

**FIELD RESULTS AND MODELING OF
APARTMENT COMPLEX HEAT PUMP DHW**
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OUTLINE

- Introductions
- Daiken Altherma Field Results
- Thermal Storage Modeling Results
- Conclusions

REDWOOD ENERGY: A TEAM EFFORT

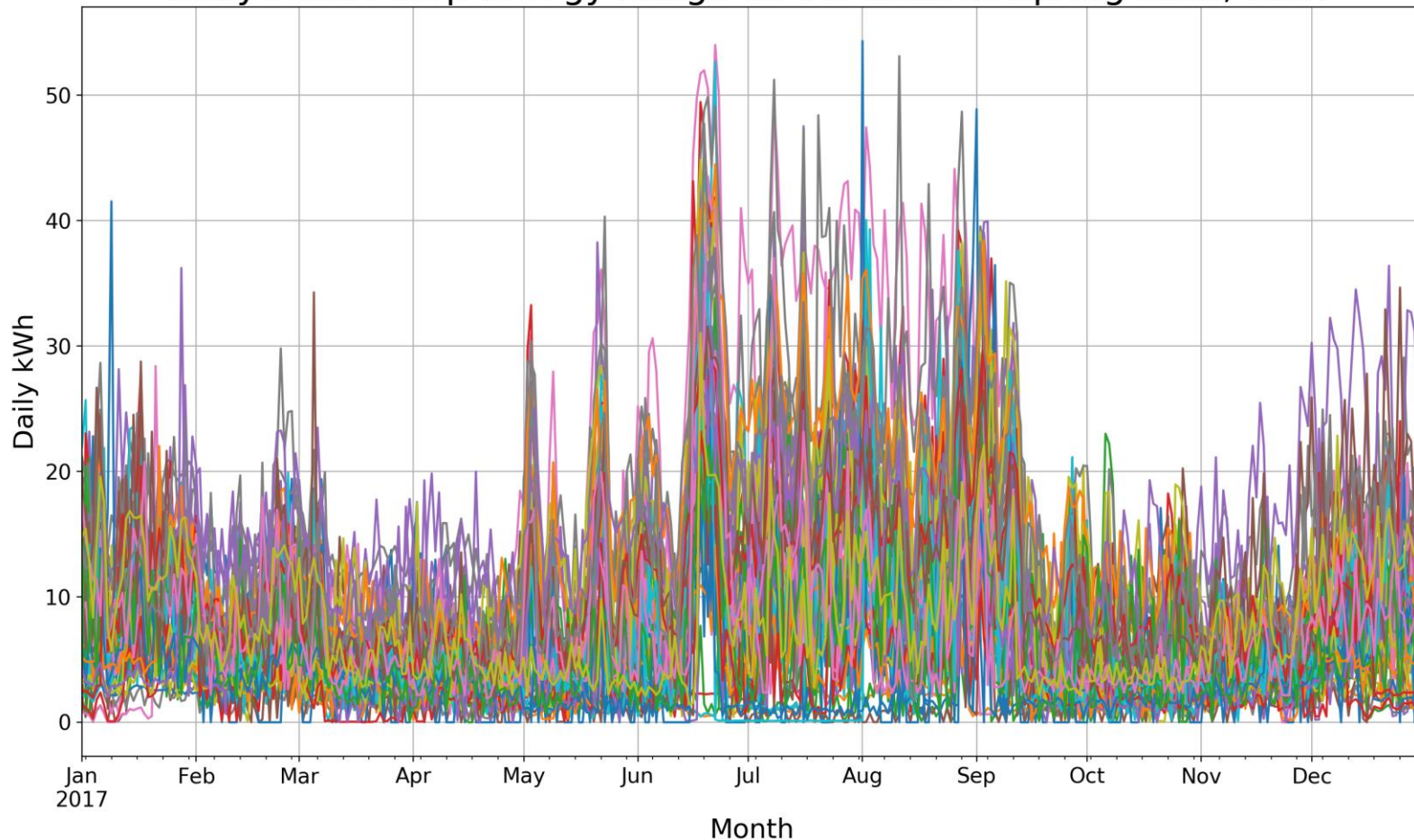


**FIELD STUDY: DAIKEN ALTHERMA
HVAC + DHW COMPRESSOR ENERGY
AT MUTUAL HOUSING AT SPRING LAKE**



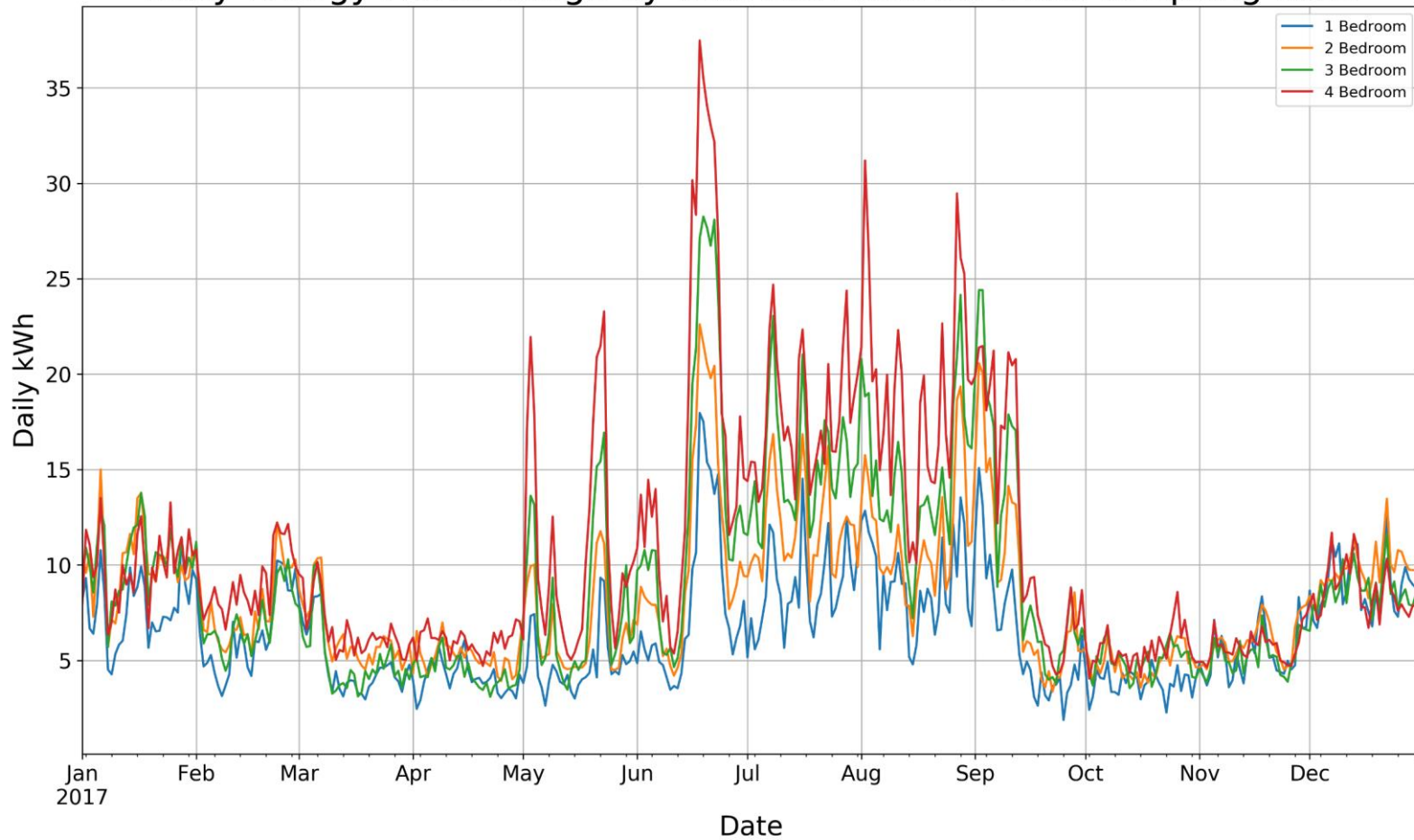
**HVAC = HSPF 11, SEER 14;
DHW = EF 2.4
COMPRESSOR ENERGY IN RAW FORM**

