Ampere Labs

WEM Quarterly Market Review

Q1 2024

April 2024 (updated July 2024)

Introduction

What is this report and where did all the data come from?

- This report presents an independent review of Wholesale Electricity Market (WEM) outcomes in Q1 2024 from a neutral perspective (*).
  - Note that this report was first published in April 2024, but revised in July 2024 to incorporate the complete settlement data published by AEMO (e.g. NCESS and FCESS uplift payments).
- The material in this report is intended to complement the data and insights published by AEMO and other WEM stakeholders.
- Please note that there is no proprietary data used in this report and all the information is derived from the following publicly available data sources:

Data Source	Link
AEMO WA market data	http://data.wa.aemo.com.au/
WEM market fees	https://aemo.com.au/-/media/files/about_aemo/energy_market_budget_and_fees/2023/wa-budget-and-fees-2023-24.pdf?la=en
LGC spot prices (Demand Manager)	https://www.demandmanager.com.au/certificate-prices/
Perth daily temperatures (Bureau of Meteorology)	http://www.bom.gov.au/climate/dwo/IDCJDW6111.latest.shtml

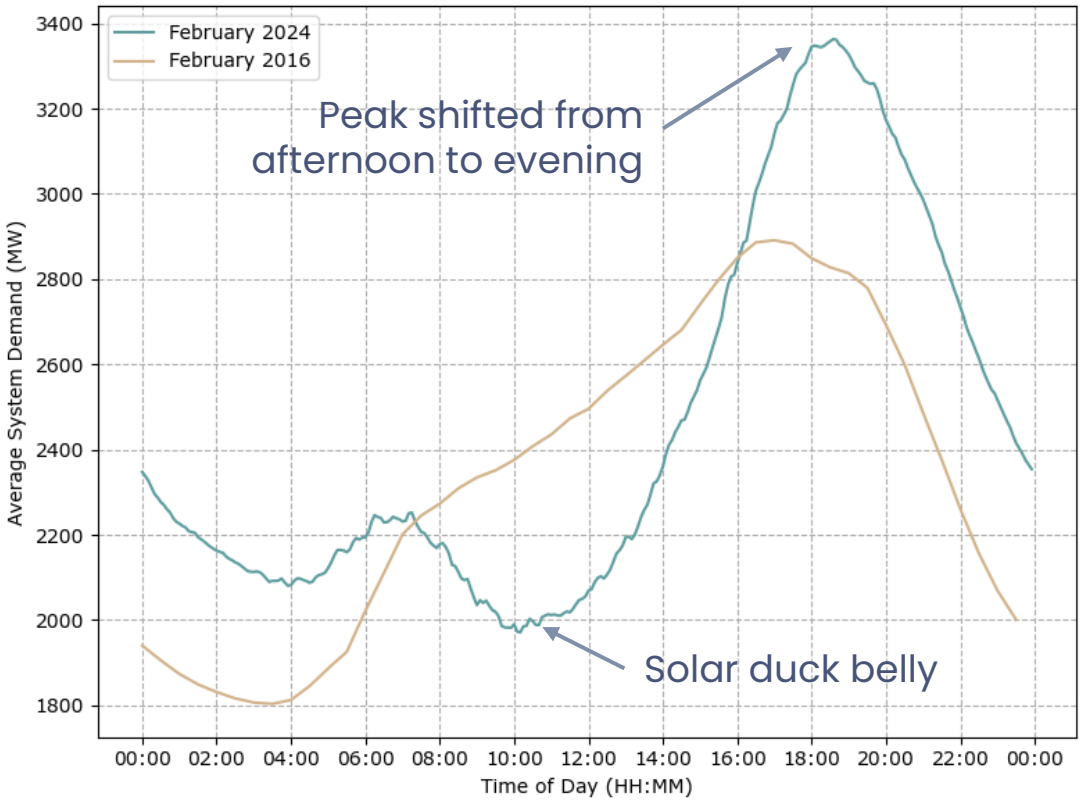
(*) Ampere Labs is an independent consultancy and is not affiliated with any WEM participants.

High-level observations from Q1 2024

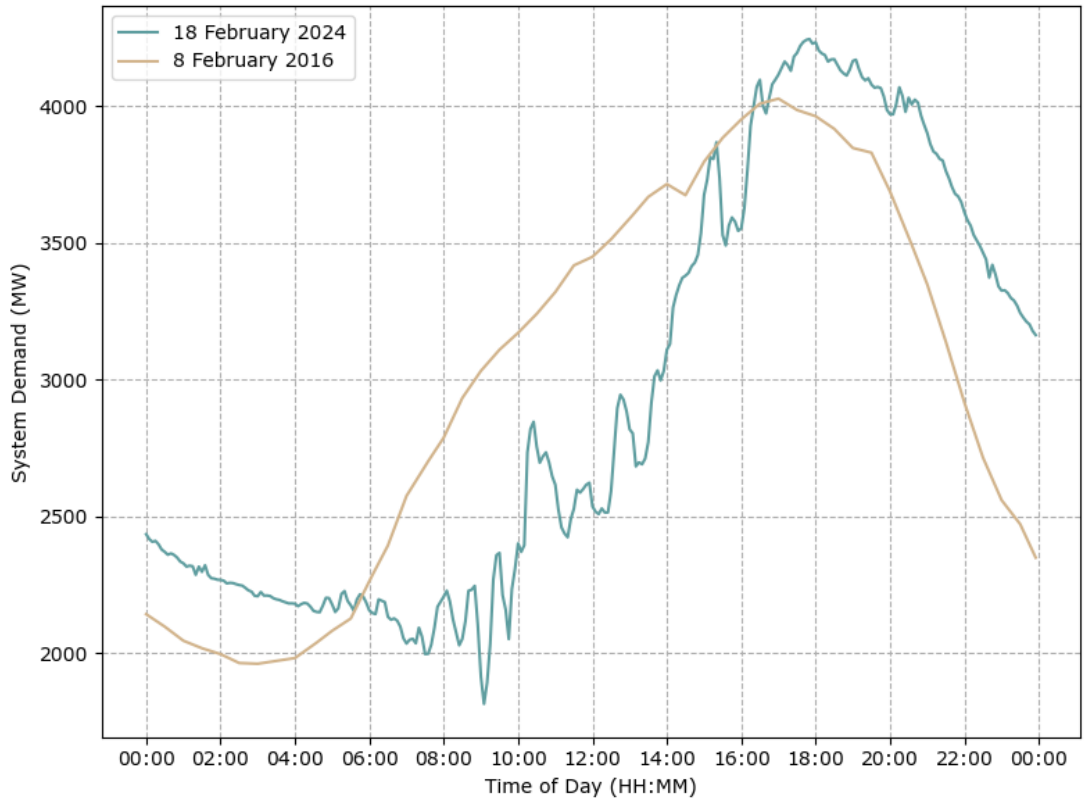
(1) The shape of the WEM demand curve has irrevocably changed

Despite a hot summer where peak demand records tumbled, the effects of rooftop solar on the shape of the system demand curve is unmistakeable, even on the hottest days.

Average Time-of-Day Demand (Feb 2016 vs Feb 2024)



Peak Demand Days (Feb 2016 vs Feb 2024)



