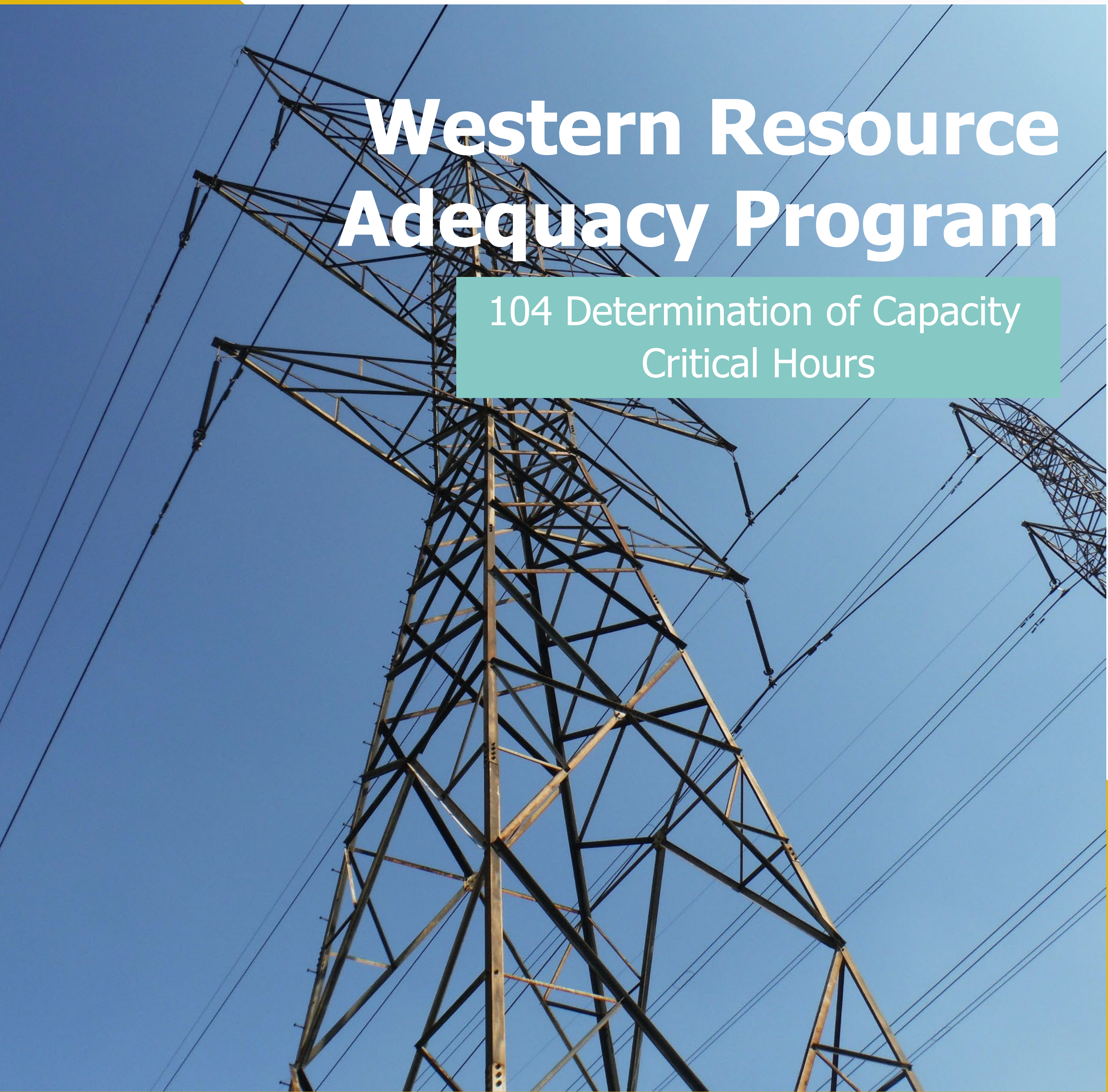
**DRAFT**

# Western Resource Adequacy Program

## 104 Determination of Capacity Critical Hours



100 – Forward Showing

## Revision History

| Manual Number | Version | Description | Revised By | Date |
|---|---|---|---|---|
| **104** | 0.1 | RAPC Glance Version | Maya McNichol | 1/17/2024 |
| **104** | 0.2 | Public Comment Version | Maya McNichol | 1/19/2024 |
| **104** | 0.3 | RAPC & PRC Discussion | Maya McNichol | 2/9/2024 |
| **104** | 0.4 | RAPC Endorsement | Maya McNichol | 2/20/2024 |
| **104** | 0.5 | Board Approval | Maya McNichol | 2/29/2024 |

# Table of Contents

# 104 Determination of Capacity Critical Hours

## 1. Introduction

The Capacity Critical Hours Business Practice Manual (BPM 104) describes the methodology for identifying the Capacity Critical Hours (CCH) for a given period (the "Capacity Critical Hours Methodology"). CCH are those hours when the Net Regional Capacity Need for the WRAP Region is expected to be above the 95$^{th}$ percentile, based on historic and synthesized data for the WRAP Region's gross load, variable energy resource performance, and interchange. CCH are used to help determine the capability of certain resource types during periods of highest system capacity need, in order to calculate the Qualifying Capacity Contribution (QCC) of such resources. CCH determination results in a single set of hours for the WRAP Region for the relevant period. Resources may vary in terms of whether they operate during the determined CCH, but all resources that use CCH in the QCC determination are assessed against the same common set of CCH for the region for the same relevant period.

### 1.1. Intended Audience

BPM 104 is intended for WRAP Participants and other interested individuals or entities. BPM 104 is particularly useful for those individuals that are responsible for determining CCH used in the development of QCC for resources.

### 1.2. What You Will Find in This Manual

BPM 104 describes the methodology for determining CCH.

### 1.3. Purpose

To provide an overview of CCH and the processes for determining the CCH for the WRAP Region.

### 1.4. Definitions

All capitalized terms that are not otherwise defined in BPM 104 have their meaning set forth in the Tariff. Any capitalized terms not found in the Tariff that are specific to BPM 104 are defined here.

