World Climate Service U.S. Regional Degree-days – 2026 Upgrade

March 2026

1. Introduction

In 2021, the World Climate Service released its U.S. Trading Markets product, consisting of subseasonal and seasonal model forecasts of HDDs and CDDs for U.S. energy market regions. A key benefit of the WCS product is that rigorous bias correction is applied to the model forecasts using long histories of model forecasts (i.e. reforecasts) and a historical database of observed regional degree-days. In the 2021 release, the historical baseline or "ground truth" for observed degree-days was the well-known NOAA/NCEI nClimDiv product, which includes monthly degree-days for 344 U.S. climate divisions. ERA5 data and spatial aggregation were then used to develop a bias-corrected daily history of degree-days for the Trading Markets regions.

While the 2021 methodology provided a sound bias correction for the model forecasts, it suffered from the shortcoming that the observed degree-day values were revised once a month when the NCEI data were updated. It also became evident that this once-a-month revision was often substantial, because the ERA5 temperature bias relative to nClimDiv is not entirely stable. Furthermore, ERA5 often underestimates the amplitude of extremes.

In view of these limitations, the WCS has developed a new historical HDD/CDD baseline using 4km temperature data from the PRISM Climate Group at Oregon State University. PRISM data is derived from ground truth weather station data and uses state-of-the-art elevation-dependent regression and interpolation. With the 2026 upgrade, we no longer rely on the nClimDiv data, as PRISM provides a bias-free interpretation of local daily temperatures.

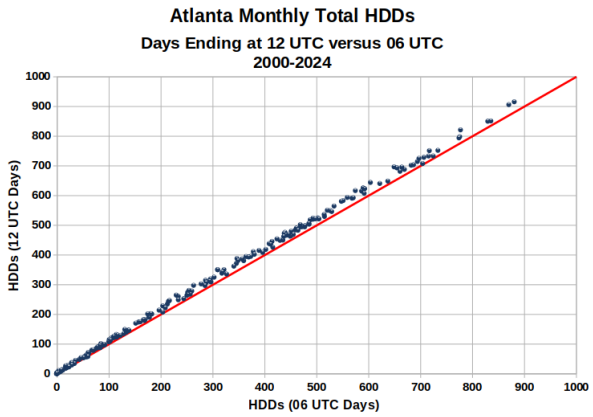
The purpose of this document is to describe the changes in the calculation methodology and to provide a summary of the differences between the 2021 and 2026 Trading Markets data.

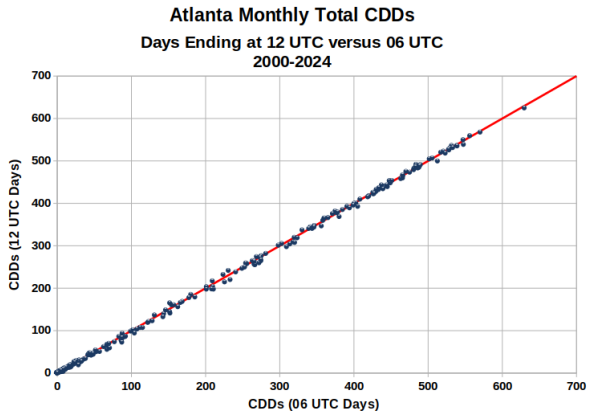
2. PRISM: Days Ending at 12 UTC

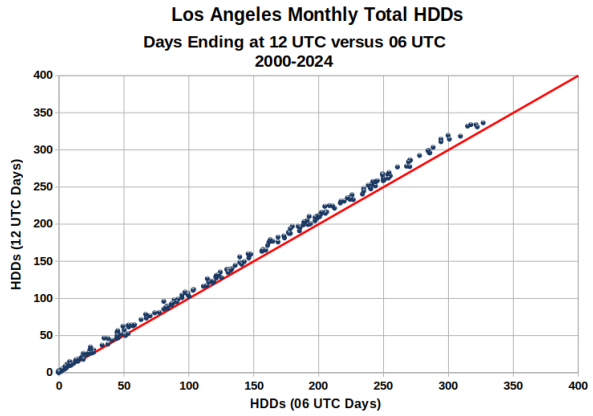
A nuance of the PRISM data is that daily values are provided for 24-hour periods ending at 12 UTC, or 7am EST. This definition of the daily period allows PRISM to use the vast array of daily reports from NWS COOP observers, but it differs from the NWS standard midnight-to-midnight definition for climate data at first-order stations. In the 2021 version of Trading Markets, ERA5 data was aggregated for 06 UTC - 06 UTC to approximate the midnight-to-midnight standard, but the 2026 version adopts the 12 UTC definition for observed degree-day values.

