26 August 2020

VSPC Generation Constraints Load Mgmt Working Group: *Residential Load Shapes*

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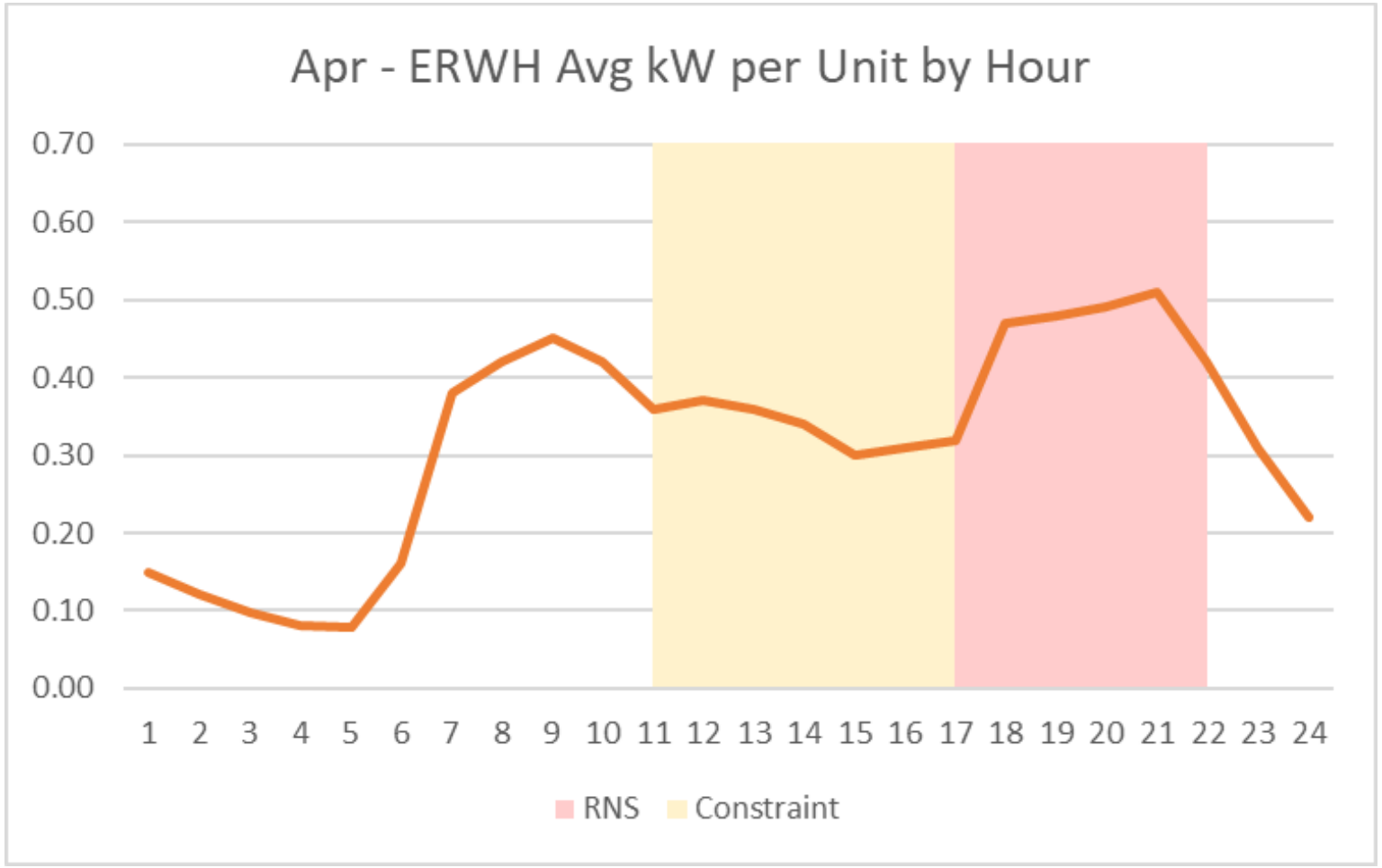
Electric Resistance Water Heaters (ERWH)

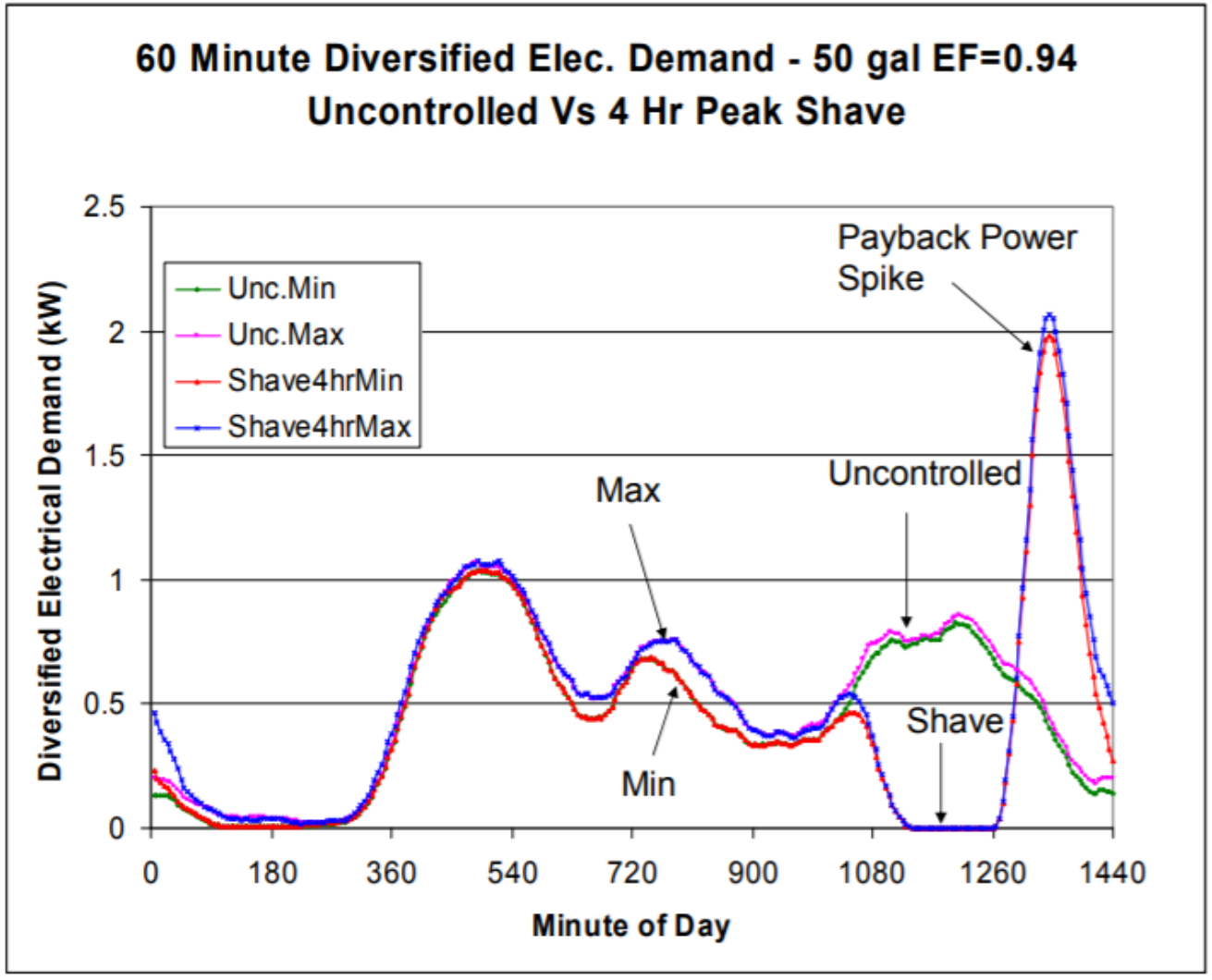
Efficiency Vermont

ERWH April Avg kW



Source: 2018 MA RES Loadshape Study

ERWH *kW flexed for peak*



Source: Brattle Group: https://brattlefiles.blob.core.windows.net/files/7167_the_hidden_battery_-_opportunities_in_electric_water_heating.pdf

