CEDU 2020 Preliminary Peak Analysis

Presented to the Demand Analysis Working Group

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Date: October 29, 2020

Introduction

Objectives

- Preview high-impact elements of the IEPR 2020 forecast update
  - Weather normalized peaks
  - Economic impacts
- Engage stakeholders ahead of the year-end IEPR workshop, in time to consider additional input

Caveats

- All results shown here are preliminary
- Update is limited in scope
- Assumes some return to normalcy
- Impacts do not currently reflect revised electric vehicle or self-generation forecasts

Summer 2020 was warm…

DAWG has previously suggested assigning a percentile rank to the peak event day as an approximate indication of the magnitude and direction of any weather adjustment to peak load.

An approach:

1. Calculate a daily historical temperature index consisting of 70 percent daily maximum and 30 percent daily minimum
2. Take the max-value index from each year over the historical record
3. Fit a gumbel distribution to this sample
4. Use the fitted distribution to determine the probability of observing a max index greater than x

…was it a 1-in-x?

Temperature index corresponding to peak load day

TAC	Date	2020 Actual	Max	Min	Avg.70.30	Percentile
PGE	Aug 14	21,065	103.3	71.4	93.73	0.86
SCE	Aug 18	24,246	103.9	73.6	94.81	0.73
SDGE	Sept 5	4,412	100.7	70.3	91.58	0.78

Highest temperature index for each TAC

TAC	Date	Avg.70.30	Percentile
PG&E	Sept 6	95.46	0.93
SCE	Sept 6	100.88	0.97
SDG&E	Sept 6	94.39	0.9

2020 Weather Normalized Peaks

Method Review

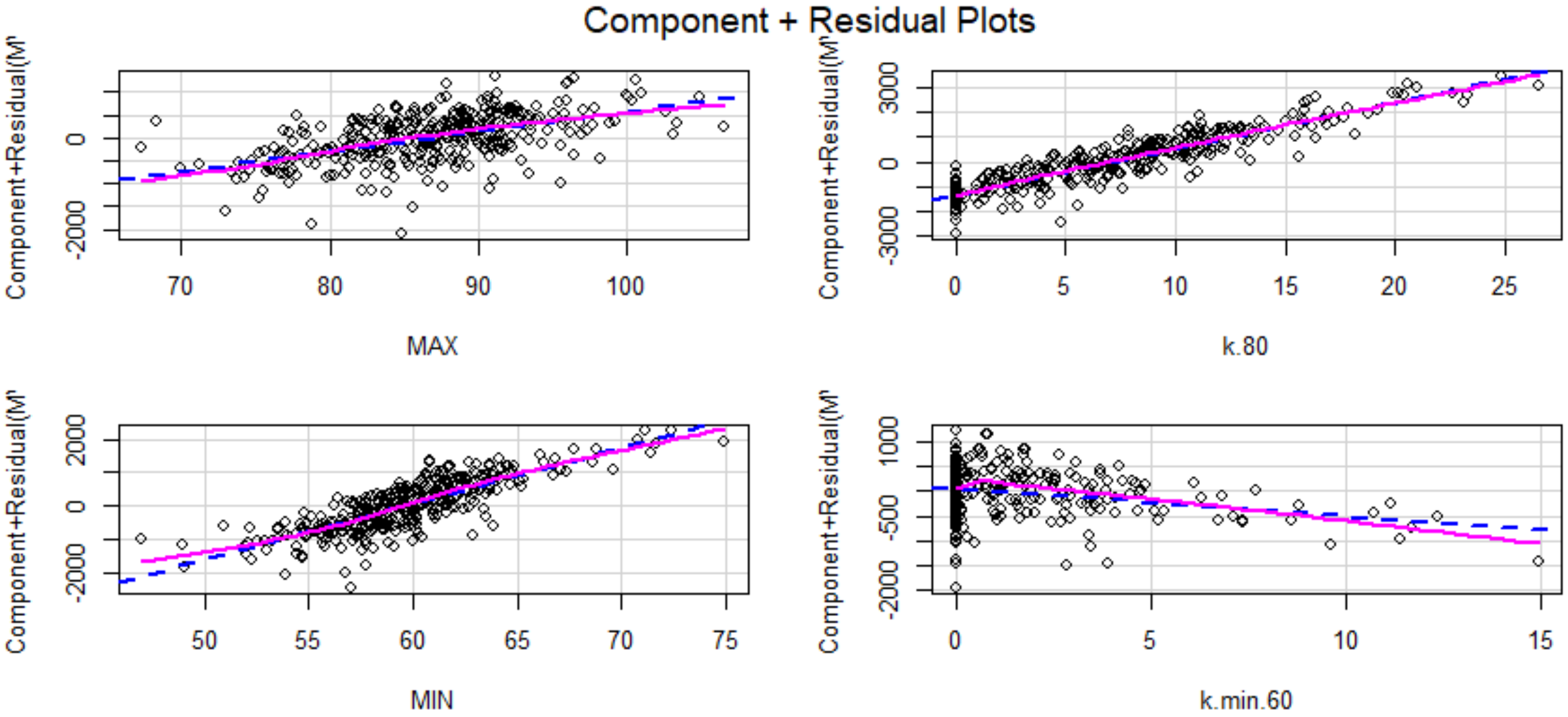
1. Data sources:
   - Hourly system loads by TAC (CAISO)
   - DR called event impact estimates (IOUs)
   - Hourly weather statistics
2. Estimate counter-factual daily peaks after adding DR impacts to recorded system load
3. Regress daily peaks against daily weather statistics and calendar effects using most recent three years of data
4. Use linear model to simulate daily peaks for historical weather years, including error term
5. Taking the maximum simulated value for each year, find the median

