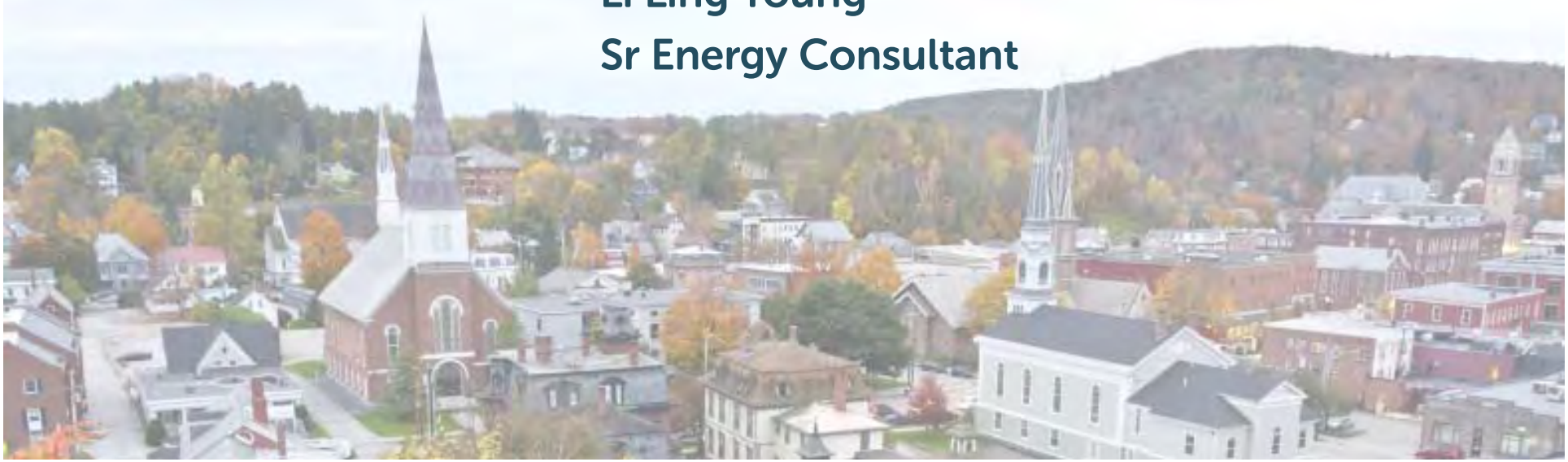
JULY 21, 2019 – SOLARFEST

Photon vs. Carbon

The Global Impacts of Solar and Grid-tied Batteries

Li Ling Young
Sr Energy Consultant



Agenda

- Distributed Renewable Energy – What Is It Good For?
- Net Metering – How Does It Really Work?
- Your Utility – Part of a Larger Network
- Carbon impacts of distributed RE

Efficiency Vermont

Renewable Energy…

What Is It Good For?

Efficiency Vermont

Why Are You Interested in RE?

- Fill in the blank…

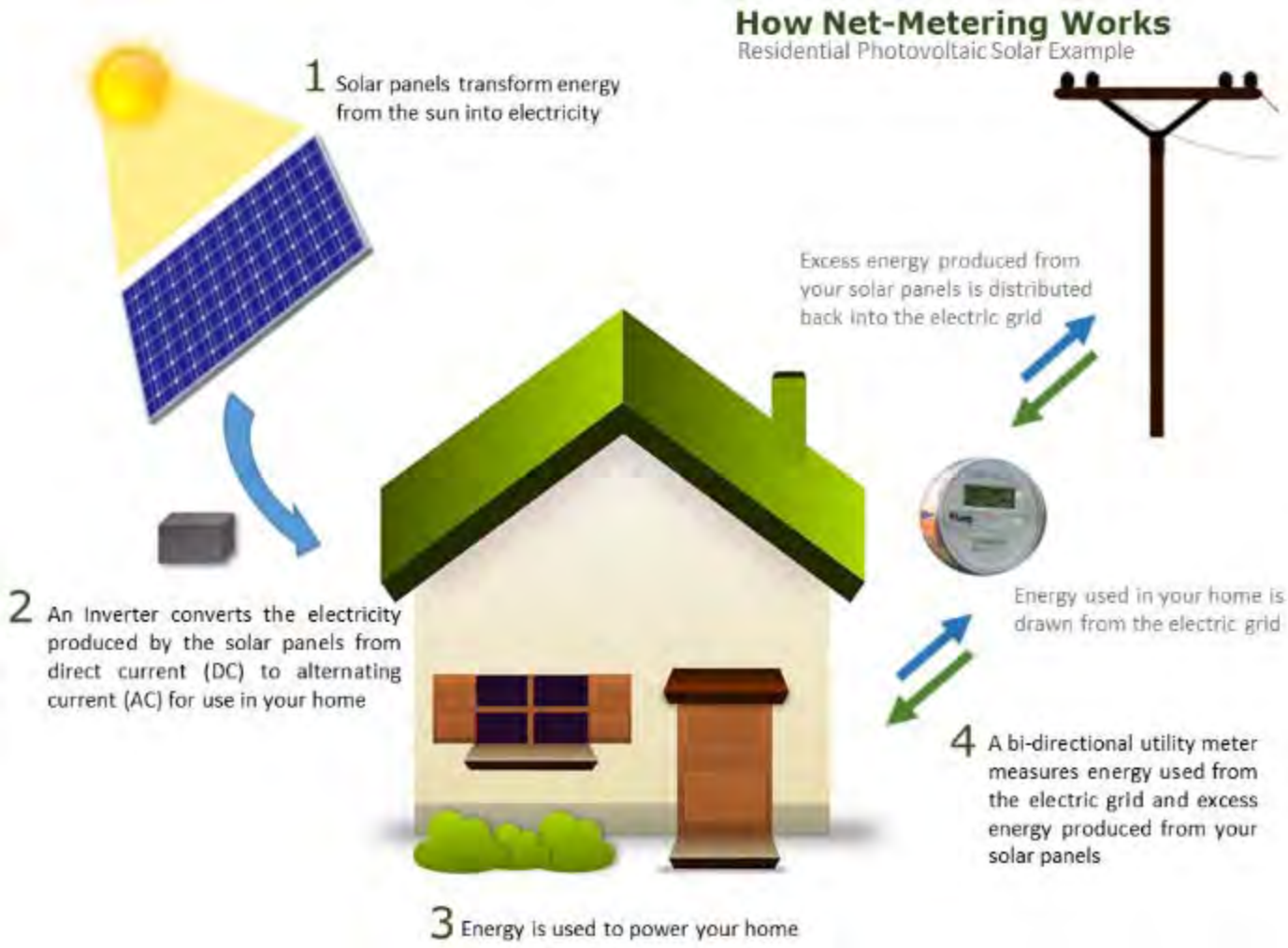
- What's obscured with "Net" metering?

Efficiency Vermont

Net Metering

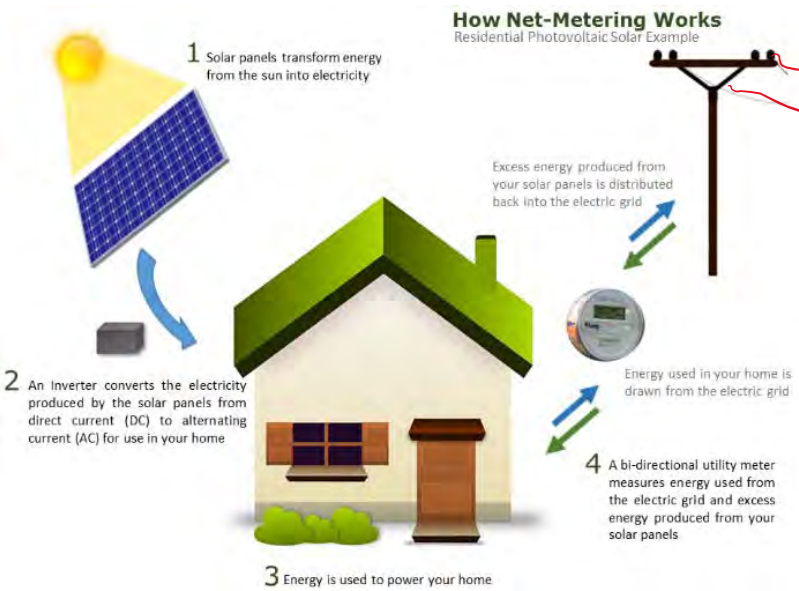
Efficiency Vermont

Not Just Accounting



Efficiency Vermont

- Gross production meter (feed-in tariff)
- Self-generation
- Rate for excess production
- Non-bypassable charges
- Time of Use



Efficiency Vermont

Green Mountain Power example

- Retail rate: $0.16446
- Efficiency charge: $.01413

- Statewide blended rate: $0.15417

- Avoided cost for electricity used before the meter:

$0.16446+$0.01413=

$0.17876

- Difference between RE used vs. purchased

$.17876-$0.15417=

$0.0246

Efficiency Vermont

GREEN MOUNTAIN POWER

Contact Us:
1.888.835.4672

Login:
greenmountainpower.com

Previous Account Balance	$248.09
Payments Received	-$248.09
Balance Forward	$0.00
New Charges	-$0.51
Adjustments	$0.51

Your Account

Bill Date 05/13/19

Account Number [redacted]
Account Name
Service Address

Your Bill

Total Amount Due

$0.00

My Energy Use Snap Shot

Learn how your renewable generation has contributed towards a sustainable energy future. For more details visit your account at greenmountainpower.com

Total Solar Generated
535
kWh

178 kWh used by your home
357 kWh Solar to the grid

Total Energy Used
611
kWh

433 kWh delivered to your home
178 kWh from generation

My Net Meter Summary

Actual Balance

Previous Balance $248.09
Payments Received -$248.09
Balance Forward $0.00
Actual Charges/Adjustments -$0.51
Total Account Balance -$0.51

