

Electric Supply Portfolio RPS Compliance Strategy

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Purpose & Outline

1. Seek affirmation of UAC support for four actions:
 - A. To seek Council approval of a carbon accounting methodology using average hourly emissions factors
 - B. To sell RPS supplies exceeding the City's annual load
 - C. To end consideration of a "Carbon Neutral Every Hour" portfolio strategy
 - D. To end consideration of using the City's banked RECs for RPS compliance
2. Present refined strategy options for complying with the state's Renewable Portfolio Standard law:
 - A. Current Portfolio
 - B. Sell Renewables > Load (while remaining Carbon Neutral)
 - C. Trade In-State Renewables > RPS Requirement for Out-of-State Renewables
3. Discuss implications of these potential changes.

Part 1:

Affirmation of UAC Support for Various Portfolio Strategies

Seek Affirmation of UAC Support for Four Actions

A. Carbon Accounting Methodology:

- Requesting UAC affirmation that portfolio emissions should be evaluated using an hourly average grid emissions approach.
- If affirmed, staff to return with amendment to Carbon Neutral Plan for UAC recommendation and Council approval.

B. To sell RPS supplies exceeding the City's annual load (while staying carbon neutral using hourly accounting)

- Sales of RPS supplies would save ratepayers about \$1.2 million / year.
- Electric portfolio would go from net carbon negative (on an hourly basis) to net zero carbon.
- Consistent with existing energy supply planning policies and can be implemented based on existing Council-granted authorities.
- Requesting affirmation that this is consistent with UAC policy positions.

Seek Affirmation of UAC Support for Four Actions

C. To end consideration of a “Carbon Neutral Every Hour” portfolio strategy for now

- “100% renewable” option instead of “100% carbon neutral” - renewable energy supply to match load in each hour of the year.
- Very costly compared to current portfolio, no impact on net carbon emissions.
- Recommending against further consideration of this option at this time.

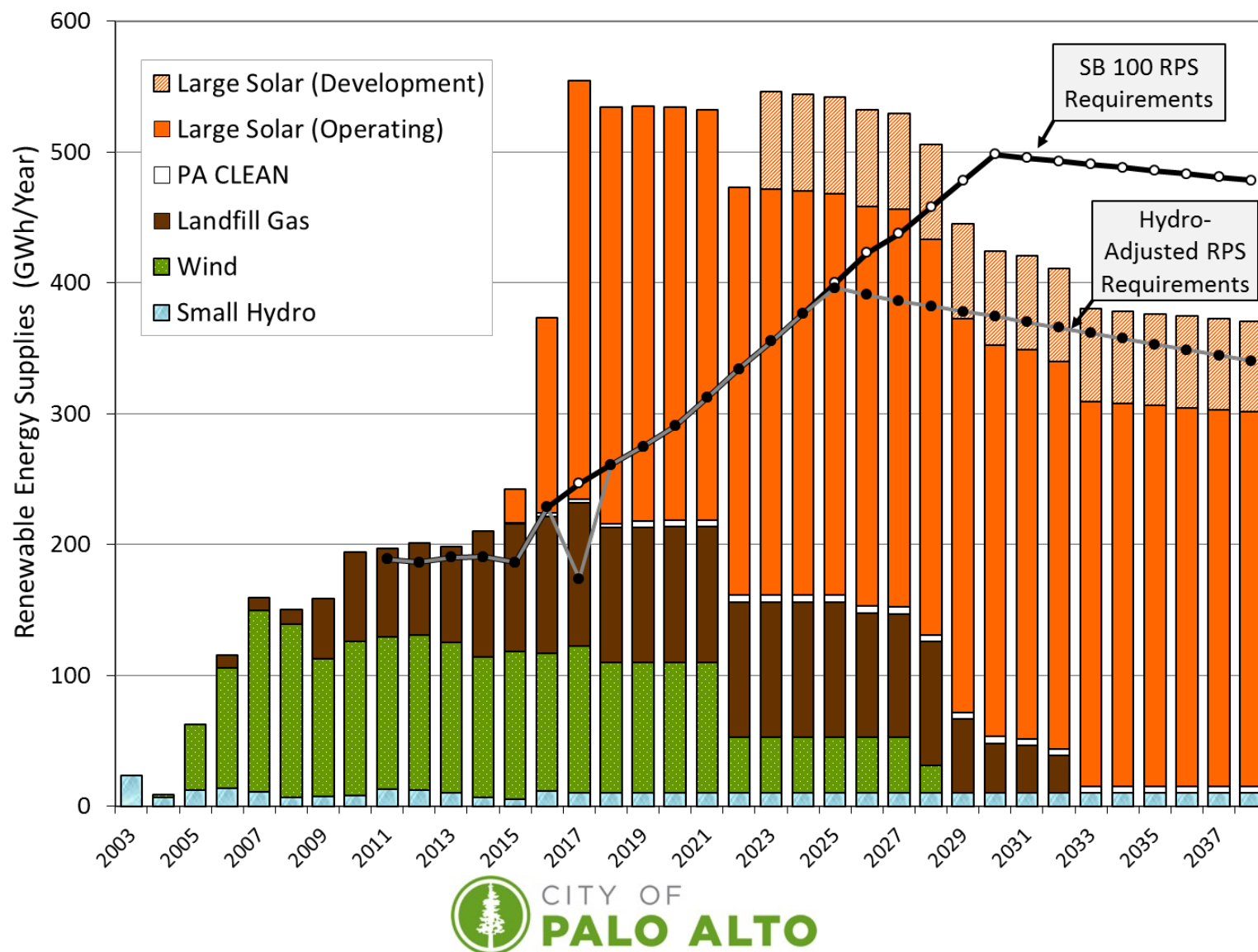
D. To end consideration of using the City’s banked RECs for RPS compliance for now

- City has accumulated a “bank” of RECs generated in previous years but not used for compliance.
- Could use these RECs for RPS compliance, reducing the amount of RPS supply we buy to very low levels.
- Recommending against further consideration of this option at this time.

Part 2: Refined RPS Compliance Strategy Options

Background – CPAU Renewable Supplies

- Palo Alto's renewable energy supplies greatly exceed state requirements



Refined RPS Compliance Strategy Options

Portfolio Options	Note	Annual Carbon-Free Supplies (as % of Annual Load)*	In-State Carbon-Free Resources (as % of Annual Load)*
1) Current Portfolio	Business-as-usual	110%	110%
2) Sell renewables > Load (remain Carbon Neutral w/ hourly accounting)	Staff intends to implement this, seeks UAC affirmation	104.5%	104.5%
3) Trade in-state renewable energy > RPS requirement for out-of-state renewable energy	Staff would like to explore this, seeking UAC feedback	100%	75% (25% out-of-state renewables)

**in an average hydro year*

Additional Option to Explore:

- Customer rate option with higher (or lower) renewable content

Part 3: Implications of RPS Compliance Strategy Changes

Effects of RPS Compliance Strategies (2019-2030)

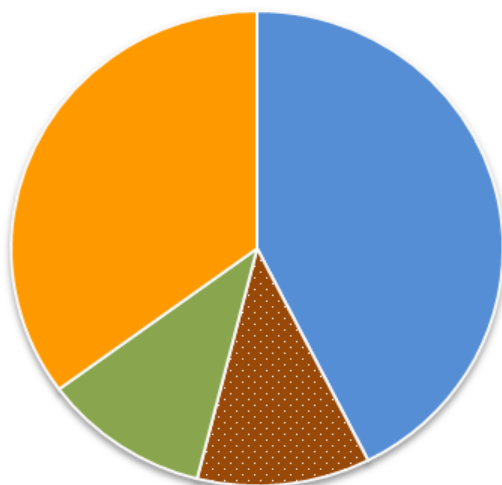
<i>Annual Averages</i>	1) Current Portfolio	2) Sell Supplies > Load (& Remain CN)	3) Sell Supplies > RPS Req.
Supply Cost Savings (\$M)	---	\$1.2	+\$1.9 (\$3.1 total)
Retail Rate Impact (%)	---	-0.7%	-1.2% (-1.9% total)
RPS Level	60%	51%	40%
Emissions Intensity (Hourly Accounting) (lb CO2/MWh)	-79	0	137 (0 w/ RECs)
Emissions Intensity (Power Content Label) (lb CO2/MWh)	-119	-43	97

Potential Uses of Revenue

- **Reducing electric rates (\$1.9M is just over a 1% reduction)**
- **Building electrification & decarbonization programs**
- **AMI investment**
- **EV infrastructure investment/incentives**
- **Second transmission line**

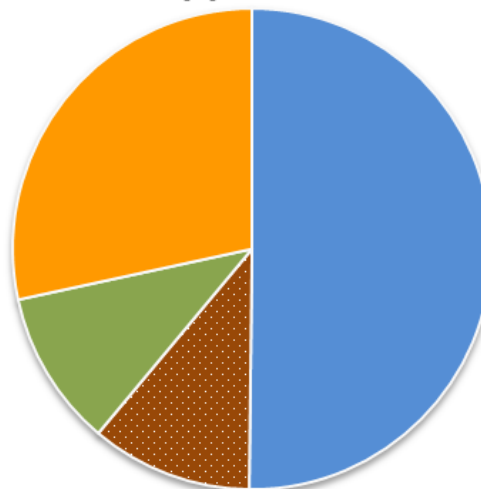
PCLs of Various RPS Compliance Strategies (2020)

Current Portfolio



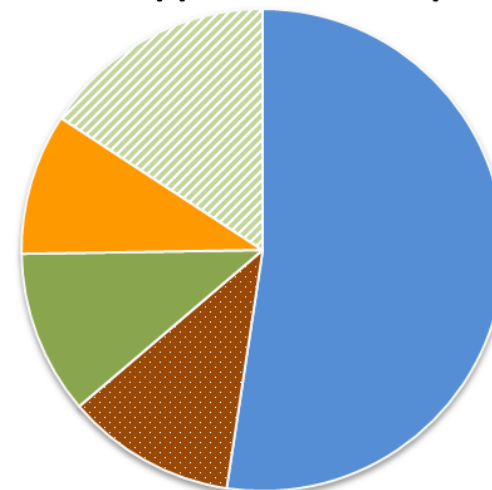
*Projected
Supply Cost:
\$84M*

Sell Supplies > Load



*Save \$1.2M
(0.7%)*

Sell Supplies > RPS Req.



*Save \$3.1M Total
(Add'l \$1.9M)
(1.9% total)*

■ Hydro ■ Landfill Gas ■ Wind ■ Solar ■ Market Power + RECs

Premium Rate Option

- **Hybrid Approach:** Customers can choose a “premium rate” (Status Quo portfolio or even Carbon Neutral Every Hour) or a lower cost option (Sell Supplies > RPS Requirement)
- **Challenges:**
 - Which rate is the default?
 - Customer confusion
 - Uncertain supply needs
 - Implementation costs (staff time, money)
- **Rate Impact:** Lower cost rate option would be only ~2% less (0.34 ¢/kWh) than Premium rate

Next Steps

- Staff will return to the UAC later this year with an amendment to the Council-approved Carbon Neutral Plan, then take it to the Finance Committee and Council.
- Staff will also share its planned RPS strategy and seek validation of any significant changes.
- Staff will also seek feedback from the environmental community on the environmental merits of trading in-state renewables for out-of-state renewables prior to returning to the UAC.
- Staff will implement any changes to portfolio strategy
- Staff will also bring a series of reports to the UAC and Council in early 2020 about the 2025 Western contract renewal and the potential for rebalancing the City's supply portfolio.

QUESTIONS?



Part 1-A: Affirmation of UAC Support for Hourly Carbon Accounting

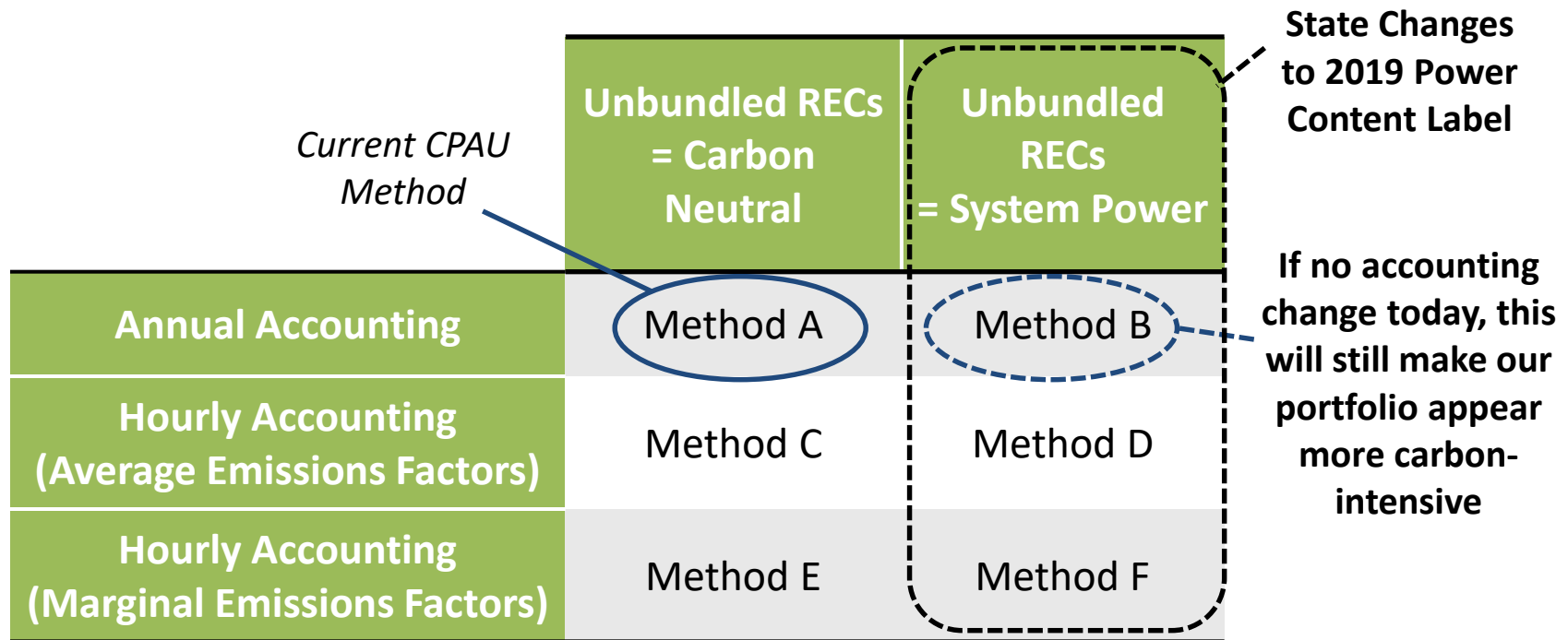
Alternative Carbon Emissions Accounting Methodologies

- **Today's Discussion:**

- Time-step Granularity: **Annual** vs. **Hourly** Accounting
- Emissions Intensity: **Average** vs. **Marginal** Emissions (for Hourly Accounting)