PG&E – Model

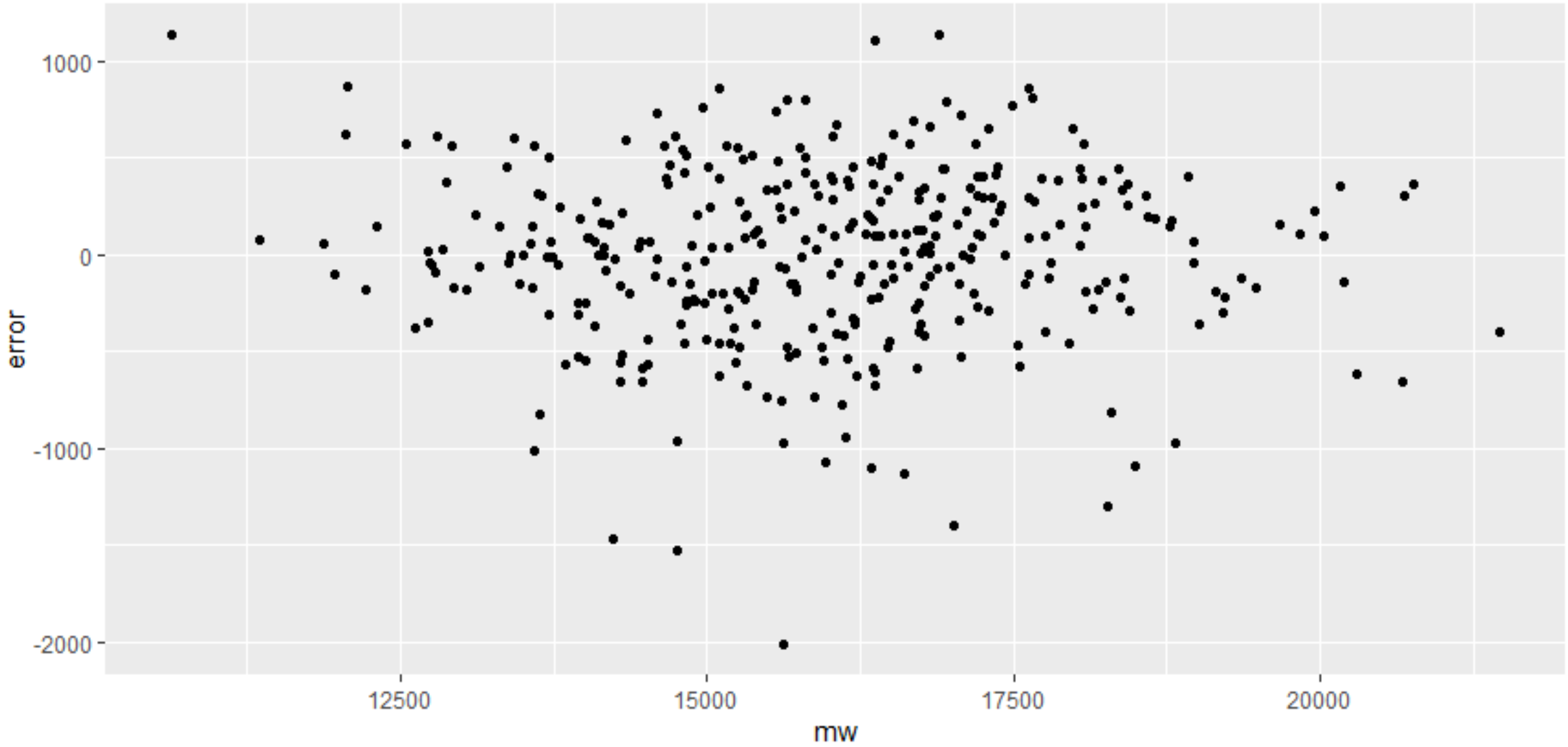
```
MW ~ MAX + k.80 + MIN + k.min.60 +
     DOW + MONTH_7 + MONTH_8 + YEAR_2018 + YEAR_2019

Coefficients:
             Estimate Std. Error t value             Pr(>|t|)
(Intercept)   674.67    1364.83   0.494              0.62138
MAX            43.55      17.45   2.496              0.01303 *
k.80          188.13      20.39   9.228 < 0.000000000000002 ***
MIN           167.67      14.76  11.359 < 0.000000000000002 ***
k.min.60      -55.93      21.14  -2.645              0.00852 **
DOW         -1137.13      52.83 -21.525 < 0.000000000000002 ***
MONTH_7       534.46      62.97   8.488 0.00000000000000576 ***
MONTH_8       562.74      65.02   8.654 < 0.000000000000002 ***
YEAR_2018     600.29      61.17   9.814 < 0.000000000000002 ***
YEAR_2019     243.12      58.54   4.153 0.000041065483439061 ***
---
Residual standard error: 453.9 on 356 degrees of freedom
Multiple R-squared:  0.9423,    Adjusted R-squared:  0.9408
F-statistic: 645.8 on 9 and 356 DF,  p-value: < 0.00000000000000022
```

