

The Journey into Time-of-use rates
by
A Small Municipal Light Department in the Northeast

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Background information on GELD

Who is GELD?

GELD is a municipal power distribution provider located in central northern Massachusetts between Lowell and Fitchburg. The distribution area is 32 square miles of hilly heavily wooded terrain with almost 2/3 of its sales to residential customers. GELD has a staff of 14 employees and gross annual sales of approximately \$12 million generated by 5061 meters with sales just over 70 million kilowatt-hours (kWh) at an average of 17.1 cents/kWh in 2023.

Two large private school customers account for 8% of GELD's sales, and 17% of the load is commercial.

GELD has a diversified power supply portfolio of ownership interests, purchase power agreements and purchases from the market. For 2023, 42.2% of our power came from nuclear sources, 31.2% from Natural gas sources, 11.4% from hydro-electric, 6.9% from solar, 5.0% from wind and a small amount from other sources.

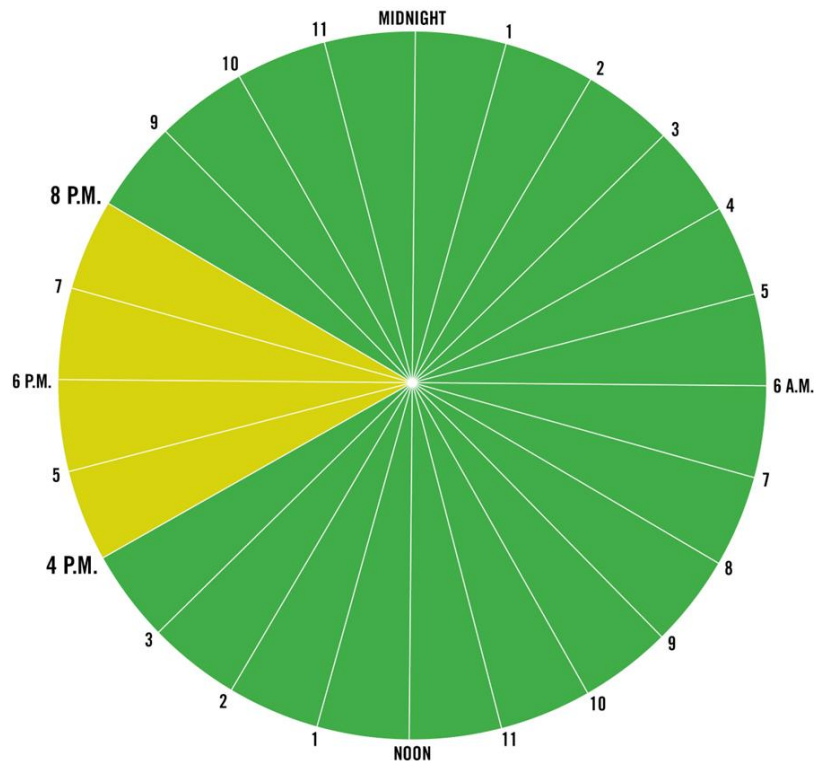
GELD's governance is a board of three elected commissioners which oversees GELD and a manager in charge of all operations.

GELD's Time-of-use Rate Story

GELD's mission statement is "to provide our customers with reliable power and excellent service at affordable prices". This rate design perfectly aligns with our mission and performance. In pursuit of that mission GELD received the APPA Gold Customer Satisfaction award in 2023. Providing incentives to our customers to change their electric use behavior and patterns, lowers our costs and allows us to keep rates lower into the future.

GELD transitioned to exclusive time-of-use (TOU) rates for most of its residential rate class beginning in September 2023. This rate has a 20 hour off peak period from 8:00 pm to 4:00 pm daily. Our peak period is from 4:00 pm to 8:00 pm, which aligns with the time period where almost all of our transmission and capacity costs have been determined over the last four years.

GELD’s time-of-use rate heavily depends on having an accurate AMI system. Without actual, accurate hourly data it is not possible to consider time-of-use rates.



Almost all of the residential rate customers are participating in TOU rates, with the addition of municipal and commercial customers under consideration.

The primary measure of success is the shift in our load curve. An analysis of our first winter with TOU rates reveals an 8:00 pm to 9:00 pm bump with increased usage later into the evening as well as in the morning. GELD is cautiously optimistic that the more than 10% shift out of the peak hours in the winter will hold for the rest of the year. Based on GELD’s experience, a larger shift in the summer is expected due to the easier programming of cooling systems compared to heating systems.

