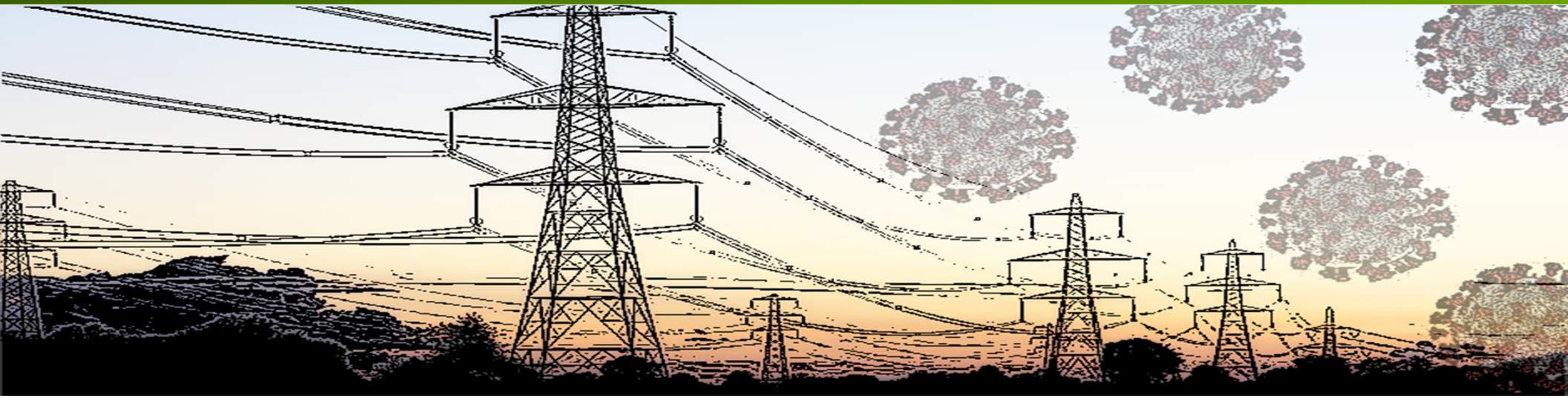
Energy Lessons from the COVID-19 Pandemic in Los Angeles



Presented by: Michael Klopfer, Ph.D. | Joy Pixley, Ph.D. | Prof. G.P. Li

California Plug Load Research Center

California Institute for Telecommunications and Information Technology

Prepared in collaboration with LADWP's ESE group

November 16, 2020 | CalPlug Workshop #16

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LA DWP Los Angeles Department of Water & Power

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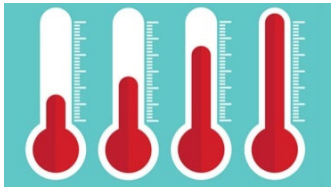
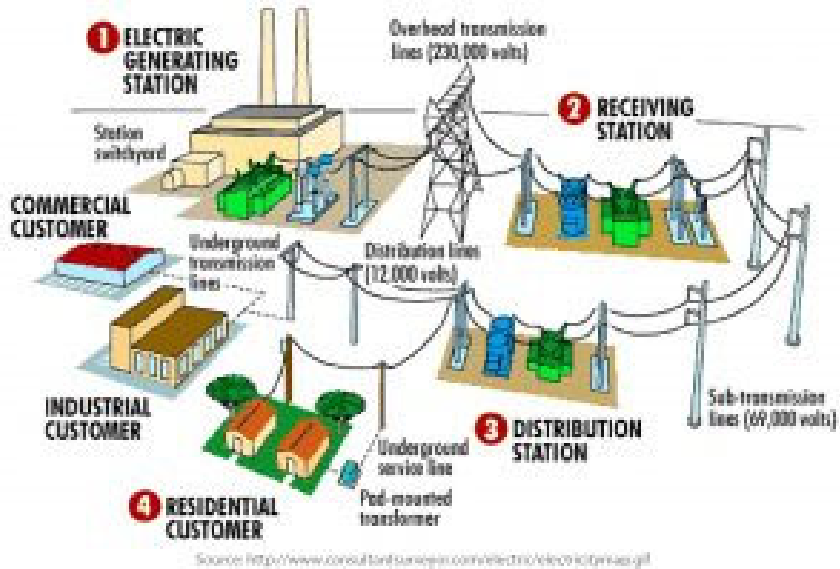
Fundamental Questions

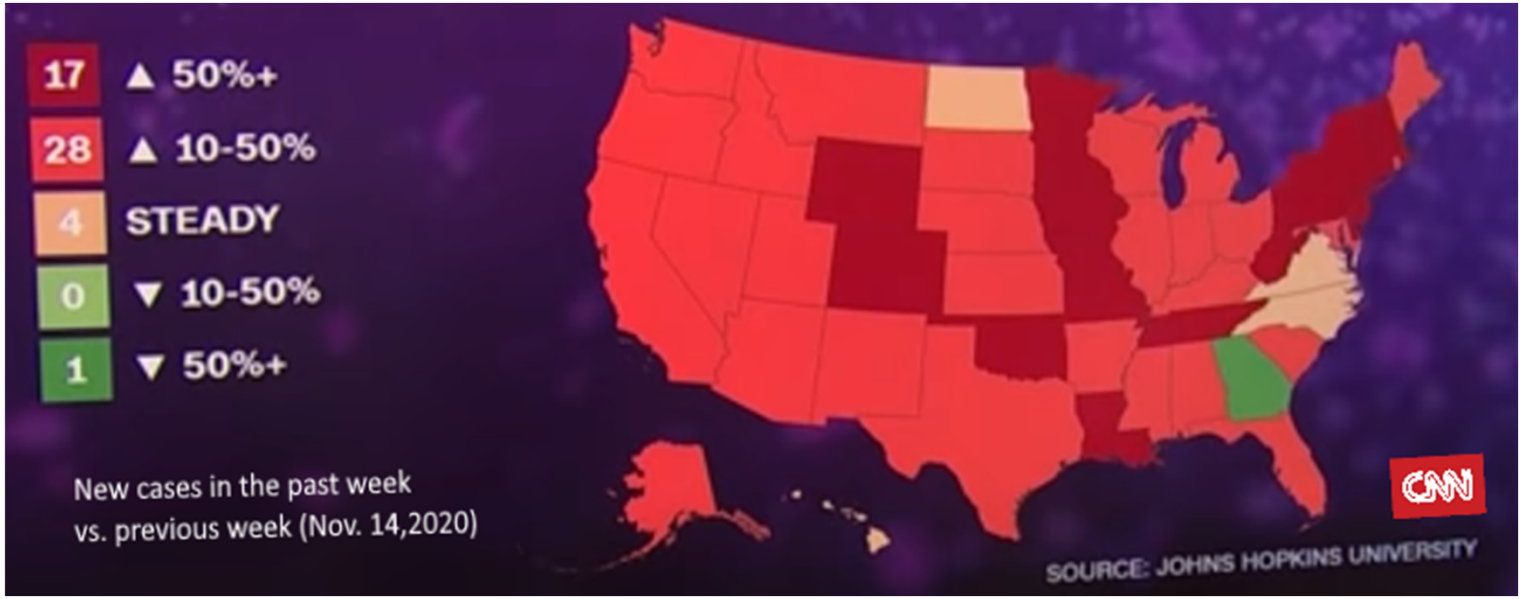
- **What has the COVID-19 pandemic had on residential energy demand?**
  Utility Impacts: forecasting, programs, direct customer cost, non-payment rate
- **Where or what is the localization of the impact?**
- **What are the likely behavioral underpinnings of the impact?**
- **Can we estimate energy usage based on general classes of loads?**
- **What are forward facing lessons, considerations?**
- **Can any/all of these be done with existing, aggregated distribution SCADA data in a transferrable method?**

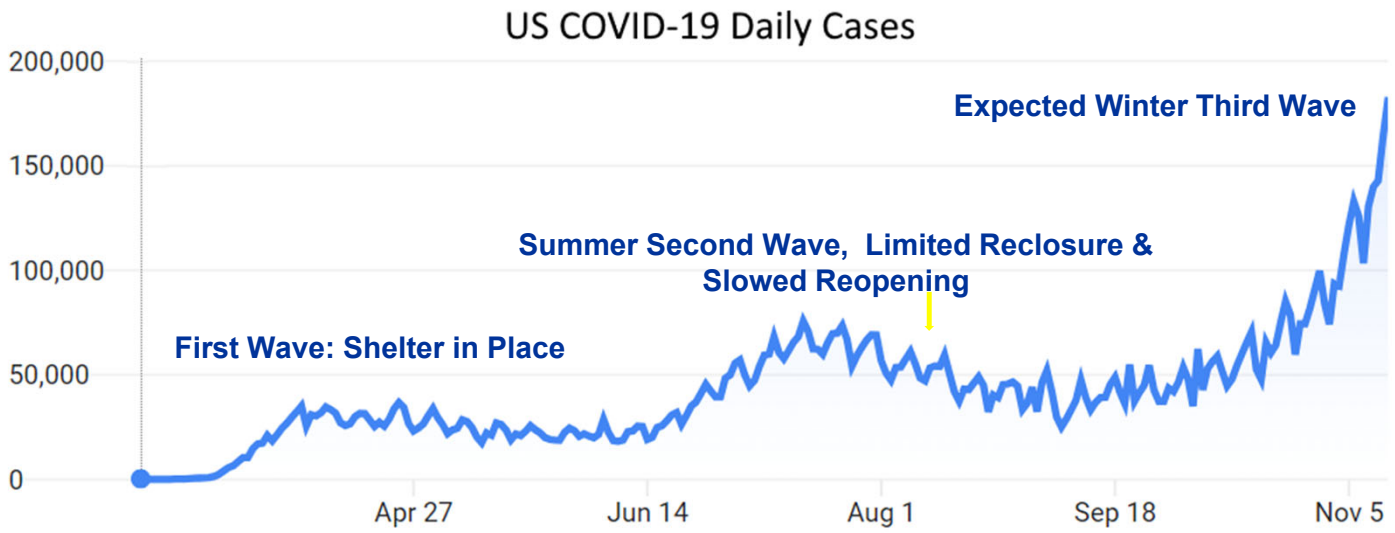




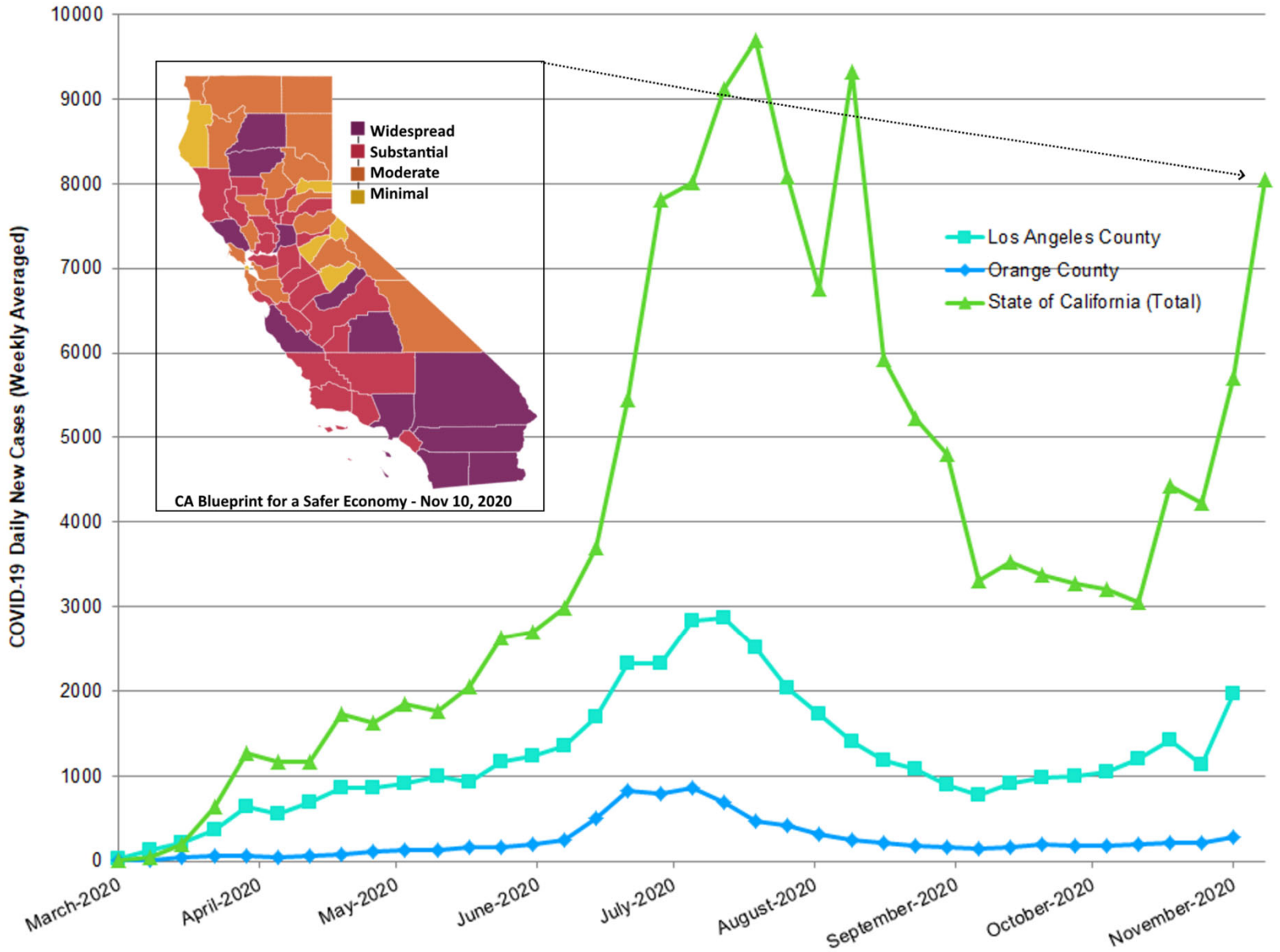
Introduction:
The COVID-19 Pandemic Sequence of Events and Population Impacts