ERWH Storage Potential

1.0 – 6.6 kWh/day of storage / unit

- Water temp & mixing valve
- Tank size

Assume 2 kWh / unit

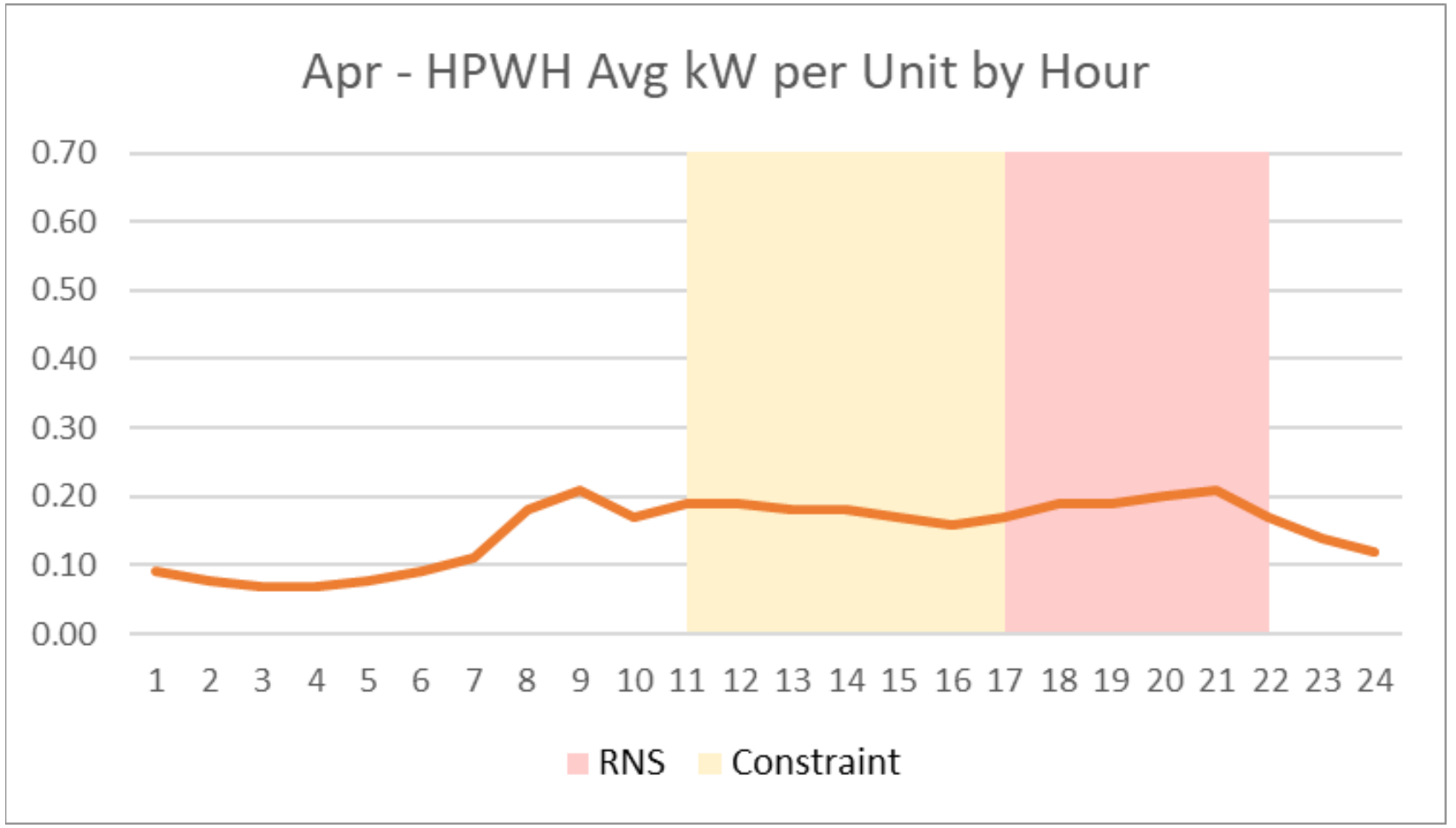
- n = 100 = 0.2 MWh
- n = 1000 = 2.0 MWh

Source: Brattle Group: https://www.energytrust.org/wp-content/uploads/2017/11/Water_Heater_Energy_Storage_wStaffResponse.pdf

Heat Pump Water Heaters (HPWH)

