

Enwex® methodology description (as of 15.12.2023)

Enwex Energy Weather Indices are created for derivative trading meeting the optimum between simplicity and accuracy along the following registered (EUIPO reg. Nr. 018892447) method:

1.) Index calculation and updates

- Index representing market regions or countrywide means.
- Largest national political units e.g., provinces or federal states with their spatial mean determine the grid points to weight.
- These points are used for weightings of each weather parameter to trade. So, there are the same grid points with parameter specific weights in % for temperature, wind and solar per country or market.
- The spatial resolution is 0,25° Lat Lon, the temporal resolution is hourly.
- Parameters currently translated into Enwex Indices:
 - a) Temperature: by population weight per region.
 - b) Wind: by installed capacity per region along dataset of „the wind power “ (filter status „in production “, wind indices are without Offshore capacities).
 - c) Solar: by installed capacity per region along public authorities' figures.
- Total installed capacities and (if possible) regional installed capacities are considered from end of each calendar year. So, Index weightings for renewables receive a yearly versioning of updates.
Versions will be calculated on the back of year 's end published installed capacities (e.g., 31.12.2023) and published at 1.7. each year as new version (e.g., v24 with installed capacities from 31.12.2023).
There will also be an updated backward calculation per version of EC operational day ahead model data since 1. Jan 2013 and of Era5 reanalysis since 1. Jan 1991 at 1.July each year and for all countries with Enwex availability.
- Available countrywide means and their weighting are attached in appendix 1.

2.) Weather model specifications

- Weather model of choice is the operational model of European center for medium range forecast (ECMWF) in its 0,25degree spatial resolution and the 00z update.
- Model parameters from ECMWF are for:
 - a) Temperature: 2m temperature
 - b) Wind: windspeed in m/s out of 100m level of u-wind and v-wind
 - c) Solar: Incoming shortwave radiation at surface
- Timesteps: Hourly resolution for the forecast period H+24 to H+48.
- Publication: Day ahead index data is daily published at 10:00 CET at enwex.com .
- Fallback: In case of ECMWF model delay, fallback solution for index calculation is identical method and parameters but using ECMWF operational with basis of 12z from previous day and its forecast timesteps H+36 to H+60.

3.) Index value formula per parameter and hourly timesteps

a) Temperature:

Enwex temperature in € = 2m temperature in ° Celsius

b) Solar:

Enwex solar in € = Utilization of installed wind capacity
= technology coefficient * (factor * shortwave radiation / 1000)

with:

technology coefficient = 1,00 (neutralizing general biases e.g., due to potential future technology improvement or aging of modules)

factor = varying per country (e.g., Germany 0,71)

shortwave radiation = ECMWF operational model output for incoming radiation at surface

c) Wind:

Enwex wind in € = Utilization of installed capacity
= technology coefficient * ((maximum utilization + addition factor) /
(1,0 + exp (start wind speed – slope * (windspeed – X-axis shift) – constant)) –
addition factor)

with:

technology coefficient = 1,00 (neutralizing general biases e.g., due to potential future technology improvement or turbine heights)

Maximum utilization = Max average power output per installed capacity, usually below 1,00 due to e.g., outages, revisions

Addition factor = needed, otherwise power generation starts at 0,0 m/s, being subtracted at end of formula again

Start wind speed = average turbine start speed

Slope = Steepness of exponential function

Windspeed = ECMWF operational model output for windspeed in 100m height

X-axis shift = Shift of formula to avoid negative values with low wind

Constant = explained in <https://www.cambridge.org/core/journals/journal-of-fluid-mechanics/article/abs/equilibrium-range-in-the-spectrum-of-windgenerated-waves/78E31A52389CCD4A92FA951CECA0BC37>

Appendix 1:

- Available countrywide mean (Dec 2023): Germany
- Countries in preparation (Enwex starting within January 2024):
UK, Netherlands, Belgium, France, Spain, Italy

Germany

Renewable installed capacity and yearly production figures:

https://www.bundesnetzagentur.de/DE/Fachthemen/Datenportal/2_Energie/ErneuerbareEnergien/start.html

Enwex solar = $1,00 * (0,71 * \text{shortwave radiation} / 1000)$

Enwex wind = $1,00 * ((0.92 + 0.05) / (1.0 + \exp(3.2 - 0.529 * (\text{windspeed} - 2.5) - 0.0074))) - 0.05$

Region represented	Latitude	Longitude	weightings in % (version 2024)		
			Temperature	Wind	Solar
Baden-Wuerttemberg	48,50	9,00	13,4	3,1	12,6
Bayern	49,00	11,50	15,9	4,6	27,1
Brandenburg-Berlin	52,50	13,50	7,5	14	8,3
Hessen	50,50	9,00	7,6	4,1	4,5
Mecklenburg-Vorpommern	53,75	12,50	1,9	6,4	5,1
Niedersachsen & Bremen	52,50	9,00	10,5	21,1	8,6
Nordrhein-Westfalen	51,50	7,50	21,5	11,4	11,1
RheinlandPfalz & Saarland	50,00	7,25	6,1	7,7	5,7
Sachsen	51,00	13,50	4,8	2,3	4,3
Sachsen-Anhalt	52,00	11,75	2,6	9,5	5,8
Schleswig-Holstein & Hamburg	54,25	9,75	5,7	12,7	3,5
Thuringen	51,00	11,00	2,5	3,1	3,4