**Capacity Critical Hours Methodology:** The methodology used to determine the hours where the net regional capacity need is above the 95th percentile (highest capacity need hours).

**Historical Load Data:** As defined in *BPM 101 Advance Assessment.*

**Net Regional Capacity Need:** The WRAP Region's net need for capacity during a given hour, as calculated in accordance with the procedure described in BPM 104.

**Regional Interchange**: The net aggregate interchange between all Balancing Authority Areas in the WRAP Region and all Balancing Authority Areas outside the WRAP Region over a given ten-Year period, as calculated in accordance with the procedure described in BPM 104.

**Resource-Specific Capacity Agreement:** as defined in *BPM 106 Qualifying Contracts*.

## 2. Background

CCH are those hours where the Net Regional Capacity Need of the WRAP Region is above the 95th percentile. CCH are used in the methodology to determine the QCC of storage hydro, thermal, run-of-river (RoR), non-dispatchable resources, and contracts (based on individual resource accreditation). CCH may differ from the peak load hours of the region, because CCH determination considers not only load of the WRAP Region, but also the performance of Variable Energy Resources (VERs), as well as the interchange across the footprint to arrive at a Net Regional Capacity Need:

| Definition: Net Regional Capacity Need |
|---|
| $\boldsymbol{Net\ Regional\ Capacity\ Need\ = Load - Wind - Solar - RoR + Regional\ Interchange}$ |
| where<br>*Load* is the aggregate Historical Load Data of all Participants in the WRAP Region in MW from the most recent ten-Year period,<br>*Wind* is the output of proposed and installed wind resources in MW for the most recent ten-Year period, including synthesized output for such period for resources that have fewer than ten years of output data;<br>*Solar* is the output of proposed and installed solar resources in MW for the most recent ten-Year period, including synthesized output for such period for resources that have fewer than ten years of output data;<br>*Run-of-river* (RoR) is the output of proposed and installed RoR resource in MW for the most recent ten-Year period, including synthesized output for such period for resources that have fewer than ten years of output data;<br>and<br>*Regional Interchange* is the modified interchange in MW for the most recent ten-Year period as calculated in accordance with the procedure described in Section 3.5. |

