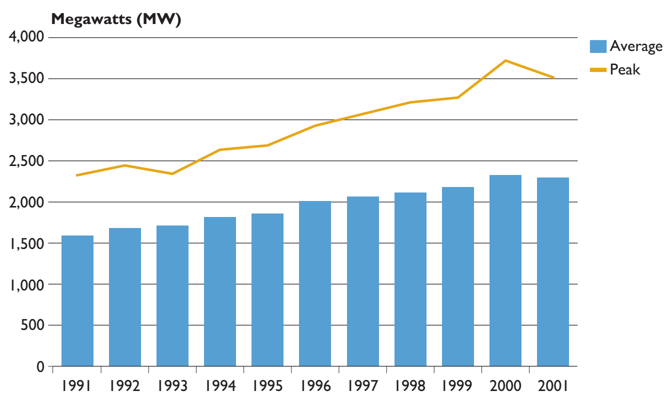
PEAK LOAD GROWTH ALONG THE WASATCH FRONT:

WHAT'S DRIVING ELECTRICITY DEMAND IN UTAH?

Until the large power outage this summer across the eastern United States and Canada, the idea of electrical peak load growth as a public policy issue was almost unheard of. Since the power outage, policymakers at all levels of government have started examining the supply and demand of electricity.

This topic is of particular importance in Utah where the large difference between average summer daytime and nighttime temperatures cause the electric grid to have large peaks and troughs in demand. In Utah, the differences between the peaks and average daily usage grew rapidly during the 1990s, placing a strain on the electrical infrastructure of the state. Since electricity cannot be stored, the infrastructure needed to meet these peaks must always be available even if that infrastructure is utilized for only one day or one week a year. Critical to sound policymaking by utility regulators is an understanding of which customers are responsible for most of the growth in peak loads. Utah Foundation has found that air conditioning use is a primary driver of peak loads and that 54.7% of households in the Salt Lake metro area had air conditioners in 1998 compare to 41.5% ten years earlier. Residences aren't the only customers placing demands on the system. From 1991 to 2001 growth in commercial and residential usage during peak times have place nearly equal demand on the system. However, while the commercial sector is a larger consumer of electricity in the number of megawatts used during peak times, residential consumption has grown at a faster percentage rate.

Figure 1: Yearly Average Load Compared to Yearly Peak
365-Day Average vs. Single Day Peak



Source: Pacificorp

FINDINGS

Utah is known for its hot, dry summers. In conjunction with the drought,[1] a booming economy and population growth, this has created a surge in peak loads in recent years. Furthermore, peak demand has emerged as a primary concern in discussions on electricity and energy policy because of its rapid growth over the last decade. Accommodating growth in peak demand is an issue that has implications on economic efficiency, environmental quality, and quality of life. It is complicated by two characteristics of electricity:

- Building new capacity takes a significant amount of time, and must be anticipated.
- There can be large differences between peak demand and average demand; however, the system must always be prepared for peak capacity. Energy used for electricity cannot be stored, so as the gap between average and peak demand grows, expensive infrastructure sits idle.[2]

Figure 1 compares Utah's peak load growth from 1991 to 2001 and the average load growth over the same time and helps illustrate the problems that electric utilities face. Average load growth can be thought of as fixed growth. Utilities know it's going to happen; they can reasonably estimate how fast it's going to happen and construct power generation and transmission infrastructure accordingly. Peak growth is more variable and it's difficult to predict how peak demand is going to behave. This has consequences for consumers where it matters most, in the cost they pay for electricity.

For the complete report on this topic and other reports, please visit our website at www.utahfoundation.org.