Daily Heat Pump Energy Usage for All Units at Spring Lake, 2017



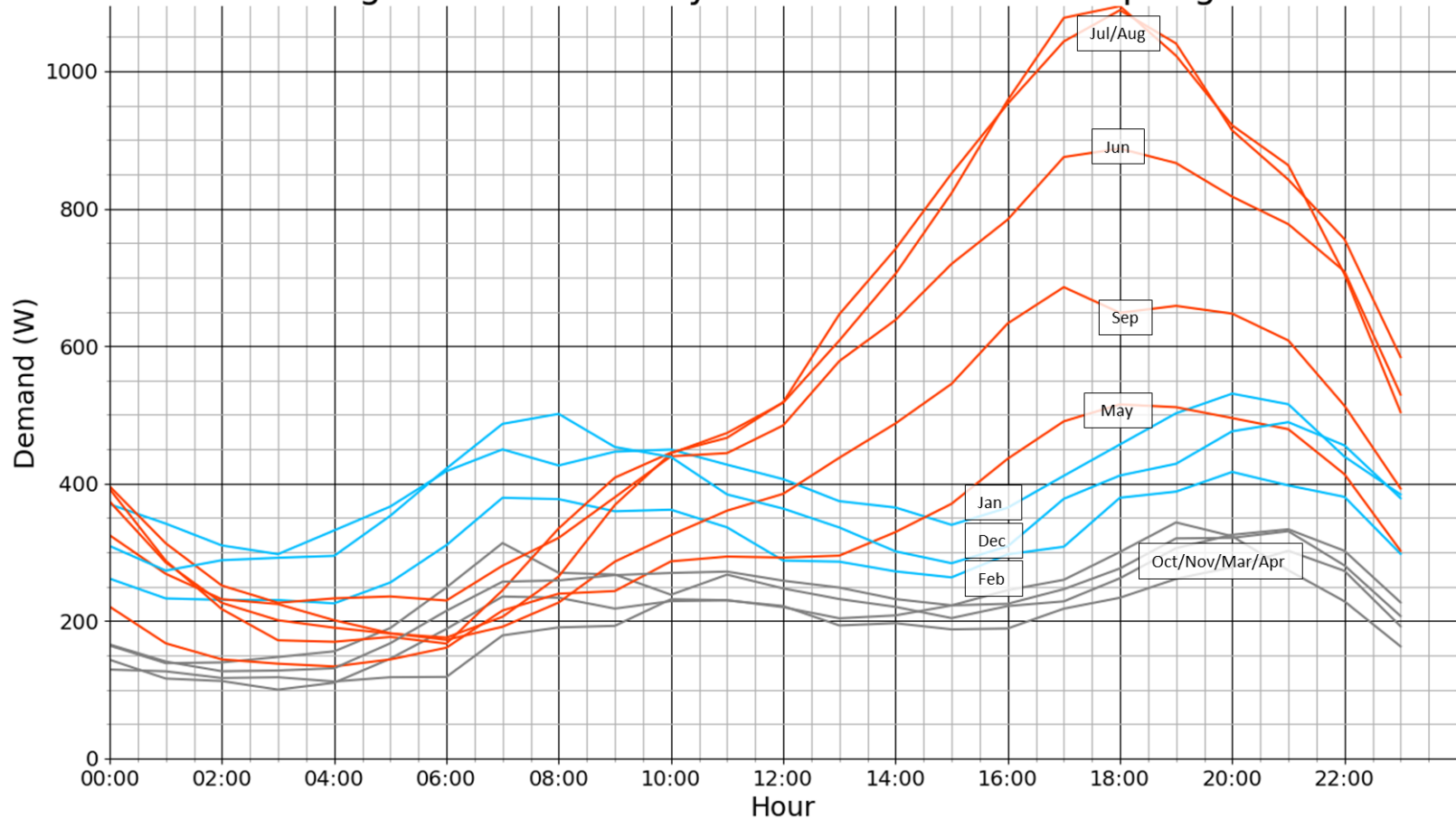
COMPRESSOR ENERGY BY UNIT SIZE

Daily Energy HVAC Usage by