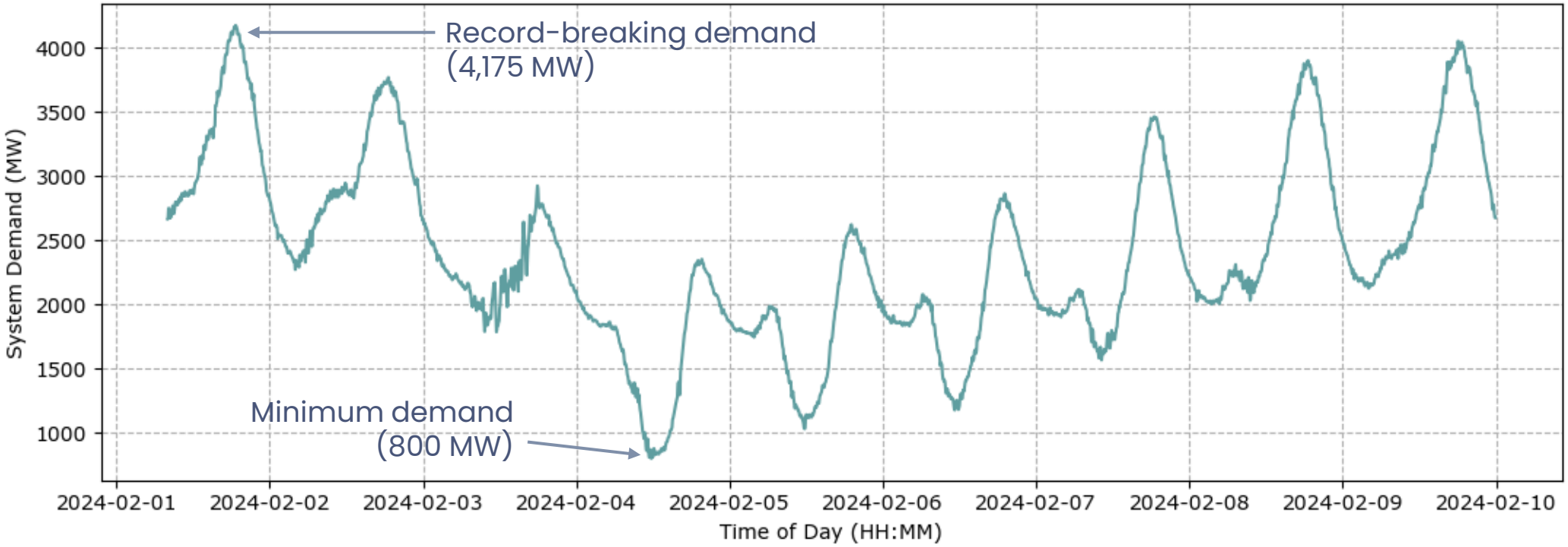
High-level observations from Q1 2024

(2) The system is becoming more dynamic than ever

The WEM can now go through huge changes in system demand in just a few days. For example, a record peak demand of 4,175 MW was reached on 1 February 2024. But just 3 days later, the minimum demand had dropped to 800 MW.

- For context, the lowest minimum demand recorded in 2020 was 978 MW.

System Demand from 1 February 2024 to 10 February 2024

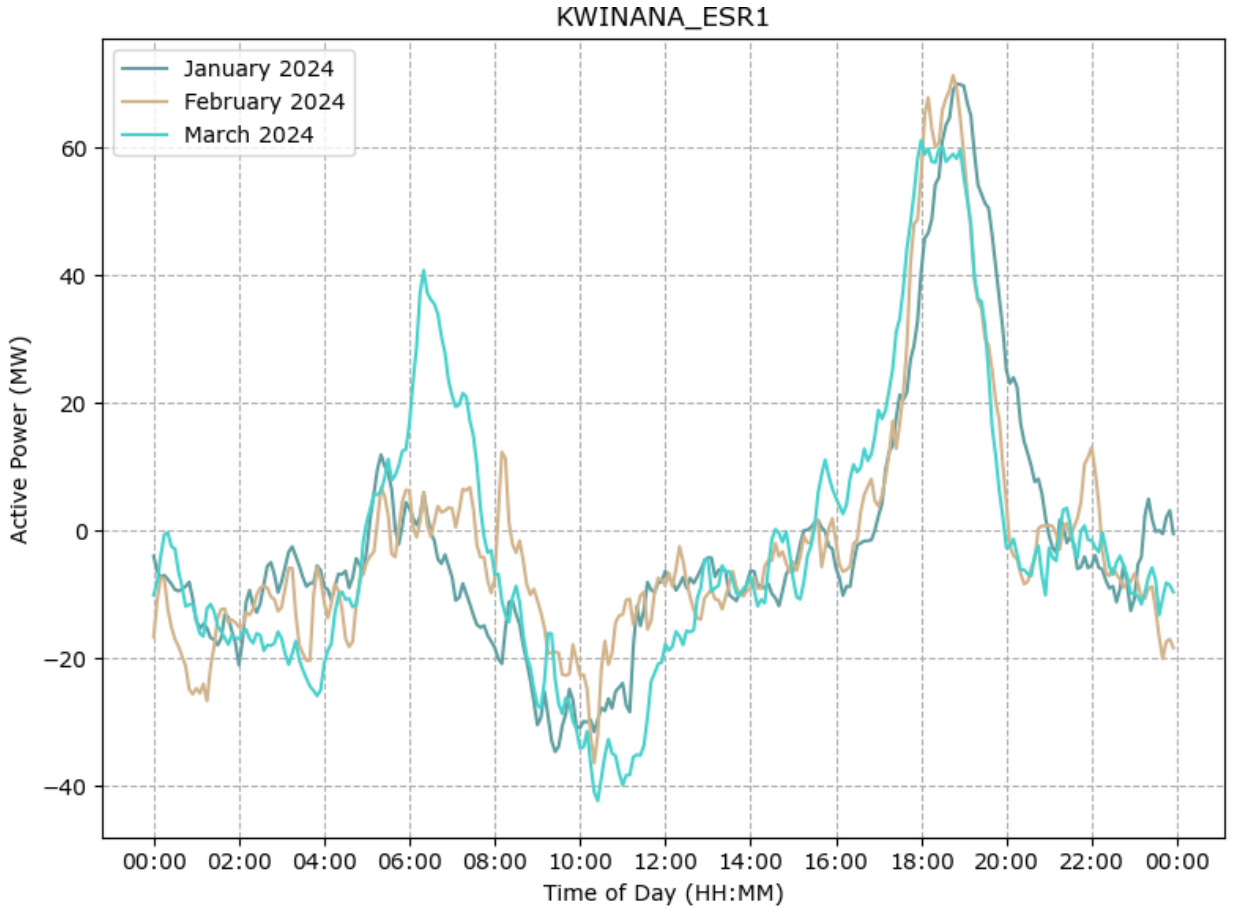


High-level observations from Q1 2024

(3) Kwinana BESS is doing what you'd expect it to do

- **Kwinana BESS 1** was commissioned in Q4 2023 and is currently the only operational large-scale Battery Energy Storage System (BESS).
- In Q1 2024, Kwinana BESS 1 has operated (on average) in the way you'd expect it to, i.e.
  - Charge up during the day and overnight
  - Discharge during the evening peak (and occasionally into the morning peak)