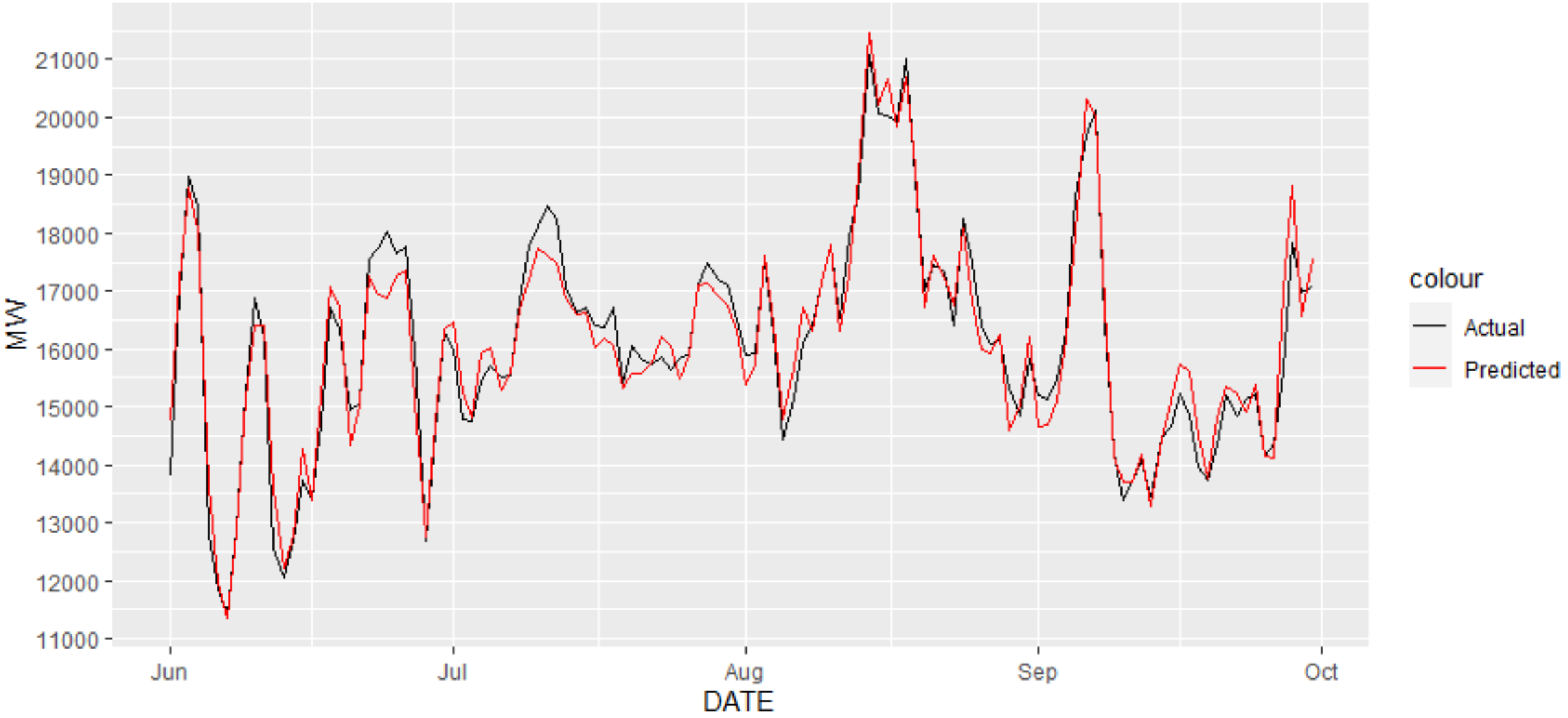
PG&E – Linearity Check



PG&E – Residuals vs Predicted



PG&E - Actual and Predicted, 2020

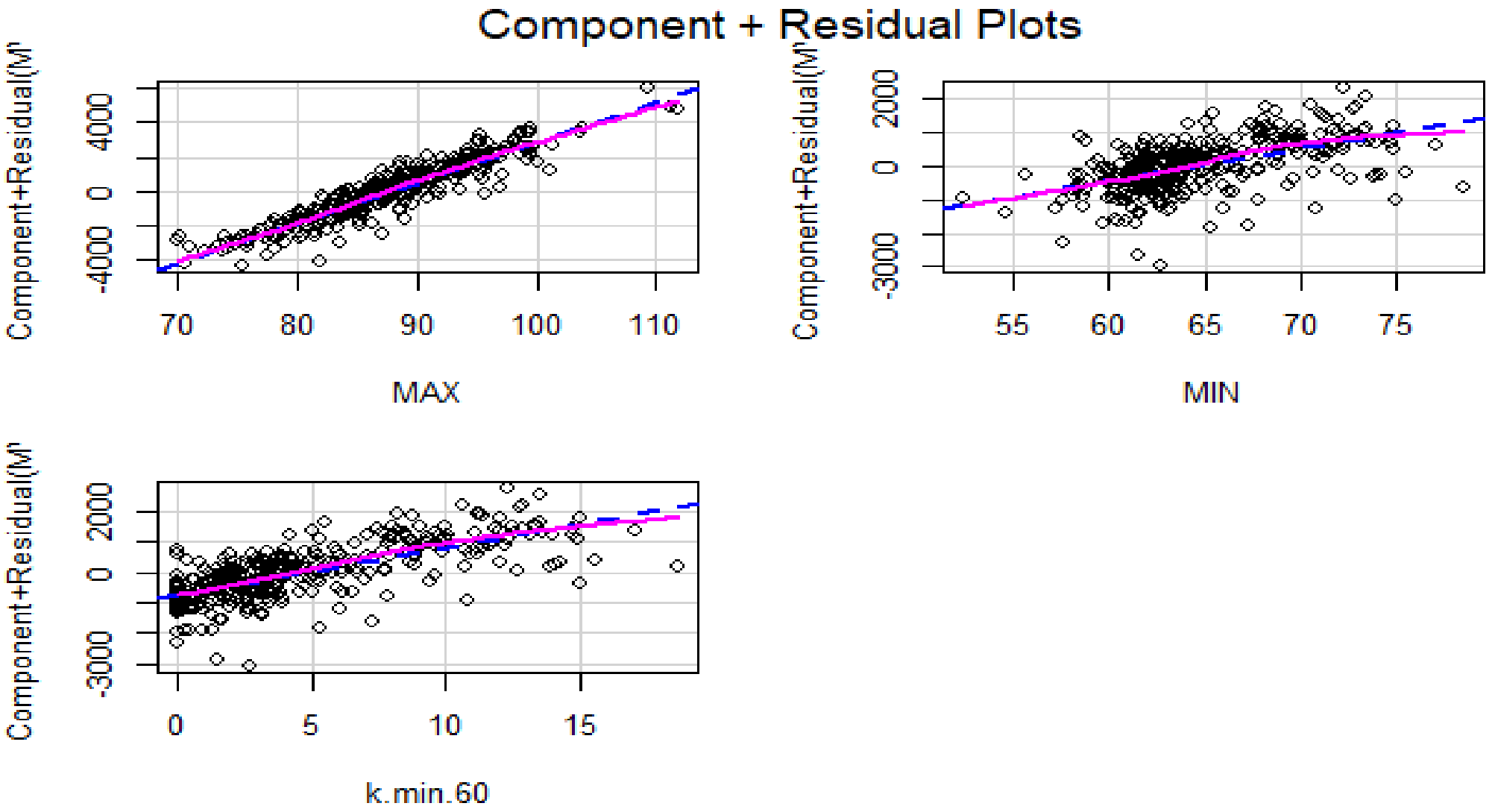


SCE – Model

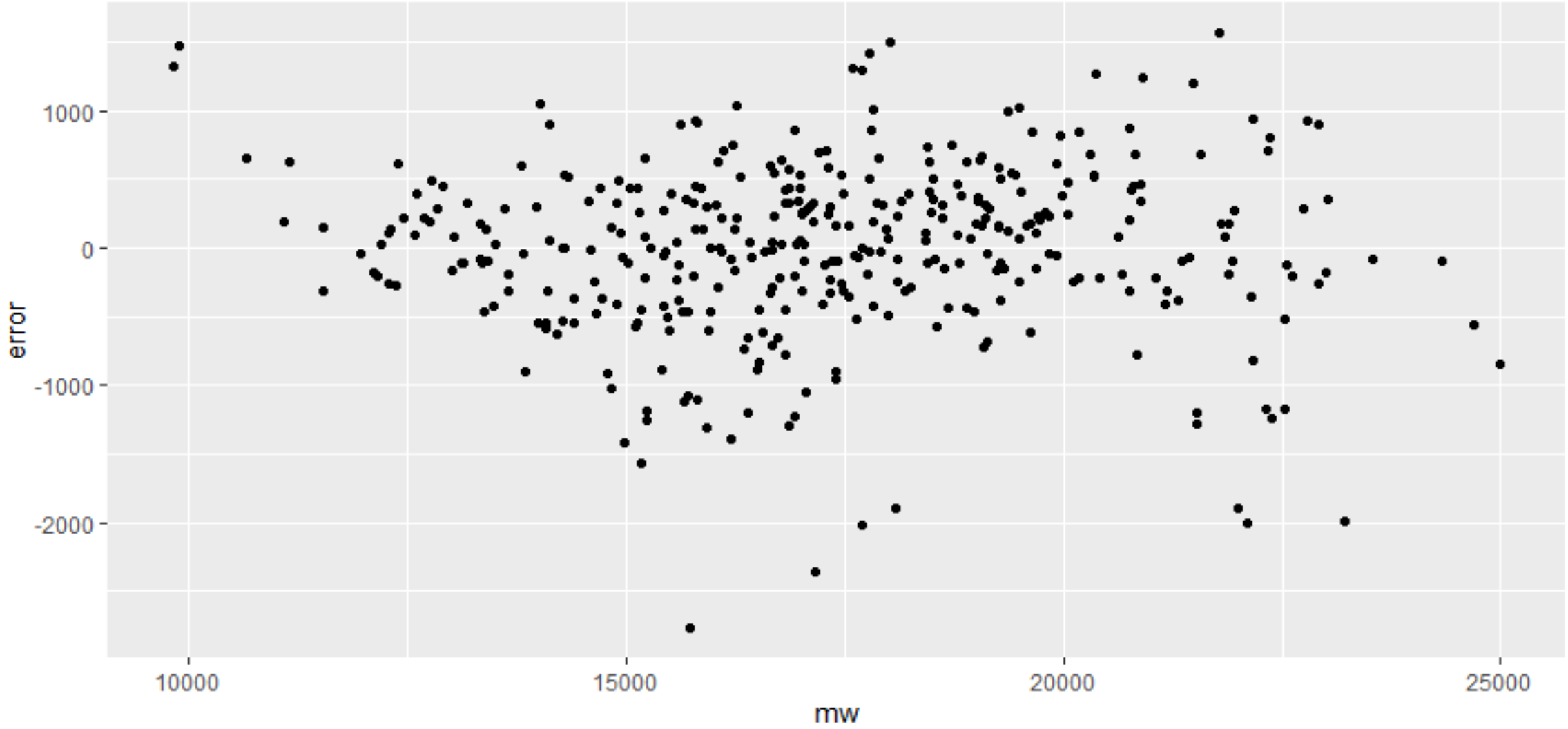
```
MW ~ MAX + MIN + k.min.60 +
     DOW + MONTH_6 + MONTH_7 + MONTH_8 + YEAR_2018 + YEAR_2019

Coefficients:
             Estimate Std. Error t value             Pr(>|t|)
(Intercept) -9975.656   3240.091  -3.079              0.00224 **
MAX           234.930      6.836  34.366 < 0.0000000000000002 ***
MIN            96.841     54.235   1.786              0.07501 .
k.min.60      155.808     56.394   2.763              0.00603 **
DOW         -1548.310     73.329 -21.114 < 0.0000000000000002 ***
MONTH_6      -685.193    101.597  -6.744      0.000000000623 ***
MONTH_7        66.306     96.287   0.689              0.49151
MONTH_8       650.777     98.688   6.594      0.0000000001546 ***
YEAR_2018     418.233     83.081   5.034      0.0000007640854 ***
YEAR_2019     -71.450     82.241  -0.869              0.38555
---
Residual standard error: 637 on 356 degrees of freedom
Multiple R-squared:  0.9537,    Adjusted R-squared:  0.9525
F-statistic: 814.2 on 9 and 356 DF,  p-value: < 0.0000000000000022
```