Peak load hours, standing alone, are not the best indication of regional capacity need because hours of significant changes in resource performance or Regional Interchange can significantly affect the region's need for capacity. For example, while there may be instances of high loads during the month of June, there is also usually an abundance of RoR generation. Since the output from RoR resources must be used at the time of such output, higher RoR output could result in periods of excess capacity even while loads are generally high. Higher wind or solar output can have similar effects, particularly as wind and solar resources increase their share of the resource portfolio in the WRAP Region.

The following FS Program methodologies rely on the CCH methodology (see *BPM 105 Qualifying Resources*):

- Storage Hydro QCC methodology determination
- Thermal Resource QCC determination
- Run of River QCC determination
- QCC determination of contracts (see the resource accreditation of each contract)
- QCC determination of VERs
- QCC determination of non-dispatchable, must-take resources

# 3. Derivation of the Net Regional Capacity Need components

## 3.1. Load (Demand)

Each Participant is responsible for providing ten Years of Historical Load Data for their respective system in accordance with *BPM 101 Advance Assessment*. This data from each Participant will be compiled by the Program Operator to form the WRAP coincident peak load shape for the ten-Year period.

## 3.2. Wind Resource Output

Each Participant is responsible for providing the hourly generation profiles for the last ten Years from wind resources per *BPM 101 Advance Assessment* for their wind Qualified Resources and for wind resources in their Resource-Specific Capacity Agreements. Participants will also provide their prospective wind resources that are expected to be in service for the Year that is studied two Years ahead in the applicable Advance Assessment (see *BPM 101 Advance Assessment Timeline* for more information). The data from all Participant wind resources will be compiled by the Program Operator into an aggregate WRAP Region wind resource output for the ten-Year period.

For wind resources that have less than ten Years of output data, the Program Operator will complete the ten-Year period by using the synthesized wind output data that was developed for the same VER Zone in which the resource is located in the Loss of Load Expectation (LOLE) study (see *BPM 102 Forward Showing Reliability Metrics*) for the Binding Season at issue.

### 3.3. Solar Resource Output

Each Participant is responsible for providing the hourly generation profiles for the last ten Years from solar resources per *BPM 101 Advance Assessment* for their solar Qualified Resources and for solar resources in their Resource-Specific Capacity Agreements. Participants will also provide their prospective solar resources that are expected to be in service for the Year that is studied two years ahead in the applicable Advance Assessment. The data from all Participant solar resources will be compiled by the Program Operator into an aggregate WRAP Region solar resource output for the ten-Year period.

For solar resources that have less than ten Years of output data, the Program Operator will complete the ten-Year period by using the synthesized solar output data that was developed for the same VER Zone in which the resource is located in the LOLE study (see *BPM 102 Forward Showing Reliability Metrics*) for the Binding Season at issue.

### 3.4. Run of River Output

Each Participant is responsible for providing the hourly generation profiles for the last ten Years from RoR resources per *BPM 101 Advance Assessment* for their RoR Qualified Resources and for RoR resources in their Resource-Specific Capacity Agreements. Participants will also provide their prospective RoR resources that are expected to be in service for the Year that is studied two years ahead in the applicable Advance Assessment. The data from all Participant RoR resources will be compiled by the Program Operator into an aggregate WRAP Region RoR resource output for the ten-Year period.

For RoR resources that have less than ten Years of output data, the Program Operator will complete the ten-Year period by using the synthesized RoR output data that was developed for the same Subregion in which the resource is located in the LOLE study for the Binding Season at issue.