Average Time-of-Day Kwinana BESS Output



Negative values = BESS charging, Positive values = BESS discharging

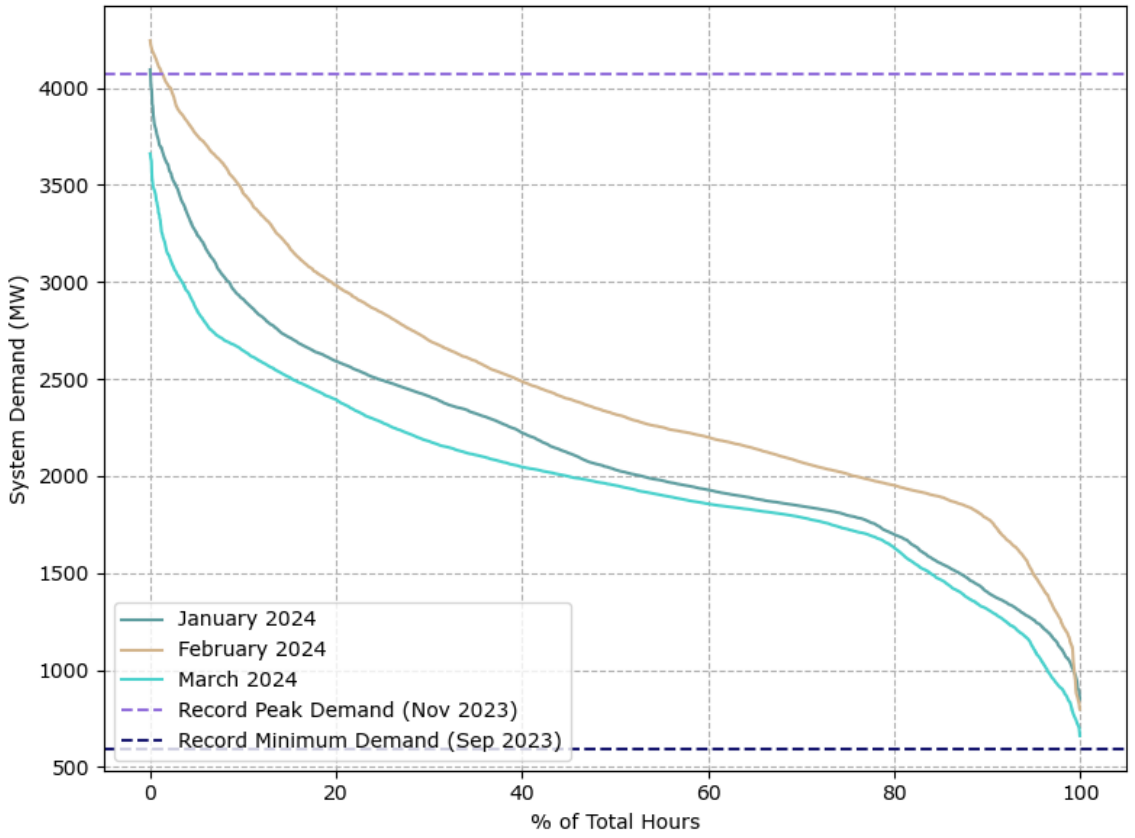
.01
System

Aggregate system level outcomes

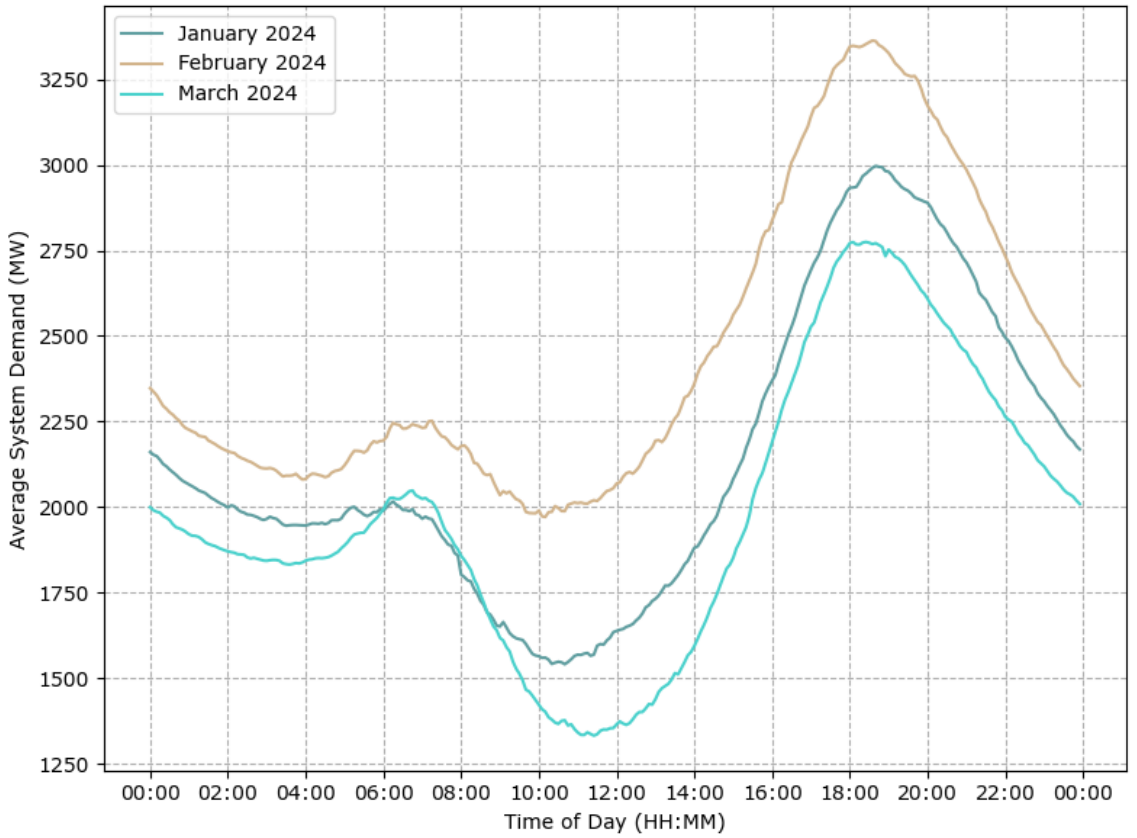
System Demand

System demand duration curves and time-of-day averages

Demand Duration Curves



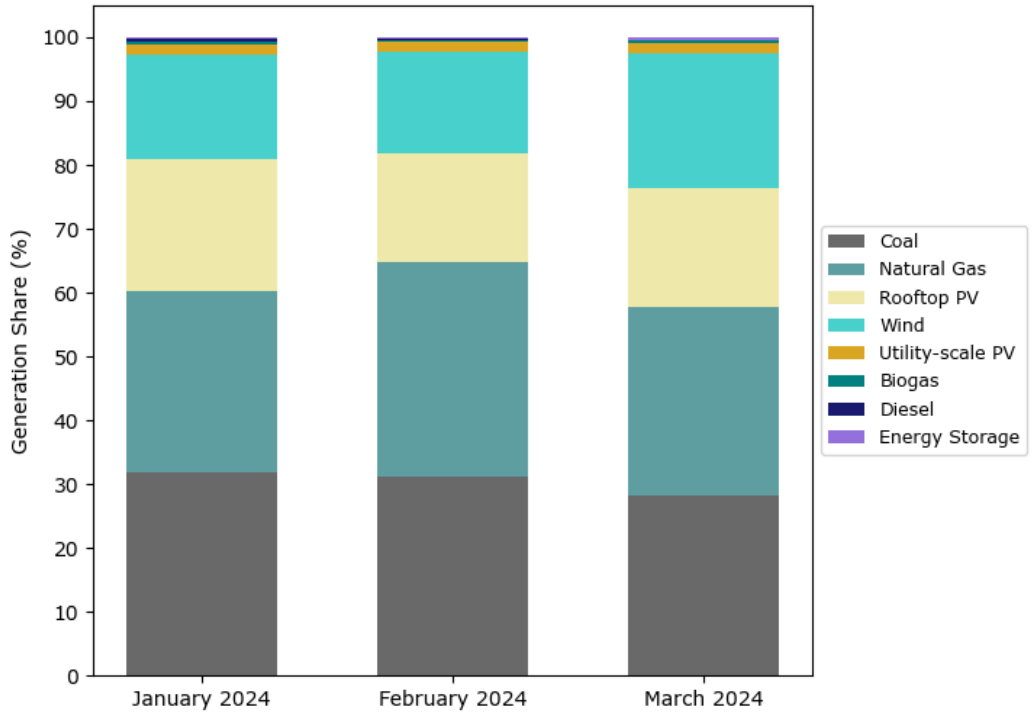
Average Time-of-Day Demand



Generation Mix

Categorised by fuel / technology type

Q1 2024 Generation Mix



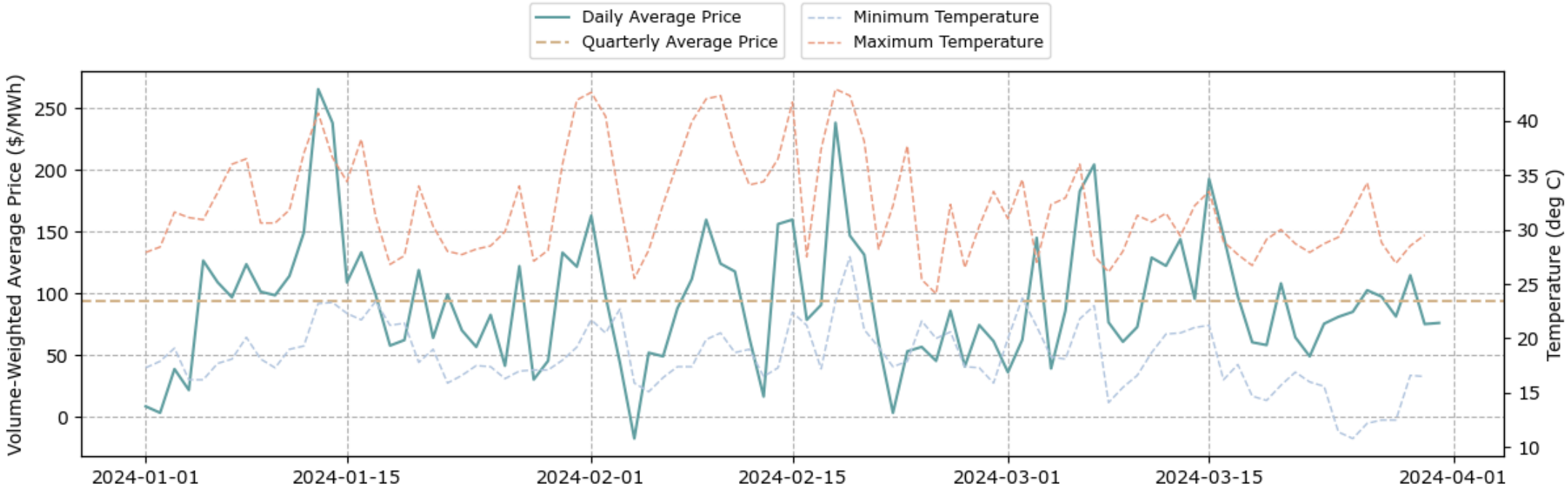
Generation Mix Breakdown

Category	Jan 2024	Feb 2024	Mar 2024
Coal	642 GWh (31.8%)	642 GWh (31.1%)	515 GWh (28.2 %)
Natural Gas	574 GWh (28.5%)	697 GWh (33.7%)	538 GWh (29.5 %)
Rooftop PV	417 GWh (20.7%)	351 GWh (17.0%)	341 GWh (18.7 %)
Wind	328 GWh (16.3%)	329 GWh (15.9%)	384 GWh (21.0 %)