Nationwide Third COVID-19 Wave





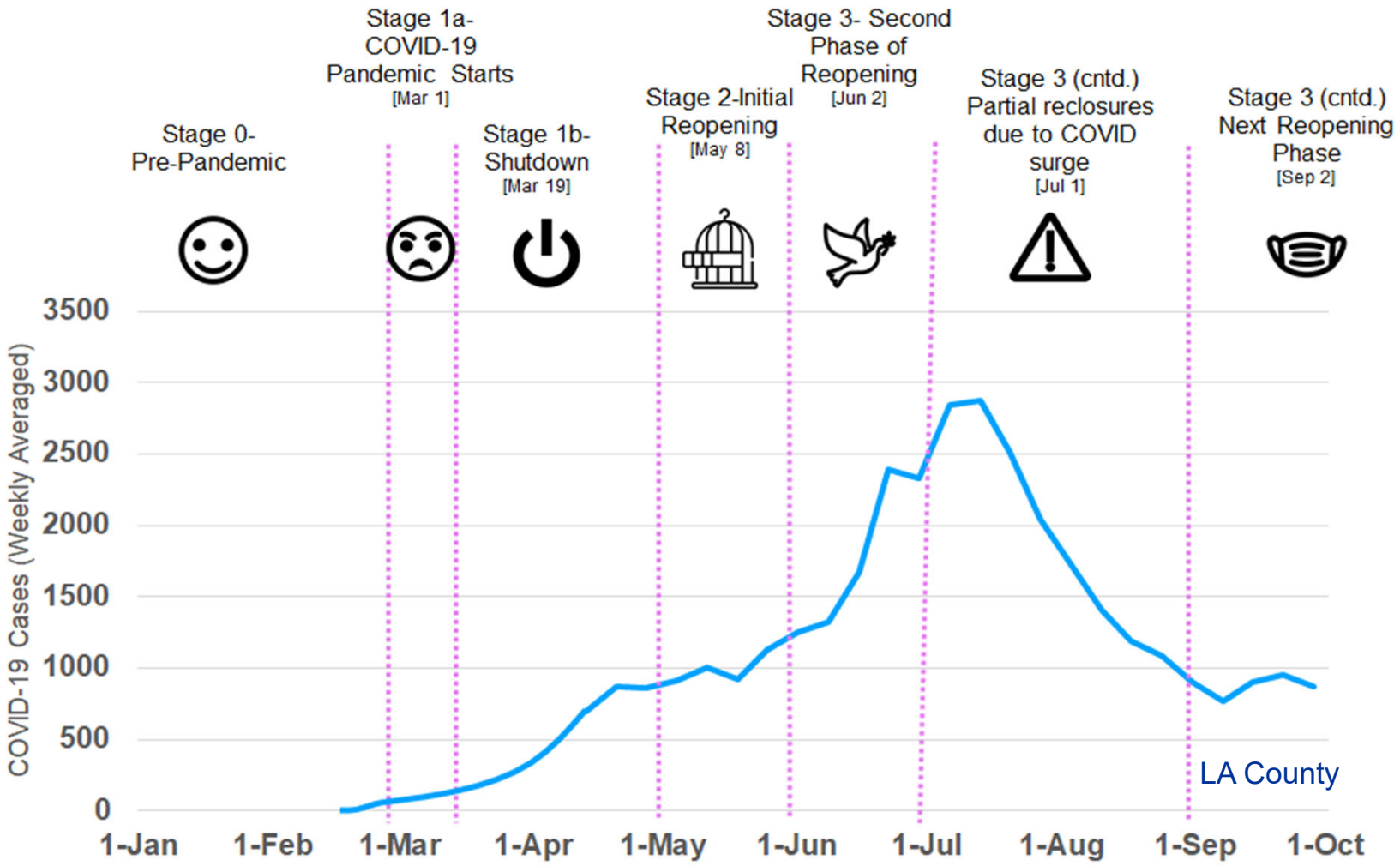
COVID-19 in California & Los Angeles, Orange Counties



Data Sources: LA County DHS, Orange County DH, New York Times / Johns Hopkins University / Alphabet (Google), Inc.

California Sequence of Events

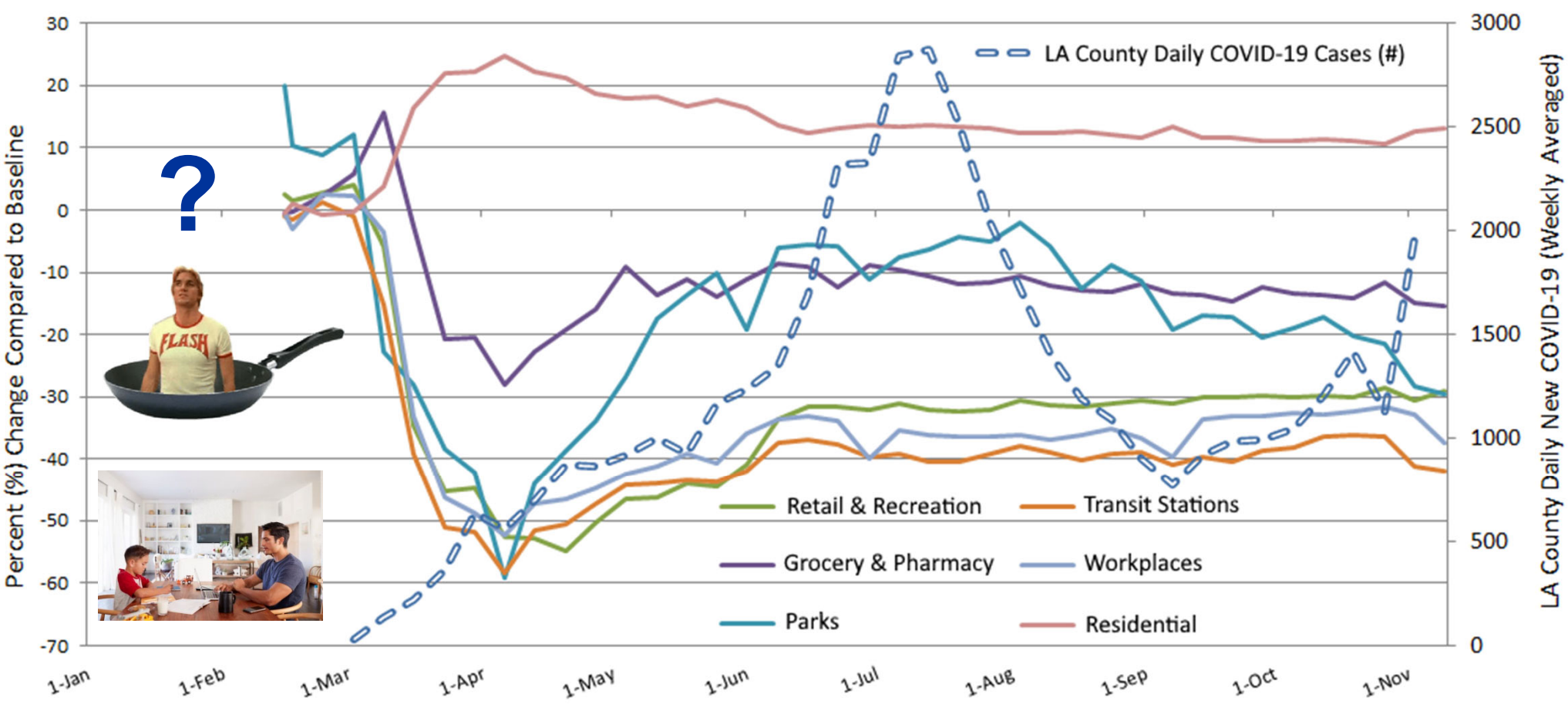
The COVID-19 pandemic is an ongoing sequence of events



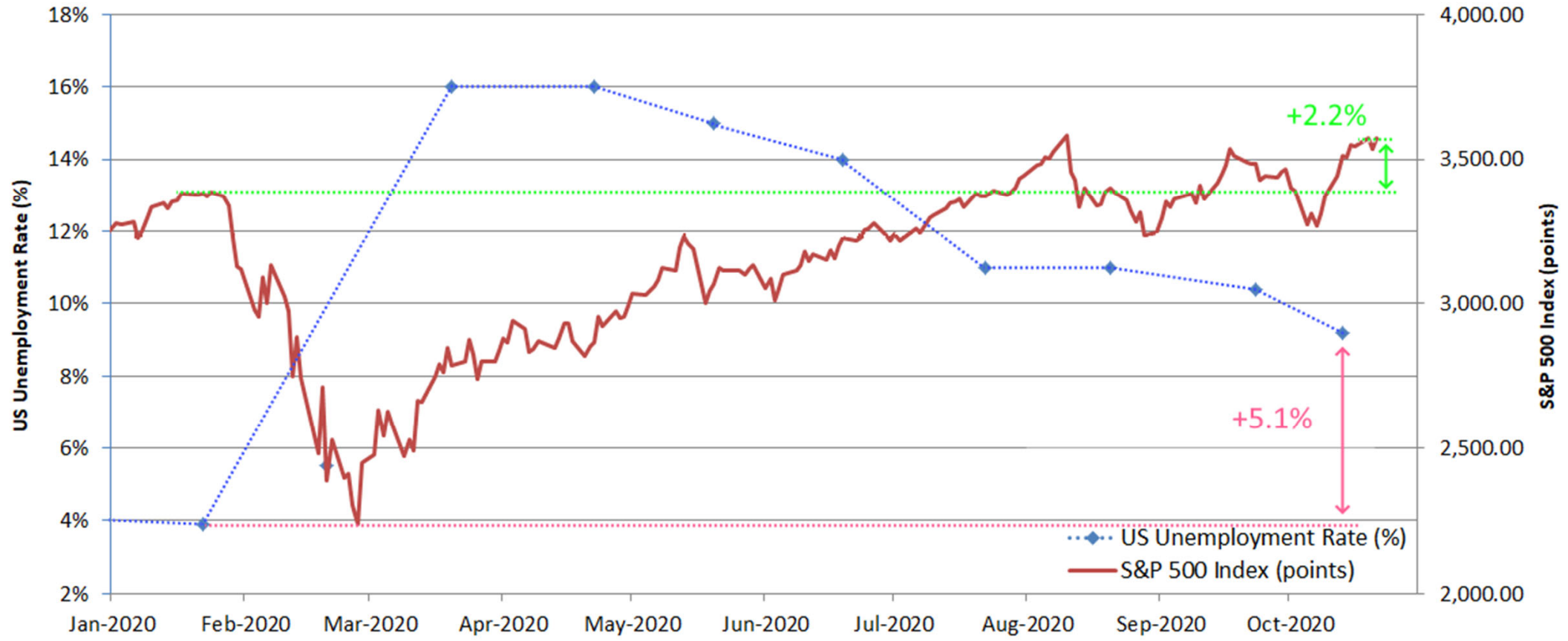
Data Source: Los Angeles DHS, Image Component Source: flaticon.com

