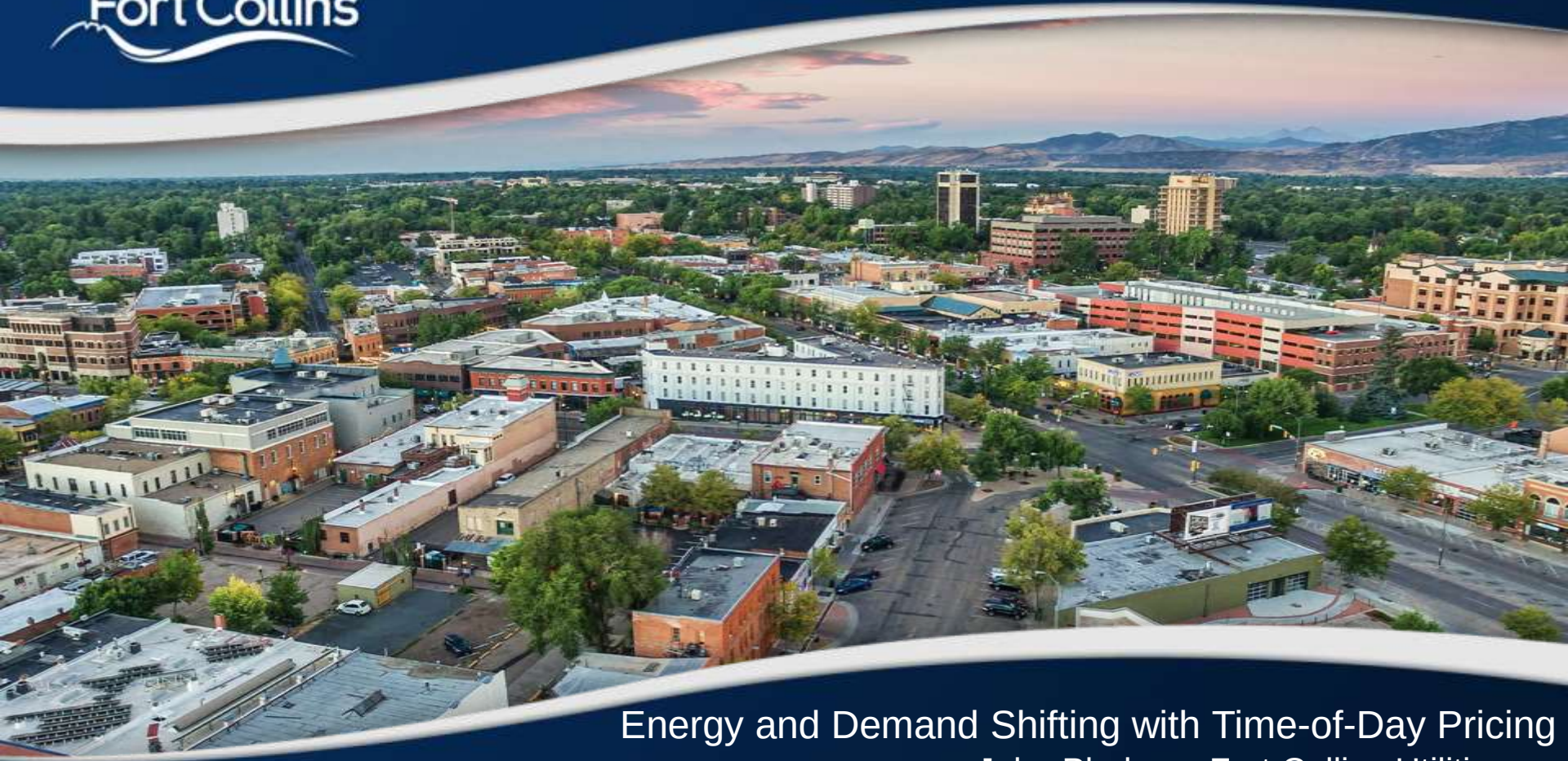
Utility Energy Forum

August 20, 2021

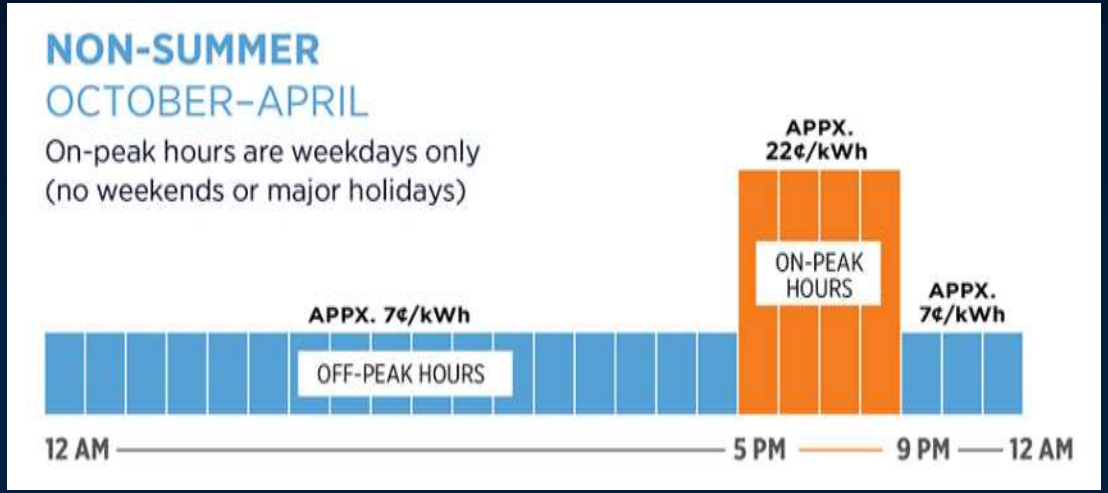


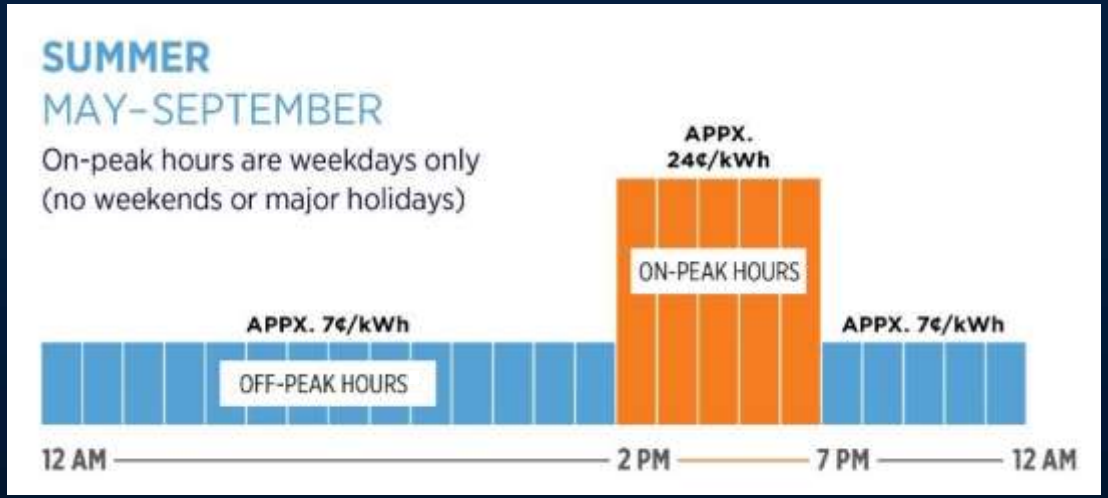
Energy and Demand Shifting with Time-of-Day Pricing

John Phelan – Fort Collins Utilities

Outline

- 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





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

Why TOD?