GELD has helped educate customers through regular articles in our monthly newsletter, town social marketing sites, and town e-mail lists.

GELD's experience shows the major factor for success has been communicate, communicate, communicate. GELD spent a three-year period beginning with an initial small pilot test. Then, a significant trial program was conducted with heavy communication in various media before implementing time-of-use rates with the residential customers.

GELD expects that with more experience, adjustments will be needed to the rate design. In the future, there will need to be constant monitoring of when peaks are occurring which may change the peak period time frames and there will need to be on going analysis of costs to determine if the summer or winter multiplier between peak and off-peak rates needs to be adjusted.

Need for new Rate

For 15 years GELD collected hourly data on each residential customer and had spent much of that time working on a wide variety of residential demand response programs. It was determined that real results would require customers to change demand behavior if GELD was to avoid substantial capital investments.

GELD NEEDED A NEW WAY to look at RATES!

After multiple attempts at different residential demand response and peak reduction programs, it was determined that the true cost of the programs exceeded the documented savings that could be returned to participating customers. A simple framework to drive our path forward was defined:

That simple framework was:

- Understand what drives costs
- Develop an understandable program
- Demonstrate that it can work
- Keep it simple
- Implement

The goal was to create a rate that provided our customers the incentive to modify their electric usage habits.

Pilot Rate and Shadow Billing

GELD worked with Boris Nikolic of RenwAI to develop a TOU rate that was both simple and captured the actual cost of service. The generation, transmission, and distribution costs were defined as:

- Generation and transmission: Generation costs were set at 4 cents per kWh for 20 hours of the day and 40 cents for the generation portion of the bill for peak times from 4:00 pm to 8:00 pm.
- Distribution: Was set at 4.3 cents/kWh to cover GELD’s operating and capital costs.

In the summer of 2020, GELD introduced the initial 4/40 TOU pilot rate to 65 customers who embraced the program and shifted a substantial amount of their electric use out of the peak evening hours. GELD decided to increase the test to as many customers as possible for the summer of 2021. GELD partnered with a professor of economics from the University of Queensland who wrote an academic paper on GELD’s program results.

The shadow bill is a bill that was delivered in addition to the customer’s regular bill. The customer’s standard bill read “please pay this bill”. While the shadow bill was for the customer’s information only. The difference between the regular bill and the shadow bill showed the customers how changing their behavior could change the dollar amount of their bill.

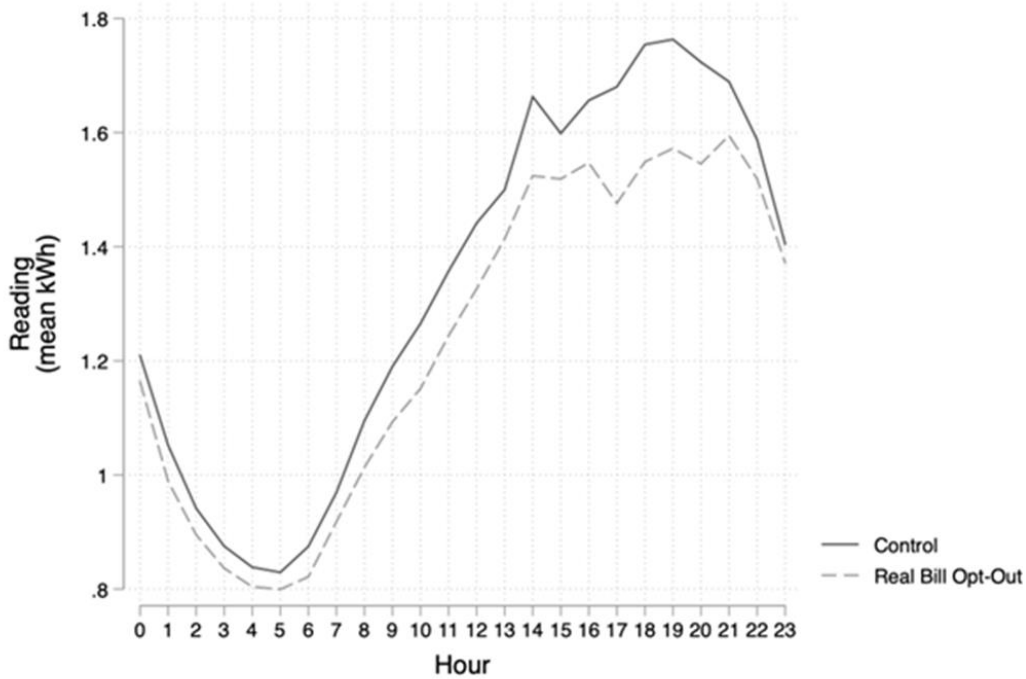
With the Shadow Bill Program customers were able to change their electric usage patterns and see the dollar effect of that change. Before the program, GELD’s average electric usage between 4-8 pm was very consistent as a percentage of our daily usage.