Utility PV	34 GWh (1.7%)	33 GWh (1.6%)	30 GWh (1.6 %)
Biogas	6 GWh (0.3%)	6 GWh (0.3%)	6 GWh (0.3 %)
Diesel	8 GWh (0.4%)	2 GWh (0.1%)	1 GWh (0.1 %)
Storage (*)	6 GWh (0.3%)	7 GWh (0.3%)	8 GWh (0.5 %)
TOTAL	**2,017 GWh**	**2,068 GWh**	**1,823 GWh**

(*) Energy storage is only counted when discharging.

Energy Prices

Daily volume-weighted energy prices and daily min/max Perth temperatures (*)

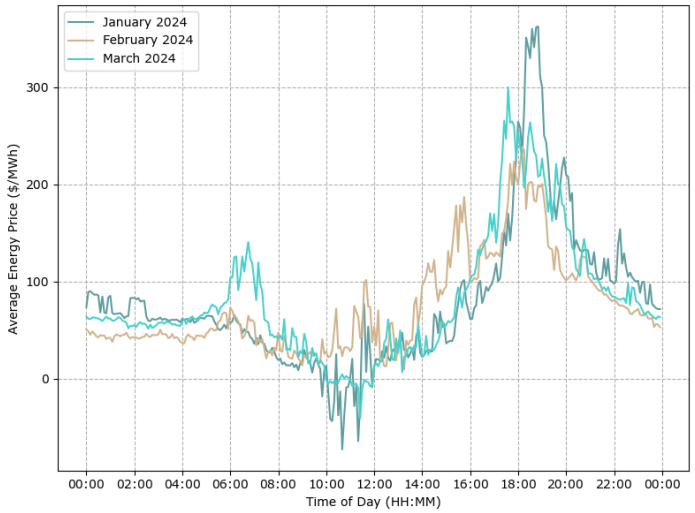


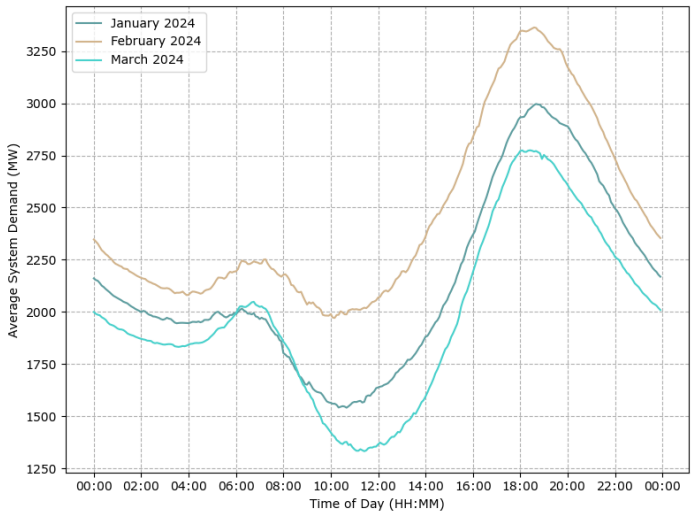
(*) Daily temperatures are based on BOM observations at the Perth Metro site.

Average time-of-day clearing prices and quantities (1)

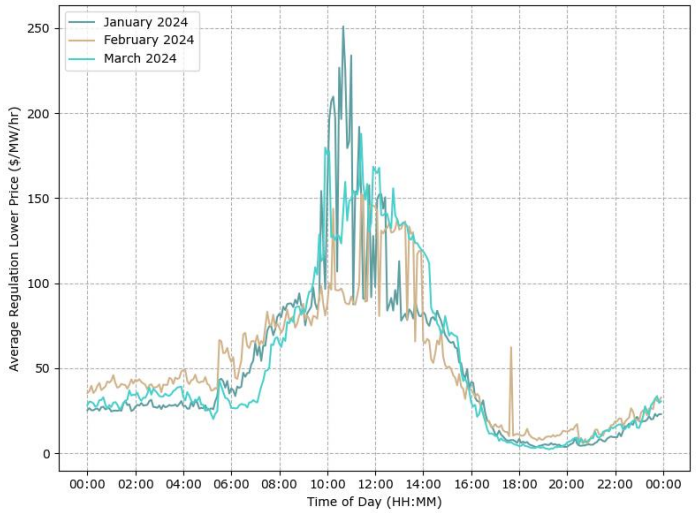
Energy, Regulation Lower and Regulation Raise ESS

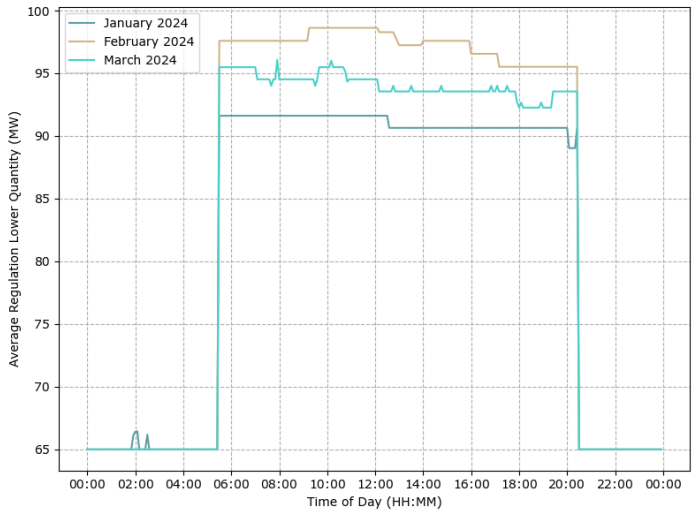
Energy



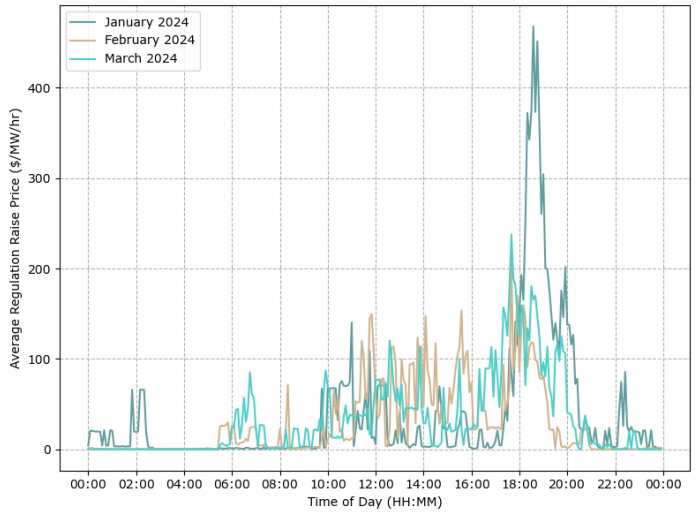


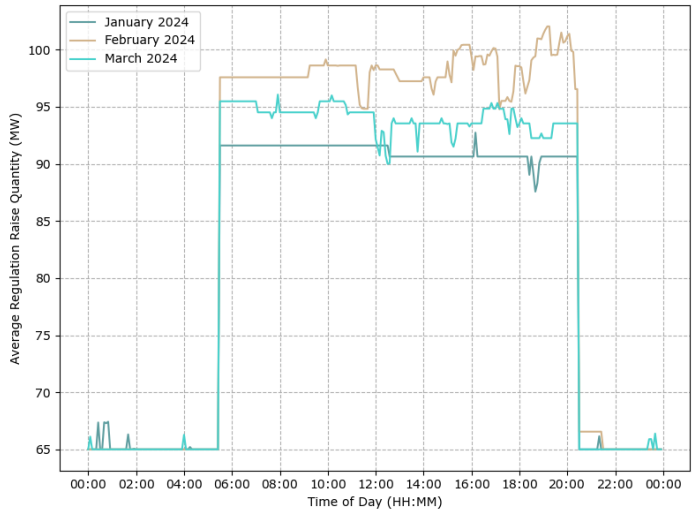
Regulation Lower (*)





