2021 ERCOT February Winter Event Analysis of Load Reductions

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Western Load Research Conference – April 15, 2021

ERCOT Role

- **Fulfills four responsibilities required by law as the independent organization certified by the PUC (PURA Section 39.151):**
- – Maintain electric system reliability
- – Facilitate a competitive wholesale market
- – Ensure open access to transmission
- – Facilitate a competitive retail market

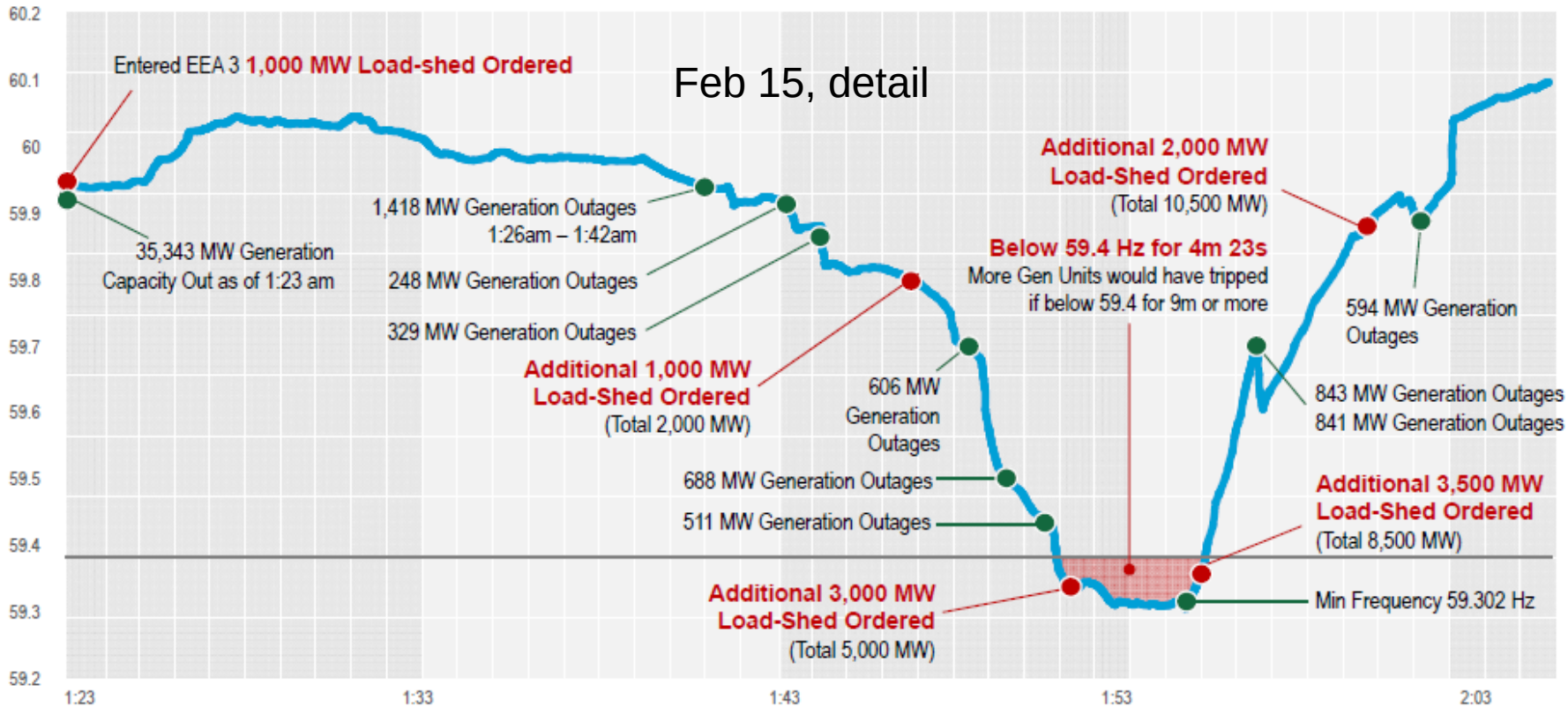
- **Manages the flow of electric power over the bulk power system to approximately 26 million Texas end-use customers.**
- – About 90% of the state's electric load
- – Over 680 generation units
- – Over 46,500 miles of transmission lines

- **Must, at all times (24/7/365), balance all consumer demand in the ERCOT region (load) and the power supplied by companies who generate electricity (generation) while maintaining system frequency of 60 Hz.**

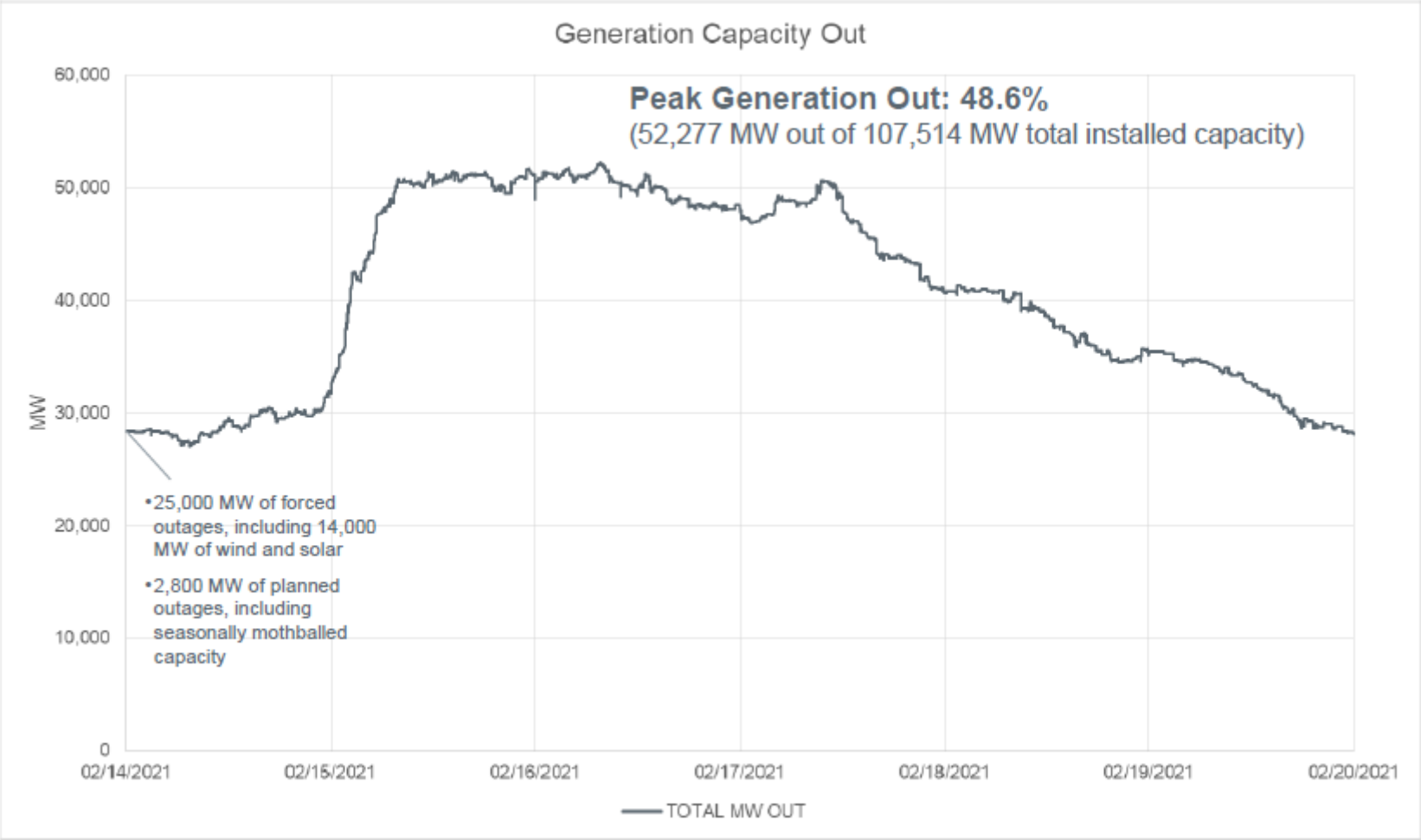
- **Performs financial settlement for the competitive wholesale bulk power market and administers retail switching for nearly 8 million premises in competitive choice areas.**

Winter Event Feb 15 - 19

- Feb 15, 00:15 EEA-1
- Feb 15, 01:07 EEA-2 – deployed ERS & Load Resources
- Feb 15, 01:20 EEA-3 – Instructed TDSPs to shed 10,800 MW
- Feb 18, 00:42 Recalled last of TDSP load shed
- Feb 19, 09:00 EEA-2
- Feb 19, 10:00 EEA-1
- Feb 19, 10:35 Canceled EEA-1 and returned to normal operation

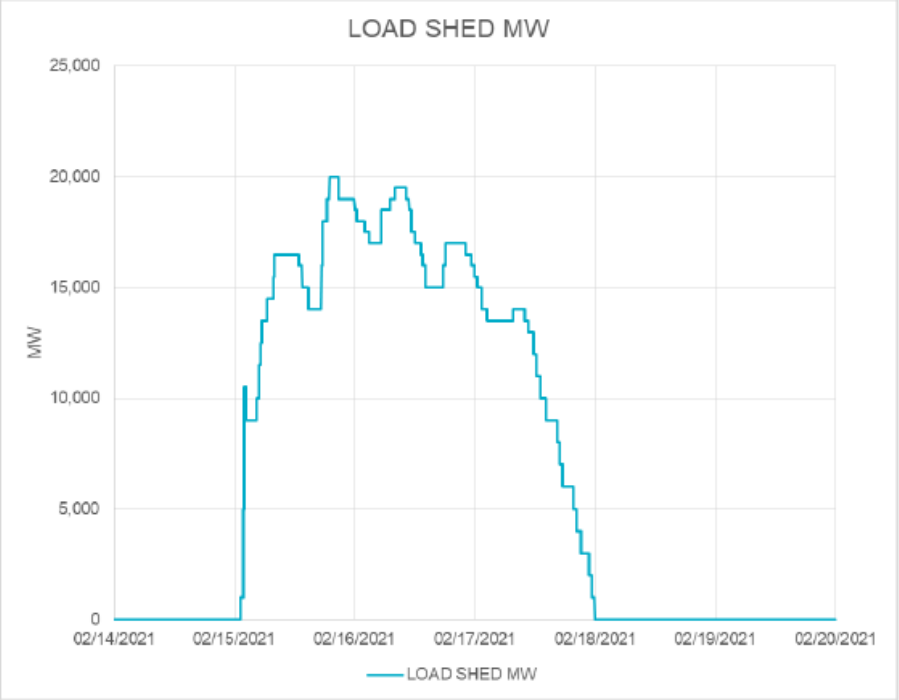


Generation Outages



ERCOT EEA-3 Load Shed

Transmission Operator	% of MW
AEP Texas Central Company	8.7
Brazos Electric Power Cooperative Inc.	4.95
Brownsville Public Utilities Board	0.37
Bryan Texas Utilities	0.51
CenterPoint Energy Houston Electric LLC	24.83
City of Austin DBA Austin Energy	3.71
City of College Station	0.28
City of Garland	0.75
CPS Energy (San Antonio)	6.79
Denton Municipal Electric	0.48
GEUS (Greenville)	0.15
Lamar County Electric Cooperative Inc*	0.07
LCRA Transmission Services Corporation	5.96
Oncor Electric Delivery Company LLC	36.01
Rayburn Country Electric Cooperative Inc.	1.3
South Texas Electric Cooperative Inc.	2.52
Texas-New Mexico Power Company	2.62
ERCOT Total	**100.00**



- Max load shed of 20,000 MW instructed
- Load shed had been conceived (and last used in 2011) as rotating outages
- For most of the event rotating outages was not possible
  - Critical use circuits and Under-frequency load shed circuits were excluded
  - TDSPs ended up shedding and keeping off all other circuits
- Dealing with storm damage and cold-load pickup made recovery extremely difficult

Analysis Overview

- Initially targeted TDSP controlled outages considering substations they reported to PUCT
- Shifted to include ESIIDs with storm-related outages – many ESIIDs had outages prior to the load shedding and were subject to TDSP load shed as well
- Analysis targeted ESIIDs identified with outages as well as ESIIDs
  - Deployed for ERS
  - Containing Load Resources deployed for RRS
  - Previously Identified as on Indexed pricing (Day-Ahead/Real-Time) and/or 4CP responders
  - Other ESIIDs identified as responding during the event
  - 4 million deployed ESIIDs to analyze (3.8 million Residential, 468,000 Non-Residential
- Developed algorithms to identify outage ESIIDs and control group ESIIDS
  - Algorithms varied across the load type
  - Based on number of zero intervals (15-min) Feb 1 – Feb 4
  - Outage ESIID - lots of zeros on Feb 15 – 19 compared to earlier days
  - Control group ESIID – small number of zeros throughout
  - Some ESIIDs were neither
  - Examined interval data for every ESIID (~8 million)

Overview

- Goal was to analyze load response for all 28 days in February
  - Real event started early on Feb 15 and lasted until Feb 19.
  - Weather forecasts were indicating severe cold weather and market notices from ERCOT were indicating the likelihood of going into EEA-3 with rotating outages.
  - Storm related damage was causing outages prior to the actual event
  - News stories indicated that some businesses were still not fully recovered for weeks after the event.