FAIR & EQUITABLE STRUCTURE

MORE CUSTOMER CONTROL

LOWER PEAK DEMANDS & COSTS

ENERGY & CARBON SAVINGS

ELECTRIC VEHICLE FRIENDLY

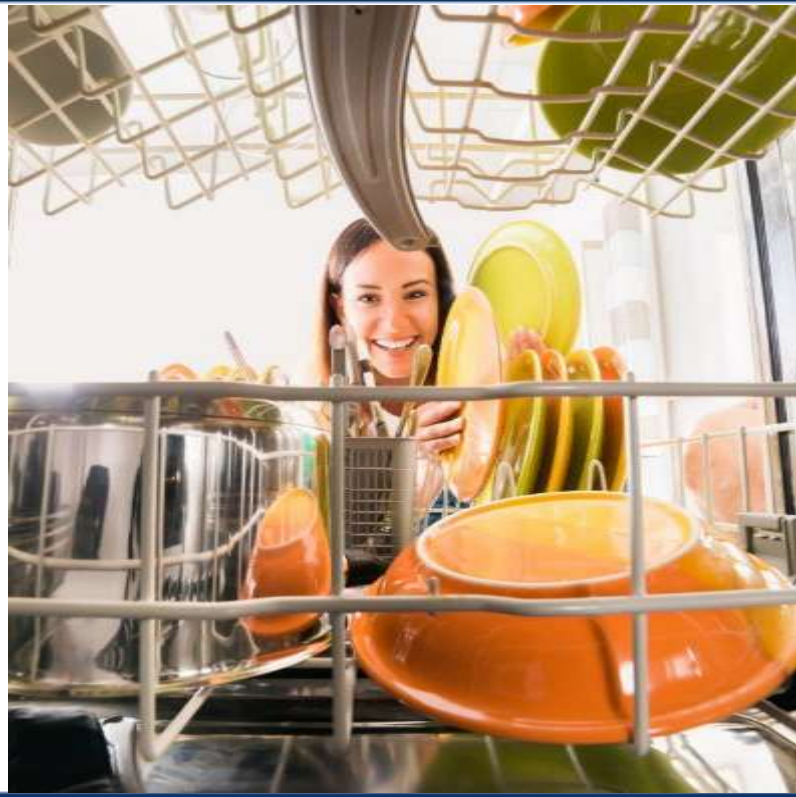
Customer Outreach

- 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

TOD Financial Results

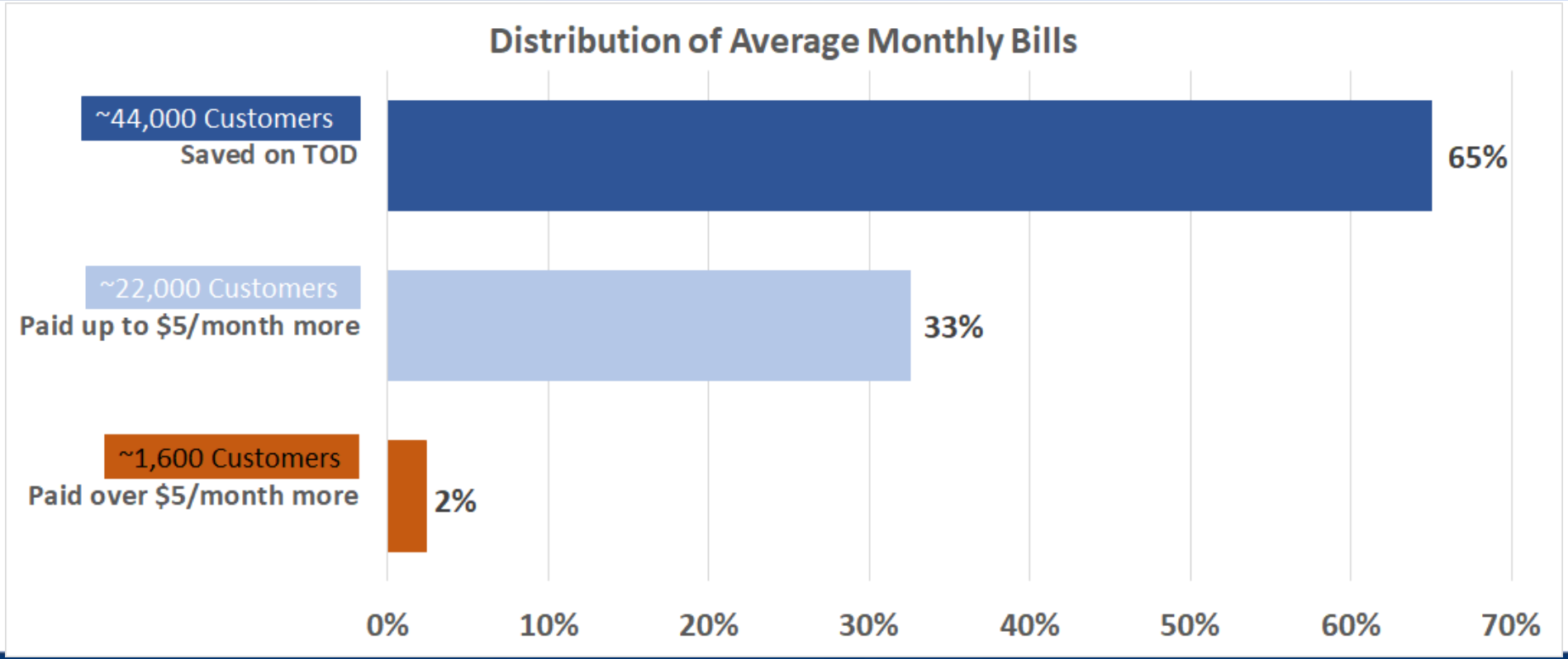
Year One Results Summary (2019)

- **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



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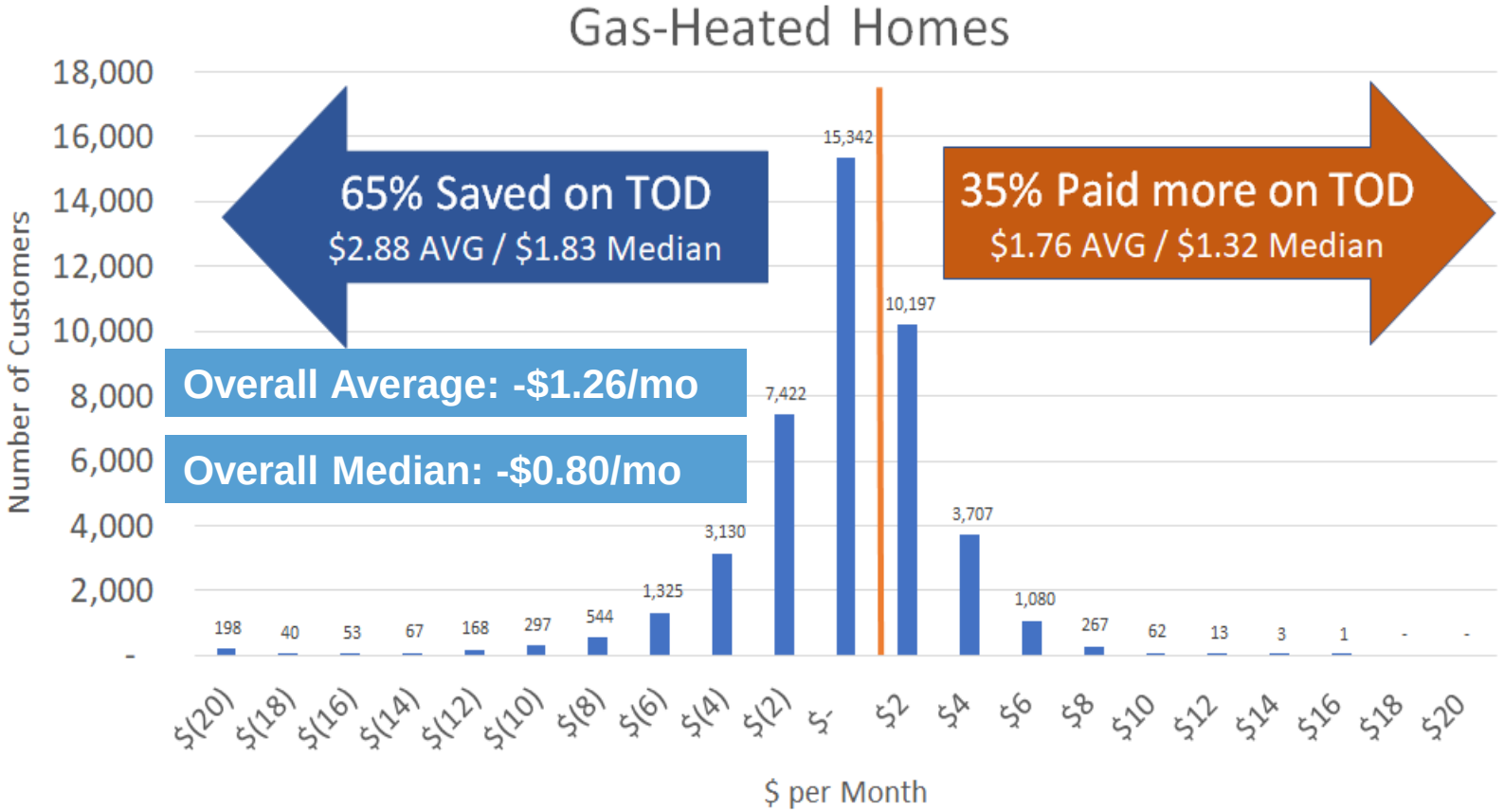