Regulation Raise (*)



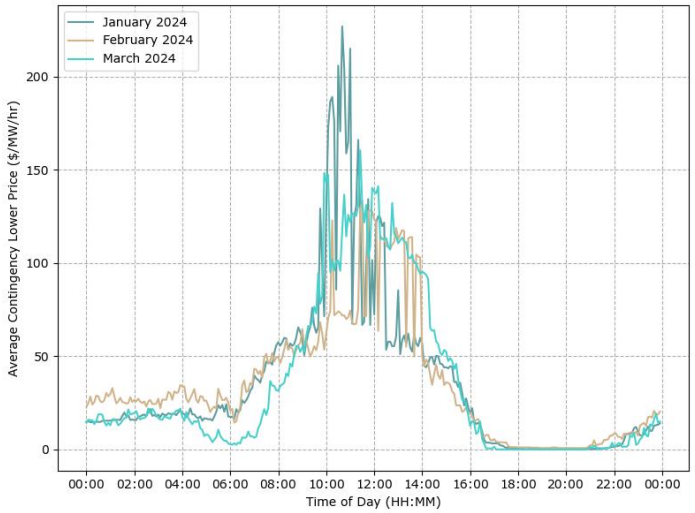


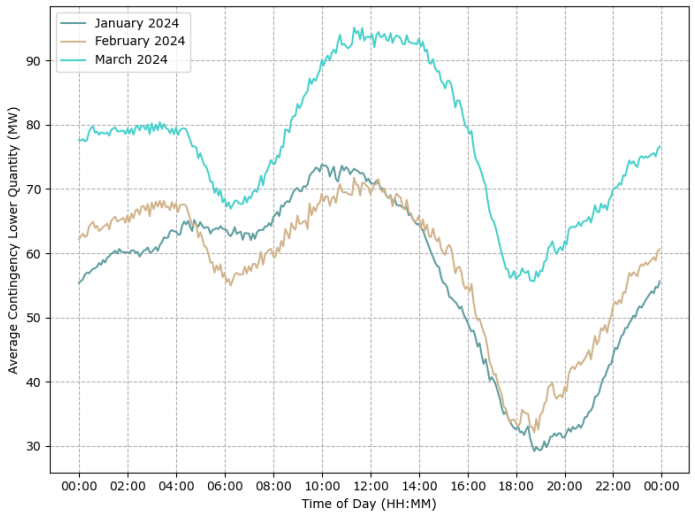
(*) Prices exclude FCESS Uplift Payments

Average time-of-day clearing prices and quantities (2)

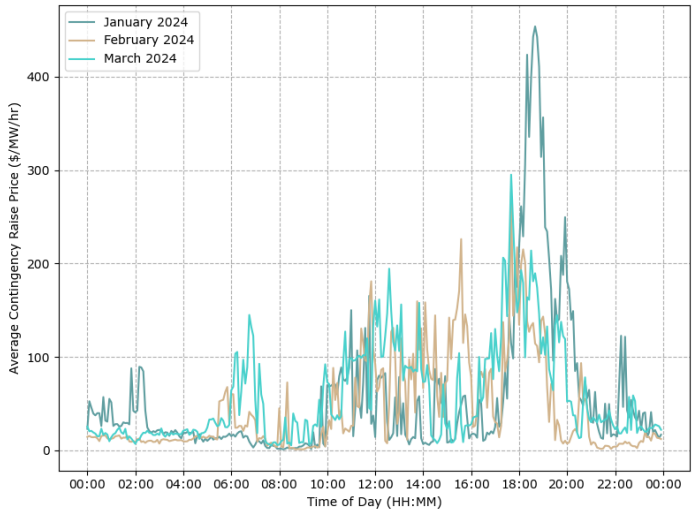
Contingency Lower, Contingency Raise and RoCoF Control ESS

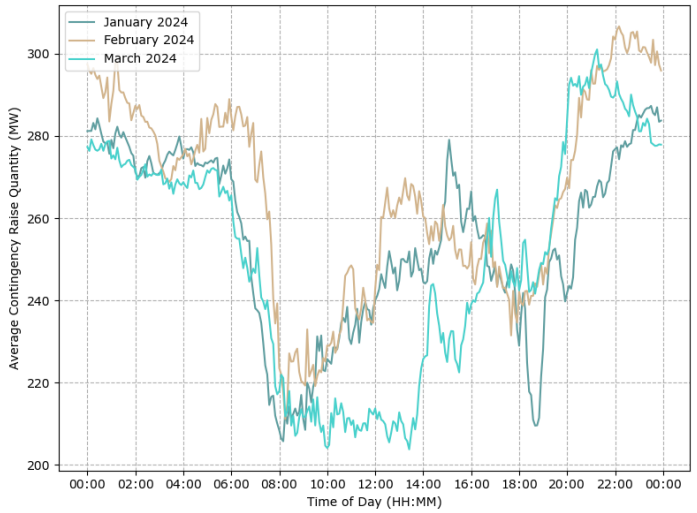
Contingency Lower (*)



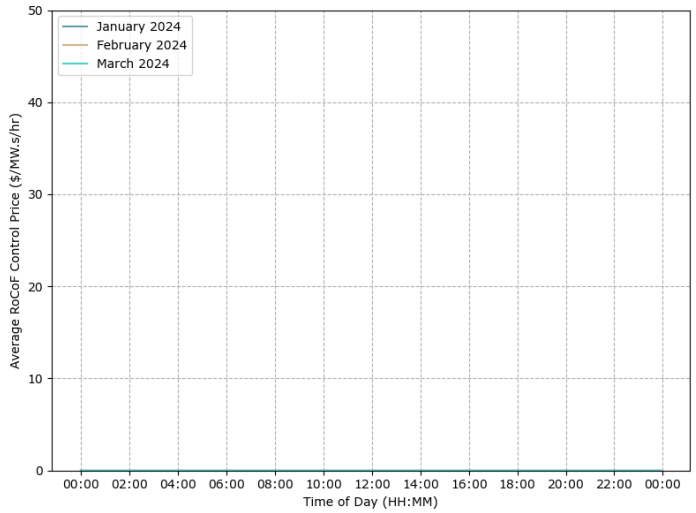


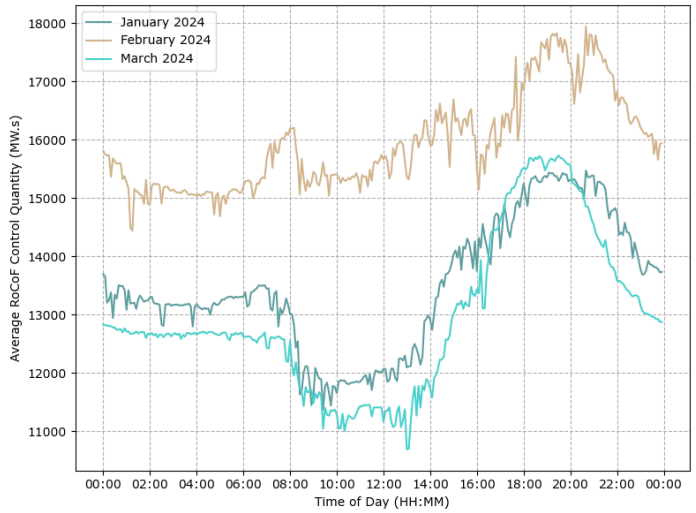
Contingency Raise (*)





RoCoF Control (*)



