Variable Resources Data Files

This document describes the different types of data files that PowerGenome uses to construct clusters of variable generation resources like wind and solar.

Overview

PowerGenome aggregates individual wind and solar sites based on characteristics like their interconnection cost, capacity factor, or generation profile. Each individual site – referenced in the data as a Candidate Project Area (CPA) – is tied to a specific location with its own generation profile and has a maximum capacity of the resource that can be built on it. The shapefiles with information on each CPA can be downloaded from Zenodo.

There are three types of data included here:

1. Metadata for each CPA, including the interconnection cost and the model region that the CPA will deliver power to.
2. Generation profiles for individual new-build CPAs.
3. Resource group files for existing wind and solar.

The CPA metadata and generation profiles are linked as part of a PowerGenome resource group. There is one resource group each for solar and onshore wind, but offshore wind is split into 4 different resource groups:

- Floating turbines, preferred sites
- Floating turbines, non-preferred sites
- Fixed turbines, preferred sites
- Fixed turbines, non-preferred sites

Each resource group has a JSON file that uniquely identifies the technology and sub-types. It also gives the name of the associated metadata and generation profile files that PowerGenome will use when constructing inputs for GenX. The files with generation profiles are large (~5GB) but do not depend on model region definitions so can be saved once and reused across systems.

Users can set the parameter RESOURCE_GROUPS in either their .env file or a settings file with the location of the JSON and metadata files. The parameter RESOURCE_GROUP_PROFILES should be set in the .env file with the location of the generation profiles.

CPA metadata (LCOE files)

Metadata for each CPA is saved in a CSV file. In addition to data from the original shapefiles, these files have information on the calculated interconnection cost, the metro area where the

CPA delivers power, and the model region that the metro area is located in. The capacity (MW) that can be built at each CPA has been adjusted downwards from the original value based on population density to account for the difficulty of building wind and solar in areas with higher population density. Every column in the metadata file can be used as a feature in PowerGenome for aggregating individual CPAs into groups of resources.

The process of assigning CPAs to metro areas depends on how model regions are defined, so metadata files are unique to each regional system setup.

Generation profiles

Generation profiles for each CPA are based on data from Vibrant Clean Energy (VCE) and represent a 2012 weather year. The folder “generation_profiles” has profiles for onshore wind, offshore wind, and solar.

Onshore wind

Capacity factors for wind in the midwest were quite poor in 2012. We have adjusted our profiles to match a 100m hub height average capacity factor from 2007-2013 using data from NREL’s ReV. The profile for each site is calculated using the following process:

1. Take the inverse distance weighted interpolation of the 4 VCE profiles (100m hub height) nearest to the CPA.
2. Calculate the average capacity factor of the site.
3. Multiply hourly capacity factors by the ratio of the nearest ReV multi-year capacity factor over the site capacity factor.
4. Clip any hours where the capacity factor is greater than 1.
5. Repeat steps 2-4 until the site average capacity factor is within 0.5% of the multi-year average.

Offshore wind

The generation profiles for offshore wind are calculated using the same method as onshore wind. The only difference is that ReV average capacity factors represent a 140m hub height.

Solar

Solar profiles represent a single-axis tracking system with an inverter loading ratio of 1.28[1] and average lifetime loss of 12% due to array shielding (4.5%), system degradation (1.5%), availability (1%), and an additional 0.5% degradation over 10 years. Rather than taking the spatial interpolation of profiles from VCE, each CPA is mapped to the nearest adjusted solar profile.

[1] Based on NREL ATB 2022