- Performed analysis generally in categories of existing Profile Types
  - Residential: Hi/Lo WR, PV, Lighting, Low-use
  - Business: Transmission, Distribution – 700 KW, Distribution 5 – 700 KW, Non-demand, Oil & Gas Flat, PV
  - Created two new ones for analysis purposes
    - 'LOWUSE' for ESIIDs with very low usage (< 2 KWh per day)
    - 'LIGHT' for ESIIDs with > 75% night-time use
  - Excluded ESIIDs with registered and unregistered generation other than PV

- Baselines developed for all ‘deployed’ ESIIDs:
  - ‘Control’ groups for Residential, Business Non-Demand, Oil & Gas Flat, Business Distribution 5 - 700 KW, and PV
  - Used ‘near-day’ baselines for Transmission or Business Distribution >700 KW
  - MAPE: Residential 1%, Business 0.5% (based on days with no reduction

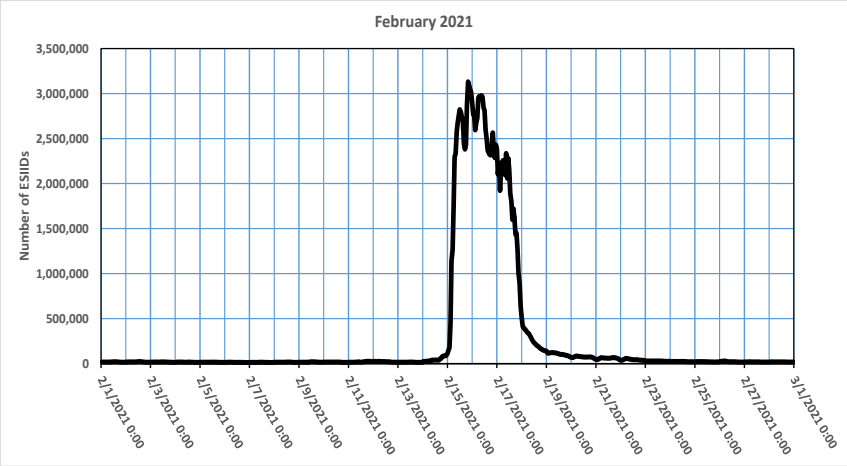
- Control groups created by TDSP, profile type, weather zone, substation, KWh stratum and for small business KW stratum
  - KWh and KW stratifications were percentiles (25, 50 75, 100) for week of Feb 7 – 13
  - If the set of potential control group ESIIDs was < 50 then omit substation
  - Omit TDSP and substation for Non-demand, Oil & Gas Flat

- Control group selection
  - Sorted list of deployed ESIIDs and candidate control ESIIDs in order by KWh
  - For each deployed ESIID selected the next smaller and next larger control group ESIIDs
  - Averaged the two control ESIIDs to create a synthetic ESIID to use in as the control
  - For Business Distribution >700 KW, if two closely matching ESIIDs were not found, switched the ESIID to a ‘near-day’ baseline

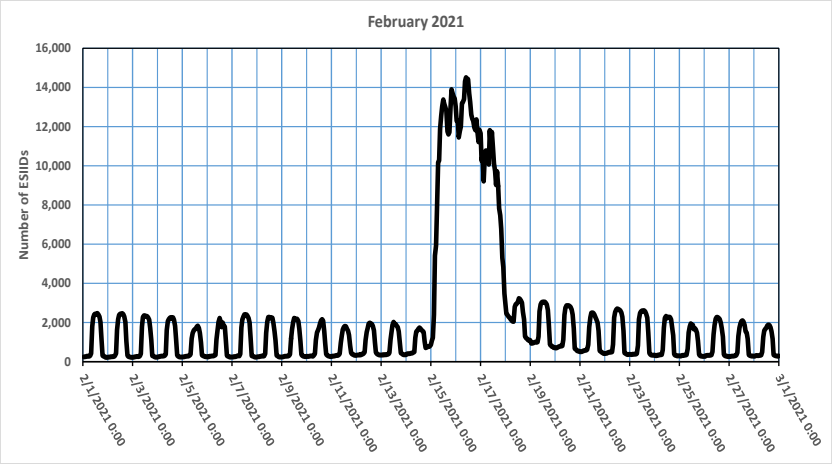
- Near-day baseline
  - For weekdays averaged Jan 11 – Feb 5 weekdays (19 days except MLK day)
  - For Sundays averaged Dec 6, 13, 20 and Sundays between Jan 10 and Feb 7 (8 days)
  - For Saturdays Dec 5, 12, 19 and Saturdays between Jan 9 and Feb 6 (8 days)
  - No adjustment factors applied to February days

Competitive Residential ESIIDs with Zero Load for Hour

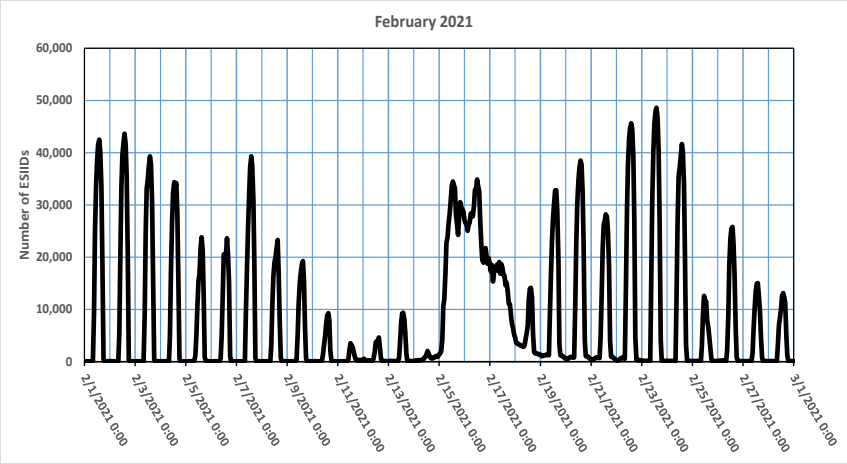
HI/LO WR



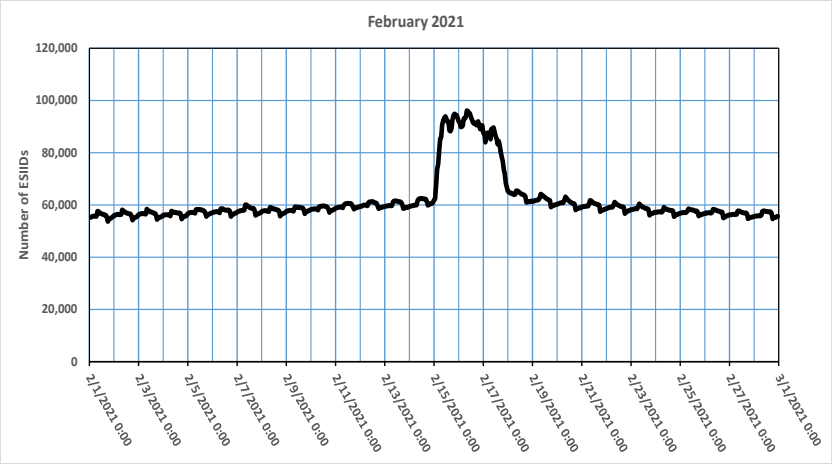
'Lighting'



PV



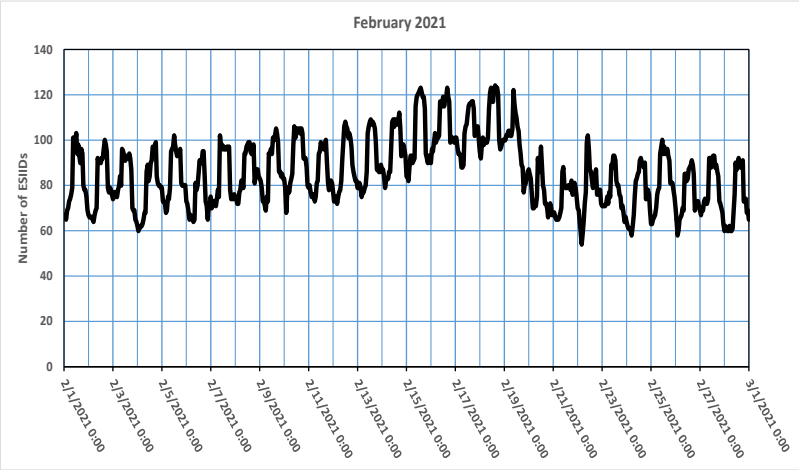
Low Use



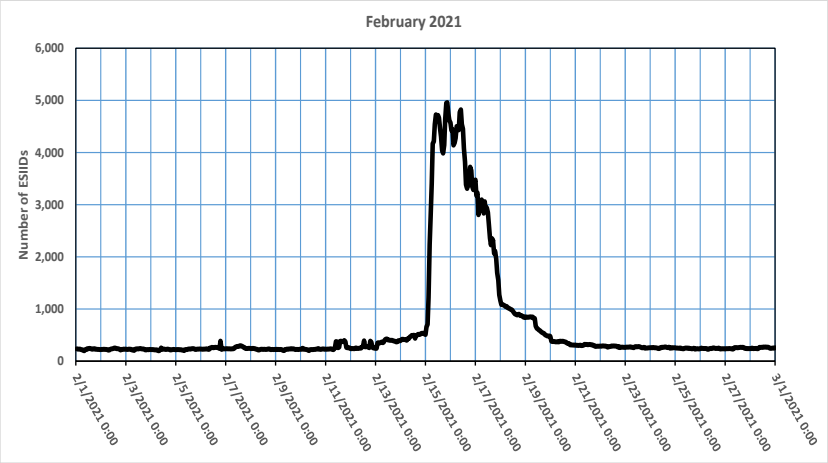
Max - 3.3 million Residential ESIIDs across the four types

Competitive Business ESIIDs with Zero Load for Hour

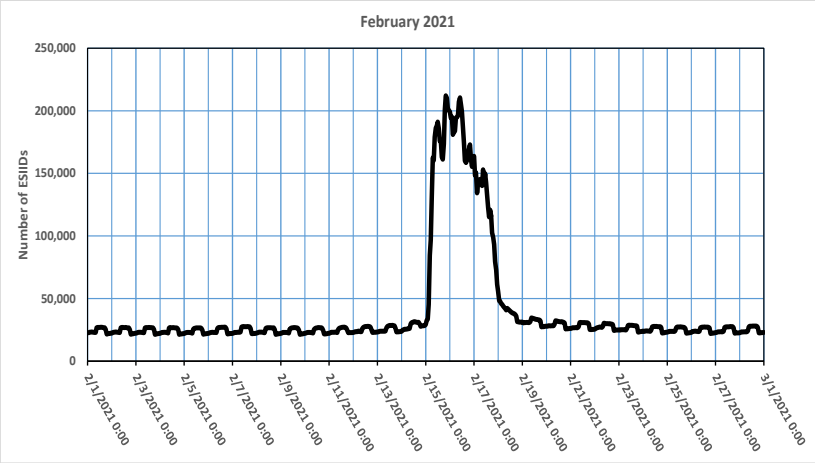
Transmission



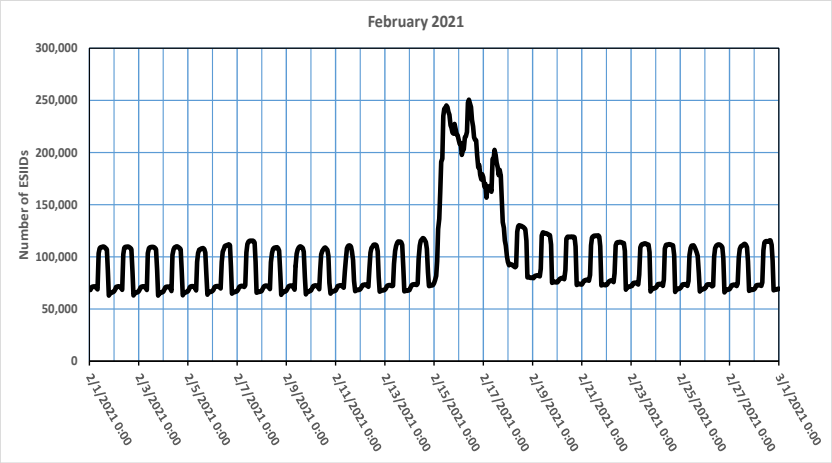
Distribution 4CP



Distribution Non-4CP



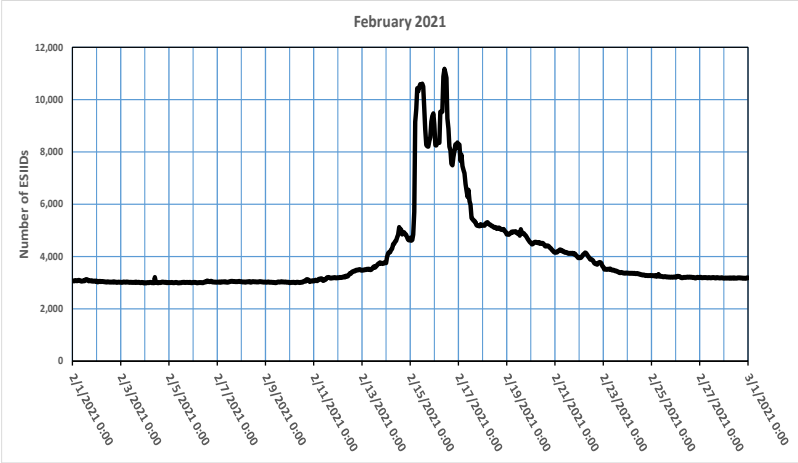
Non-demand



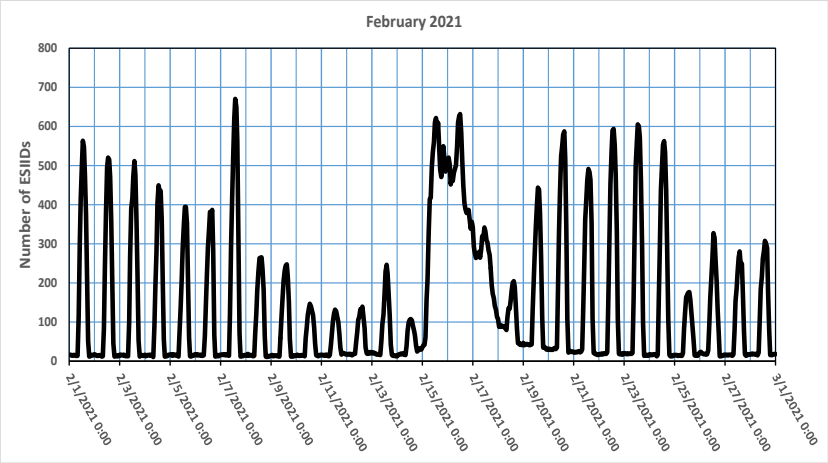
Max – 477,000 Business ESIIDs across six types