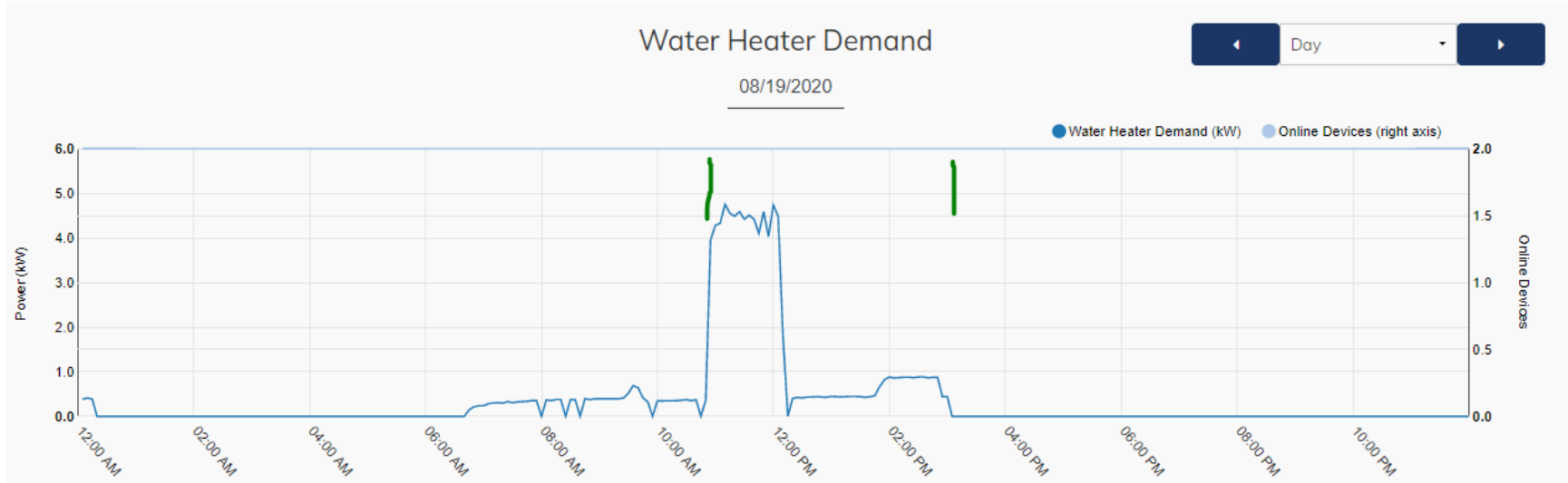
Efficiency Vermont

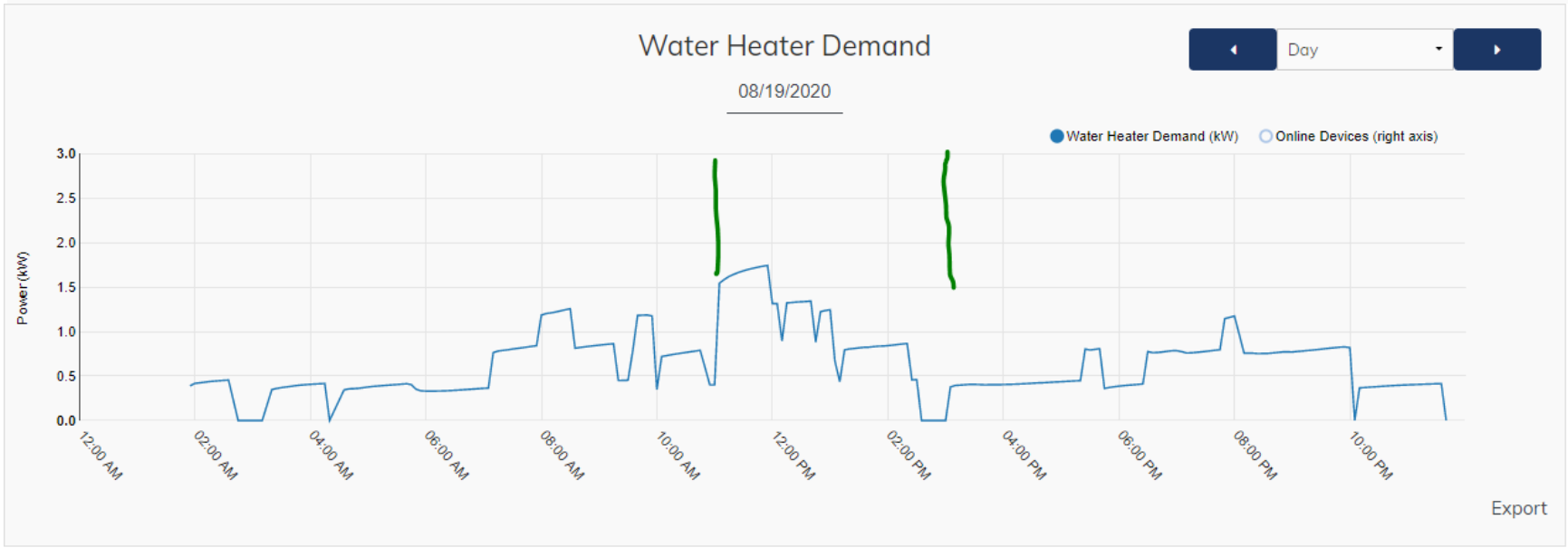
HPWH April Avg kW



Source: 2018 MA RES Loadshape Study

HPWH kW *flexed for PV*





Source: WEC & Virtual Peaker

HPWH Storage Potential

0.4 – 4.1 kWh/day of storage

- Water temp & mixing valve
- Tank size

Assume 1 kWh / unit

- n = 100 = 0.1 MWh
- n = 1000 = 1.0 MWh

Sources:

- https://www.aceee.org/sites/default/files/pdf/conferences/hwf/2018/2a-delforge.pdf
- https://www.aceee.org/sites/default/files/pdf/conferences/hwf/2019/2a-eustis.pdf
- https://www.energytrust.org/wp-content/uploads/2017/11/Water_Heater_Energy_Storage_wStaffResponse.pdf

Cold Climate Heat Pumps (CCHP)

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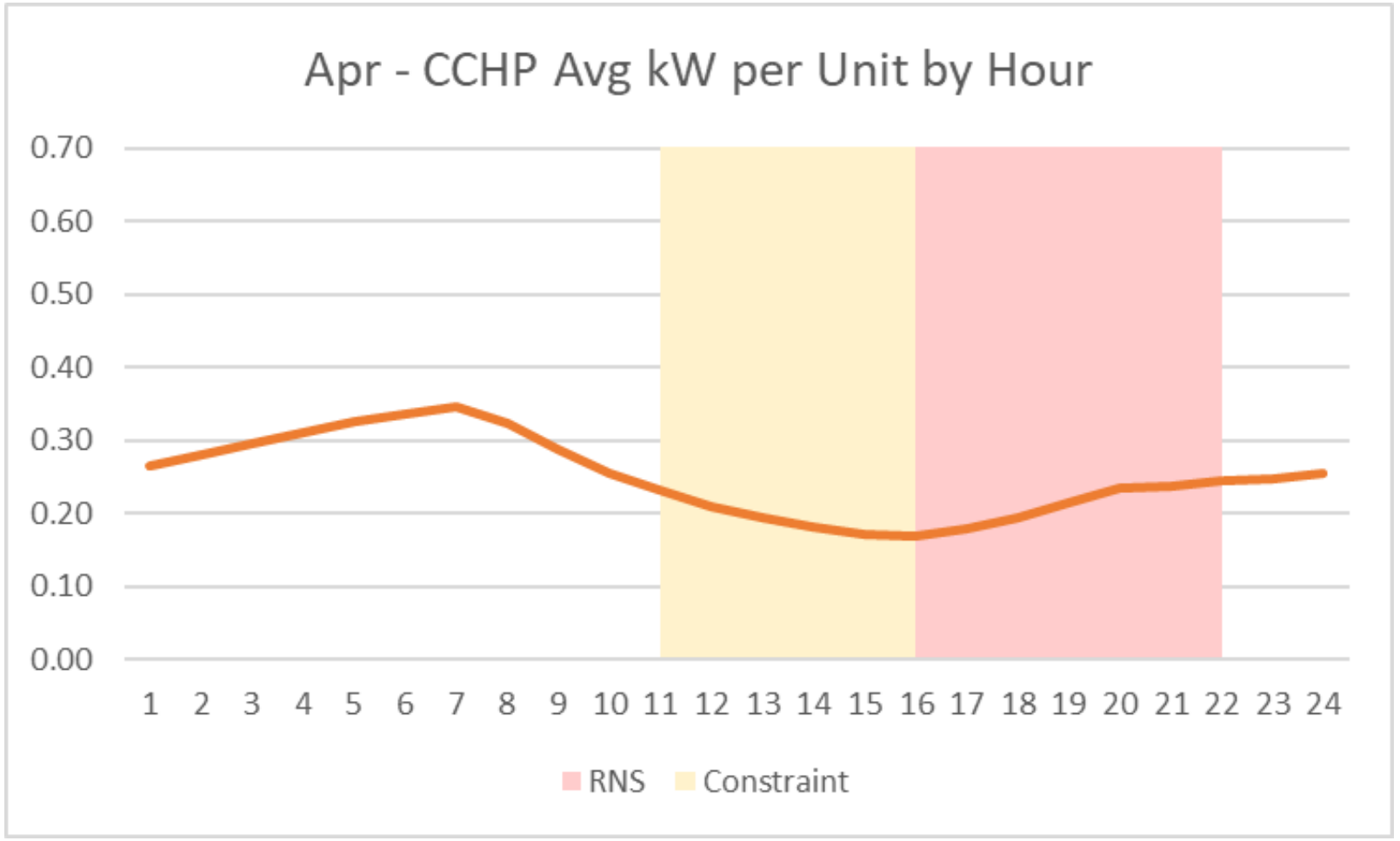
CCHP April Avg kW
(single and multi-zone combined)