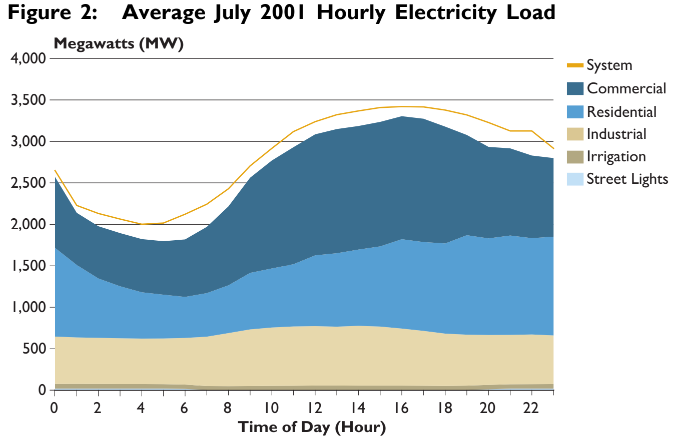
The electric utility industry is also focused on peak demand because the likelihood of system outages is highest during peak times.[3] As a result, utilities must build capacity to serve electricity for the most extreme peak loads, which may only occur for one or two weeks of the year. Since energy cannot be stored, utility providers have two options during these times. They can fire up the higher cost electricity generating plants to meet that peak demand or they can buy energy on the "spot" market at rates above the usual going price. Both options are very costly and these costs are ultimately passed on to the consumer.

An analogy with another form of infrastructure helps highlight this problem better. Building electrical generation capacity to only serve peak loads is akin to expanding I-15 to 10 lanes each way in order to accommodate rush hour traffic. While this may sound like a wonderful idea for commuters who sit through the afternoon rush, the rest of the day, those 20 lanes will be sparsely populated with vehicles. The costs for building such a highway are prohibitively high and do not make sense when the need for all 20 lanes is only for a few hours a day. Utilities must build the infrastructure, regardless of the efficiency in cost, in order to meet peak demand. Figure 1 illustrates the growing difference between peak and average demand since 1991. While Utah's average load has grown by 44.3%, peak load grew by 51.2% during this period.

The average coal-fired power plant that services Utahns produces approximately 400 megawatts (MW) per year and costs $450 million to build. This does not include the cost of transmission lines from the plant to the consumer or the ongoing costs of running the facility. The $450 million price tag is just the capital cost. Utah Foundation calculates the average gap[4] between peak demand and base demand for July has grown approximately 200 MW from 1991 to 2001 and has been growing more rapidly since 1996. A 200 MW increase necessitates the building of a 400 MW plant to meet current peak demand, as well as anticipated future demand. In addition to this new infrastructure cost, older facilities need to be maintained, upgraded or replaced, as they no longer operate efficiently.

For these reasons, it becomes imperative to examine peak load growth and the causes behind it. It is also important to determine which type of customers: residential, commercial or industrial are contributing the most to this growth, as conservation measures and pricing mechanisms vary accordingly.

Figure 2: Average July 2001 Hourly Electricity Load



Source: Ibid

An examination of PacifiCorp customer data from 1991-2001 reveals that growth in commercial and residential usage during peak times have place nearly equal demand on the system. Figure 2 highlights each sectors demand on the system for a typical July day in 2001. While the commercial sector is a larger consumer of electricity in the number of megawatts used during peaks times, residential consumption has grown at a faster percentage rate. Figure 3 highlights the changes for each sector since 1991, first showing the total change in demand over the period as well as a look at each year.