Pilot Rate Results

Historically, in the summer, about 21% of GELD’s electric use was between the hours of 4:00 and 8:00 pm. A control group of customers was selected by the economist to provide a point of comparison when trying to determine the actual

transmission and capacity savings generated by the TOU rate. With the shadow bill program, a sizable drop in evening electric usage was shown. Some customers reduced their electric use to a quarter of what it had previously been, between 4:00 p.m. and 8:00 p.m.

Figure 1.
Average Residential Hourly Electric Usage in Summer 2021



The figure above shows the average hourly use of the control group (1001 customers) who were not in the TOU program and the real bill group (279 customers) who participated in the TOU program. The customers using the time-of-use rate had substantially lower evening usage than their peers. The reduction in evening usage translates into substantial savings in capacity and transmission costs. Another notable mention is the graph shows that so much communication about pre-cooling homes had occurred in town, that the control group had a usage spike between 3:00 and 4:00 pm.

As a primarily residential utility, GELD historically peaked between 6:00 pm and 8:00 pm in the summer. Before beginning the TOU pilot programs, the peak was rarely between 3:00 pm and 4:00 pm. Recent history shows that over 40% of daily peaks were hour ending 19 (7:00 pm), and another 40% of daily

peaks were hour ending 20 (8:00 pm). The highlighted areas below clearly show a measurable change in customer behavior to outside of the peak hours.

Figure 2

Substation Electric Load During 2021 Heatwave

	Hour	28-Jun	29-Jun	30-Jun
	10	12,948	13,640	13,666
	11	13,910	14,550	14,706
	12	14,934	15,402	15,387
Off-peak	13	15,886	16,515	16,302
	14	16,624	17,768	17,025
	15	17,462	17,982	17,768
	16	18,044	18,387	18,553
	17	17,784	17,597	17,976
On-peak	18	17,768	17,534	15,106
	19	17,841	17,623	14,555
	20	17,602	17,306	16,016
	21	17,659	17,503	15,709
Off-peak	22	16,900	16,817	14,498
	23	15,335	15,122	12,662
	24	14,019	13,343	10,806

The table above shows GELD’s substation load during the three-day heatwave of 2021 that set the capacity hour for that year. The blue highlight number indicates the hour of the regional transmission peak which determined our transmission and capacity payments.

In ISO-New England transmission and capacity payments are determined by contribution to the regional peak. Our costs are determined by the hour highlighted in light blue, which *is a full MW below our system peak*. The figure above shows the 4/40 study group, reduced and flattened their demand and GELD’s load at the substation from 4:00 pm to 8:00 pm. Most importantly, outside of this heatwave the peak moved to the hour ending 16, (4:00 pm) on a regular basis during the summer.

In New England, 1 MW of peak reduction is currently worth \$154,350 based on the Regional Network Service charge, also known as a transmission charge. Going forward, ISO-NE has indicated there will be an increase of at least \$10,000 per year in our RNS costs. 1 MW of generation capacity reduction is currently worth about \$45,000 which is also expected to increase.

TOU Rate Implementation

After demonstrating the success of TOU rates to customers and the Board of Commissioners, the Groton Electric Light Board voted to retire the standard residential rate effective September 24, 2023.

The consultant who helped design the TOU rates created a tool to keep track of costs and expenses and assist GELD in creating rates into the future. GELD began saving all hourly customer data in 2020. Monthly generation and transmission costs were also collected. GELD overhead is spread evenly over 12 months.

Instead of hiring a consultant every six months in this rapidly changing world, historical data can be used to make models to analyze the potential impact of potential rates. Using the RenwAI tool and a few assumptions, net income with various rates can be estimated. With this tool, for a fraction of the cost of a typical rate consultant, a rate design that works for any system can be developed.