Net Meter Bank

Previous Credits Balance $0.00
Total Net Meter Adjustments -$0.51
Total Credits Balance -$0.51

Continued on back

GREEN MOUNTAIN POWER

163 Acorn Lane
Colchester, VT 05446

Contact Us: 1.888.835.4672

Bill Date	05/13/19
Account Number	56738175548
Balance Forward	$0.00
New Charges/Adjustments	$0.00
Total Amount Due	**$0.00**

Message Center

Would you like to win an iPad or an electric bicycle? Make the switch to eBilling, and you're entered to win! Paperless billing is a simple step you can take to reduce your carbon footprint while also cutting clutter and wasted paper. Now, every time we reach 5,000 more customers signed up for eBilling, we're giving away an iPad. And when we reach 100,000 customers signed up, we'll give away an ebike! All GMP customers who've switched to eBilling are eligible to win. Signing up is easy! Give us a call at 888-835-4672 and you can learn more on our website: https://greenmountainpower.com/2019/03/27/cut-carbon-switch-to-ebilling/

Bill Details

6 EMMA ST

New Charges	
Customer Charge: 31 Days @ $0.48	$14.88
433 Total KWH Consumed	
357 Total KWH Generated	
76 Total KWH Net Billed @ $0.16446	$12.50
Energy Efficiency Charge 76 x $0.01371	$1.04
Power Adjustment	$0.08
Federal Tax Reform Credit	-$1.65
Electric Assistance Progrm Fee	$1.00
535 Total KWH Generation	
535 Solar Incentive KWH @ $-0.053	-$28.36
New Actual Charges	**-$0.51**
Adjustments	
Transfer Credit To/From Net Meter Bank	$0.51
Total Adjustments	**$0.51**

Usage History

Next reading approx 06/11/19

This Bill
76
kWh

Service Address: 6 EMMA ST
Usage Period: 04/12/19 - 05/13/19
Meter Number + Start: 42457 Stop: 42890
6061649 - Start: 15208 Stop: 15565
Rate: E01 Residential Net Metering

This Bill
535
kWh

Service Address: 6 EMMA ST
Usage Period: 04/12/19 - 05/13/19
Meter Number + Start: 0 Stop: 0
6188172 - Start: 22361 Stop: 22896
Rate: Generation

Efficiency Vermont

ISOs – Your local grid environment

Efficiency Vermont

ISO-New England

- Manages all the generation supply
- Provides all the power
- Responsible for reliability
- Controls the Forward Capacity Market
- Forecasts and plans for the next 10 years

None of us is an island

Efficiency Vermont

What's in store for summer?

Adequate electricity supplies are expected to meet peak consumer demand for electricity under both typical and extreme weather conditions. EE and BTM PV are forecasted to reduce the summer peak by 3,600 MW.

Today's Snapshot

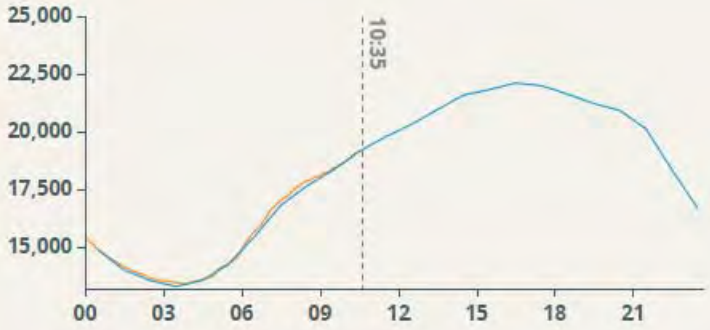
AS OF 07/17/2019 08:20 AM

26,629	22,110	2,081	20,951
AVAILABLE CAPACITY (MW)	FORECASTED PEAK DEMAND (MW)	SURPLUS CAPACITY (MW)	YESTERDAY'S PEAK DEMAND (MW)

Go To Today's Morning Report

REAL-TIME DATA

SYSTEM DEMAND



19140 FORECASTED (MW) 19217 ACTUAL (MW)

FUEL MIX

71%	NATURAL GAS
20%	NUCLEAR
6%	RENEWABLES
3%	HYDRO
<1%	OTHER
<1%	OIL

INTERNAL HUB PRICE

$32.90	ENERGY
$0.00	CONGESTION
$-0.08	LINE LOSS
$32.82 ↑	

SYSTEM STATUS

Normal

More Real-Time Data

Efficiency Vermont

We have received confirmation from BED that they are targeting a peak today ***Wednesday, July 17th from 4:00 pm – 7:00 pm.*** *It does not look like a peak-day here in Vermont, but the New England system is peaking and southern NE is forecasted to experience much higher humidity and temperatures this afternoon. As such, we will be doing what we can to decrease demand during this time.*

Today's peak day plan of action:

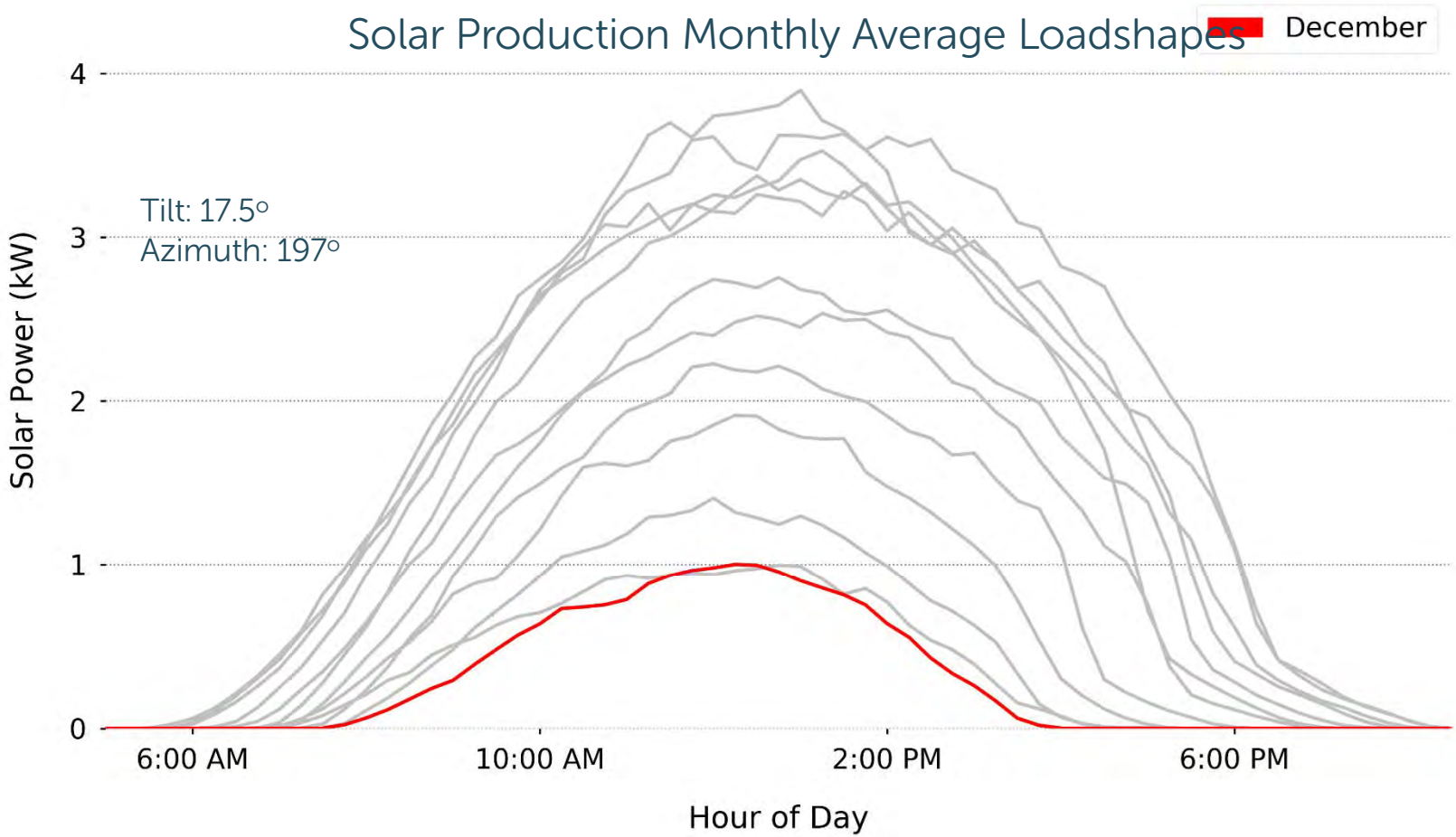
- *Unplug your laptops and run off battery power. Remember that a docked laptop with a second monitor in use draws ~50 watts.*
- *No printing – Commercial printers used in an office will draw 30 to 50 watts on standby and 300 to 500 watts when printing.*
- *No EV charging please. VEIC pays for the EV Charging (thanks for the perk). EV charging, if curtailed during peak periods, can have a huge impact on demand goals.*
- *To reduce water heating, water heaters in 4th floor hubs will be shut off. Hot water in the kitchen will remain on. If possible, try not to brew coffee during this time!*