Figure 3a: Sectors' Contribution to Peak Load Growth From 1991-2001

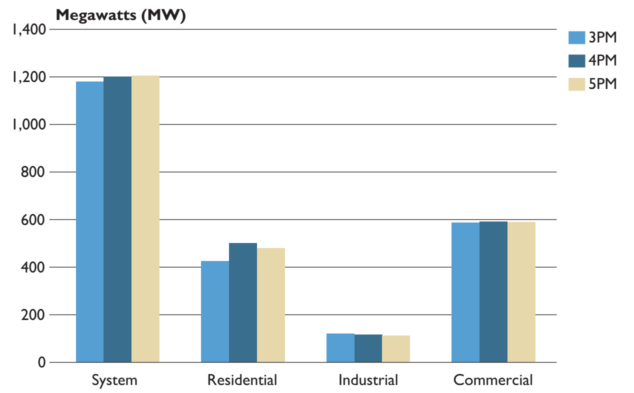
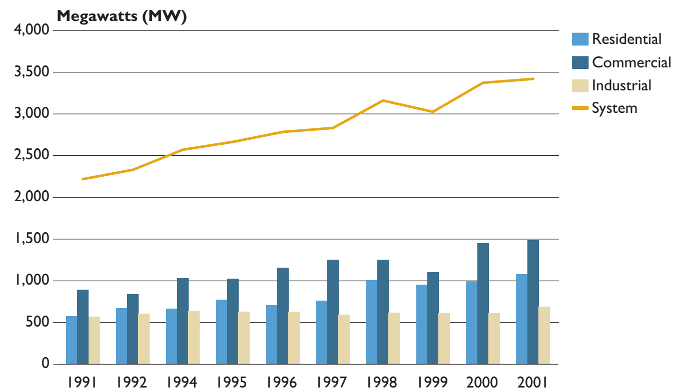


Figure 3b: Summer Coincident Peak Demand for Similar July Temperature Days, 1991-2001



Source: Ibid

These data only tell part of the story, and while it is important to know in which sectors growth is occurring, it is equally as important to know why. The next sections discuss sources of growth for both residential and commercial customers.

DRIVERS OF PEAK DEMAND

Of the three main drivers of peak demand (climate, demographics and the economy) only demographic and economic changes occur in way that can significantly change the characteristics of peak load and demand over time. Climate can be held relatively constant, because although a particularly hot summer may increase peak demand in one instance, temperature tends to fluctuate within a relatively predictable band. While global warming may be a cause of long-term temperature increases, the immediate impacts are not large enough to change the planning process for new power generation.

Demographic trends, on the other hand, affect housing and equipment use patterns. Trends in household size, lifestyle, and age of household occupants influence both equipment ownership and daily usage patterns.[5] Total customer growth in Utah averaged 2.9% annually in the period from 1992 to 2002. This is the highest growth rate for the states PacifiCorp supplies.[6] Additionally, The average annual growth in the number of households during that period was about 2.6%.

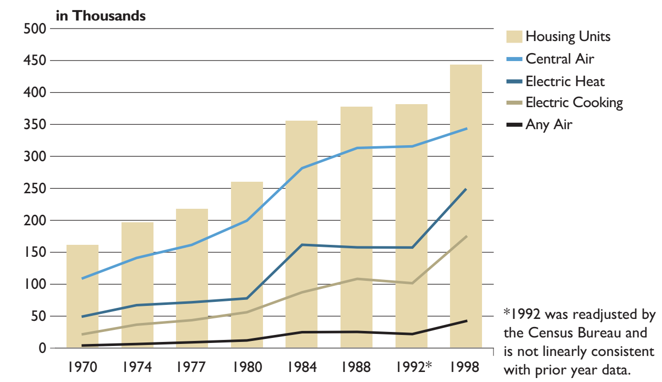
The final driver of electricity demand is the economy. Economic trends are tied partly to demographics, but also to business cycles and regional developments. The strong economic growth of the mid to late 1990s led to more building construction and in-migration. This increased electricity consumption and peak demand. The nature of economic growth (e.g., whether caused by relatively more or less energy intensive industries) also affects electricity use.[7]

Of these three, economic factors seem to be the best indicator of growth in electricity consumption and average demand. Regression analysis comparing electricity usage, both consumption and summer peaks, to gross state product (GSP) and per capita personal income (PCPI), showed very high correlations between electricity use and economic growth in constant 2002 dollars. During the economic boom of the 1990s Utah's GSP grew rapidly at an average annual rate of 5.7%.