### 3.5. Regional Interchange

For the final component of Net Regional Capacity Need, i.e., Regional Interchange, the Program Operator aggregates and nets interchange data between Balancing Authority Areas in the WRAP Region and Balancing Authority Areas outside the WRAP Region. In this term of the formula, a positive value indicates a net export position, and a negative value indicates a net import position. For the ten-Year analysis required for CCH determination, the Program Operator uses the previous ten Years of regional interchange data from publicly available U.S. Energy Information Administration data. If the historical record reveals a consequential change in the WRAP Region's interchange with other Balancing Authority Areas (potentially driven by increased demand, emerging markets, and other factors), the Program Operator will identify such a change and adjust the historical record of the Years before a consequential change, such that a ten-Year data set representative of current conditions (after the consequential change) of Regional Interchange data can be used in the analysis. Such a consequential change has been observed in 2018 and an example of adjustments is included in Appendix A.

### *3.5.1. Further Modifications to Interchange*

Further modifications to the interchange shape will be made to account for market conditions that result in high export periods where the capacity that was exported may have otherwise been able to have been used for the benefit of the WRAP Region (had the program existed at the time). For example, if exports occurred during periods of excess capacity (e.g., high RoR output) within the WRAP Region, and the energy price outside of the WRAP Region was at typical market (or below market) prices, the capacity may not have been exported if the WRAP Region were to have a need for the capacity, as future conditions anticipate.

The following categories were created to evaluate these exports:

> *Economic sales:* made possible by excess generation in the WRAP Region; the Regional Interchange calculation assumes this capacity would have been available for the WRAP Region, had it been needed.
>
> *Scarcity sales*: in times of high market prices in areas outside of the WRAP Region, it was assumed that historical exports made during those time periods would not have been available, even if required by Participants.

In order to separate exports into the above two categories, energy market conditions were analyzed, and criteria were developed to determine whether exports may be economic sales or scarcity sales. The criteria are as follows:

- The market-clearing heat rate (price of power from Locational Marginal Price for the Day-Ahead Market at the TH_SP15_GEN-APND node divided by price of natural gas from SoCal daily gas price) for California was used as a proxy for external demand:

- For conditions when the heat rate is less than 10mmBTU/MWh, exports from the WRAP Region were determined available to the WRAP Region; export interchange was reduced to zero (imports were unchanged). This low level of heat rate indicates that market prices were not reflecting scarcity events and the exports were economic.
- For conditions when the heat rate is greater than 15mmBTU/MWh, exports from the WRAP Region were considered to be scarcity sales; accordingly, these values remained in interchange and were not used as a load modifier (imports were also unchanged). This higher heat rate is reflective of traditional peaking units, which are commonly operated and exported under scarcity conditions.
- For conditions when the heat rate was greater than 10 but less than 15, exports were linearly reduced from their values at 15 to zero based on the observed heat rate relative to 10 and 15.

In addition, starting in 2013, a carbon adjustment of the actual California Carbon Allowance cost for the applicable vintage year (dollars per MTCO2e), multiplied by the prevailing California Air Resources Board unspecified emissions rate for that year is applied to California market price before determining the market clearing heat rate.

For import transactions, it was assumed that these imports would continue to be brought into the WRAP Region regardless of market conditions.

## 4. Determining the CCHs

Once the data from Section 3 is collected and aggregated by the Program Operator, the Net Regional Capacity Need is calculated for each hour in the ten-Year period. Then the 95$^{th}$ percentile of the Net Regional Capacity Need for the ten-Year period is determined and each hour with a Net Regional Capacity Need greater than that 95$^{th}$ percentile value is designated as a CCH, and each hour with a Net Regional Capacity Need less than or equal to that 95th percentile value is not designated as a CCH.

CCH will be re-determined on an annual cycle in conjunction with the Advanced Assessment, as detailed in *BPM 101 Advanced Assessment*. The CCH will be posted on the Western Power Pool website.