Under current conditions, GELD sets rates with a small number of variables. Over the course of a year, the “summer” rate covers eight billing cycles between March 24 to November 24 and the winter rate covers four billing cycles between November 24 to March 24. For the multiplier of the summer rate, the peak rate generation charge is 10 times the off-peak rate, while the winter multiplier is seven times the off-peak rate. The current generation charge for the summer rate is 5 cents off peak and 50 cents peak while the winter generation rate is 7 cents off peak and 43 cents peak. GELD offers an early pay discount of 1.7 cents/kWh, which most of our customers take advantage of. With the 4.3 cents/kWh distribution charge, the total summer rate is 7.6 cents off peak and 52.6 cents peak. In the winter, the total rate is 9.6 cents off peak and 45.6 cents peak.

GELD now has a path forward using a tool that allows rate changes as needed, ensuring costs are covered, while incentivizing customers to change their behavior by moving their power demand out of peak hours and lowering their monthly bill, creating a win-win dynamic.

TOU Rate Results

GELD is currently gathering data to compare last year under the flat electric rate to the current year under the TOU rate to verify that the results are sustainable and beneficial to customers. Early indications are promising, and similar results should continue.

The following graphs compare monthly data for TOU rate, (TU) in our billing system, in 2024 compared to the same customers with the “old” flat residential rate (R1) utilized in 2023.

The R1 data is for GELD residential meters in 2023.

The TU data is the same customers under the new time-of-use rate in 2024.

The ISO data is the regional data for the same period for ISO-New England.

Figures 3, and 4 show the percentage of the customer’s electric load that is occurring during the peak hours on the peak day.

Figure 3.

The Percentage of customers electric use in peak hours during the January peak day in 2023 and 2024.

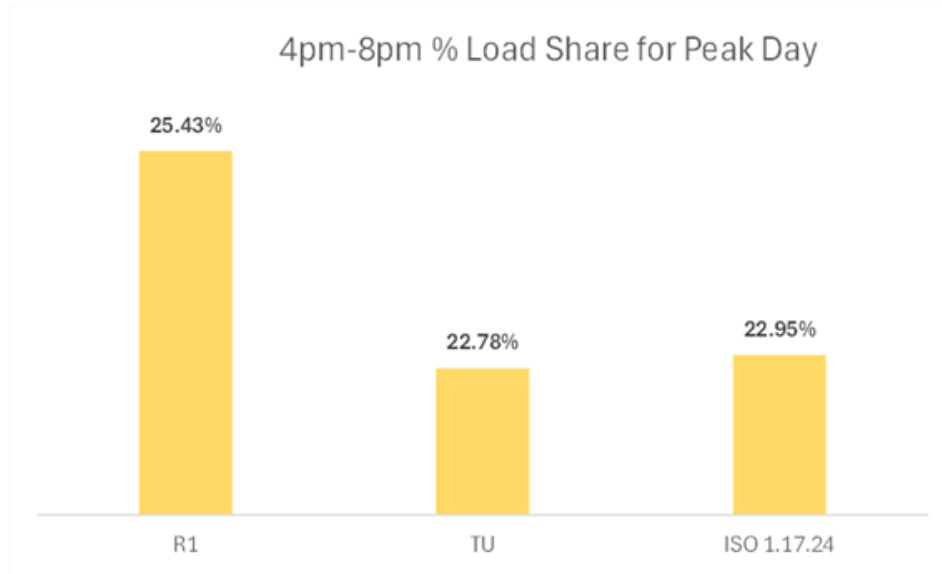


Figure 4.

The percentage of customers electric use in peak hours during the March peak day in 2023 and 2024.

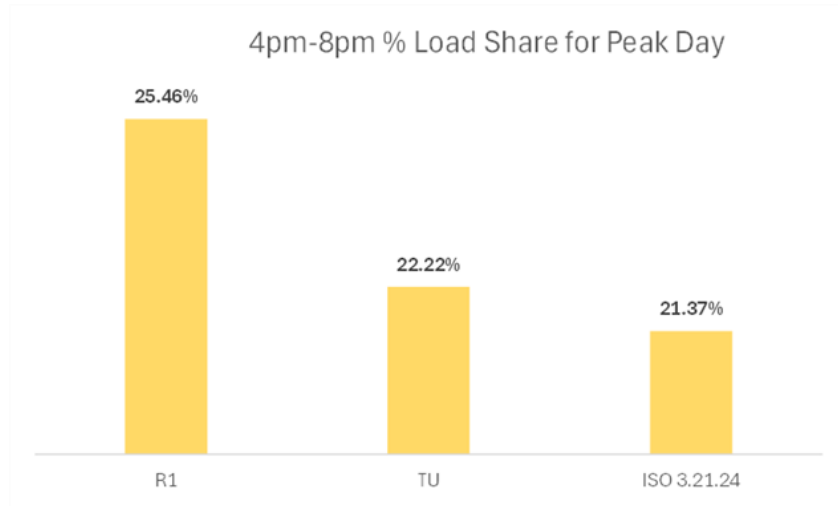


Figure five shows the peak day in January of 2024, compared to the Peak day in January 2023. In 2024, it was significantly colder than 2023 which caused an increase in electric use across ALL off-peak hours while there is a reduction during the peak hours.