Bedroom Size for Units at Spring Lake



HOURLY ENERGY DEMAND BY SEASON

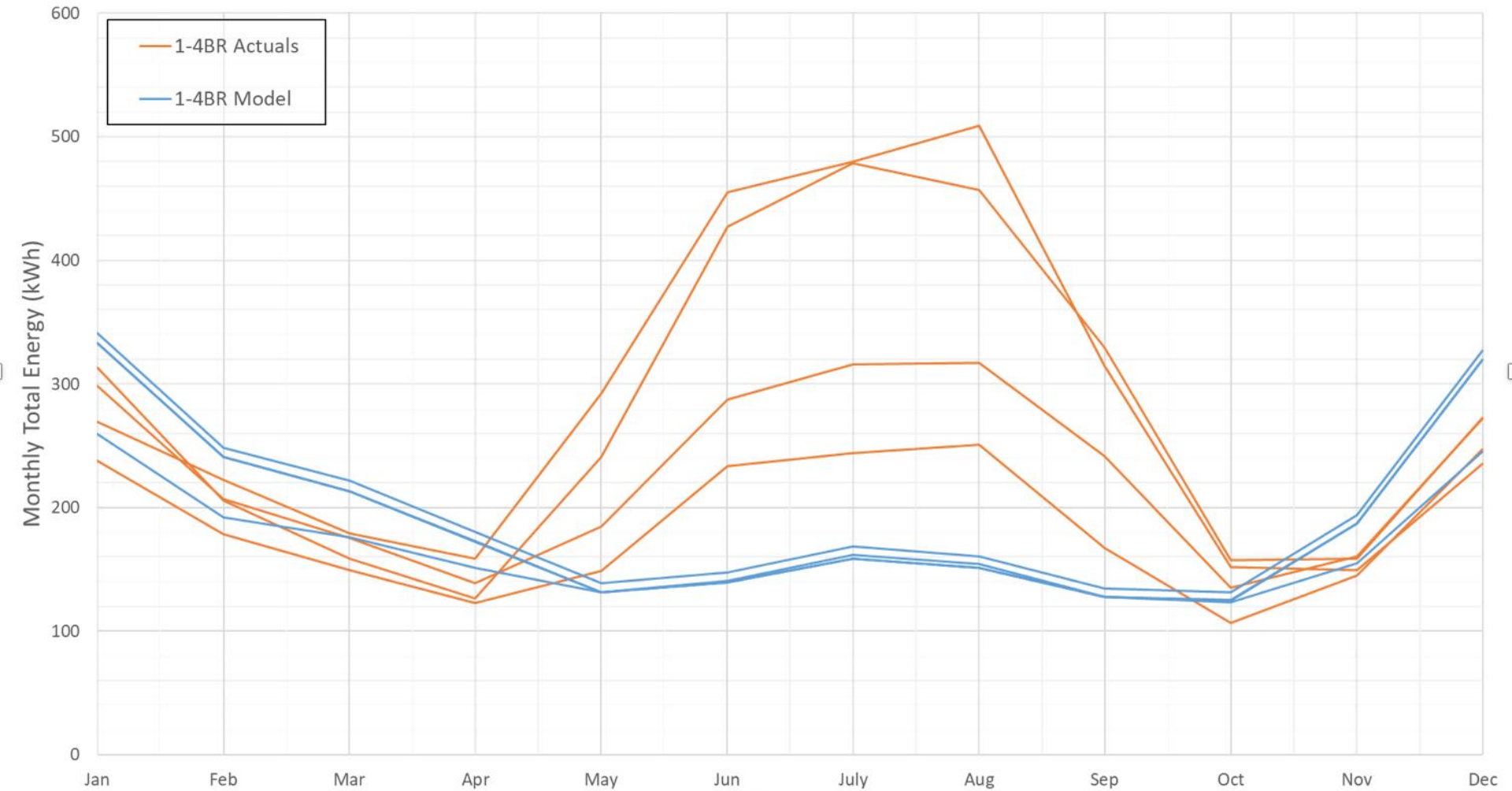
Average Seasonal Hourly Demand for Units at Spring Lake