Impact on Locations Visited (LA County)

- Greatest overall impact was during mid-March through late-April
- Initial recovery and initial stabilization by mid-June



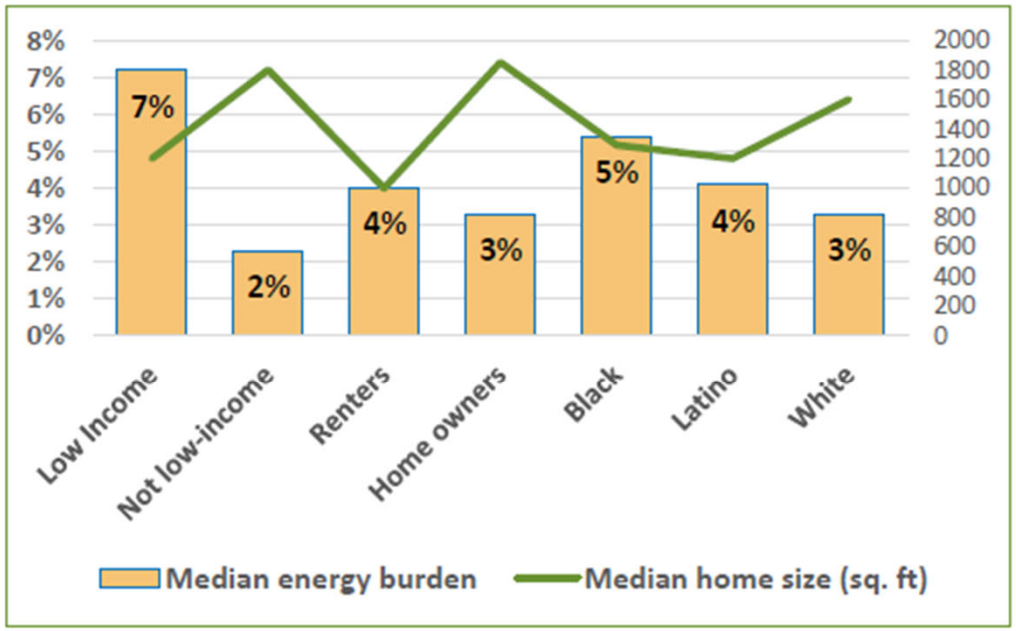
Lasting Economic Disparity



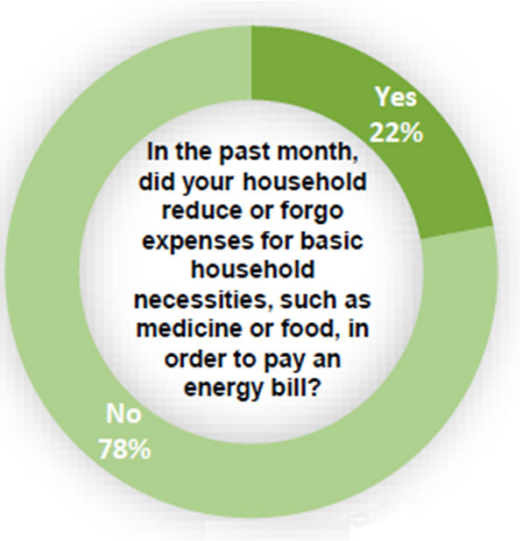
Data Sources: Bureau of Labor Statistics, S&P 500.

Income and Community Burden

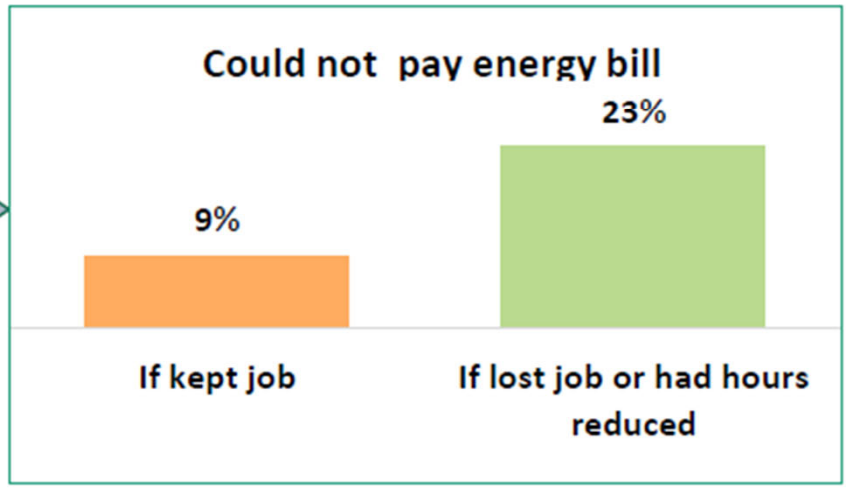
- Disadvantaged Angelenos already had a higher "energy burden" – that is, the percent of their household income spent on energy bills.
- As a result, both the loss of jobs and the increase in energy bills hits hardest for those who are already doing the worst.
- In a national survey of lower-income respondents April 30 to May 25, nearly 13% reported that they couldn't pay an energy bill, and over 9% received a shut-off notice.



Disadvantaged groups (low-income, renters, and people of color) have smaller homes but still pay a larger proportion of their income on energy bills.



Respondents who had lost a job or had their hours cut due to COVID-19 had significantly more problems paying their energy bills.



Data Source: David Konisky and Sanya Carley, June 2020,"Survey of Household Energy Insecurity in Time of COVID: Preliminary Results of Wave 1," Indiana University.

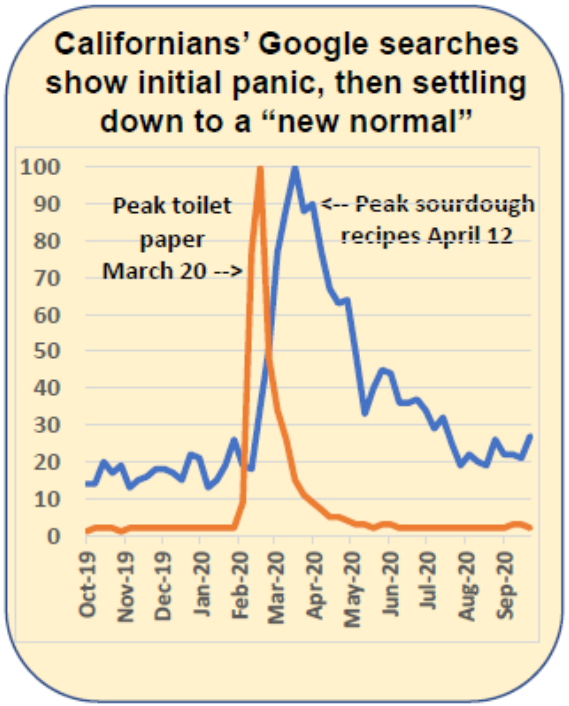
Changes in Habits at Home During SIP

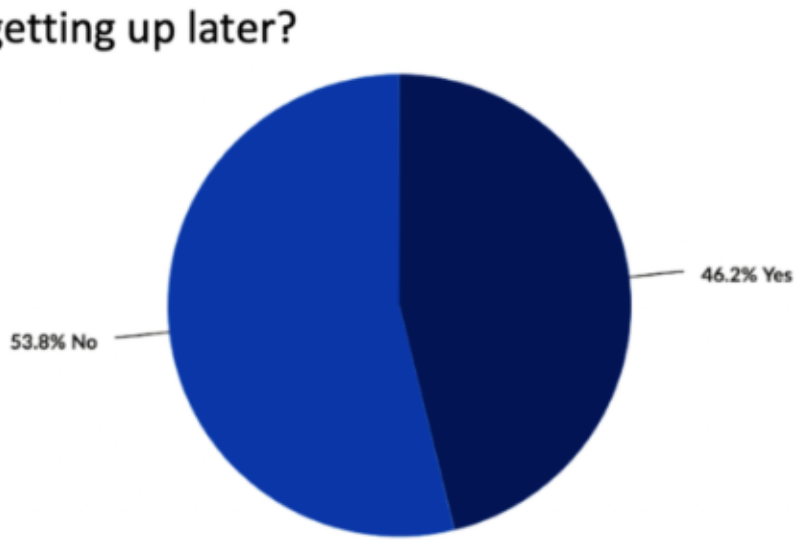
Pecan Street's Shelter-In-Place (SIP) Survey:

76% reported changes in cooking habits

69% indicated more individual home during the day than before SIP

Majority of homes have children 0-12 or 13-17





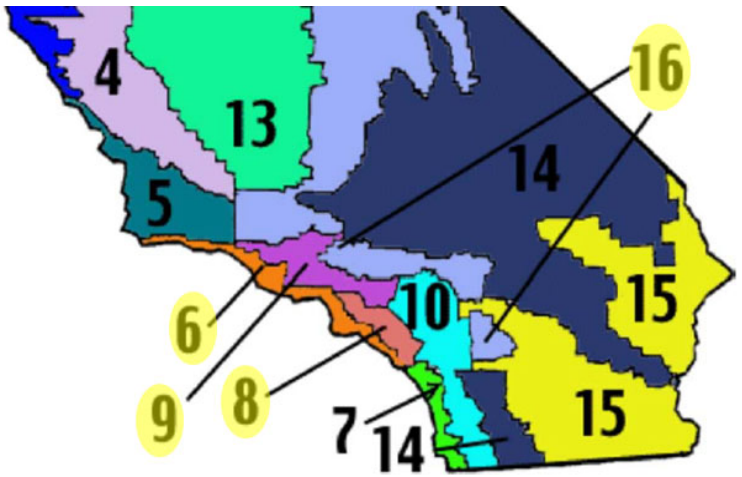
Figure, Data Source: R. Jenkens, C Johnson "Unlocking Insights: How COVID-19 & SIP are Shifting Behaviors & Home Energy Use." Pecan Street. June, 2020. | Google Trends

Materials and Methods: Evaluation of Energy Impact in Los Angeles

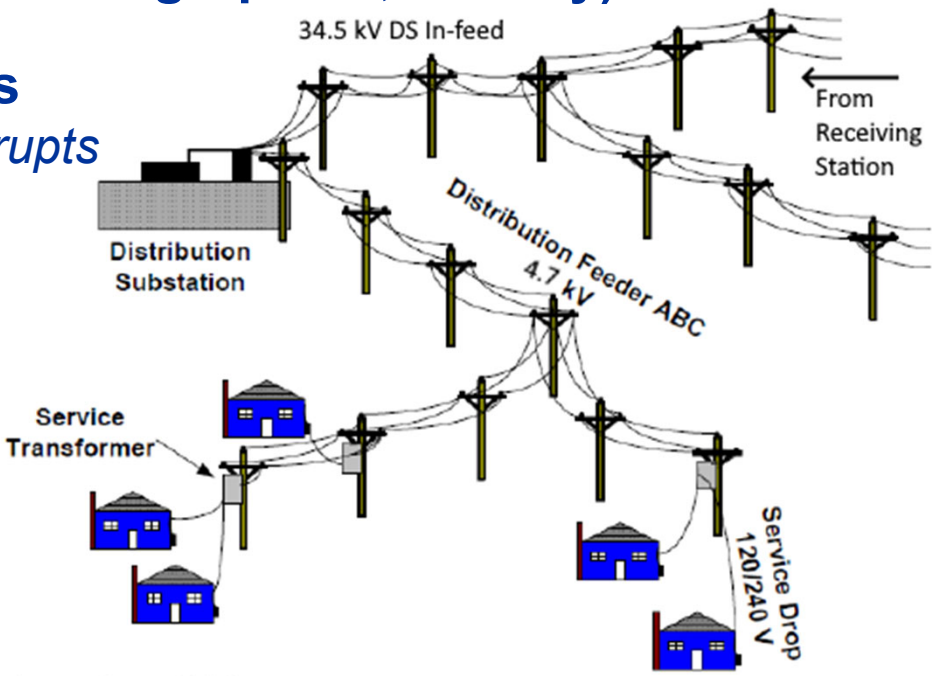
Data Selection / Analysis Approach

Feeders from LADWP DS stations were chosen, considering:

- **High (<90%) residential service**
- **Homogeneous service population**
- **Semi-homogeneous building type**
- **Representative locations (climate zone, demographics, density)**
- **Data free of major non-reparable defects**
  M&V errors, recalibration, reconfiguration, interrupts



Source: California Energy Commission staff



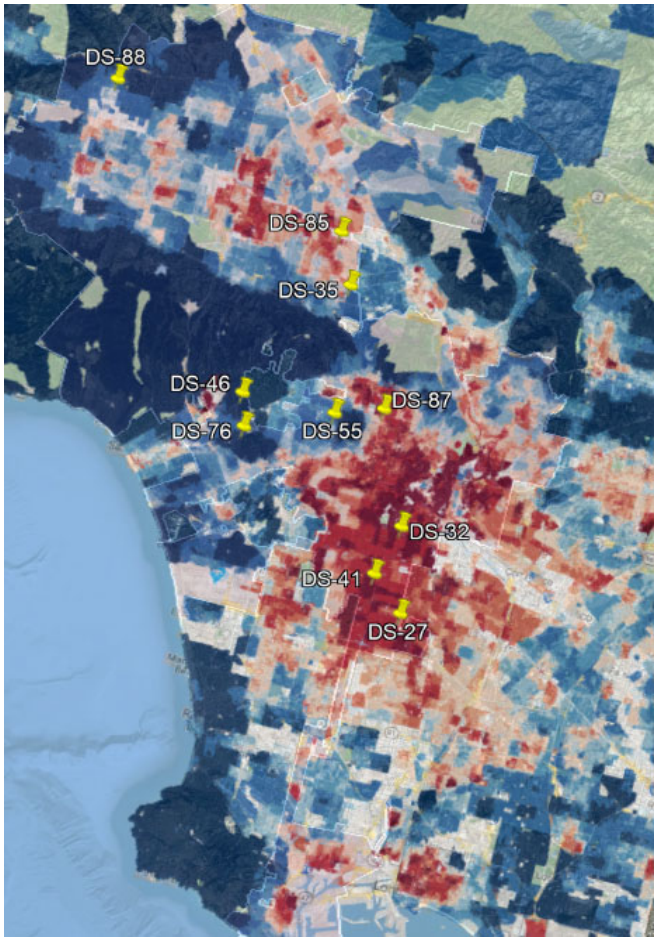
Source: Pepco Holdings

Analysis Approach: Selected Communities

7 Residential Feeders
1 Commercial Feeder

2 Climate Zones
Multiple LA regions:
(valley, downtown, mid-city, south)

Each selected feeder controlled for population homogeneity

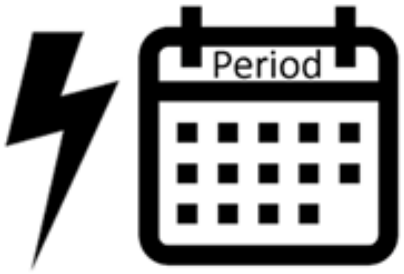


Feeder	Community	Feeder Residential Customer Percentage	CEC Climate Zone / Sunset Planting Zone	Structure Types	ZCTA / Approximate Feeder Area Community Median Income
Feeder A	Watts (90059)	91.18%	8 / 22	Section 8 apartment housing	$51,635 / $24,720
Feeder B	Southeast LA (90037)	90.10%	8 / 22	Majority single family homes	$44,965 / $31,738
Feeder C	Hancock Park (90004)	92.75%	9 / 22	Single family and small apartments mixed	$82,746 / $40,374
Feeder D	Toluca Lake (91602)	96.50%	9 / 20	Mixed single family homes and apartments	$109,254 / $49,039
Feeder E	Burbank (91601)	89.14%	9 / 20	Single family homes, small apartments	$72,868 / $58,570
Feeder F	Chatsworth (91377)	86.83%	9 / 18	Apartments with mixed small businesses	$112,763 / $110,300
Feeder G	Central Wilshire (90036)	94.62%	9 / 22	Low-rise buildings and community grounds in large apartment community	$117,596 / $111,910
Feeder H*	Downtown LA (90014)	0% - Commercial service/office building	9 / 22	Pair of mid-rise commercial/retail office buildings in downtown LA	N/A

* Non-residential feeder, not averaged with residential feeders

ZCTA - Zip Code Tabulation Area: Census-focused approximation of area of a corresponding postal zip code route, median income for ZCTA areas is shown in addition to the approximated feeder tract area corresponding to the specific feeder service area community.

Analysis Approach

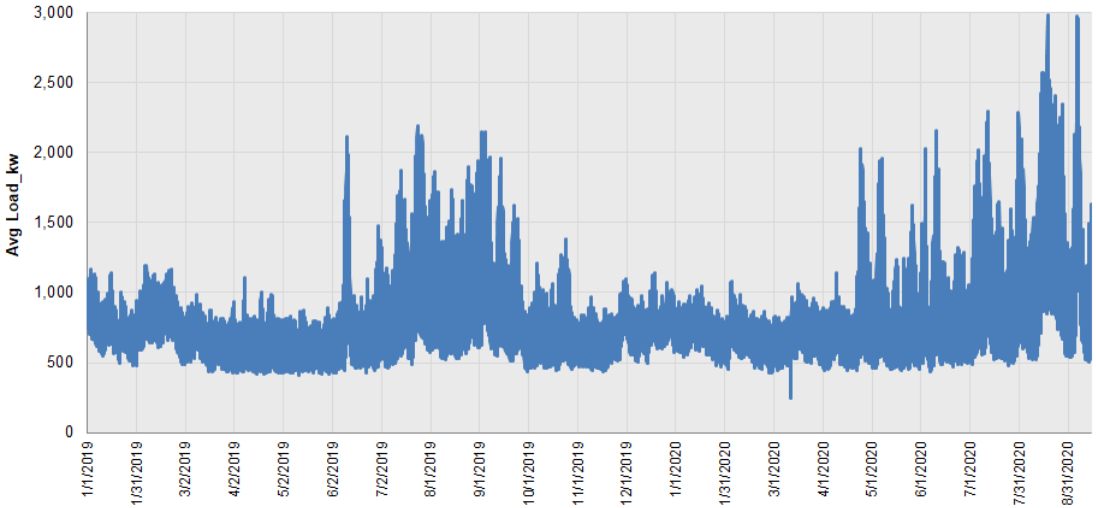


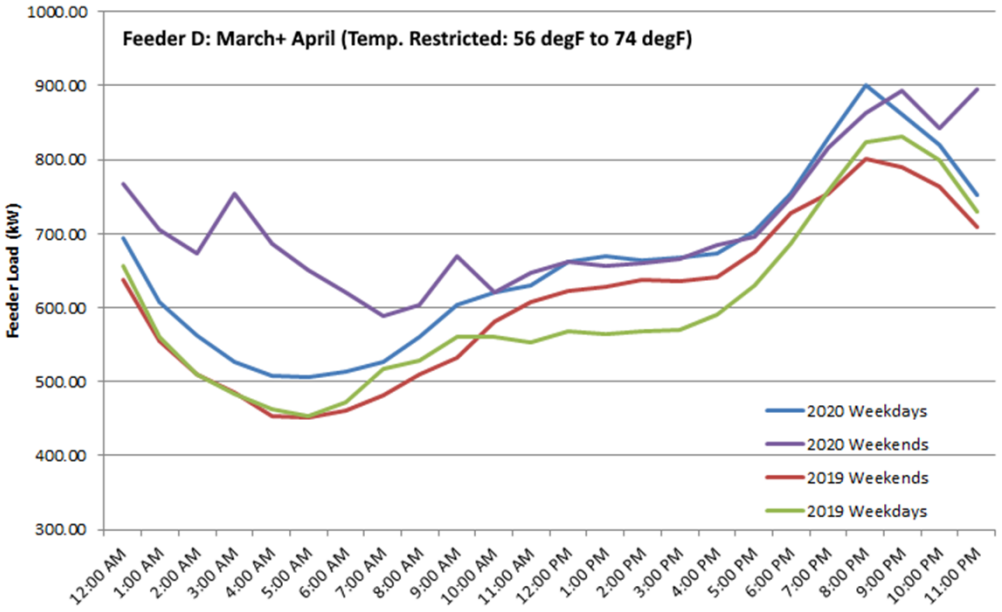
Analysis Type 1: Total energy use during a time period

Analysis of average total energy usage during select periods (e.g., a specific month) compared to the corresponding 2019 period, used as baseline consumption.

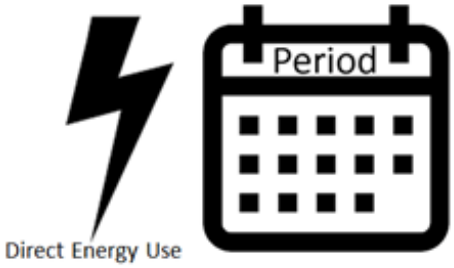
Analysis Type 2: Evaluation of energy use on a day-type basis

Analysis of averaged patterns of energy usage on an hourly basis over the course of a day during selected analysis period, either overall or for a selected day type (weekdays vs. weekends), again compared to an average baselines of the corresponding time period in the prior year.



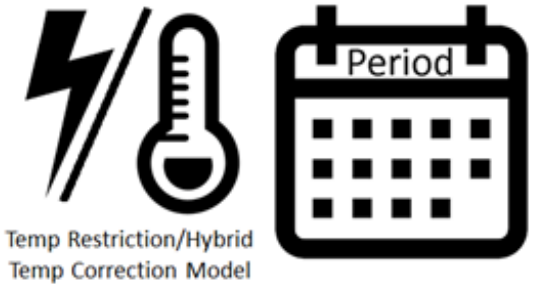


Analysis Approach: Methods



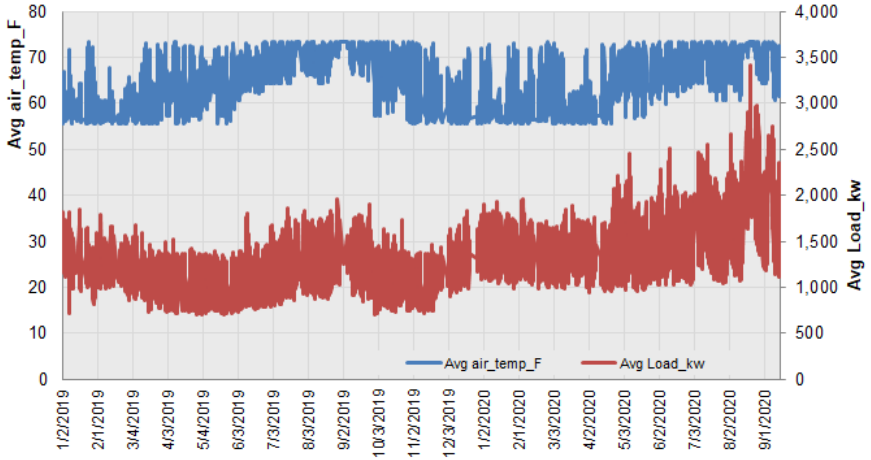
Method 1: Direct Evaluation

Use of raw electrical energy usage in 2020 compared to 2019 to estimate total billing impact due to the events related to the COVID-19 on served customers. This provides a comparison to what was used the year before without direct assessment of weather changes.