Figure 5.

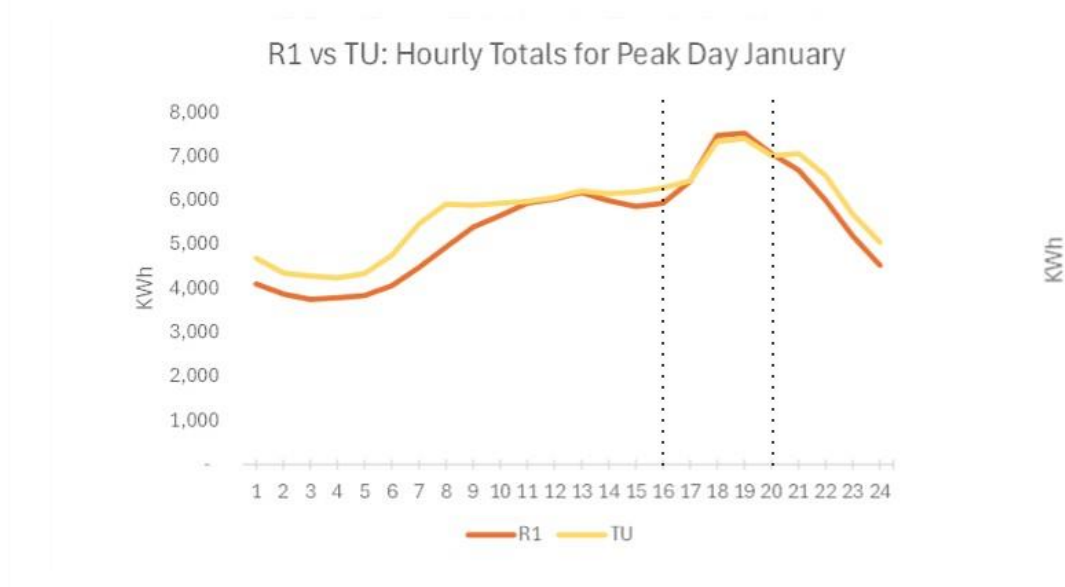


Figure six shows a compilation of the entire month of February and clearly shows a shift in electric use later into the evening.

Figure 6.

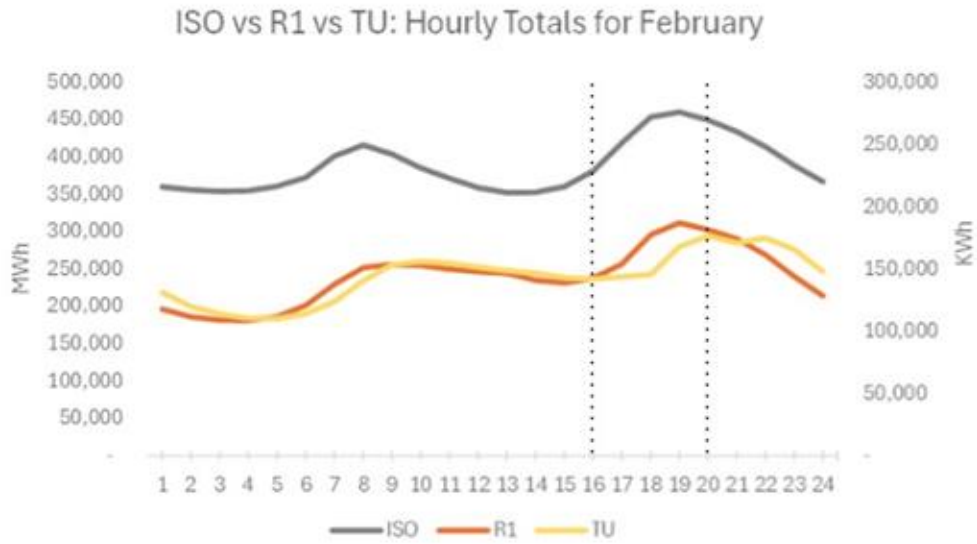
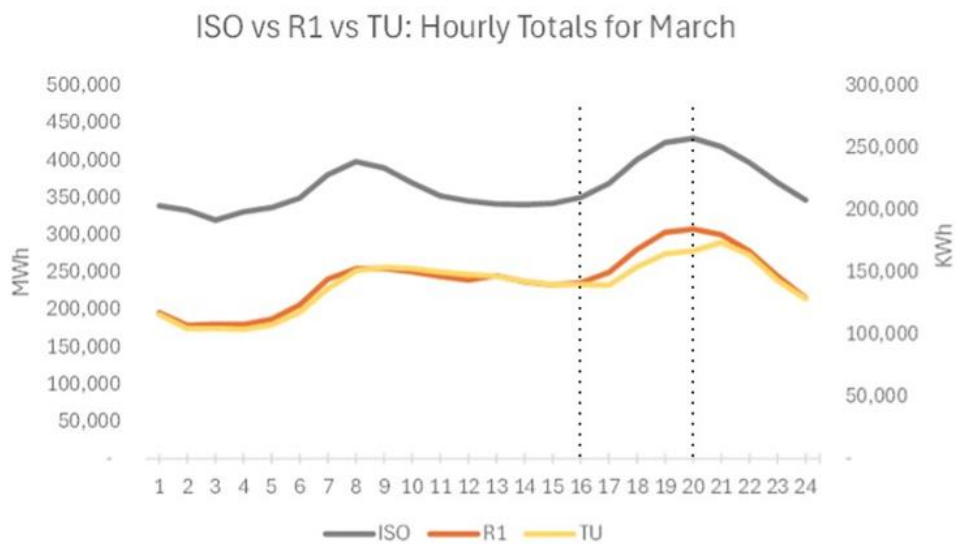


