

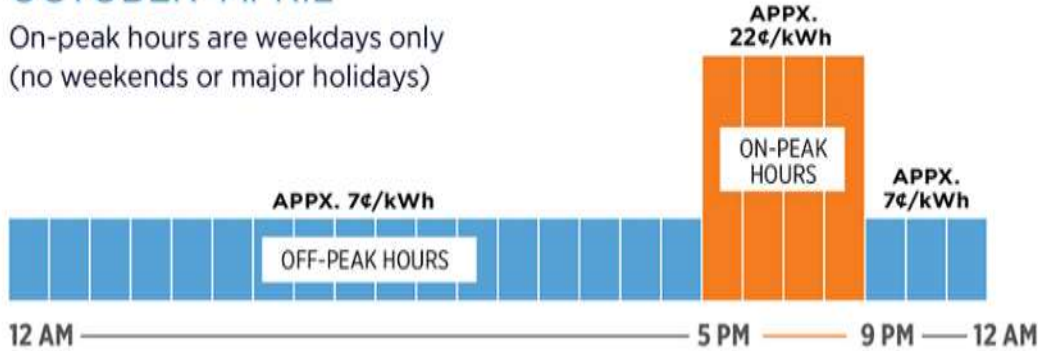
Energy and Demand Shifting with Time-of-Day Pricing  
John Phelan – Fort Collins Utilities

- Background on Fort Collins Time of Day (TOD) pricing
- Year one impacts with two analysis methods
  - Financial, energy, demand
- Year two impacts (sort of... it was 2020)
- Ongoing implications for programs and services
  - Efficiency, demand response, solar, storage, EV's



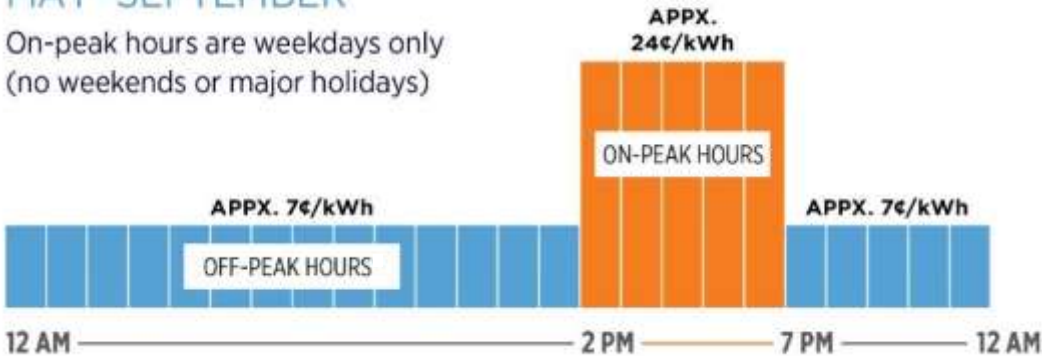
## NON-SUMMER OCTOBER-APRIL

On-peak hours are weekdays only  
(no weekends or major holidays)



## SUMMER MAY-SEPTEMBER

On-peak hours are weekdays only  
(no weekends or major holidays)



# TOD Pricing Structure

- **On-peak hours:** Monday-Friday
- **Off-peak hours:** Weekends and major holidays



# Fort Collins Residential TOD Rates

Residential TOD	Charges-E125
Fixed Charge	\$8.59 /Mo
Non-Summer (Jan-Apr & Oct-Dec)	
Off-Peak	\$0.0719 /kWh
On-Peak (5 - 9 pm) M - F	\$0.2242 /kWh
Over 700 kWh tier	\$0.0246 /kWh
Summer (May - Sept)	
Off-Peak	\$0.0719 /kWh
On-Peak (2 - 7 pm) M - F	\$0.2624 /kWh
Over 700 kWh tier	\$0.0246 /kWh
All-Electric TOD	Charges-E120
Fixed Charge	\$8.59 /Mo
Non-Summer (Jan-Apr & Oct-Dec)	
Off-Peak	\$0.0804 /kWh
On-Peak (5 - 9 pm) M - F	\$0.2326 /kWh
Summer (May - Sept)	
Off-Peak	\$0.0804 /kWh
On-Peak (2 - 7 pm) M - F	\$0.2708 /kWh







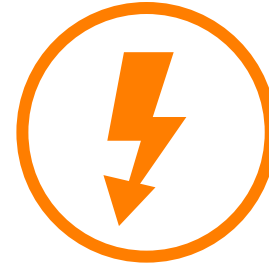
FAIR &  
EQUITABLE  
STRUCTURE



MORE  
CUSTOMER  
CONTROL



LOWER PEAK  
DEMANDS &  
COSTS



ENERGY &  
CARBON  
SAVINGS



ELECTRIC  
VEHICLE  
FRIENDLY

# TAKE CONTROL OF YOUR ELECTRIC BILL

KNOW WHAT IT COSTS TO USE AN APPLIANCE FOR ONE HOUR

ON-PEAK HOURS (5-8PM, 10-4PM, 2-7PM, 9PM-5PM / WEEKENDS ONLY)    OFF-PEAK HOURS (ALL OTHER HOURS OF THE DAY, NECESSARY AND PUBLIC HOLIDAYS)

 \$1.06 / 52¢ / 53¢ to use an electric water heater	 79¢ / 24¢ / 55¢ to charge an electric vehicle with a Level 2 charger (3.3 kW)	 73¢ / 22¢ / 55¢ to use a central air conditioner	 67¢ / 20¢ / 55¢ to use an electric dishwasher	 43¢ / 13¢ / 55¢ to use an electric heater
 28¢ / 9¢ / 55¢ to use a space heater	 24¢ / 9¢ / 55¢ (incandescent) 1¢ / 3¢ / 55¢ (LED) to light a string of large bulbs	 20¢ / 8¢ / 55¢ to use a furnace	 24¢ / 9¢ / 55¢ to use a window/door air conditioner	 13¢ / 4¢ / 55¢ to run a refrigerator for two hours
 12¢ / 3¢ / 55¢ to use a dishwasher	 7¢ / 2¢ / 55¢ to use a clothes washer	 15¢ / 9¢ / 55¢ to use a large holiday holiday decoration	 3¢ / 1¢ / 55¢ to run a slow cooker	 2¢ / 1¢ / 55¢ to run a fan or ceiling fan
 2¢ / 1¢ / 55¢ to play video games	 1¢ / 1¢ / 55¢ to use a computer	 1¢ / 1¢ / 55¢ to watch TV	 48¢ / 41¢ / 55¢ to use an LED light bulb	 41¢ / 41¢ / 55¢ to charge a cell phone

## APPLIANCES THAT USE ELECTRICITY 24/7 FOR ONE DAY

 65¢ / DAY to keep a hot water tank	 11¢ / DAY to run a refrigerator	 2¢ / DAY to run a router
----------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------

# Customer Outreach

- [Fcgov.com/TOD](http://Fcgov.com/TOD)
- websites per month
- customer calls and emails
- SARs
- How to read my bill
- How to save on TOD
- Rate information for all-electric homes, gas heated homes, solar homes



## Year One Results Summary (2019)

- **2.3%** customer bill savings
- **\$1.54** monthly savings on average
- **~2.7%** reduction in wholesale costs