	kWh		\$ (Fixed)		\$ (TOU)	
	Actual	Modeled	Actual	Modeled	Actual	Modeled
1 Bedroom	2,233	2,012	\$ 291	\$ 247	\$ 289	\$ 233
2 Bedroom	2,734	2,302	\$ 372	\$ 394	\$ 379	\$ 274
3 Bedroom	3,326	2,308	\$ 414	\$ 403	\$ 418	\$ 370
4 Bedroom	3,418	2,394	\$ 479	\$ 423	\$ 507	\$ 389

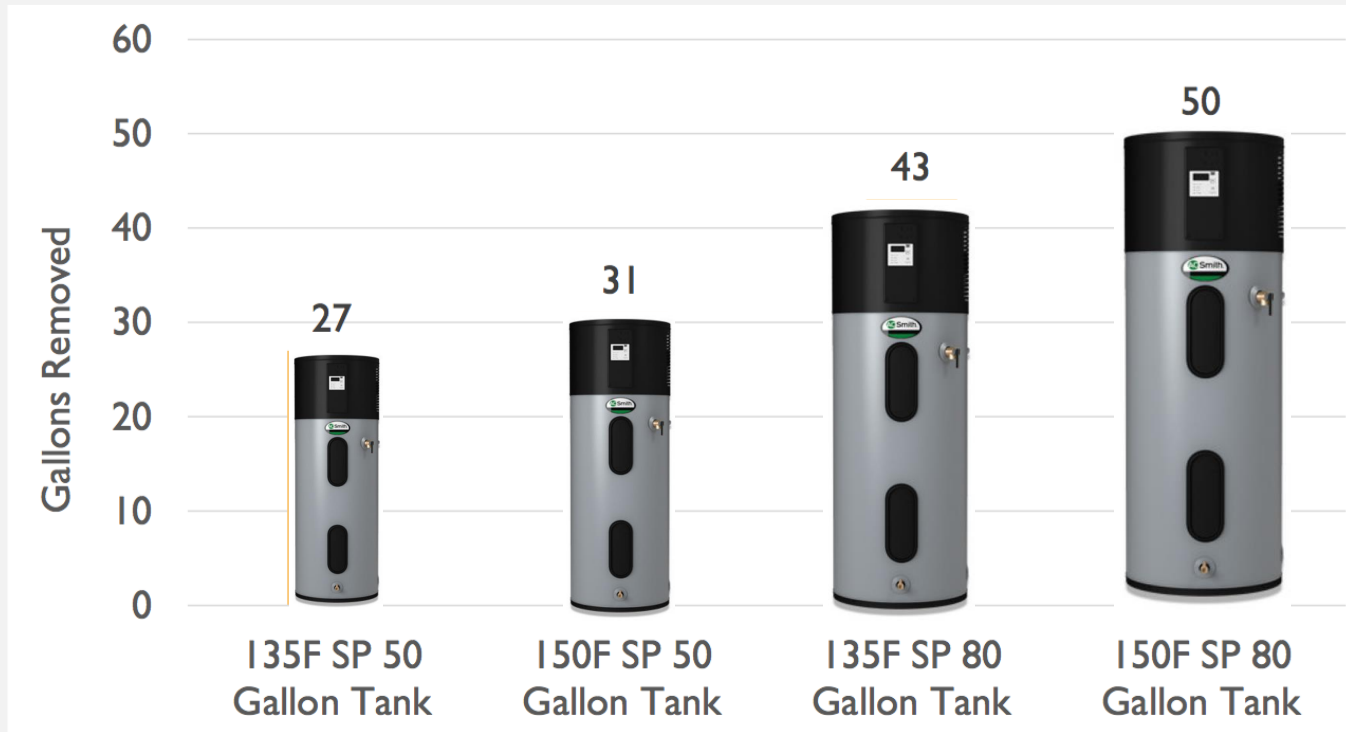
MODELS VS. ACTUALS

Modeled Heat Pump Consumption Compared to Actuals at Spring Lake



1ST LINE OF INQUIRY—WHEN A TANK IS STORING THERMAL ENERGY VIA INCREASED TEMP, HOW MUCH MORE HOT WATER IS AVAILABLE?