Competitive Business ESIIDs with Zero Load for Hour

Oil & Gas Flat

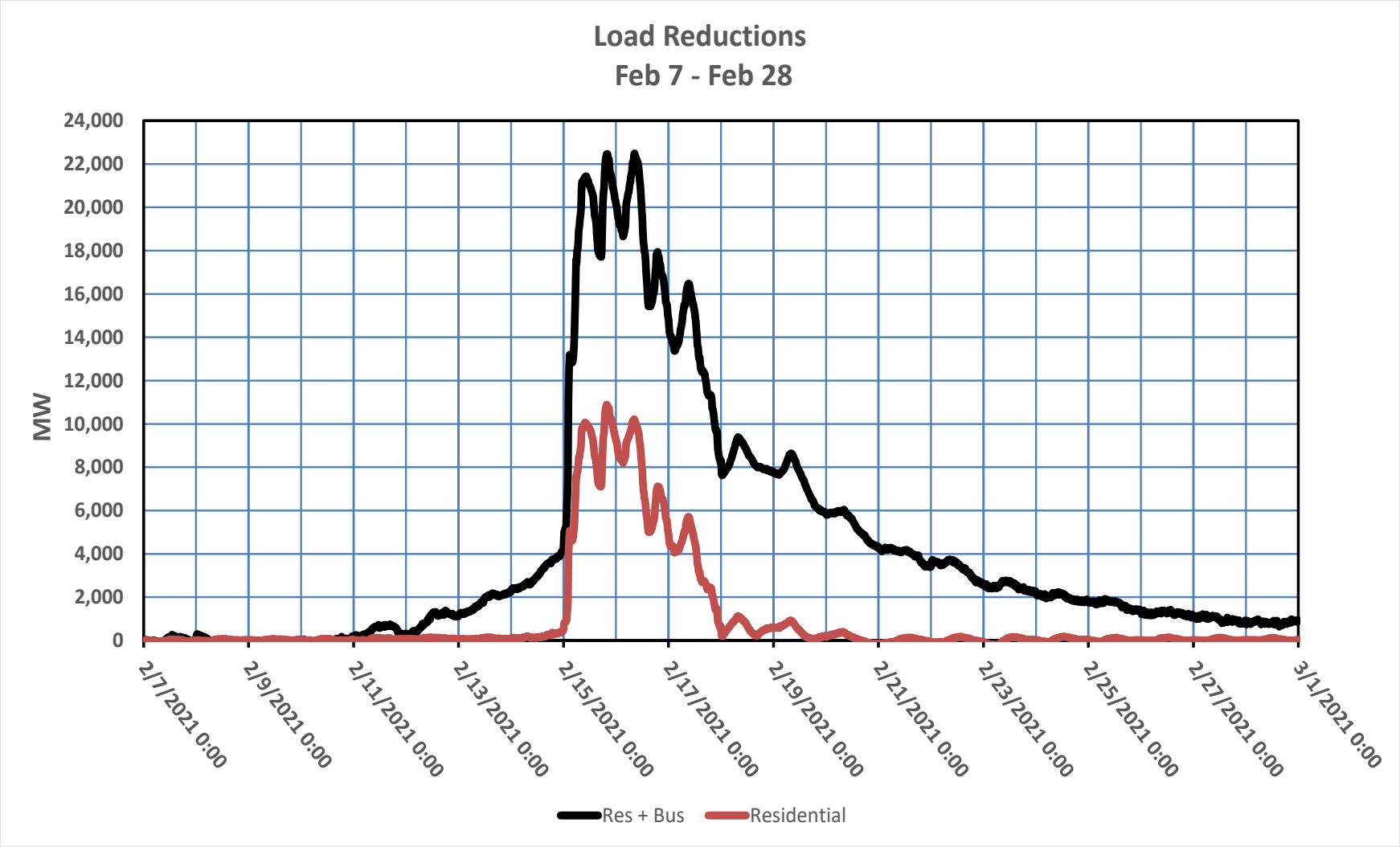


PV



Max – 477,000 Business ESIIDs across six types

Competitive Res Plus Bus Load Reductions

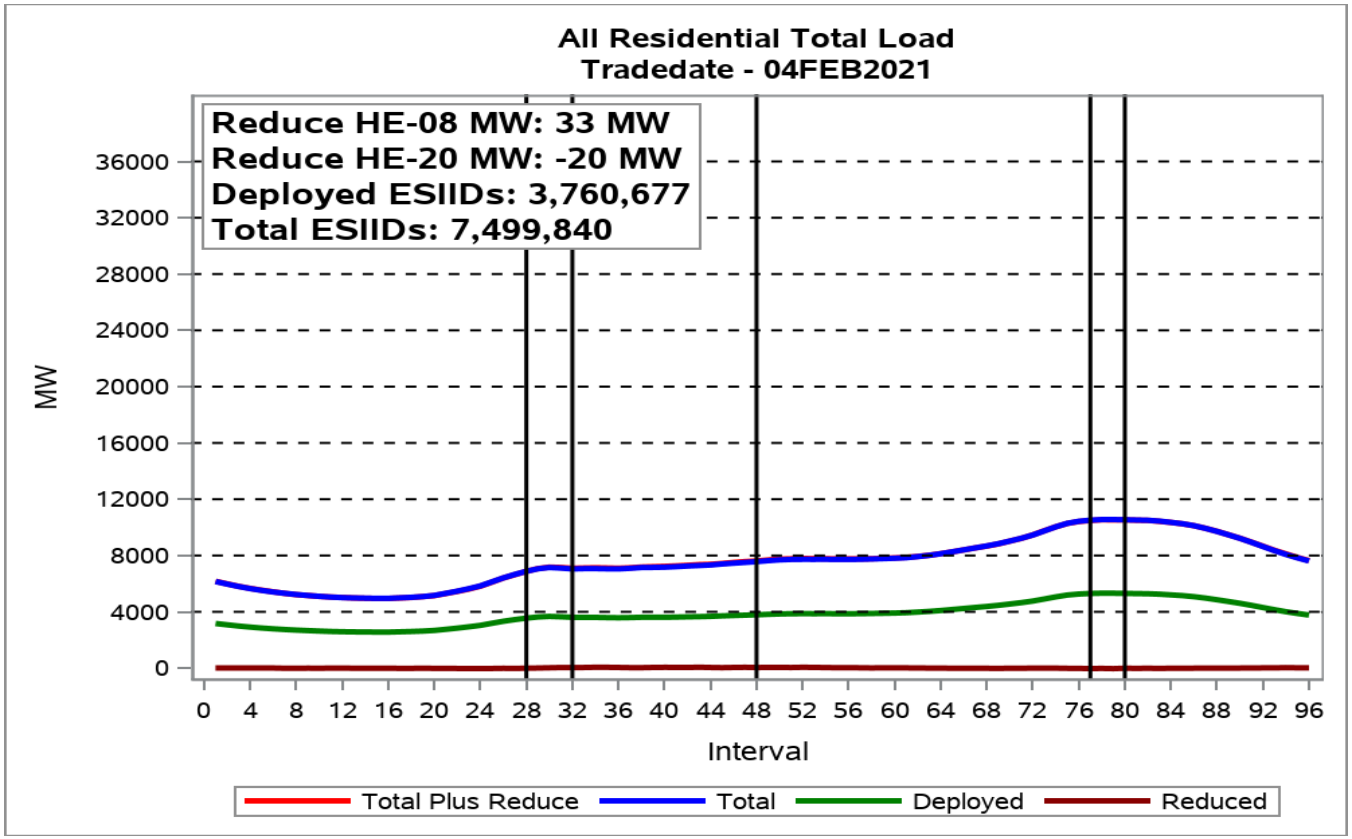


Daily Load Reductions Feb 14 – 20, 2021

Total Competitive Residential Plus Business Load Reductions

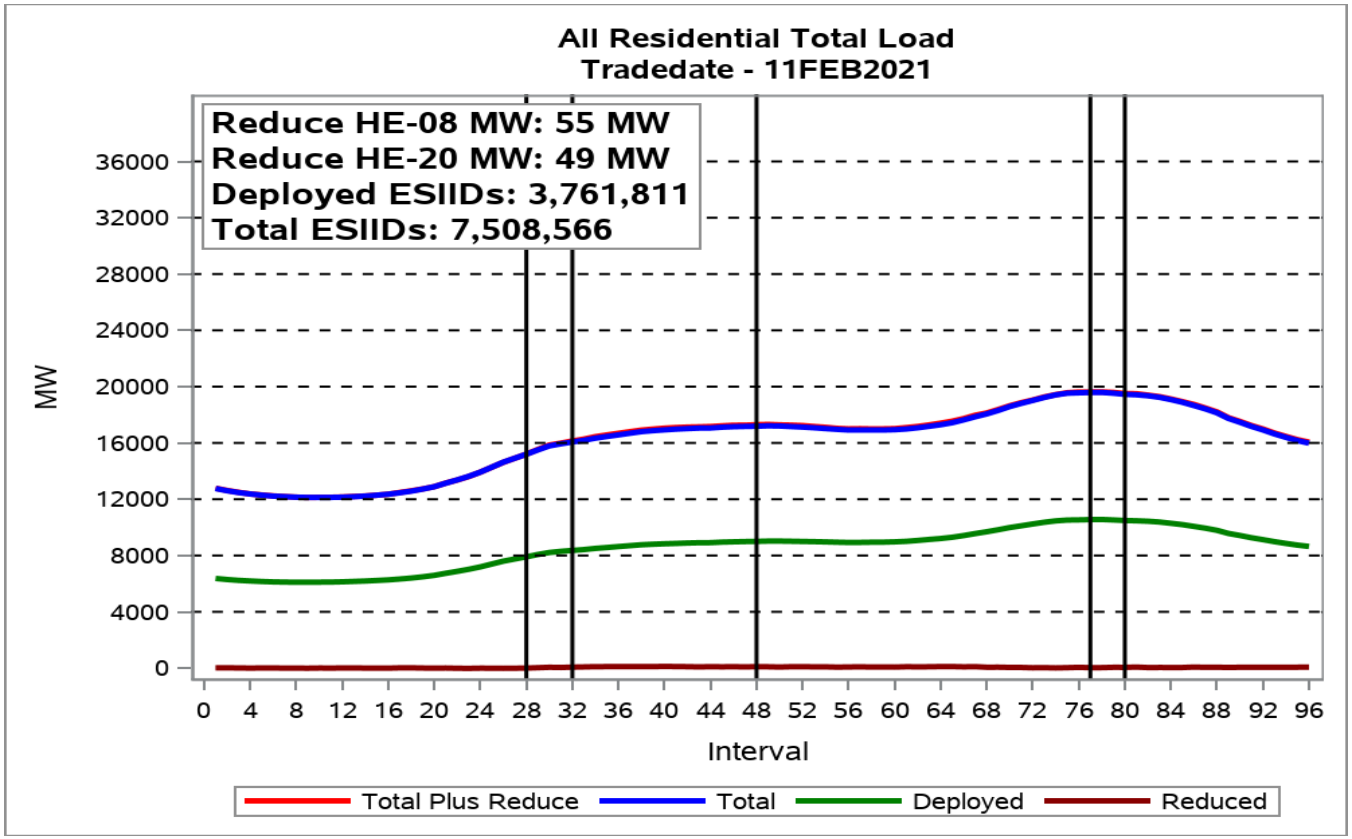
Event Day	Max Reduce Interval	Max Reduce MW	Min Reduce Interval	Min Reduce MW	Average Day Reduce MW
2/14/2021	96	4,276	1	2,360	3,094
2/15/2021	80	22,460	1	5,013	18,070
2/16/2021	34	22,487	96	14,818	18,578
2/17/2021	36	16,477	95	8,224	13,101
2/18/2021	31	9,382	2	7,626	8,327
2/19/2021	32	8,640	96	5,848	7,313
2/20/2021	33	6,036	95	4,280	5,327