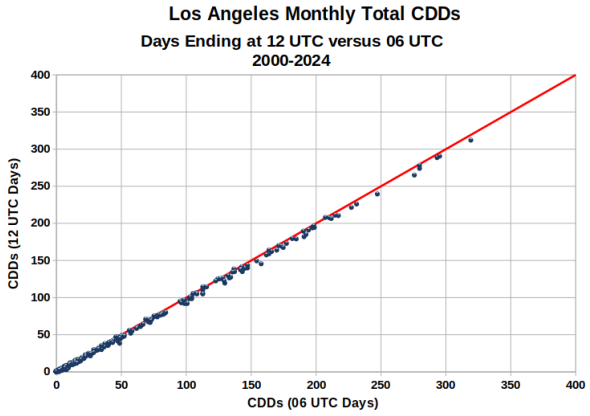
The change to a 12 UTC ending time leads to slightly higher accumulated HDD totals in winter, because daily minimum temperatures tend to occur close to 12 UTC, and so the 24-hour period ending at 12 UTC is prone to double-counting the lowest minimum temperatures. In summer,

when minimum temperatures occur before 12 UTC in the eastern U.S., there is little bias in accumulated CDDs for eastern regions, but western zones still have a cool bias (i.e. lower CDDs). The magnitude of the differences is illustrated below using daily degree-days calculated for both ending times with observed hourly temperature data from Atlanta and Los Angeles.









3. County-Level Calculations

In the 2021 version of Trading Markets, the historical baseline was derived from the 344 NCEI climate divisions, but the 2026 methodology begins with county-level aggregation of the 4km gridded PRISM data. With an average of 9 counties per climate division, the spatial granularity of the analysis is greatly improved. Moreover, the 2026 approach uses county-level population and home heating fuel classifications, obtained from the U.S. Census American Community Survey (ACS) database. This contrasts with the 2021 method, which relied on climate division populations and state-level fuel use data.

The aggregation from county to regional (e.g. ERCOT) data is performed from area intersections of counties with regions. For example, the population-weighted HDD in a region that includes 70% of the area of county A and 40% of the area of county B is as follows:

$$Regional\ Value = \frac{0.7Pop_A HDD_A + 0.4Pop_B HDD_B}{0.7Pop_A + 0.4Pop_B}$$

More generally,

$$Regional\ Value = \sum_{i=1}^{n} \frac{f_i p_i z_i}{f_i p_i}$$

where the region (e.g. ERCOT) intersects with an area fraction f_i of county i (i=1..n), and county i has population p_i and HDD/CDD value z_i.

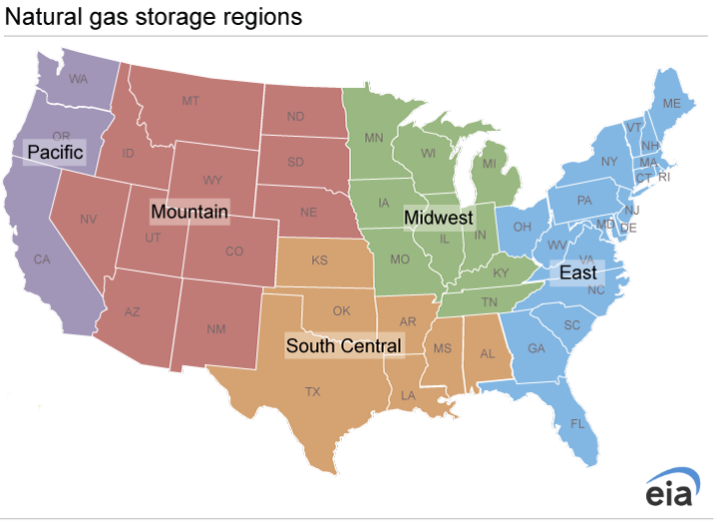
The fuel-weighted aggregation is performed in the same way, but using the county populations that rely on each fuel source (e.g. natural gas).