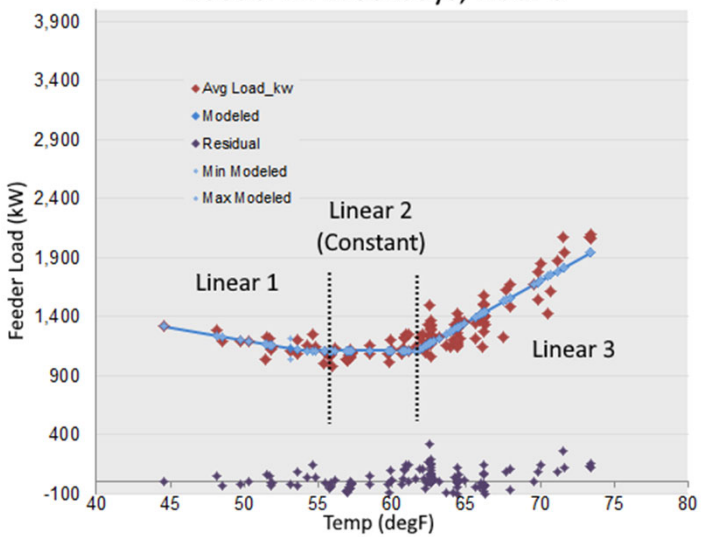


Method 2: Temperature-based energy evaluation

Use of a temperature sensitivity model for correcting or restricting method to normalize the impact of temperature to compare yearly energy usage. The two methods used provide a means to directly estimate the impact in the change of use for temperature insensitive loads and changes in the impact for temperature sensitive loads.



Feeder A: Weekdays, Hour 5

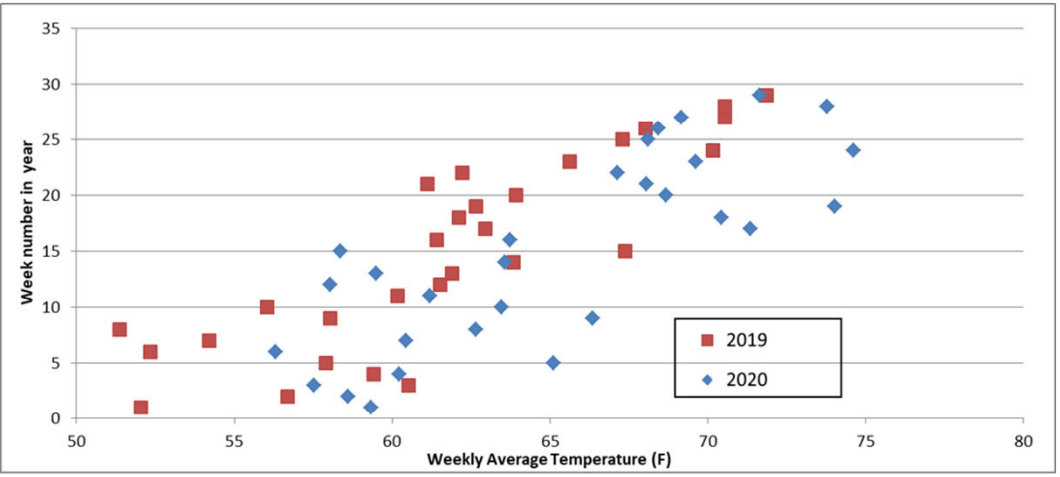


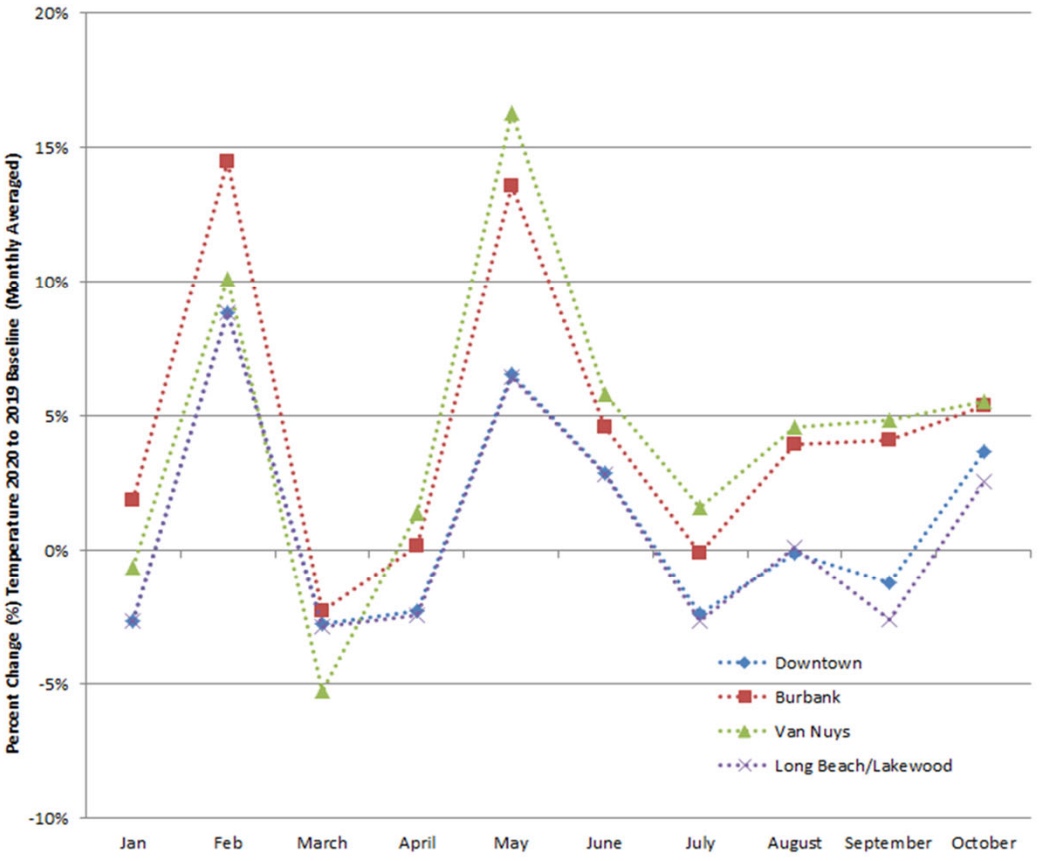
Temperature Baseline Considerations

2019
Δ↓
2020
Jan through Oct

Year Summary:

Downtown: +0.92% (+0.25°F)
Burbank: +4.38% (+2.31°F)
Van Nuys: +4.31% (+2.43°F)
South LA (Long Beach/Lakewood): +0.04% (+0.59°F)





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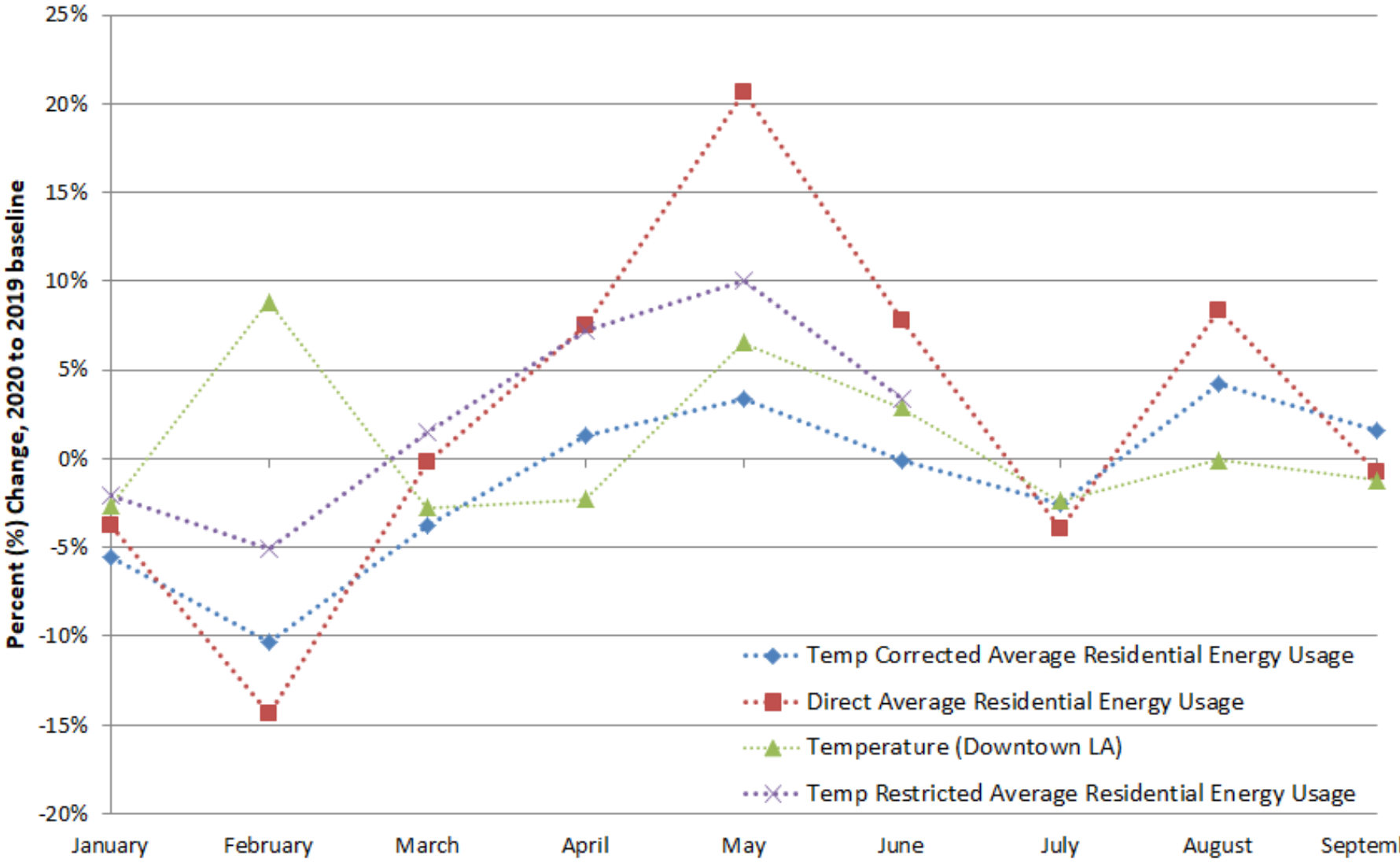
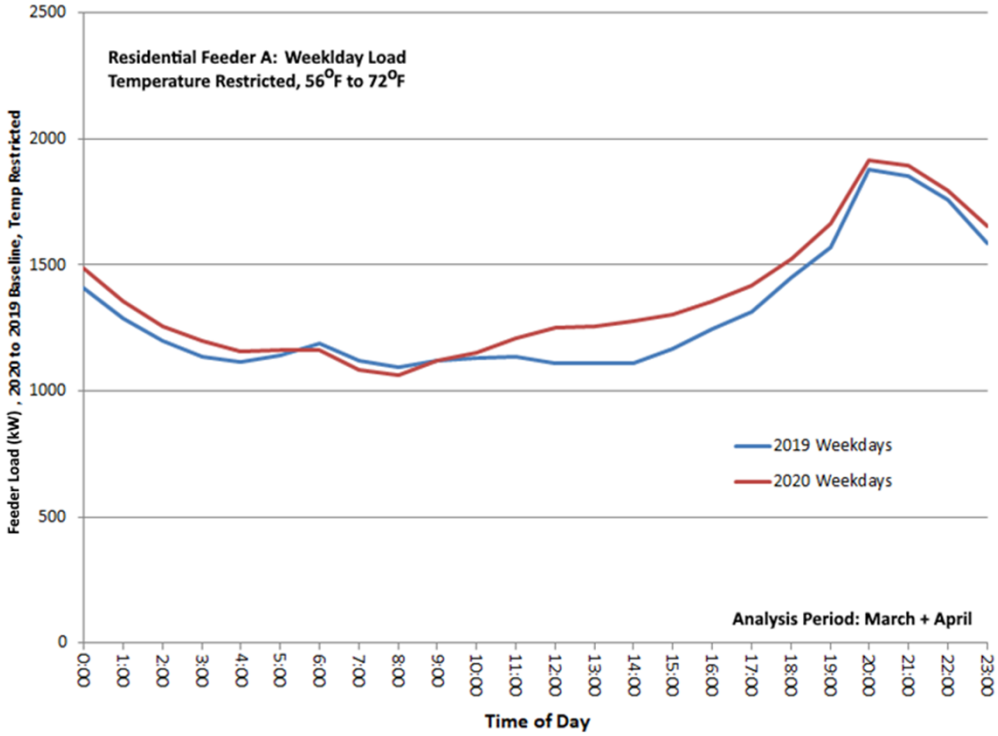
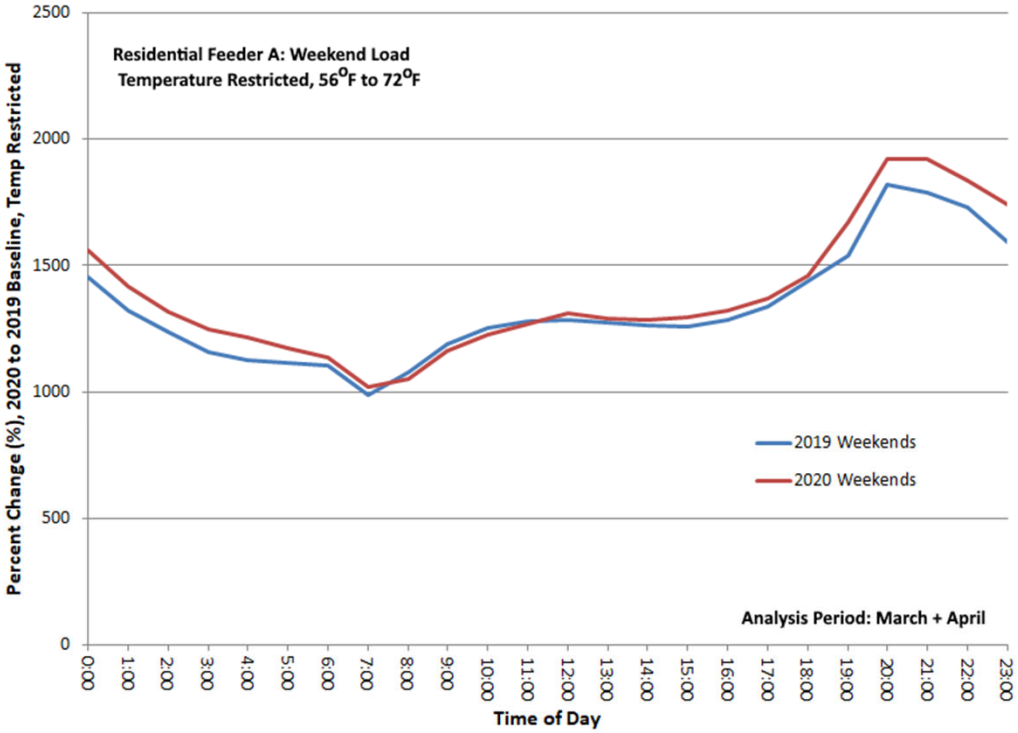
Results: Evaluation of Energy Impact in Los Angeles