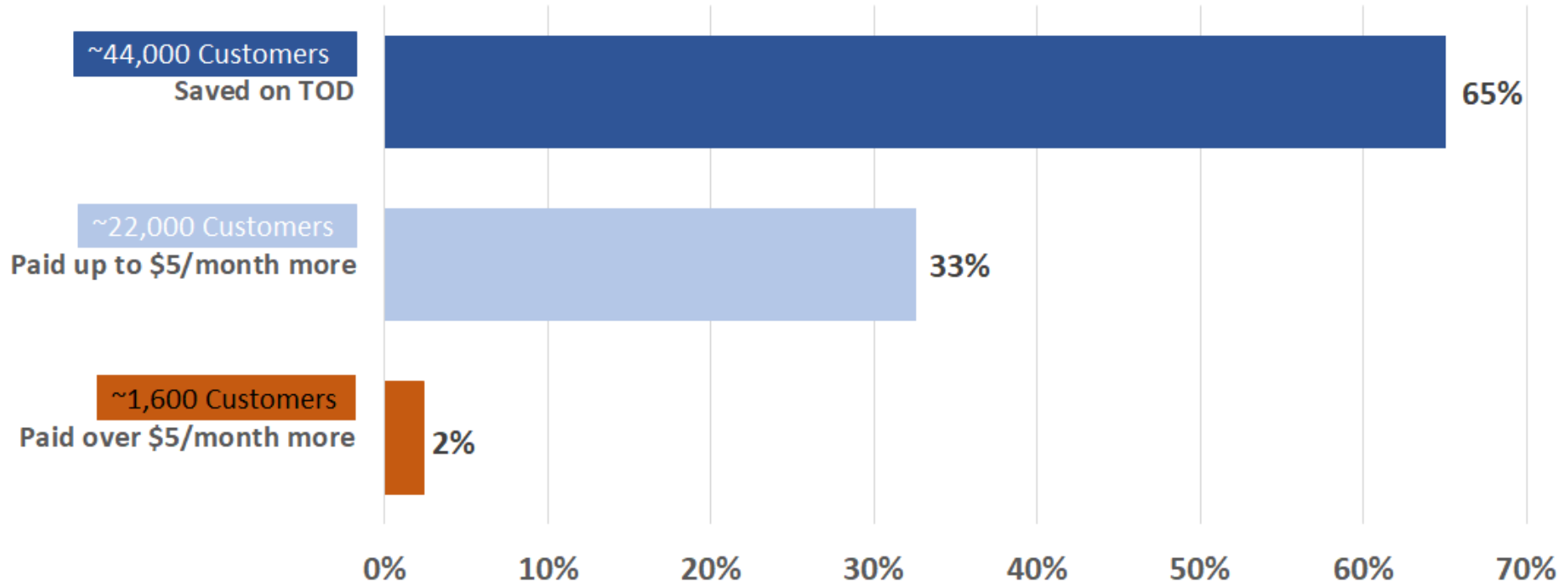


Compared to previous tiered rate



# Year One Results Summary

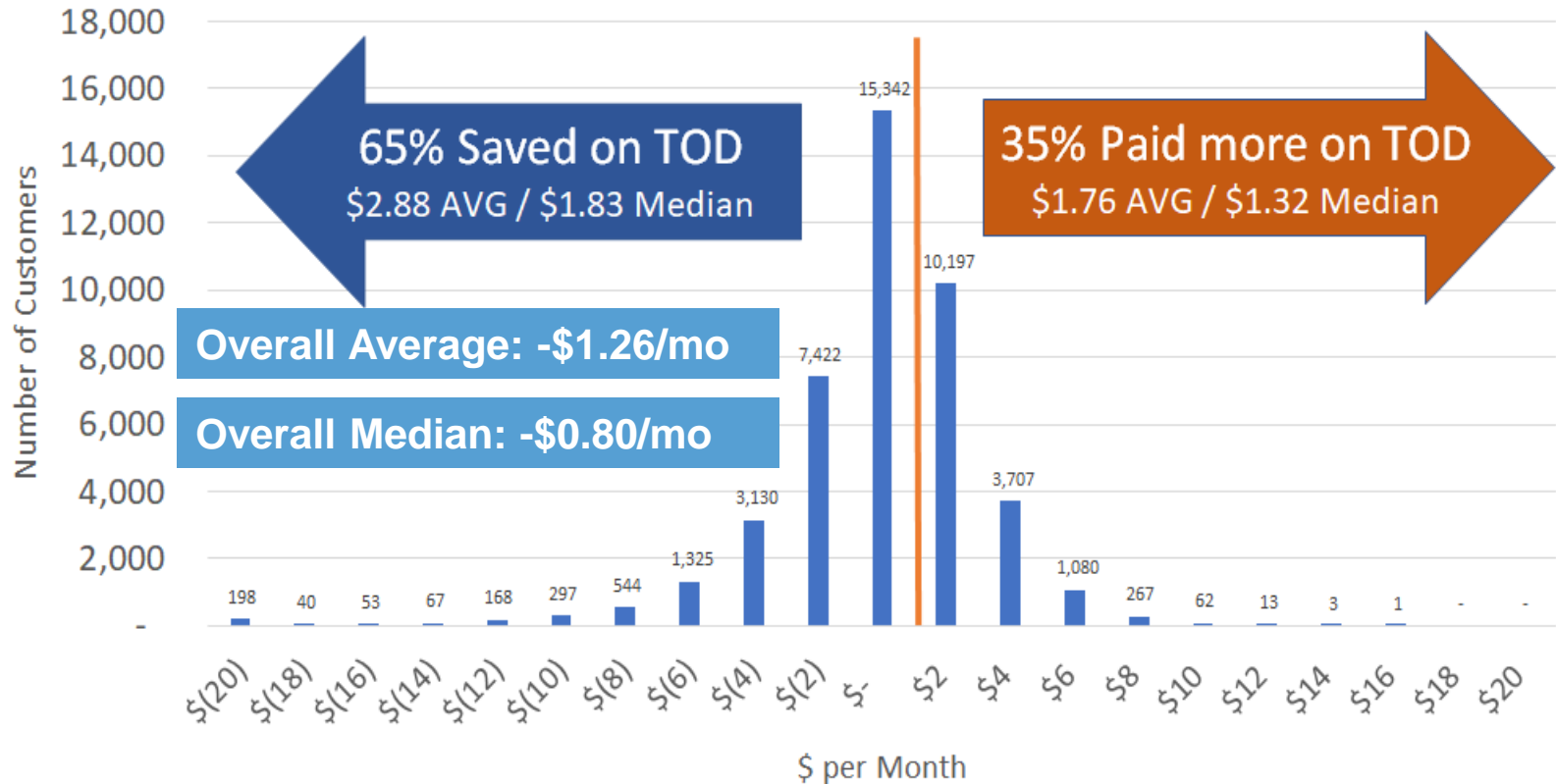
## Distribution of Average Monthly Bills



Compared to previous tiered rate

# Year One Results Summary

## Gas-Heated Homes



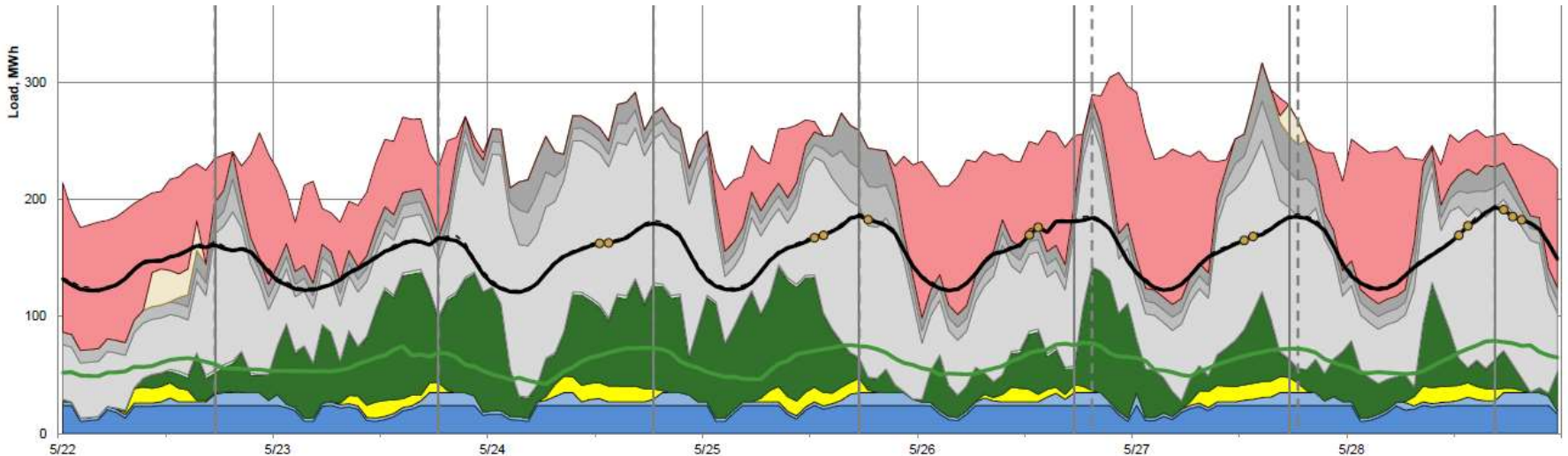
**Are residential customers still realizing the expected benefits of the TOD rate structure?**

	Pilot	2019	2020
Customer Bill Savings *			
Gas Heated (TOD w/ Tier)	\$1.38	\$1.26	\$1.43
Electric Heated (TOD only)	\$2.58	\$3.51	\$4.68