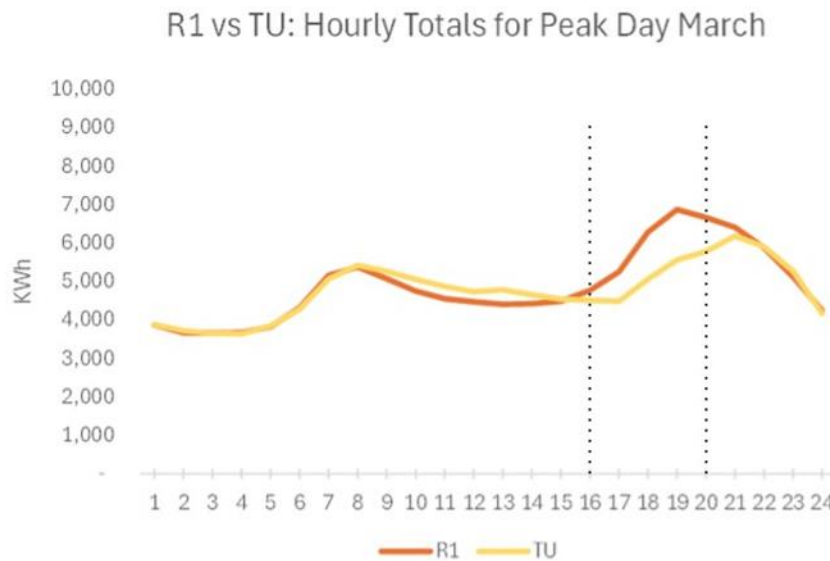
Figure seven shows a compilation for the entire month of March.

Figure 7.



While figure eight just shows the peak day in March.

Figure 8.



These figures clearly show a significant reduction in GELD’s electric usage during the peak hours. Up to three percent of customer demand has shifted from peak to off peak due to the rates. All peak reduction reduces both transmission and capacity costs. GELD’s total capacity and transmission costs are almost \$3 million out of a \$12 million annual budget. If these numbers hold for the remainder of the year, creating a rate structure that encourages customers to use electricity outside of the peak hours could lower transmission and capacity costs by about 10% or \$300,000 per year. There are also solid savings in generation costs as generally the generation prices outside the 4:00 pm to 8:00 pm period are lower than the peak generation costs for each day.

Conclusion

GELD is willing to share what we have done. We encourage others to jump into the world of TOU rates to help flatten the load and reduce the need for peak generation. If you’d like additional information or a copy of the academic paper or the pilot rate results, please email Kevin Kelly kpkelly@grotonelectric.org Jon Patterson jpatterson@grotonelectric.org or Tammi Lemire tlemire@grotonelectric.org or give us a call at 978-448-1150.