Monthly Energy Usage: Estimation Bounds

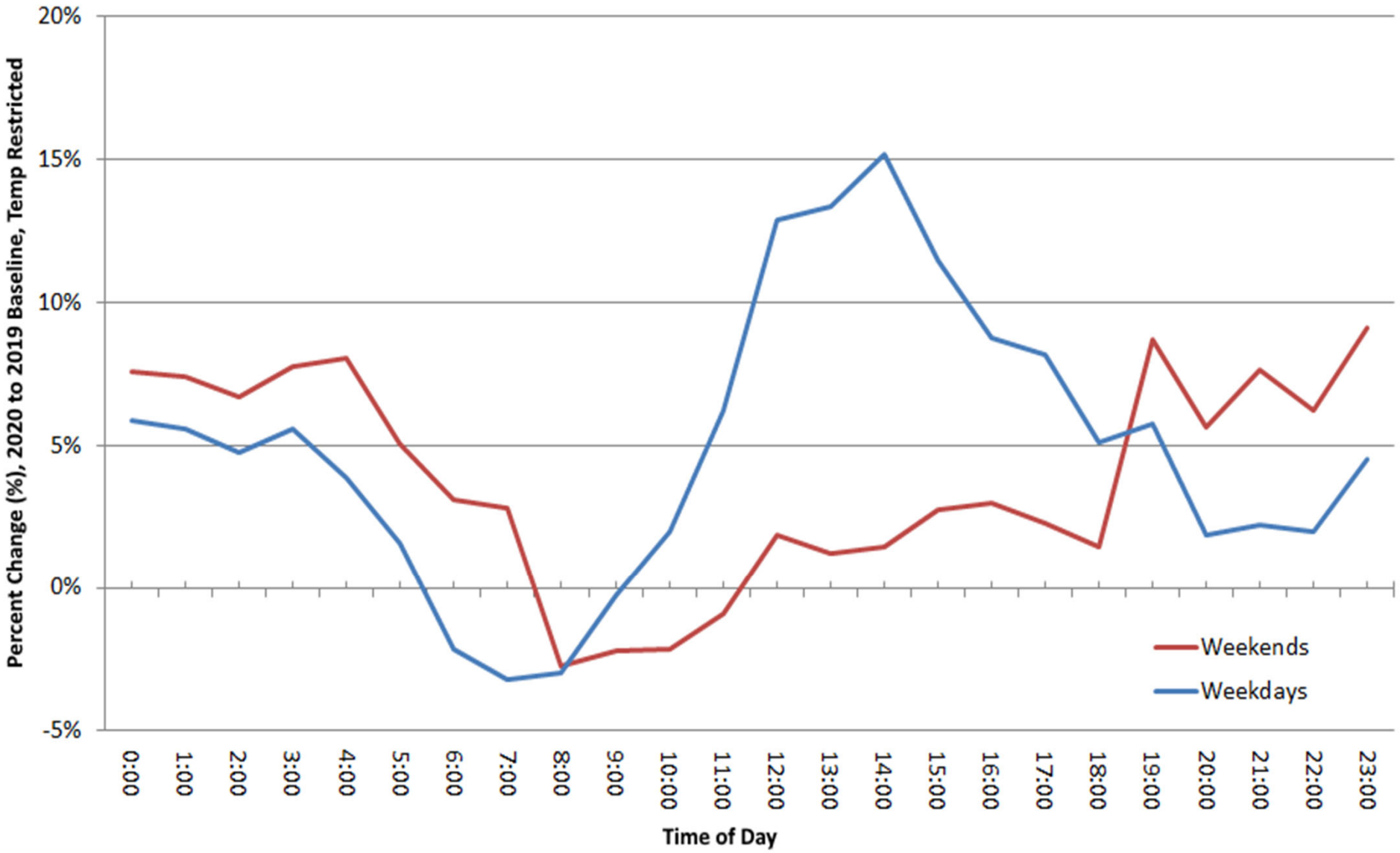


Daily Energy Use Changes: Feeder A Example

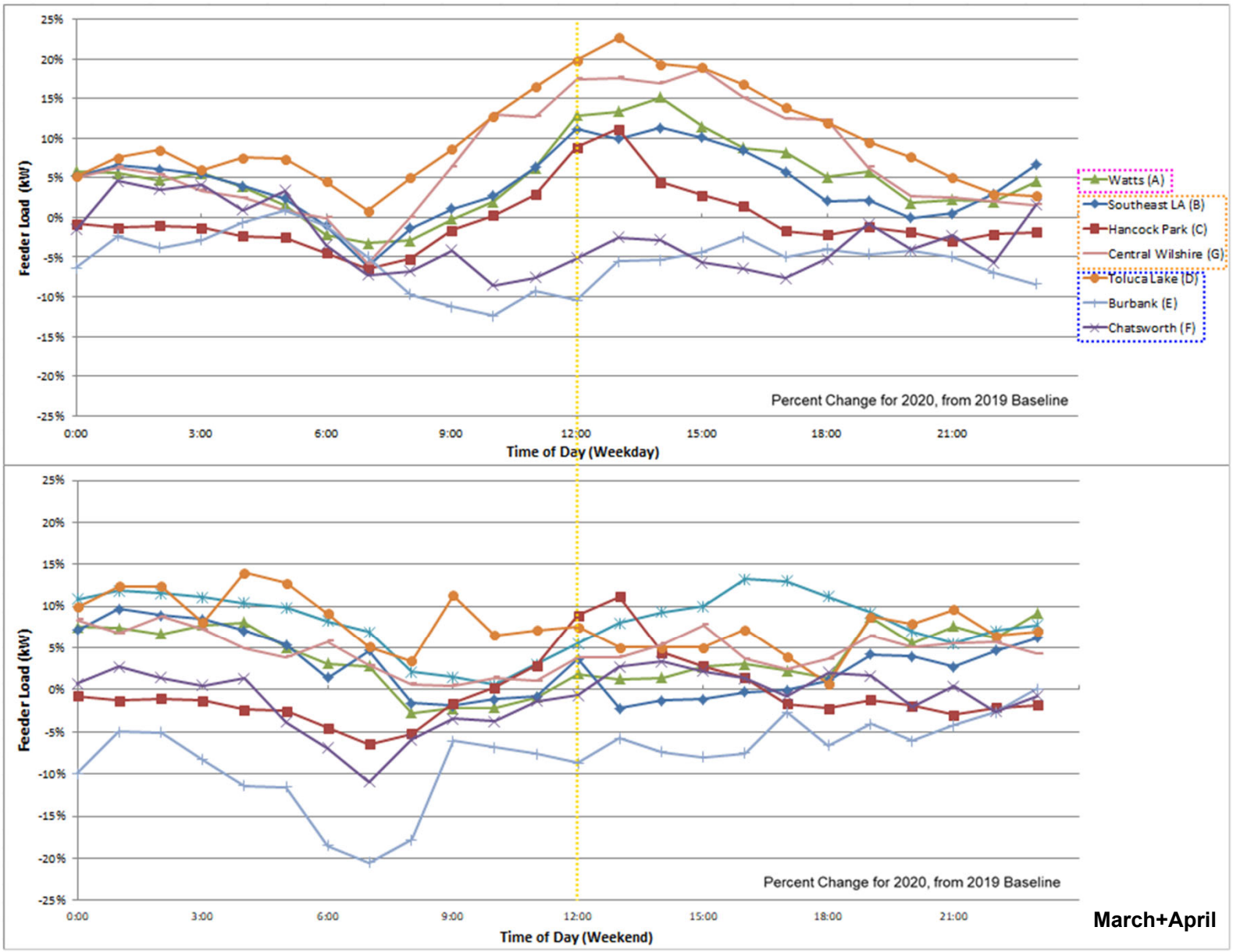




Example Monthly Energy Usage Change: Feeder A Example



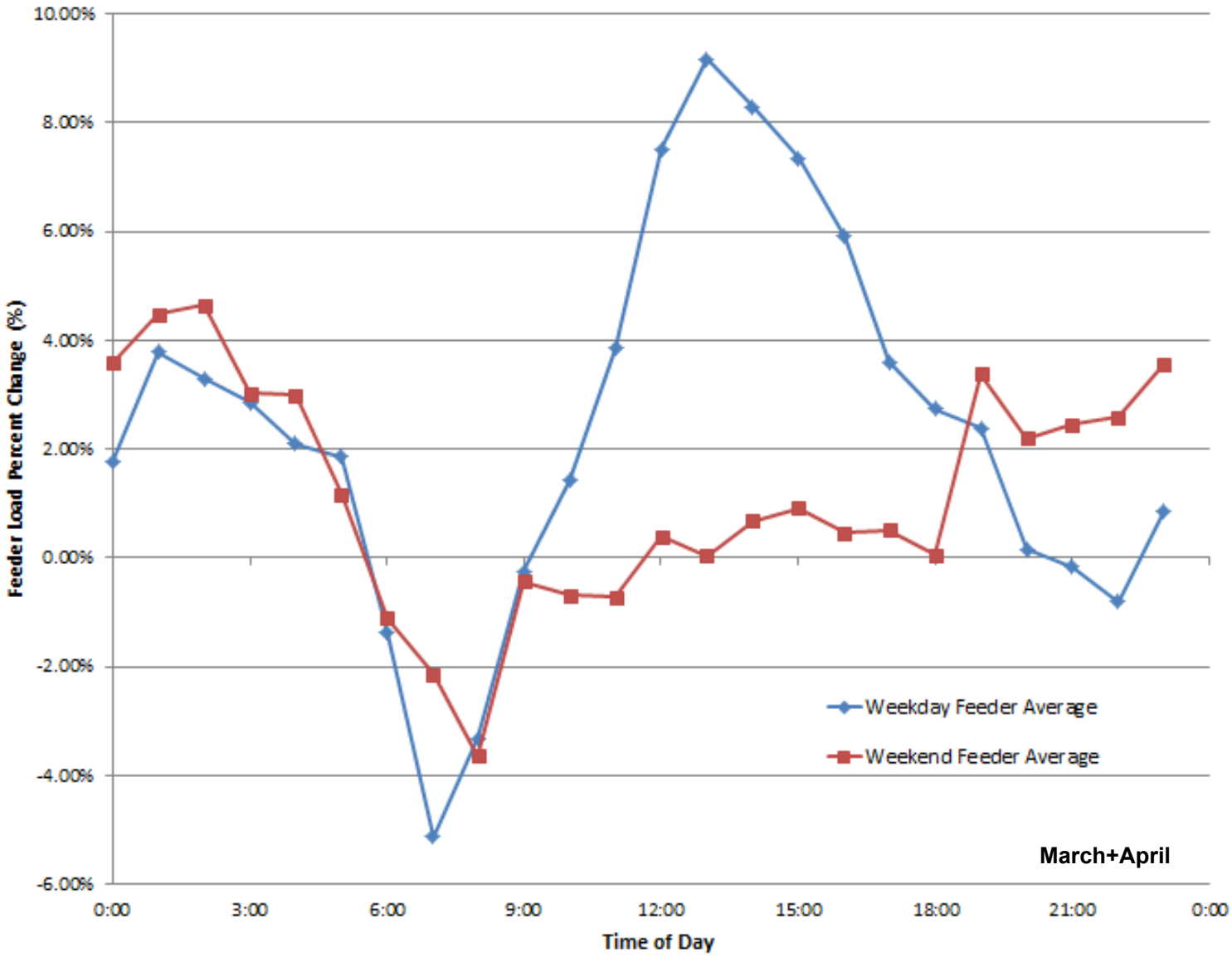
Daily Energy Use Changes: Peak SIP



22% Max Mid-day Change, Weekdays

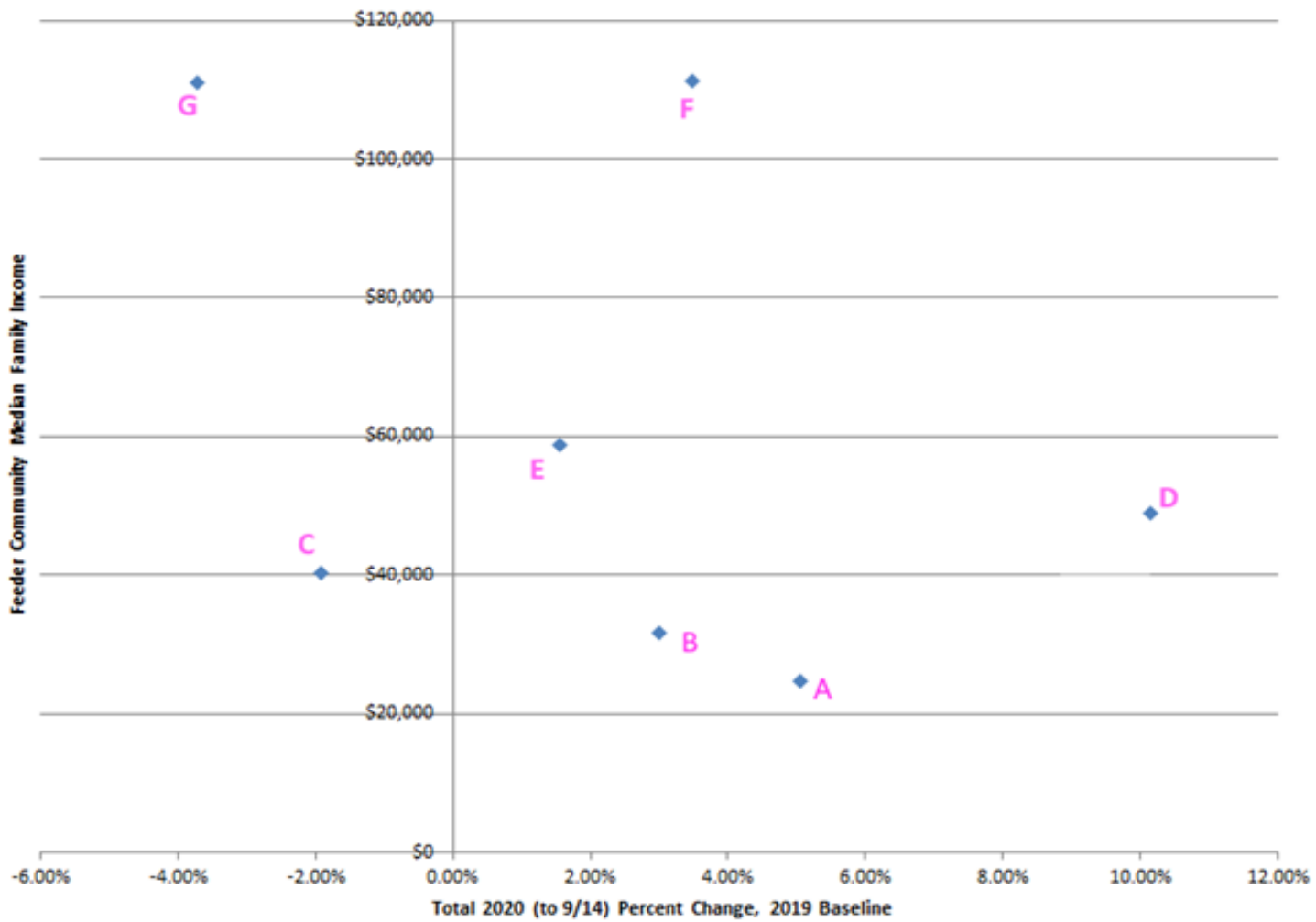
-5.5% Min. "Morning Peak" Change, Weekdays