Residential Load Mildest Weekday Before Event



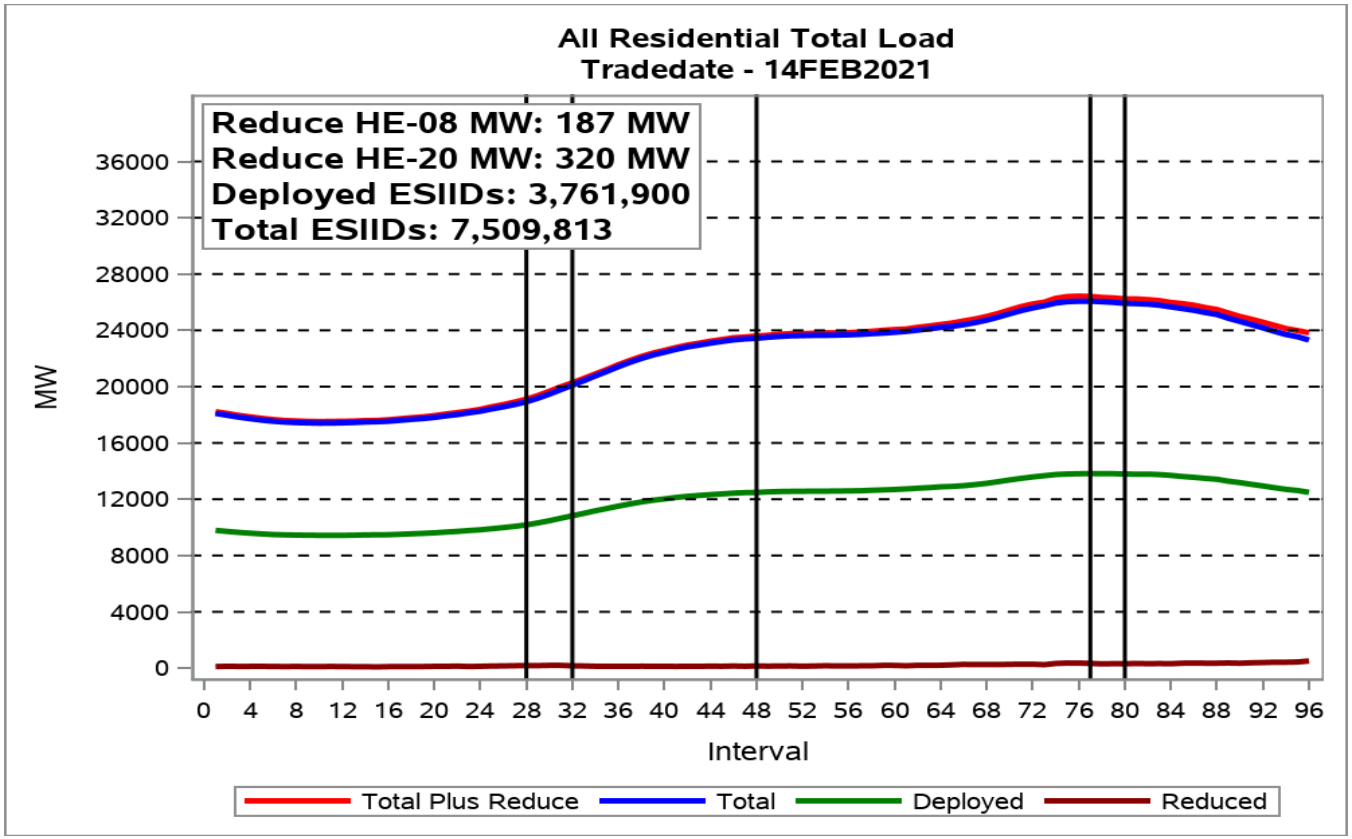
- Day Weighted Average Dry Bulb 60.5°
- Hourly Peak Total Plus Reduce 10,526 MW – 1.4 KW per ESIID

Residential Load Coldest Weekday Before Event



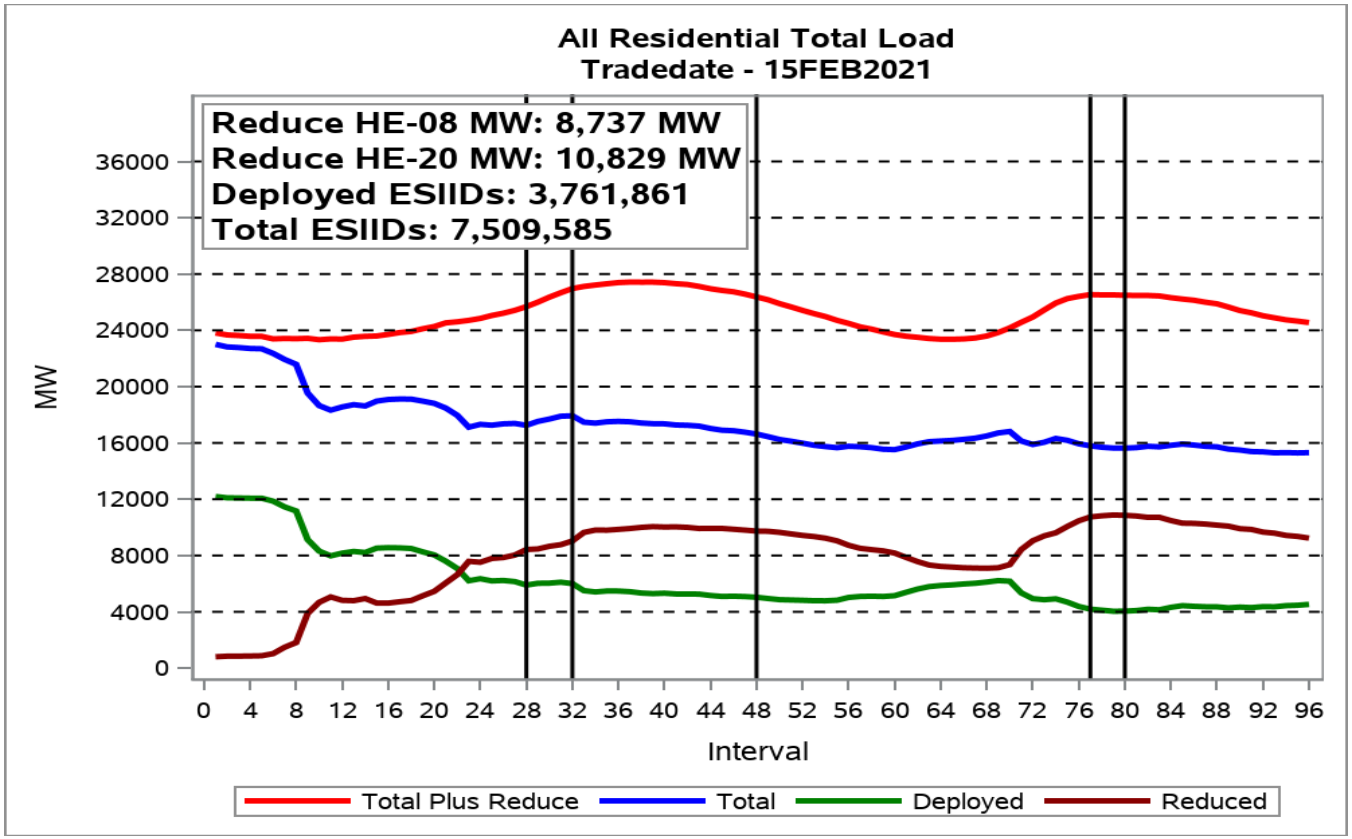
- Day Weighted Average Dry Bulb 32.5°
- Hourly Peak Total Plus Reduce 19,591 MW – 2.6 KW per ESIID
- Peak was 1.2 KW per ESIID higher than Feb 4 mild day

Residential Load Sunday Before Event



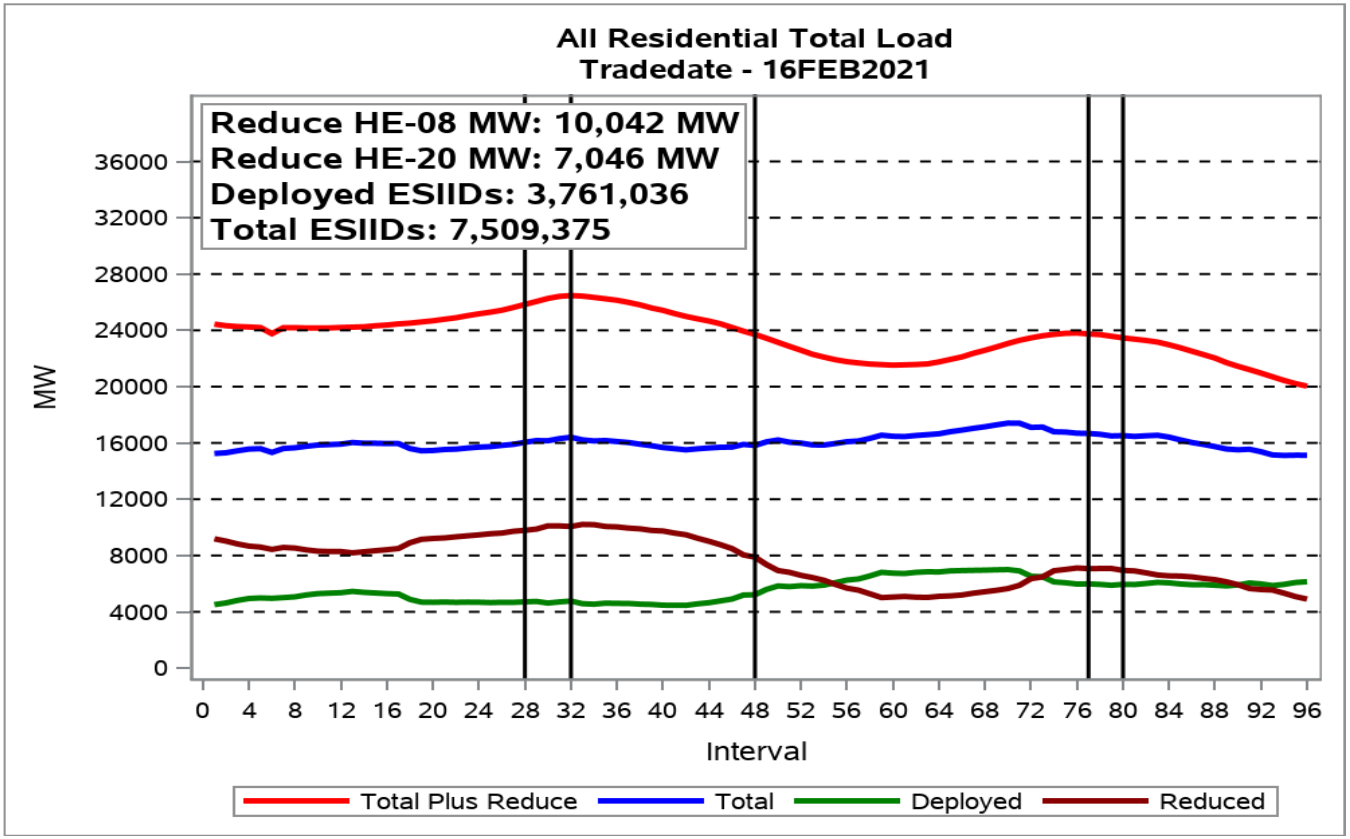
- Day Weighted Average Dry Bulb 22.4°
- Hourly Peak Total Plus Reduce 26,324 MW – 3.5 KW per ESIID
- Peak was 1.2 KW per ESIID higher than the Feb 4 mild day

Residential Load First Day of Event



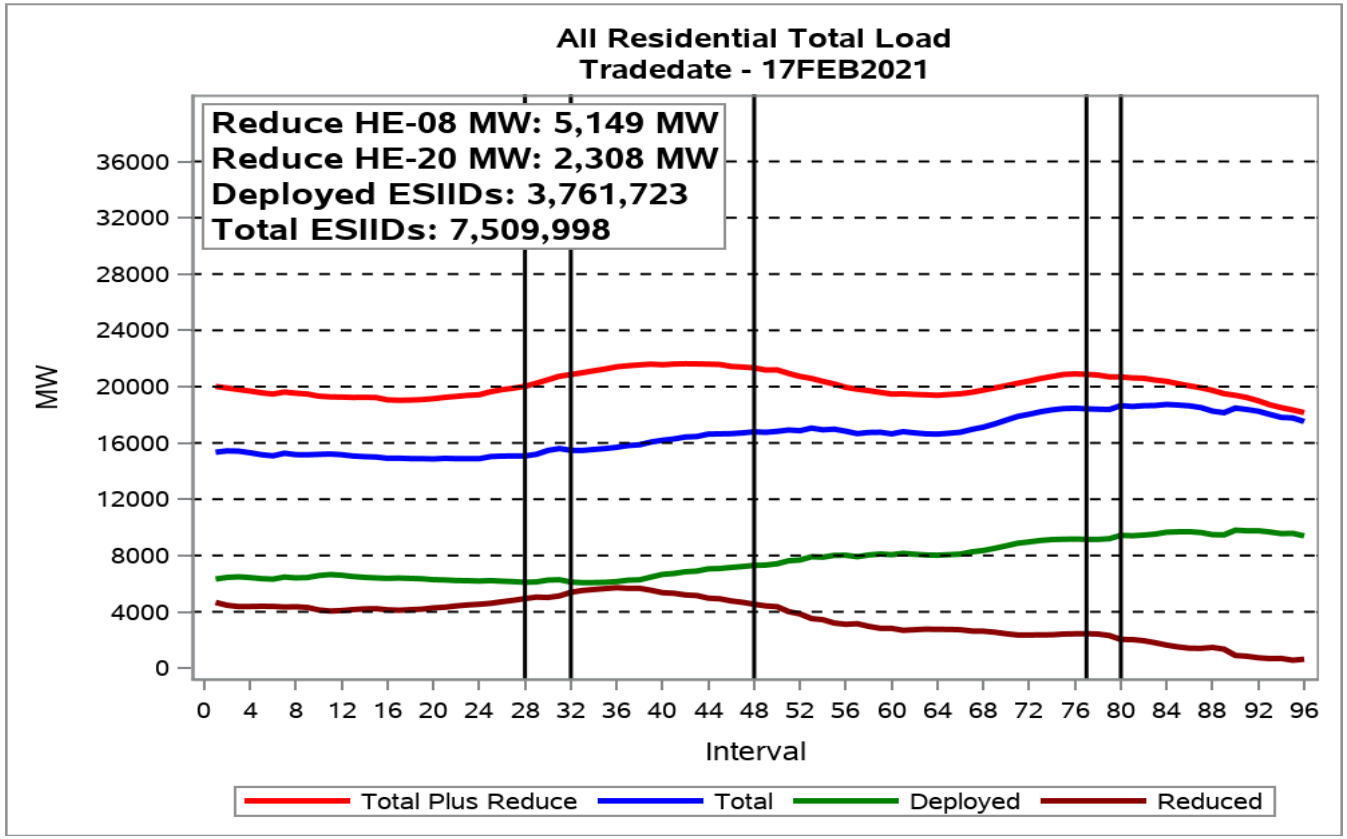
- Day Weighted Average Dry Bulb 13.4°
- Hourly Peak Total Plus Reduce 27,418 MW – 3.7 KW per ESIID
- Peak was 2.3 KW (264%) per ESIID higher than the Feb 4 mild day