Efficiency Vermont

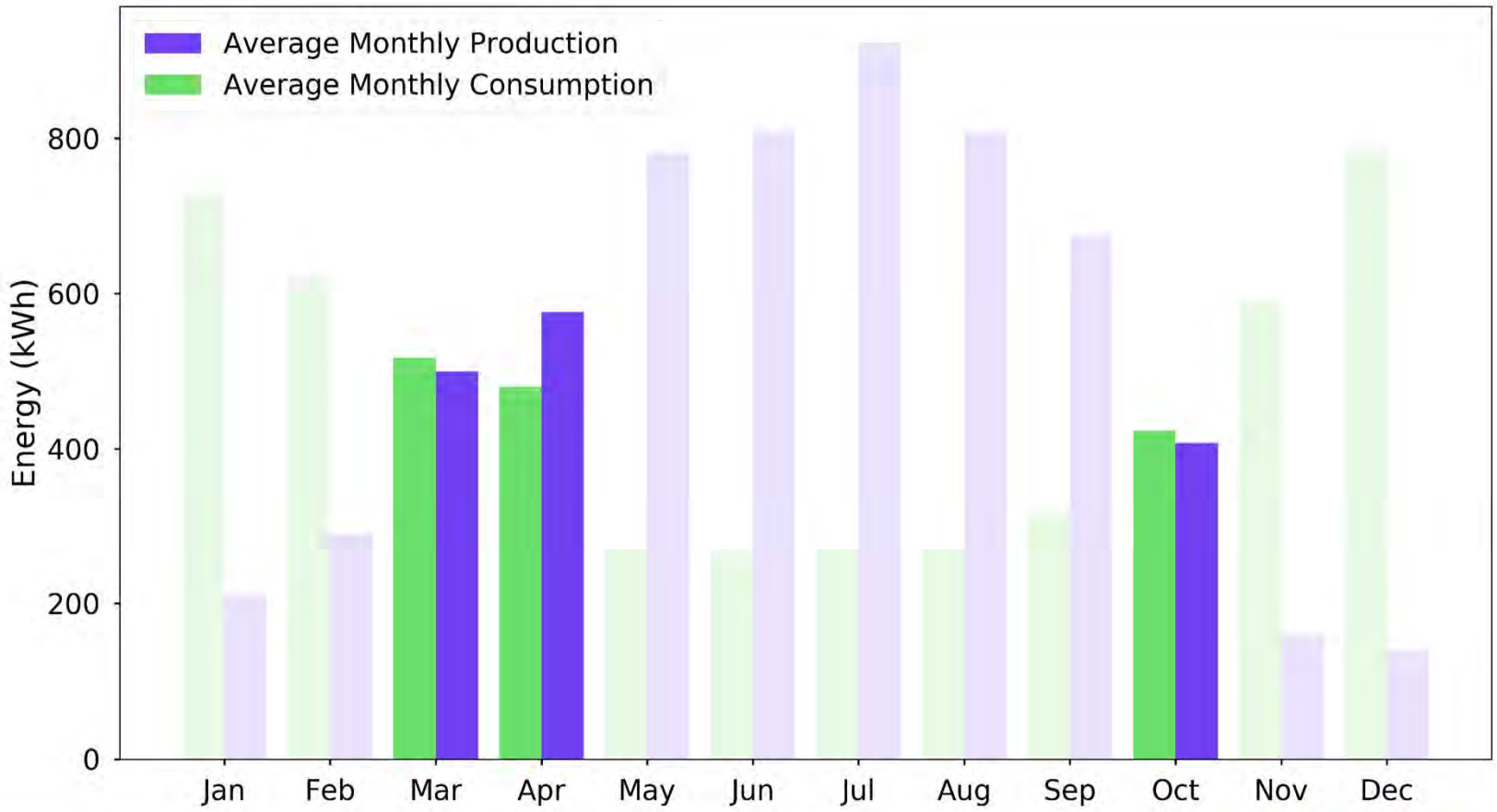
Net Metering and Carbon

Is it a winner?