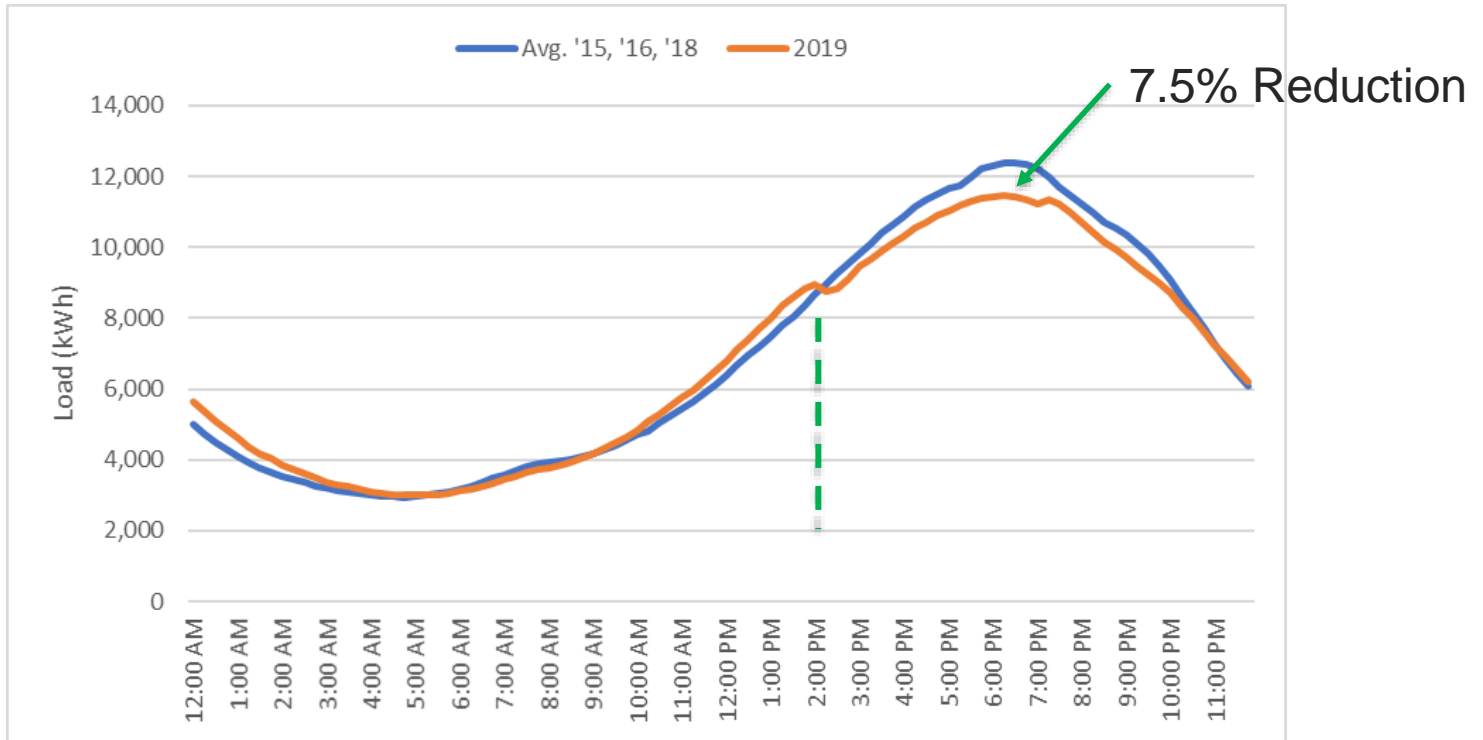
\* Compared to what they would have paid escalating the previous 3 tiered rate structure forward.

# TOD Energy and Demand Results

- Direct comparison of peak loads
- Traditional weather normalization
- (New) Hourly matching method



# Direct Comparison - Peak Load Day

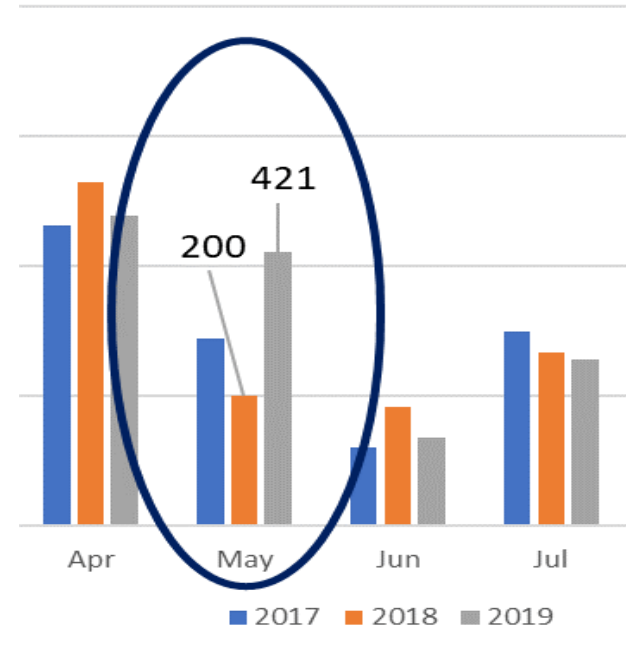


(15-min Load from 18k Premise Set)



- Traditional weather-normalization
  - Monthly degree days
- Results
  - **3.5% to 5% reduction** in overall electricity use
  - **Up to 10% reduction** in peak hours electricity use

Degree Days



# Weather-Adjusted Savings - Hourly Matching

## **An Analysis of Time-of-Day Electricity Rate Impacts Using Hourly Matching of Pre and Post-Period AMI Data in Fort Collins, Colorado**

*John Phelan, City of Fort Collins Utilities*

*Wendell Stainsby, Gerald P. Duggan, Department of Systems Engineering, Colorado State University*

*Pablo Bauleo, Michael Authier, Leland Keller, City of Fort Collins Utilities*

## Data Sources

- AMI data (15 minute)
- Weather data (10 minute)
- Premise data (utility)
- Property data (county)

## Site Filtering

Table 2. Exclusion of residential premises

Total Residential Premises	60,741
Rooftop Solar and/or Batteries	1,546
Part of TOD Pilot Study	7,078
Peak Partners DR Programs	4,245
Community Solar Subscribers	211
Premises with Electric Heat	6,030
Premises with Occupancy Change	33,309
<b>Remaining Premises</b>	<b>18,247</b>

Empirically derived parameters for load model

<b>Bin Parameter</b>
Temperature
Solar Irradiance
Yesterday High Temperature
Overnight Low Temperature
Solar Irradiance
Hour of Day (hours 4-20)
Hour of Day (hours 0-3, 21-23)
Day of Year