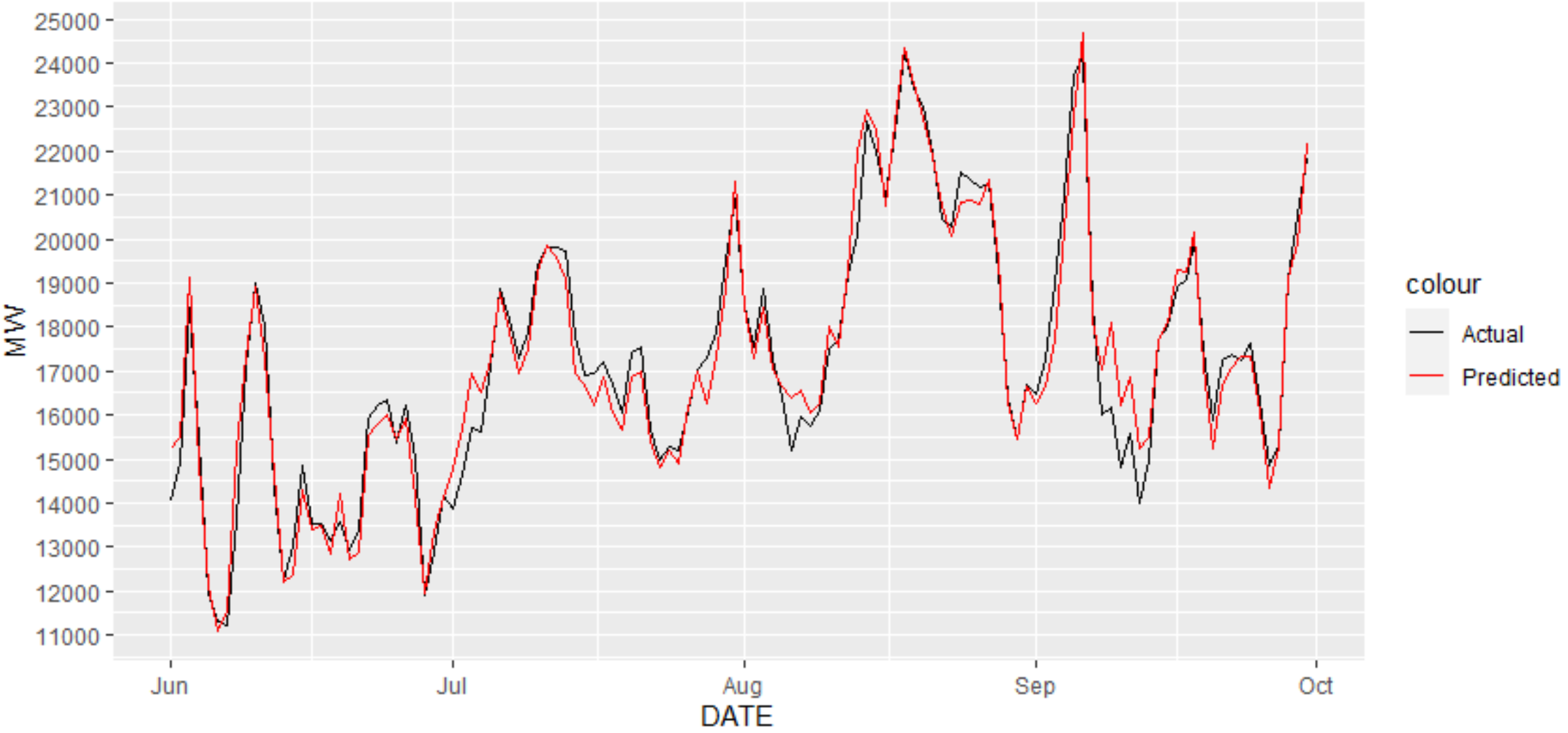
SCE – Linearity Check



SCE – Residuals vs Predicted



SCE - Actual and Predicted, 2020

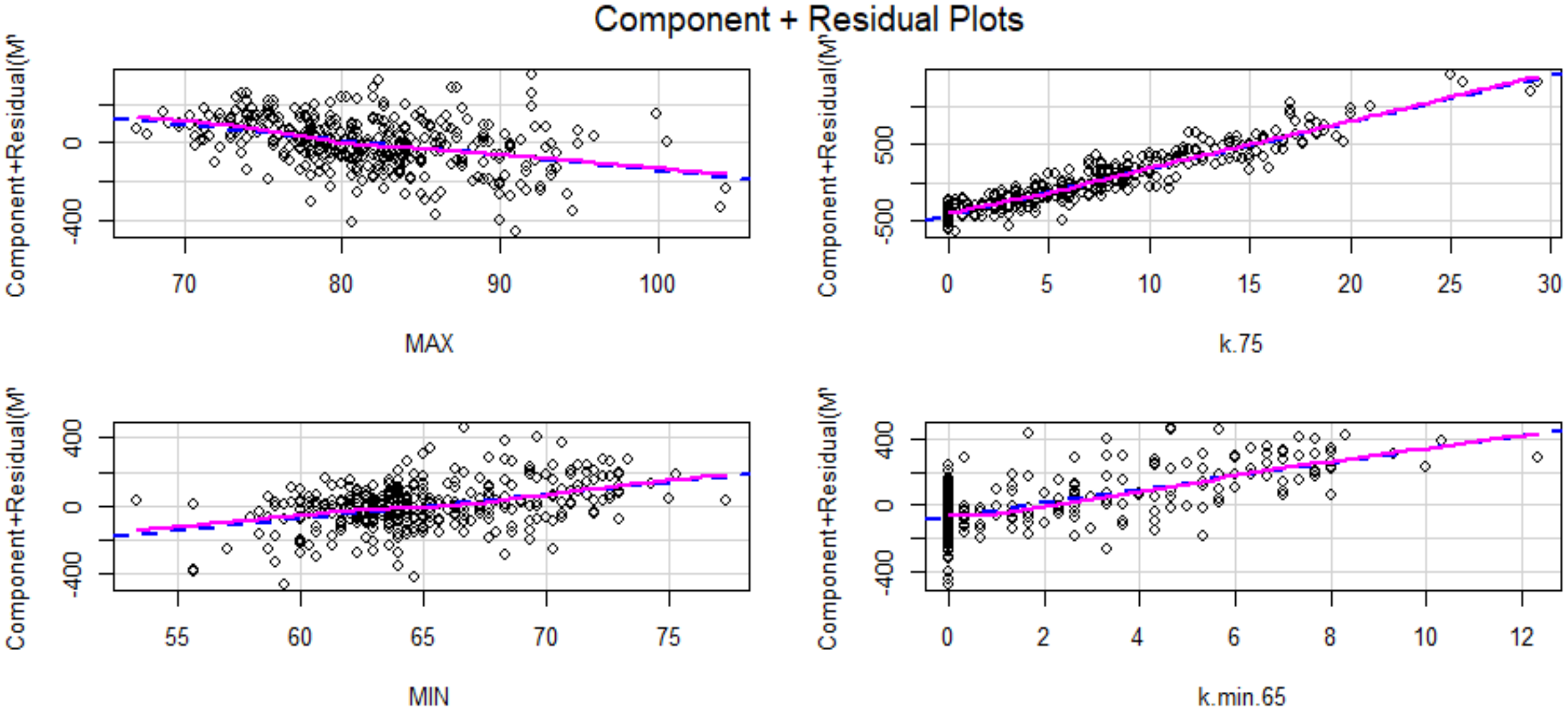


SDG&E – Model

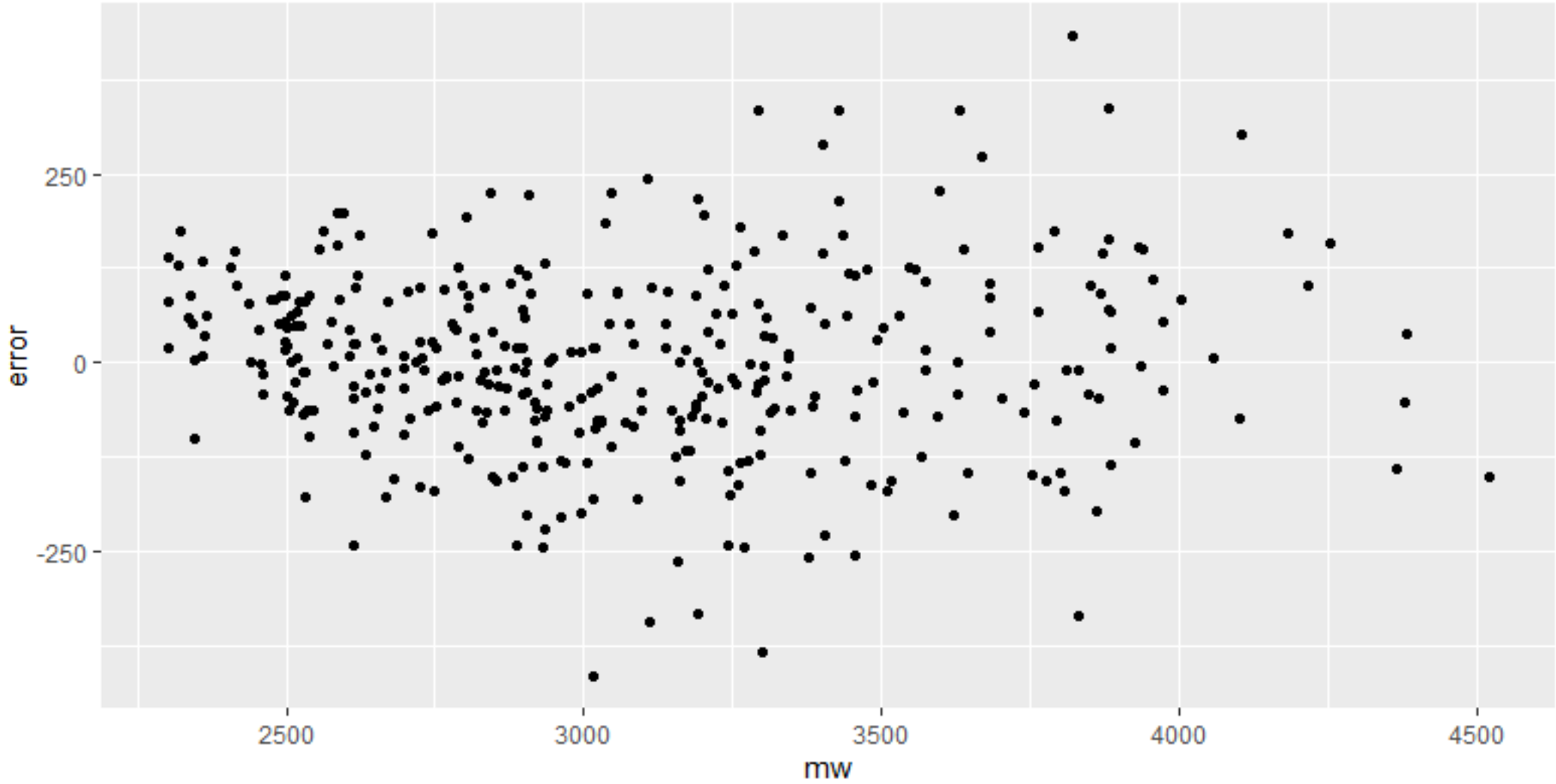
```
MW ~ MAX + k.75 + MIN + k.min.65 +
     DOW + MONTH_6 + MONTH_7 + MONTH_8 + YEAR_2018 + YEAR_2019

Coefficients:
             Estimate Std. Error t value             Pr(>|t|)
(Intercept) 2433.885    575.522   4.229 0.000029901227367307 ***
MAX           -7.969      6.719  -1.186             0.236399
k.75          61.513      7.218   8.522 0.000000000000000454 ***
MIN           14.337      4.105   3.492             0.000539 ***
k.min.65      40.127      6.209   6.463 0.000000000338840518 ***
DOW         -178.797     14.346 -12.463 < 0.000000000000002 ***
MONTH_6     -229.973     22.031 -10.439 < 0.000000000000002 ***
MONTH_7     -131.039     18.823  -6.962 0.000000000016329029 ***
MONTH_8      -29.006     19.872  -1.460             0.145270
YEAR_2018     81.688     16.748   4.877 0.000001624651716356 ***
YEAR_2019    -13.101     16.109  -0.813             0.416601
---
Residual standard error: 123.8 on 355 degrees of freedom
Multiple R-squared:  0.9369,    Adjusted R-squared:  0.9351
F-statistic:   527 on 10 and 355 DF,  p-value: < 0.00000000000000022
```