RESIDENTIAL CONSUMPTION

The number of housing units in Utah has seen an almost three-fold increase since the 1960s. Additionally, technological innovation has increased significantly and the economic boom experienced in Utah throughout the 1990s provided Utahns the means to accumulate and access that technology. Furthermore, that economic boom contributed to an increase in the median square footage of housing units, while the number of people occupying those units have held steady or decreased. The confluence of these three factors has created significant growth in electricity consumption in the residential sector.

Figure 4: Drivers of Household Electricity Demand, Salt Lake MSA 1970-1998



Source: U.S. Census Bureau

Figure 4 shows that approximately 57% of Salt Lake's households currently use some form of electrically produced air conditioning and 37% rely on central air conditioning systems that use significantly more energy than their room-unit counterparts. In conjunction with the increased median square footage of households since the 1970s, and the tendency of the electrical grid to peak during the summer months, the difference in the numbers suggests that residences could be one of the driving factors of peak demand.

Figure 5: Housing Characteristics by MSA

	Housing Units	Average Sq. Footage*	Units With Air Conditioning: Any Air	Centrai Air	Room Units	% Units w/ Any Air
Salt Lake City						
1970	163,000	1,888	49,500	21,700	27,800	30%
1998	444,000	2,151	251,800	176,200	75,600	57%
CAGR**	3.6%	0.9%	6.0%	7.8%	3.6%	
Denver						
1970	392,100	1,890	70,400	25,800	44,600	18%
1998	771,900	2,020	311,300	198,400	112,900	40%
CAGR**	2.7%	0.7%	6.1%	8.5%	3.8%	
Phoenix						
1970	317,000	1,469	225,400	181,500	43,900	71%
1998	1,316,400	1,758	1,242,900	1,211,800	31,100	94%
CAGR**	4.5%	1.1%	5.5%	6.1%	-1.1%	
Portland						
1970	357,400	1,588	31,200	10,000	21,200	9%
1998	809,300	1,769	354,000	232,400	121,600	44%
CAGR**	2.6%	0.7%	7.9%	10.3%	5.6%	

* Sq Footage data was not collected until the 1984-86 round of Census of Housing Surveys.The CAGRs are adjusted accordingly.
** CAGR = Compound Annual Growth Rate
Source: U.S. Census Bureau

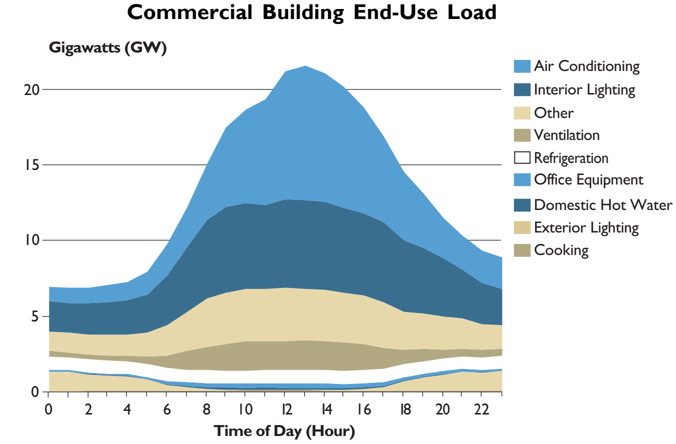
Figure 5 shows that growth in housing units with air conditioning is clearly outpacing general housing growth for the Salt Lake Metropolitan Statistical Area (MSA). This adds pressure to electricity demand, but the other MSAs shown exhibit the same trends, and these pressures are probably even greater in Denver and Portland than in Salt Lake.

There is a paradox, however, to housing units in Salt Lake City. Despite having the fastest growth rate of new housing units among the metropolitan areas reviewed, Salt Lake City still has the oldest housing stock compared with those other areas. Only 44.5% of Salt Lake's housing stock was built after 1970, compared to 45.2% in Portland, 54.9% in Denver and 70% in Phoenix. Older homes are less energy efficient, even if retrofitted with a new air conditioner, and require a greater amount of electricity to cool than a newer home of the same size.