Daily Energy Use Changes: Averaged Peak SIP



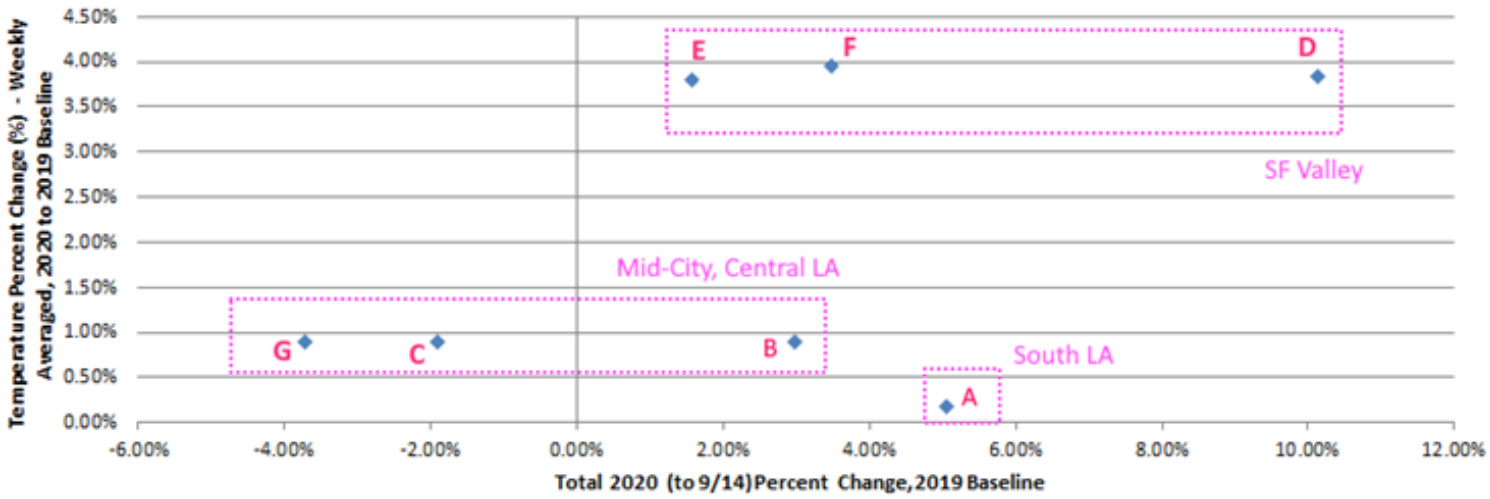
9.2% Avg. Mid-day Change, Weekdays

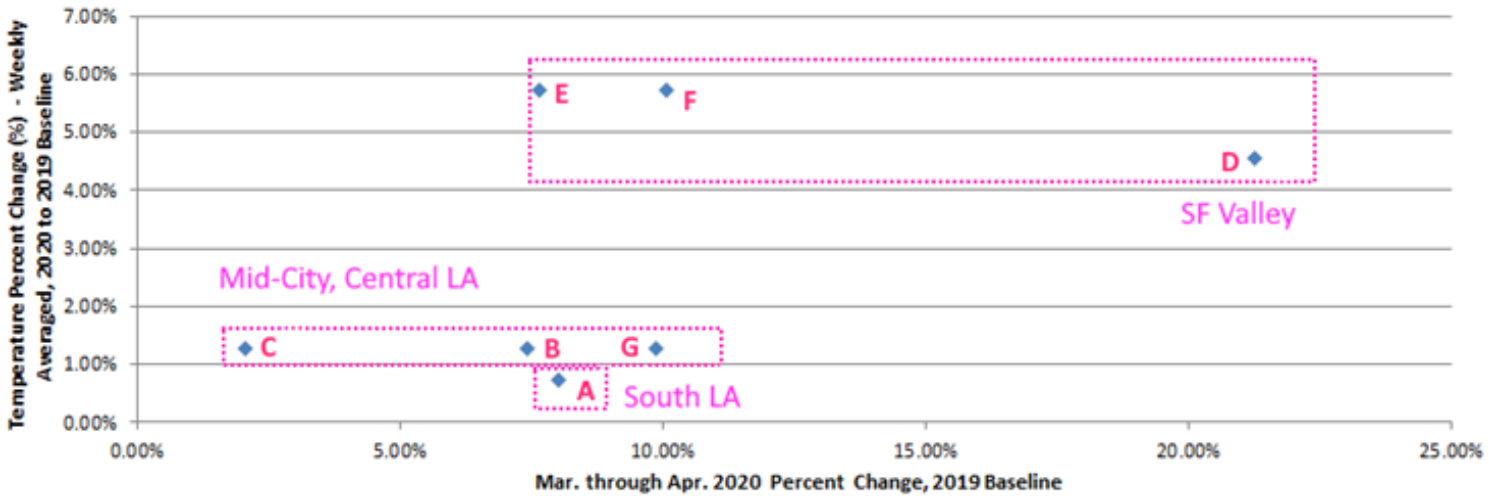
Income Impact on Yearly 2020 Energy Use



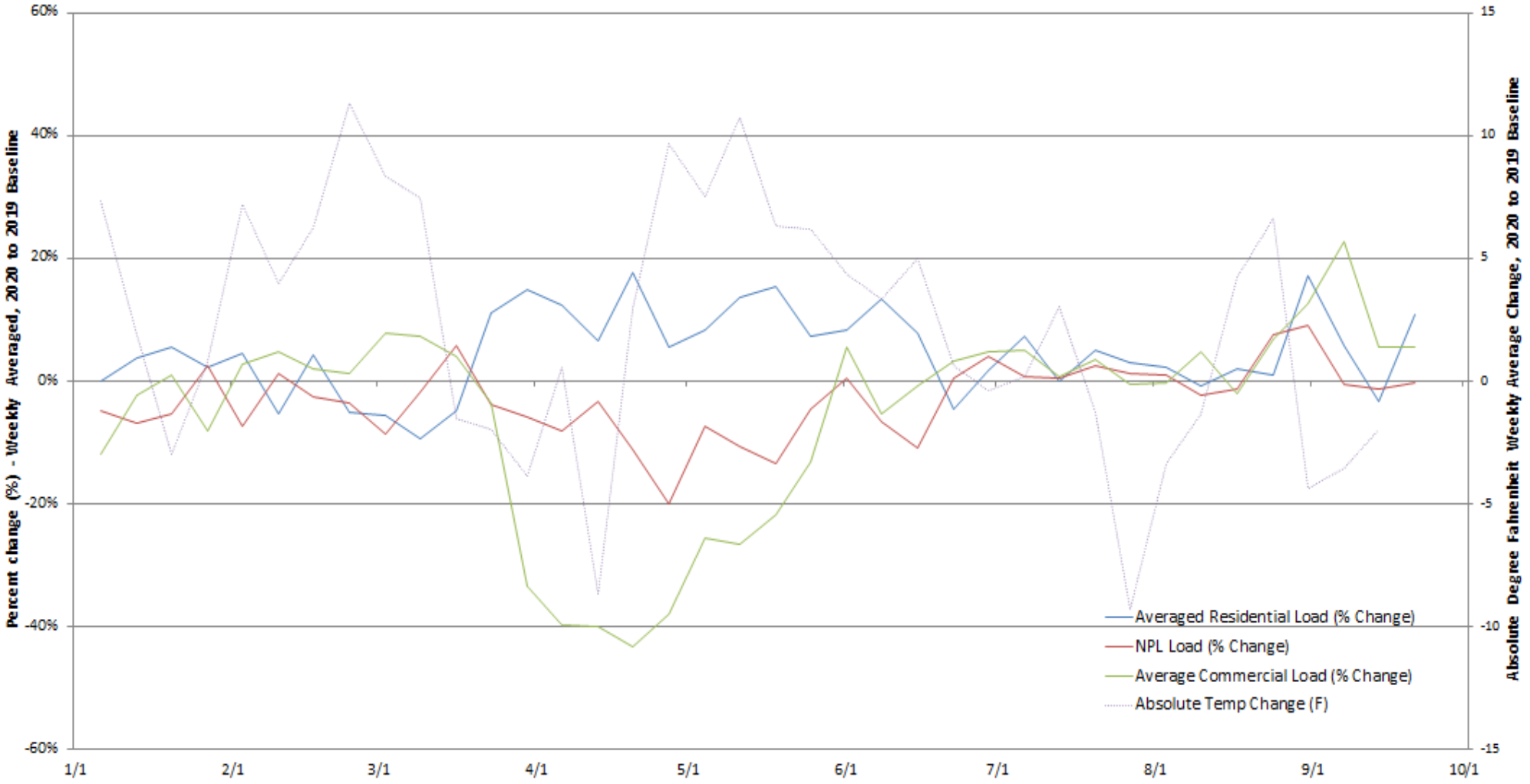
Energy usage percent change in 2020 compared to 2019 baseline versus mean income for each evaluated residential feeder.

Daily Energy Use Changes: Peak SIP

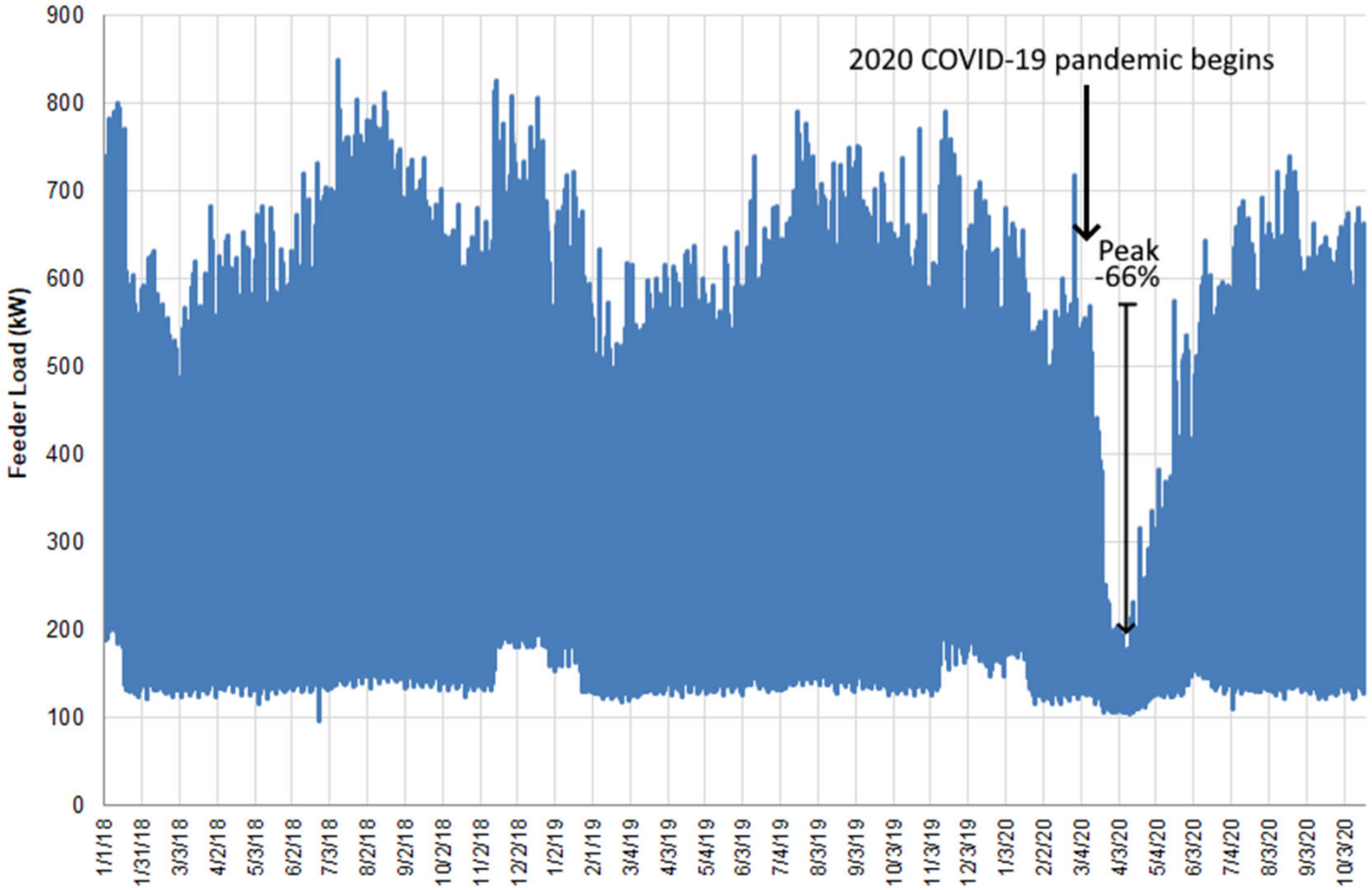




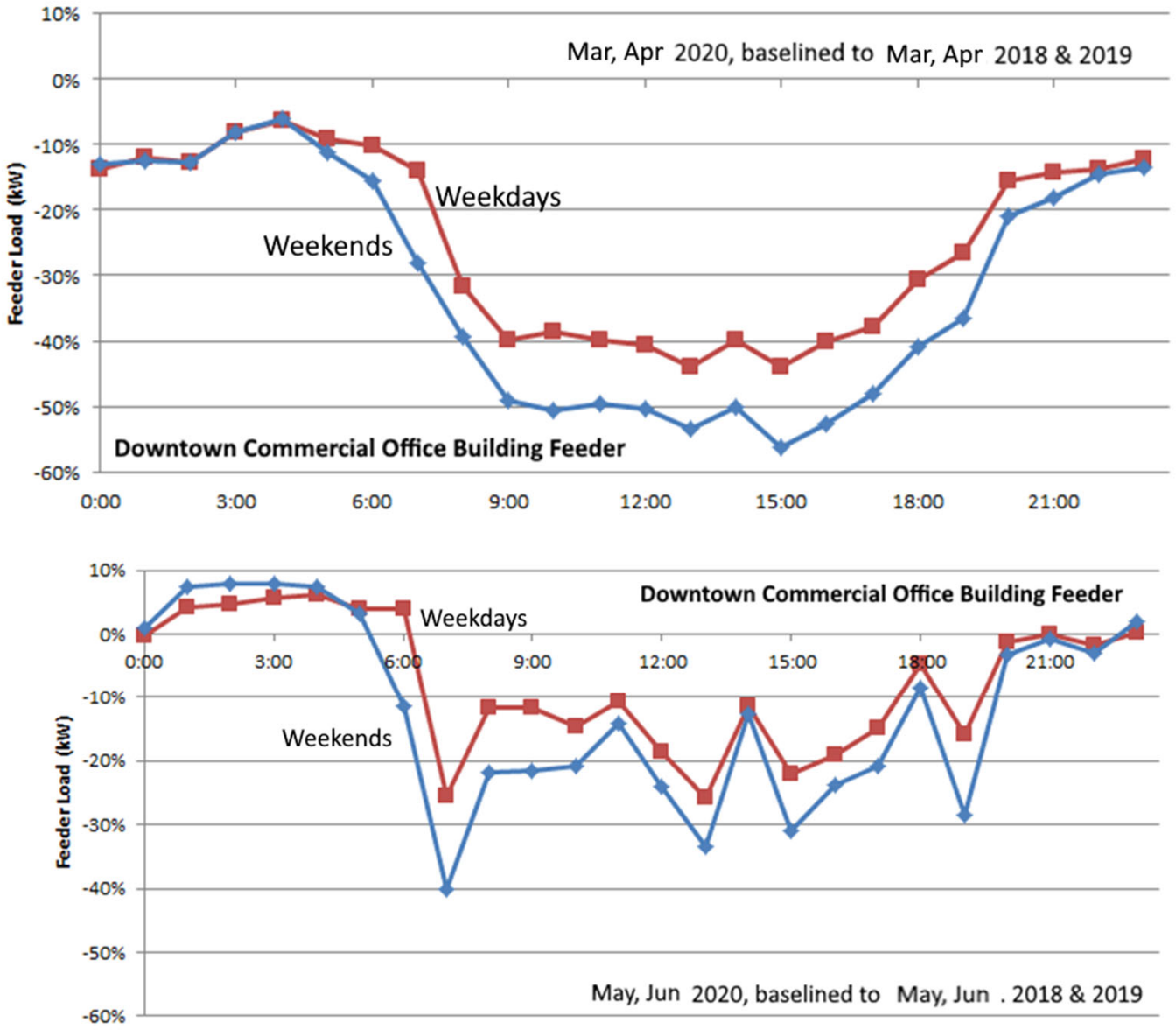
Extended Impact On LADWP System Load



Commercial Example: Daily Load



Commercial Example: Daily Load



Major Conclusions

- Major rapid-onset societal impact due to COVID-19 pandemic + SIP
- Long term equilibrium holding largely irrespective of COVID-19 case numbers
- Expected continued trend, spare major SIP order
- Commercial peak and average substantially stronger than residential