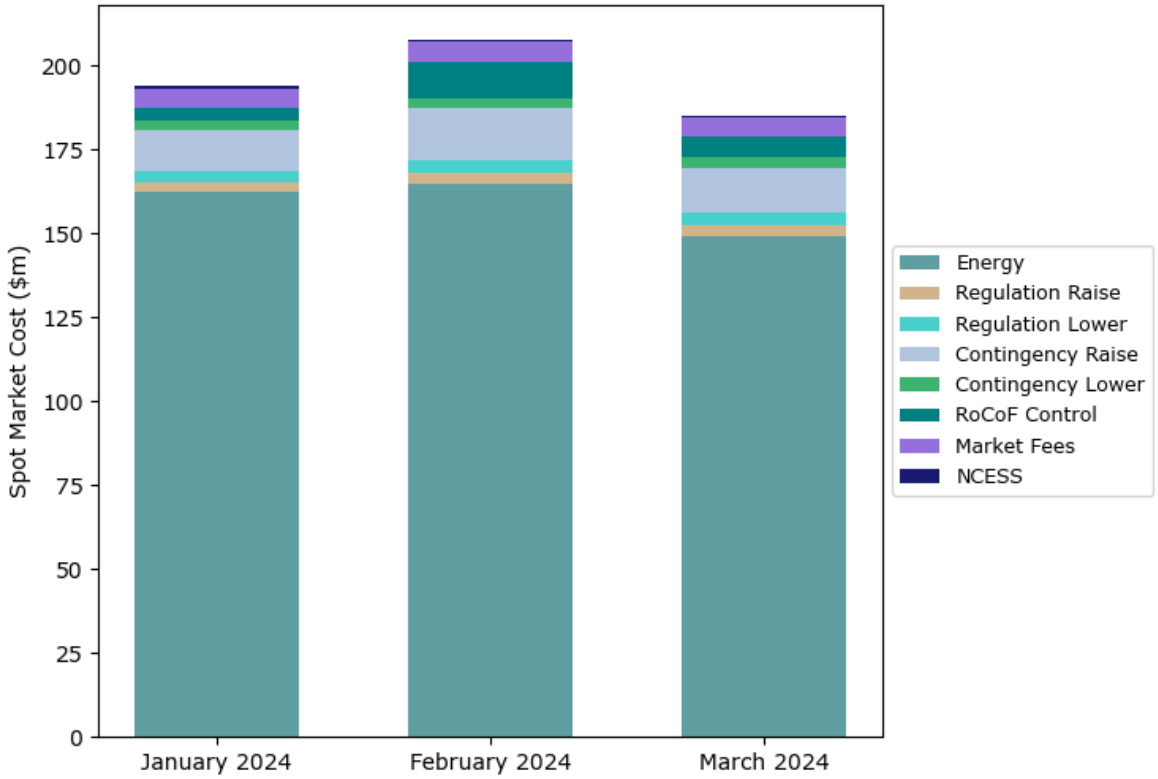


(*) Prices exclude FCESS Uplift Payments

WEM Total Spot Market Costs

Total mark-to-market cost of the WEM (excluding Reserve Capacity)

Q1 2024 Market Costs



Market Cost Breakdown ($m AUD)

Category	Jan 2024	Feb 2024	Mar 2024
Energy	$162.15m	$164.76m	$148.98m
Regulation Raise (*)	$2.97m	$3.09m	$3.44m
Regulation Lower (*)	$3.34m	$3.83m	$3.60m
Contingency Raise (*)	$12.30m	$15.73m	$13.48m
Contingency Lower (*)	$2.71m	$2.75m	$3.12m
RoCoF Control (*)	$3.94m	$10.71m	$6.41m
Market Fees	$5.77m	$6.19m	$5.34m
NCESS	$0.65m	$0.57m	$0.81m
TOTAL	**$193.83m**	**$207.62m**	**$185.18m**
$ / MWh	**$121.71**	**$121.47**	**$125.58**

(*) Includes FCESS Uplift Payments

.02
Facilities

Selected facility level outcomes

Facility-Level Metrics

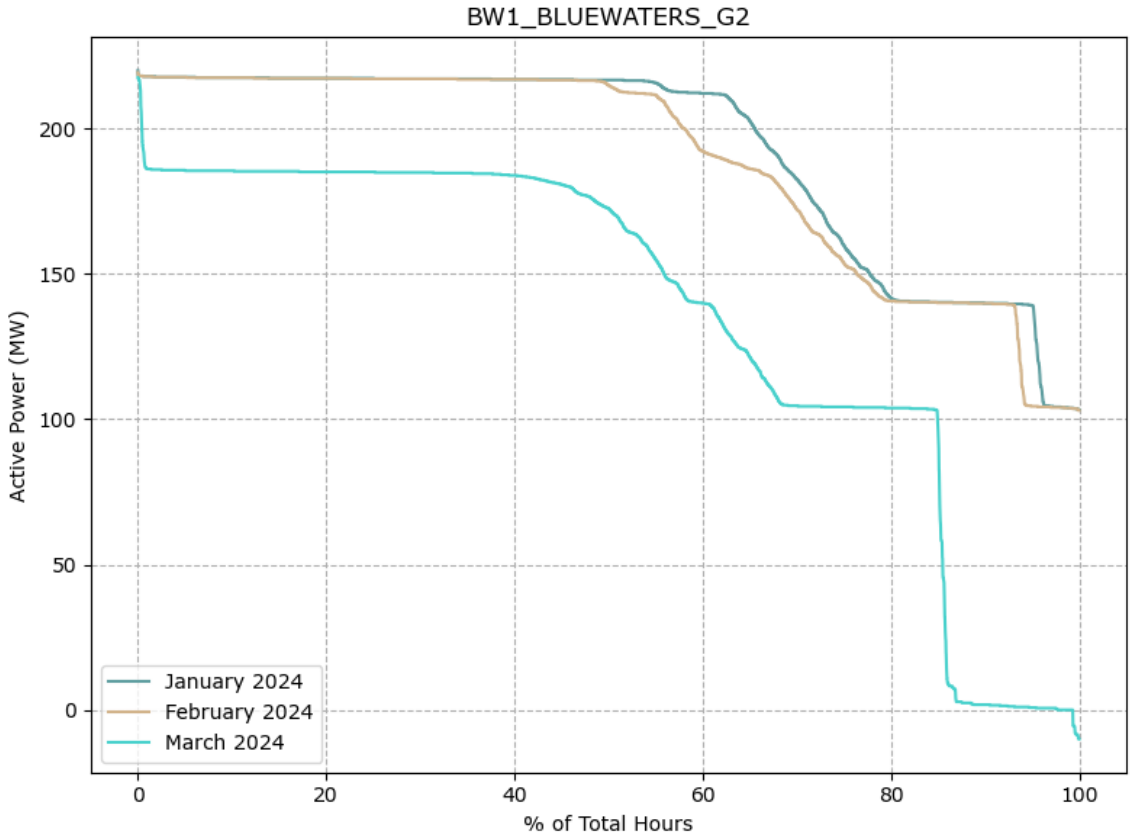
Definitions for the facility-level metrics reported in this section

Facility Metric	Description
Monthly Generation Duration Curve	Curve showing the proportion of time in a month that a facility is operating above a specific output.
Average Time of Day Output	Curve showing the mean output from a facility over a month at a 5-min resolution (with no adjustments for a facility being offline).
Facility Merchant Spot Revenue	The implied monthly revenue that a facility would have received from all energy and ESS markets if it were a merchant facility. Where a facility receives Large Generation Certificate (LGC), this revenue is estimated based on publicly available LGC spot prices published on Demand Manager.
Facility Capacity Factor	Daily average capacity factors based on the daily energy generated and the registered facility size. Note that for energy storage facilities, the net energy throughput is used.
Average Energy Capture Price	Daily average volume weighted energy price that the facility receives based on the following calculation: $$Average\ Energy\ Capture\ Price = \frac{\sum Energy\ Revenue}{\sum \lvert Energy\ Generated\ or\ Consumed \rvert}$$