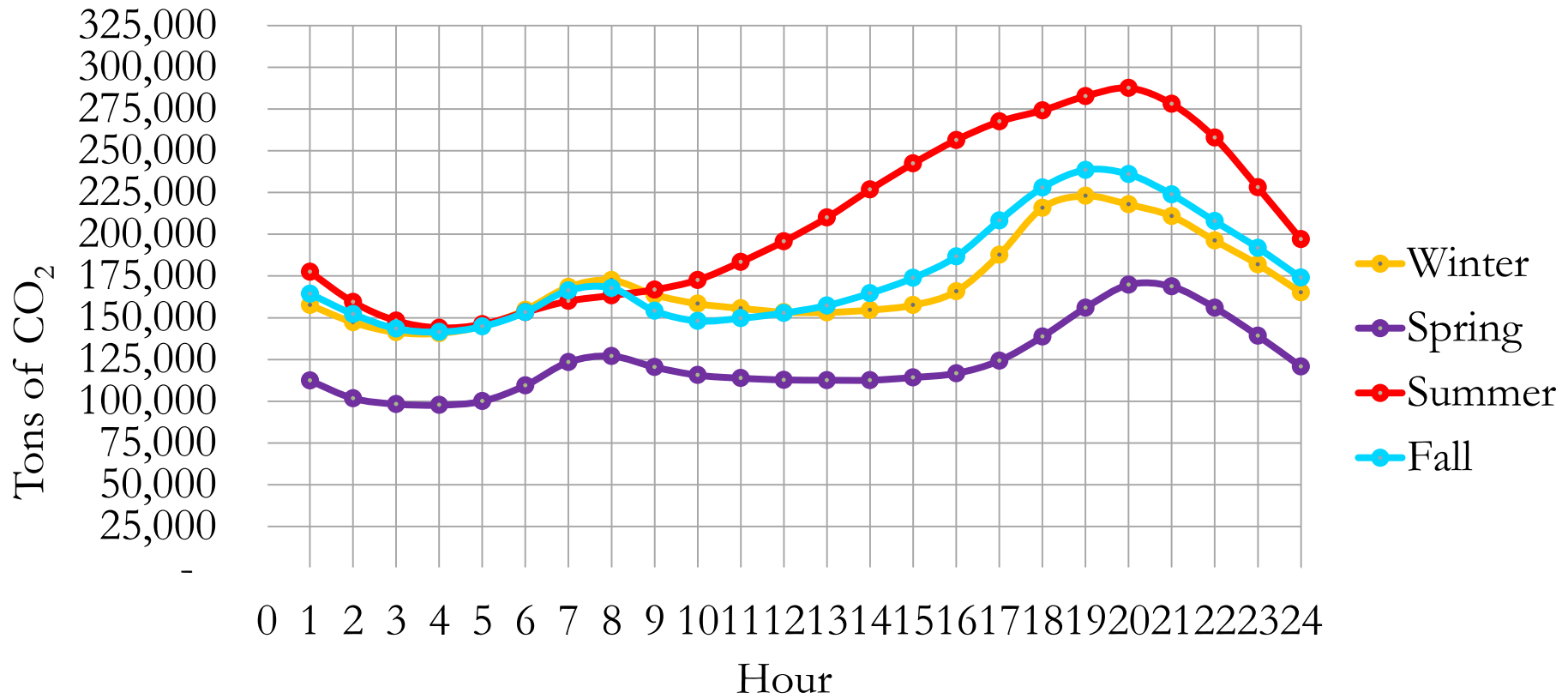
HOT WATER AVAILABILITY ANALYSIS



3-Bedroom apartment uses 60-80 gallons per day of hot water

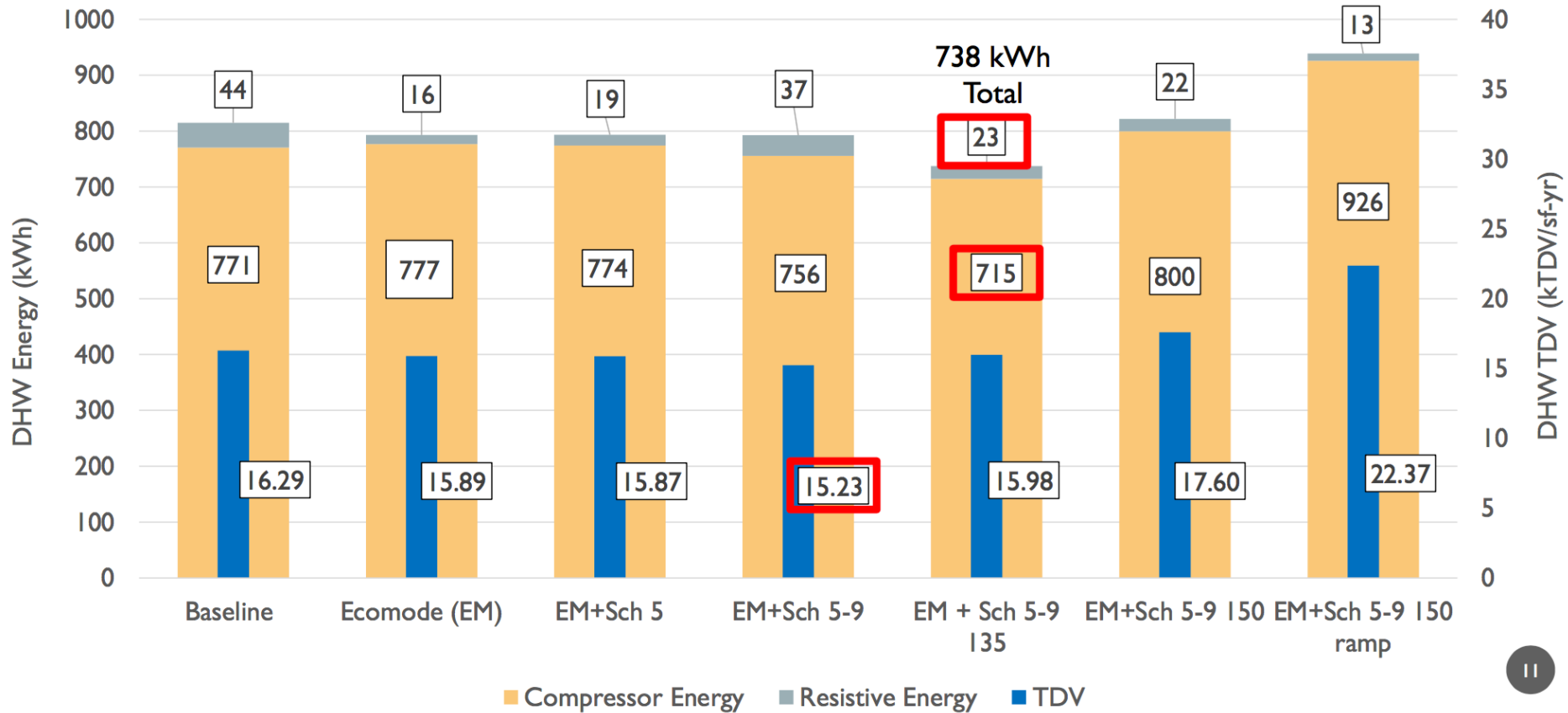
Gallons removed while maintaining a water temperature greater than 100F in the tank

IDENTIFYING LOW CARBON/LOW COST TIMES FOR HEAT PUMP OPERATION: CAISO DATA (2016)