Benefits to Customers

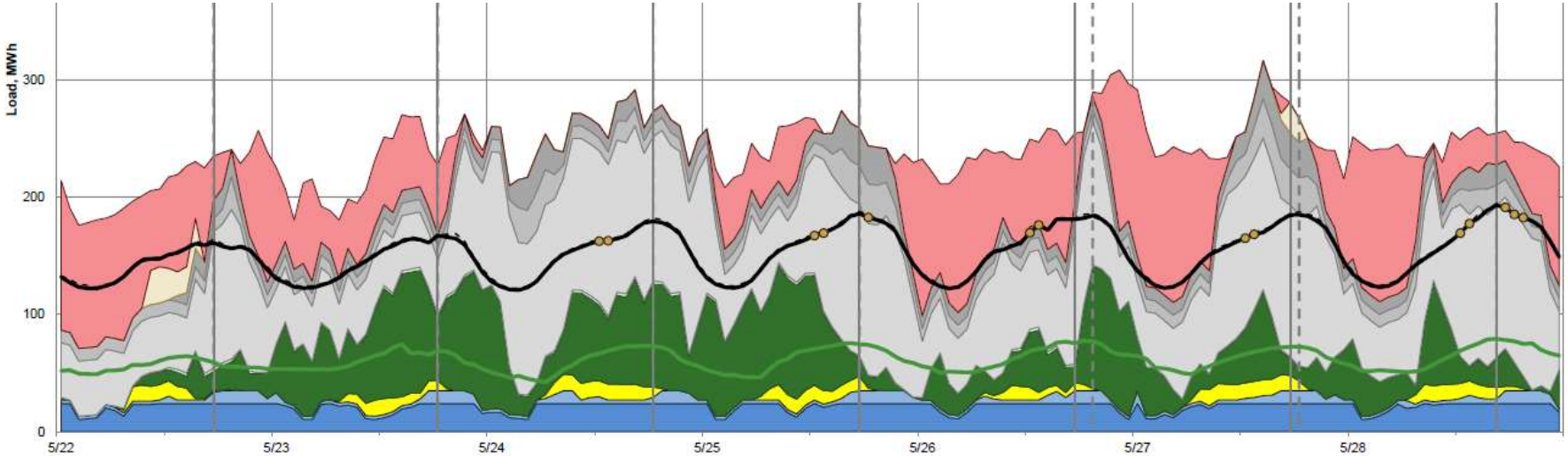
Are residential customers still realizing the expected benefits of the TOD rate structure?

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

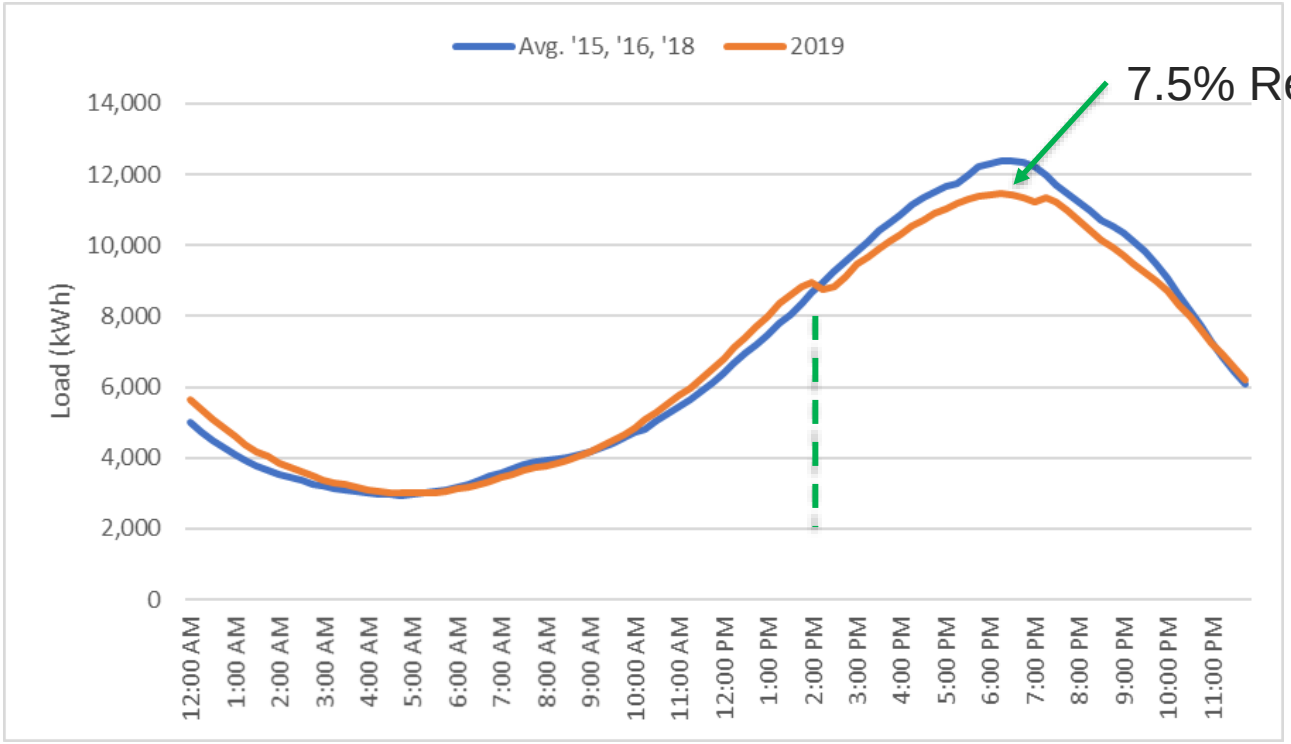
* Compared to what they would have paid escalating the previous 3 tiered rate structure forward.

TOD Energy and Demand Results

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



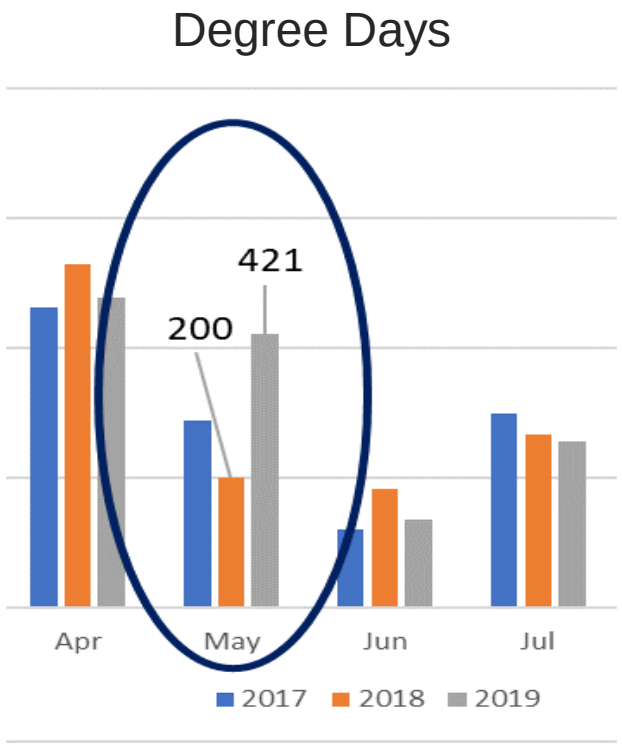
Direct Comparison - Peak Load Day



(15-min Load from 18k Premise Set)

Weather-Adjusted Savings

- 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



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

https://aceee2020.conferencespot.org/event-data

Hourly Matching – Data Sources

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
Remaining Premises	**18,247**