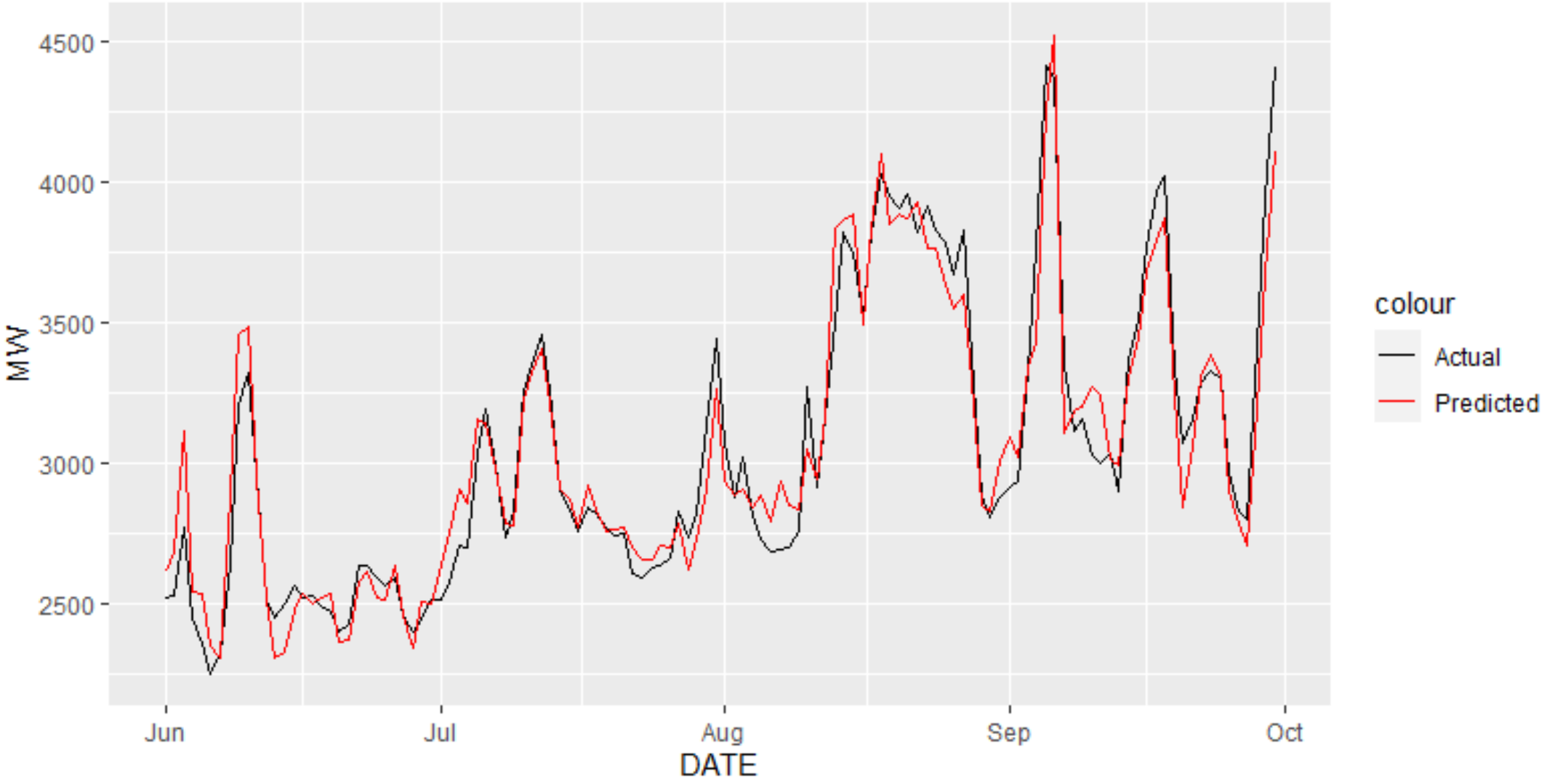
SDG&E – Linearity Check



SDG&E – Residuals vs Predicted



SDG&E - Actual and Predicted, 2020



Simulation Results

	MAPE		Simulation Results	
	Overall	Top 10	Without Error	With Error Term
PGE	2.20%	1.36%	20,287	20,370
SCE	2.76%	3.00%	23,069	23,364
SDGE	3.04%	4.39%	4,134	4,173

	CED 2019	
	2019 Normalized	2020 Forecast
PGE	20,779	20,486
SCE	23,623	23,343
SDGE	4,194	4,138

Peak weather variants

- 1-in-x weather variants are derived by applying a constant factor to each year of the 1-in-2 annual peak forecast
- Related to the weather normalization process, these factors are derived by examining historical weather patterns
- Staff are not proposing to alter these factors for the current update
- EAD will coordinate with ERDD to examine ways in which planned climate modeling efforts might inform our expectation of load variation over time