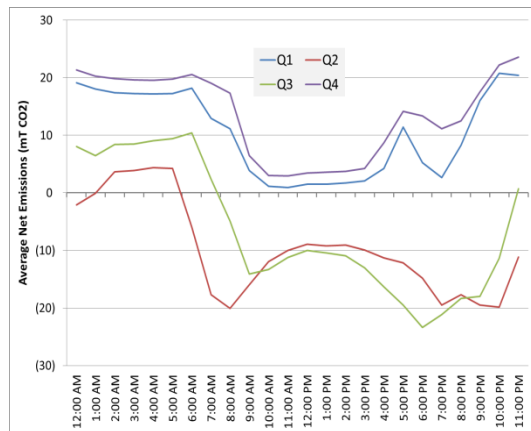
- **State 2019 Changes:**

- Unbundled RECs (which we deem Carbon Neutral) will be treated as System Power

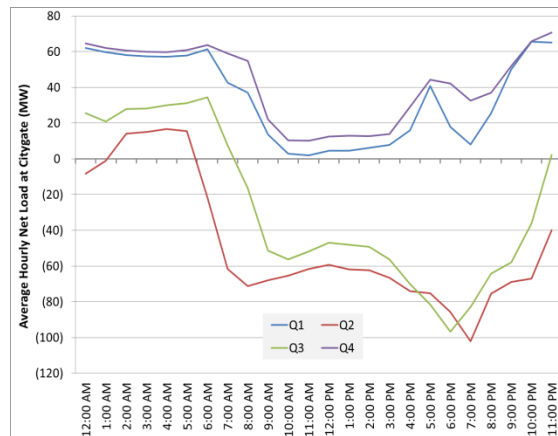


Calculation of Palo Alto's 2018 Emissions on an Hourly Basis

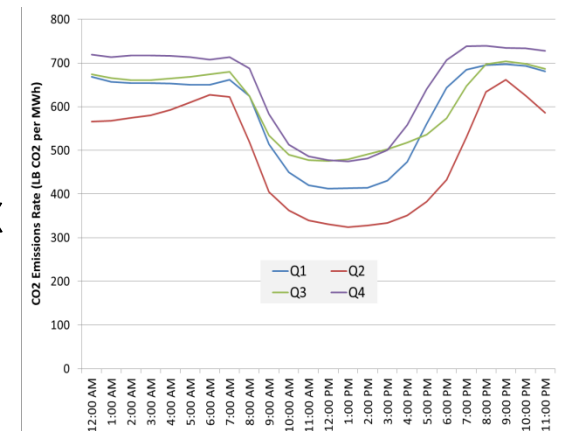
$$\text{Total Emissions} = \sum_{h=1}^{8760} \text{Net Load}_h * \text{Average Emissions Intensity}_h$$



=

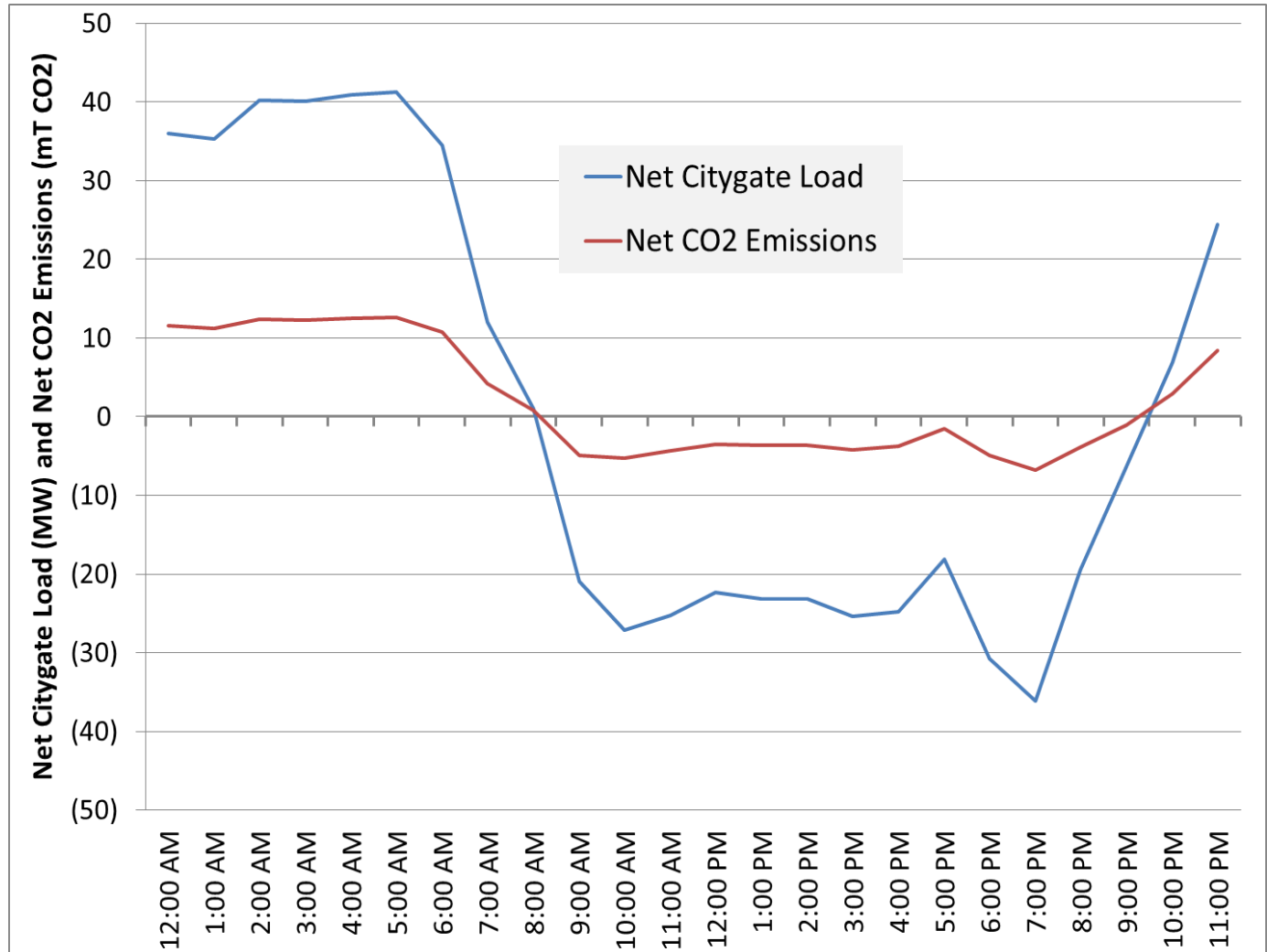


X



2018 Average Net Load & Total Emissions

Net Annual
Emissions:
16,118 mT CO₂



2018 Total Emissions by Accounting Methodology

After purchase of 3,638 unbundled RECs

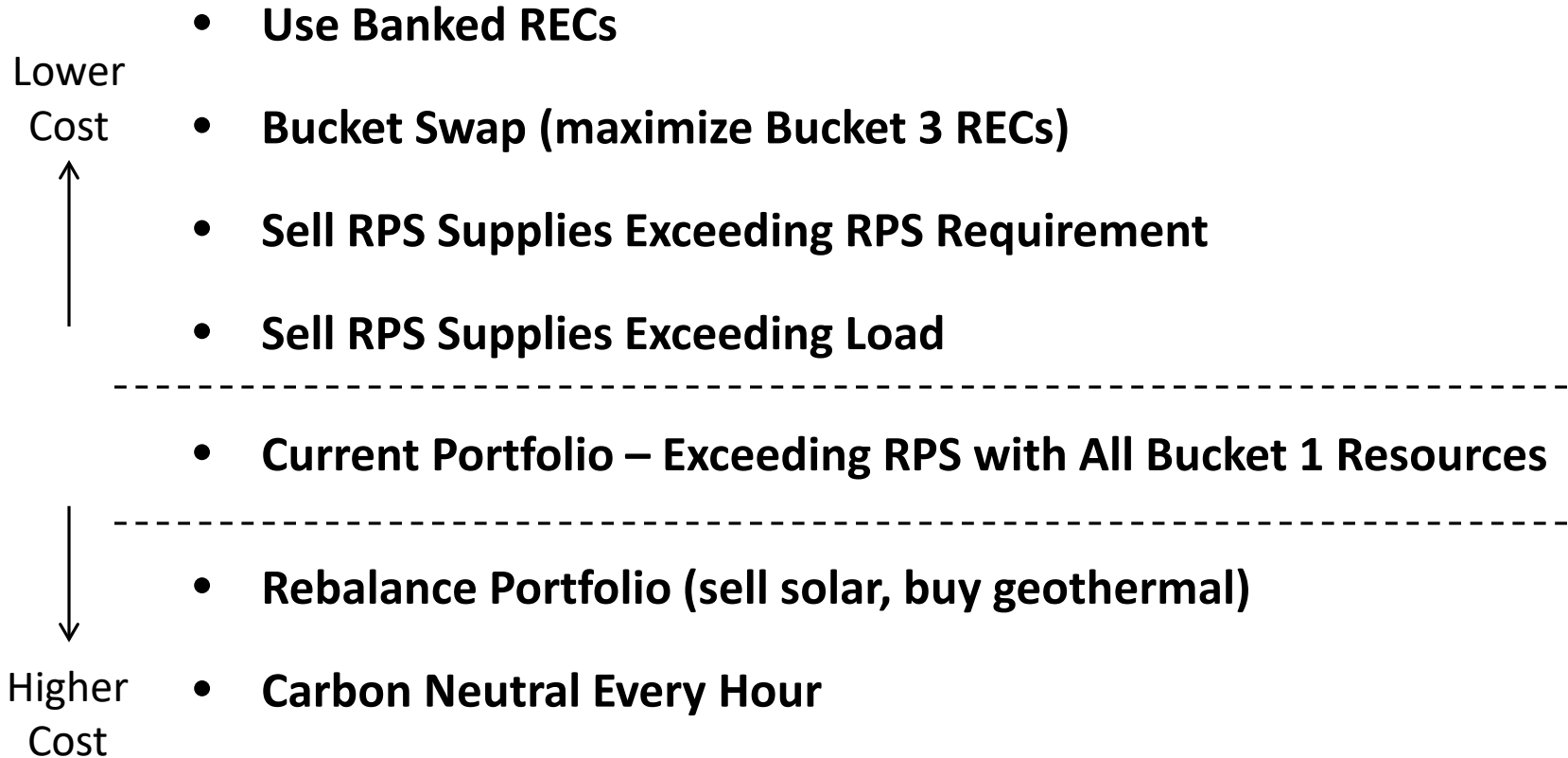
(Note: 3,638 MWh @ system power emissions intensity = 1,557 mT CO₂)

	Unbundled RECs = Carbon Neutral			Unbundled RECs = System Power		
	Method	Net Emissions (mT)	Emissions Intensity (lb/MWh)	Method	Net Emissions (mT)	Emissions Intensity (lb/MWh)
Annual Accounting	A	0	0	B	1,557	3.8
Hourly Accounting (Average Emissions Factors)	C	16,118	39.2	D	17,675	43.0
Hourly Accounting (Marginal Emissions Factors)	E	(2,038)	(5.1)	F	(526)	(1.3)

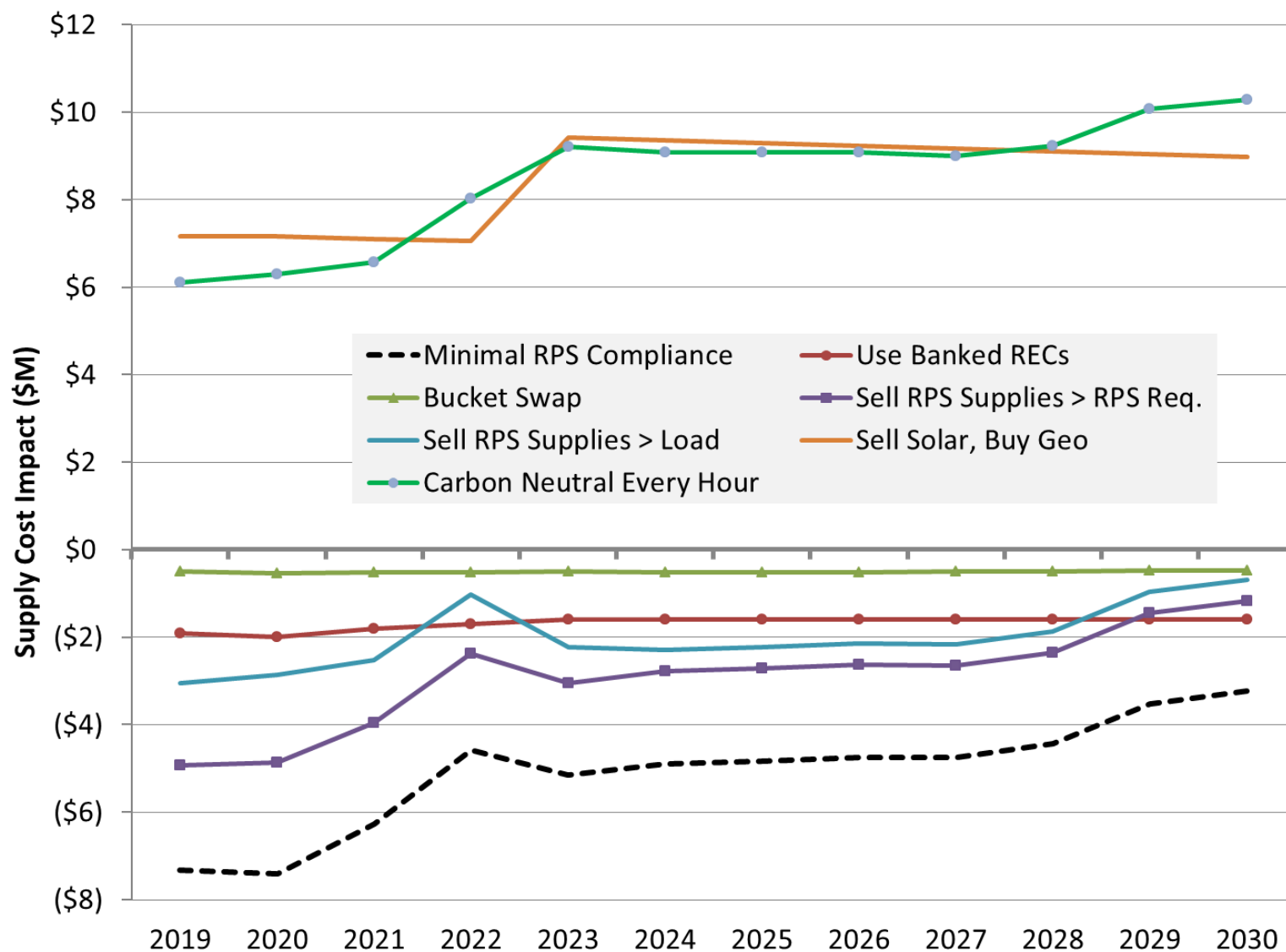
*If our whole portfolio consisted of average grid power we would have emitted 237,000 mT CO₂ and had an emissions intensity of 576 lb CO₂/MWh.