4 per hour * 8,760 hrs. * 5 yrs. * 18,250 prems ≈ 3.2 billion records

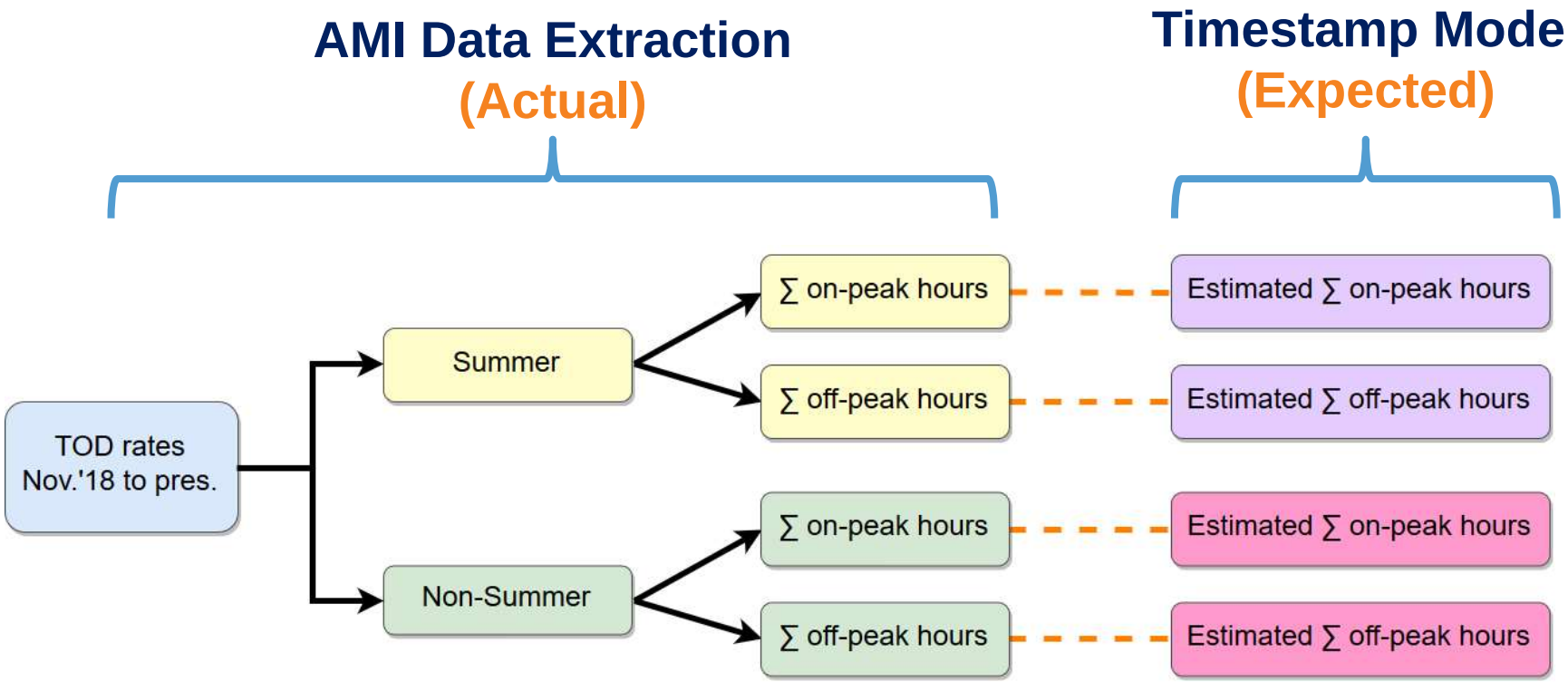
Hourly Matching – Model Parameters

Empirically derived parameters for load model

Bin Parameter
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

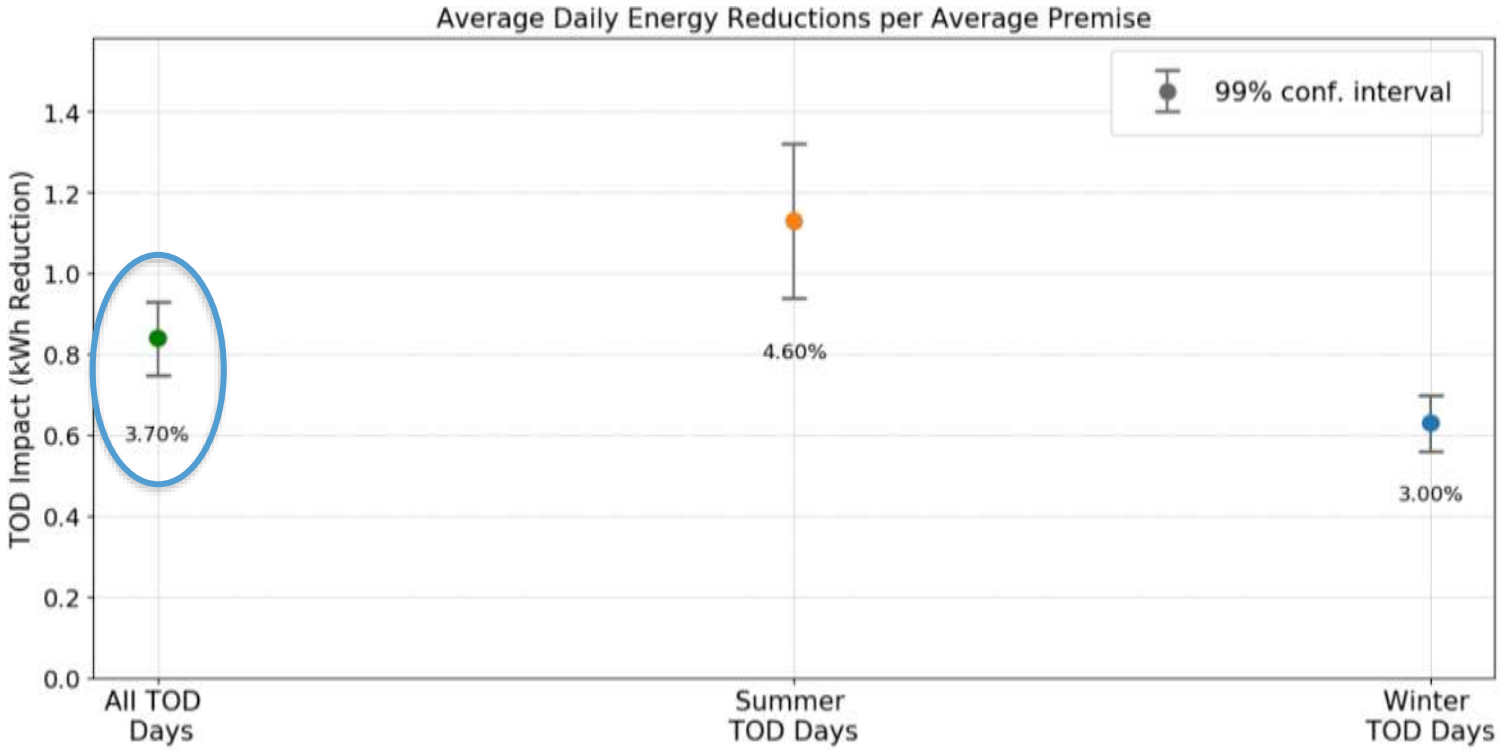
Comparing Delivered Energy



Results

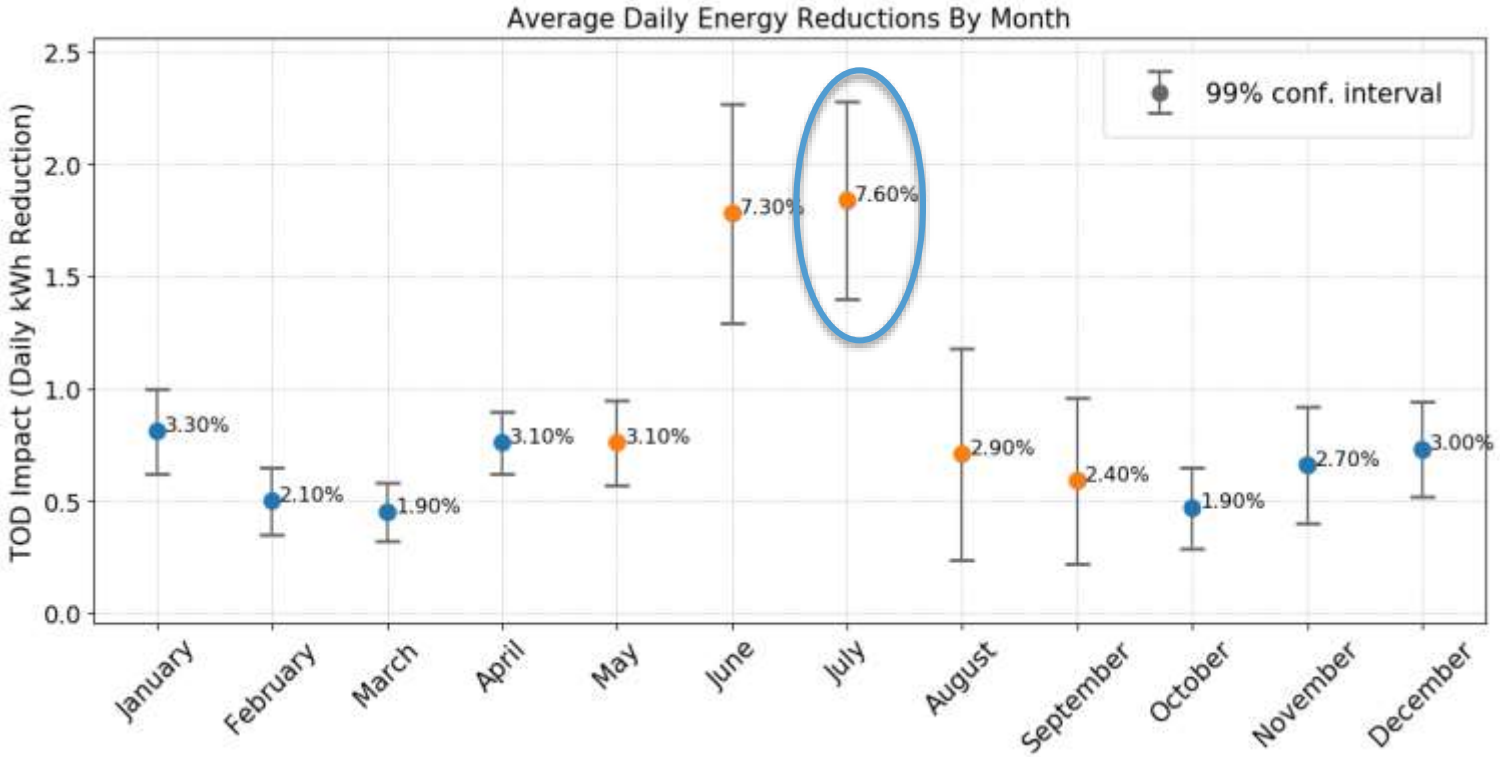
- Daily Aggregation
    - Pre-TOD days versus post-TOD days (all, summer, winter)
    - Daily TOD Reductions by Month
- Hourly Aggregation, Seasonally and by On- and Off-Peak Periods
    - Pre-TOD hours versus post-TOD hours
        - Summer – all, on-peak, off-peak
        - Winter – all, on-peak, off-peak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