4. Additional Regions

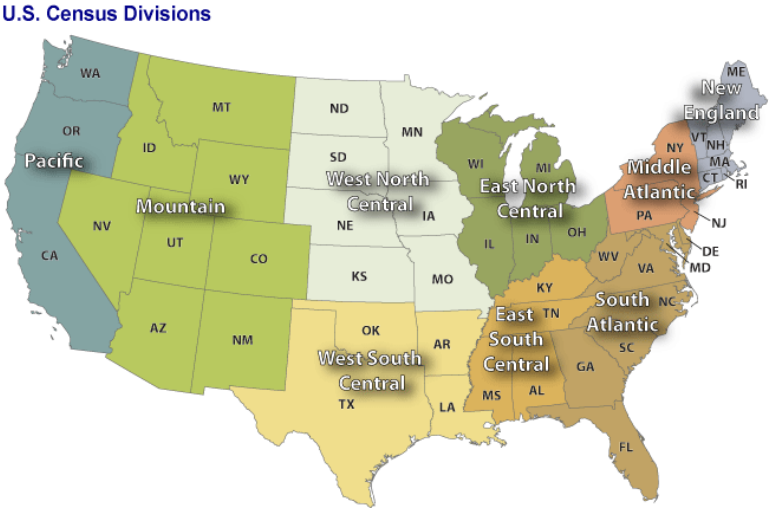
The 2021 version of Trading Markets included regional degree-day data for U.S. ISOs, EIA gas storage regions, and U.S. census divisions. For the 2026 upgrade, we have added U.S. states as well as the ERCOT load and weather zones. The maps below illustrate the five categories of regional aggregation.