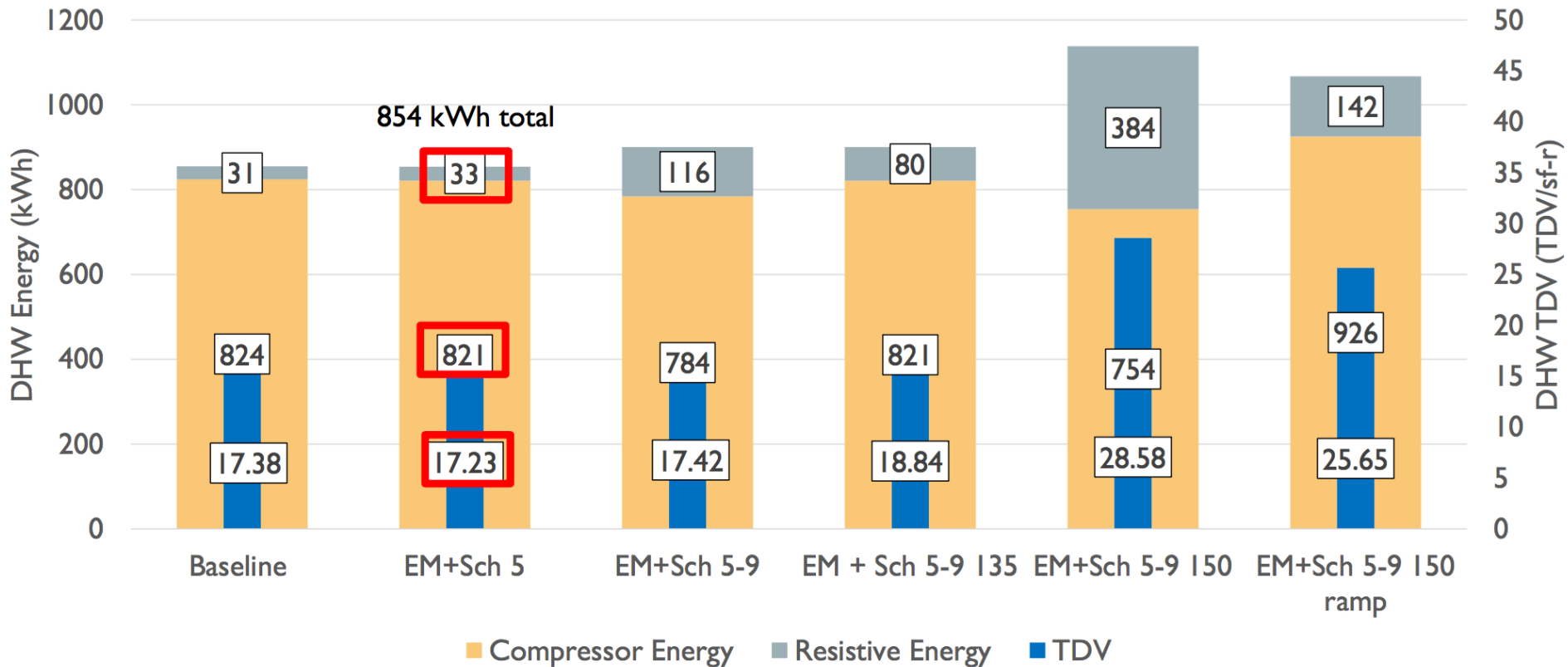
VARYING RUN TIMES AND TEMPS: AO SMITH 50 GALLONS

AO SMITH 50 GALLON



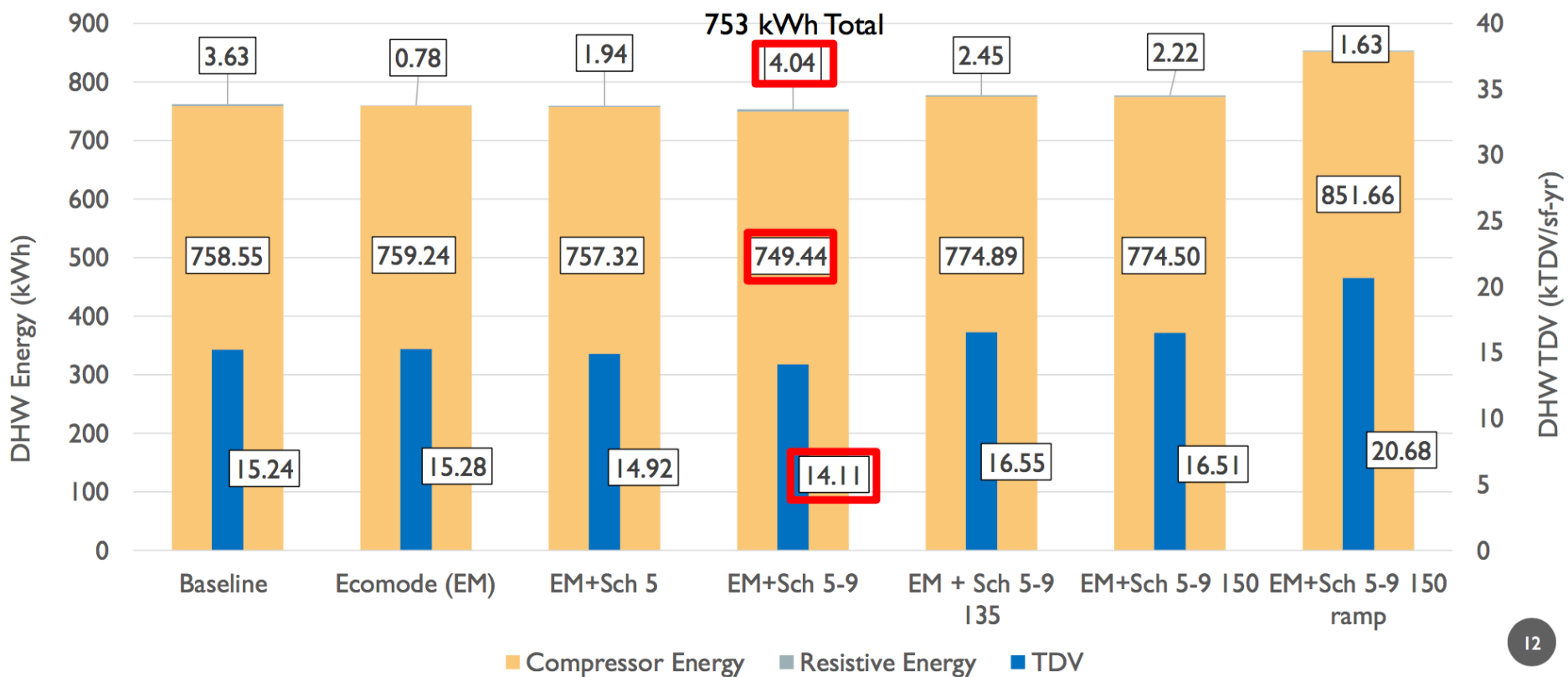
VARYING RUN TIMES AND TEMPS: RHEEM 50 GALLONS

