Weather data for energy analysis

23rd February 2022
Why weather data matter for energy analysis?
• Granular weather data can be used as starting point to model solar electricity generation

Data sources: IEA Weather for Energy Tracker, IEA Monthly Electricity Statistics
Energy consumption is highly correlated to weather indicators

- This graph shows France electricity consumption (y-axis) versus temperature (x-axis).
- Space heating and cooling requirements show linear correlation with heating and cooling degree days, reflected in country total power figures.
- The profile varies depending on the countries.

Source: RTE
Variability of weather indicators

Cooling degree days, Nigeria, reference temperature: 23°C
Variability of weather indicators

Cooling degree days, Nigeria, reference temperature: 23°C

28%
The weather indicators are key to analyse or exclude the significant effect of weather on energy consumption
Temperature correction methodology to exclude effect of weather

Temperature correction

\[ E_i^{TC} = E_i^{act} \cdot \frac{HDD}{HDD_i} \]

where:
- \( E_i^{TC} \) is the temperature-corrected energy consumption for the year \( i \),
- \( E_i^{act} \) is the actual energy consumption in year \( i \),
- \( HDD \) is the average heating degree days of the given period (2000-latest year), and
- \( HDD_i \) is the total heating degree days in the year \( i \).

Energy consumption temperature-corrected
Temperature correction – example on end-use indicators

Data for IEA 20 (Australia, Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Netherlands, Norway, Slovakia, Spain, Sweden, Switzerland, UK, USA).

* Temperature correction using heating degree days

Data source: IEA, Energy efficiency indicators, All rights reserved.
Selected examples of use of the database by IEA analysts

- Heating, cooling degree days and humidity indicators are used for energy modelling feeding World Energy Outlook and Global Energy Review reports in order to:
  - Normalise energy demand for basis for projections
  - Understand the impact of weather on energy demand and emissions
  - Assess distribution of population in need to cooling

- Temperature, heating and cooling degree days are used for assessment in the Climate Resilience Policy Indicator report

- Irradiation and wind speed indicators to derive technical generation potentials for solar and wind generation at the hourly level.
The Weather for Energy Tracker database
The Weather for Energy Tracker database

- Free platform providing high resolution weather indicators relevant to the energy sector. Extensively used by modellers.

- Reliable, consistent and easily accessible data on an expanded portfolio of weather variables, e.g. temperatures, degree days, solar radiation, precipitation, are becoming more and more important.

- Help statisticians, researchers, modellers and analysts around the world, as well as a broader audience interested in the energy sector.

- Developed by the IEA in collaboration with Fondazione Euro-Mediterraneo sui Cambiamenti Climatici (CMCC).

- Primary weather variables extracted from ECMWF Copernicus Climate Change Service information (2022).

- Updated every January, April, July and October

[Link: ieao.org/articles/weather-for-energy-tracker]
Three free tools to access the Weather for Energy data

Interactive map
And
customisable
CSV download

Interactive excel file

Data repository
50+ primary weather variables and derived indicators

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>average, min, max, dew, wet bulb, humidex, heat index</td>
</tr>
<tr>
<td>Heating and cooling degree days</td>
<td>methodologies: standard, Eurostat, humidity corrected, wet-bulb temperature based, wind speed corrected Reference temperatures: 65°F, 16, 18 and 20°C for HDD and 65°F, 10, 16, 18, 21, 23 and 26°C for CDD</td>
</tr>
<tr>
<td>Wind</td>
<td>wind direction, intensity, wind turbine capacity factor</td>
</tr>
<tr>
<td>Sun</td>
<td>direct normal radiation, global horizontal irradiance, duration of sun light</td>
</tr>
<tr>
<td>Other primary indicators</td>
<td>relative humidity, precipitation, snowfall, runoff, evaporation, cloud coverage, pressure</td>
</tr>
</tbody>
</table>
Data available at grid, national and sub-national level

- **National**: 240 countries and territories
- **Grid**: 0.25° resolution
- **Sub-national**: 244 sub-national entities in 7 key countries
Two methodologies for computing national/sub-national indicators

Surface-weighted average
Indicators evenly distributed across area (e.g. country sun irradiation potential)

Population-weighted average
Indicators sensitive to population geographical distribution (e.g. cooling requirements)

Maps show 2020 mean temperature
Time granularity

- Data are available at different time granularity:
  - Yearly
  - Monthly
  - Daily

- Time series span from 2000 to latest available month

- The database also includes monthly climatologies and anomalies

- A climatology is the mean of a monthly indicator over the period 2000-2019

- Anomalies are the difference between monthly value and corresponding monthly climatology
Users Guide

- Users guide detailing:
  - How to access the data
  - Coverage and definitions
  - Sources
  - Methodology

Please address any question to Emissions@iea.org

iea.org/articles/weather-for-energy-tracker
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