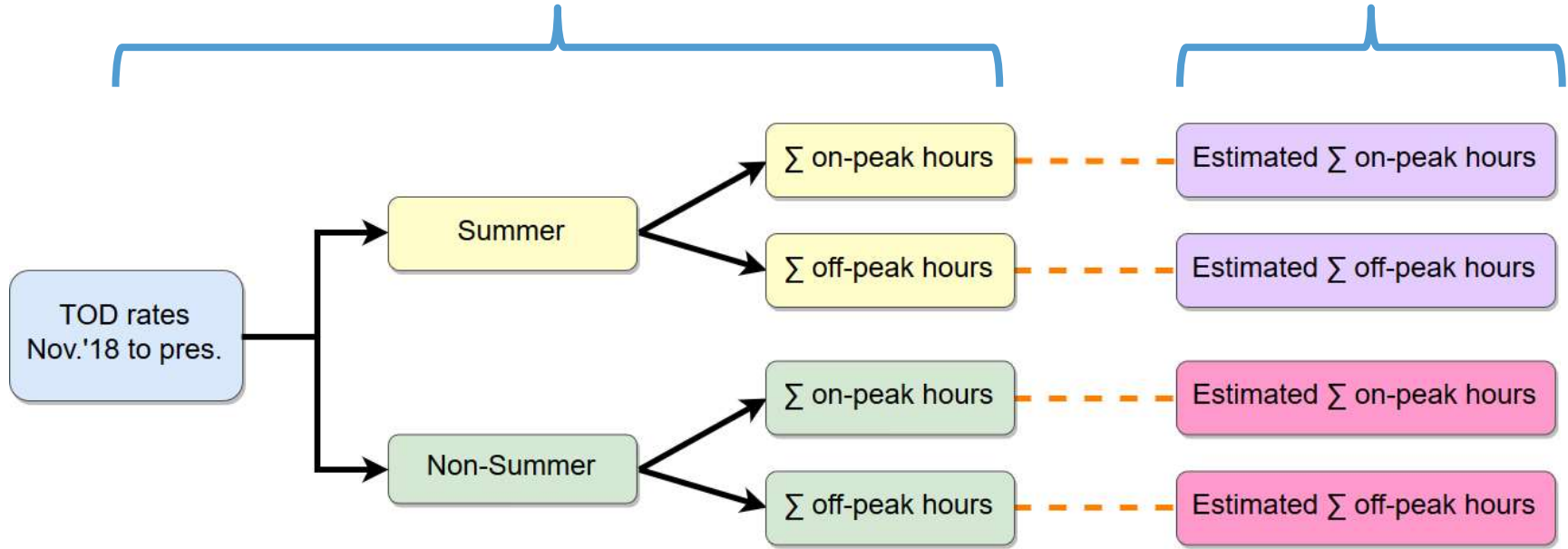


Comparing Similar Periods

# Comparing Delivered Energy

## AMI Data Extraction (Actual)

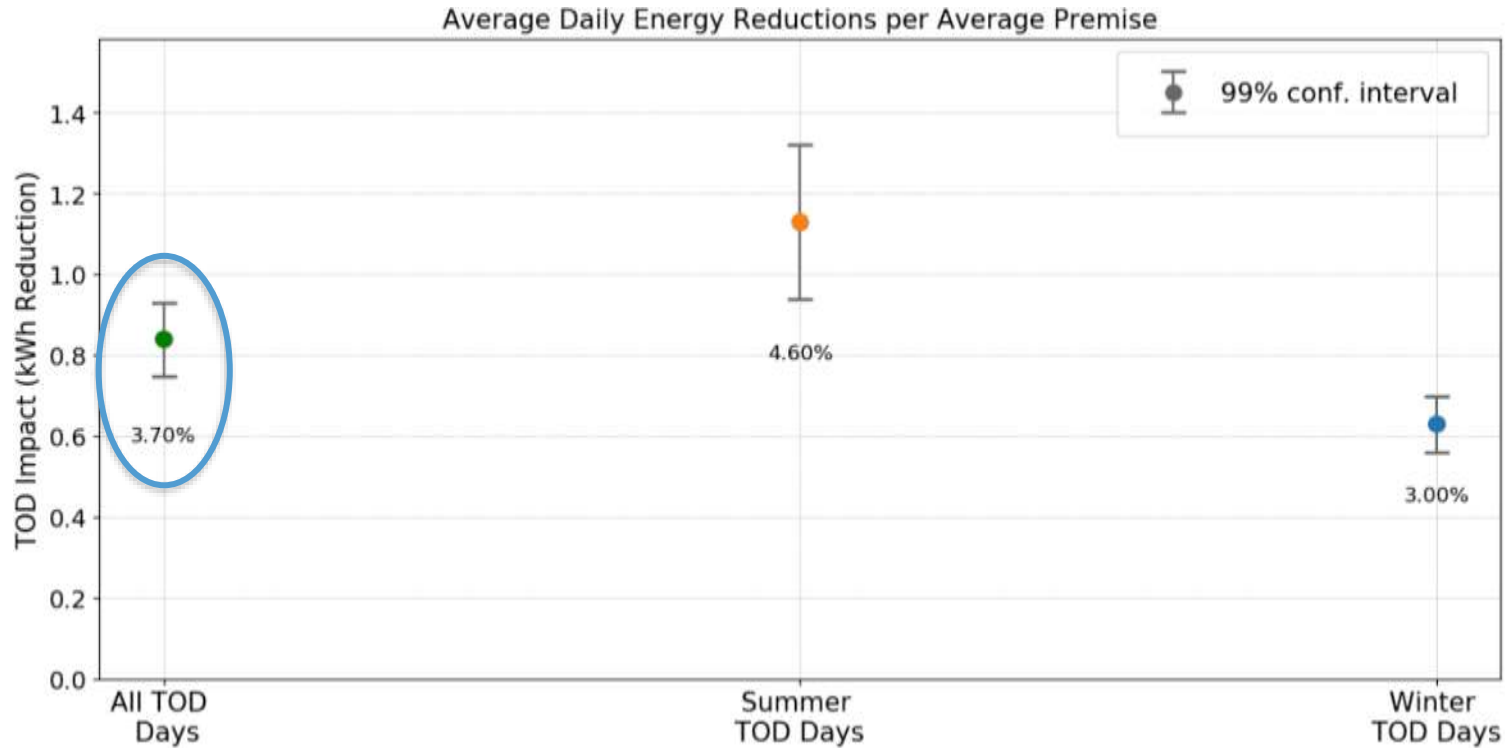
## Timestamp Model (Expected)