COMMERCIAL AND INDUSTRIAL GROWTH

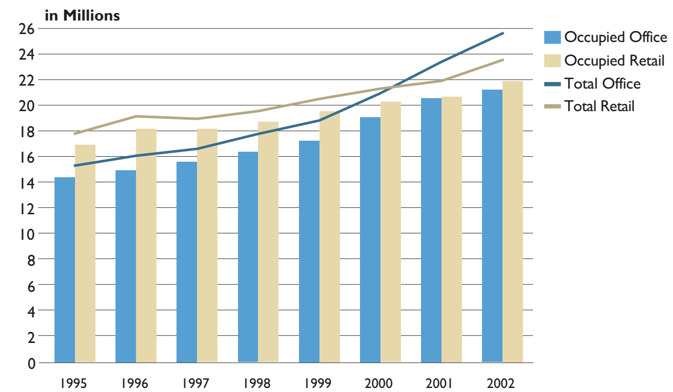
Peak loads within the general service category are mainly driven by commercial building usage. The general service category consists of commercial and industrial consumers. Figure 6 shows the summer electricity loads of the major end-uses of commercial buildings in California. The California figure is used because there have not been any comprehensive end-use surveys conducted in Utah thus far, and because of the relative similarities

Figure 6: California 1999 Summer Peak-day Commercial Building End-Use Load



Source: Ernesto Orlando Lawrence Berkeley National Laboratory of the summer climate. Also, the overall commercial load shape in California fairly resembles the load shapes of Utah commercial loads, and so provides useful insight for Utah commercial building usage. The figure shows that the largest contributors to peak demand and overall consumption are: air conditioning, interior lighting, "other", ventilation, refrigeration, office equipment, hot water, exterior lighting, and cooking. The "other" category includes office equipment, portable fans, and task lighting. Commercial loads rapidly rise as the business day begins shortly after 6 am and significantly taper as the business day ends around 5 pm. Because air conditioning's contribution to peak loads is so substantial, commercial peak loads are dramatically higher in summer months than at other times of the year.

Figure 7: Occupied and Total Office and Retail Square Footage
Salt Lake City



Source: Colliers International

Additionally, commercial building space has been growing rapidly since 1995. While the industrial sector, primarily manufacturing and warehousing, still has the majority of square footage in Salt Lake City with approximately 97 million square feet or 66.3 percent of the total, the commercial sector has been growing faster and is now a larger portion of the total than it was in 1995. The commercial sector contains two types of space, retail and office. While retail space grew from 17 million to 23 million square feet over the eight years, office space grew from 15 million to 25 million square feet during the same time. Starting in 2000, office space became a larger portion of the total inventory. Figure 7 compares office and retail space, both total and occupied space in Salt Lake City from 1995.

Together, these data suggest that the commercial sector encompassing office and retail space have been the drivers of general service peak load growth during the 1990s, while industrial customers have remained fairly constant. Since commercial air conditioning is the largest component of business' peak load usage, this seems to be the main driver behind the general service peak load spikes seen during the hottest days of the year.

ENDNOTES

[1] Since 1996, summer temperatures have been above normal which may be related to drought conditions that existed in the state during this time.
[2] Brown, Richard E. and Koomey, Jonathon G. "Electricity Use in California: Past Trends and Present Usage Patterns." Ernesto Orlando Lawrence Berkeley National Laboratory, LBL-47992, 2002. Available online at http://enduse.bl.gov/Projects/CAdata.html
[3] Ibid
[4] "Average gap" was determined by taking typical temperature days during July 1991 and 2001, and looking at the difference between base load and peak load. The "peak" was assumed to be between 3-5 pm, based on historical trends.
[5] Ibid
[6] These states are California, Idaho, Oregon, Utah, Washington and Wyoming.
[7] Ibid

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