## Appendix A

An illustrative example for ten-Year periods that include Years prior to 2018 is included here for reference. The method for determining future regional interchange assumes that i) recent interchange shape from 2018 and after is most representative of future patterns and ii) interchange during the hour ending 19:00 (meaning 07:00pm PPT) has changed the least from the pre-2018 period, given the lack of solar resource output during that hour, such that hour ending 19:00 can serve as a benchmark for adjusting the interchange observed in ten-Year periods that include Years before 2018. Ten-Year periods that include Years before 2018 require an adjustment methodology, as illustrated in this section. For example, in 2021 the Program Operator developed Regional Interchange from interchange data for the Years 2010-2020, where 2018-2020 was the last three Years and 2010-2017 was the previous seven Years.

- Step 1 - The interchange for all hours prior to 2018 is averaged on an hourly basis. See regional interchange data below in Figure 1.

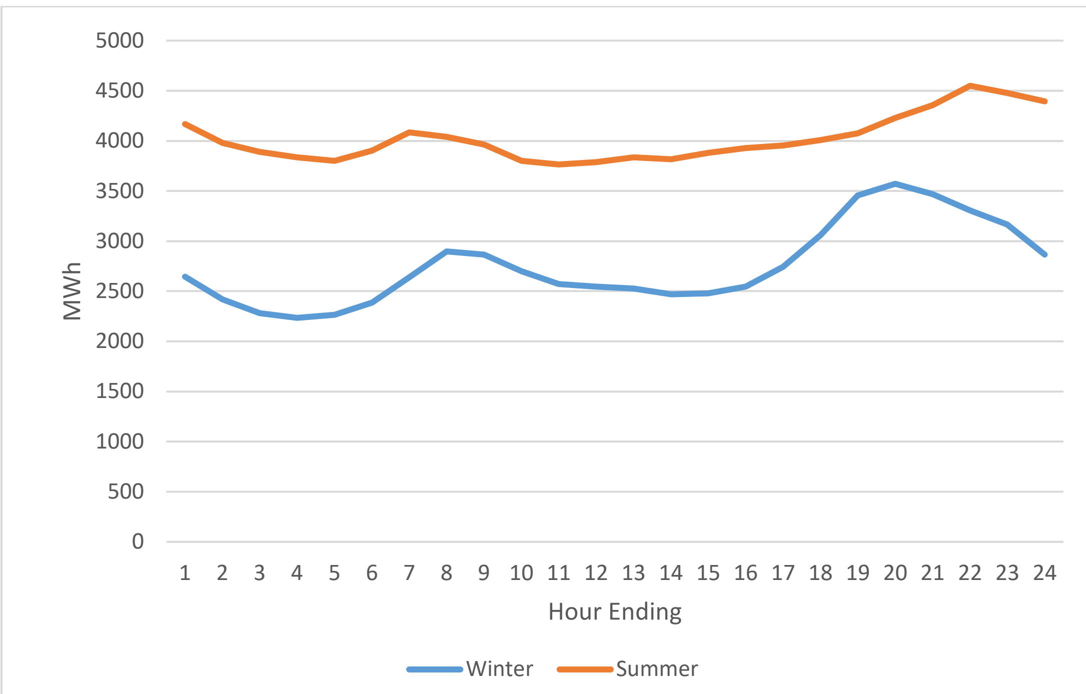



*Figure 1. Raw regional interchange 2010-2017 – a relatively flat/consistent interchange profile for both seasons.*

- Step 2 - The interchange for all hours including and after 2018 is averaged on an hourly basis. See regional interchange data below in Figure 2.