Part 1-B: Affirmation of UAC Support for Portfolio Management Choices

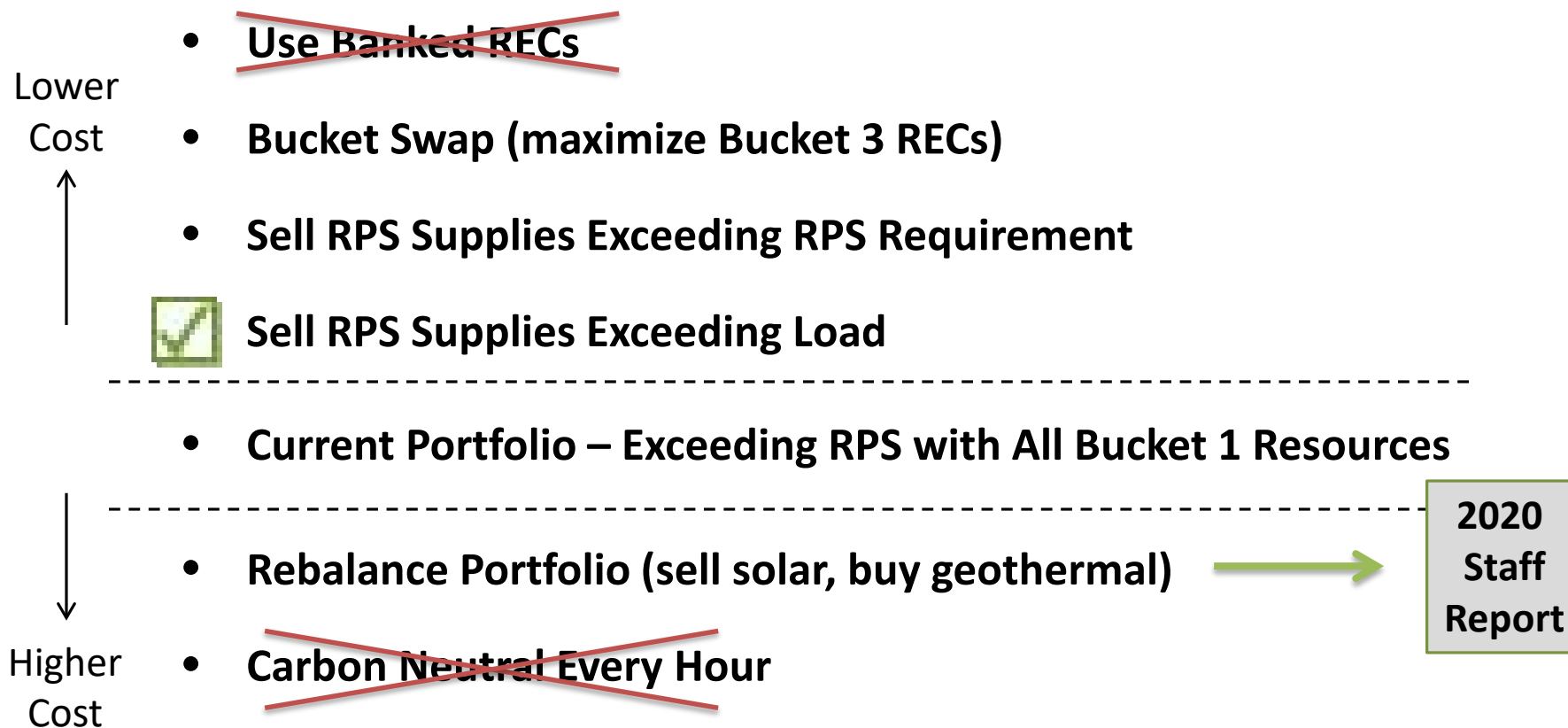
Potential RPS Compliance Strategies



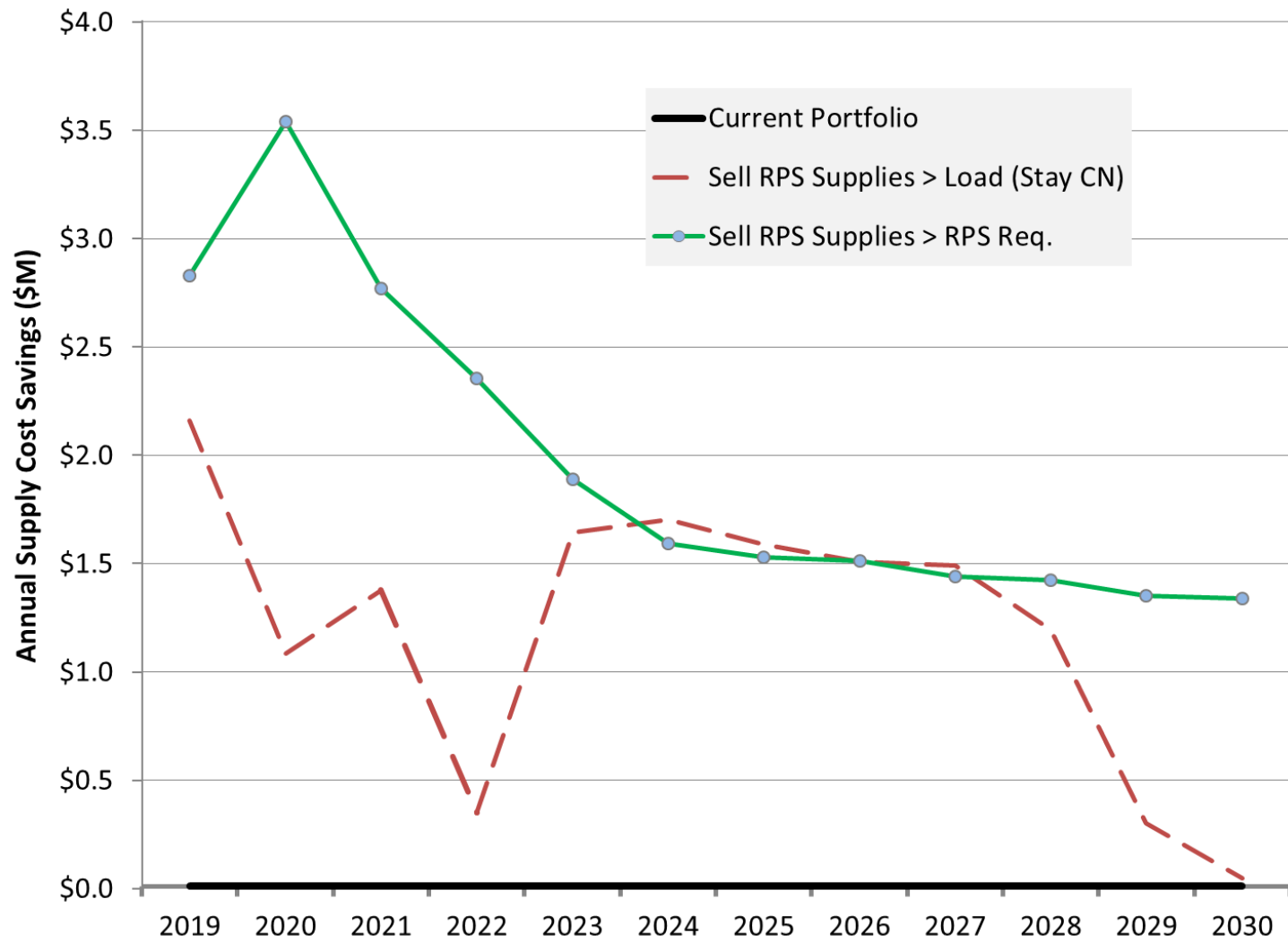
Supply Cost Impacts of RPS Compliance Strategies



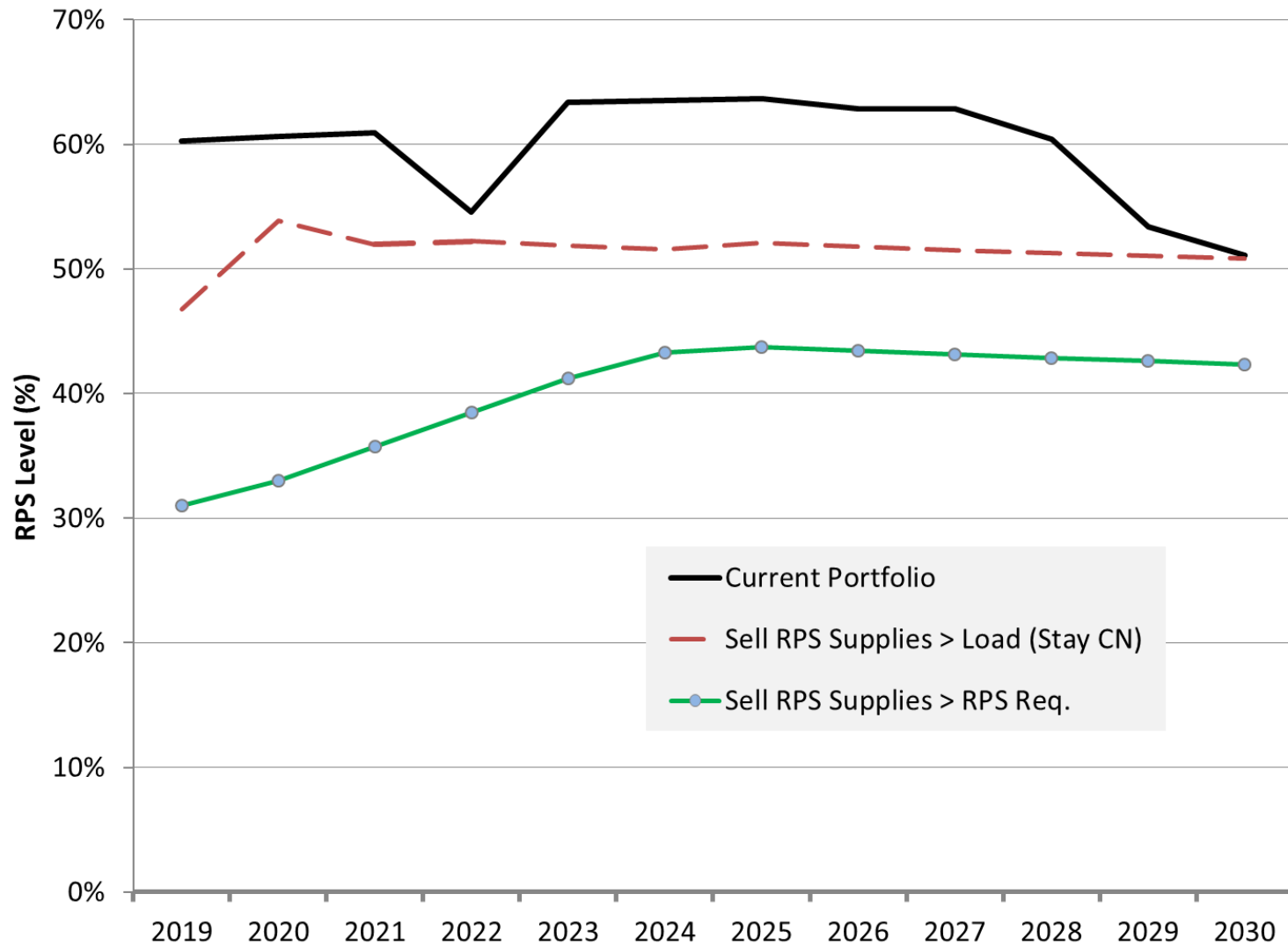
Potential RPS Compliance Strategies



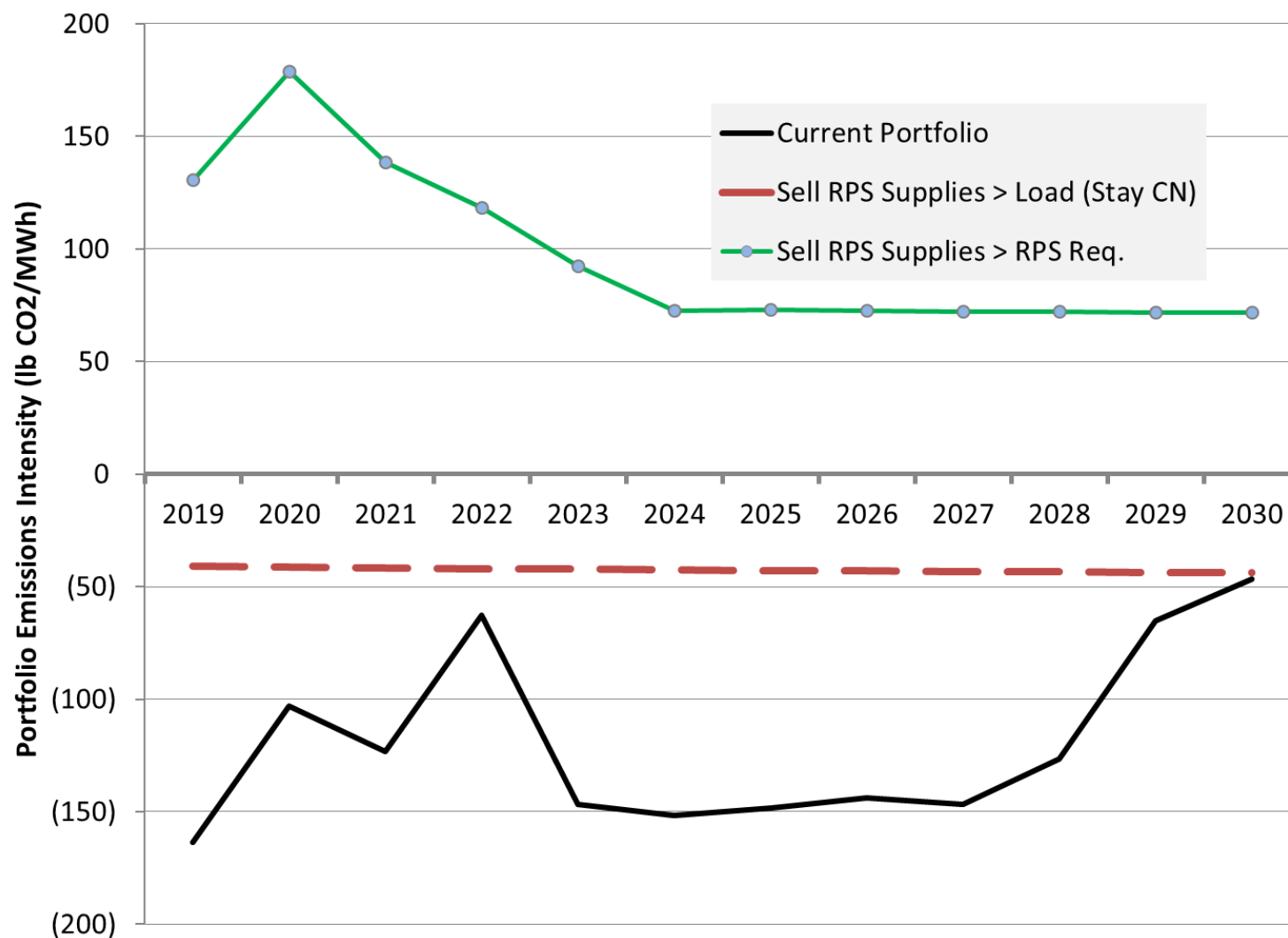
Supply Costs Savings (2019-2030)



RPS Level Impacts (2019-2030)

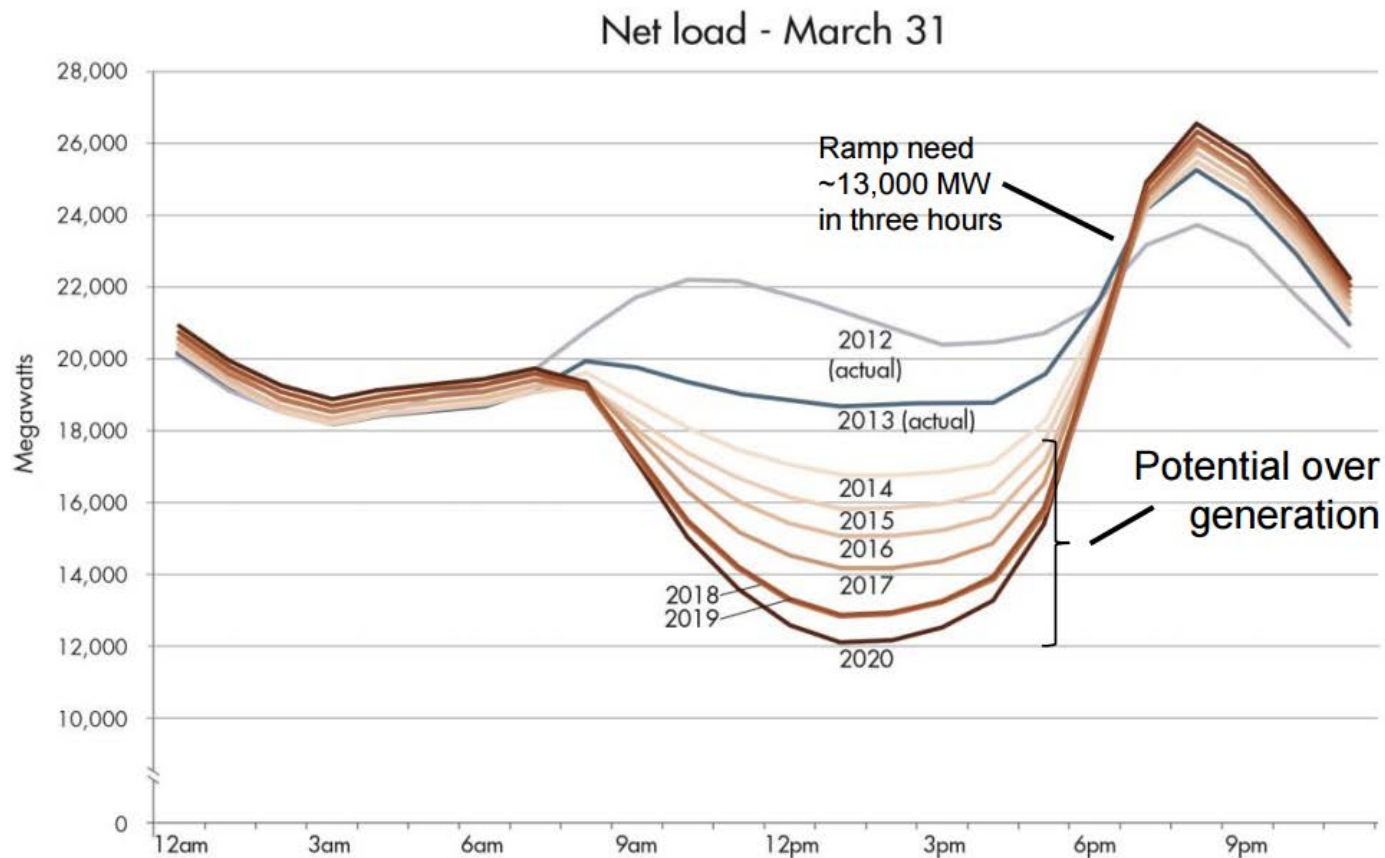


PCL Average Emissions Intensities (2019-2030)