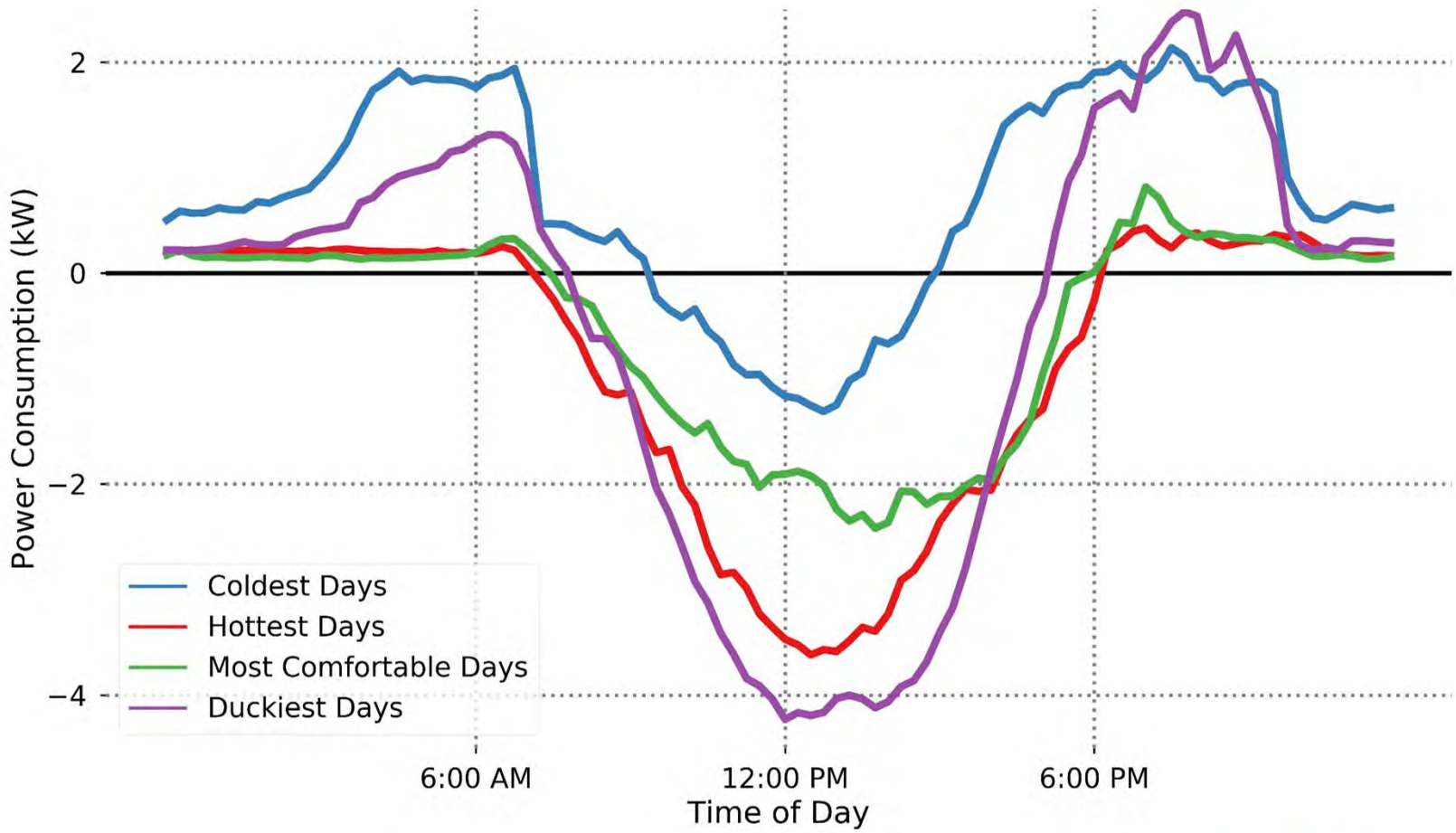
Efficiency Vermont



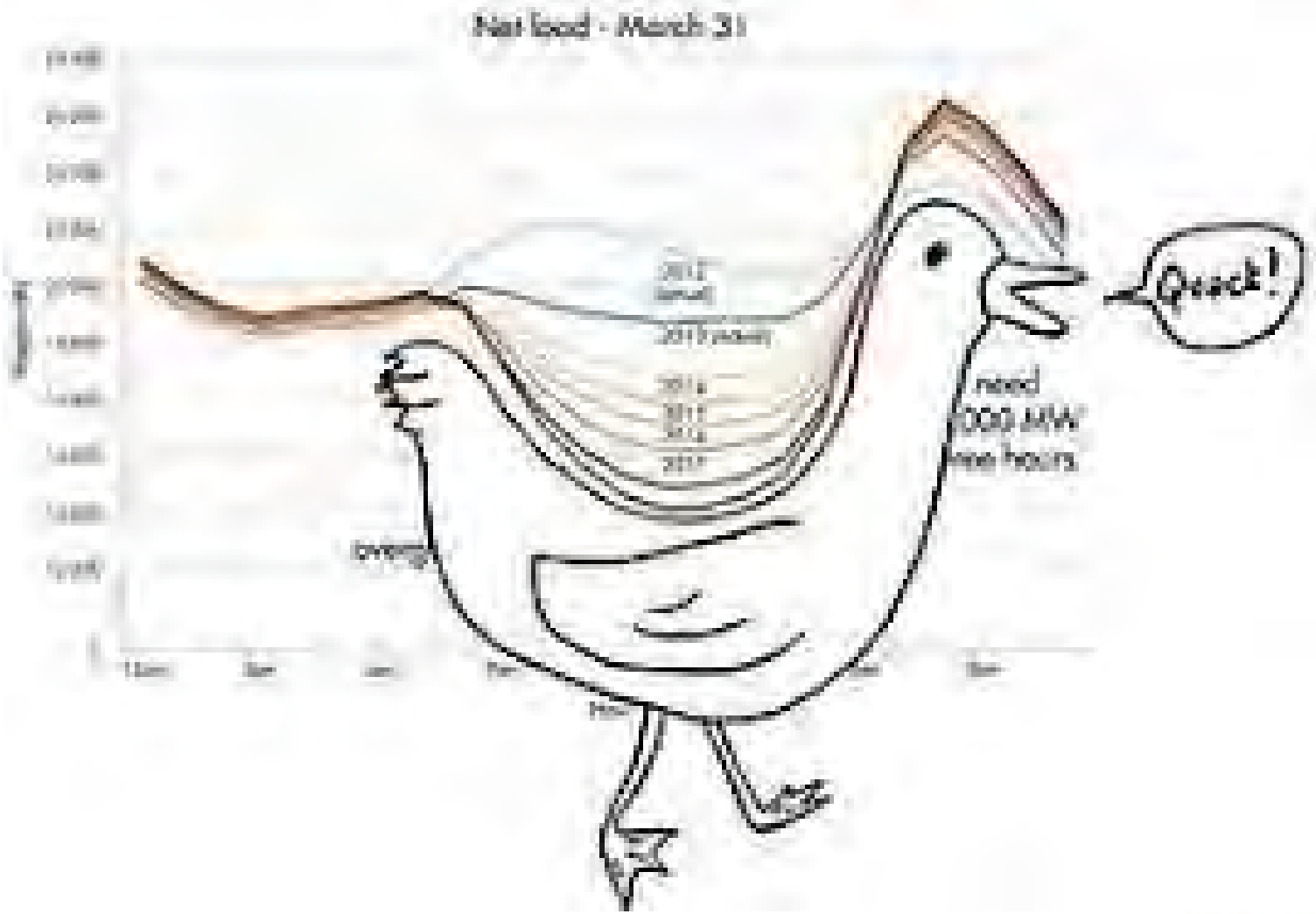
Efficiency Vermont



Efficiency Vermont



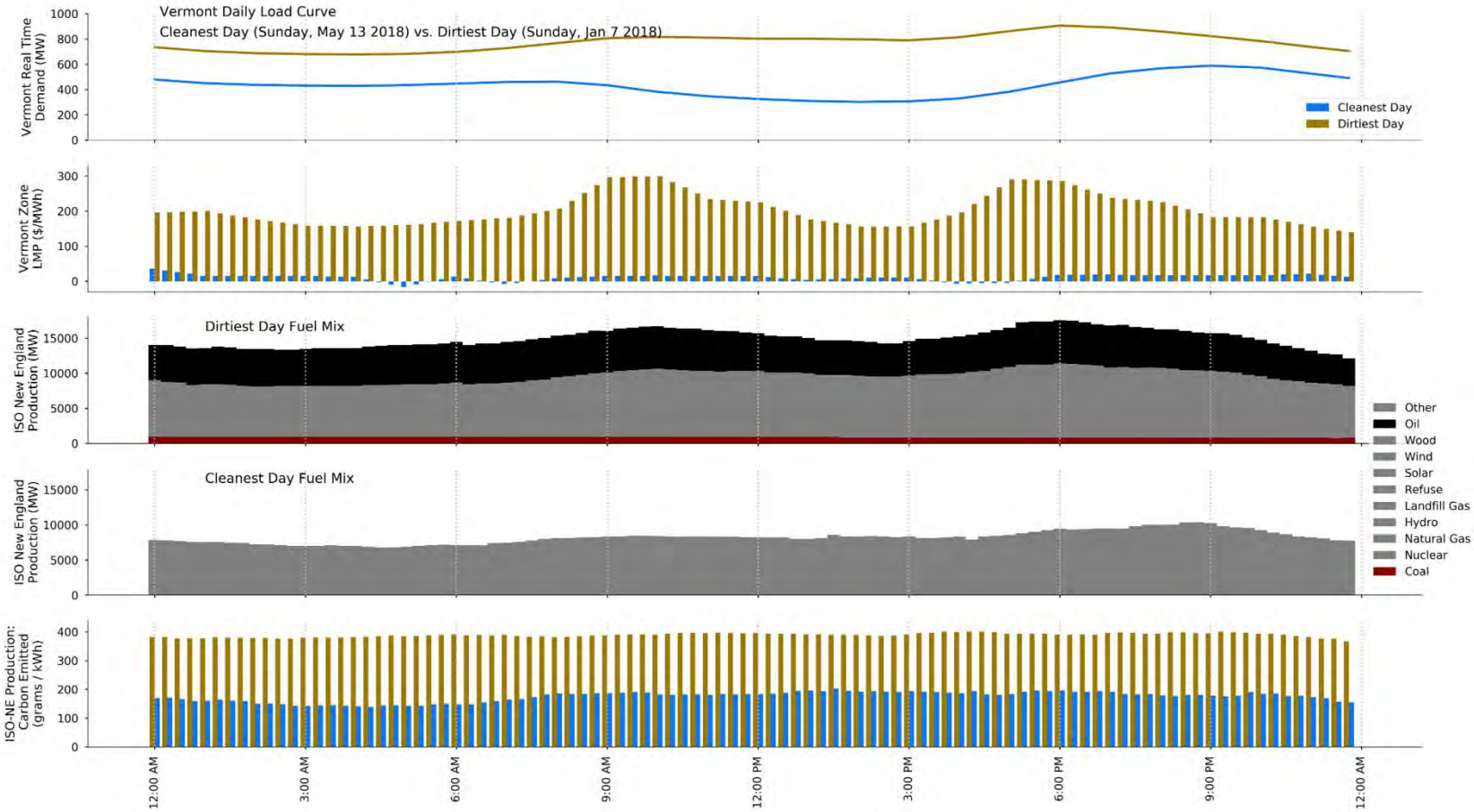
Efficiency Vermont

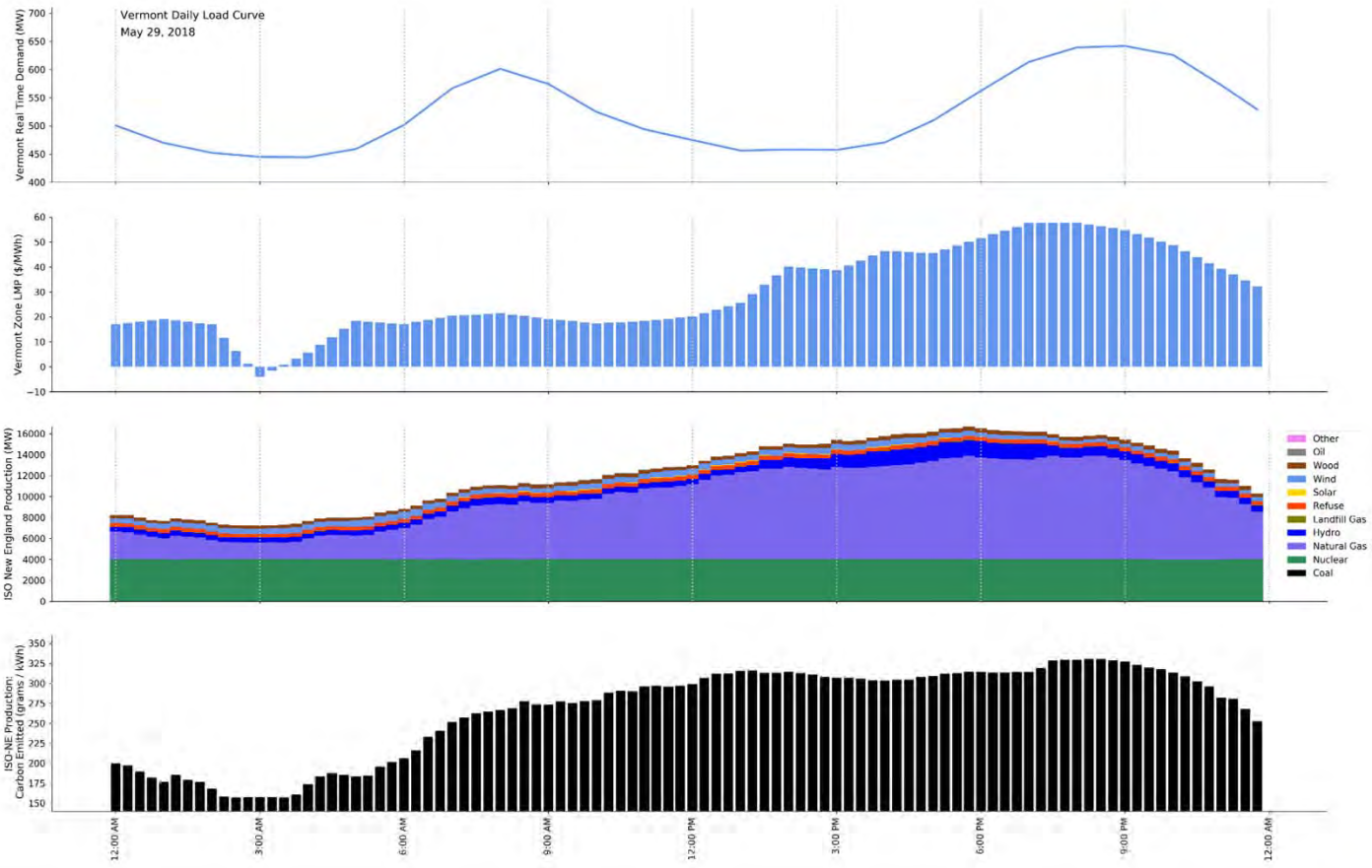


Efficiency Vermont

So … you're producing and consuming at different times. As long as the carbon footprint per unit of energy on the grid is pretty constant, who cares?