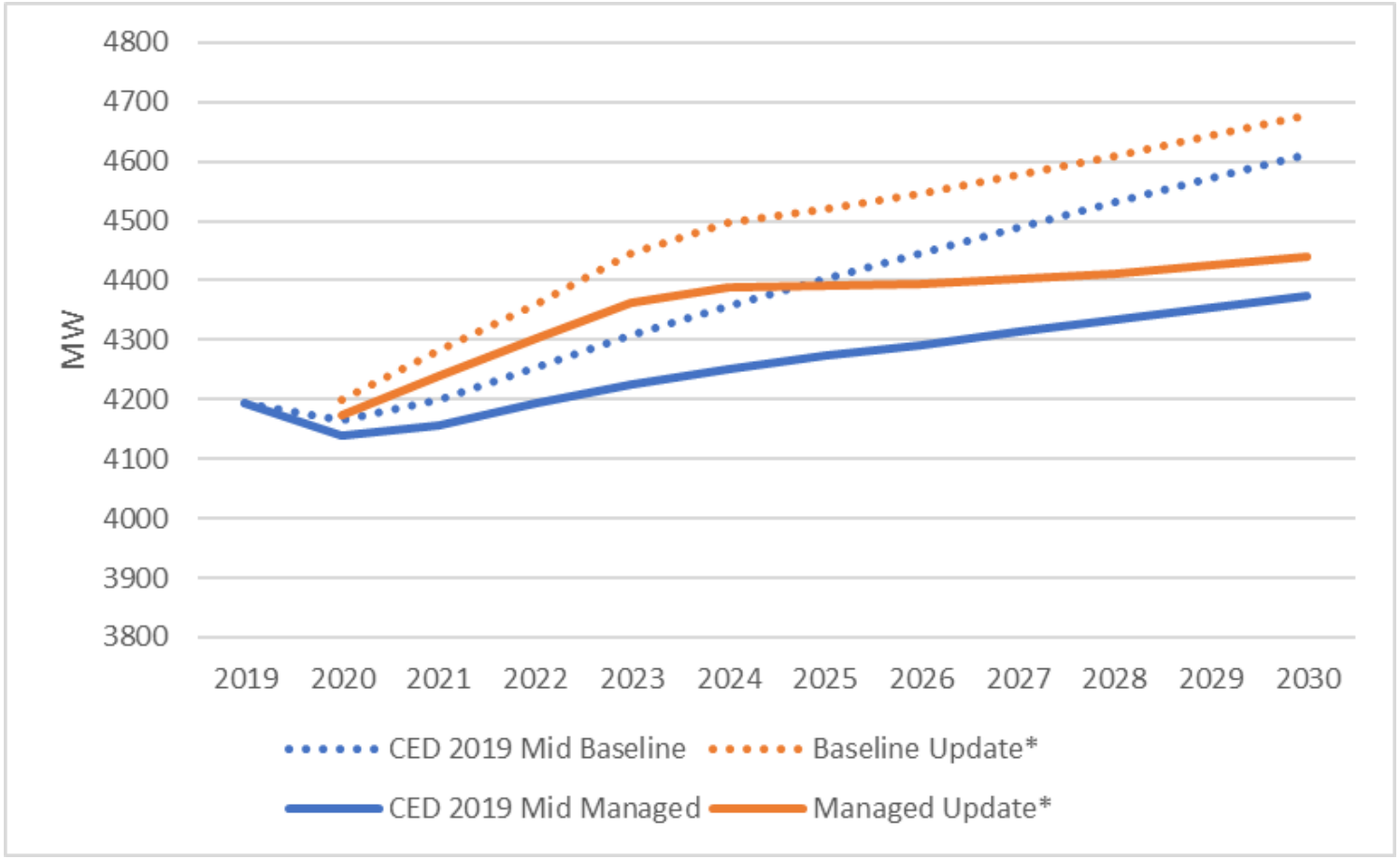
Peak Forecast Impact

What has changed

- Updated annual consumption forecasts have been applied to CED 2019 hourly load ratios
- All demand modifiers are (currently) unchanged
- Load ratio profile has been adjusted such that managed net peak aligns with the weather normalized annual peak in 2020
- Changes in growth rate reflect changes in underlying economic projections
  - Near term recovery period drives increased growth relative to CED 2019 assumptions
  - Lower long term growth
- Timing of SCE peak shift