Residential Load Second Day of Event



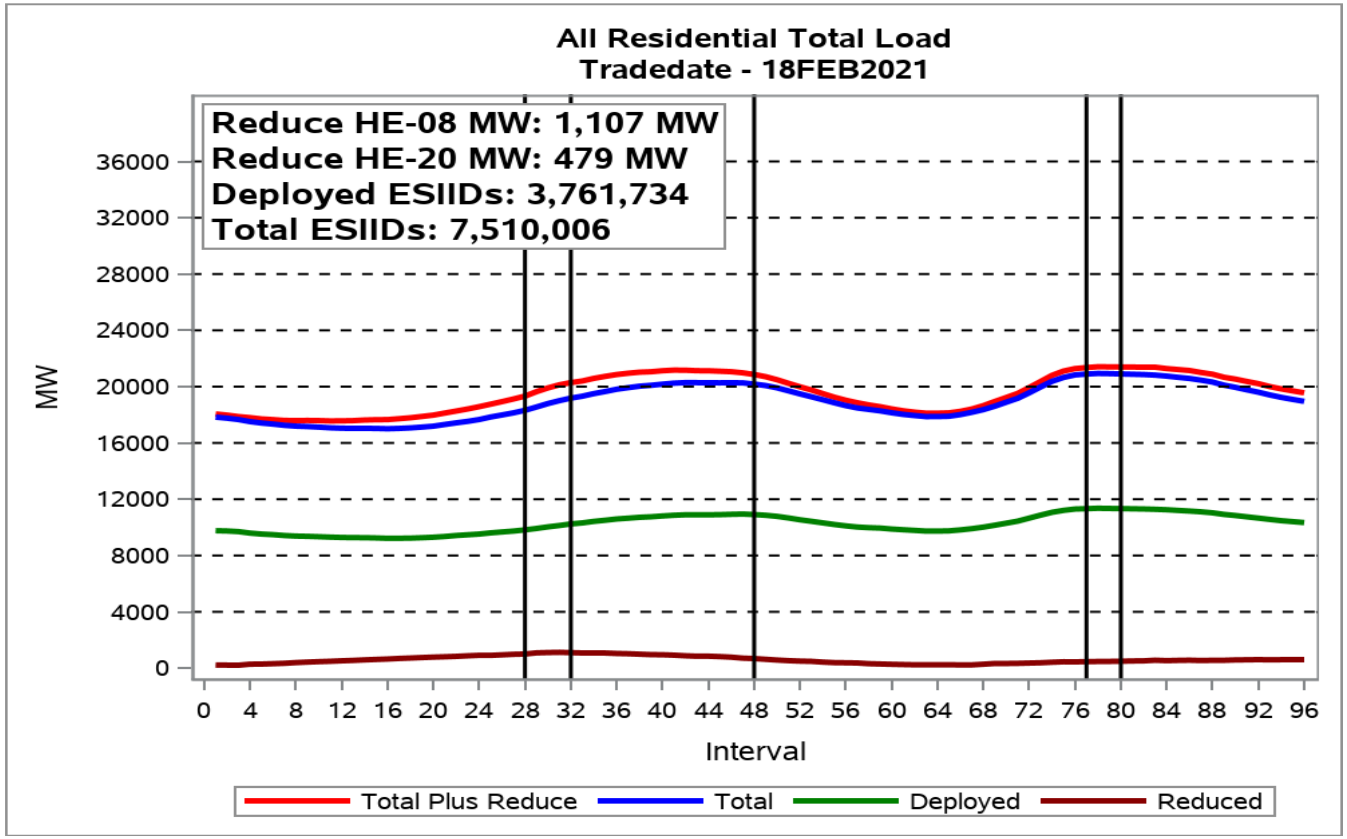
- Day Weighted Average Dry Bulb 17.6°
- Hourly Peak Total Plus Reduce 26,304 MW – 3.5 KW per ESIID
- Peak was 2.1 KW per ESIID higher than the Feb 4 mild day

Residential Load Third Day of Event



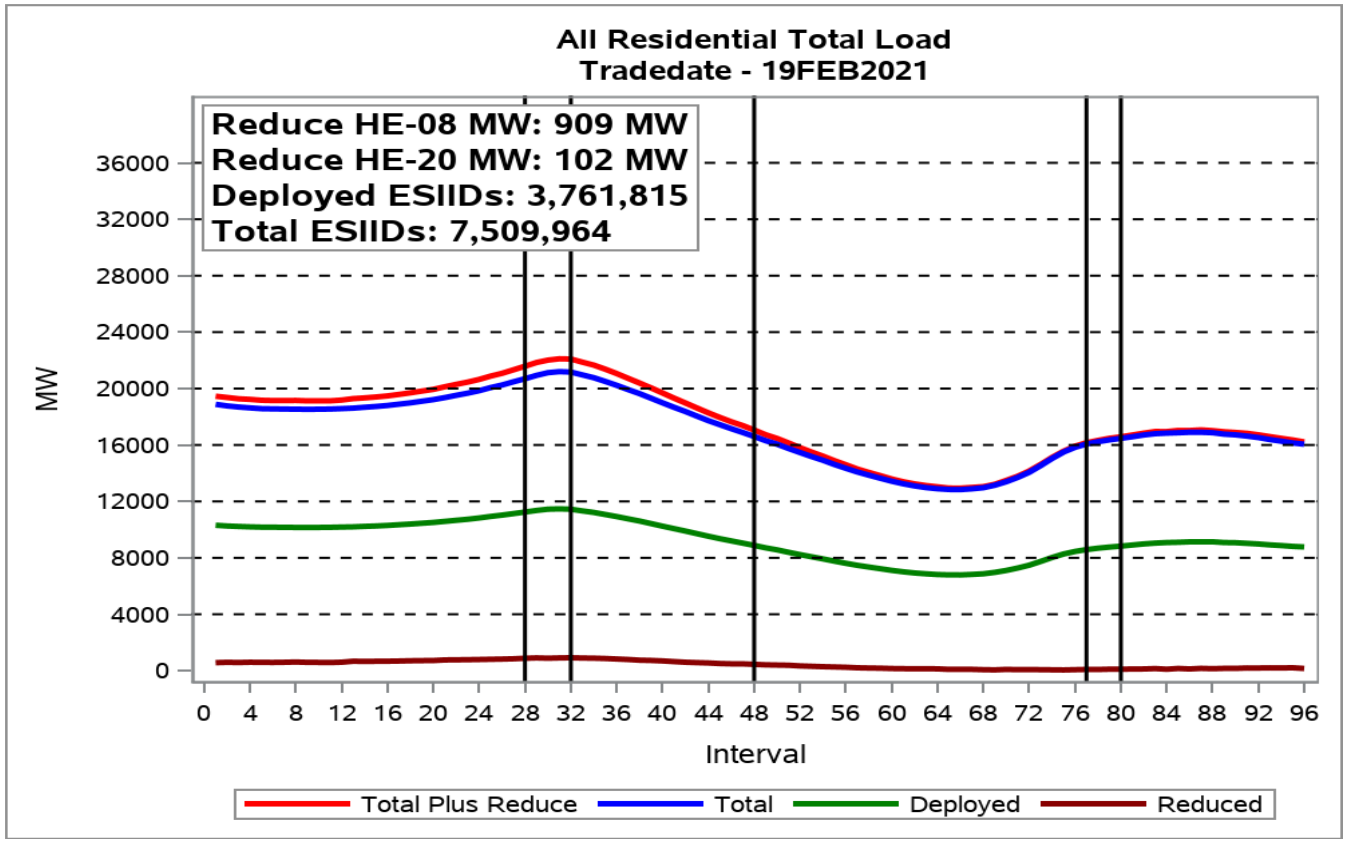
- Day Weighted Average Dry Bulb 28.0°
- Hourly Peak Total Plus Reduce 21,615 MW – 2.9 KW per ESIID
- Peak was 1.5 KW per ESIID higher than the Feb 4 mild day

Residential Load Fourth Day of Event



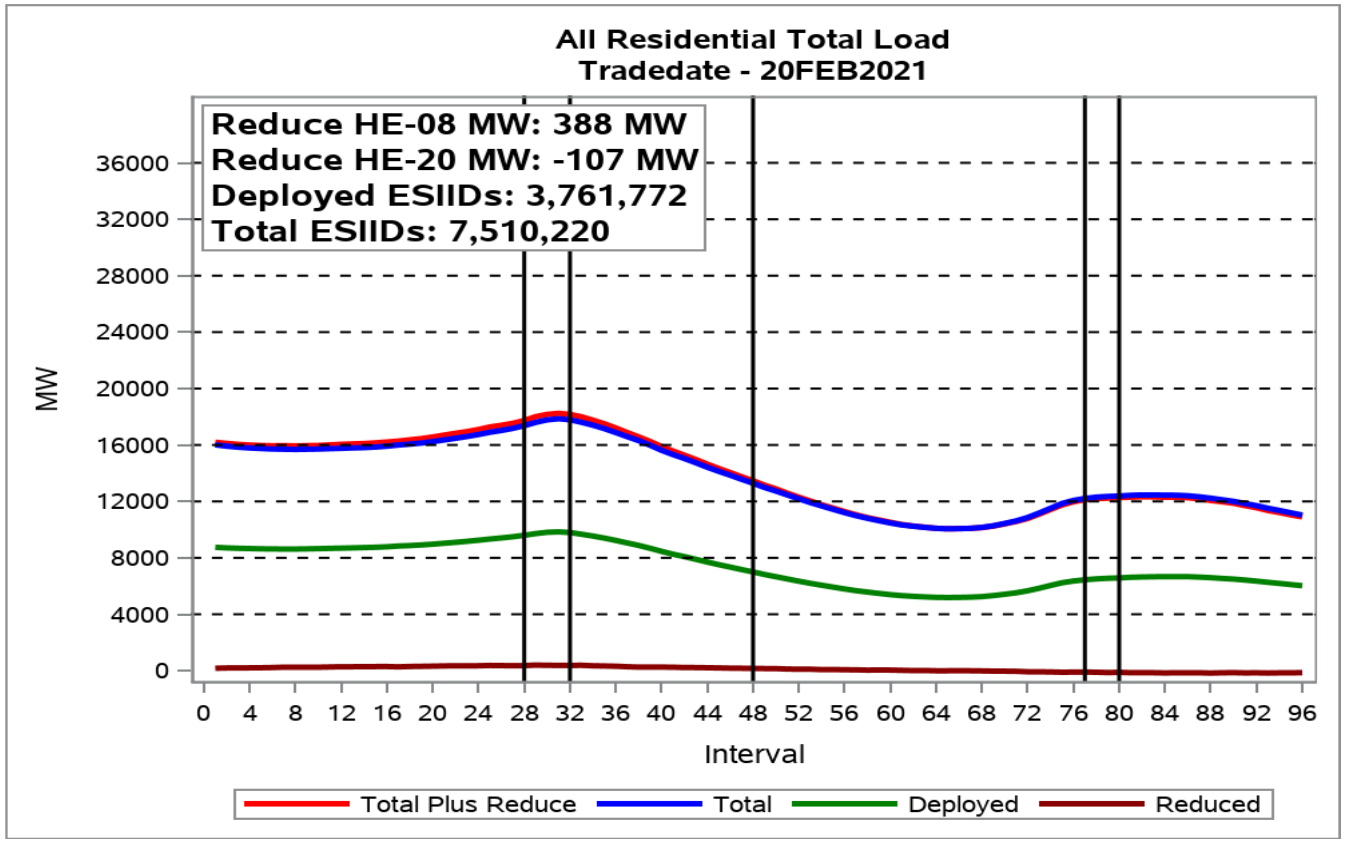
- Day Weighted Average Dry Bulb 27.7°
- Hourly Peak Total Plus Reduce 21,395 MW – 2.8 KW per ESIID
- Peak was 1.4 KW per ESIID higher than the Feb 4 mild day