Efficiency Vermont


Vermont Daily Load Curve
Cleanest Day (Sunday, May 13 2018) vs. Dirtiest Day (Sunday, Jan 7 2018)
Vermont Real Time Demand (MW)
Cleanest Day
Dirtiest Day
Vermont Zone LMP ($/MWh)
Dirtiest Day Fuel Mix
ISO New England Production (MW)
Cleanest Day Fuel Mix
ISO New England Production (MW)
Other
Oil
Wood
Wind
Solar
Refuse
Landfill Gas
Hydro
Natural Gas
Nuclear
Coal
ISO-NE Production: Carbon Emitted (grams / kWh)
12:00 AM
3:00 AM
6:00 AM
9:00 AM
12:00 PM
3:00 PM
6:00 PM
9:00 PM
12:00 AM



Efficiency Vermont

For every 15-minute period, I will calculate…

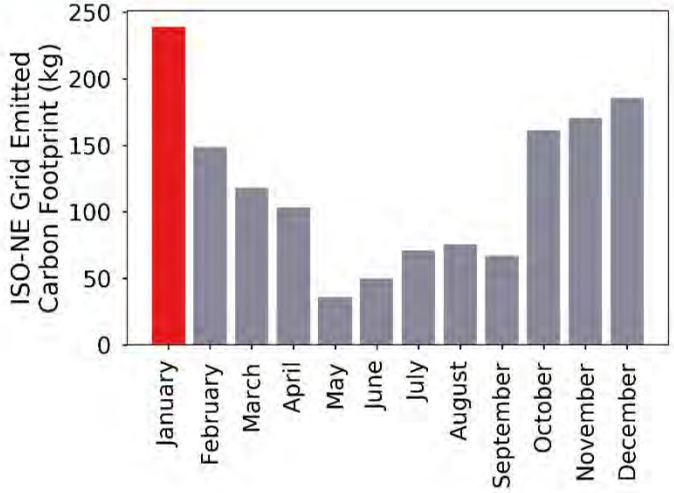
Emitted carbon (g) = ISO-NE footprint (g/kWh) x my consumption (kWh)

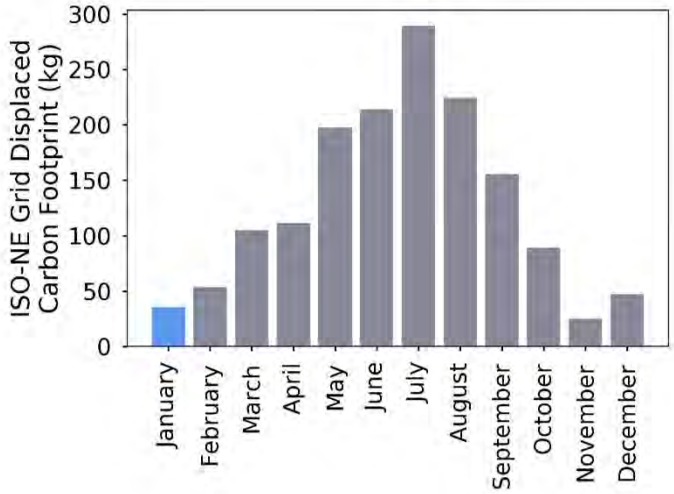
Credited carbon (g) = ISO-NE footprint (g/kWh) x my production (kWh)

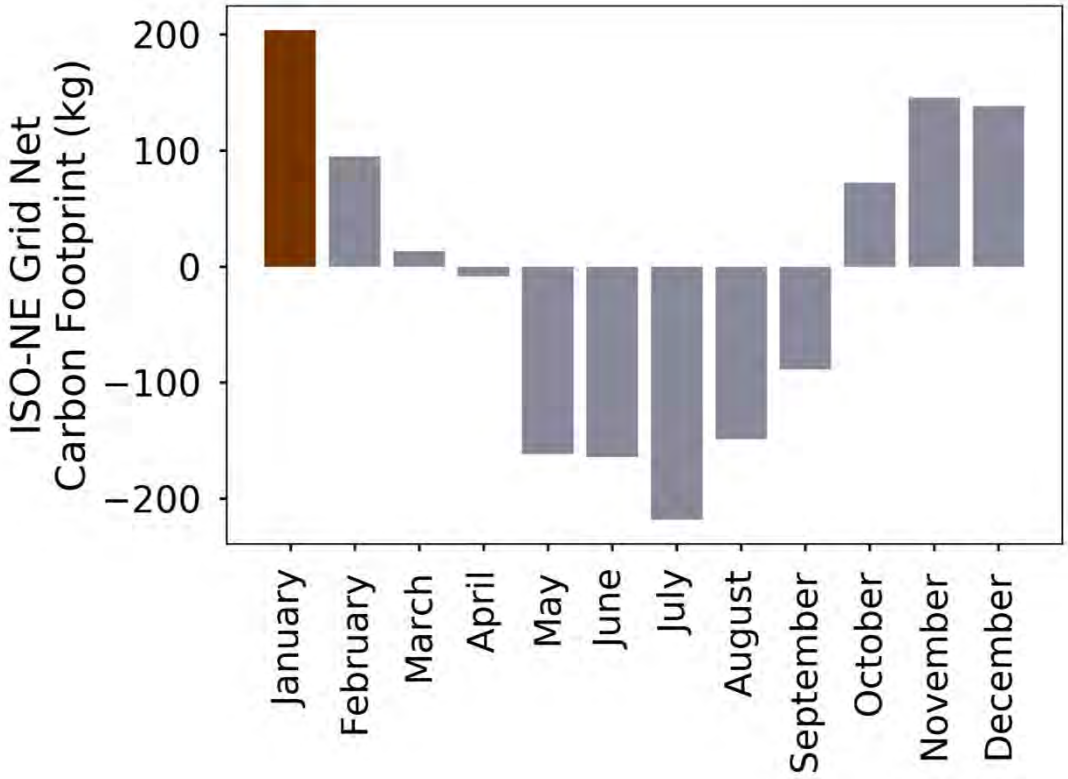
At the day / month / year level, I will calculate…

Net carbon (g) = Emitted carbon (g) - Credited carbon (kWh)

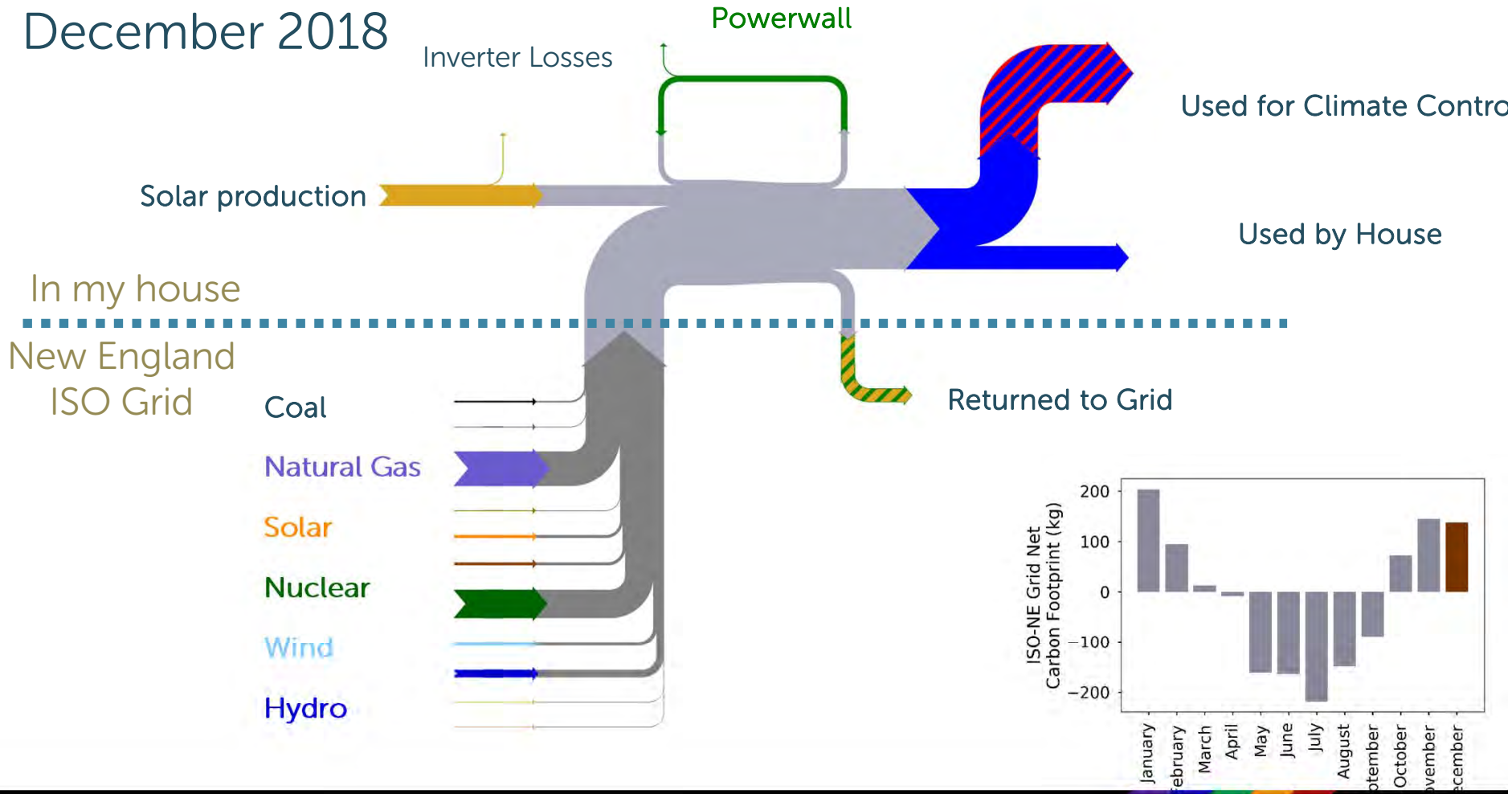
Efficiency Vermont


ISO-NE Grid Emitted Carbon Footprint (kg)
250
200
150
100
50
0
January
February
March
April
May
June
July
August
September
October
November
December


ISO-NE Grid Displaced Carbon Footprint (kg)
300
250
200
150
100
50
0
January
February
March
April
May
June
July
August
September
October
November
December


ISO-NE Grid Net Carbon Footprint (kg)
200
100
0
−100
−200
January
February
March
April
May
June
July
August
September
October
November
December

December 2018



Efficiency Vermont

So… what was my overall footprint for electricity usage?