Daily Aggregation



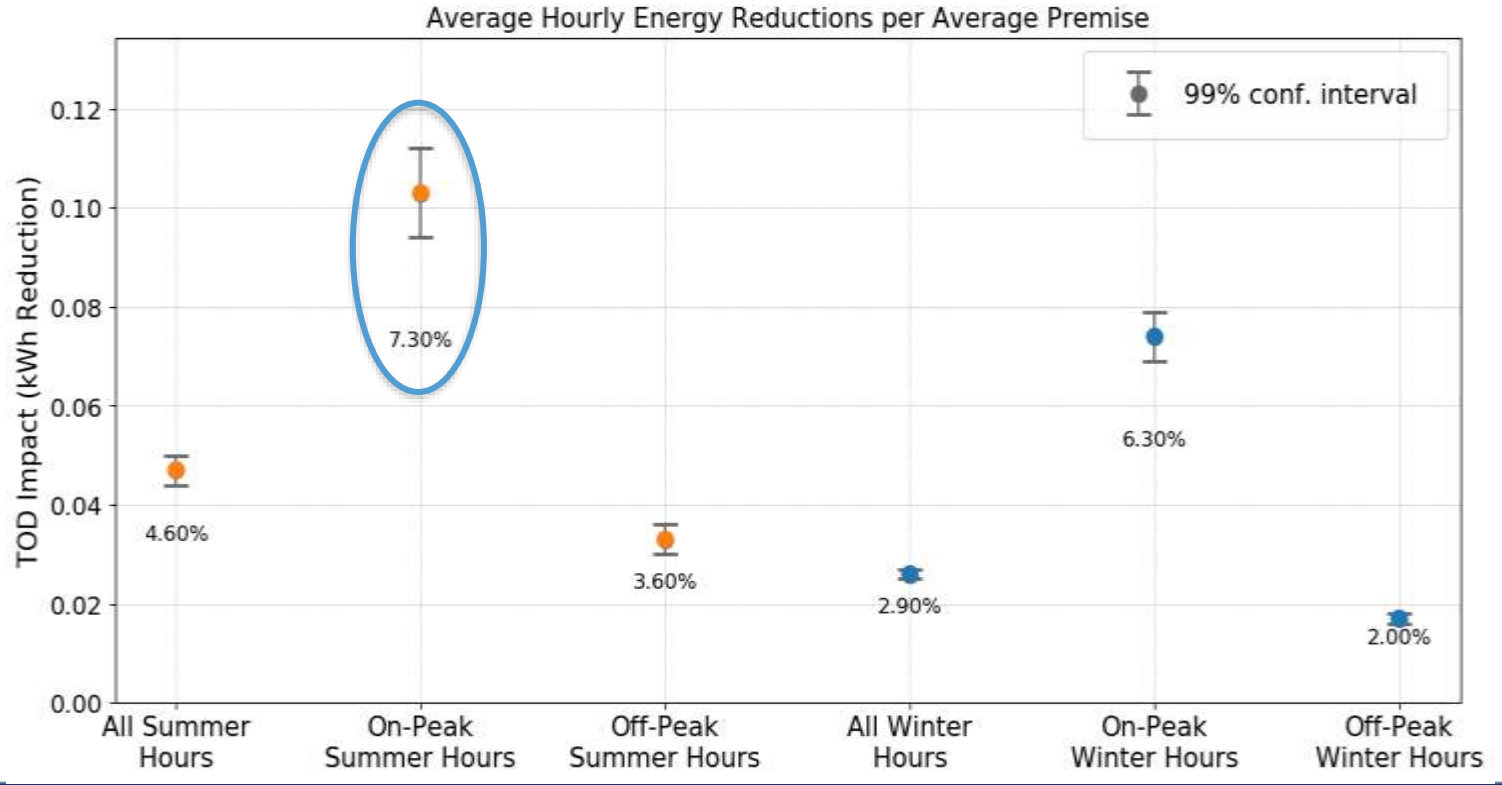
Pre-TOD days versus post-TOD days (all, summer, winter)