Residential Load Last Day of Event



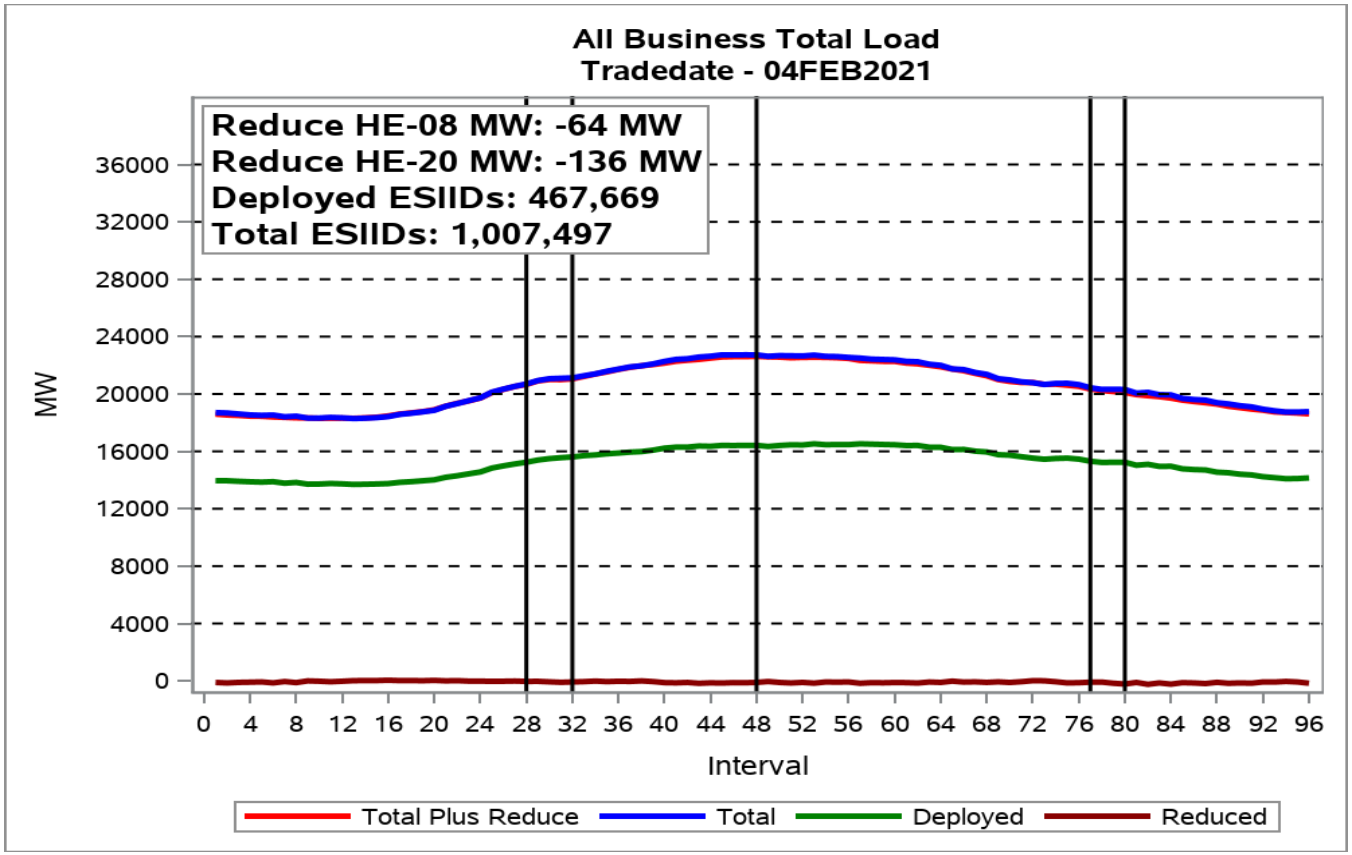
- Day Weighted Average Dry Bulb 30.4°
- Hourly Peak Total Plus Reduce 22,019 MW – 2.9 KW per ESIID

Residential Load Saturday After Event



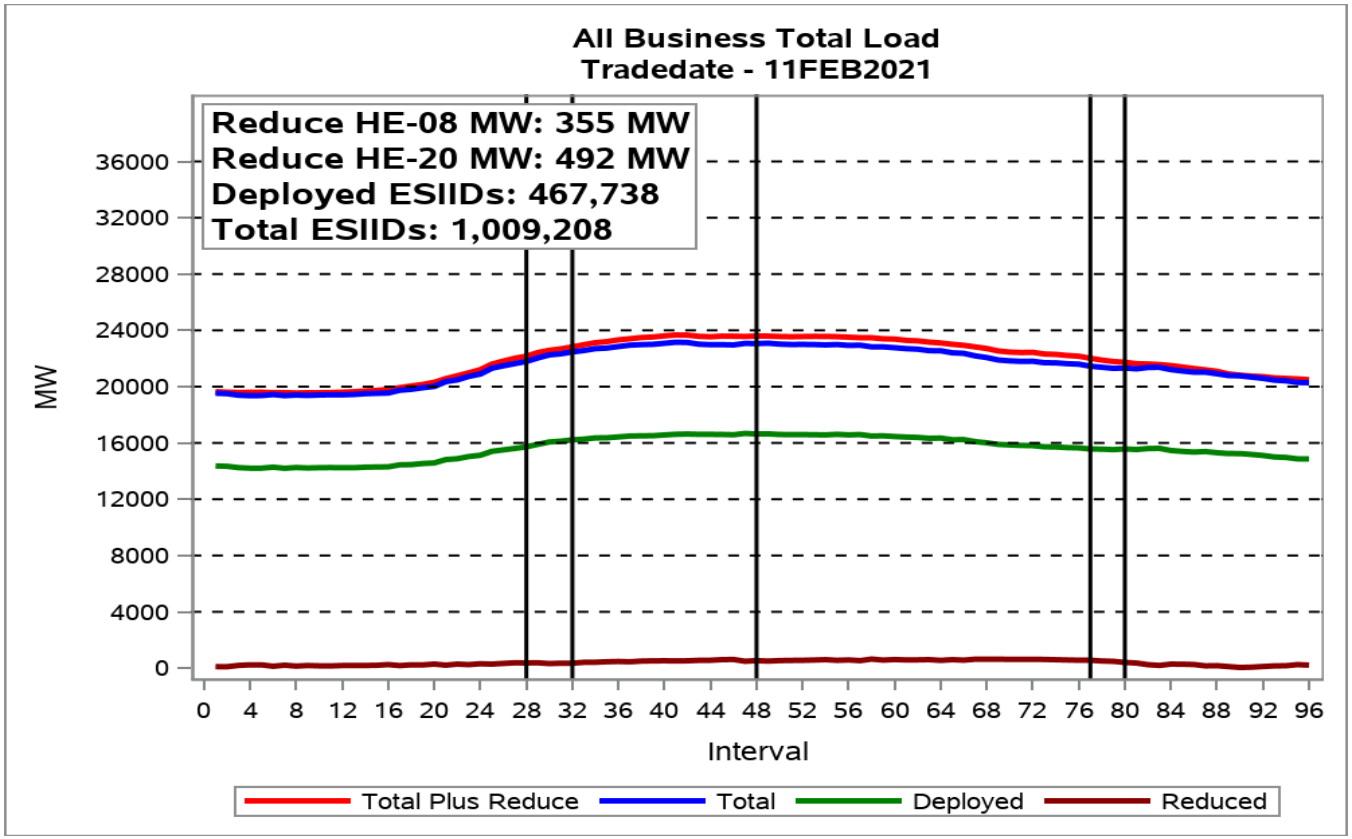
- Day Weighted Average Dry Bulb 41.7°
- Hourly Peak Total Plus Reduce 18,150 MW – 2.4 KW per ESIID

Business Load Mildest Weekday Before Event



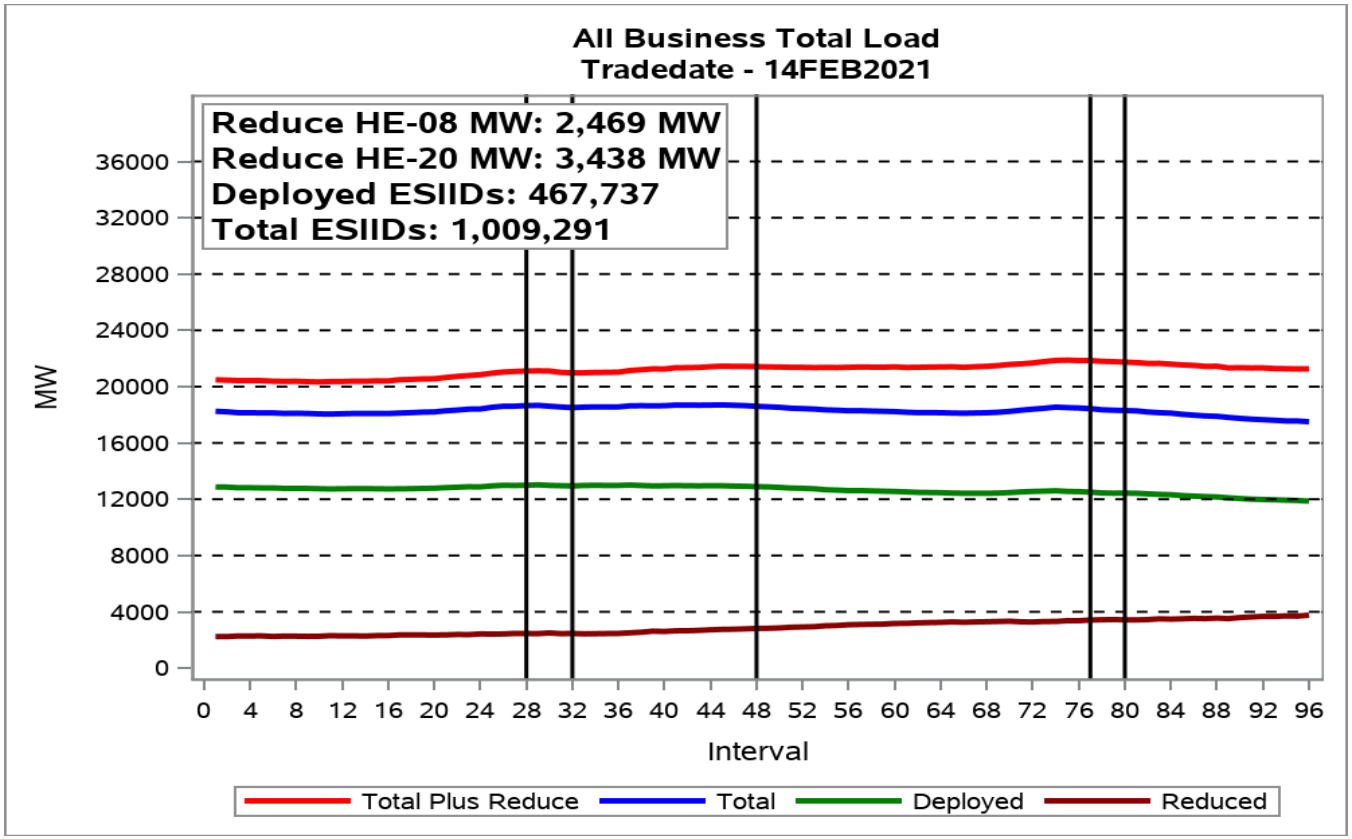
- Day Weighted Average Dry Bulb 60.5°
- Hourly Peak Total Plus Reduce 26,607 MW – 26.4 KW per ESIID
- No high prices

Business Load Coldest Weekday Before Event



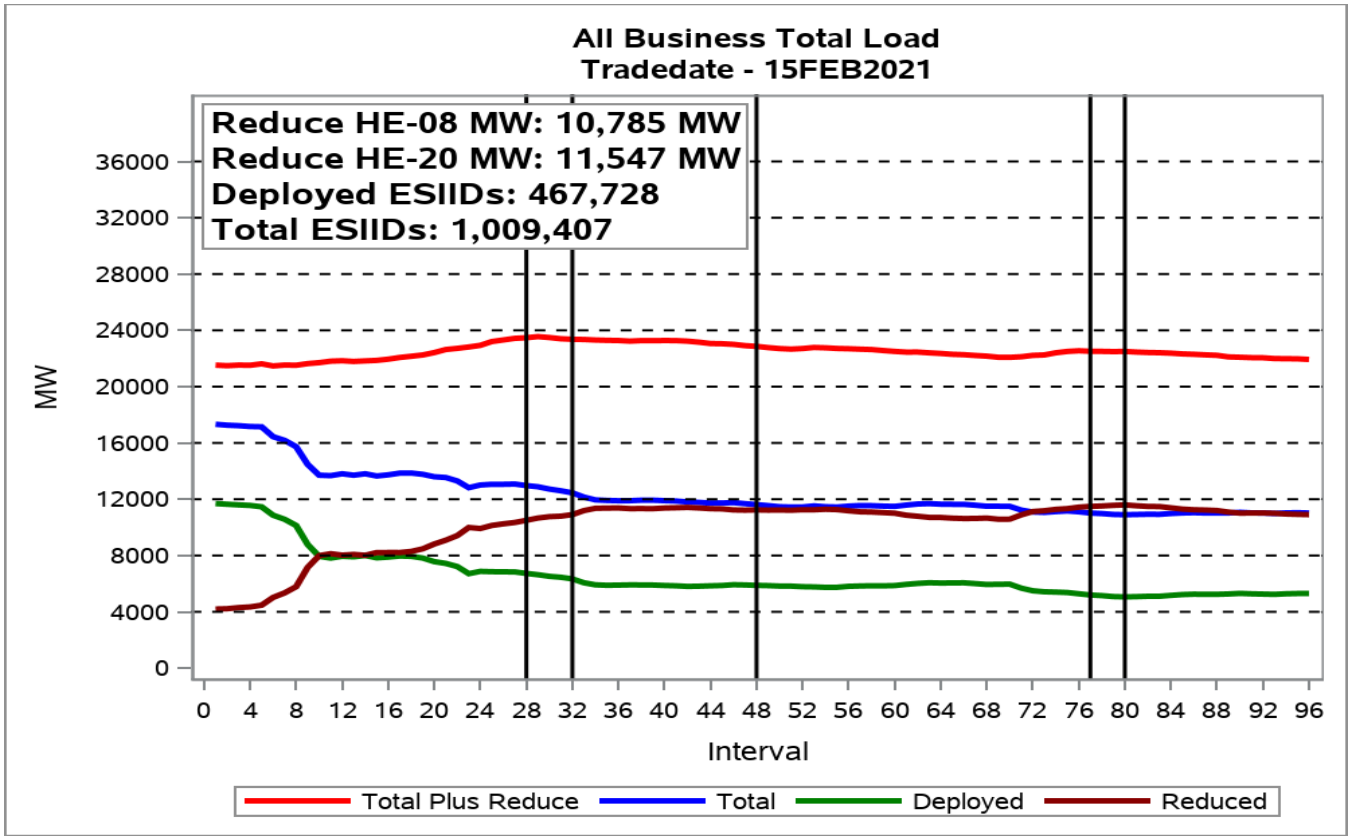
- Day Weighted Average Dry Bulb 32.5°
- Hourly Peak Total Plus Reduce 23,615 MW – 23.4 KW per ESIID …89% of mildest day peak
- Price response started ~500 MW, … 6 KW per ESIID decrease
- High prices started 08:30 and averaged $1,130 / MWh through the rest of the day