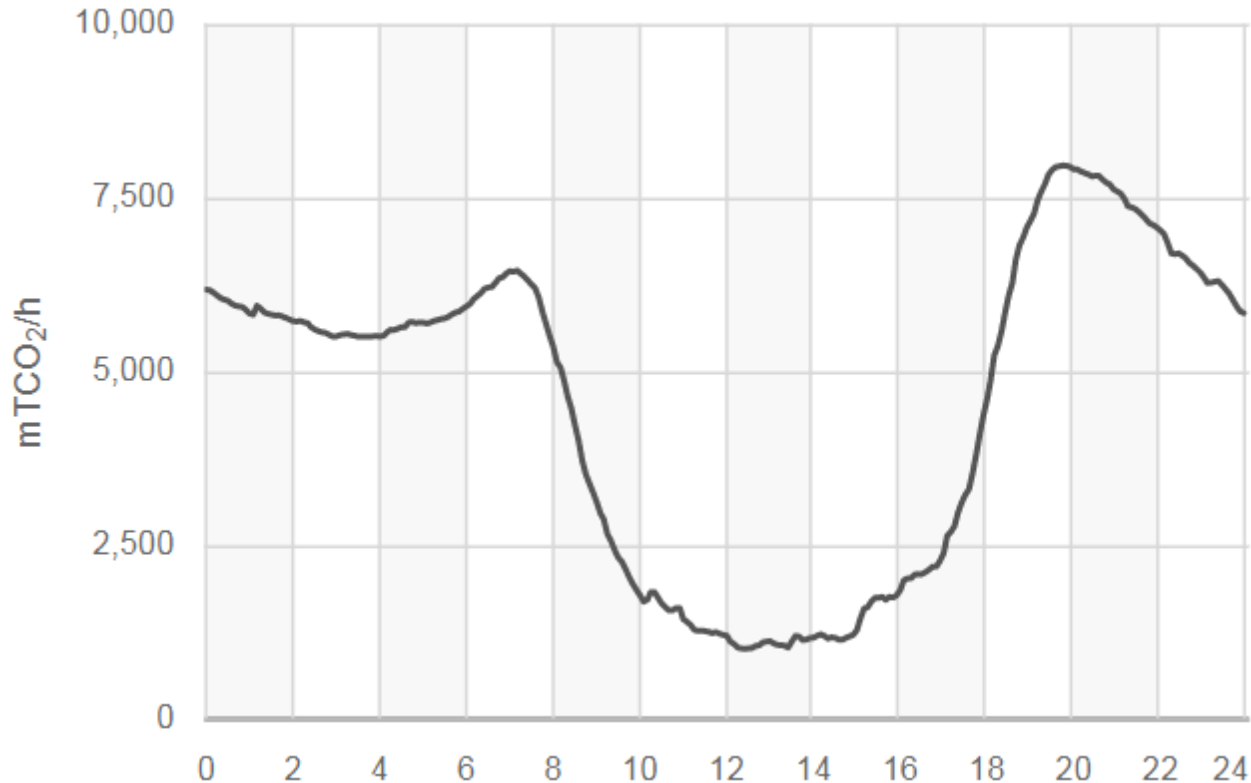
Background – Duck Curve

- In 2013, Palo Alto approved its Carbon Neutral Electric Supply Plan – and the Duck Curve first appears



Background – Duck Curve, cont.

- Because of the Duck Curve, the CO₂ emissions intensity of grid electricity now varies tremendously, on an hourly and seasonal basis



Source: CAISO (Hourly Average CO₂ Emissions Rates for March 16, 2019)
<http://www.caiso.com/TodaysOutlook/Pages/emissions.aspx>

Average vs. Marginal Emissions

Average* Emissions Intensity:

*Appropriate
emissions factor for a
portfolio approach

$$\frac{\text{Total System-wide Emissions}}{\text{Total Energy Generation}}$$

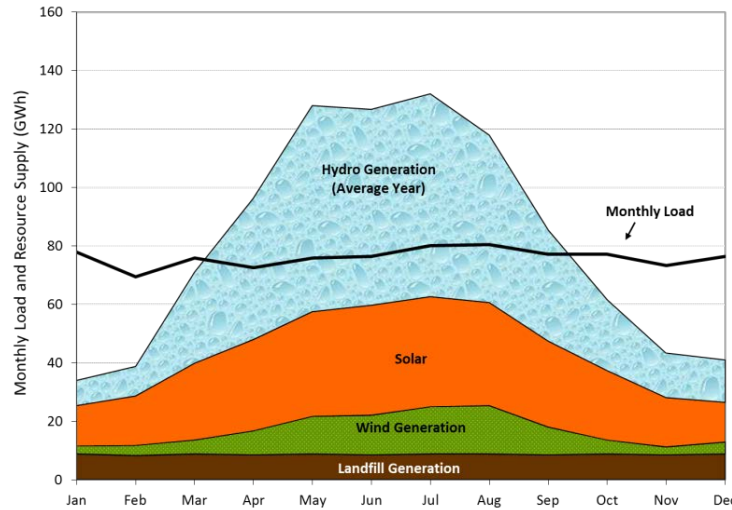
Marginal Emissions Intensity:

- The emissions intensity of the generating unit called on to provide the last MWh
- Useful for thinking about the impact of an individual action (e.g., turning on a light switch)
- Not appropriate for a whole sector inventory

Background – CPAU Load & Resource Balance

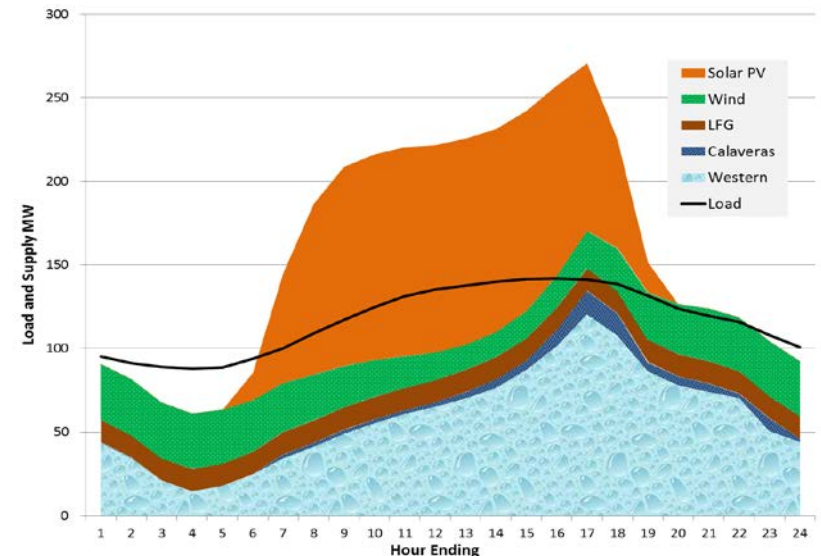
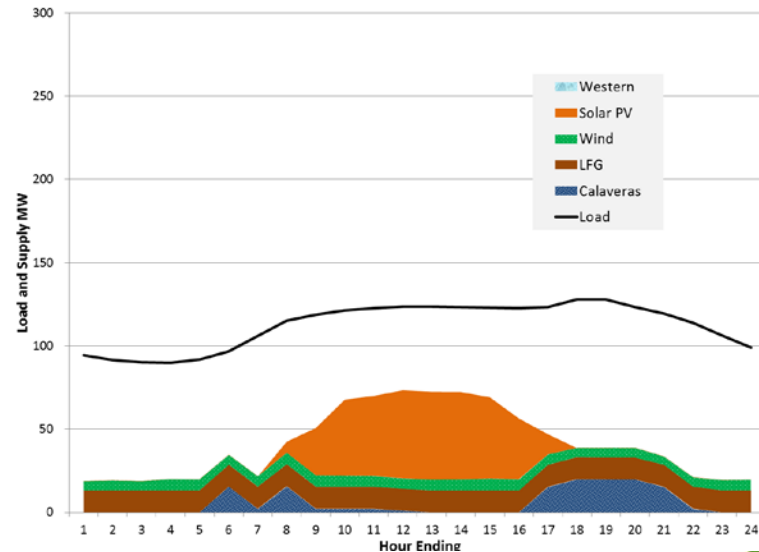
- Palo Alto's electric supply resources vary both hourly and seasonally

Monthly
Totals



January
(Average day)

July
(Average day)



State Changing Treatment of Unbundled RECs (Bucket 3 RECs)

- **Unbundled RECs:** Selling the *environmental attribute* of renewable generation separate from the underlying energy, generally outside of California
- **Industry convention:** The REC carries all of the environmental properties of the energy generated (including the emissions profile), while the energy is treated as “null” or “system” power
- **Counts towards RPS requirements** (with limitations – 10% of RPS requirement)
- **Current CPAU accounting methodology:** Unbundled RECs + market purchases are treated as carbon neutral
- **Power Content Label treatment:** CEC proposal is that 2019 Power Content Label will not treat unbundled REC purchases as carbon neutral

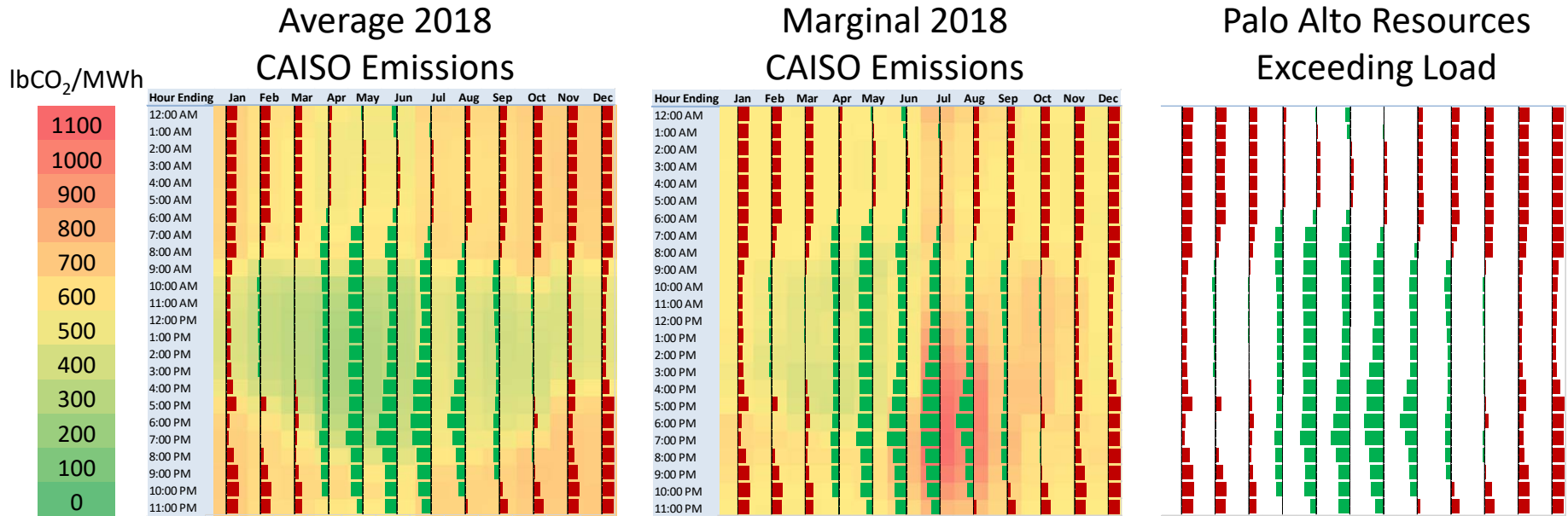
2017-2018 Loads & Supply Resources

	CY 2017	CY 2018
Hydroelectric	667,772	342,419
Solar	329,938	342,640
Wind	97,239	107,414
Landfill Gas	107,495	110,140
Net Market Power	(255,795)	3,638
Total Load	946,649	906,251
Carbon Neutral Supplies (% of Total Load)	127.0%	99.6%

“Average year”
hydroelectric
generation:
496,000 MWh

3,638 RECs needed
under current
Carbon Neutral
accounting method

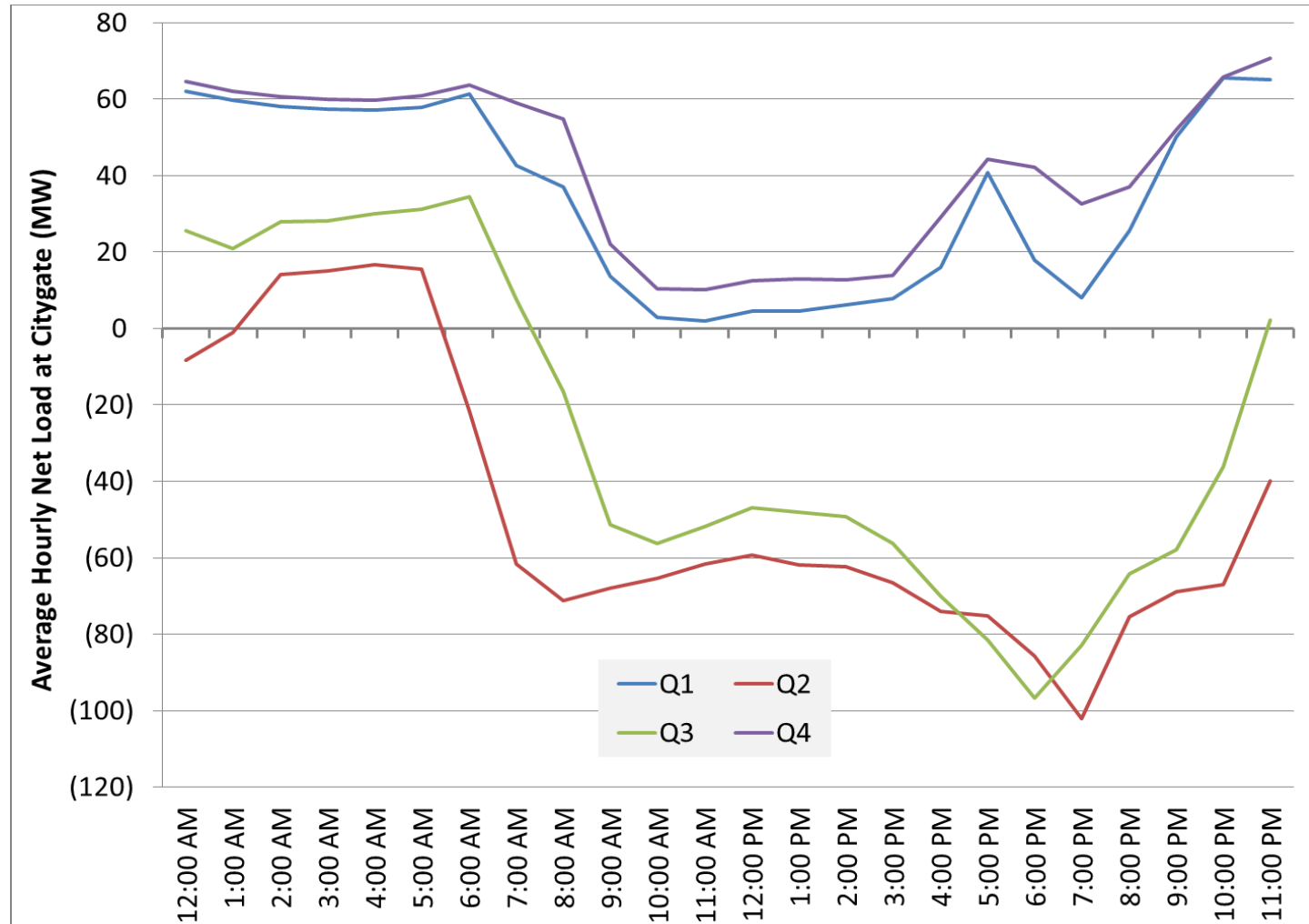
Takeaways from Hourly Emissions Analysis