Daily Aggregation



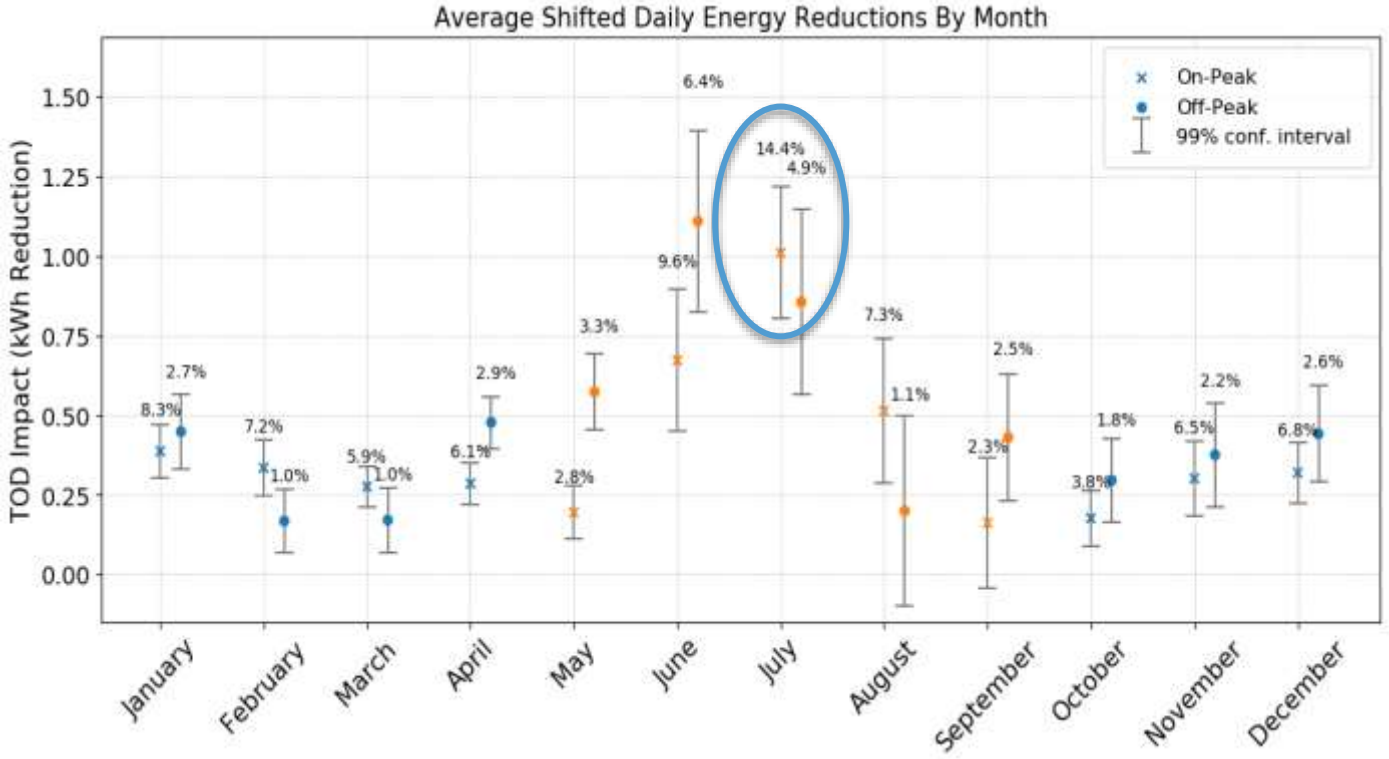
Daily TOD Reductions by Month

Hourly Aggregation



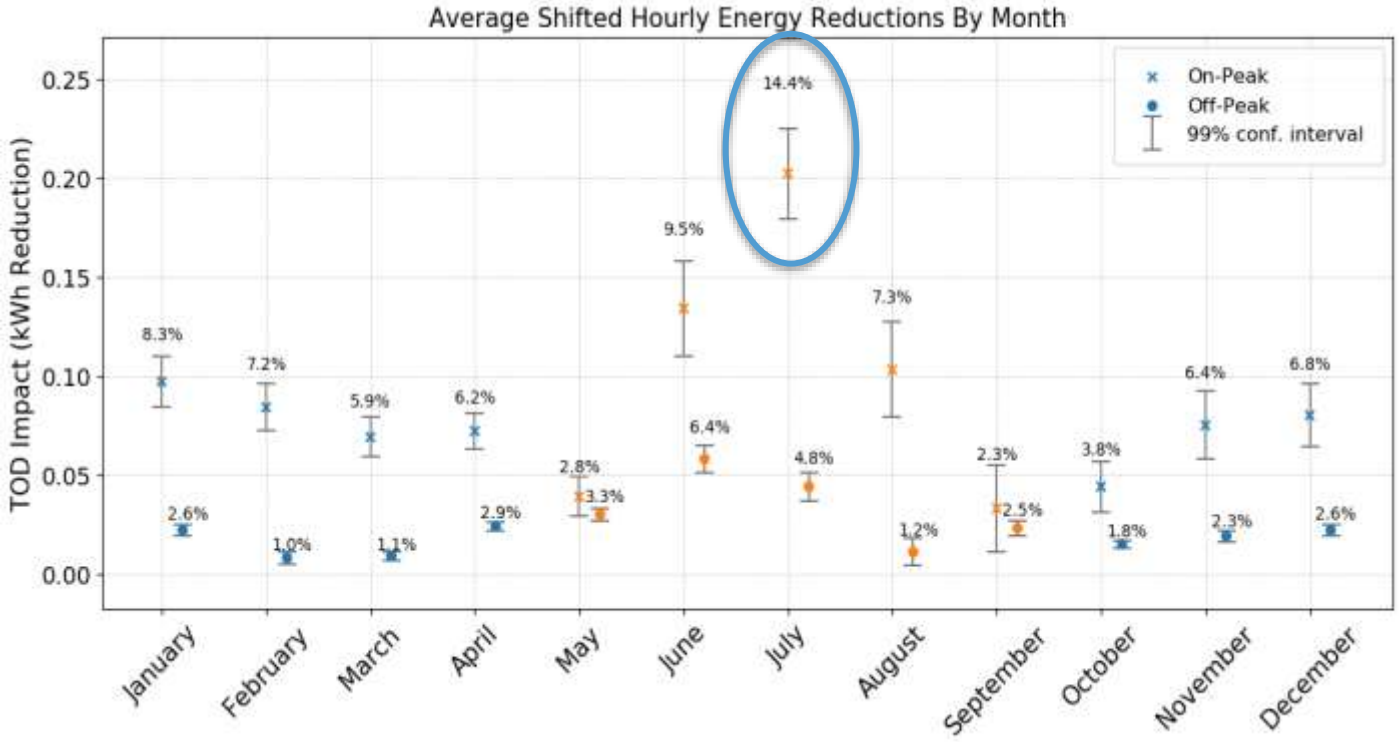
Summer and winter – all, on-peak, off-peak