Source: Tier 3 TAG docs – LINK

CCHP kW *flexed for ?*

[no data readily available]

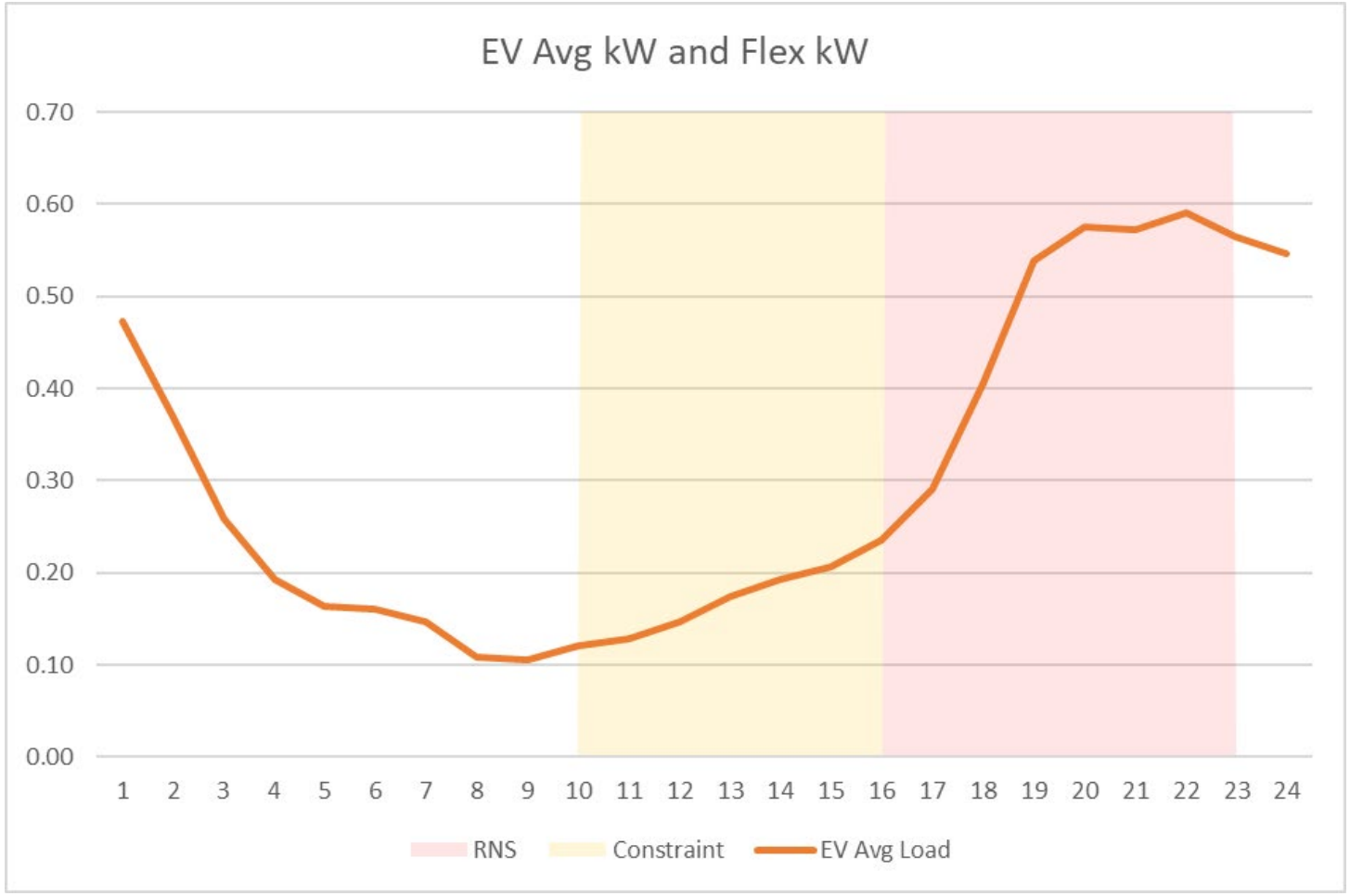
CCHP Storage Potential

[no data readily available]

Electric Vehicle Chargers (EV)

