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RESEARCH SUMMARY
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By Steve Colt

Low Cost, Reliable Power: How Does Anchorage Compare?

Costs of doing business in Alaska remain generally high, but the low cost and reliability of electric power in Anchorage has been a bright spot on the economic landscape—thanks largely to abundant supplies of natural gas from Cook Inlet and to creation of a unified power grid for the railbelt.

This research summary presents data on the changing cost and reliability of electric power from Municipal Light and Power (ML&P)—one of Anchorage's two electric utilities—from 1960 through 2004. It concludes with a brief discussion of the outlook for the utility, given rising natural gas prices.

Adjusted for inflation, ML&P rates are about a third lower now than in 1960 and slightly above national average rates. The time customers are without power has also dropped significantly. In 1980, the average ML&P customer was without power for about 6 hours per year, compared with 1.2 hours now. The limited national data available show the average U.S. customer is without power about 1.8 hours a year.

Assigning an economic value to improved reliability is difficult. But taking into account the duration of outages, types of customers, and other factors (described more inside), I estimate that the reduced time without power now, as compared with 1980, saves ML&P customers anywhere from about $7.7 million to $19.4 million per year. Those savings mean improved quality of life for households and more profit for businesses.

Alaska's Primary Energy Sources

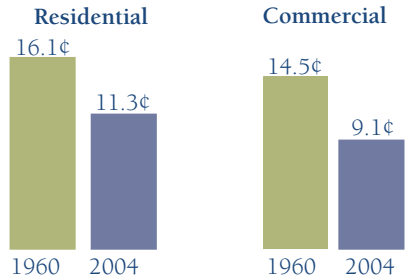
For 40 years, Anchorage's people and economy have benefited from inexpensive natural gas. The rest of the railbelt has also benefited in recent decades, as pipelines and electrical interties were extended throughout the region.

By contrast, diesel is the main energy source in remote communities—and in 2004 diesel outside the railbelt cost about five times as much per unit of energy as natural gas.[1]

The adjacent figure shows the sources of energy not only for electricity, but also for heat and transportation in Alaska places with natural gas and in remote rural places.[2]

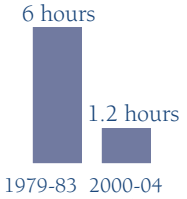
Diesel provides 75% of energy for all uses in remote places. In communities with access to natural gas, that gas provides about 40% of all energy and generates most of the electricity.

Average Real Price of Electricity (Per Kilowatt-Hour, in $2004)



Source: ML&P data

Hours Per Year Without Electricity, Average ML&P Customer



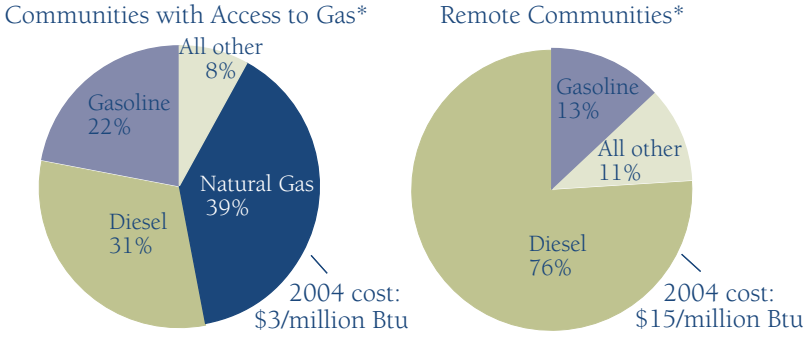
Source: ML&P data

Estimated Value of Reduced Outages

Residential Customers
$583 thousand – $1.1 million
Commercial Customers
$7.1 million – $17.7 million
Others
$633 thousand
Total
$7.7 million– $19.4 million

Source: Author's estimates

Primary Energy for Alaska



*See endnote 2. Includes energy for electricity, heat, and transportation.
Source: Author's estimates, based on 2004 data

Overview of ML&P

Municipal Light and Power is operated by the Municipality of Anchorage. Its service territory covers about 20 square miles and includes many of the city's commercial and high-density residential areas (see map). It accounts for 42% of electricity sales in Anchorage.

In 1960, the population of Anchorage was about 44,000 and ML&P served roughly 8,400 customers, including both residential and commercial. Today the city's population is around 280,000 and ML&P serves about 6,000 commercial customers and 24,000 residential customers.