Year	Carbon emissions (kg)	Carbon credits (kg)	Net carbon emissions (kg)
2017	1,184	1,642	-457
2018	1,427	1,549	-122

Good… but there are two problems:

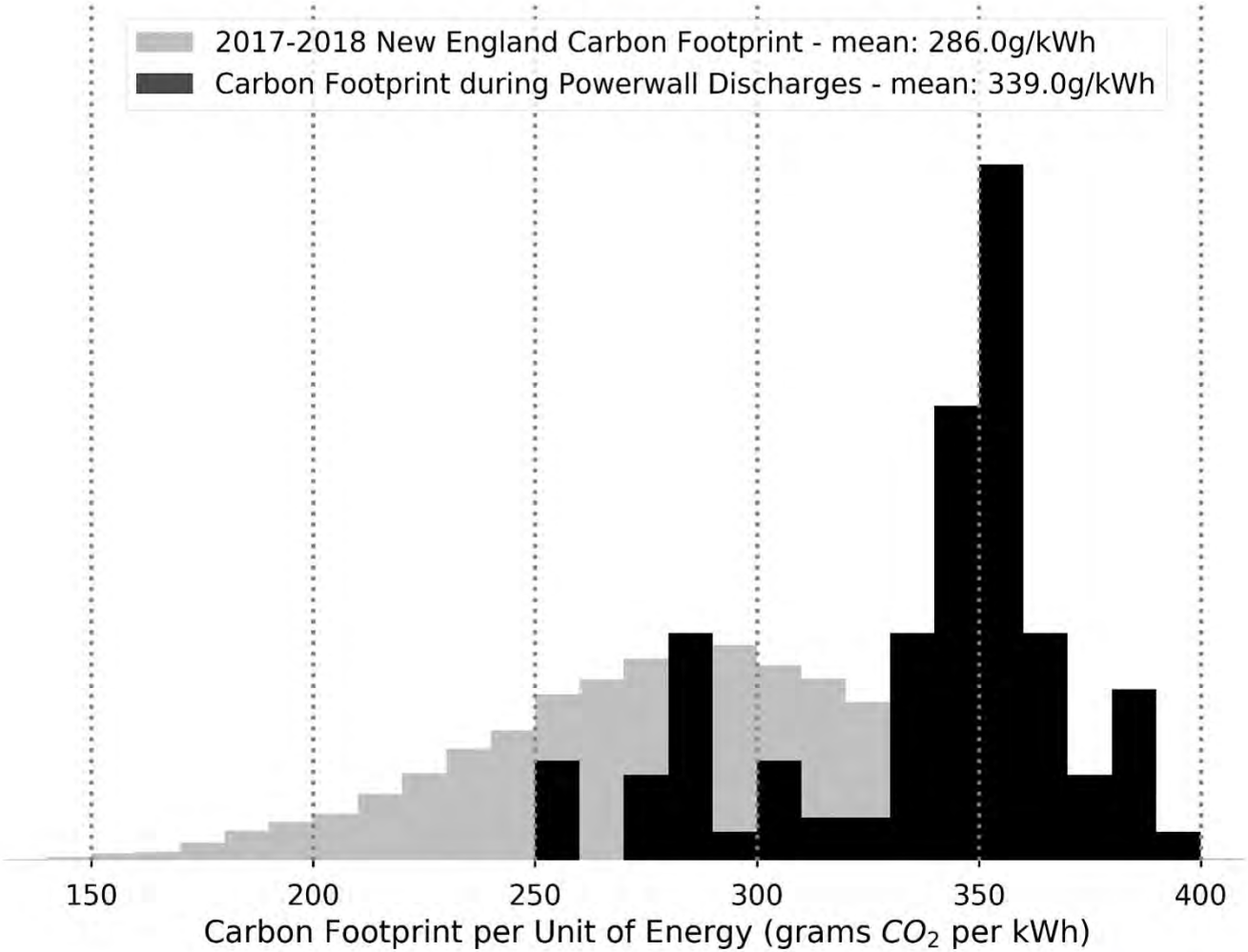
1) Your trend looks horrible – can you explain this?
2) Aren't these numbers going to look worse once you electrify the rest of your heat and transportation?

Efficiency Vermont

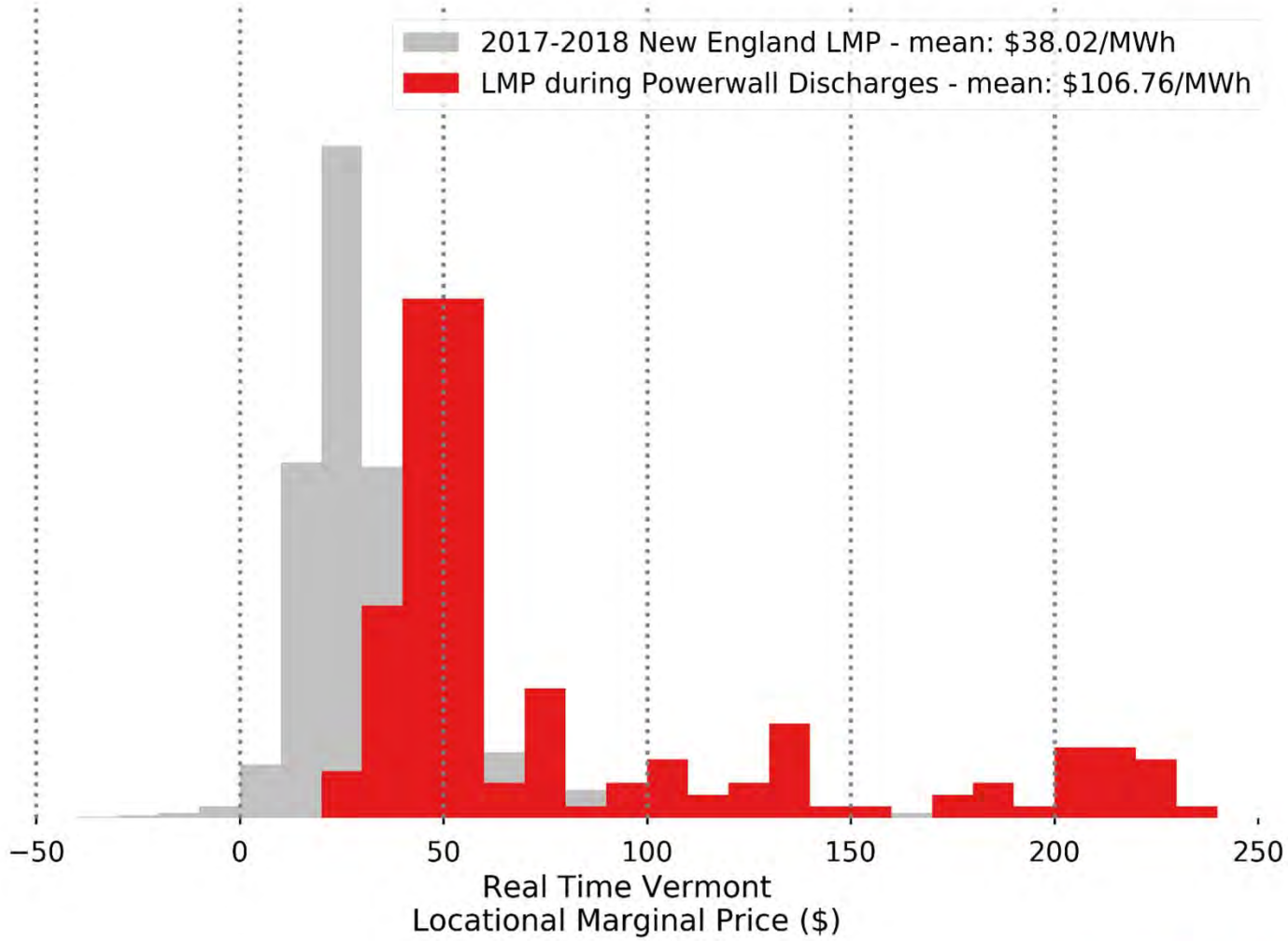
Can't I add a battery and suck up energy during the 'clean' times and discharge during the 'dirty' times and make my energy cleaner?

Let's see if adding a GMP-controlled battery helps the carbon footprint and prices!