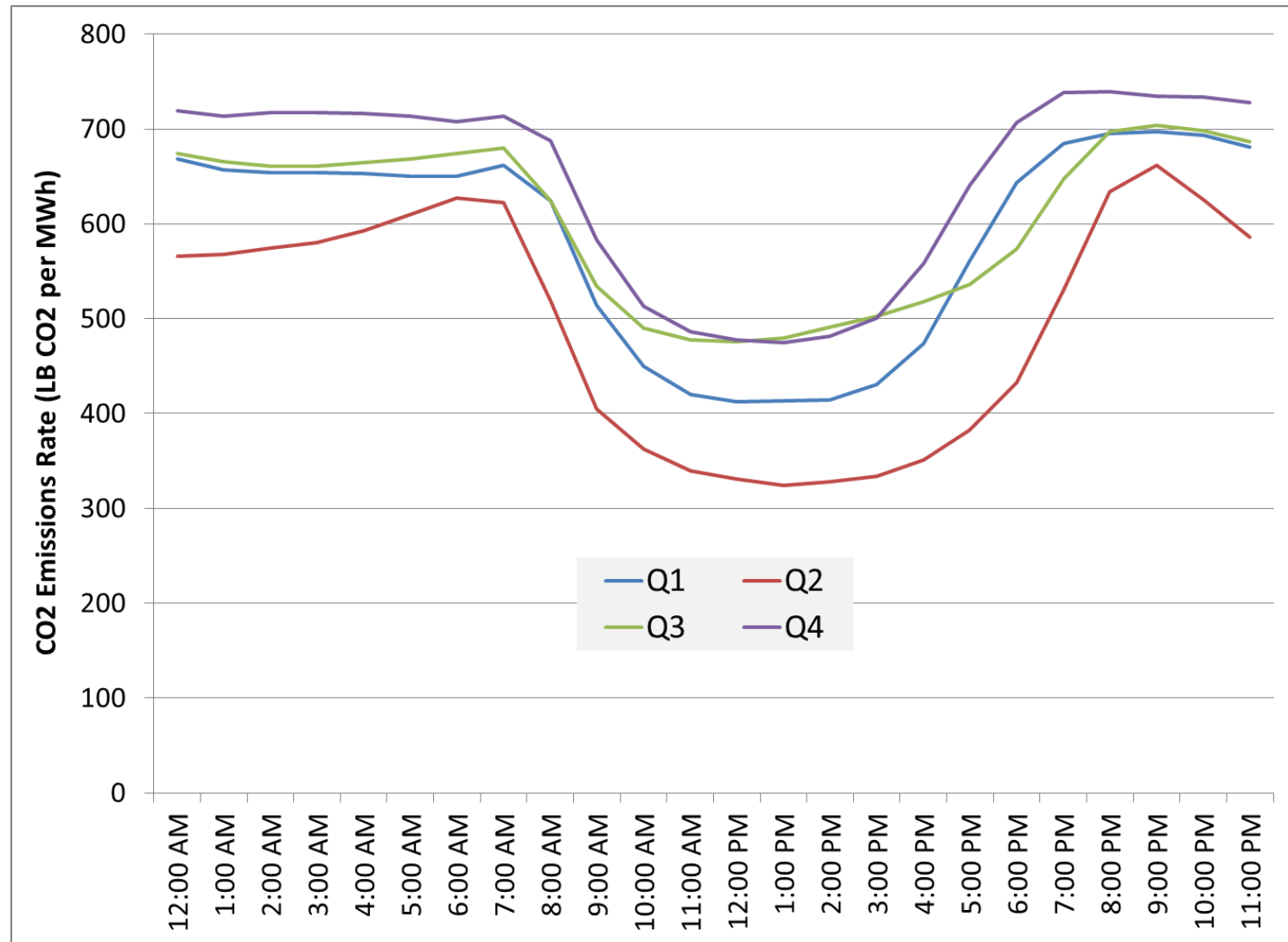
1. We are displacing a lot of carbon with the hydro resources in the summer evenings.
2. By generating at times of peak electricity prices, our hydro resources displace a lot of carbon (price and carbon are correlated in CAISO).

Palo Alto's 2018 Net Load by Hour

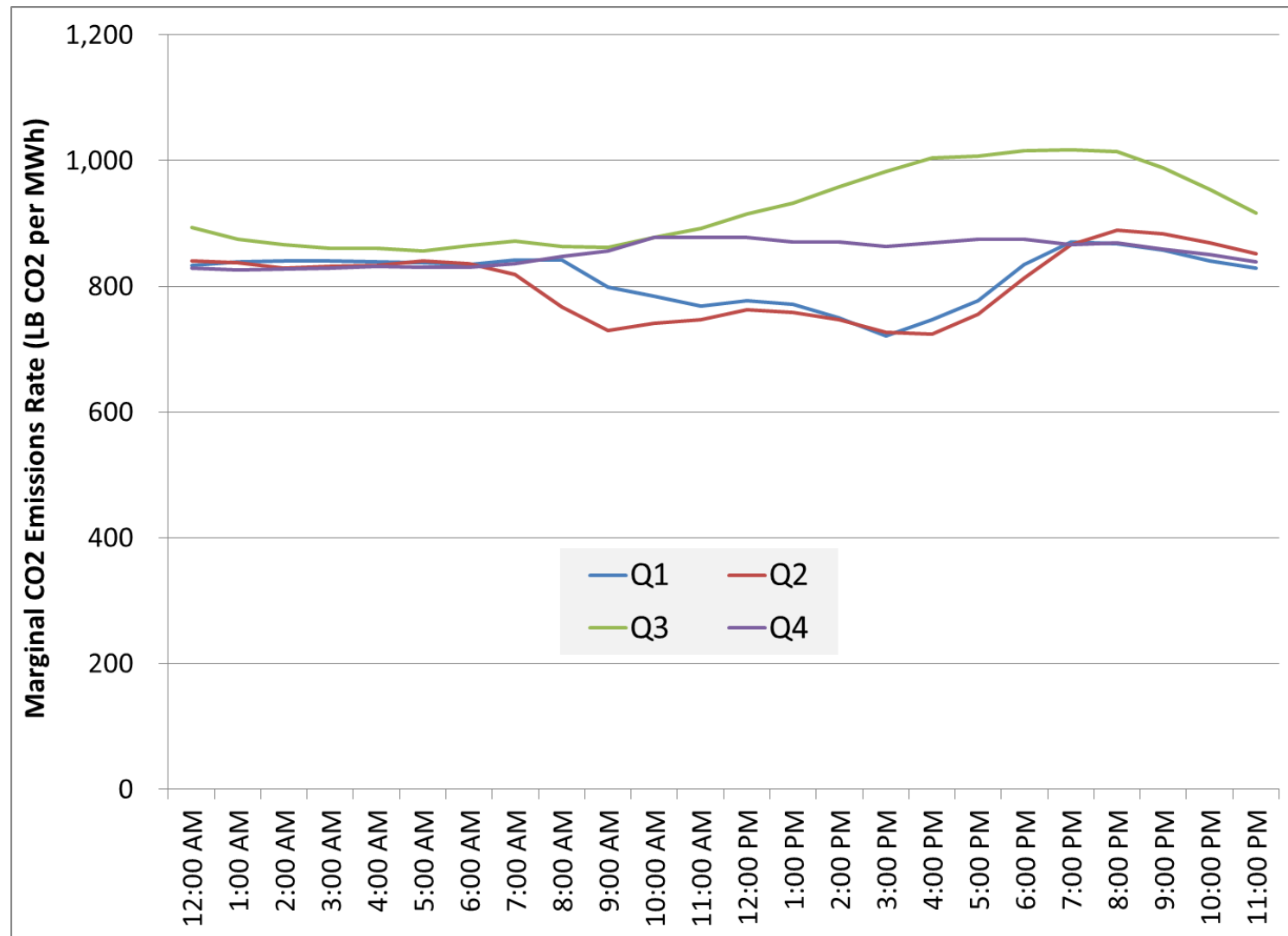
Net Load = Palo Alto Demand – Total Generation



CAISO's 2018 Hourly Average Emissions Intensities



CAISO's 2018 Hourly Marginal Emissions Intensities



Palo Alto's 2018 Hourly Average Total Emissions

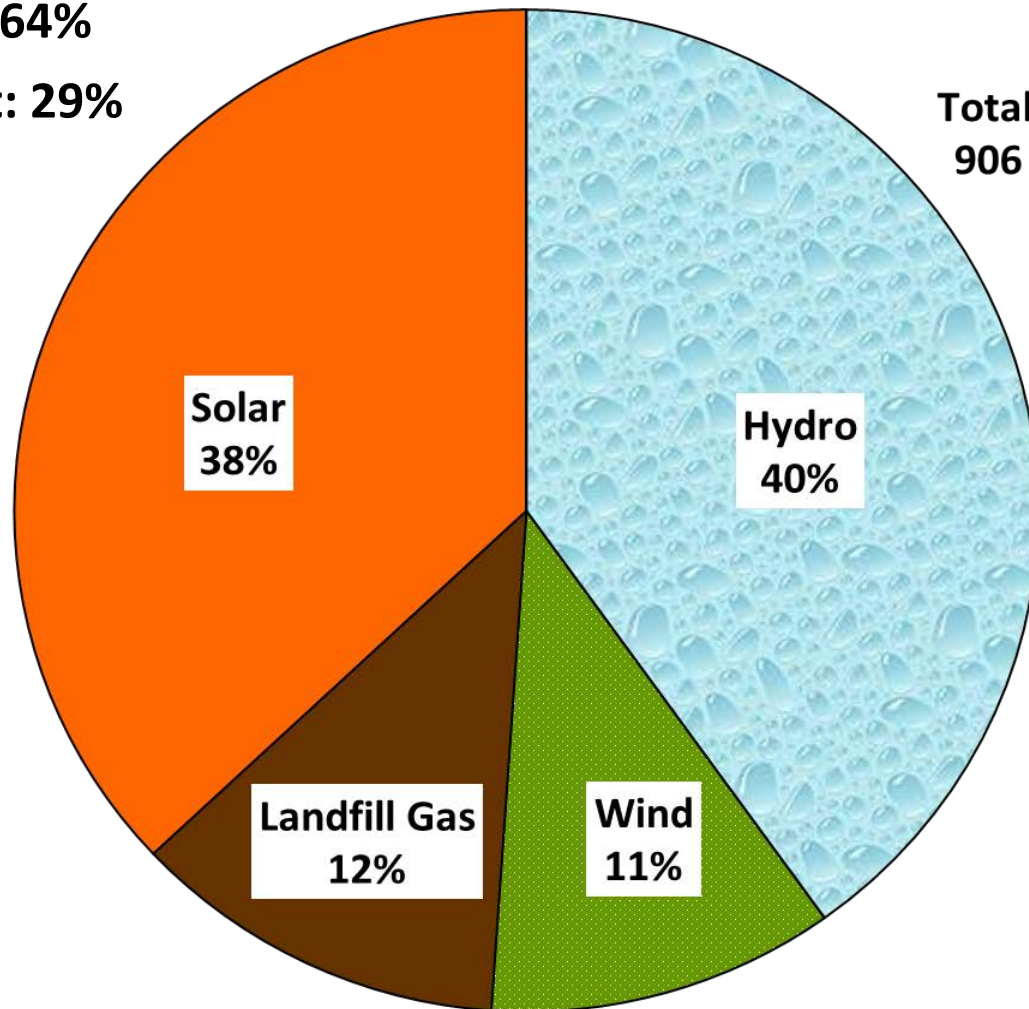


Background – CPAU 2018 Electric Supplies

CPAU RPS Level: 64%

State requirement: 29%

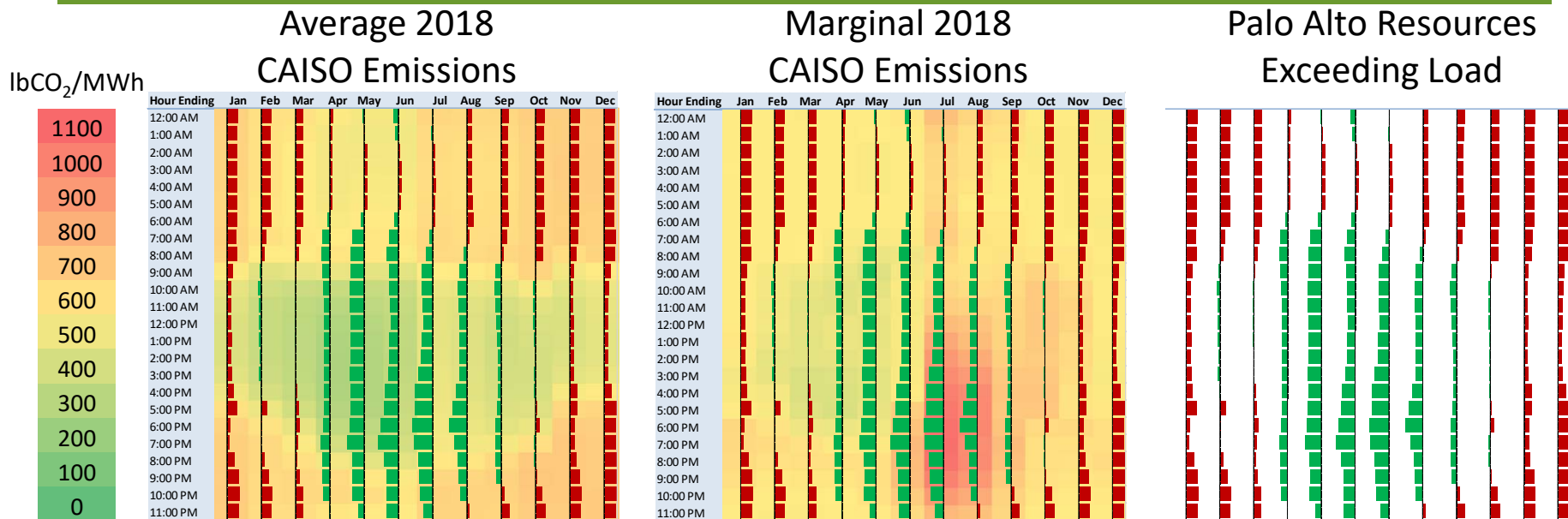
**Total Load:
906 GWh**



Seeking feedback on the following issues:

1. **Power Content Label Confusion:** If we opt for an accounting methodology whose end result differs from the PCL methodology, how do we address the confusion that might cause?
2. **Hourly Emissions Accounting:** Should we adopt an hourly emissions accounting approach? If so, how should we address the portfolio's residual emissions—e.g. in a dry year, or if hourly accounting yields a positive annual emissions total?
3. **RPS Strategy Change to Reduce Portfolio Cost:** If we choose to sell excess renewables and “swap” bundled REC resources for unbundled RECs (and system power), the above issues will be accentuated. Is that OK?

Key Takeaways from Hourly Emissions Analysis



1. By generating at times of peak electricity prices, our hydro resources displace a lot of carbon (price and carbon are correlated in CAISO).
2. Even in a drier than average hydro year, and using an hourly accounting method, the City's average electric portfolio emissions intensity is extremely low.
3. Average emissions intensities are appropriate for evaluating the emissions associated with the City's entire electric load.
4. Marginal emissions intensities are appropriate for calculating the emissions impact of energy efficiency and load shifting measures.

Methods of Abating Residual Emissions

The mechanisms that could be used to abate the City's residual emissions, and their current approximate costs per metric tonne of CO₂ abated, include:

- Unbundled RECs (\$3.50/mT CO₂)
- Carbon Offsets (\$14/mT CO₂)
- Carbon Allowances (\$18/mT CO₂)
- Bundled (Bucket 1) RECs (\$44/mT CO₂)
- Rebalancing the Portfolio (Difficult to quantify)

Purchasing unbundled RECs or carbon offsets would be the easiest mechanisms to implement, and the easiest to explain. The argument against unbundled RECs is that they don't provide any "additionality."

However, aside from the CEC's PCL protocols, all industry protocols recognize the emissions value of unbundled RECs.