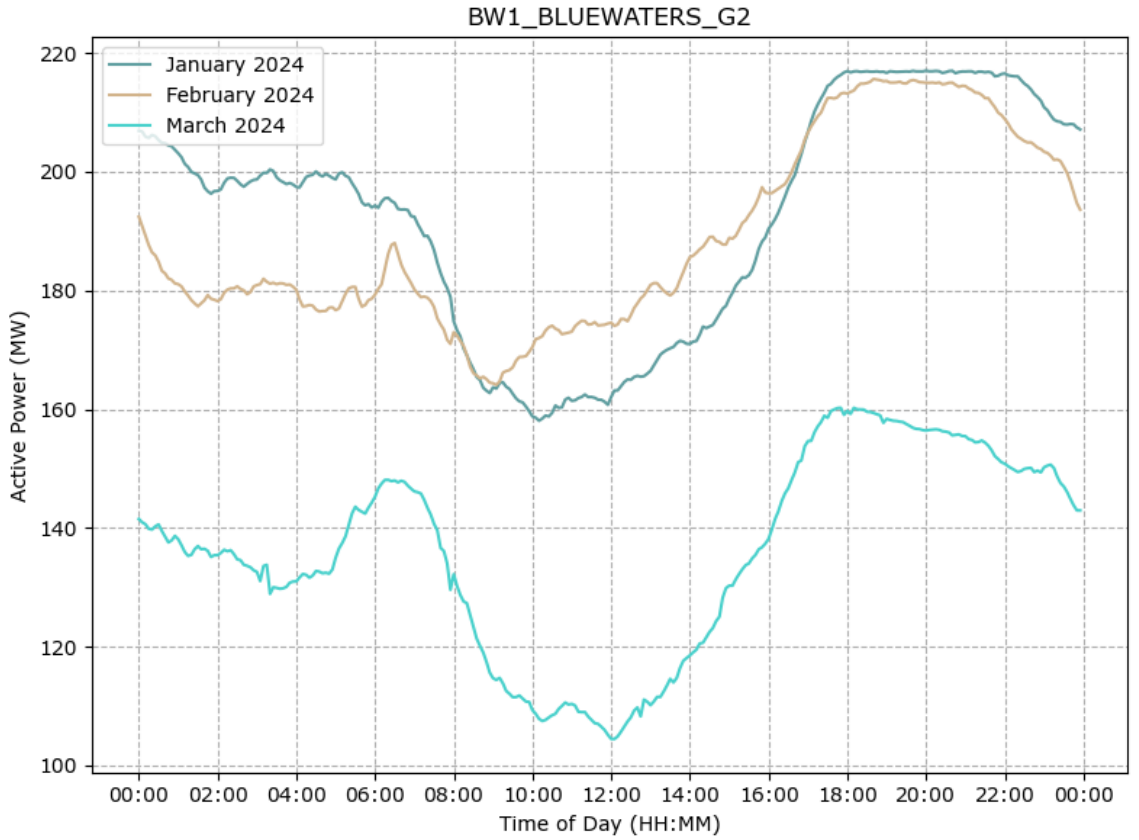
Bluewaters Power Station BW1-G2

Coal-fired Scheduled Facility, 217 MW, Summit Southern Cross Power

Generation Duration Curves



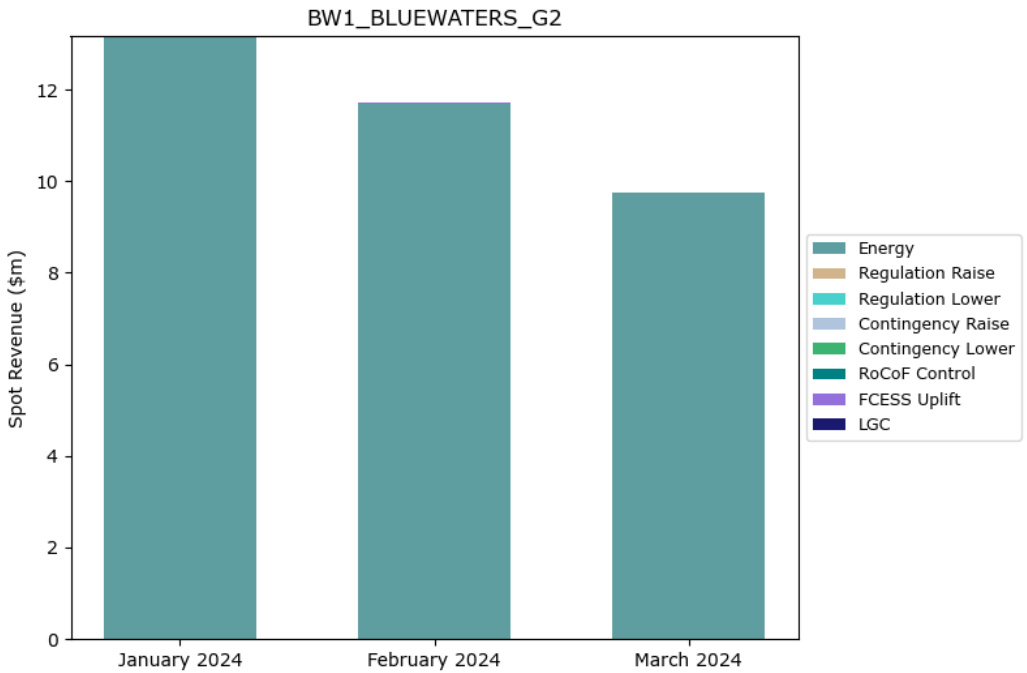
Average Time-of-Day Output



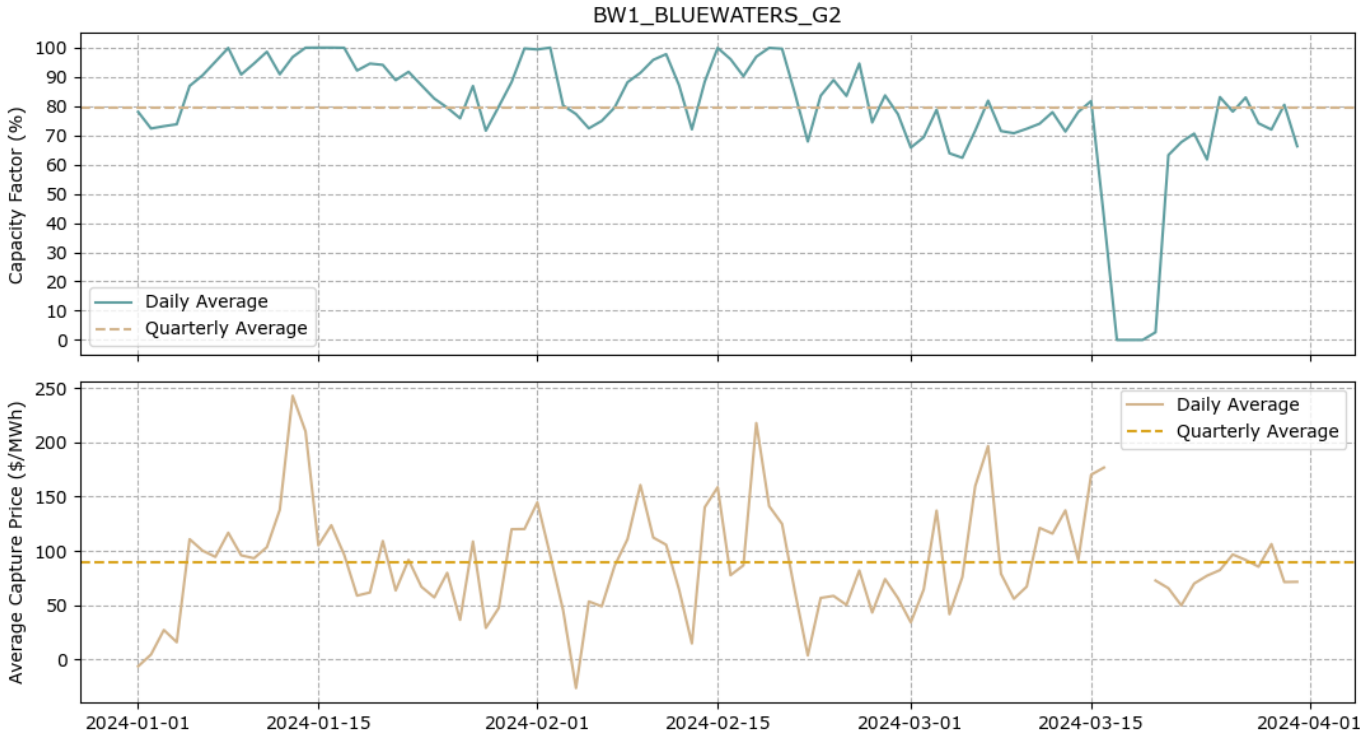
Bluewaters Power Station BW1-G2

Coal-fired Scheduled Facility, 217 MW, Summit Southern Cross Power