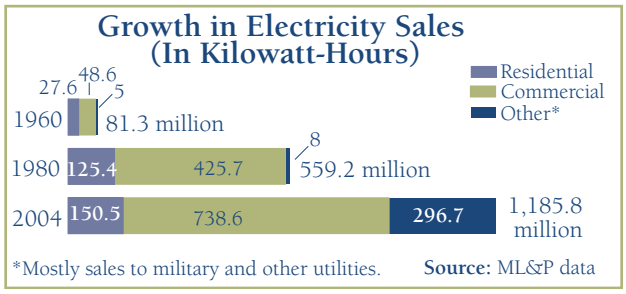
It also sells electricity to Anchorage's two major military bases—Fort Richardson and Elemendorf Air Force Base—and to other Alaska utilities on the railbelt grid, primarily around Fairbanks. (The railbelt runs from Seward on the Kenai Peninsula to Fairbanks in the Interior.)

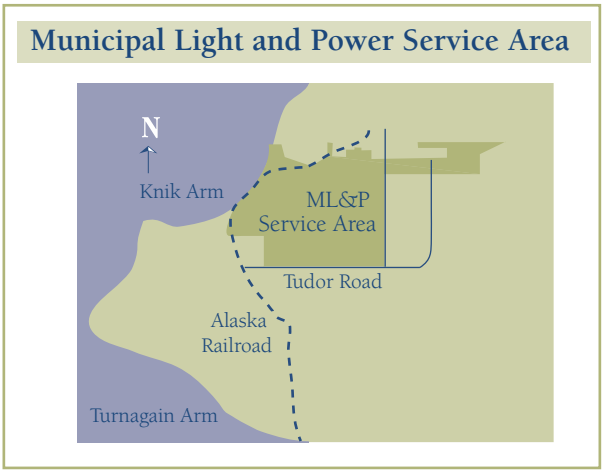
Since 1962, the utility has generated electricity from natural gas turbines, which now supply about 85% of all power it produces. Hydroelectric dams provide the rest. The utility maintains about 308 megawatts of gas-fired generating capacity and sells almost 1.2 billion kilowatt-hours (kWh) of power annually. That's nearly 15 times more electricity than it sold in 1960.

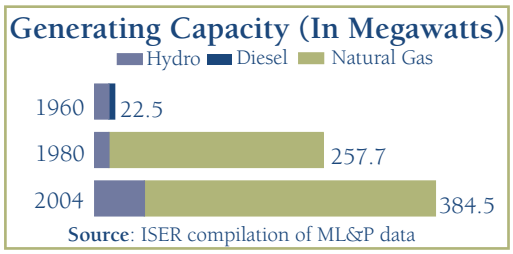
About 60% of ML&P's sales are to "commercial class" customers—including not only businesses but also government and nonprofit entities such as hospitals, schools, and public facilities. For example, in 2004 more than 85 million kWh went to power the rapidly growing U-Med District, which includes Alaska's two largest medical centers and two universities. ML&P also "exports" significant power out of its core service territory. In 2004 it sold 5% of all power generated to the Anchorage military bases, and those sales were slated to double in late 2005.

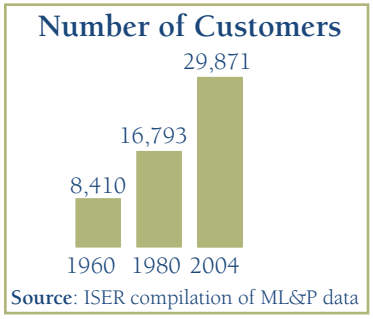
Electricity Prices

The price of electricity from ML&P fell about a third between 1960 and 2004, when adjusted for inflation (see figure on front page). In 2004 dollars, the residential average price dropped from 16.1 cents to 11.3 cents per kWh while the commercial average price dropped from 14.5 cents to 9.1 cents.





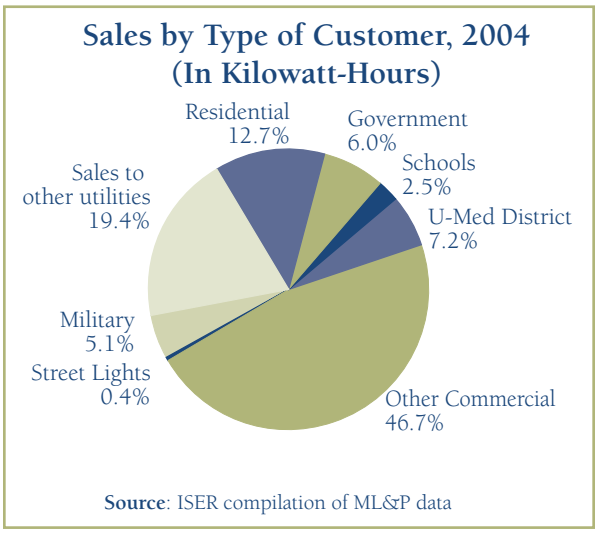




National Comparisons

How do ML&P prices compare with those in other places? The table on the facing page shows comparison samples of all private, cooperative, and publicly owned utilities nationwide that are similar in size to ML&P, based on 2003 data from the Energy Information Administration.