Methods & Cost of Abating Residual Emissions

Cost of Abating 2018 Total Emissions

	Annual Accounting	Hourly Accounting (Average Emissions Factors)
<i>Total Emissions</i>	<i>1,557 mT CO₂</i>	<i>17,675 mT CO₂</i>
Unbundled RECs	\$5,500	\$62,000
Carbon Offsets	\$21,800	\$247,000
Carbon Allowances	\$28,000	\$318,000
Bundled (Bucket 1) RECs	\$68,500	\$778,000

Renewable Energy in California

- **Bucket 1 (PCC1)** – Energy and RECs (typically from CA) delivered to a California Balancing Authority (CBA) without substituting electricity from another source. Premium product, **~\$20/MWh, Min 75% RPS**
- **Bucket 2 (PCC2)** – Energy and RECs (typically from an out-of-state renewable energy project) that cannot be delivered to a CBA without substituting energy from another source (i.e. intermittent wind energy needs to substitute in another energy source to meet demand during times when the wind facility is not generating electricity). **\$8 to \$12/MWh**
- **Bucket 3 (PCC3)** – Unbundled RECs, or RECs that do not meet Category 1 and 2 conditions. **\$2/MWh, Maximum 10%**

Effects of RPS Compliance Strategies in 2020

RPS Compliance Options

For CY 2020	RPS Compliance Options					Current Portfolio	Sell Solar, Buy Geo	Carbon Neutral Every Hour
	Minimal RPS Compliance (Sum of options A, B, C)	A: Use Banked RECs	B: Bucket Swap	C: Sell Supplies > RPS Req.	Sell Supplies > Load			
Supply Cost Change (\$M)	(\$7.4)	(\$2.0)	(\$0.5)	(\$4.9)	(\$2.9)	---	+\$7.2	+\$6.3
RPS Level	21.6%	49.3%	60.7%	33.0%	44.4%	60.7%	60.7%	44.4%
PCL Emissions Intensity (lb CO ₂ /MWh)	237 (Delta: +385 from Current Portfolio)	-45 (+103)	-118 (+30)	104 (+252)	--- (+148)	-148	-148 (+0)	--- (+148)
Total Emissions (Annual Accounting) (mt CO ₂)	98,200 (Delta: +159,500)	-18,500 (+42,800)	-48,900 (+12,400)	42,900 (+104,200)	--- (+61,300)	-61,300	-61,300 (+0)	--- (+61,300)
Total Emissions (Hourly Accounting) (mt CO ₂)	114,300 (Delta: +159,500)	-2,400 (+42,800)	-32,800 (+12,400)	59,000 (+104,200)	16,100 (+61,300)	-45,200	-61,300 (-16,100)	--- (+45,200)

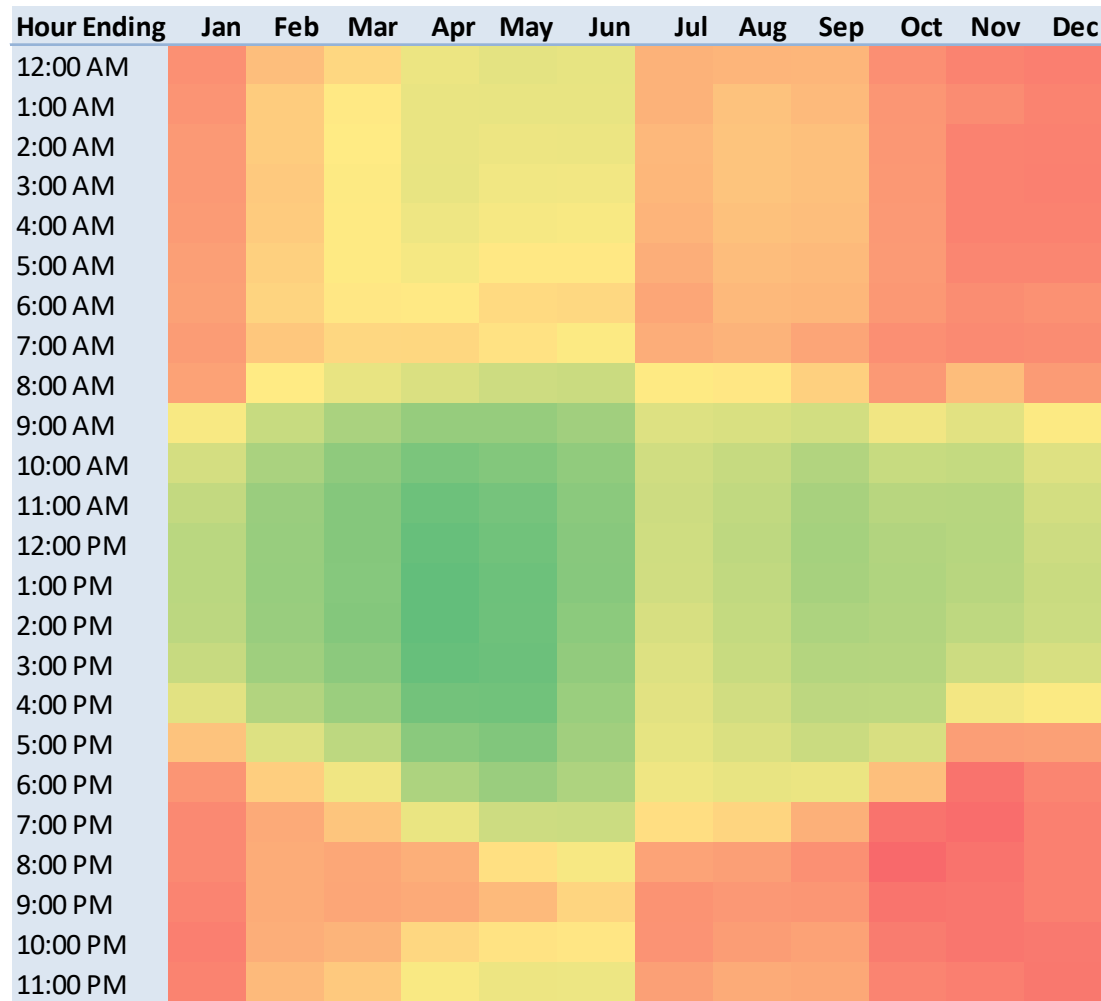
2018 Annual Total Emissions by Accounting Methodology

After purchase of 3,638 unbundled RECs

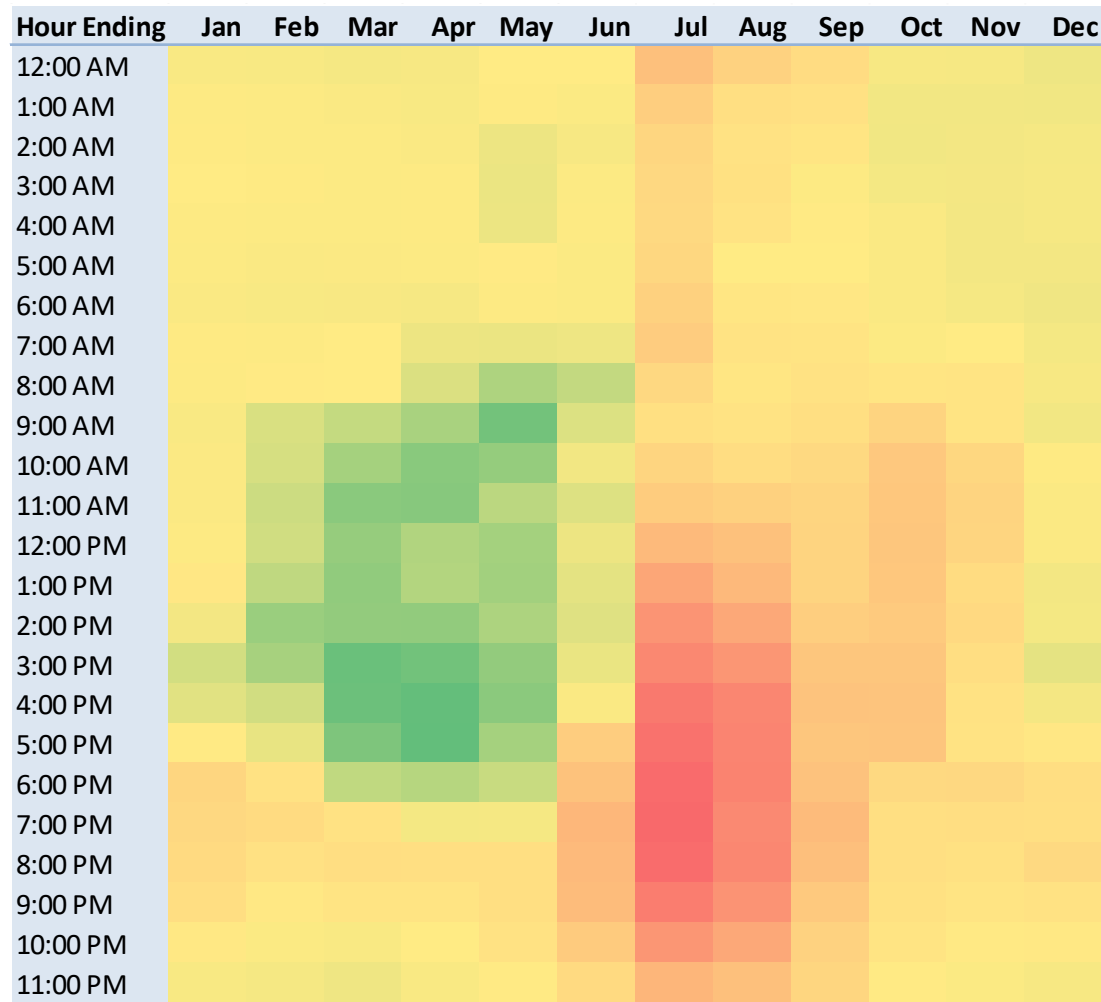
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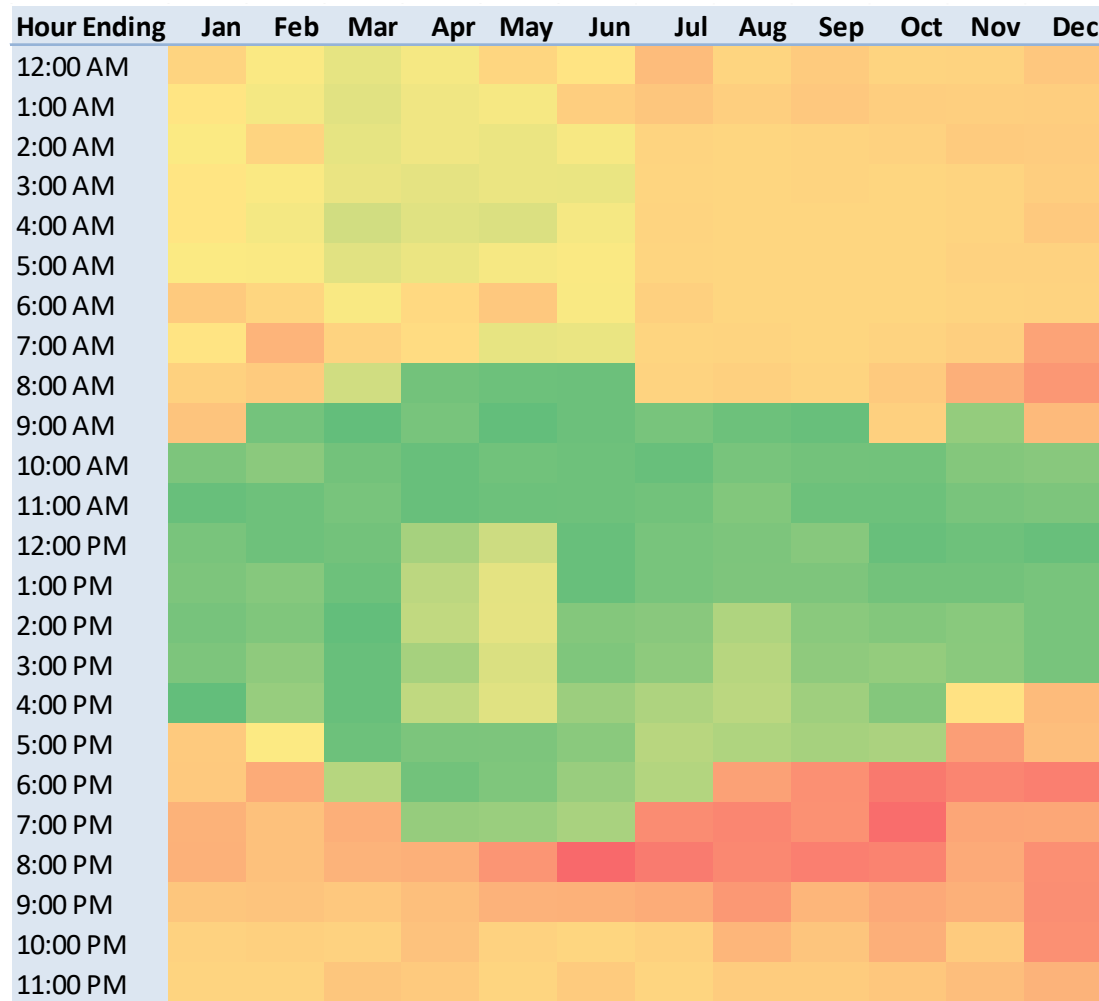
Heat Map of Average CO2 Emissions Intensities



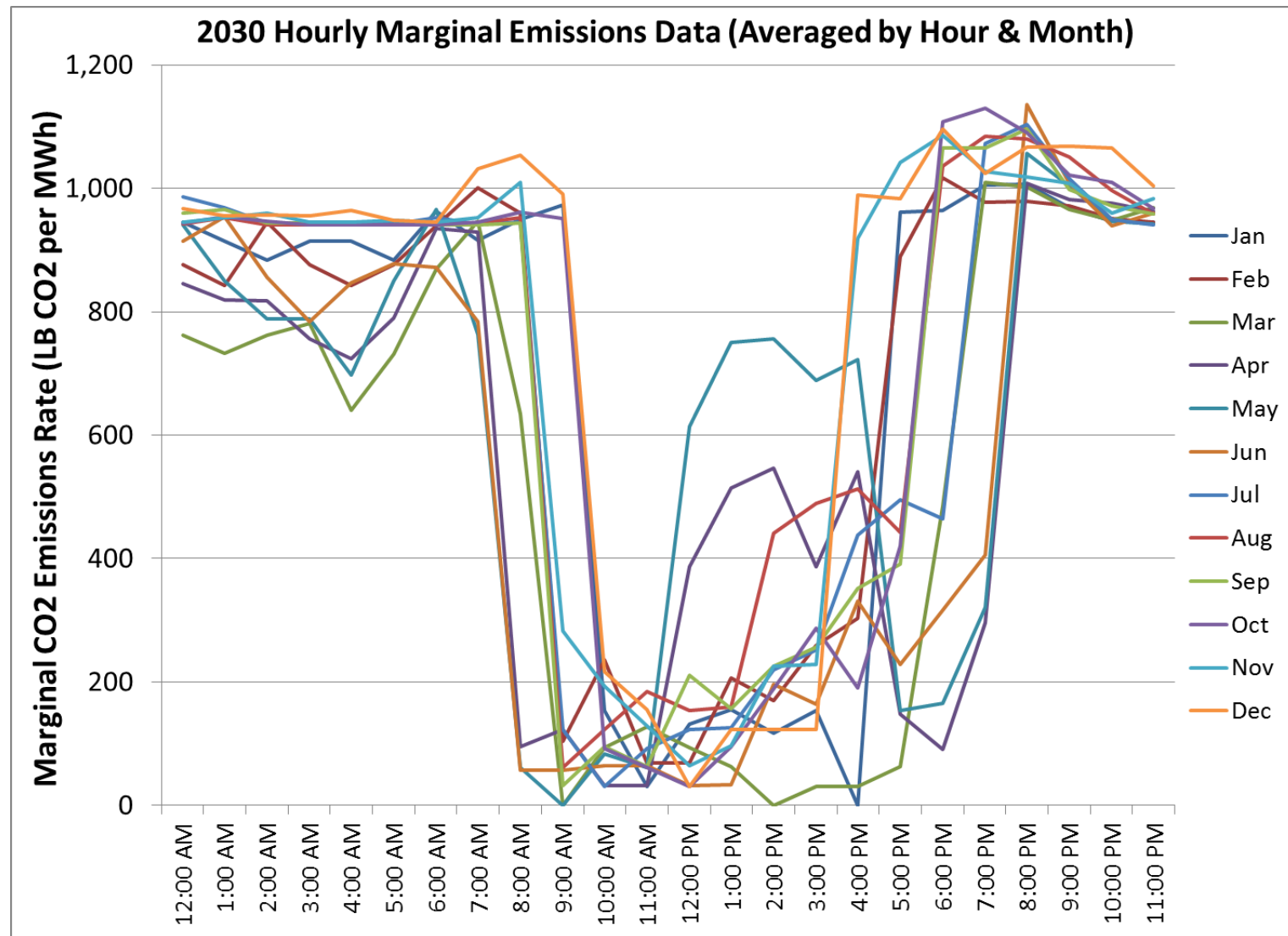
Heat Map of Marginal CO2 Emissions Intensities (2018)