Daily Aggregation



By month, on- and off-peak

Hourly Aggregation



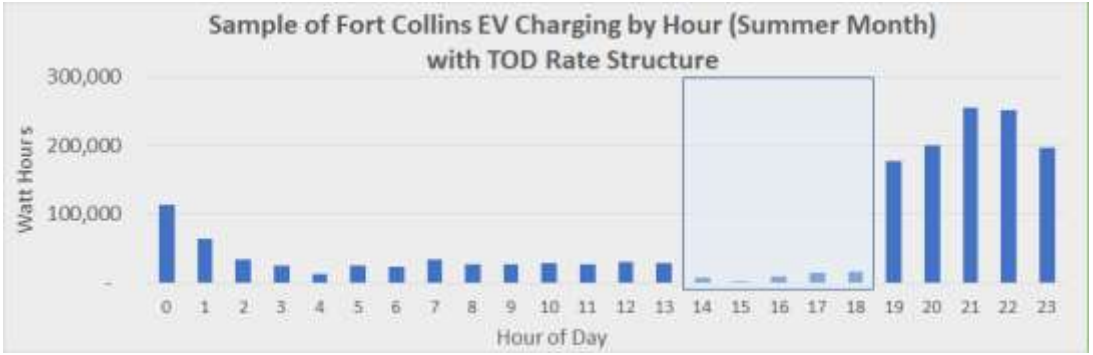
By month, on- and off-peak

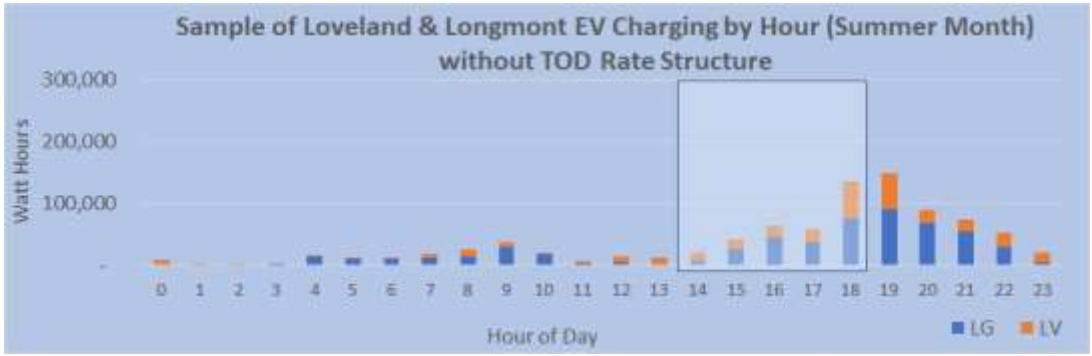
TOD Energy and Demand Results Summary

- 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

TOD Program Impacts

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





Ongoing Roadmap

- 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

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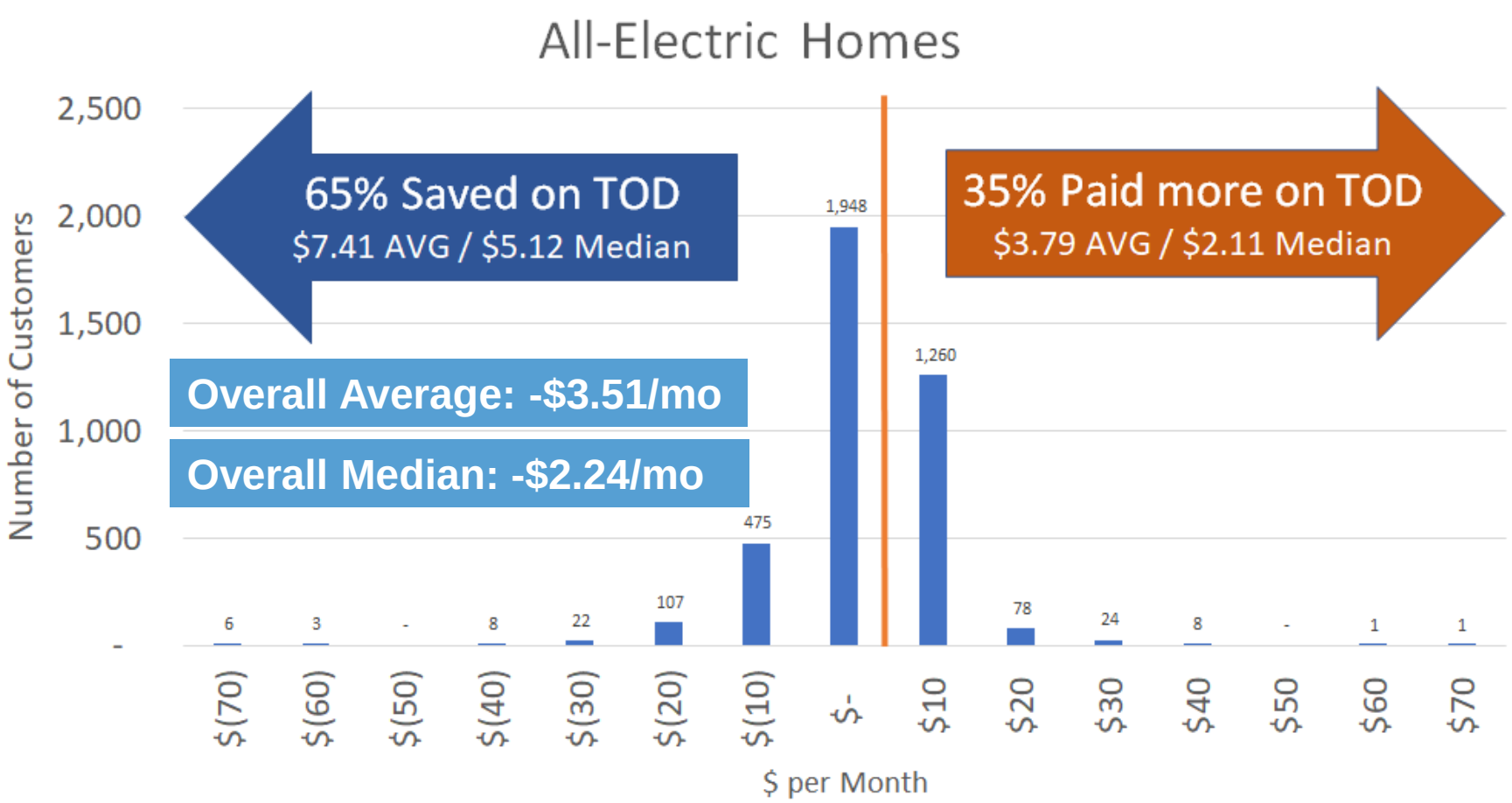
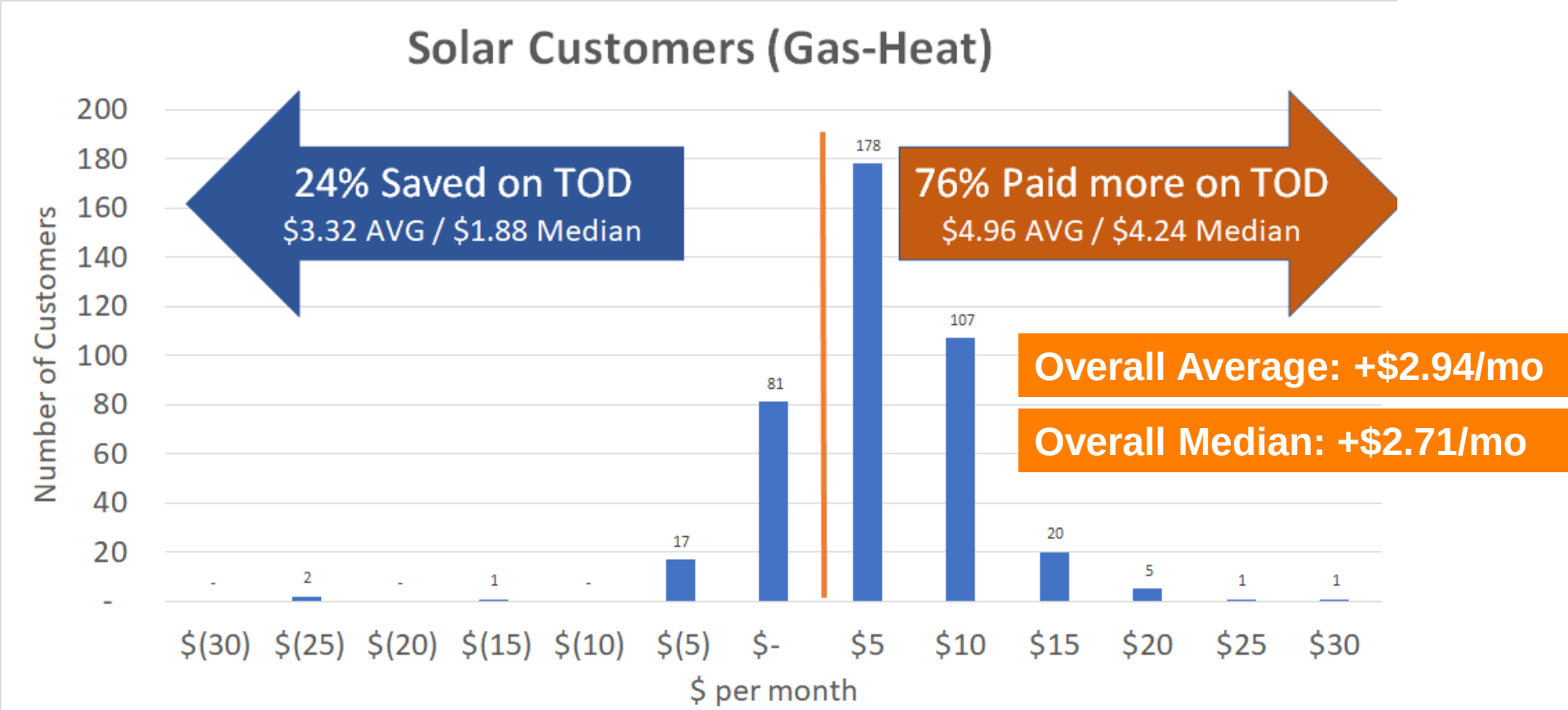
Backup Content