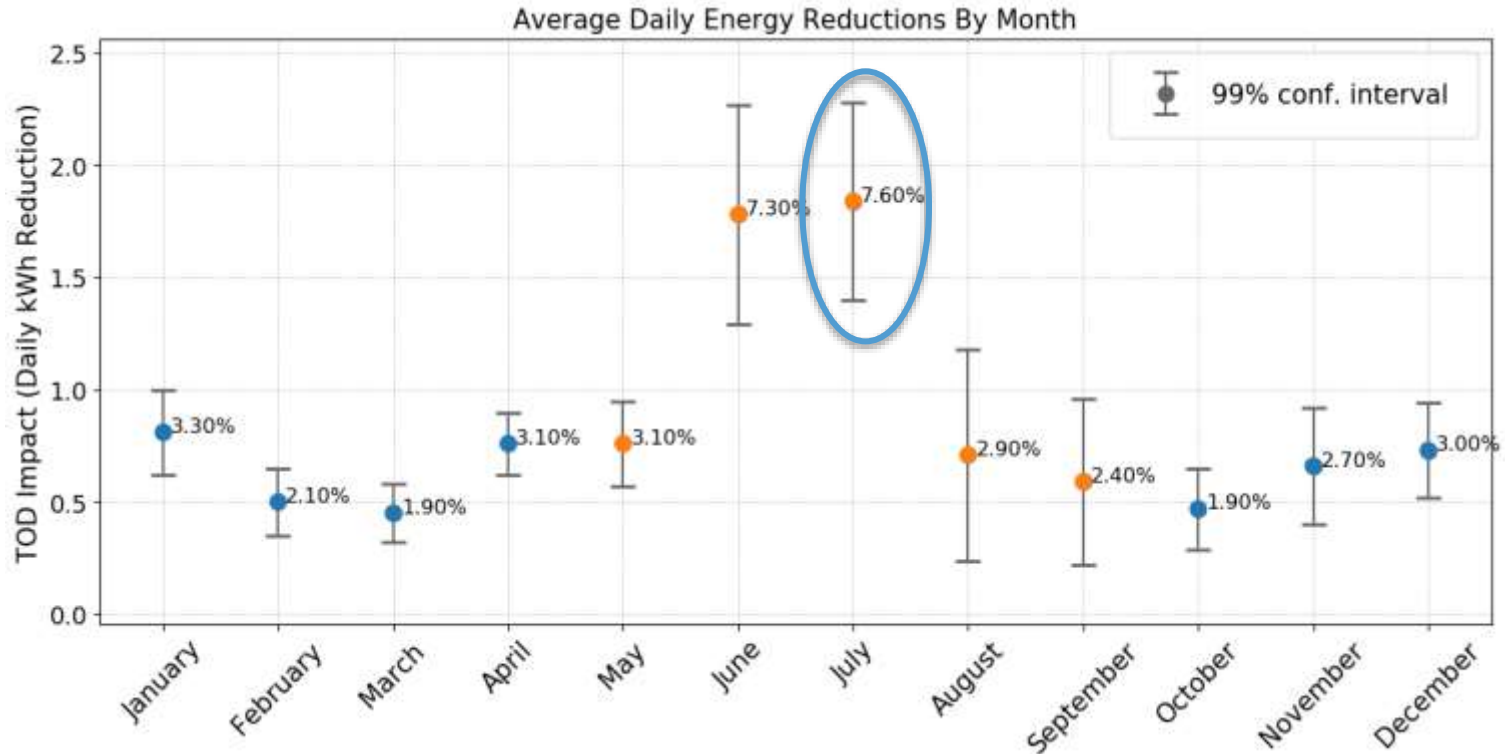


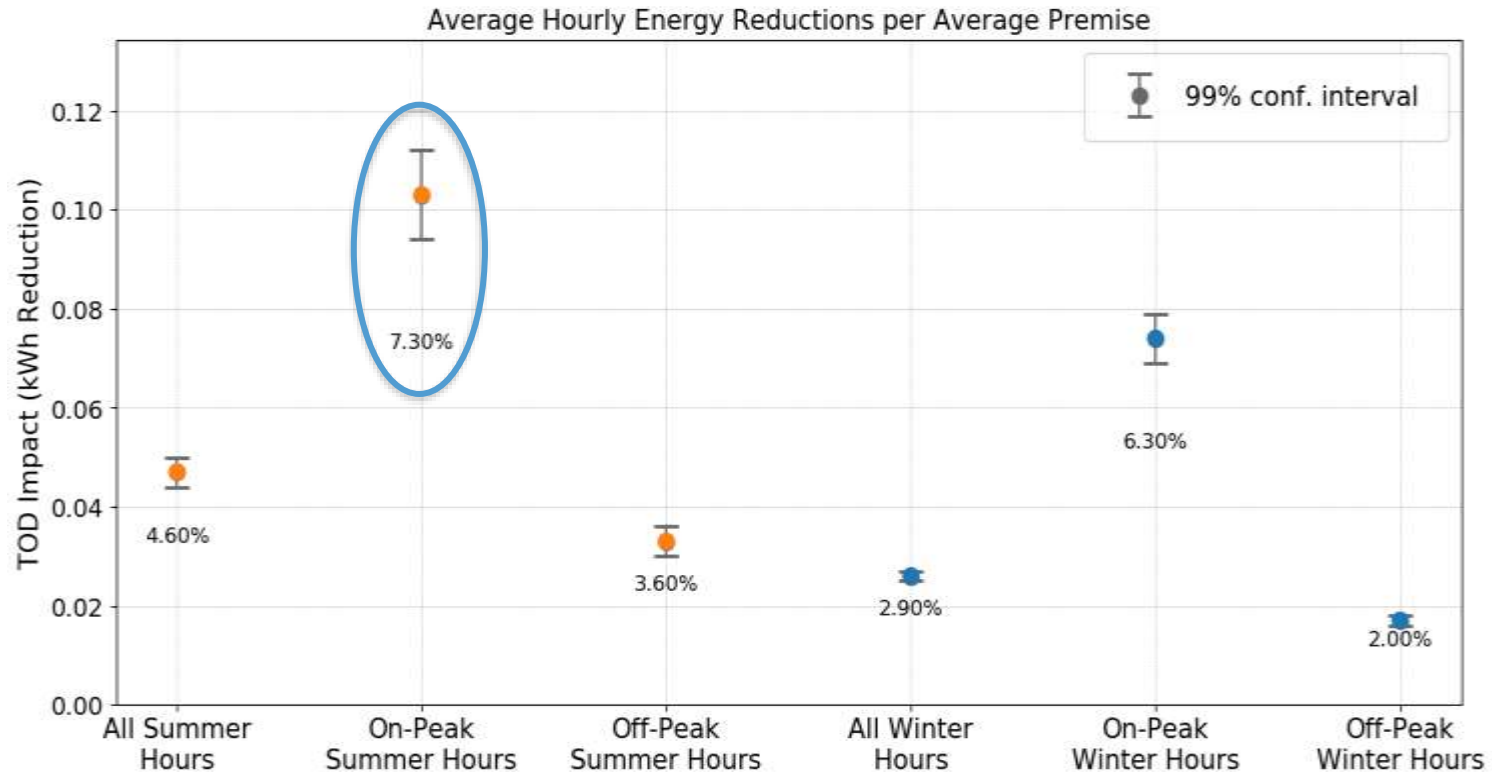


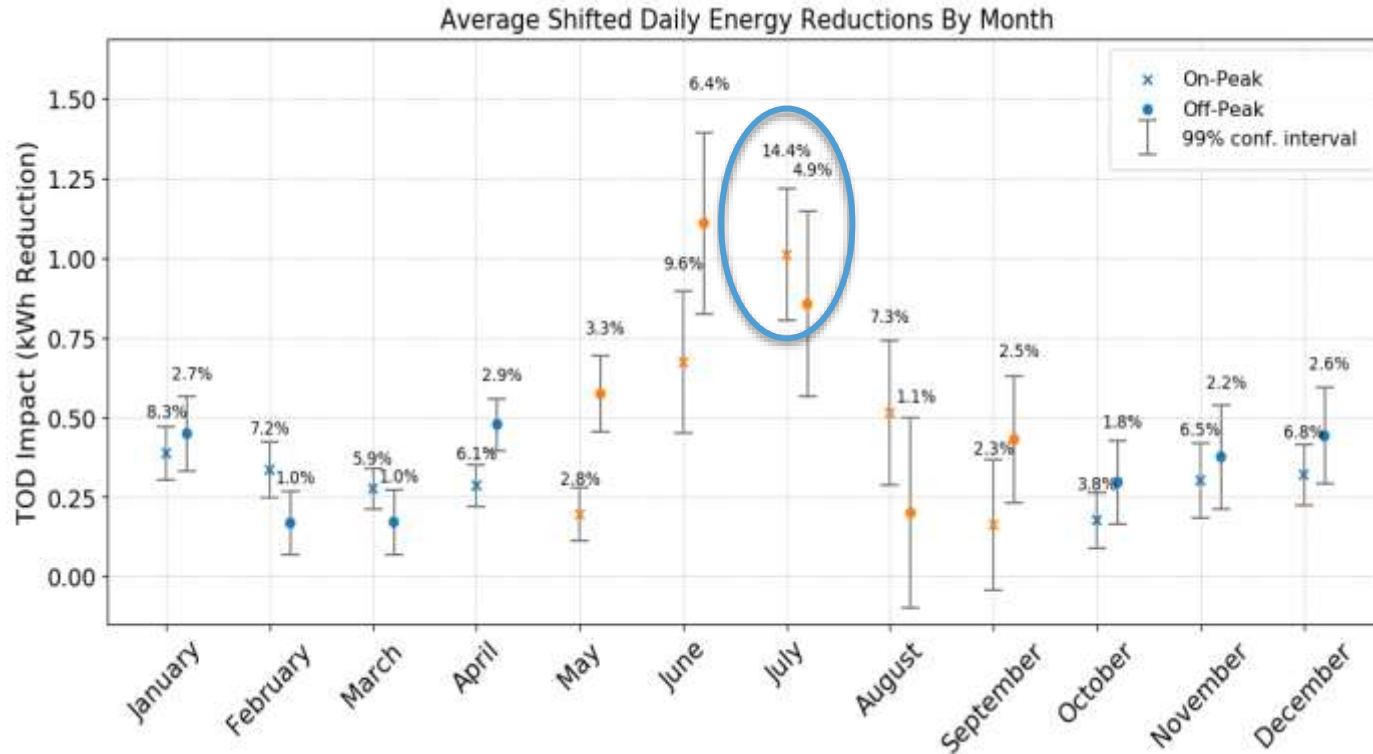
- Daily Aggregation
  - Pre-TOD days versus post-TOD days (all, summer, winter)
  - Daily TOD Reductions by Month
- Hourly Aggregation, Seasonally and by On- and Off-Peak Periods
  - Pre-TOD hours versus post-TOD hours
    - Summer – all, on-peak, off-peak
    - Winter – all, on-peak, off-peak
- By month, on- and off-peak
  - Daily and hourly aggregation