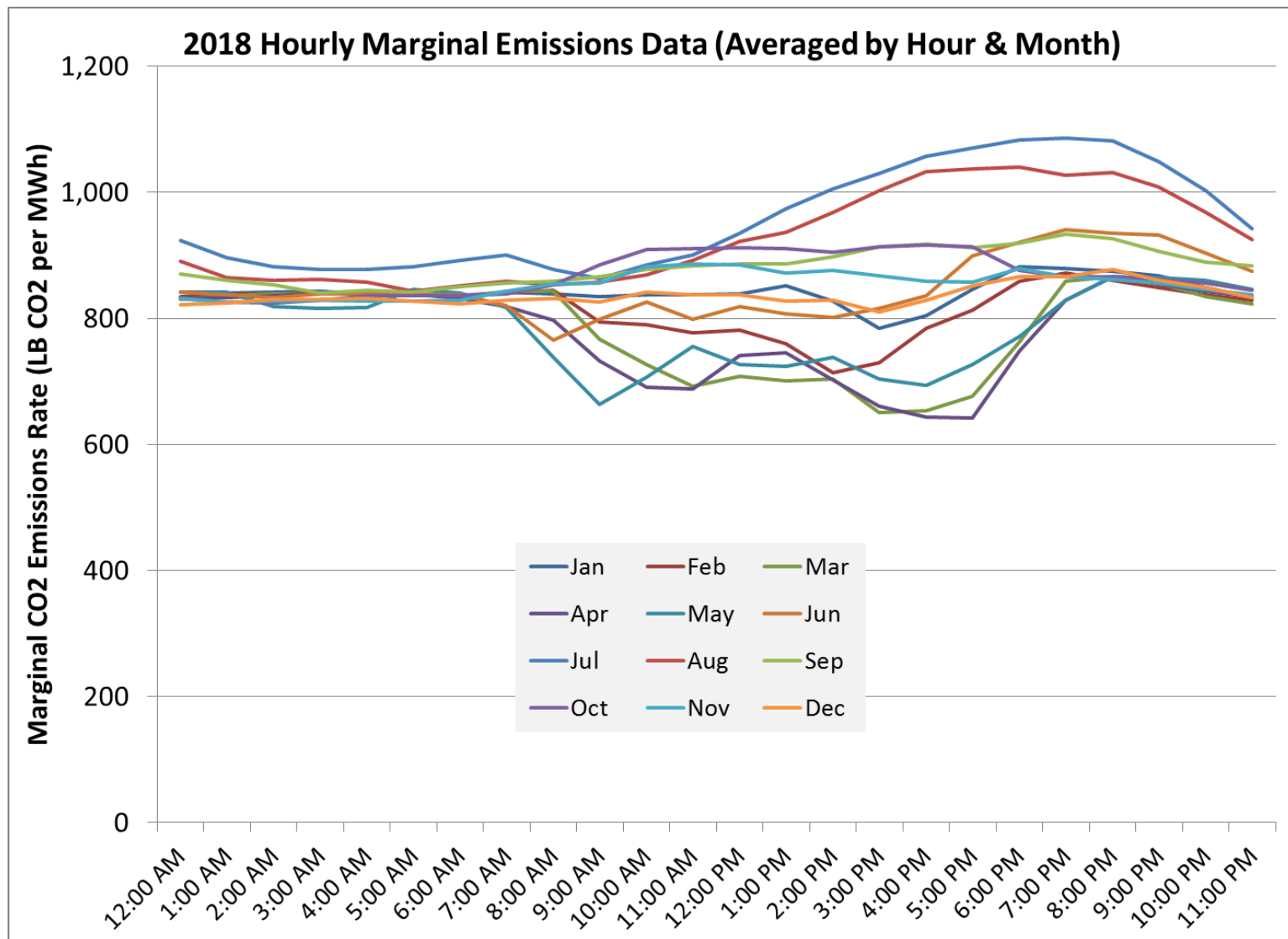
Heat Map of Marginal CO2 Emissions Intensities (2030)



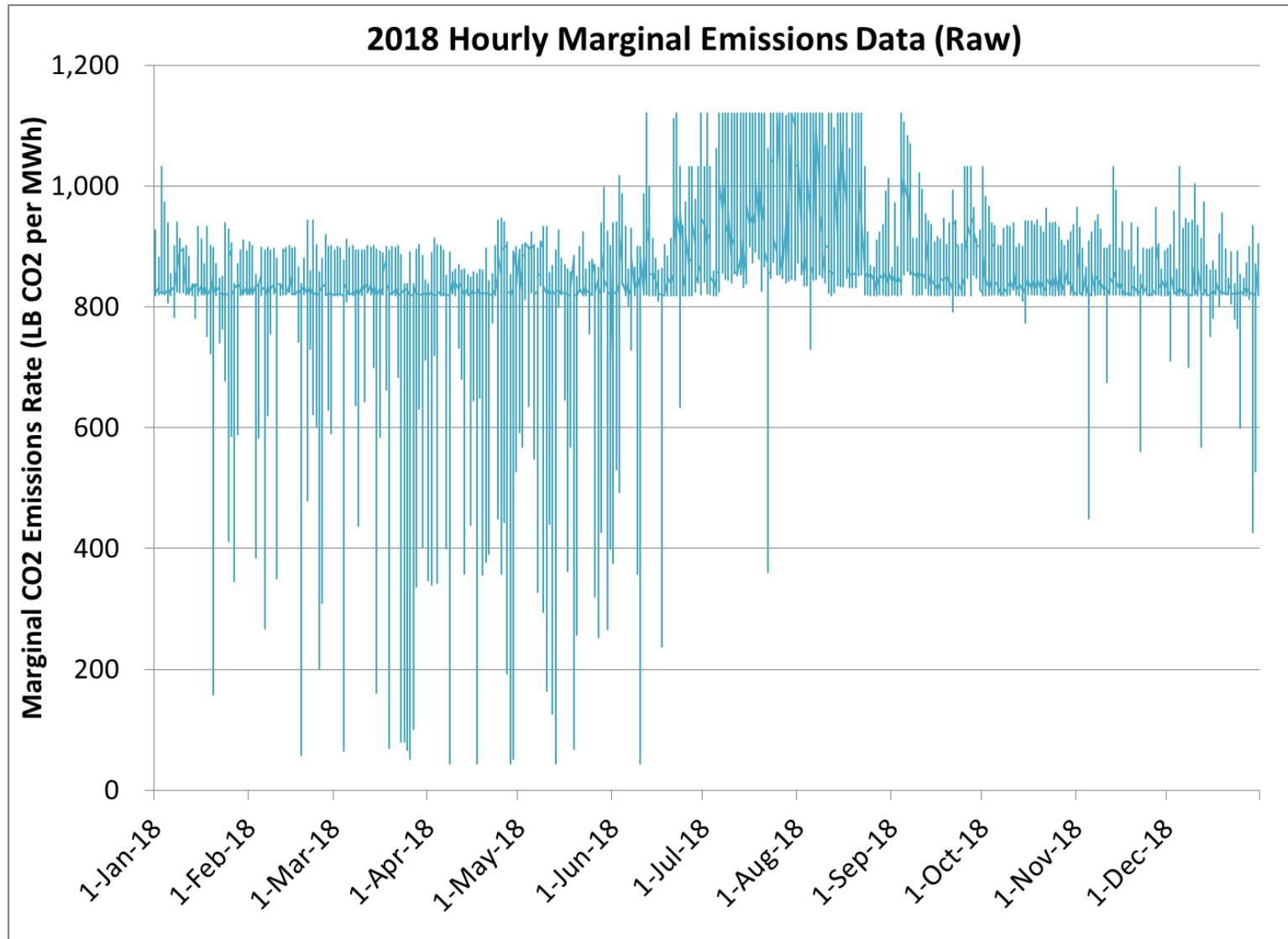
2030 Projected Marginal CO2 Emissions Intensities



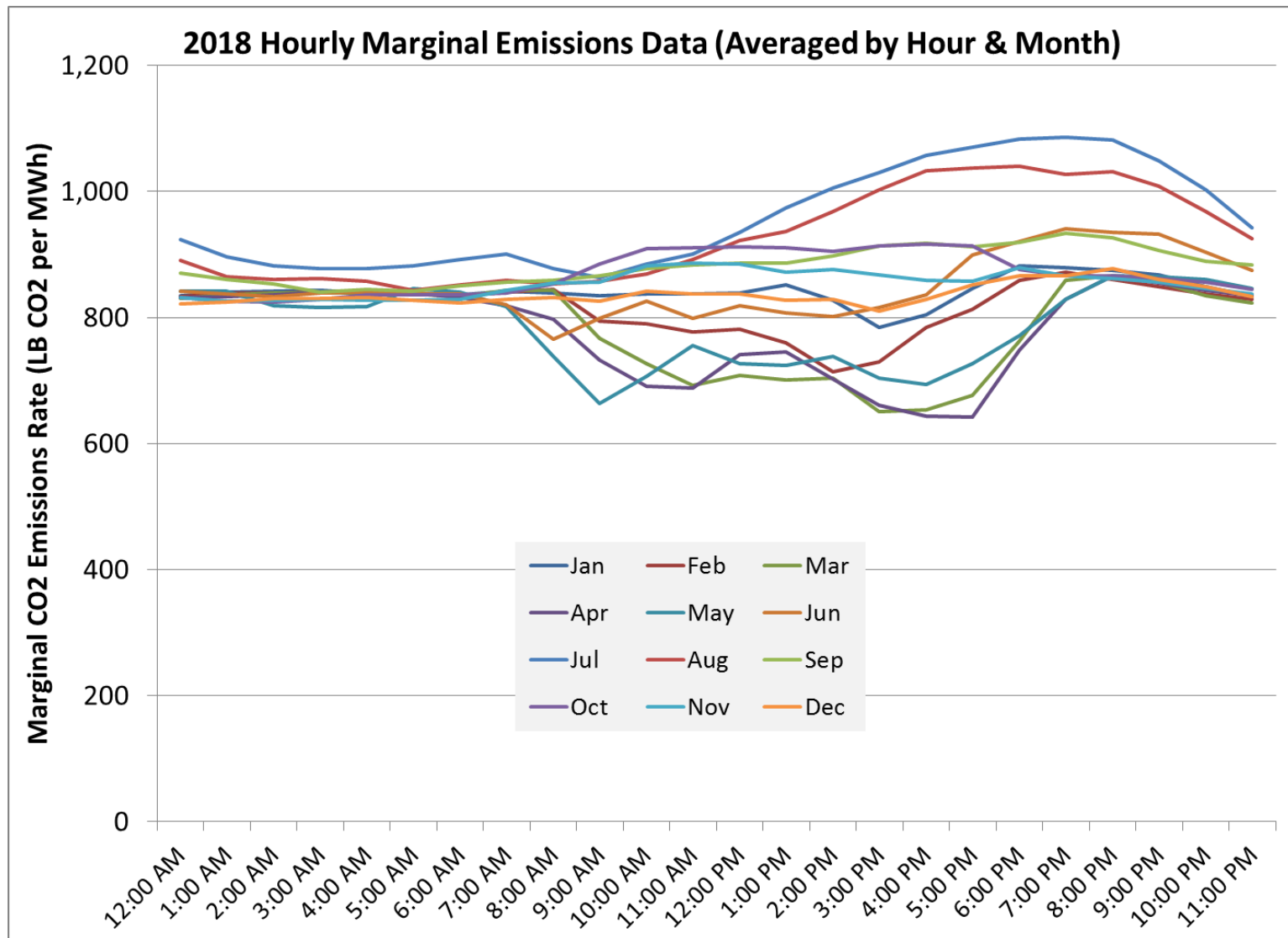
2018 Marginal CO2 Emissions Intensities



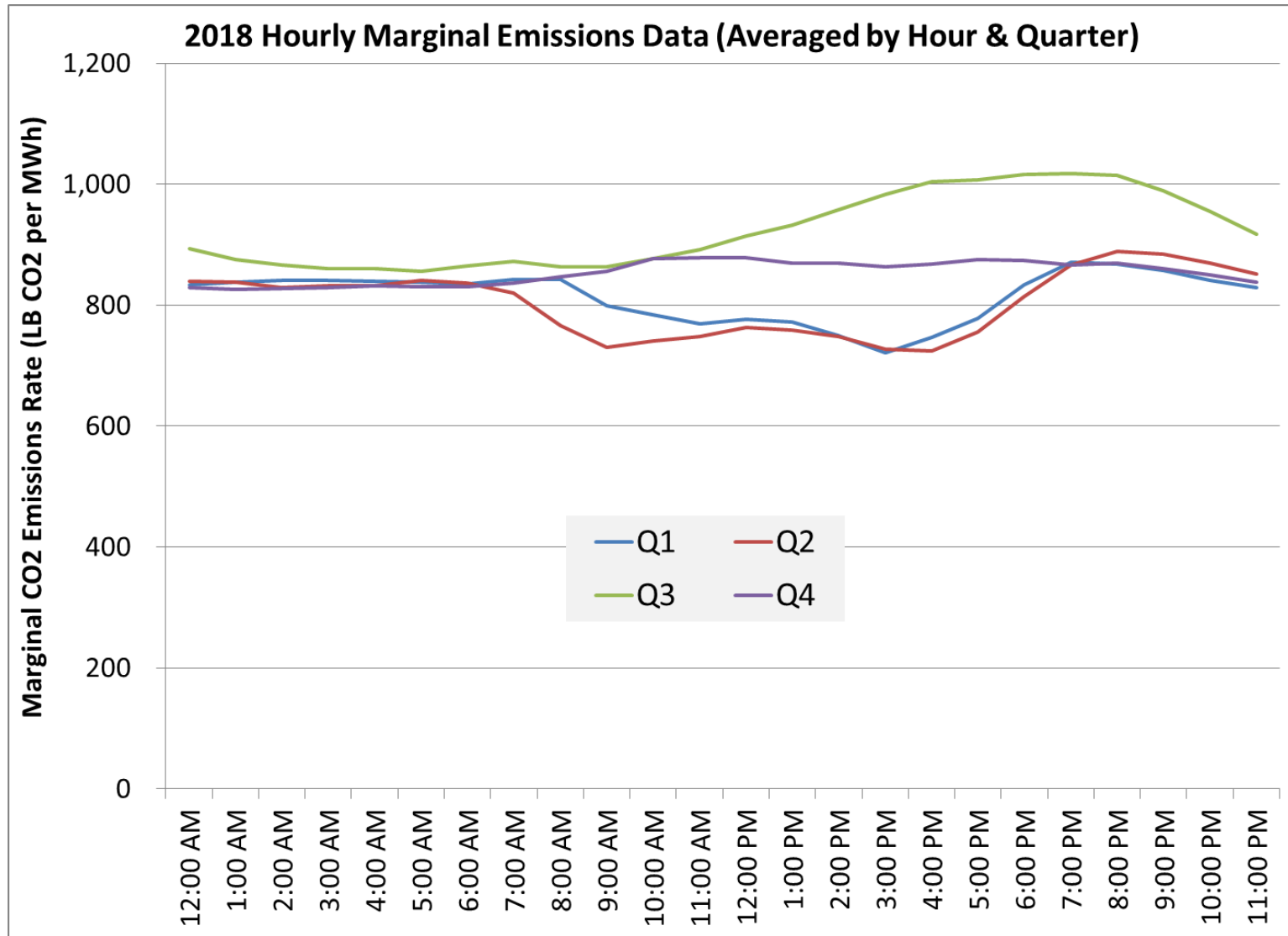
Development of “Average” Marginal Emissions Rates (1)