The commercial sample includes 867 utilities that serve between 1,000 and 10,000 commercial customers. The residential sample includes 696 utilities with between 10,000 and 100,000 residential customers. Prices for utilities in selected representative states are shown for perspective.



Washington has low prices because it has inexpensive hydropower. New Mexico uses coal for baseload and natural gas to meet peak demand. California uses natural gas—purchased at world market prices—for half the power it generates.[3]

Compared with these national samples, ML&P prices are slightly above the U.S. average and slightly below prices in states that rely heavily on natural gas. Natural gas from Cook Inlet has historically been less expensive than gas from other sources, partly because it was locally abundant and only a limited share could be exported.

Measures of Reliability

Traditionally, "reliability" of electricity referred to the number, duration, and timing—such as winter versus summer—of service interruptions. With the increased use of advanced digital devices such as computers, robotics, and medical imaging systems, the concept of reliability is now expanding to take greater account of the quality of electric power. In other words, for some customers, the power need not be entirely out to disrupt economic activity. However, consistent measures of power quality and data using those measures are still being developed and the value of power quality is poorly understood at present. This analysis is based on the traditional concept of reliability as measured through sustained power outages.[4]

There are currently three fundamental standard reliability measures derived from data on individual outages.

- The average number of outages per customer per year[5]
- The total number of hours without power per customer per year[6]
- The average hours per outage[7]

ML&P Reliability

ML&P reliability has improved significantly during the past 25 years. While the average length of an outage remained relatively constant at about 1 hour, the number of outages dropped from an average of 5.7 annually (during 1979-1983) to 1.6 (during 2000-2004). There was a temporary increase in outages in 1986-87 following the interconnection of ML&P with other railbelt utilities, but ultimately that interconnection led to further improvements in reliability.

Overall from 1980 to 2004, the number of hours customers went without power declined 80%, from 6.0 to 1.2 hours per customer annually (see figure on front page). That 1.2 hours compares quite favorably with an average of 1.8 hours that customers go without power outside Alaska, based on a small sample of utilities across the U.S.[8] There is no comparison data for periods prior to the late 1990s.

The Economic Value of Improved Reliability

Due to improved reliability, ML&P customers each now receive on average 4.8 more hours of uninterrupted electric service annually than they did during the 1979-1983 period, as shown on page 1. How much are these additional hours worth? Conceptually, these benefits are valued as the avoided cost of interruptions that don't occur now. Analysts have struggled for decades to measure these avoided costs, yet a 2000 report from the Electric Power Research Institute (EPRI) still says "the current state of knowledge is fragmented and incomplete," and notes "a vast array of conflicting and confusing data and studies."[9]

Comparison of Average Electricity Prices, Year 2003 (cents per kwh)

Commercial	
Washington	5.3
U.S. Average	7.7
ML&P	8.2
New Mexico	8.4
California	11.4
Residential	
Washington	5.9
U.S. Average	8.1
New Mexico	9.8
ML&P	10.2
Alaska average	10.5
California	10.9

Source: Energy Information Administration

That's not surprising, given that the value of an avoided service interruption depends on many factors specific to the interruption (when, how long, what season, how cold) and to the customer (type of equipment, available substitutes, and activities interrupted, for example).

To estimate the value of improved reliability to ML&P customers, I used recent published estimates that tie the value of an avoided outage to its duration and the type of customer affected.[10] I first determined the total customer-hours of avoided outages for residential and commercial customers and classified them as due either to "short"outages (up to 1 hour) or to "long" outages (longer than 1 hour).

Next, I assigned dollar values per hour to each type of outage, as shown in the table on page 4. I developed low and high estimates for these values. The low estimate for residential customers is based on what customers say they are willing to pay to avoid an interruption. The high estimate is based on their willingness to accept a lower monthly bill in exchange for enduring the interruption. For example, the low estimate for an avoided outage of less than 1 hour for a residential customer is $6.99 per hour and the high estimate is $13.08.