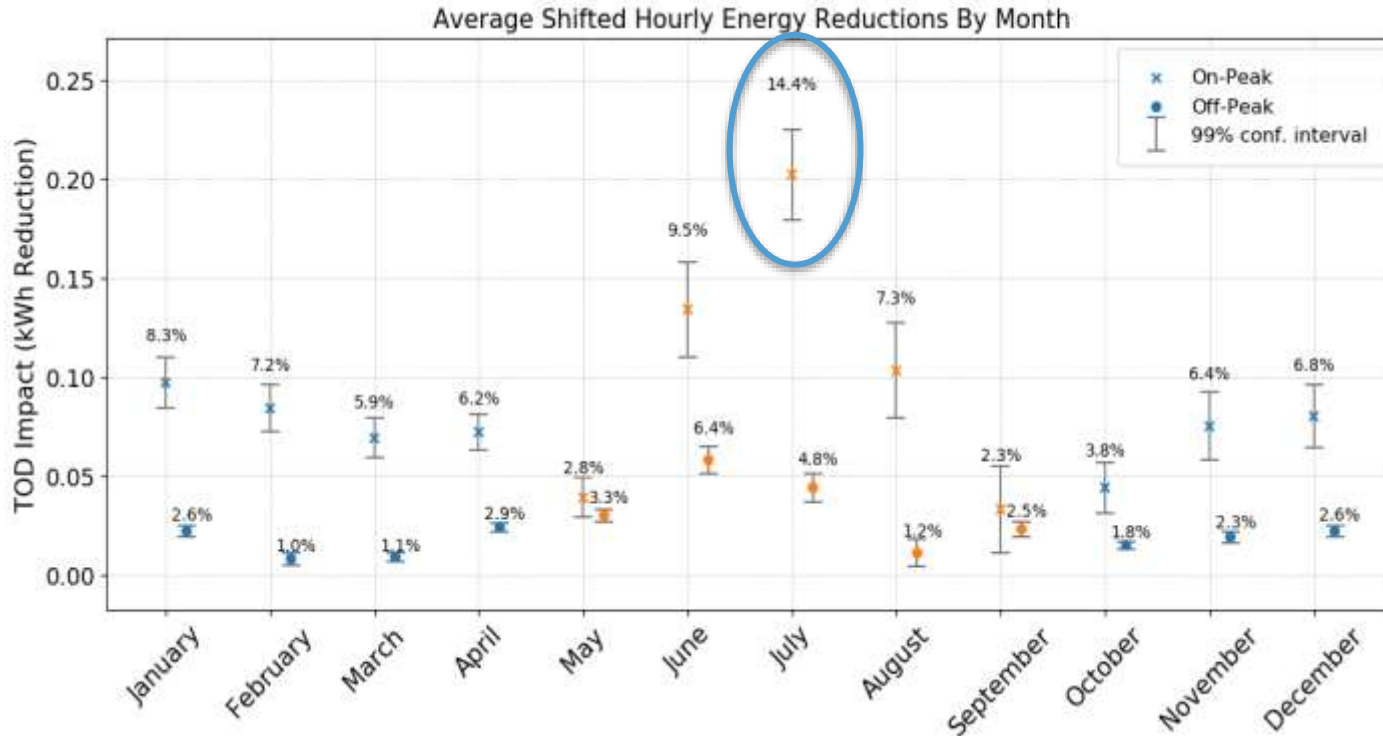







By month, on- and off-peak

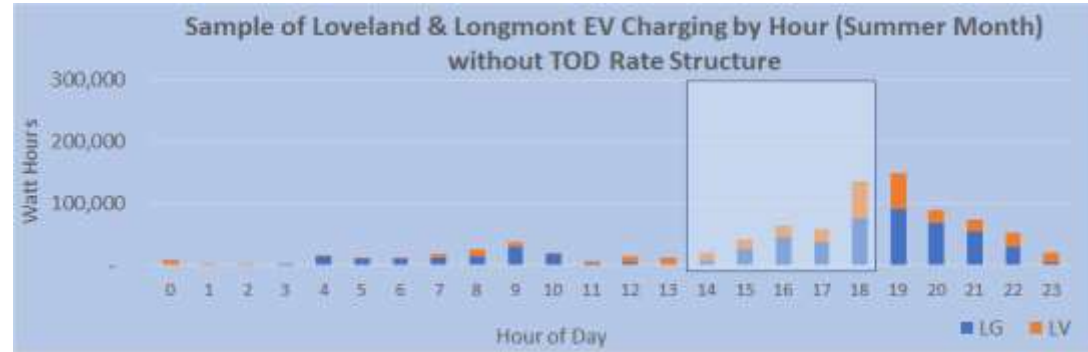
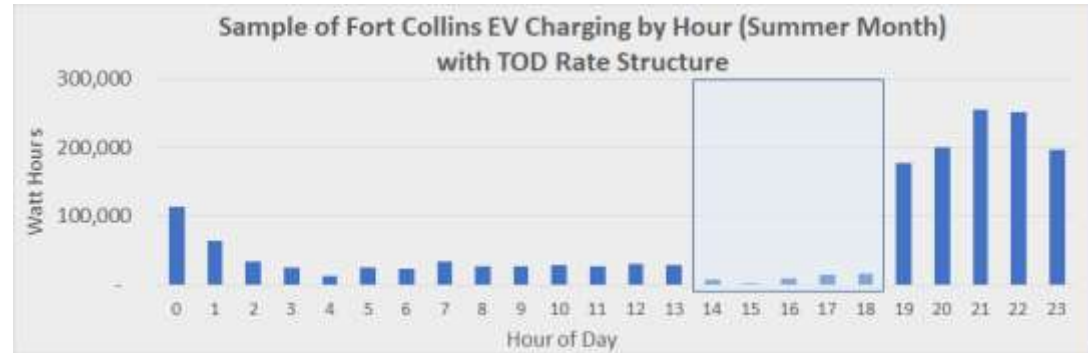




# TOD Energy and Demand Results Summary

- Time of Day rate change resulted in significant impact on residential electricity consumption
  - Year over year reduction of 2.5%, peak demand shift of 7.5%
  - Two-thirds of customers saved on annual bills
  - Traditional weather normalization increases savings (5%/10%)
- Hourly matching approach shows 3.7% energy savings, 7.3% peak shift
  - Allows analysis of hourly, daily and seasonal analysis
  - Further building segmentation possible

- EV owners recognize off-peak charging savings
- Demand response
- Shift to opt-out daily electric water heater control
- Battery adoption 



- Continued education and outreach
- Refining rate components to reflect ongoing changes in usage patterns and costs
- Report ongoing TOD observations
  - E.g. Low use all electric customers in 2020
- Adapt programs and services to emphasize grid flexibility



# Thank You

John Phelan

[jphelan@fcgov.com](mailto:jphelan@fcgov.com)