Efficiency Vermont

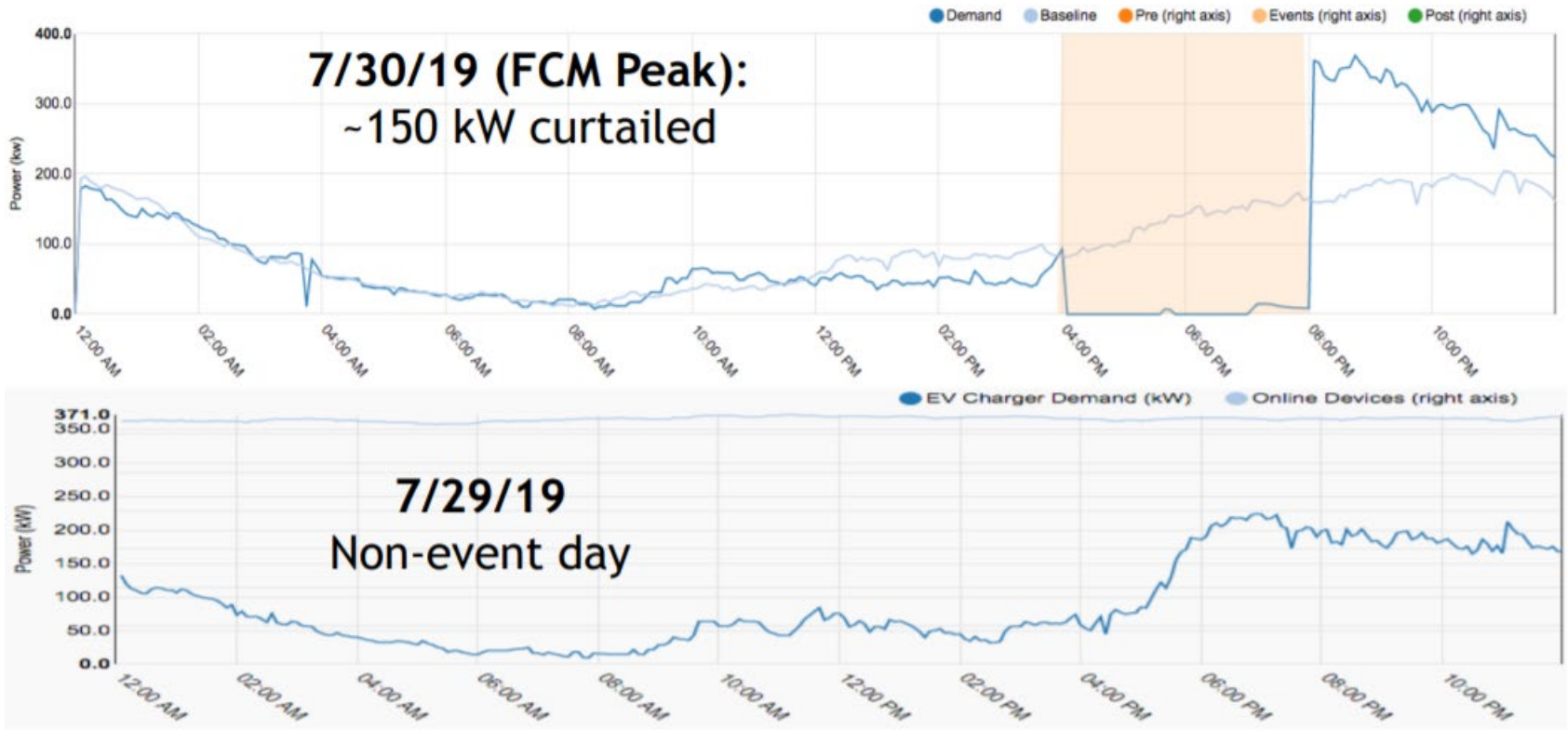
EV All Months Avg kW



Source: GMP 19-3586-TF, Exhibit AND-3

EV kW *flexed* (for FCM)

PEAK MANAGEMENT RESULTS



Source: GMP RDI slides

EV kW *flexed for PV*

[no data readily available]

EV Storage Potential

~7 kWh/day of charge required / unit

- Charging location is a factor
- Flexibility of charging is a factor

Ability to charge at home midday is limited

Assume 1/2 can be done midday at home

- n = 100 = 0.35 MWh
- n = 1000 = 3.5 MWh

Takeaways

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Takeaways

Customer economics

- How to motivate/reward? Chicken and the egg
- Market opportunity vs. retrofit

Electrification

- Impact w/o without controls
- Market oppotunity w/controls—easiest onramp
- Mixing valve for water heaters
- Midday charging locations for EVs

Controls are critical

Scale is critical

Questions?

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ERWH & HPWH storage capacity

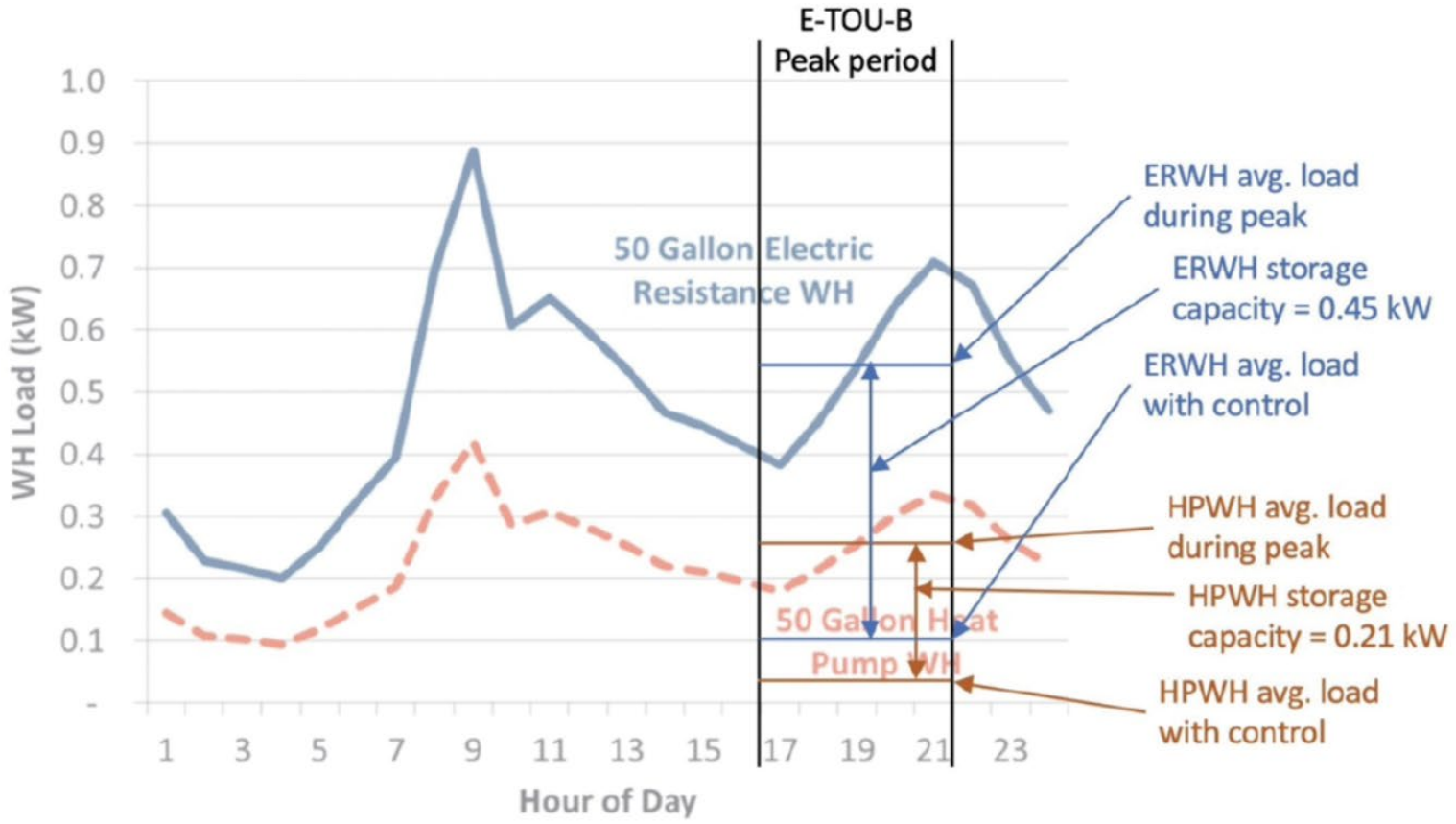
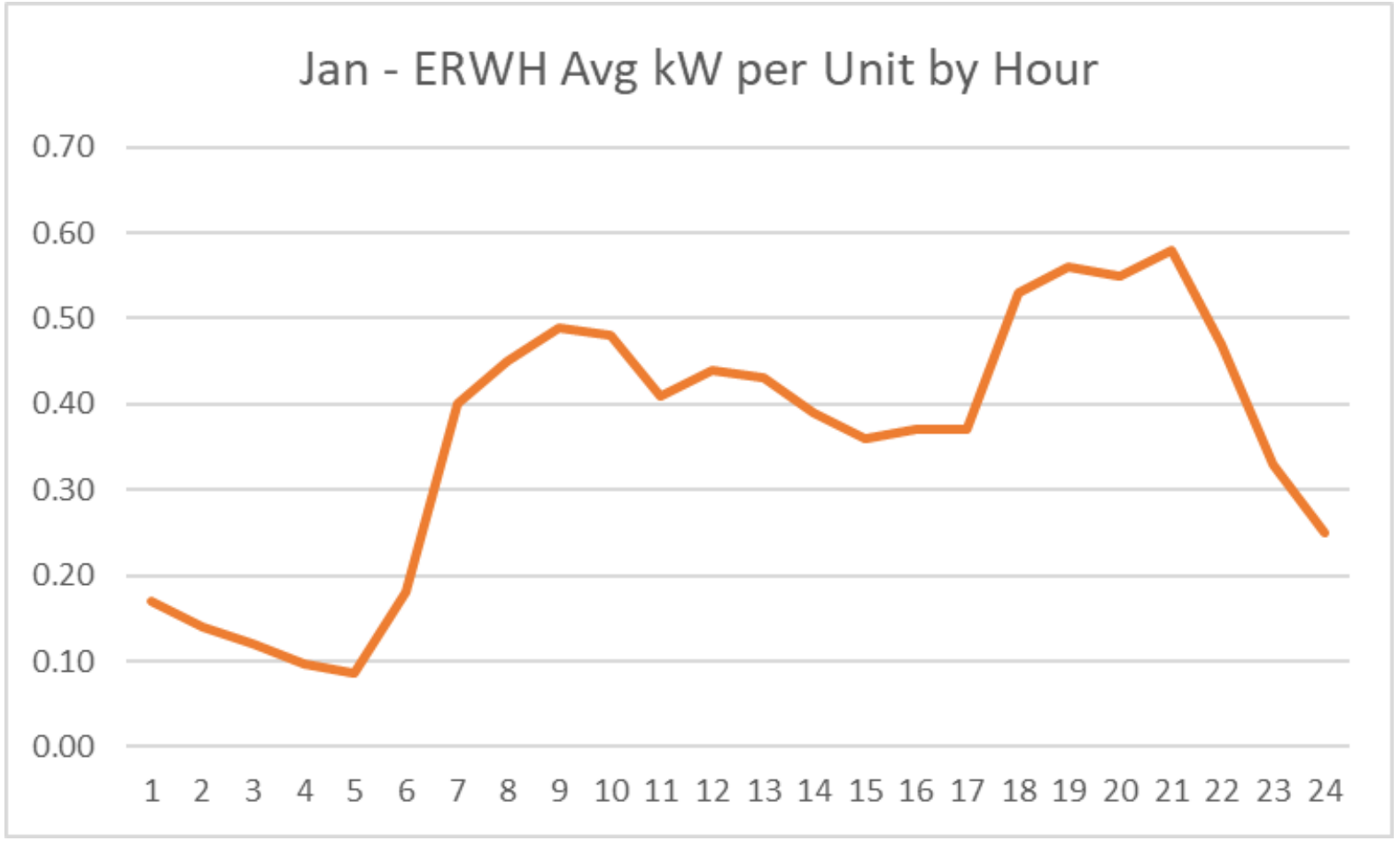