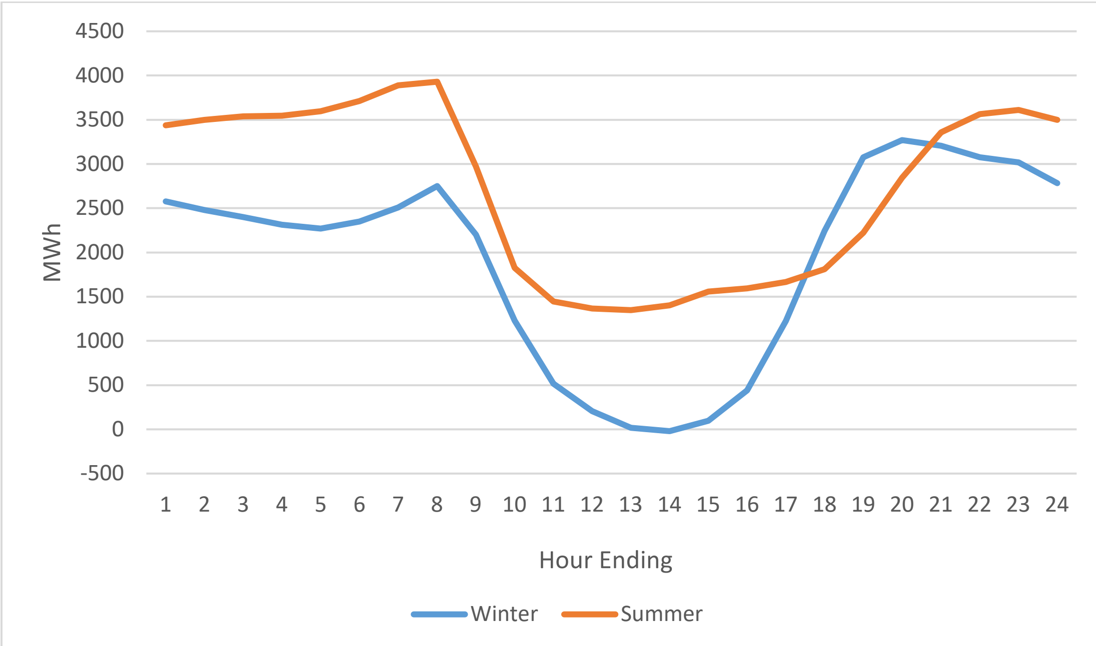



*Figure 2. Raw regional Interchange 2018-2020 - declining daytime exports and peaks in morning and evenings. Roughly follows California solar production.*

- Step 3 - The average interchange in hour ending 19 of 2018 and after is compared to all other hours of the hourly average interchange shape that was created using the hours before 2018. The difference of the averages is applied to the hourly average interchange for all ten Years.

  In the example here, hour ending 19 compared to each individual hour (see arrows on Figure 3 of these interchange values from the 2018-2020) was then applied to the hourly interchange of all Years in the ten-Year period (2010-2020).

  This results in a new hourly interchange shape for the entire ten-Year period.