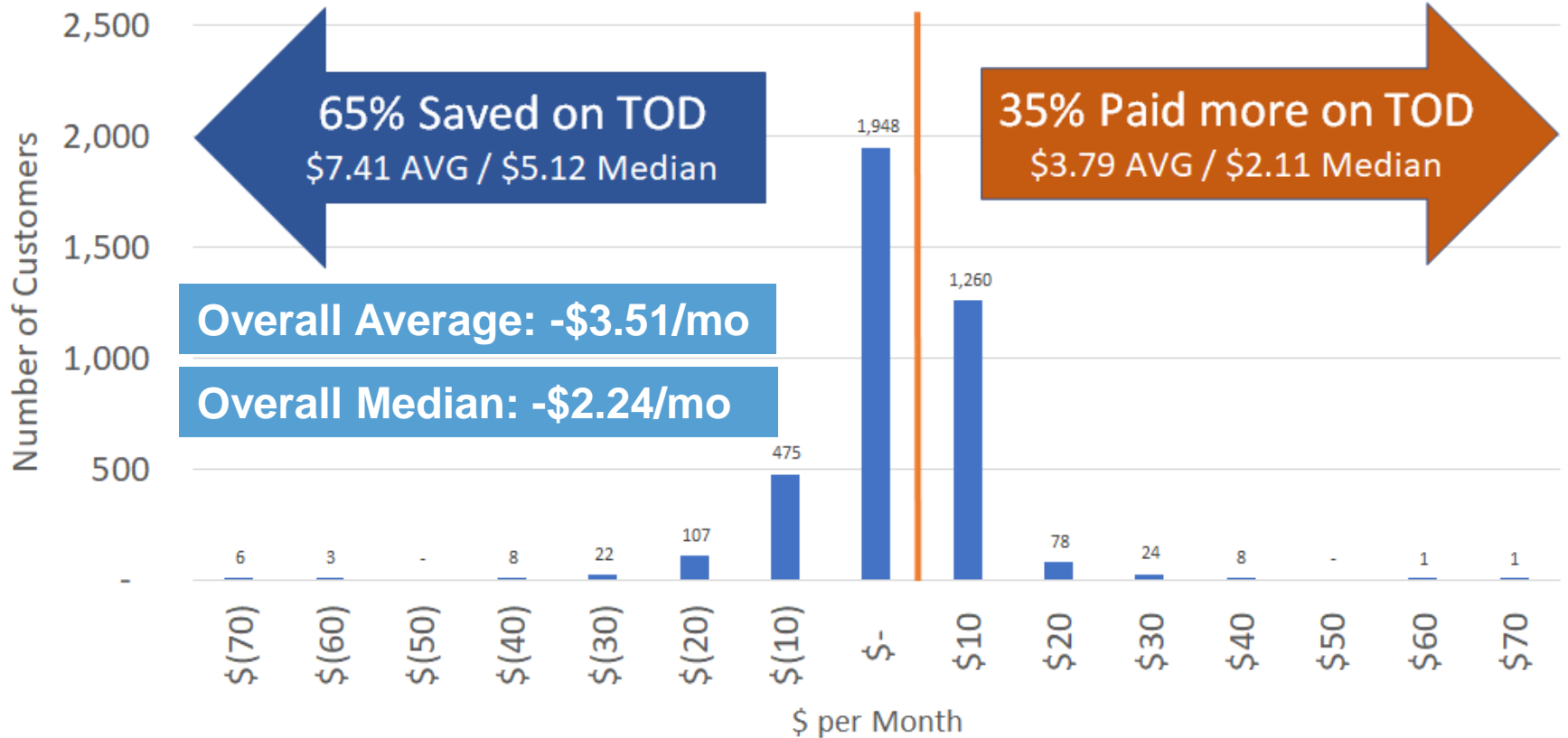


# Backup Content



# Year One Results Summary

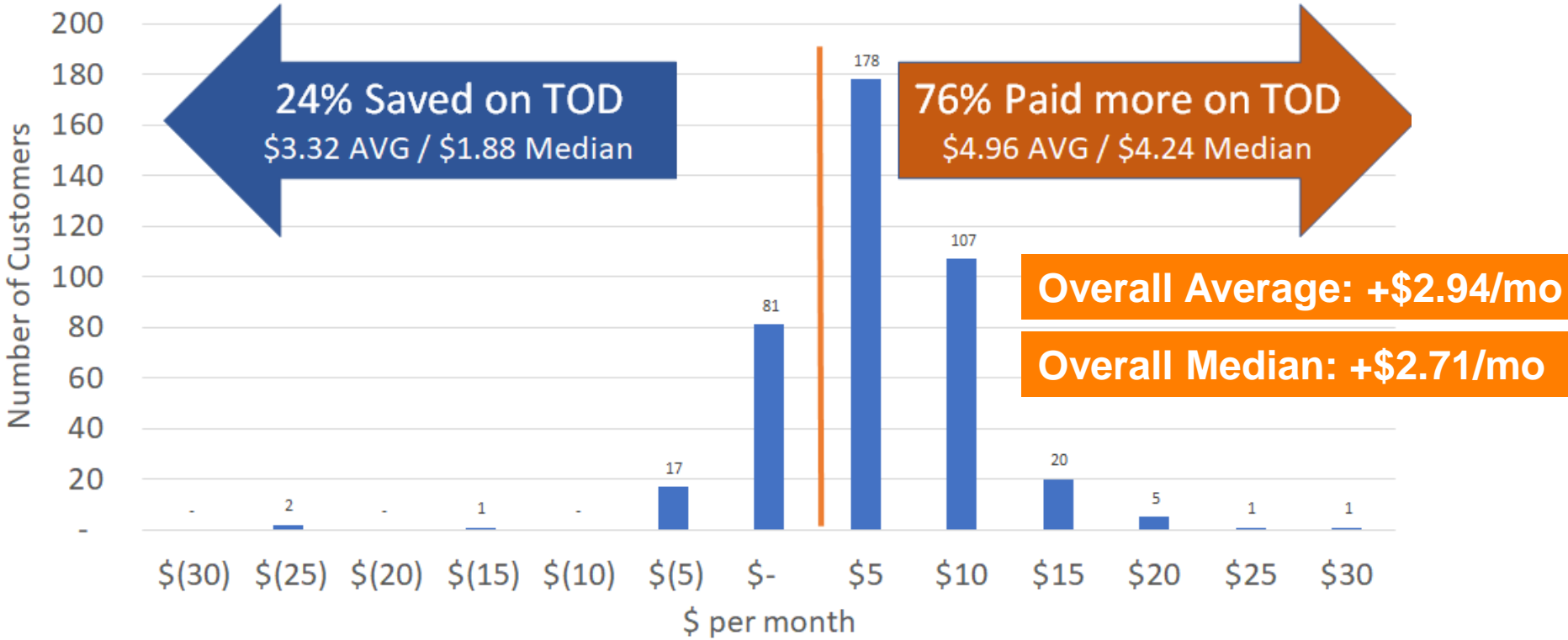
## All-Electric Homes



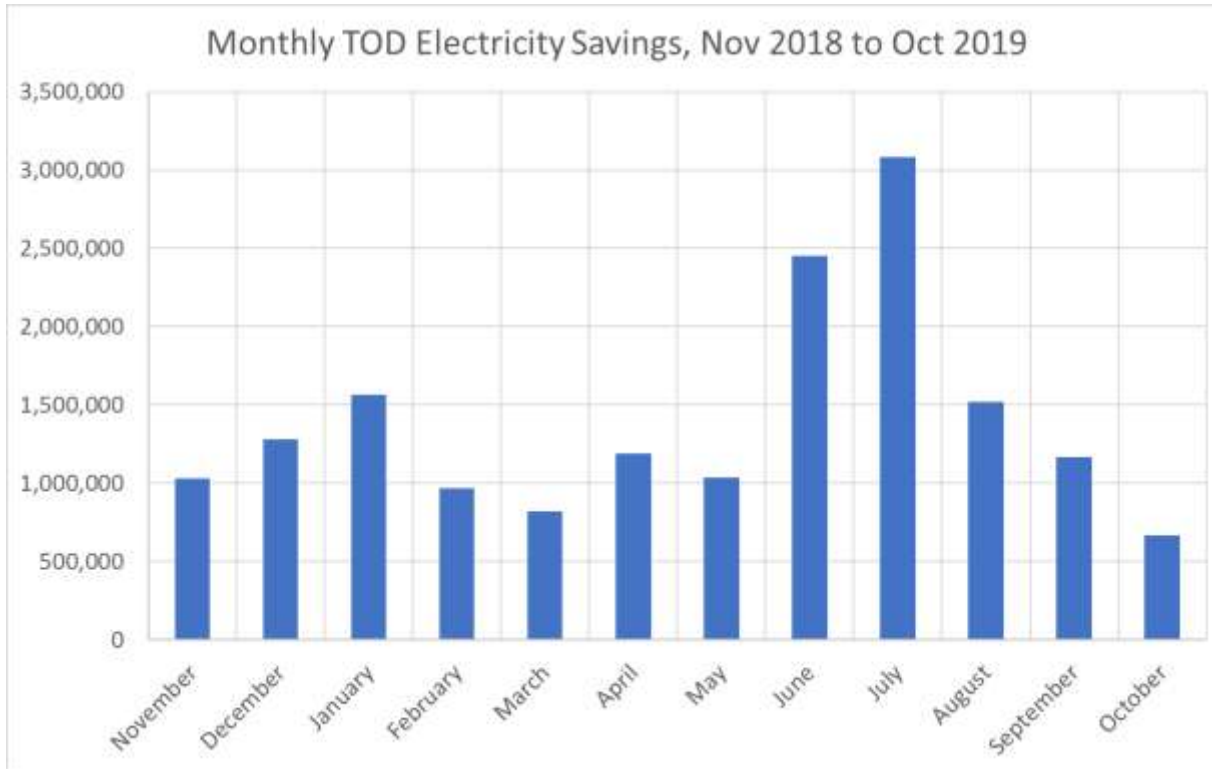


# Year One Results Summary

## Solar Customers (Gas-Heat)



# Year One Monthly Energy Savings

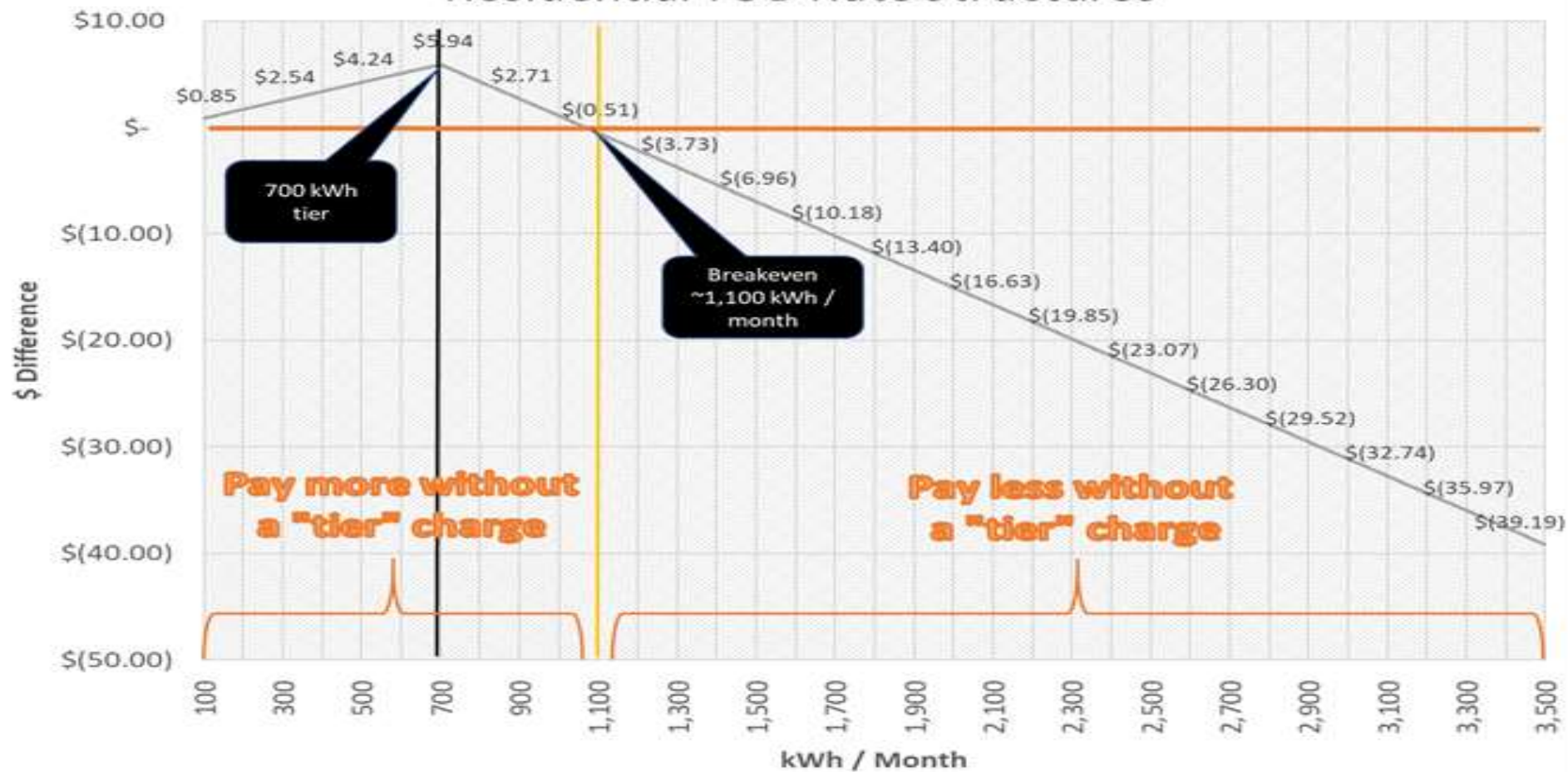


# 2020 Shift in Energy Use

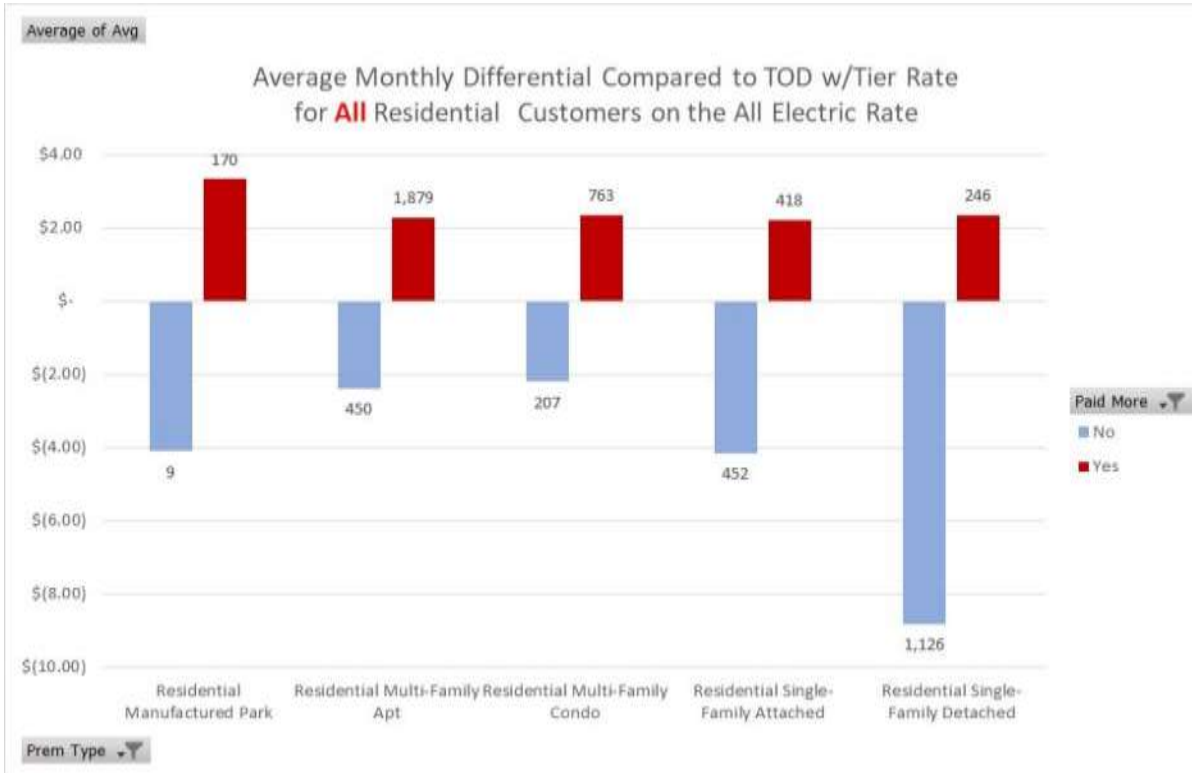
2020 over 2019

Rate Class	Energy	Revenue
Residential	4.1%	8.0%
TOD with Tier	5.2%	13.1%
All electric TOD	-1.2%	3.4%
Commercial	-7.6%	-3.9%
Industrial	-3.5%	-3.3%
Total	-1.8%	2.5%

# Cost Differences Between the Residential TOD Rate Structures



# Monthly Impact by Housing Type



## Energy Policy Report 2020 Annual Update



We can lead in ENERGY EFFICIENCY and RENEWABLES with HIGH RELIABILITY, AFFORDABLE BILLS and AWARD-WINNING PROGRAMS.

The Energy Policy reflects Fort Collins' values of reliability, affordability, safety, greenhouse gas emissions reduction, pollution prevention, environmental stewardship and energy independence. It is aligned with the Climate Action Plan (CAP) goals of 20% carbon reduction below 2005 levels by 2020, 80% by 2050 and carbon neutral by 2050. Read the full annual report at [fcgov.com/what-we-do](http://fcgov.com/what-we-do).

How do you fit in?

### COMMUNITY ENERGY USE

Per capita reductions from 2005



Electricity use per capita is the lowest it's been since 1986.

### SINCE 2005



Building square footage increased by 21%, but buildings are 11% MORE EFFICIENT.

### OUR IMPACT

Despite a growing population, efficiency programs have helped limit the increase in electricity use. It would be 15% higher without Utilities' programs.

Residential Efficiency Savings: 63M kWh