Business Load Sunday Before Event



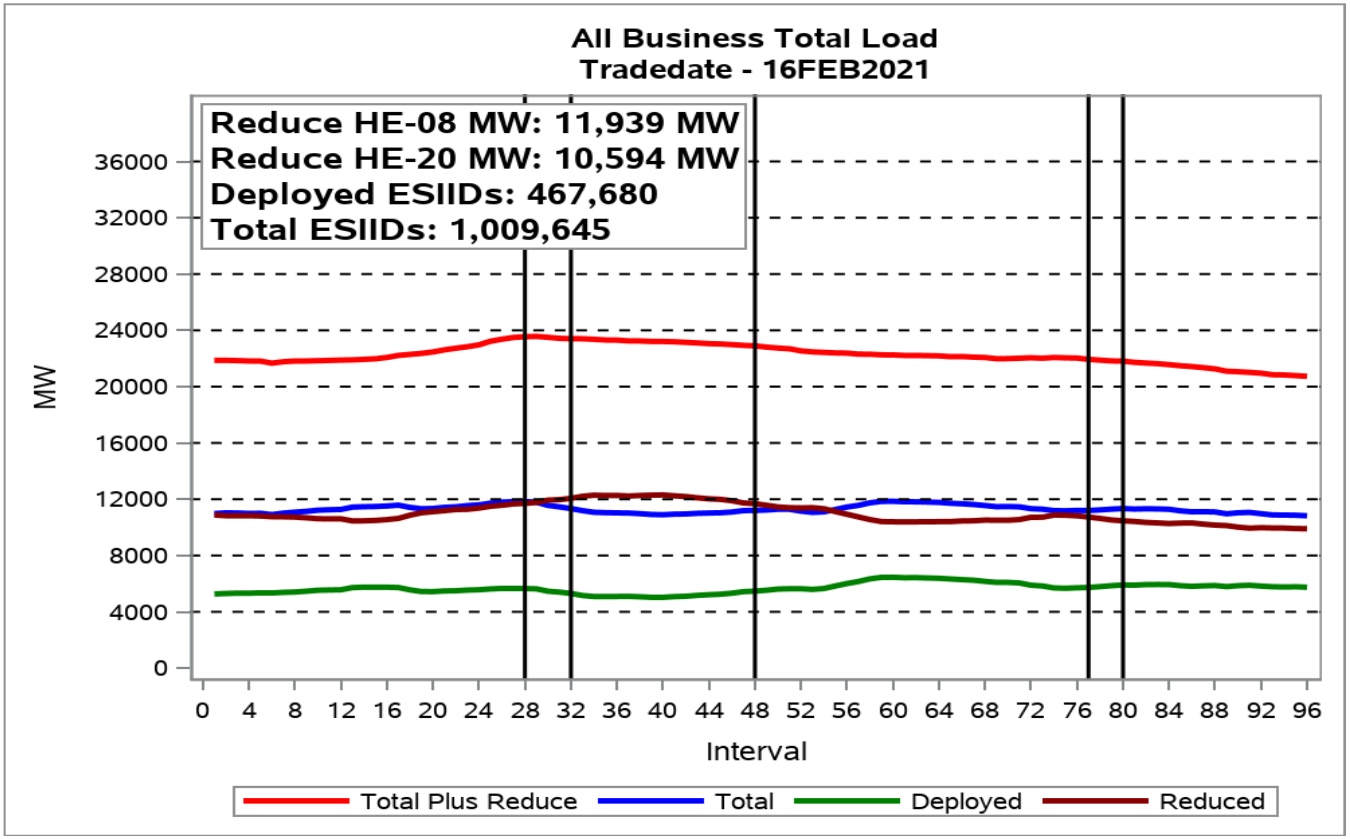
- Day Weighted Average Dry Bulb 22.4°
- Hourly Peak Total Plus Reduce 21,849 MW – 21.6 KW per ESIID
- Price response increased steadily to ~4,000 MW by midnight
- High prices started day at $1,200 / MWh and increased to cap around 22:45

Business Load First Day of Event



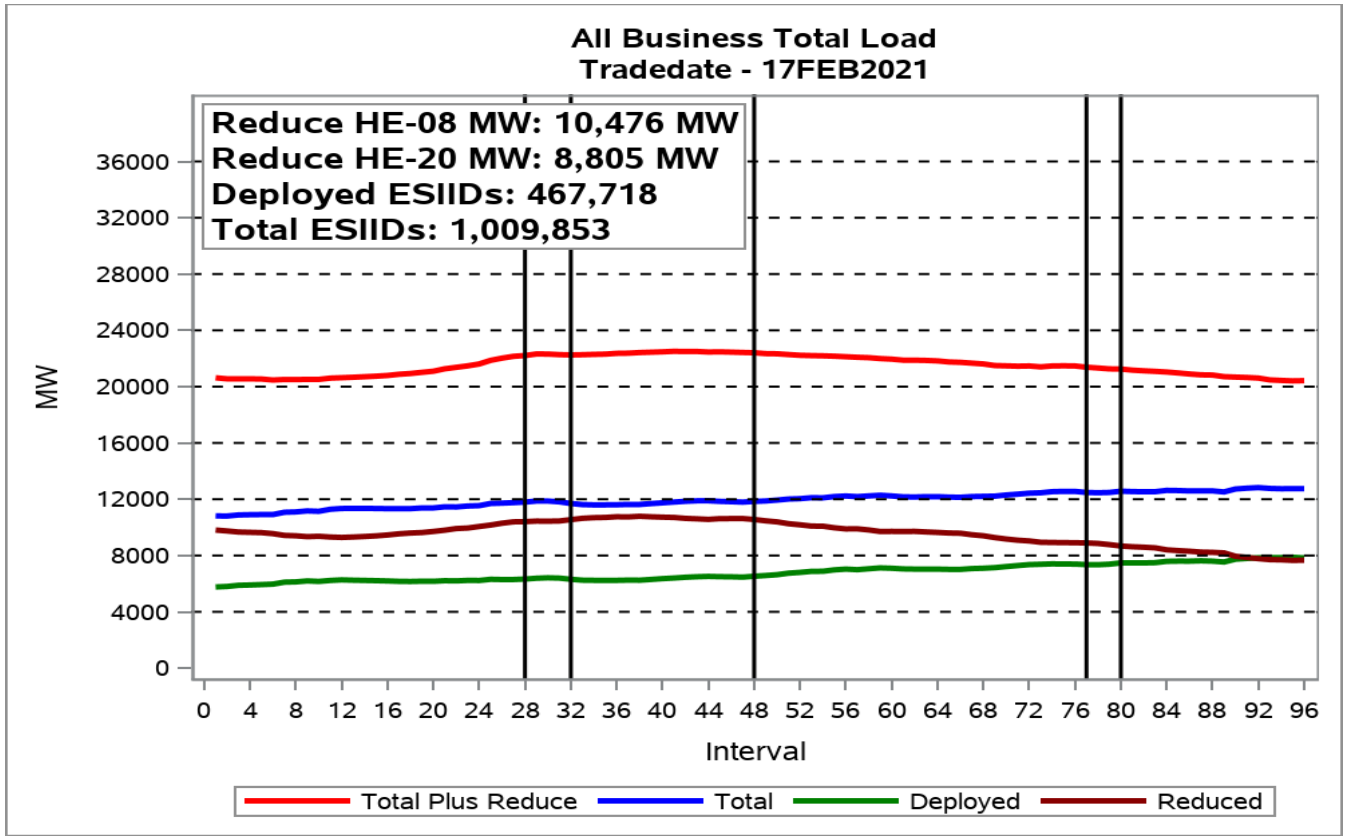
- Day Weighted Average Dry Bulb 13.4°
- Hourly Peak Total Plus Reduce 23,455 MW – 23.2 KW per ESIID
- 88% of mildest day peak … 3.2 KW per ESIID decrease
- Price and other response grew to ~12,000 MW during the day
- High prices all day with oscillations from $1,600 - $9,000

Business Load Second Day of Event



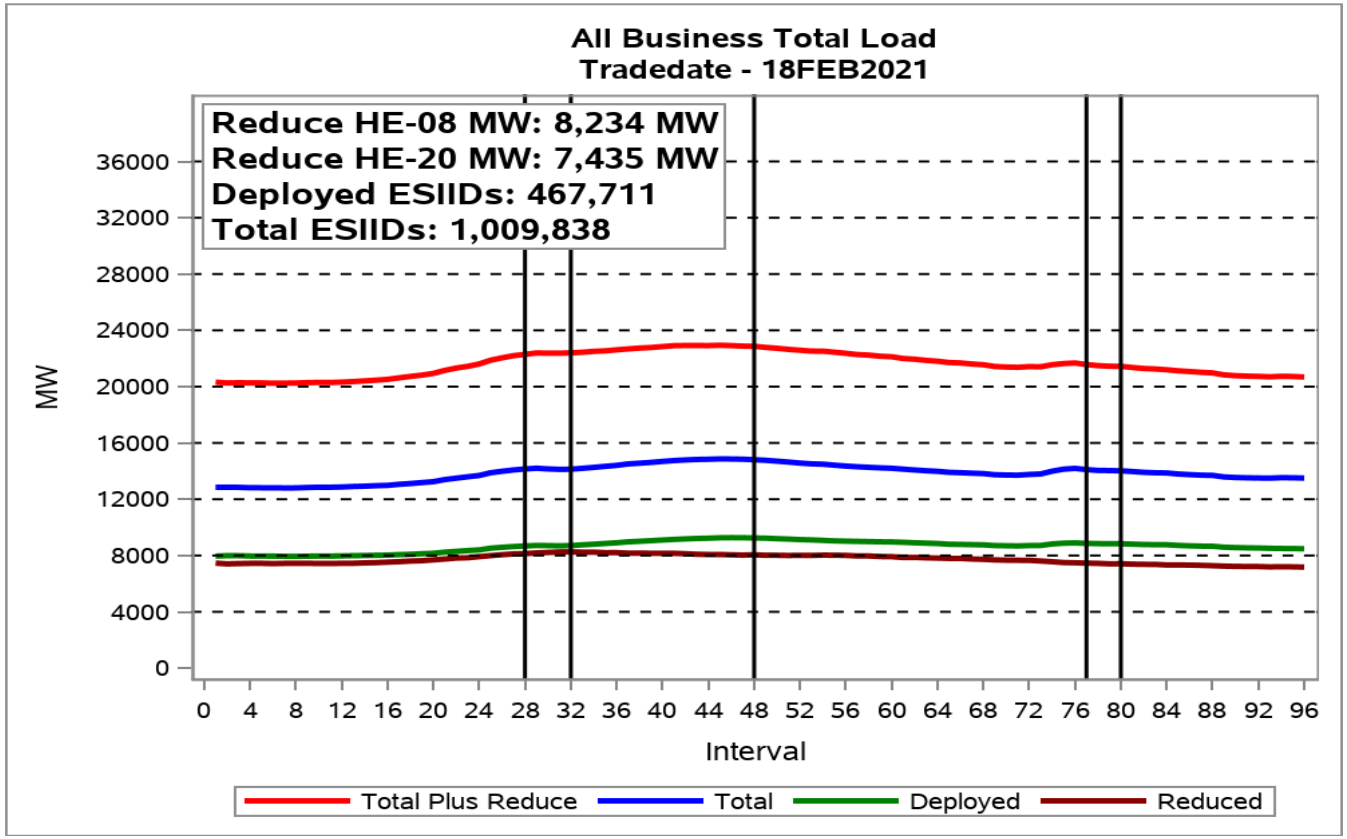
- Day Weighted Average Dry Bulb 17.6°
- Hourly Peak Total Plus Reduce 23,480 MW – 22.5 KW per ESIID
- 88% of mildest day peak … 3.9 KW per ESIID decrease
- Price and other response ~12,000 MW during the day
- Prices high all day - averaged $9,007