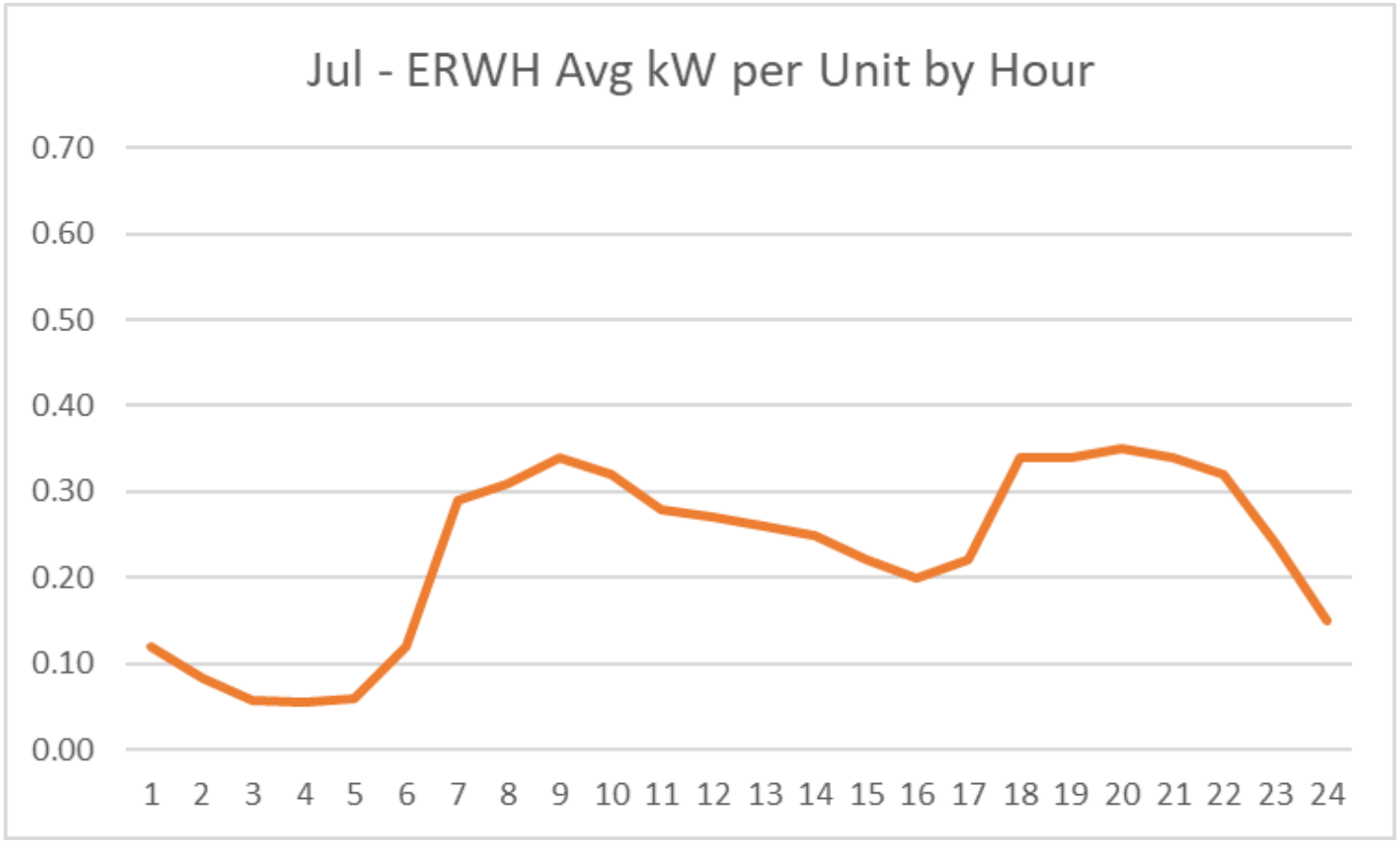
Figure 8. Illustration of the method for measuring average peak reduction due to load coordination.