A. U.S. ISOs

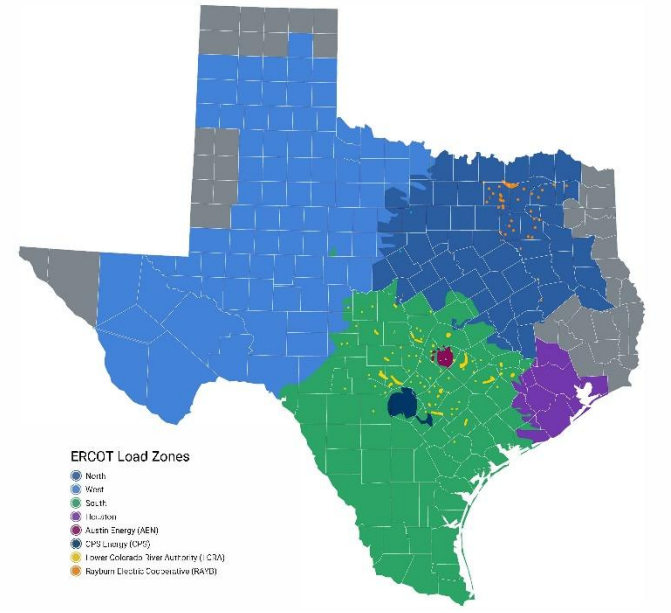
B. EIA gas storage regions



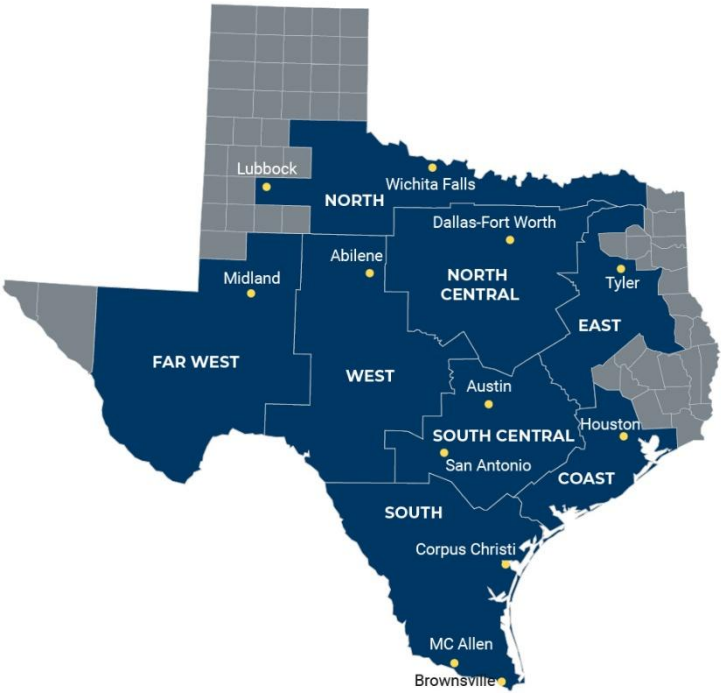
C. U.S. census divisions



D. ERCOT load zones



E. ERCOT weather zones

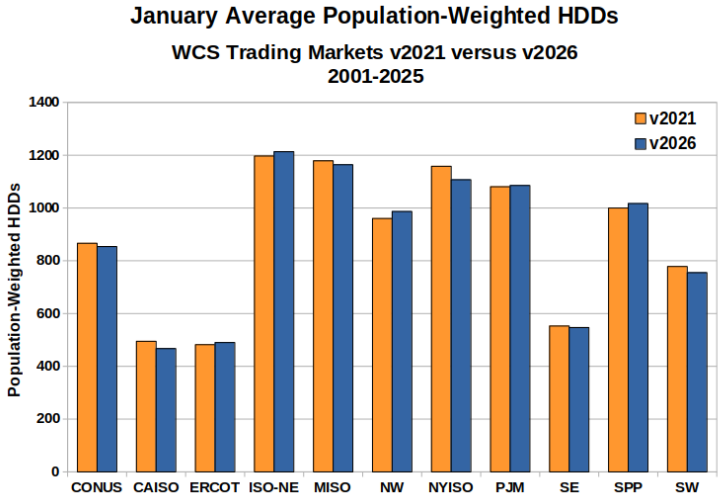


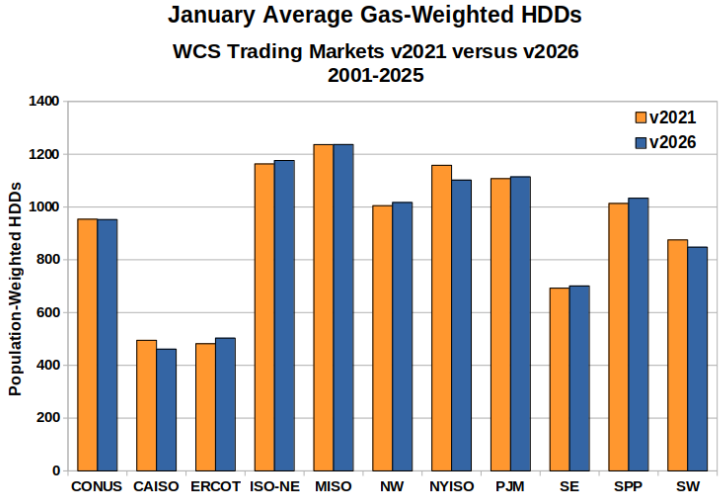
5. 2020 Weights

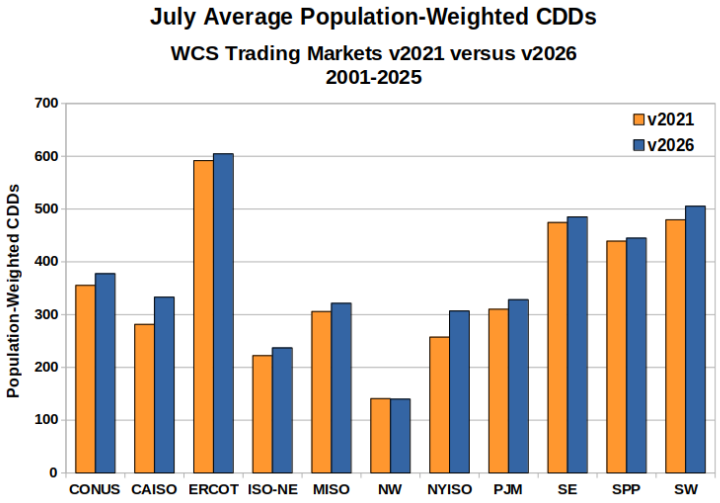
The 2021 version of Trading Markets used 2010 population and fuel weightings, but the 2026 release adopts data from the 2020 Census. The spatial distribution of U.S. population and fuel use has shifted significantly in recent decades, and the new Trading Markets data is more relevant to current energy demand profiles.