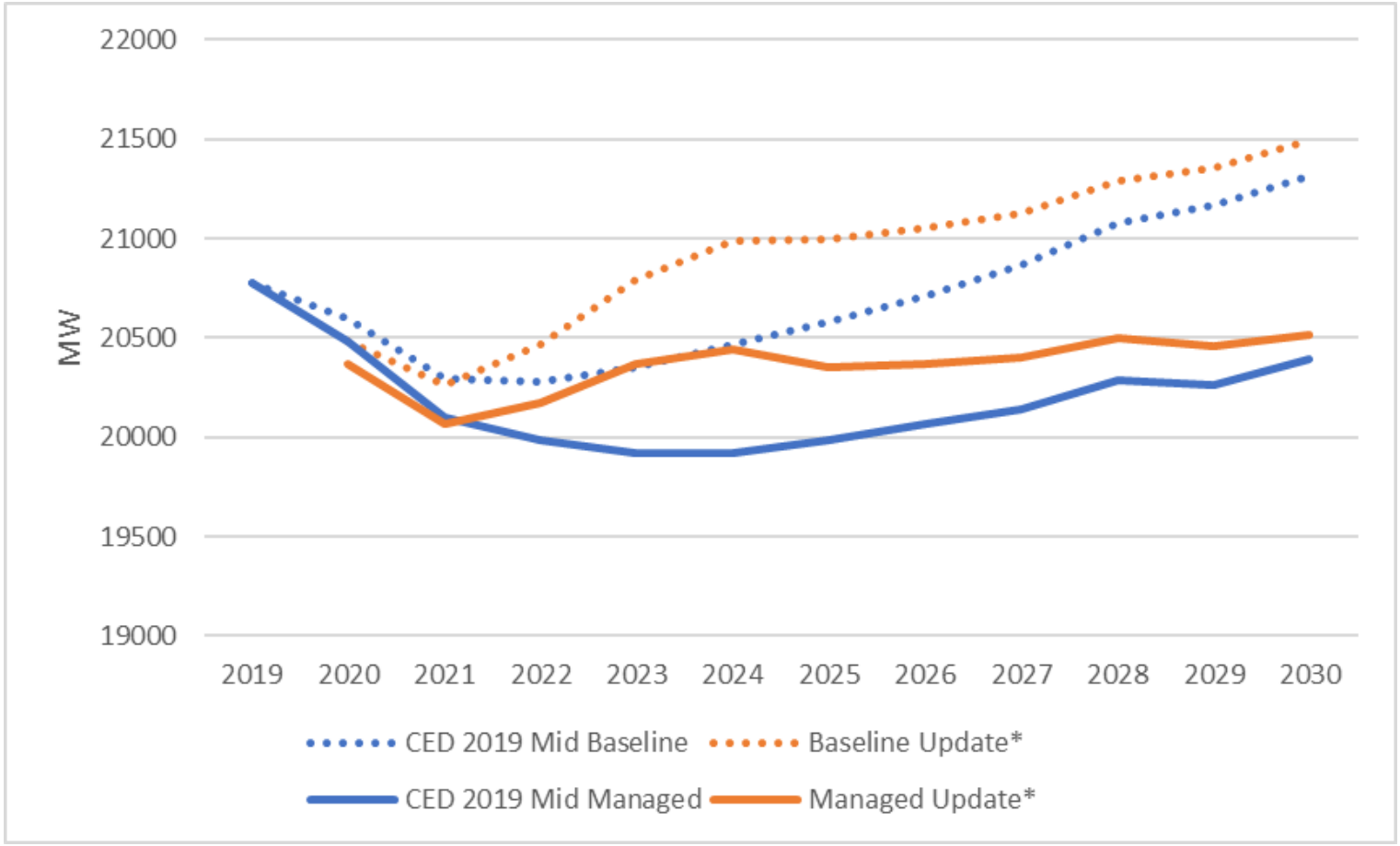
SDG&E – Annual Peak Comparison

Peak Hour		
YEAR	CED 2019	Update*
2019	19	
2020	19	19
2021	19	19
2022	19	19
2023	19	19
2024	19	19
2025	19	19
2026	19	19
2027	19	19
2028	19	19
2029	19	19
2030	19	19



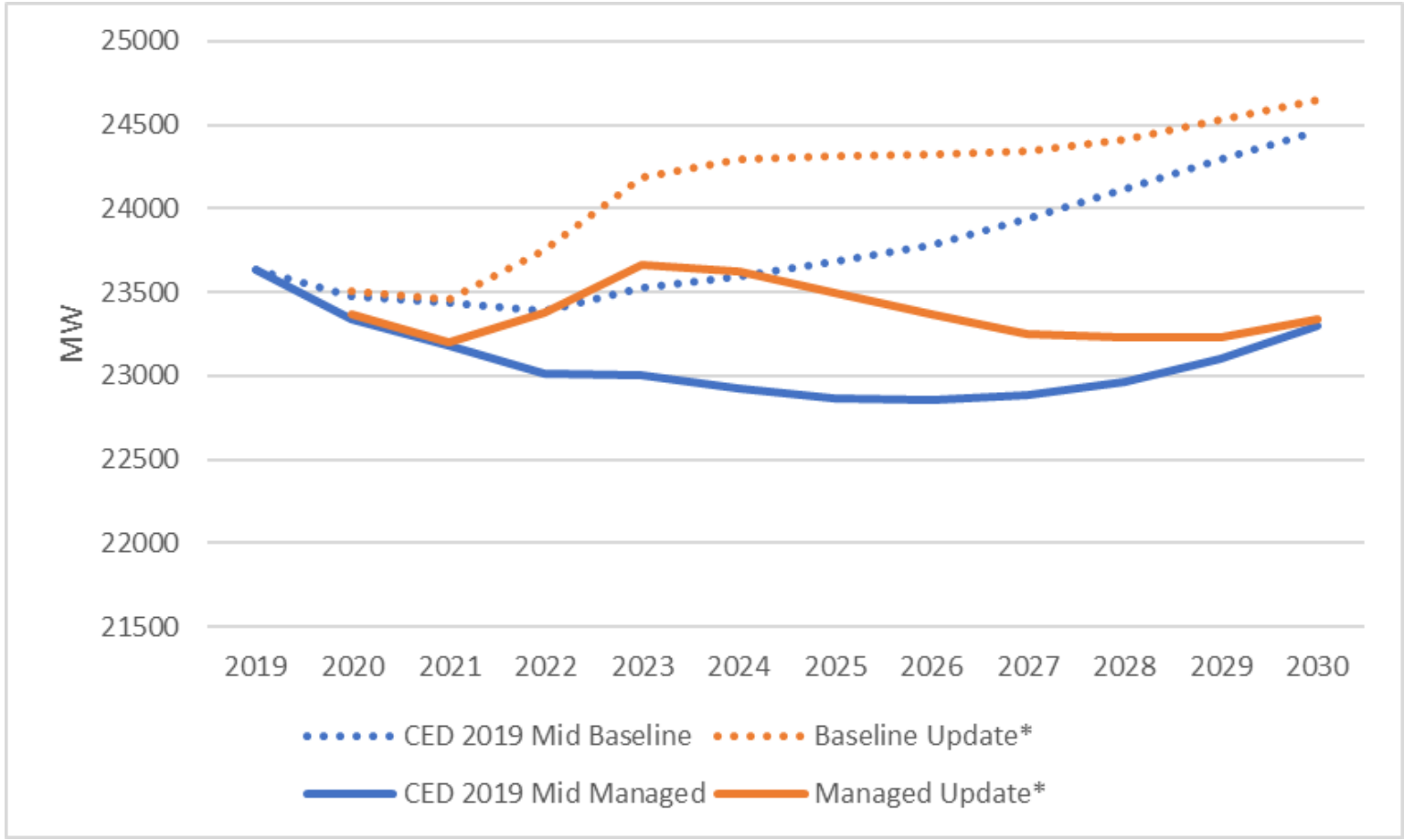
PG&E – Annual Peak Comparison

Peak Hour		
YEAR	CED 2019	Update*
2019	17	
2020	17	17
2021	18	18
2022	18	18
2023	18	18
2024	18	18
2025	19	19
2026	19	19
2027	19	19
2028	19	19
2029	19	19
2030	21	21



SCE – Annual Peak Comparison

Peak Hour		
YEAR	CED 2019	Update*
2019	15	
2020	16	15
2021	16	16
2022	16	16
2023	16	16
2024	16	16
2025	16	16
2026	17	16
2027	17	17
2028	19	17
2029	19	17
2030	19	19



Additional changes

- Underlying consumption forecast projects a significant decline from 2019 to 2020
- Observed summer loads do not indicate a comparable decline in peak load from 2019 to 2020
- Has the effect of propagating the abnormal 2020 load factor through the forecast, causing significant near term growth in peak
- One option could be to calibrate only 2020 hourly loads to 2020 weather normal peak, but subsequent years to 2019
- Staff welcome additional insights on near term peak projections

Next Steps

- Further discussion with stakeholders as staff revise and complete the forecast
- November DAWG meeting
  - Updated self-gen and electric vehicle forecasts
  - Further-revised sales and annual peak forecasts
  - CAISO-coincident and monthly peaks
- December 3 IEPR workshop
- January CEC Business Meeting
- January/February IEPR Workshop
  - Economic outlook
  - Structural changes to transportation and business practices

Thank You!