ERWH January Avg kW



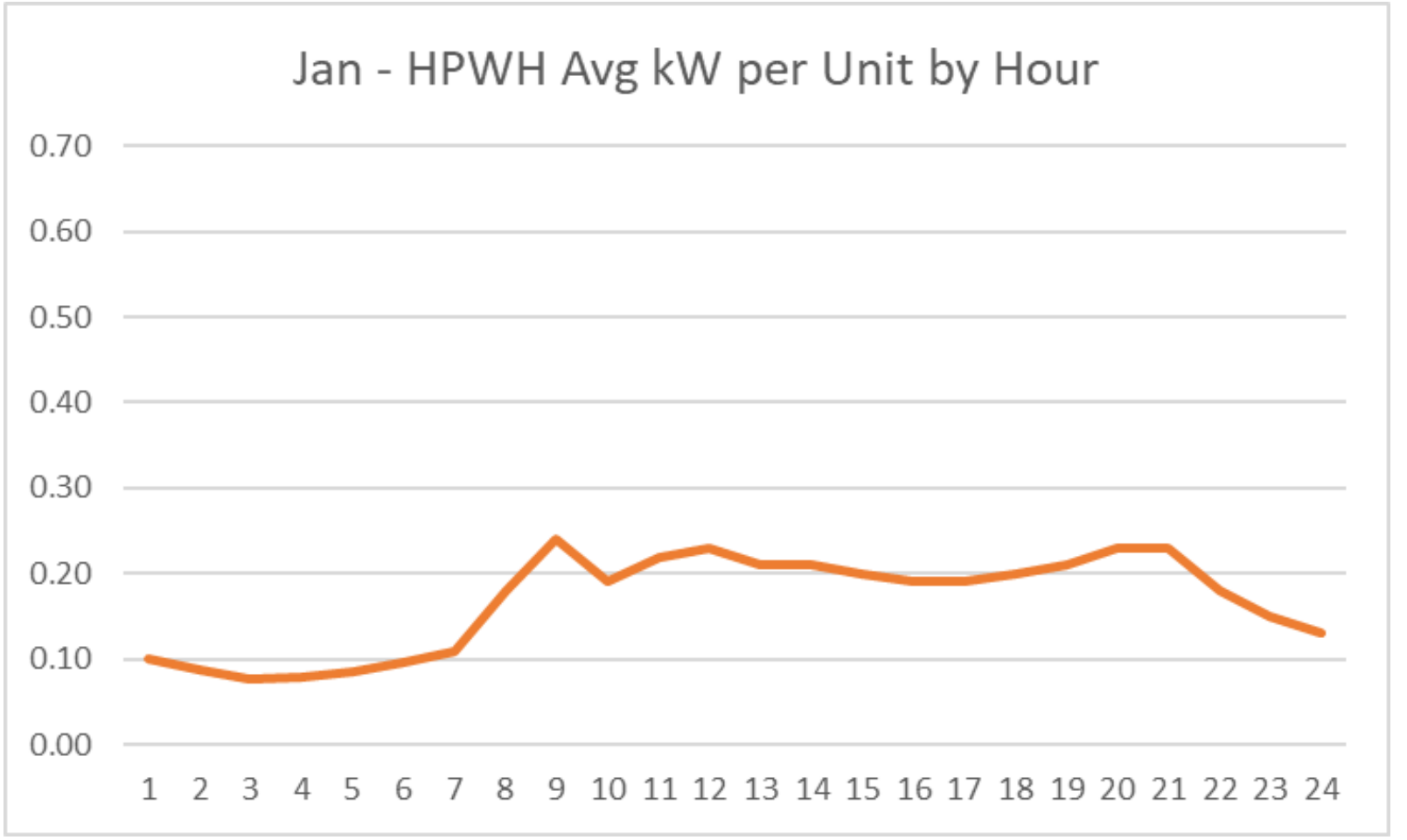
Source: 2018 MA RES Loadshape Study

ERWH July Avg kW



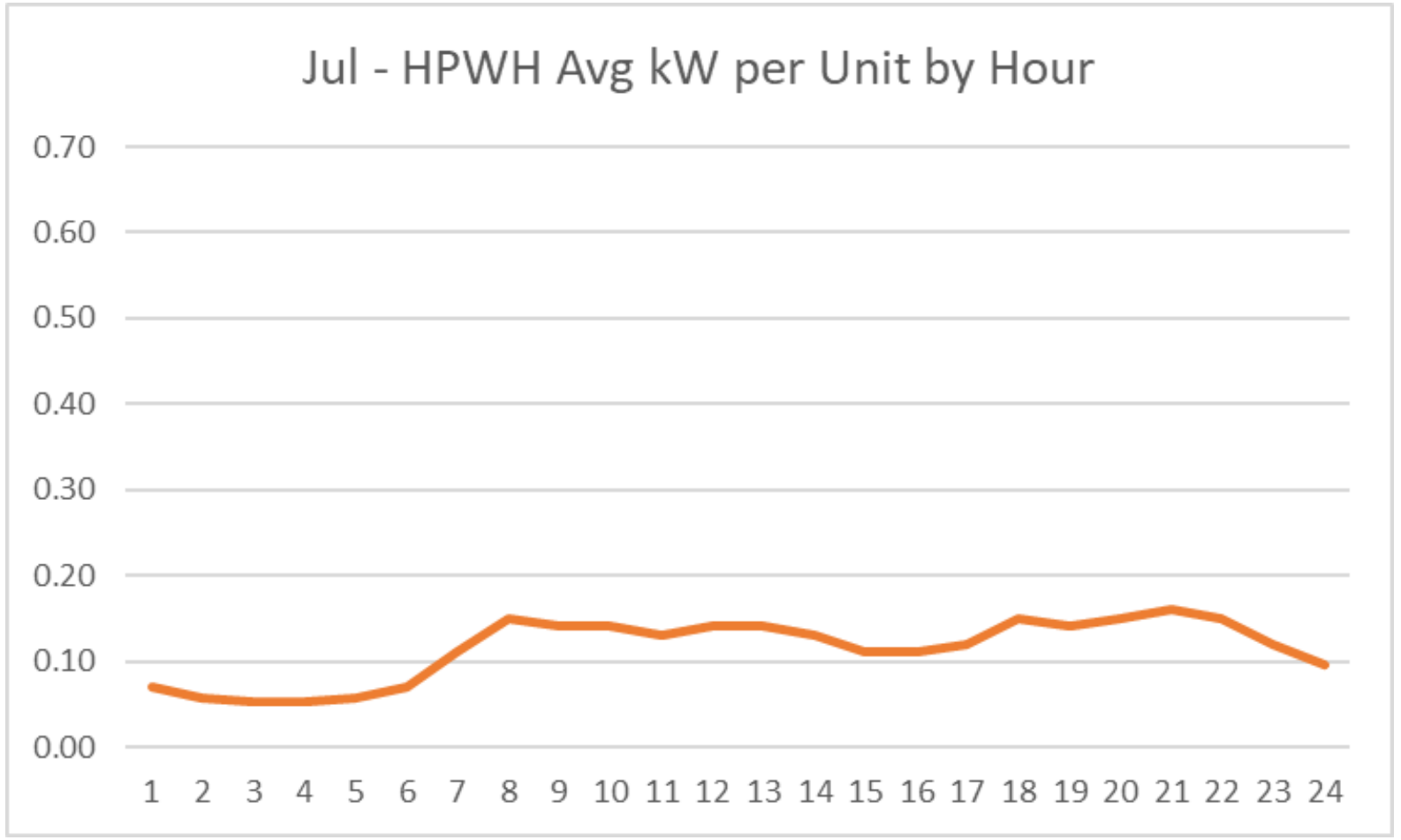
Source: 2018 MA RES Loadshape Study

HPWH January Avg kW



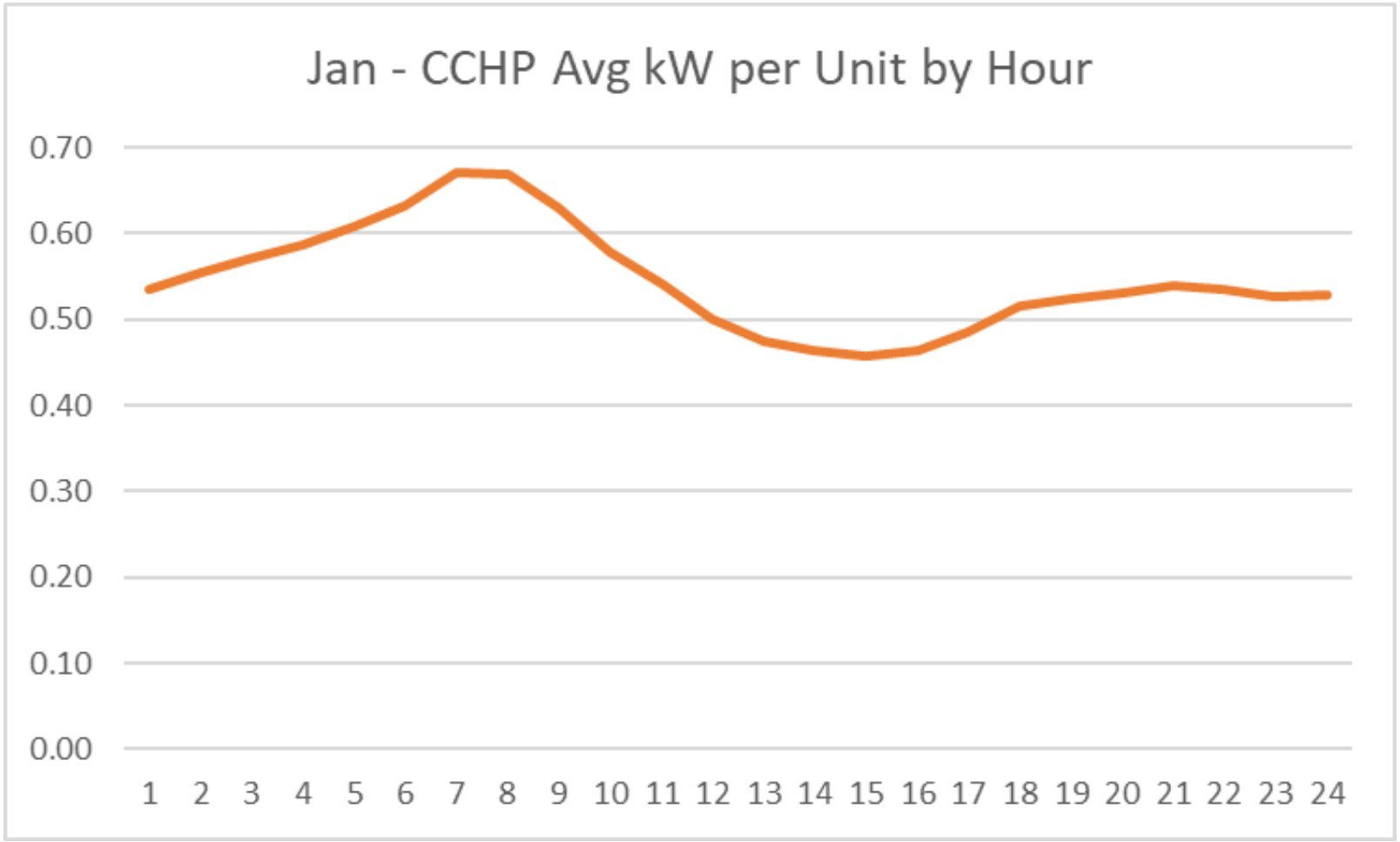
Source: 2018 MA RES Loadshape Study