Business Load Third Day of Event



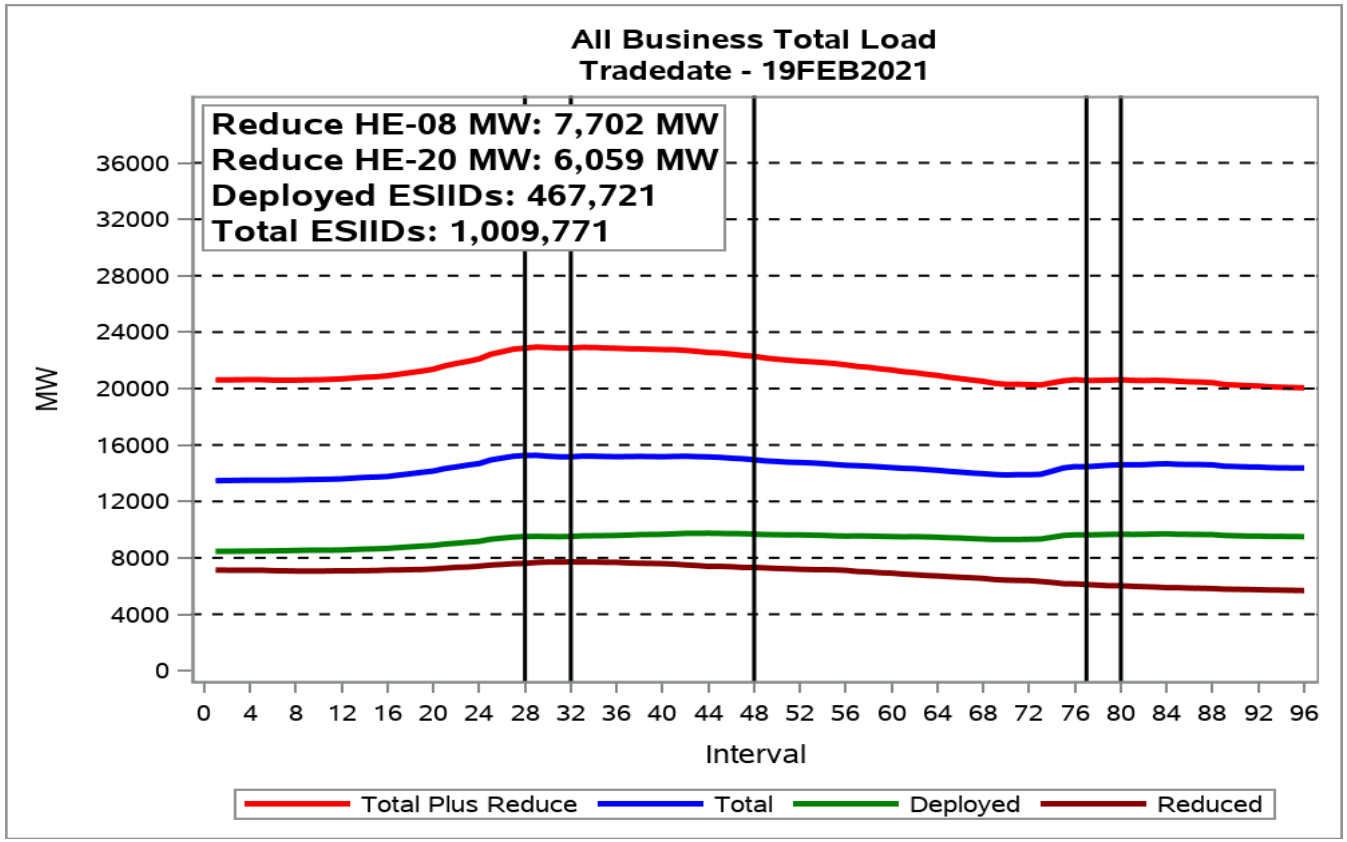
- Day Weighted Average Dry Bulb 28.0°
- Hourly Peak Total Plus Reduce 22,494 MW – 22.3 KW per ESIID
- 84% of mildest day peak … 4.1 KW per ESIID decrease
- Price and other response fell off to ~8,000 MW during the day
- Prices high all day - averaged $9,000

Business Load Fourth Day of Event



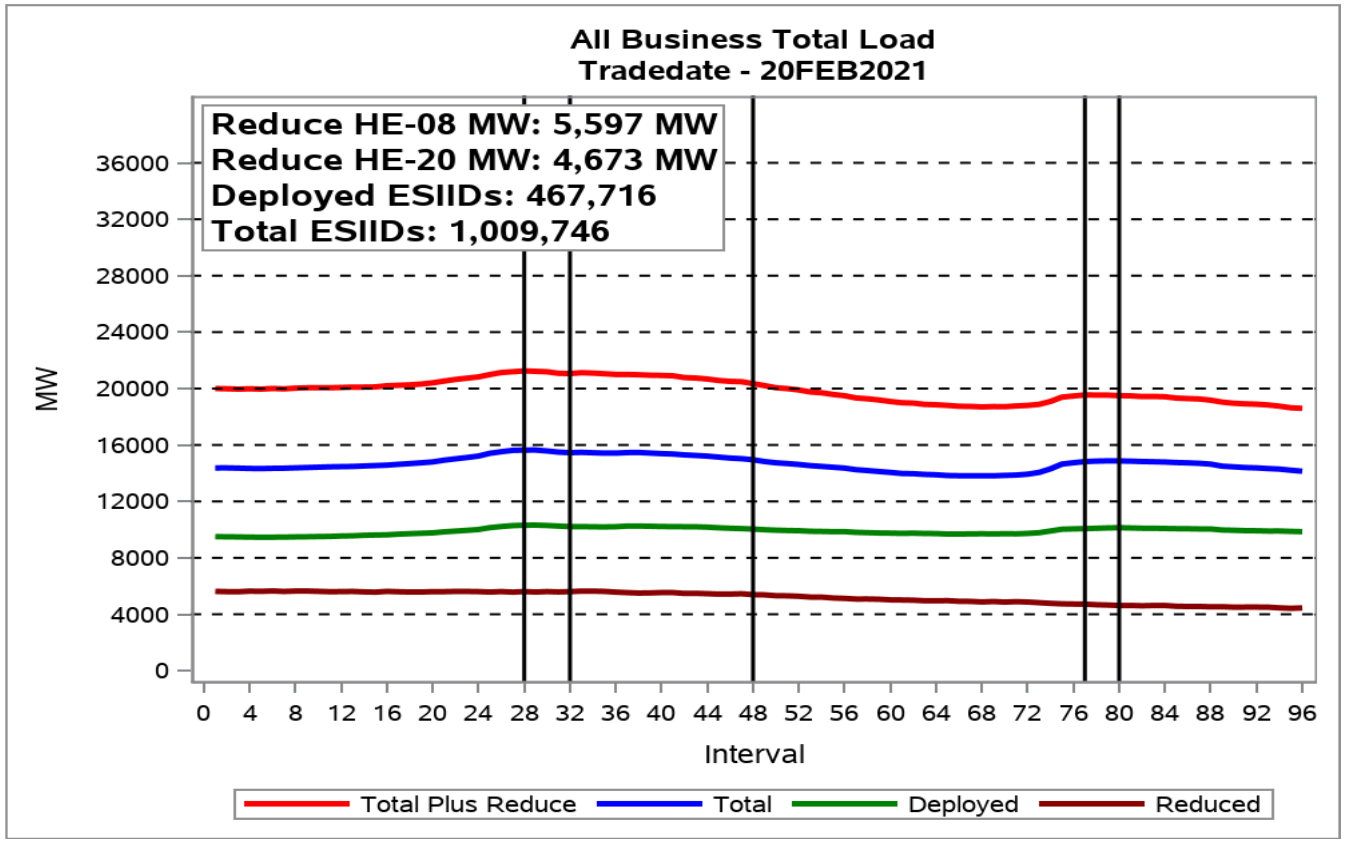
- Day Weighted Average Dry Bulb 27.7°
- Hourly Peak Total Plus Reduce 22,920 MW – 22.7 KW per ESIID
- 86% of mildest day peak … 3.7 KW per ESIID decrease
- Price and other response leveled off at ~8,000 MW during the day
- Prices high all day - averaged $9,015

Business Load Last Day of Event



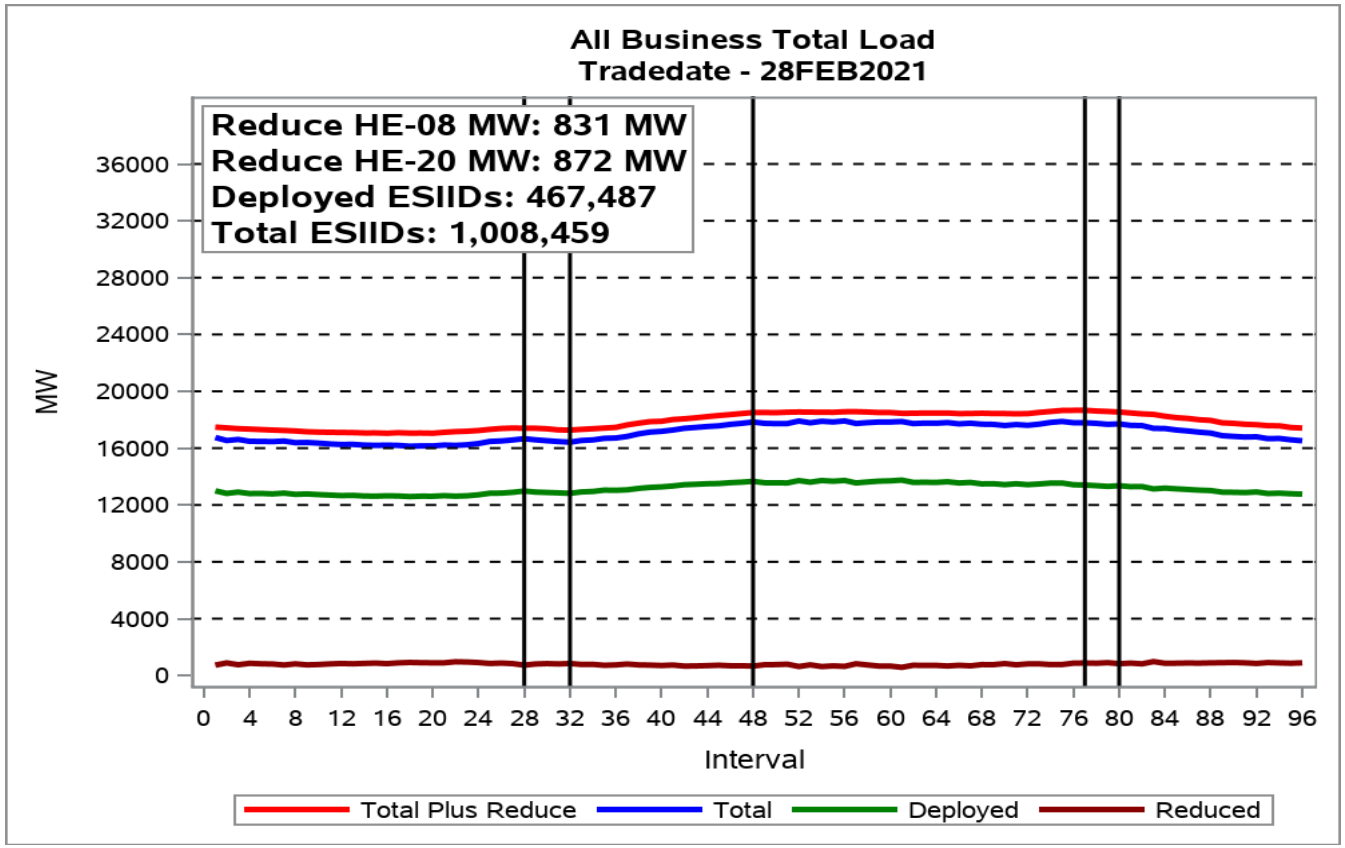
- Day Weighted Average Dry Bulb 30.4°
- Hourly Peak Total Plus Reduce 23,217 MW – 23.0 KW per ESIID
- 87% of mildest day peak … 3.4 KW per ESIID decrease
- Price and other response started falling off from 8,000 MW at the beginning of the day to 6,000 MW by the end of the day
- Prices averaged $8,994 until 09:00 and were back to normal at 09:30

Business Load Saturday After Event



- Day Weighted Average Dry Bulb 41.7°
- Hourly Peak Total Plus Reduce 21,147 MW – 20.9 KW per ESIID
- 79% of mildest day peak … 5.5 KW per ESIID decrease
- Remaining response decreased slowly all day to about 4,400 MW
- No high prices all day long

Business Load Saturday After Event

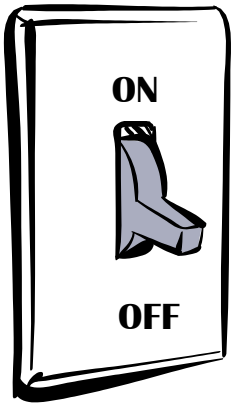


- Day Weighted Average Dry Bulb 64.3°
- For Feb 21 – 28 load reductions decrease from 4,400 MW to about 800 MW at the end of the month.
- No high prices all day long

Next Steps

- Extend analysis into March
- NOIE Load response
- Response from ESIIDs
  - Deployed for ERS
  - Deployed as Load Resources providing RRS
  - Price Response (including 4CP responders)
- Settlement Only Generators/Puns
- Additional Subgroup break outs e.g. by Weather Zones, TDSP, etc

Questions?



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