6. Comparison of 2026 and 2021 Datasets

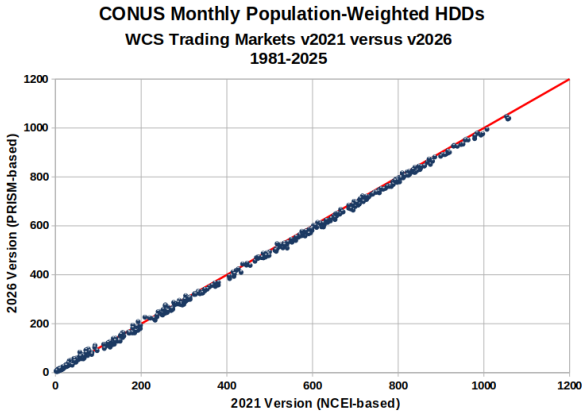
The figures below compare the 2026 and 2021 versions in terms of average January HDDs and July CDDs for the electricity ISOs. For HDDs, the differences vary both in sign and in magnitude, but CDDs are generally higher in the 2026 version. The differences arise from several contributing factors, including the change to county-level granularity, the change to 2020 population/fuel weights, the change to a 12-12 UTC day, and the change in the underlying data source.

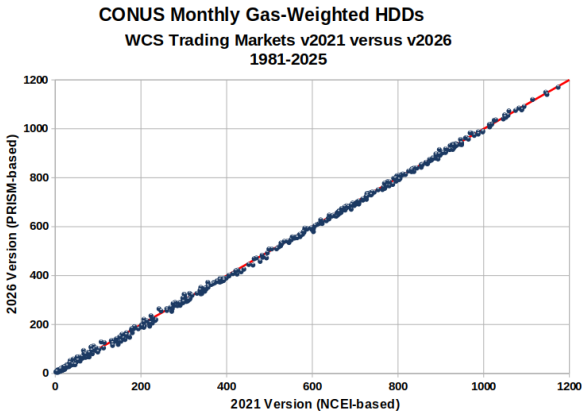


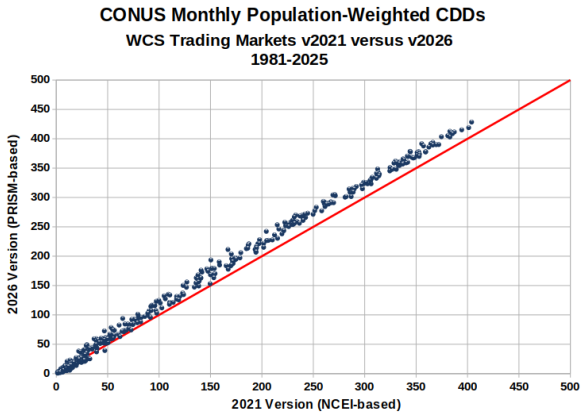


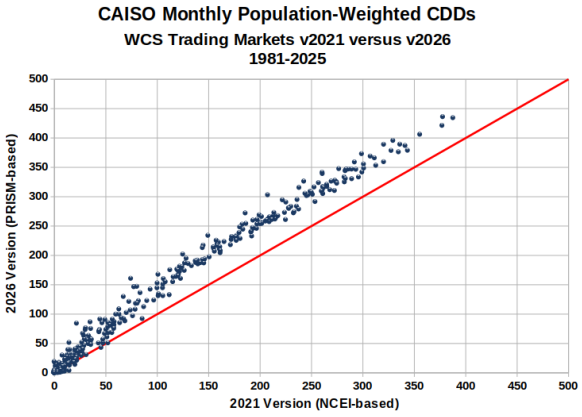


The overall correlation between v2021 and v2026 degree-day totals is high for both HDDs and CDDs, but the changes in the CDD values are more significant (see below). The largest changes are found in California, where the increased granularity of the population and weather data has produced a substantial increase in the CAISO CDD baseline.