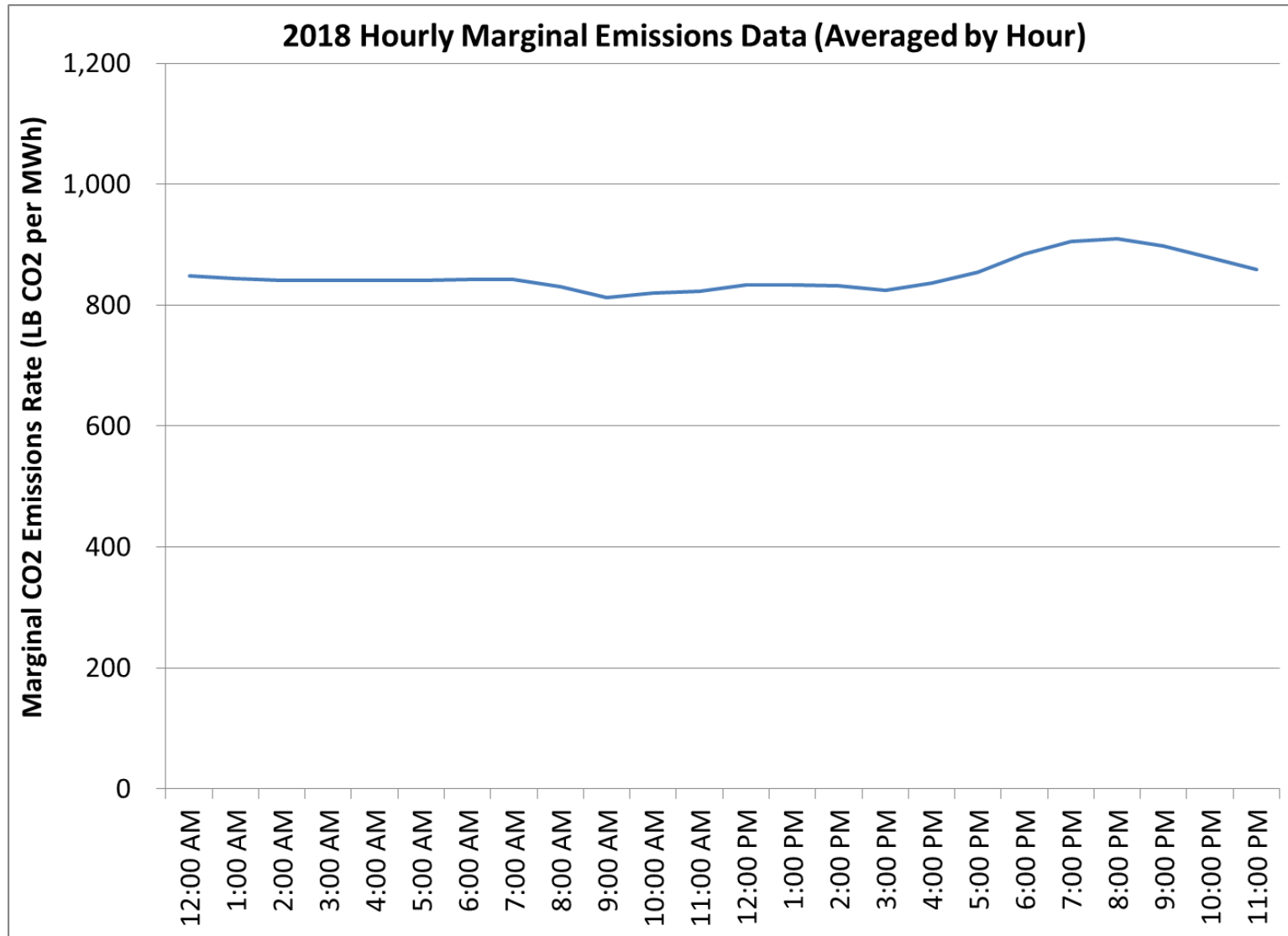
Development of “Average” Marginal Emissions Rates (2)



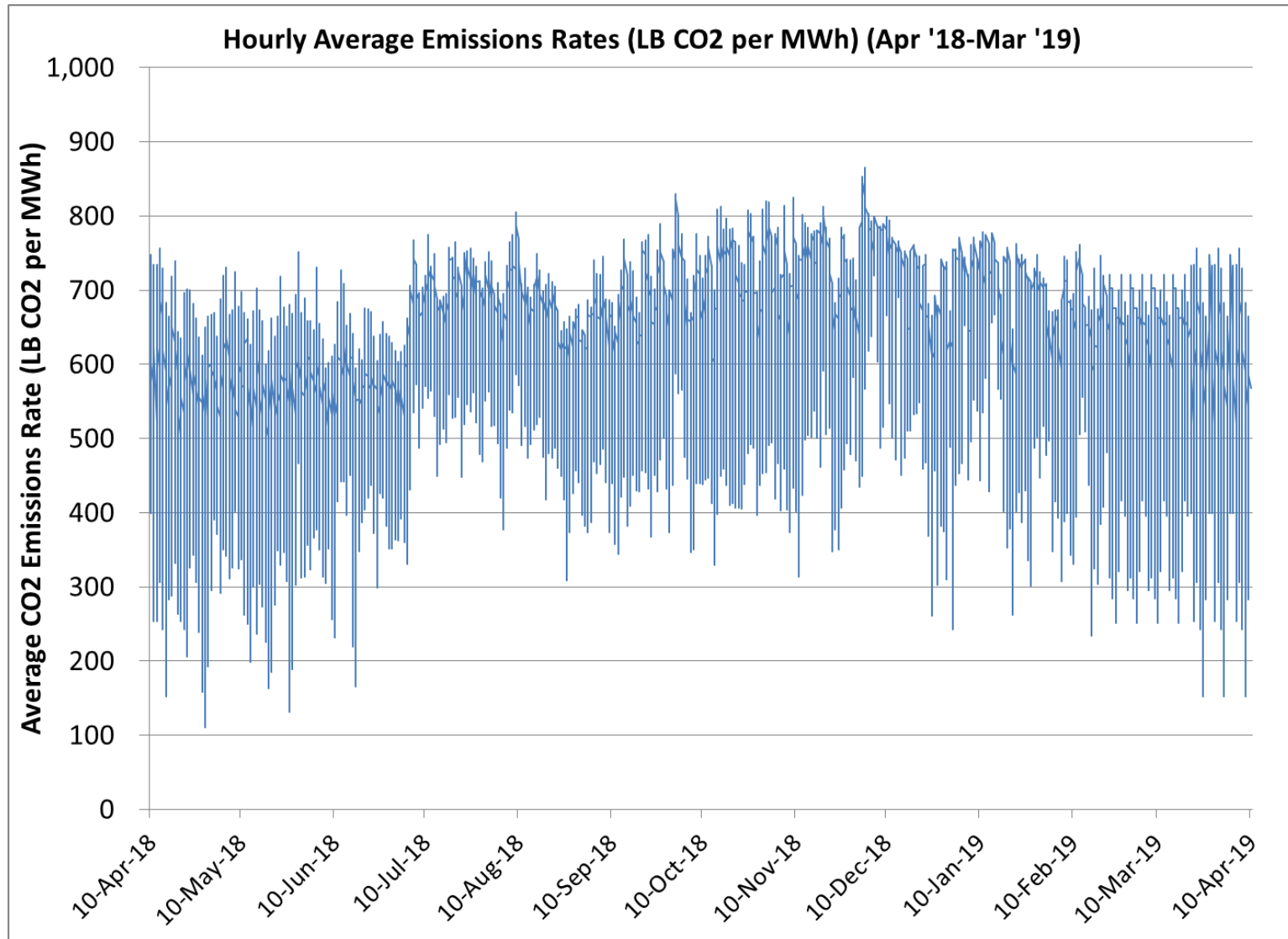
Development of “Average” Marginal Emissions Rates (3)



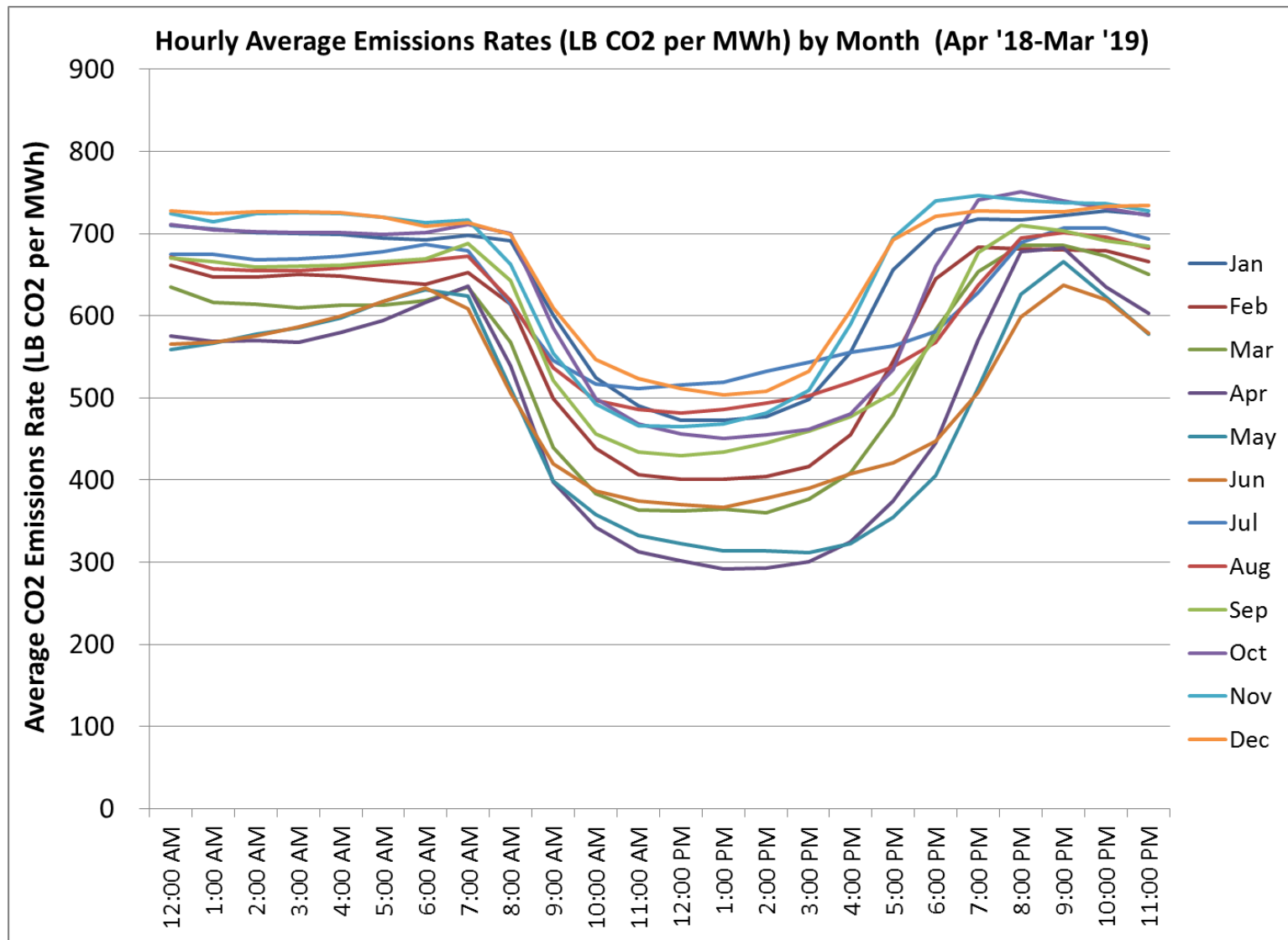
Development of “Average” Marginal Emissions Rates (4)



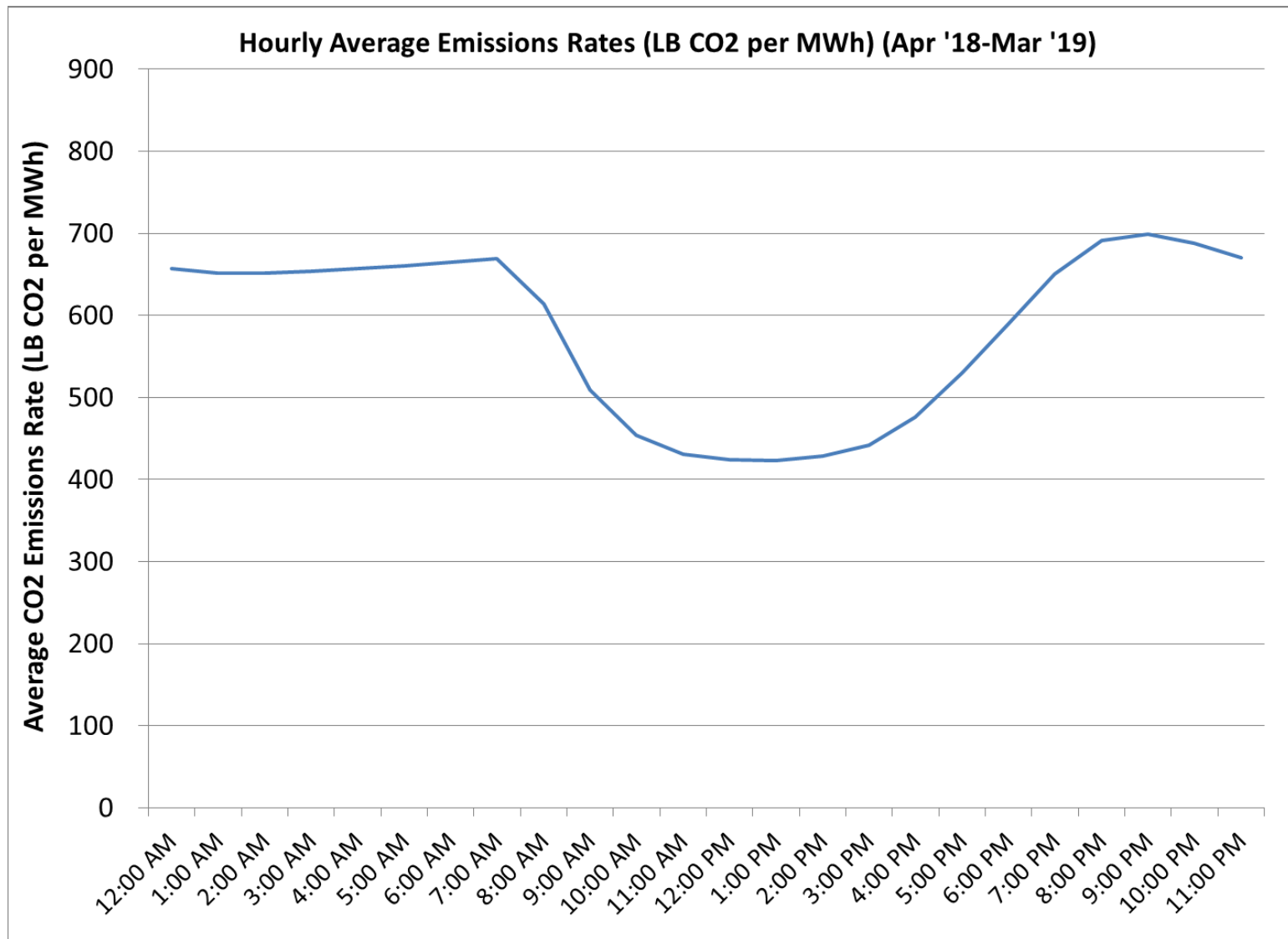
Development of “Average” Average Emissions Rates (1)



Development of “Average” Average Emissions Rates (2)



Development of “Average” Average Emissions Rates (3)



Qualitative Factors to Consider

- **Public messaging consistency (City claims vs. PCL)**
- **Public perception of carbon intensity**
- **Carbon impact of alternative products (unbundled RECs, carbon offsets, Bucket 1 RECs)**
 - **Additionality, verifiability**