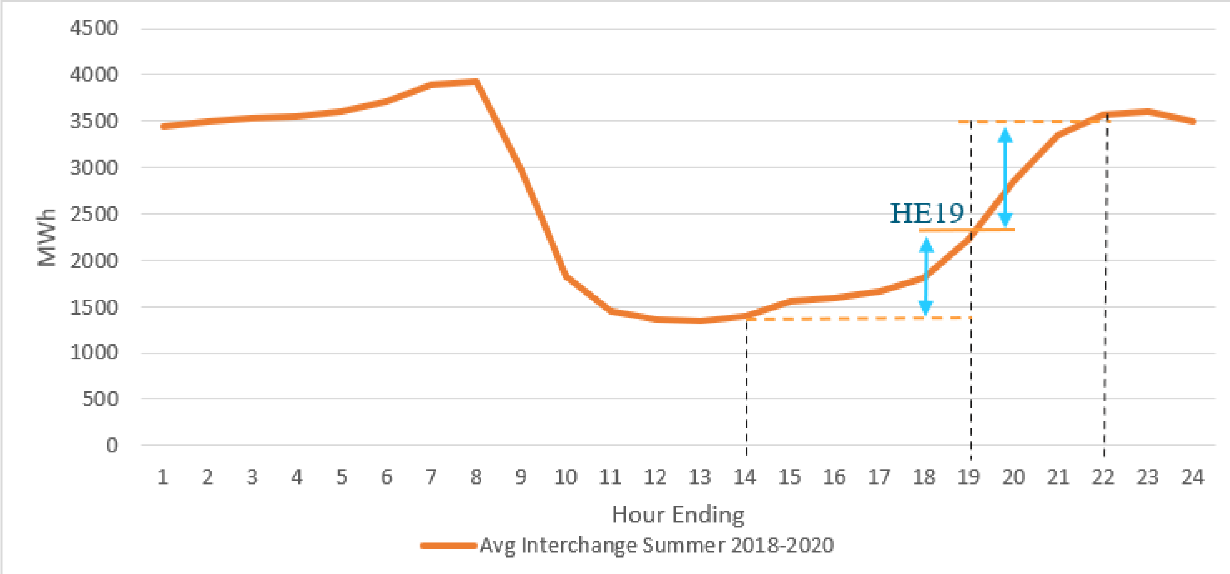



*Figure 3. 2018-2020 hourly average loads were analyzed to determine appropriate offsets to apply to 2010-2017 load shapes.*

Continuing the example, the results of the further modifications of the load shape described in this subsection resulted in the load shapes in Figure 4.

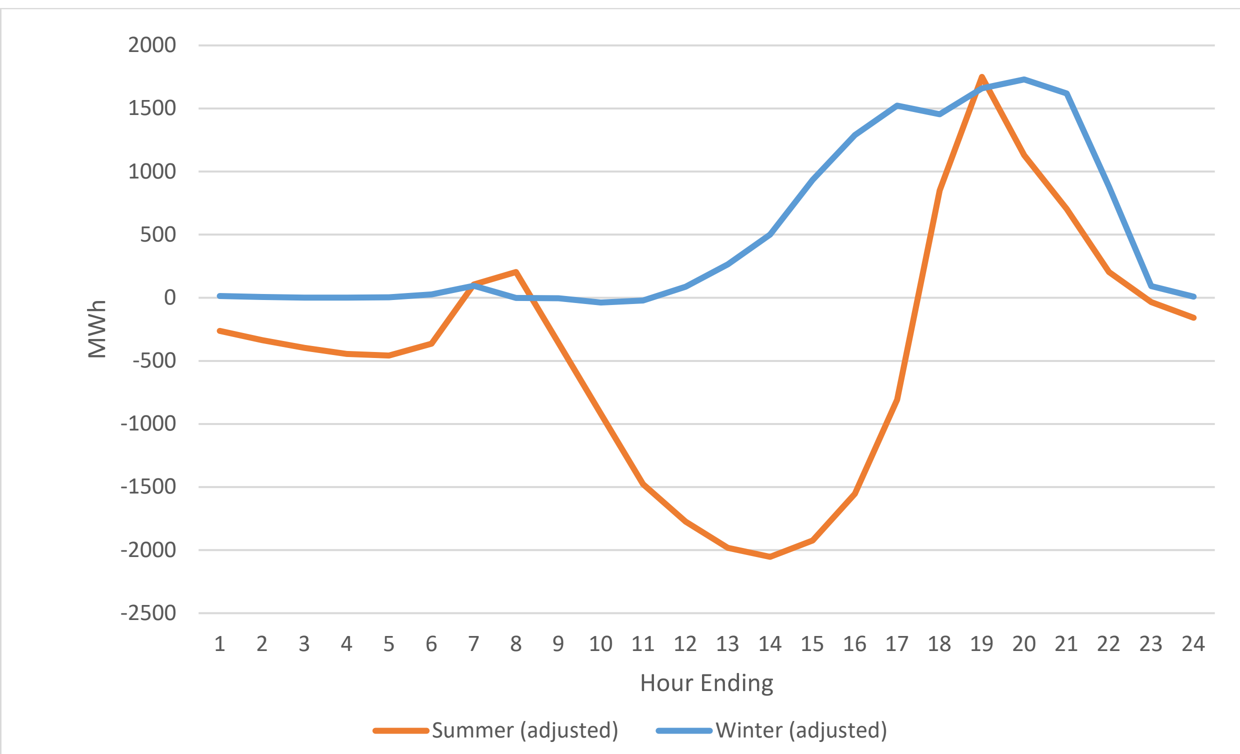



*Figure 4. 2010-2020 interchange adjusted by CA heat rate analysis.*