

Methodology for China East Grid Simulated Hourly Electricity Flow Profiles

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Overview

We developed a toolkit for constructing hourly electricity flow profiles between Chinese provinces using TOU schedules, monthly export totals, load shapes, and network constraints.

This toolkit computes an hourly time series of interprovincial electricity transmission based on:

- the receiving province's hourly simulated load profile,
- peak/valley TOU (time-of-use) schedules,
- monthly provincial export totals,
- transmission line capacity constraints,
- special East-China routing rules.

Use Cases

You may use this tool to:

- redistribute annual or monthly interprovincial energy transfers into hourly profiles,
- simulate TOU-driven transmission patterns,
- enforce line congestion limits under realistic hourly loading,
- test effects of new transmission buildout,
- replicate or extend East China Power Grid scheduling logic.

Data Format

The dataset is provided in **CSV format**.

Each row represents **the simulated hourly electricity transmission flow between two provinces**.

Field	Description
from_province	Exporting province of the electricity flow
to_province	Importing province of the electricity flow

Field	Description
flow_mwh	Simulated hourly electricity transmission flow in megawatt-hours (MWh)
year	Simulation year
month	Simulation month
day	Simulation day
hour	Simulation hour

Workflow for Generating Hourly Flow Profiles

This pipeline generates hourly inter-provincial electricity transmission profiles based on historical flow data, time-of-use (TOU) rules, and network capacity constraints. For each sender–receiver province pair and target period, monthly transmission is disaggregated into hourly flows while respecting operational constraints and grid limitations.

The workflow consists of six stages: (1) load receiving province hourly profiles, (2) assign TOU classifications, (3) apply optional new transmission capacity, (4) compute monthly transmission amounts, (5) distribute monthly flows across hours, and (6) enforce network capacity constraints.

Step 1: Load receiving province hourly profile

Hourly electricity usage profiles for the receiving province are loaded for the specified time range and filtered to the selected months. This provides the baseline temporal demand structure used in downstream allocation.

Step 2: Assign time-of-use (TOU) classification

Each hourly record is assigned a TOU category based on a predefined schedule, classifying hours into Valley (V), Normal (N), Peak (P), and Top-Peak (T) periods.

Transmission allocation primarily focuses on TOU-active hours (N, P, T), while Valley hours are typically excluded from transmission activity through masking.

Step 3: Incorporate new transmission capacity (optional)

If additional transmission capacity is introduced, the annual transferable energy is adjusted accordingly. New capacity additions are converted into energy terms using a fixed capacity factor assumption (60%), and integrated into the existing transmission limits.

Step 4: Compute monthly transmission amounts

Monthly transmission quantities are constructed based on historical flow data and sender–receiver relationships.

For most province pairs, monthly transmission values are directly taken from sender-side reported exports.

For special cases (e.g., Shanghai as a multi-destination exporter), monthly exports are adjusted and split between multiple receiving provinces using a rule-based allocation derived from historical patterns. Missing or incomplete months (e.g., January and December) are corrected using historical inference and consistency adjustments.

The result is a complete set of monthly transmission values for each sender–receiver pair.

Step 5: Distribute monthly transmission across hours

Monthly transmission is disaggregated into hourly flows using TOU-aware allocation rules.

When a predefined routing schedule exists, transmission is restricted to specific hours where sending conditions and receiving demand conditions align (e.g., Valley-to-Peak transfer windows). The monthly total is distributed exclusively across these eligible hours.

When no routing constraint is defined, transmission is distributed across all TOU-active hours (Normal, Peak, and Top-Peak). Allocation weights favor higher-demand hours, while Valley hours receive no or minimal allocation.

Step 6: Enforce network capacity constraints

Hourly flows are constrained by transmission line capacity derived from network topology data. For each sender–receiver path, hourly flows are checked against maximum allowable limits.

When violations occur, excess energy is first clipped and then redistributed within the same day to hours with remaining capacity, proportionally to available headroom. This iterative adjustment continues until all hourly flows satisfy network constraints.