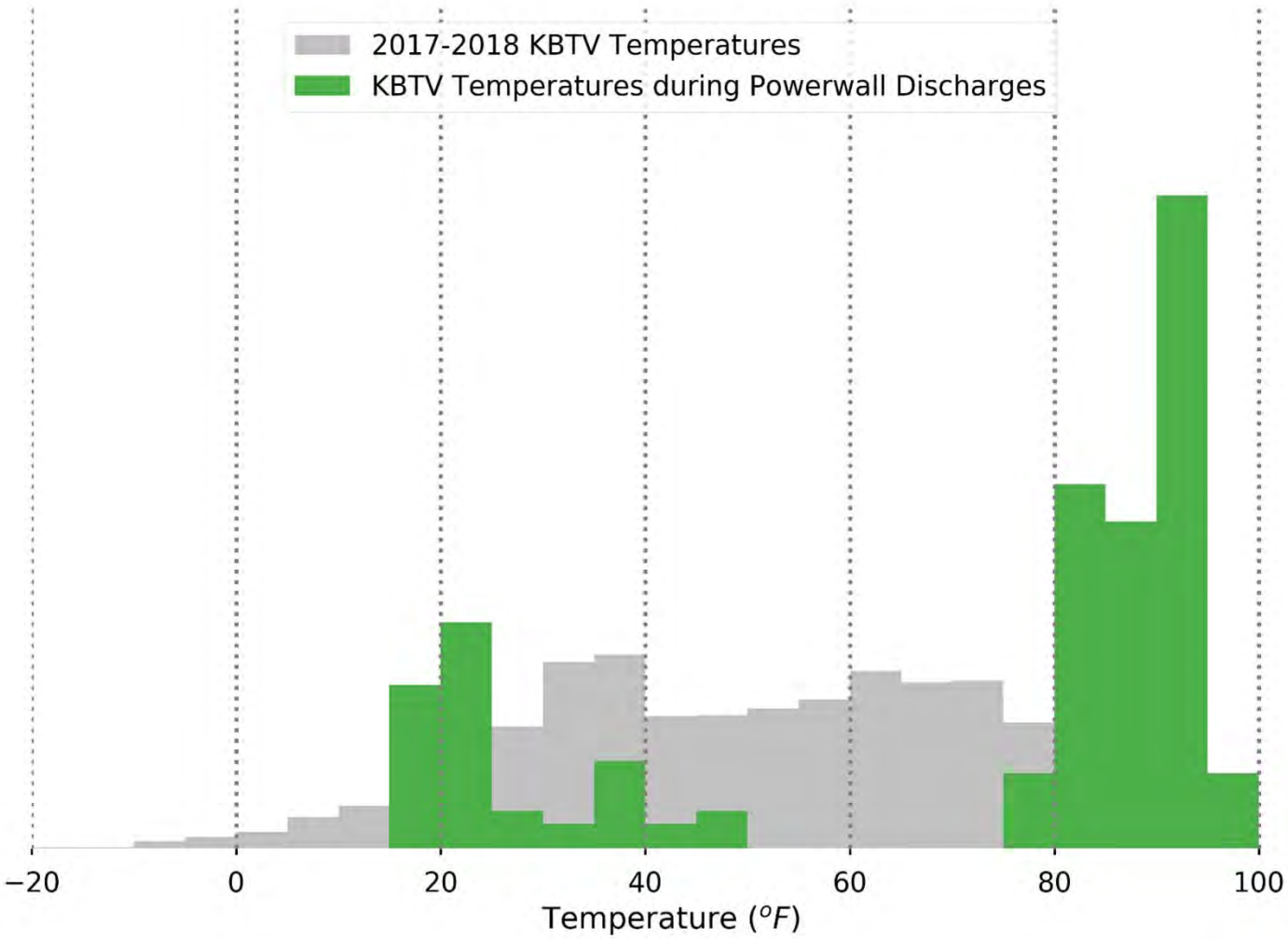
Efficiency Vermont

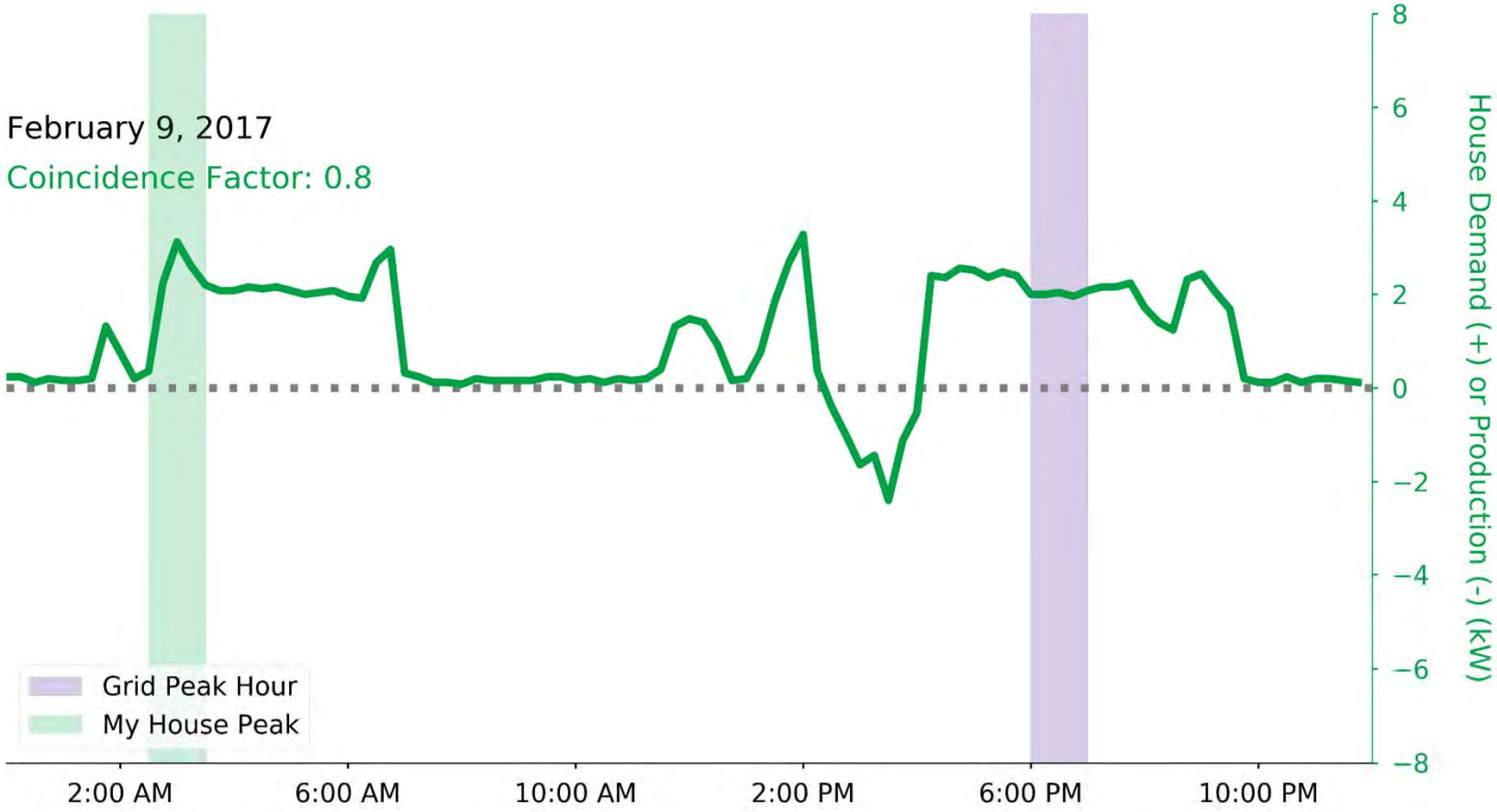


Efficiency Vermont

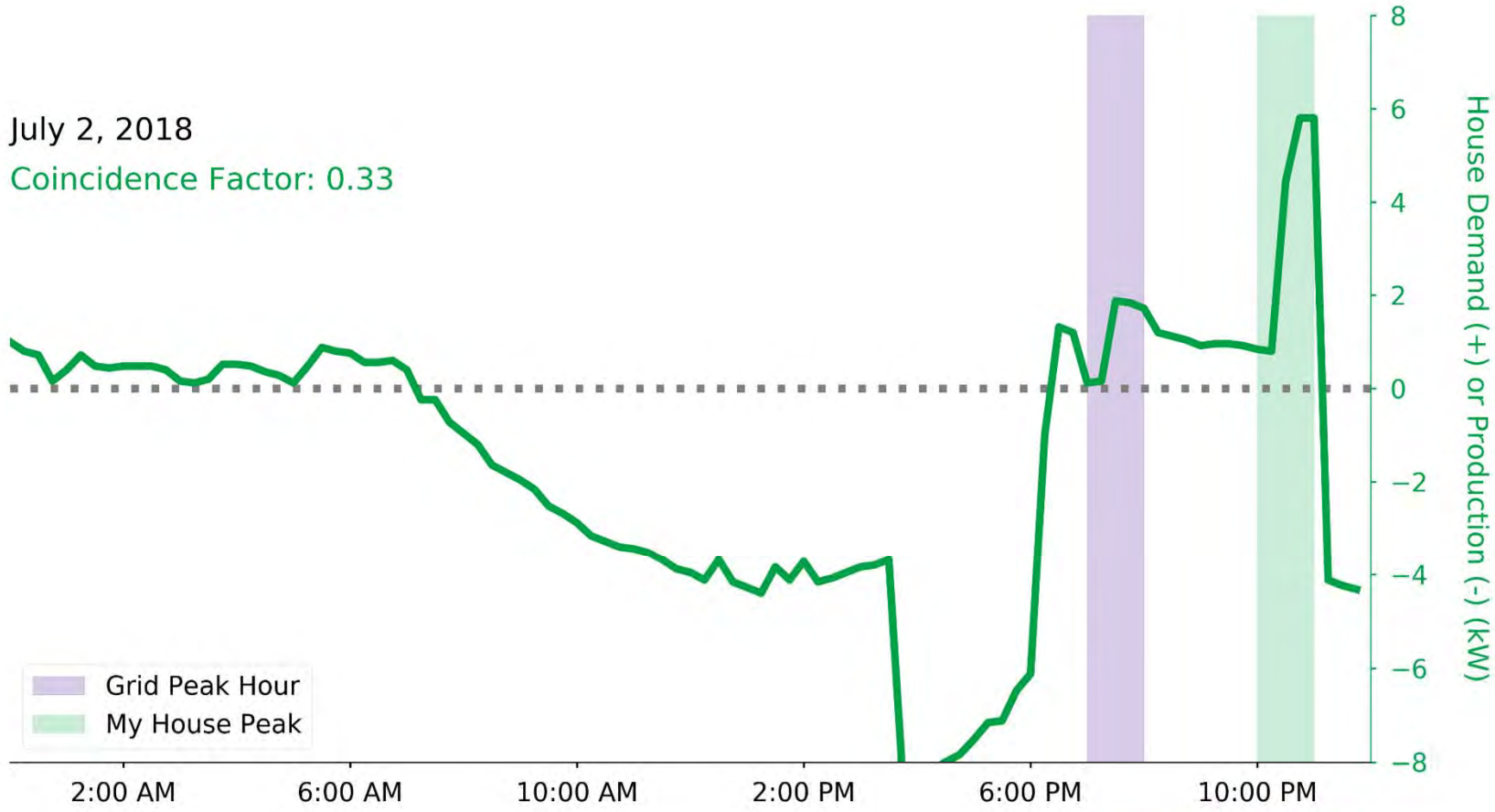


Efficiency Vermont

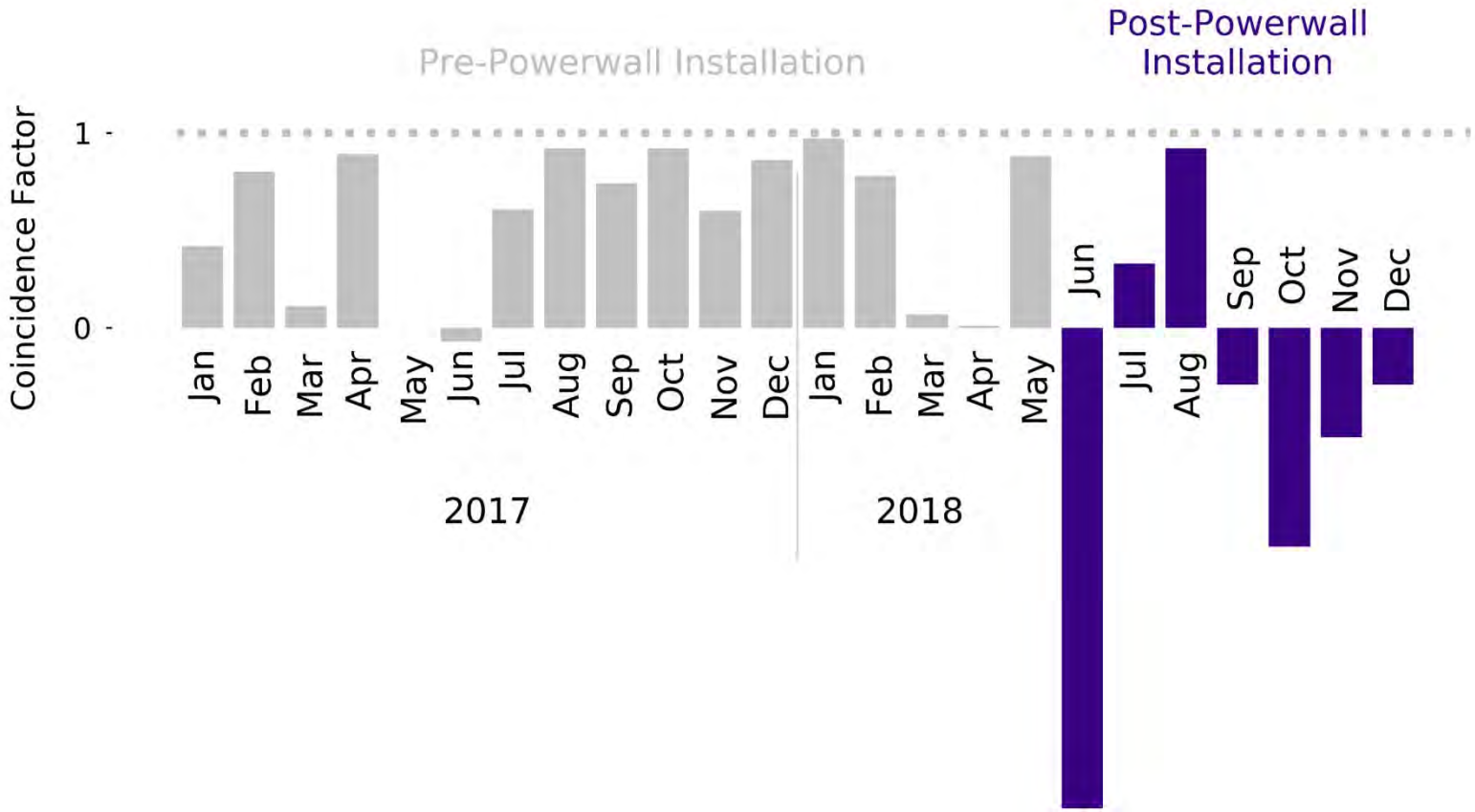

2017-2018 KBTV Temperatures
KBTV Temperatures during Powerwall Discharges
−20
0
20
40
60
80
100
Temperature (^oF)