For the commercial sector, I based the dollars per hour values on measured direct costs of outages, using established methodologies published by EPRI.[11]

The economic value of avoided residential and commercial outage hours is the product of avoided hours times dollars per hour. As a final step in the analysis, I estimated the value of

avoided interruptions to the military and street light uses by calculating the additional number of kWh that would be provided to these customers due to improved reliability and multiplying by estimated values per kWh. The low value per kWh is zero, because it is not clear how many interruptions these customers actually suffer. I derived the high value from the commercial sector "low" value used above. This choice reflects the fact that these uses can be considered a mix of residential and commercial activities.

The adjacent table summarizes these calculations. Because of improved reliability, ML&P customers today experience 143,782 fewer customer-hours of outage than they would have at 1980 reliability levels. That reduced time of power outages has an estimated economic value of between $7.7 million and $19.4 million per year.

Outlook

Low-cost power in Southcentral Alaska has derived principally from locally abundant supplies of natural gas in Cook Inlet, found as a byproduct of oil exploration. With reserves of this low-cost gas now in decline, gas prices are generally rising and most consumers are already seeing significantly higher costs. However, ML&P will be able to keep its gas costs low for the next 10 to 15 years because it owns part of the Beluga River gas field.

Ultimately, ML&P will also pay significantly higher prices for natural gas. Those prices will depend on available supplies. ML&P's reliability, which derives mainly from its interconnection with the railbelt power grid, should not be affected by higher gas prices.

Endnotes

1. Assuming diesel costs $2 per gallon and natural gas $3 per thousand cubic feet.
2. Rural communities here are those qualifying under the state's Power Cost Equalization program, which subsidizes part of electricity costs for places that rely mostly on diesel and meet other requirements. Besides Anchorage, other areas with access to gas include the western Kenai Peninsula (south to Kasilof), Whittier, and the Mat-Su Borough north to Big Lake.
3. Generation data from: http://www.eia.doe.gov/cneaf/electricity/st_profiles/e_profiles_sum.html
4. The Institute of Electrical and Electronics Engineers (IEEE) recently defined a "sustained" interruption as an interruption that lasts at least five minutes and is not classified as a momentary interruption.
5. Known as SAIFI—Service Average Interruption Frequency Index.
6. Known as SAIDI—System Average Interruption Duration Index.
7. Known as CAIDI—Customer Average Interruption Duration Index. The three indexes are related by the equation SAIDI = SAIFI x CAIDI. For example, if the average customer experiences two outages per year, each lasting one hour, then the values of these measures would be SAIFI = 2 outages per customer per year; SAIDI = 2 hours without power per customer per year; and CAIDI = 1 hour per outage.
8. LaCommare and Eto, 2004. *Understanding the Cost of Power Interruptions to U.S. Electricity Consumers.* Lawrence Berkeley National Laboratory. LBNL-55718. The authors found only 162 data points from 39 utilities. Their study agrees almost perfectly with results obtained by a 2003 EPRI study (TR 1008459), but both studies probably used substantially the same data.
9. *Customer Needs for Electric Power Reliability and Power Quality*, Electric Power Research Institute (EPRI), Palo Alto, CA: 2000. 1000428.
10. Lawton, L., Eto, J., Katz, A., Sullivan, M. 2003. *Characteristics and Trends in a National Study of Consumer Outage Costs*. Center for Research in Regulated Industries. www.crri.rutgers.edu.
11. *Outage Cost Estimation Guidebook,* EPRI, Palo Alto, CA: 1995. TR-106082; Project 2878-04.

Economic Value of Improved Reliability

		Short (0-1hr) Outages	Long(>1hr) Outages	Total
Residential				
Additional hours served		72,847	41,915	114,762
Value per hour	low	$6.99	$1.76	
	high	$13.08	$3.09	
Total residential value	low	$509,200	$73,770	$582,970
	high	$952,838	$129,517	$1,082,355
Commercial				
Additional hours served		18,421	10,599	29,020
Value per hour	low	$306	$135	
	high	$882	$135	
Total commercial value	low	$5,641,643	$1,428,291	$7,069,934
	high	$16,247,932	$1,428,291	$17,676,223
Military and Street Lights				
Additional kWh served		20,408	11,743	32,151
Value per kWh		$24.76	$10.89	
Total military / street light value		$505,319	$127,931	$633,250
Total Value of Improved Reliability:	low			$7,652,905
	high			$19,391,828

Source: Author's estimates

About the author: Steve Colt is an associate professor of economics at ISER. He has studied Alaska energy issues for more than 20 years.

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