HPWH July Avg kW



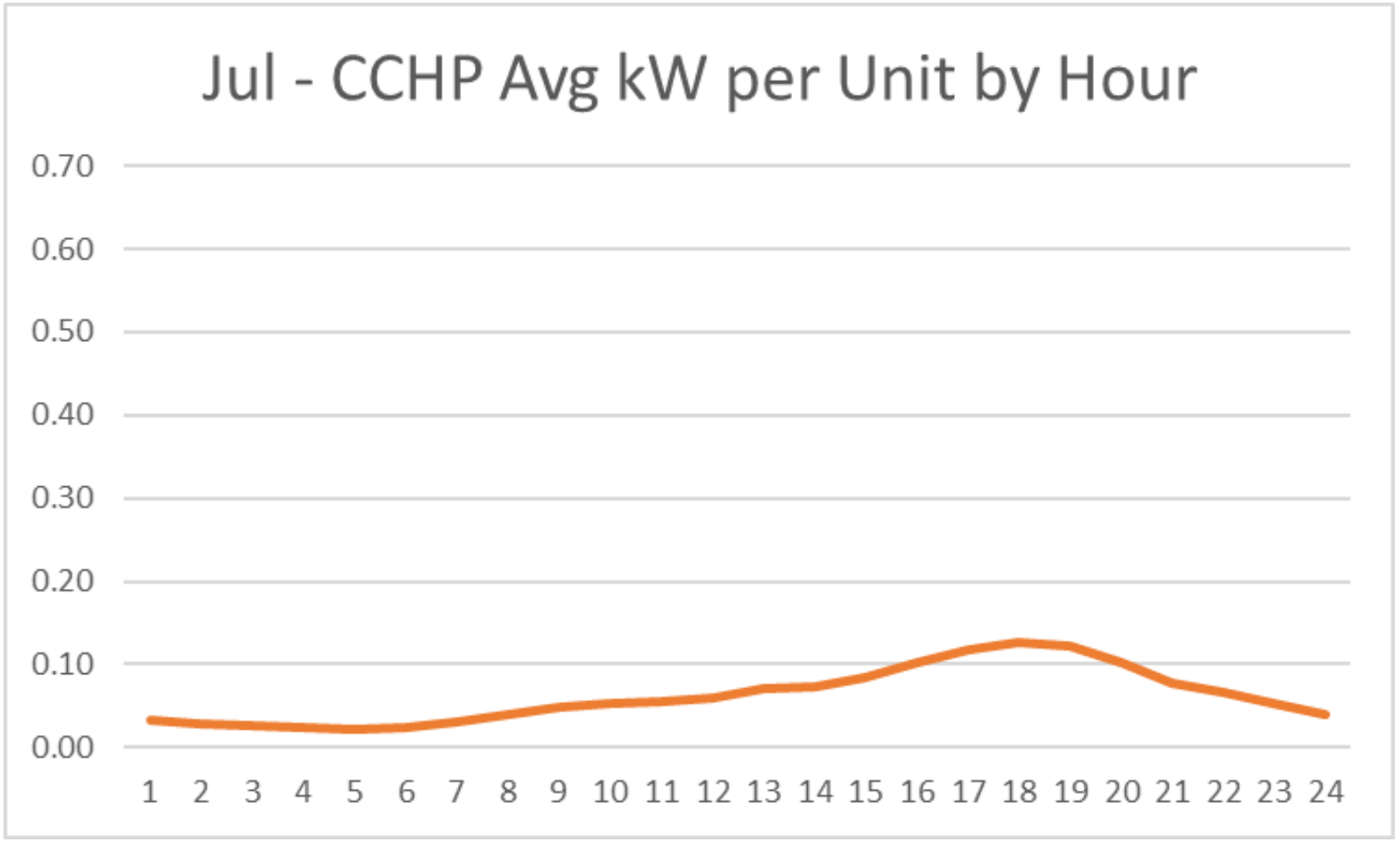
Source: 2018 MA RES Loadshape Study

CCHP January Avg kW
(single and multi-zone combined)



Source: Tier 3 TAG docs – LINK

CCHP July Avg kW
(single and multi-zone combined)



Source: Tier 3 TAG docs – LINK