RHEEM 50 GAL



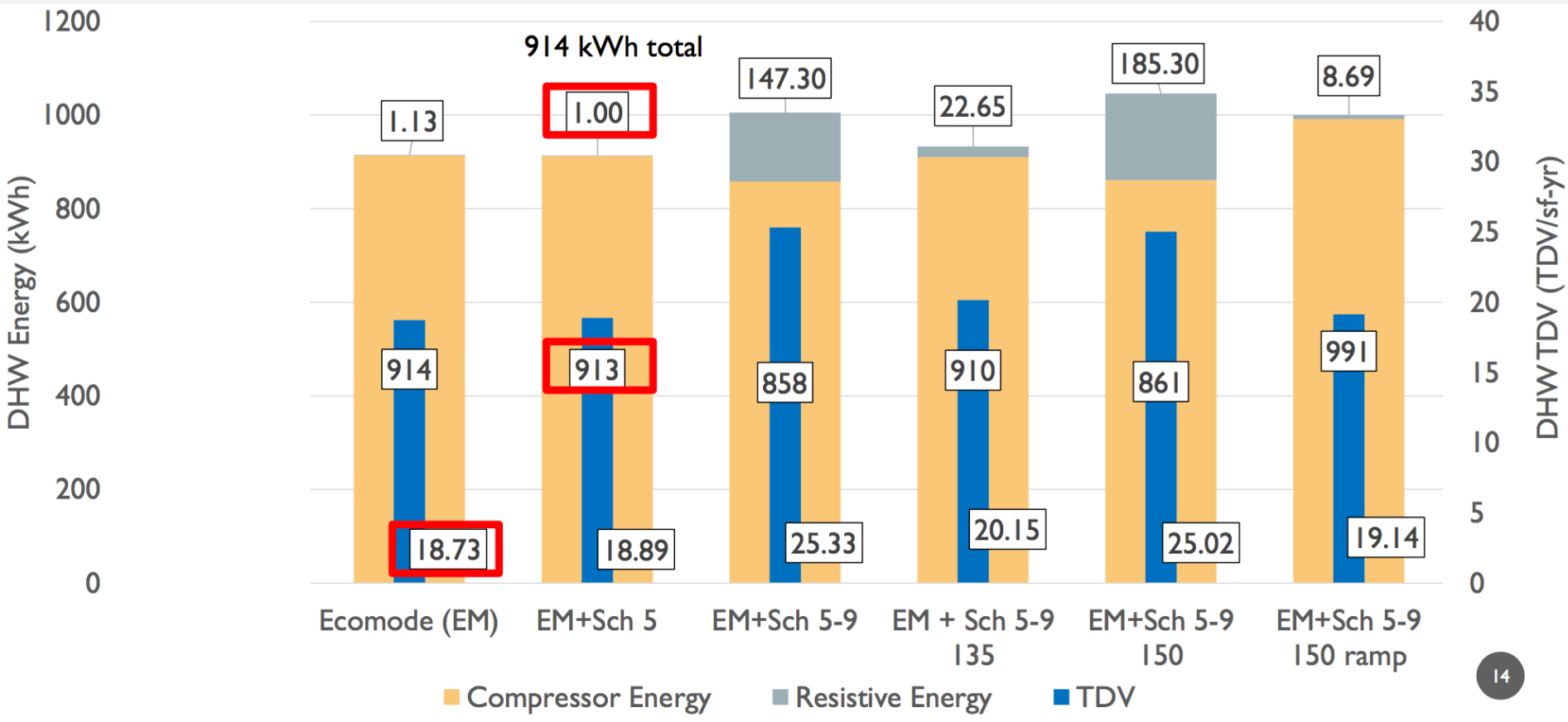
VARYING RUN TIMES AND TEMPS: AO SMITH 80 GALLONS

AO SMITH 80 GALLON



VARYING RUN TIMES AND TEMPS: RHEEM 80 GALLON

RHEEM 80 GALLON



CONCLUSIONS

1. High AC demand is not well met with low-efficiency hydronic cooling
2. As we structure efficiency efforts and rate schedules, the disproportionate impact on low income households is real
3. In most cases, compressor-only “Eco” mode saves both total energy and Time Dependent Valuation (TDV)
4. Storing DHW at 135F does not increase energy use by much, if at all.
5. Storing at 150F increases energy use, although slowly ramping up to 150F
6. Storing 80 gallons of DHW vs. 50 gallons does increase energy use--~5% in AO Smith, and ~12% in Rheem.

QUESTIONS?