Efficiency Vermont

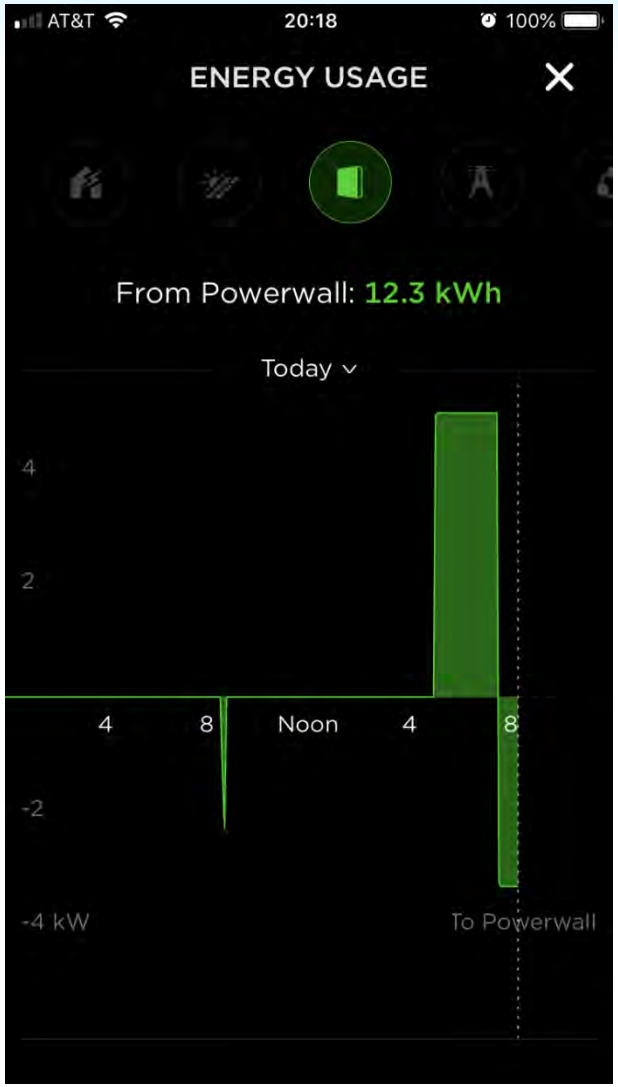


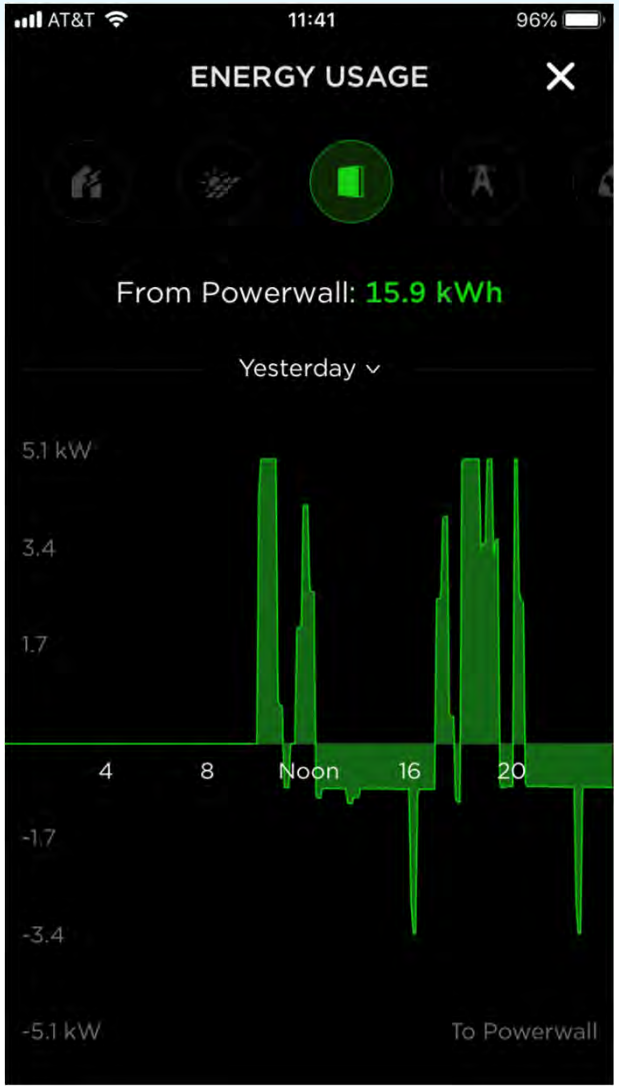
Efficiency Vermont



Efficiency Vermont

Old GMP Powerwall Behavior – December 7, 2018





New GMP Powerwall Behavior – April 9, 2019

Efficiency Vermont

Thank You

Li Ling Young
Sr Energy Consultant
888-921-5990

Efficiency Vermont