Business Efficiency Savings: 168M kWh



Fort Collins is designated a Smart Energy Provider by the American Public Power Association.



Learn more ways to conserve at [fcgov.com/consERVE](http://fcgov.com/consERVE)

### Energy Savings

Customer electricity savings from programs totaled 43M kWh (2.8% of the community's annual use), equivalent to taking 5,600 homes' electric use off the grid.



The average residential customer uses about 620 kWh per month (or 7,400 kWh per year).

Did you know?  
It is cheaper to save electricity with efficiency (14 cents) than it is to buy more electricity (62 cents).

### Reliability

With 99.9991% reliability, most residents did not experience an outage.

### Community Economics

Customer projects generated more than \$44M in local economic benefits through reduced utility bills, direct rebates and leveraged investments, and also supported 240+ JOBS.



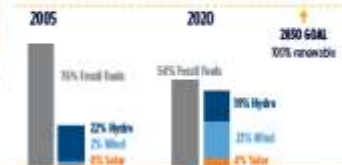
### Peak Usage

With Peak Partners, customers reduced demand by 1,000 kW during peak times.

### Electricity Carbon Emissions

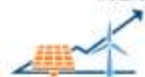


### Electricity Supply



### Local Renewables

Installed 454 new renewable energy systems, adding 3,200+ kW.



1.4% of electricity came from local renewables.

### Time-of-Day Rates

65% of residential customers saw a decrease in annual electric bills with TOD pricing.



The average monthly bill was \$1.43 lower.

### LOOKING FORWARD

#### Our Climate Future

With people at the center of our work, we'll discover what's possible as we strive toward our energy and climate goals.

You are part of the solution. Get engaged at [fcgov.com/OurClimateFuture](http://fcgov.com/OurClimateFuture).