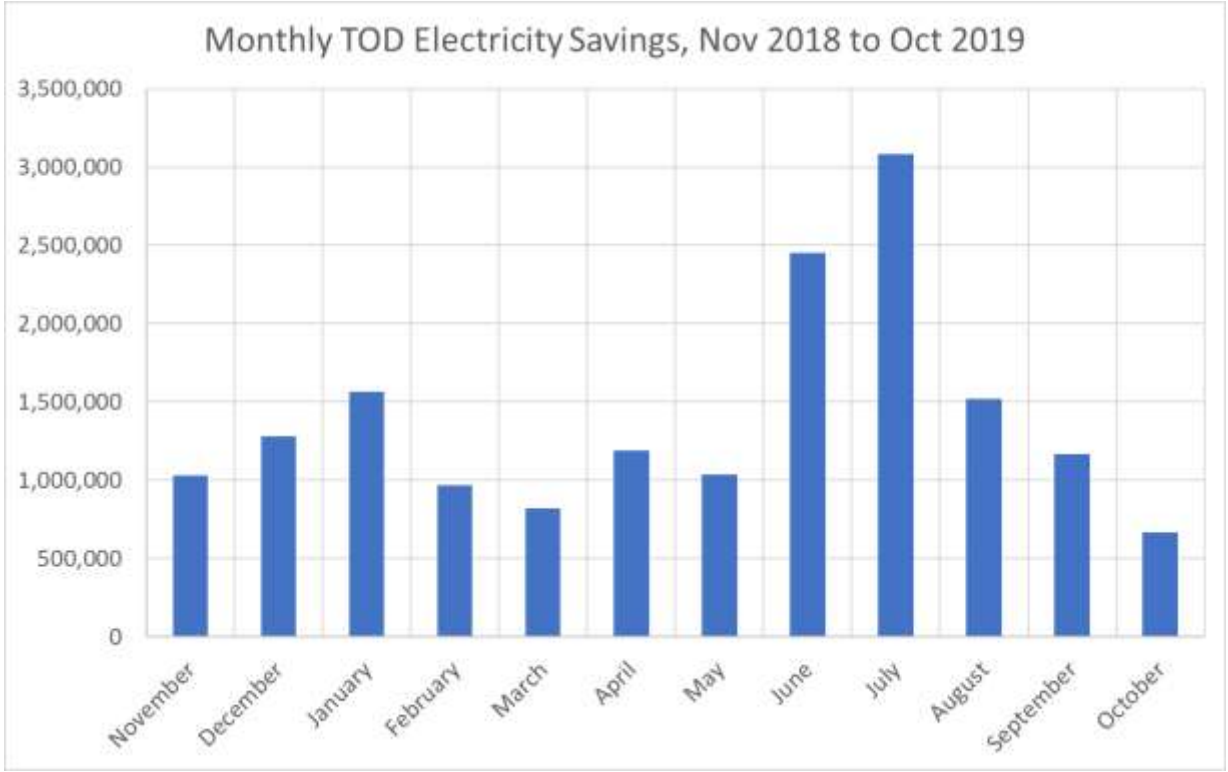
Year One Results Summary



Year One Results Summary



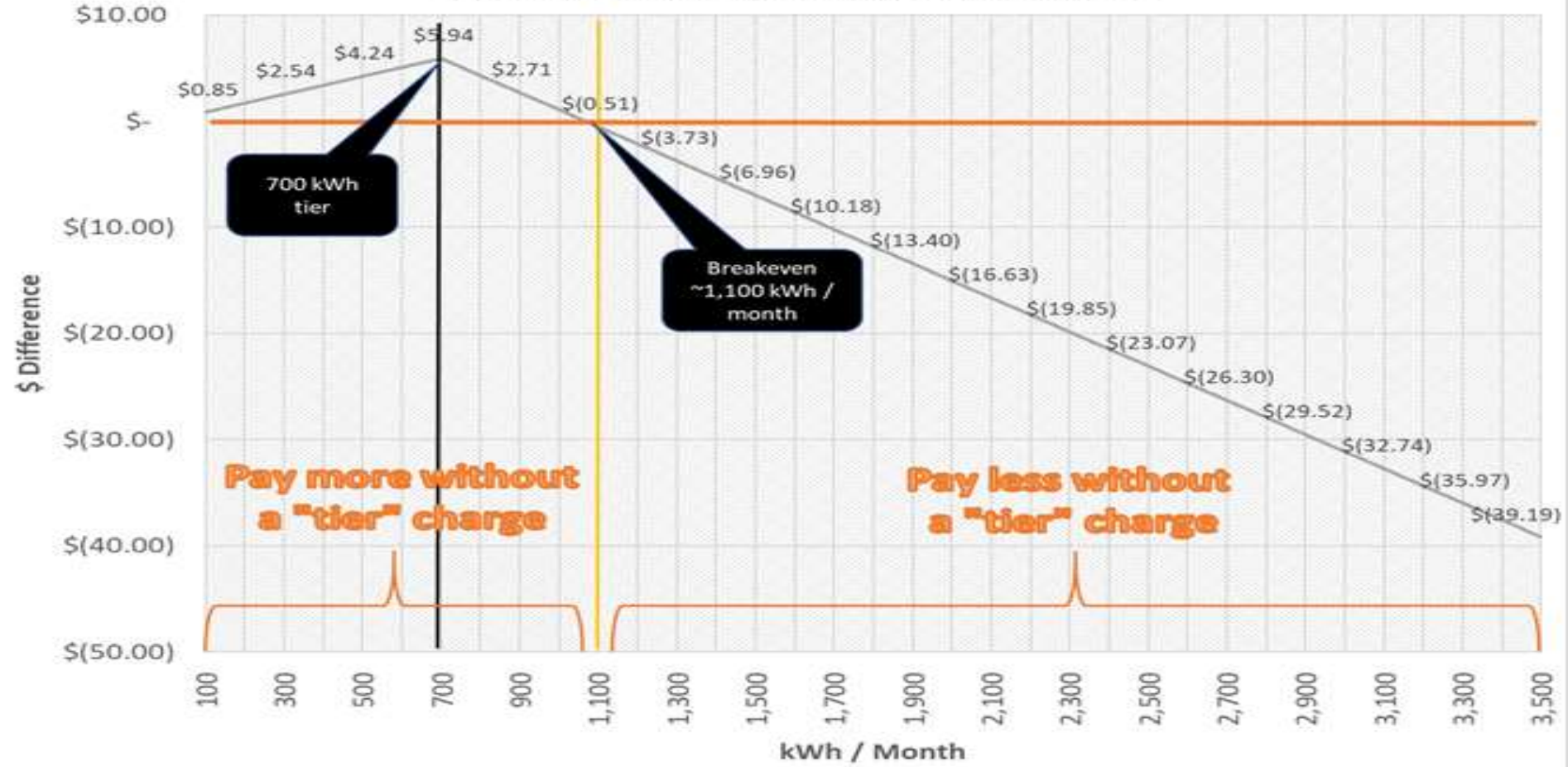
Year One Monthly Energy Savings



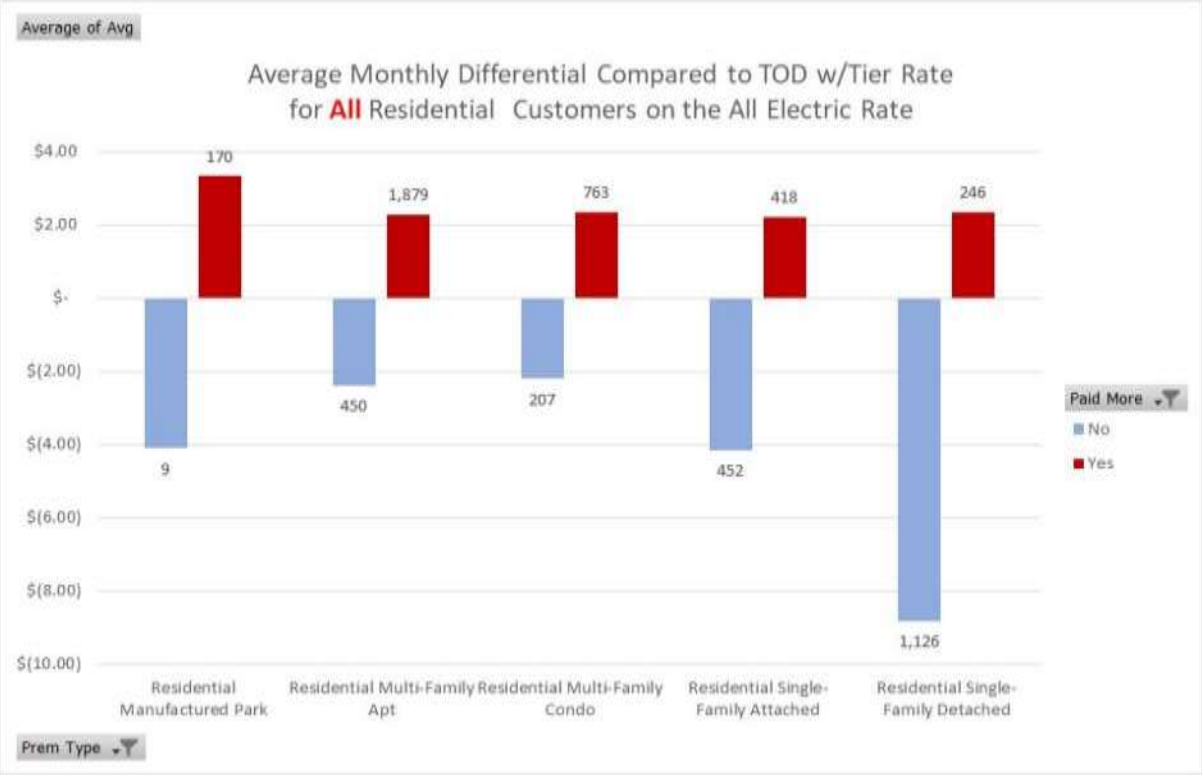
2020 Shift in Energy Use

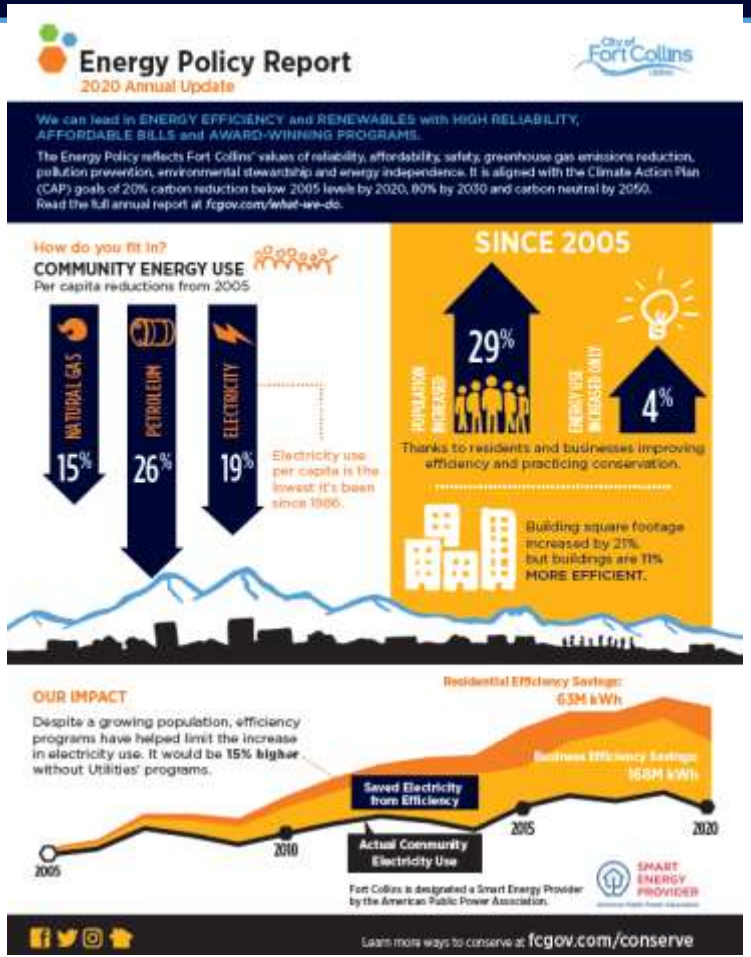
	2020 over 2019	
Rate Class	Energy	Revenue
Residential	4.1%	8.0%
TOD with Tier	5.2%	13.1%
All electric TOD	-1.2%	3.4%
Commercial	-7.6%	-3.9%
Industrial	-3.5%	-3.3%
Total	-1.8%	2.5%

Cost Differences Between the Residential TOD Rate Structures



Monthly Impact by Housing Type





Energy 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.

X 100

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

Reliability

With **99.9981%** reliability, most residents did not experience an outage.

Did you Know?

It is cheaper to save electricity with efficiency (3.4 cents) than it is to buy more electricity (6.2 cents).

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 **1,800 kW** during **peak** times.

Electricity Carbon Emissions

DOWN 38% from 2005

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 showed 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**.