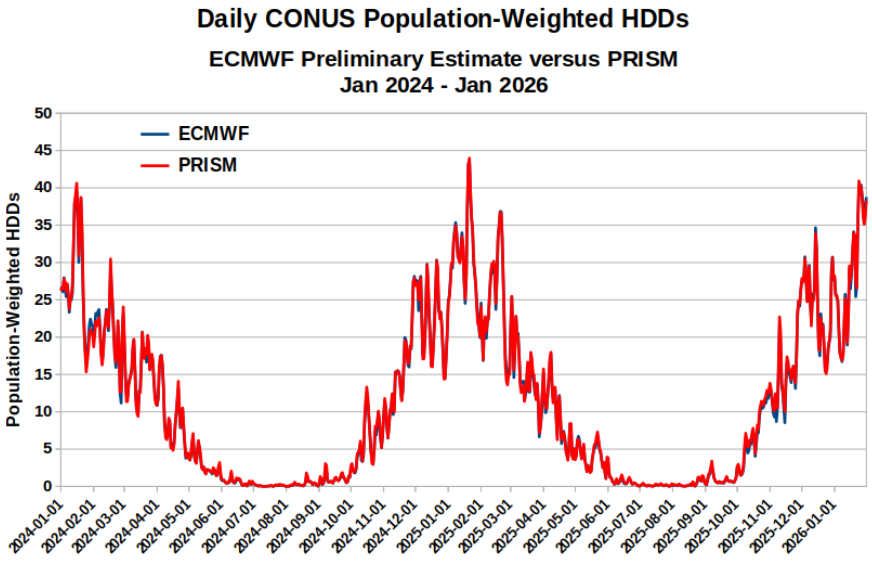


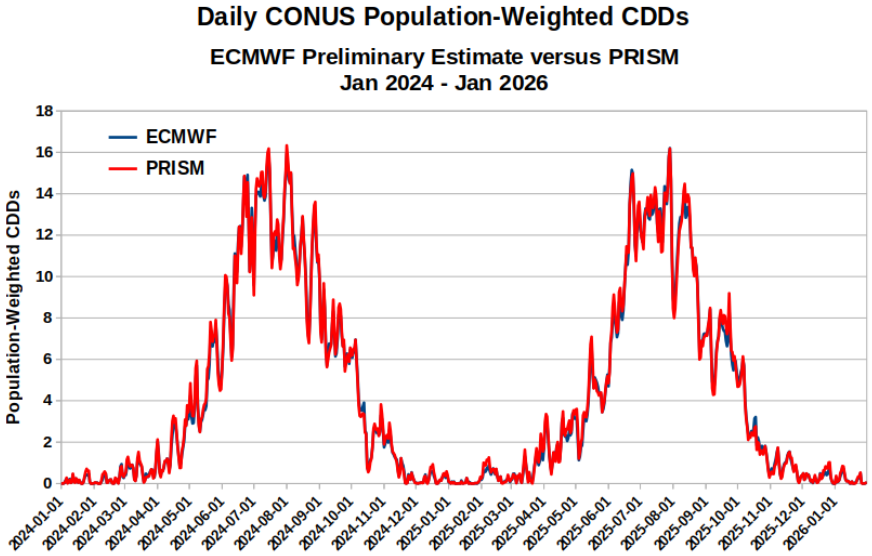


7. Preliminary ECMWF Estimates

There is a 24-hour lag in the daily PRISM updates, and therefore we use ECMWF short-range forecasts to obtain preliminary degree-day values for the most recent date. A running 30-day bias correction removes ECMWF temperature bias at the county level before calculating degree-days and aggregating to the regional values.

The figures below illustrate the performance of the preliminary CONUS estimates since the beginning of 2024. There is a small negative bias in most regions for both HDDs and CDDs, reflecting the fact that the ECMWF underestimates extremes, and the mean absolute error of the preliminary daily CONUS values is approximately 0.5°F for HDDs in winter and 0.3°F for CDDs in summer. The regional MAE values range from 0.4°F to 1.8°F for HDDs in winter and 0.3°F to 1.4°F for CDDs in summer.





8. Model Forecasts

The forecast component of Trading Markets has also been revised to be fully consistent with the new historical baseline. For each model, the bias is first removed from the gridded temperature forecasts by subtracting the reforecast climatology (i.e. the model "normal"), resulting in temperature anomaly forecasts. The gridded anomalies are then converted to county-level values and added to the PRISM county-level climatology to arrive at county-level temperature and HDD/CDD forecasts. Finally, the county-level degree-day values are aggregated to regional values using the same spatial weightings as the PRISM aggregation.

9. Data Availability

The 1981-present daily and monthly regional degree-day values are available at the following URLs:

https://s2s.worldclimateservice.com/wcs/regional_degree_day_history_daily_v2026.csv

https://s2s.worldclimateservice.com/wcs/regional_degree_day_history_monthly_v2026.csv

10. Conclusion

The World Climate Service has released a major upgrade to the Trading Markets product. The key changes involve (i) a change to PRISM data for the historical baseline and real-time degree-day observations; (ii) county-level calculations, and (iii) 2020 county-level population and fuel use data. On a national level, the HDD baseline values are little changed, but CDD baseline values have generally increased. Compared to the 2021 version of Trading Markets, the quality of the historical and preliminary real-time degree-day values is significantly improved, and the product no longer relies on monthly nClimDiv updates from NOAA/NCEI.