- Change in daily usage patterns patterns still present, temperature sentitive impact is main driver, long term plug load trends possible.

Acknowledgements

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California Plug Load Research Center

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Thank You!

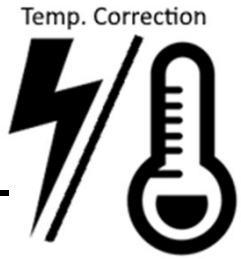
Backup Slides

Results Summary

Residential Energy Change During Shelter-in-Place

+14.2% Average Total Residential Energy Usage Increase

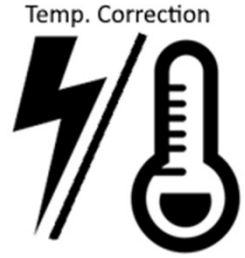
+3.2% to 8.9% Average Normalized Total Increase
(+0.23 to 5.5% Non-Temperature Sensitive)



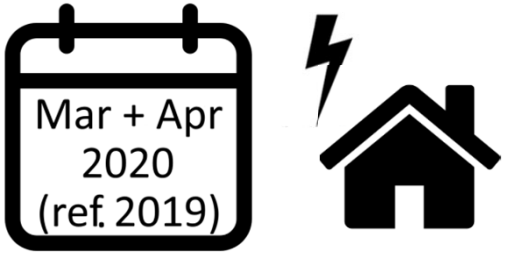
Results Summary

Residential Energy Change During Summer 2020

<u>+2.8% Average Normalized Total Increase</u>
(-0.2% Non-Temperature Sensitive)



Results Summary



Residential Energy Change During Summer 2020

12-1 PM year to year greatest change in usage, at (avg) 16.2%, +5.5% increase in late afternoon peak