Facility Merchant Spot Revenue



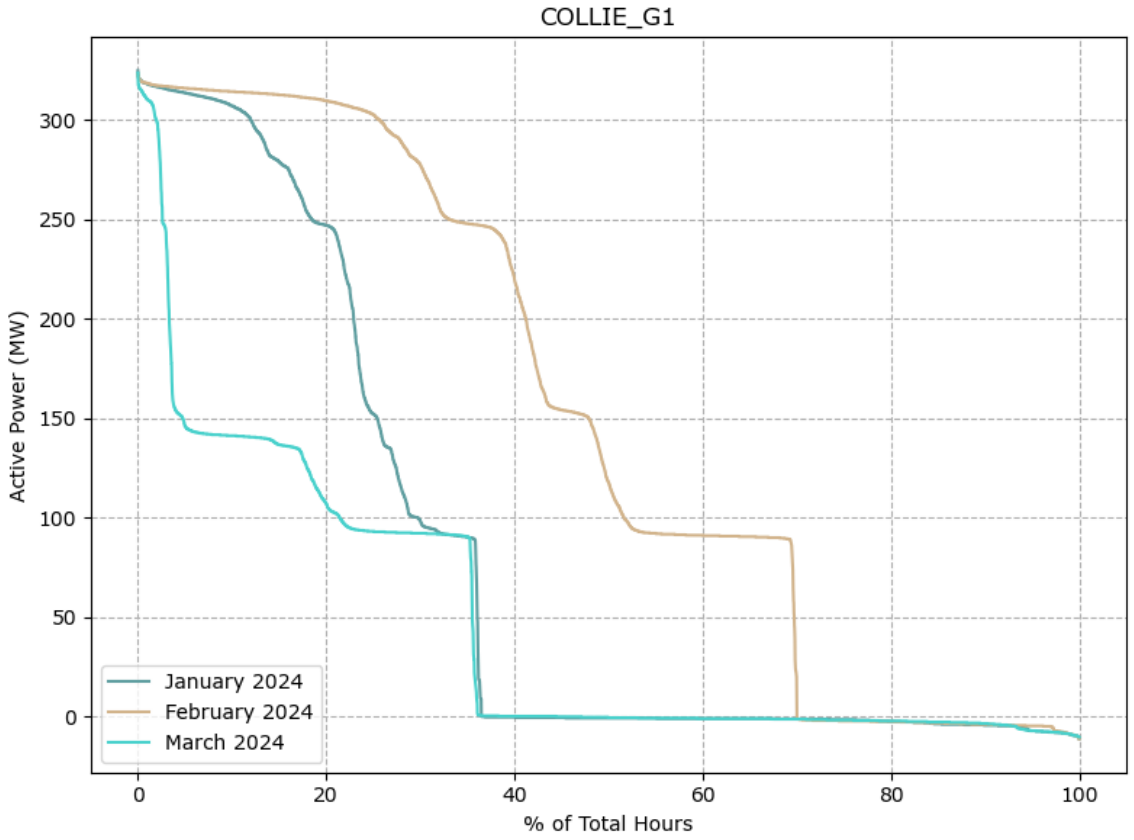
Daily Capacity Factor and Average Energy Capture Price



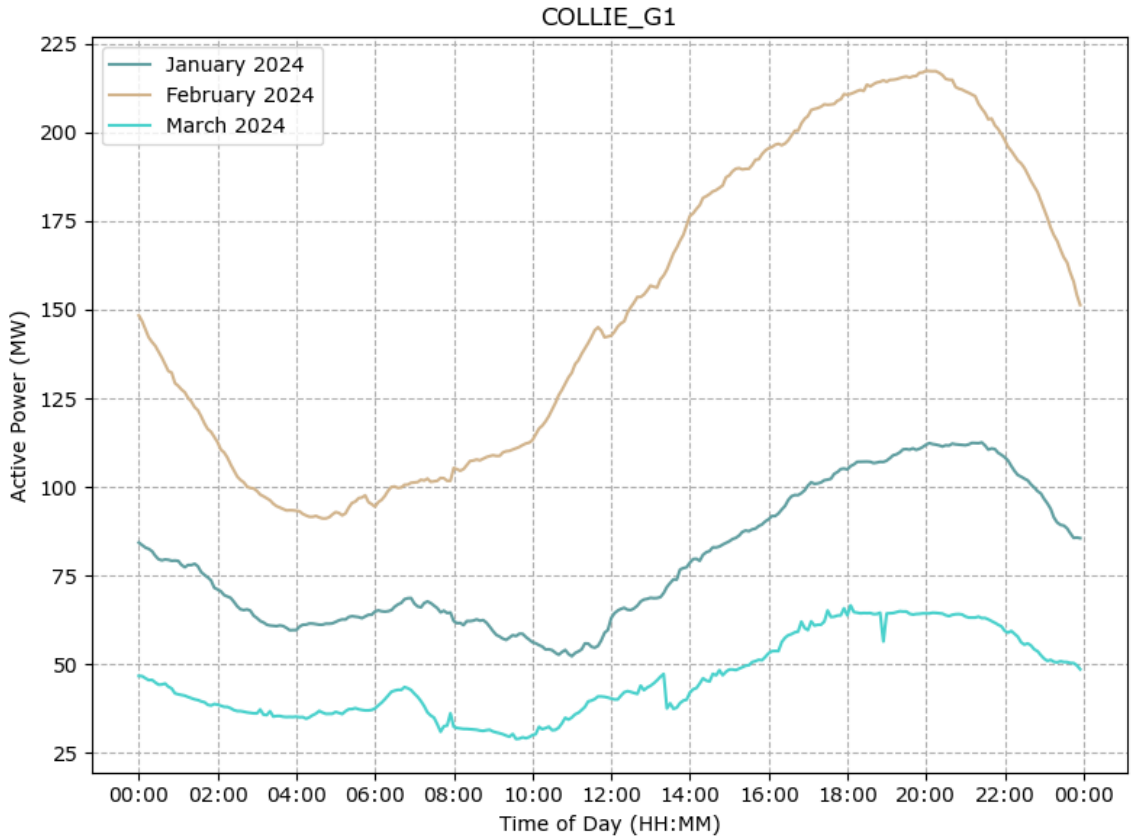
Collie Power Station G1

Coal-fired Scheduled Facility, 318.3 MW, Synergy

Generation Duration Curves



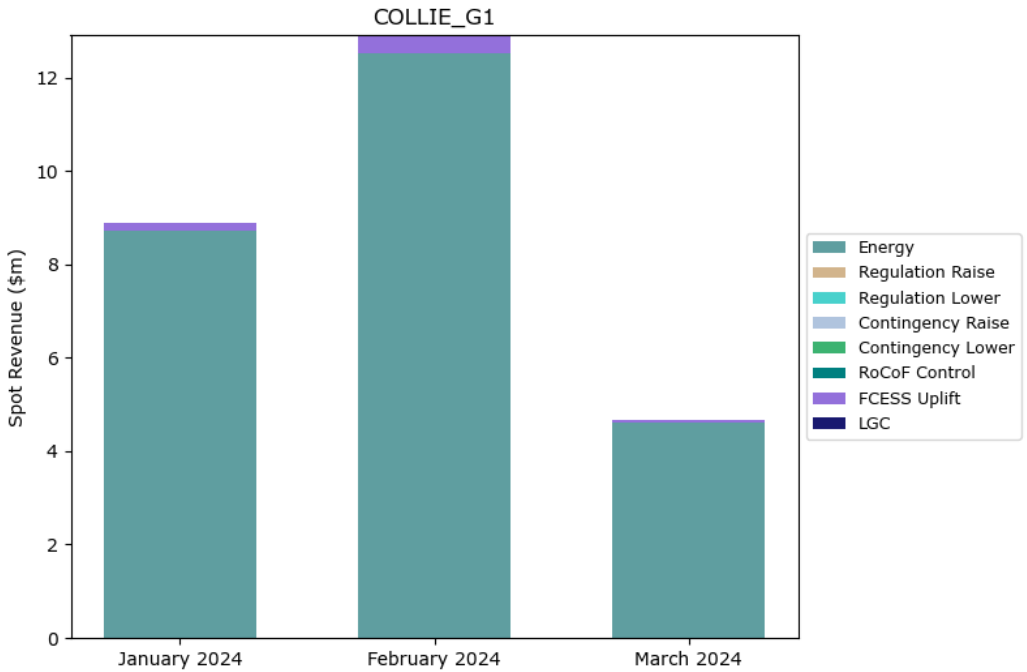
Average Time-of-Day Output



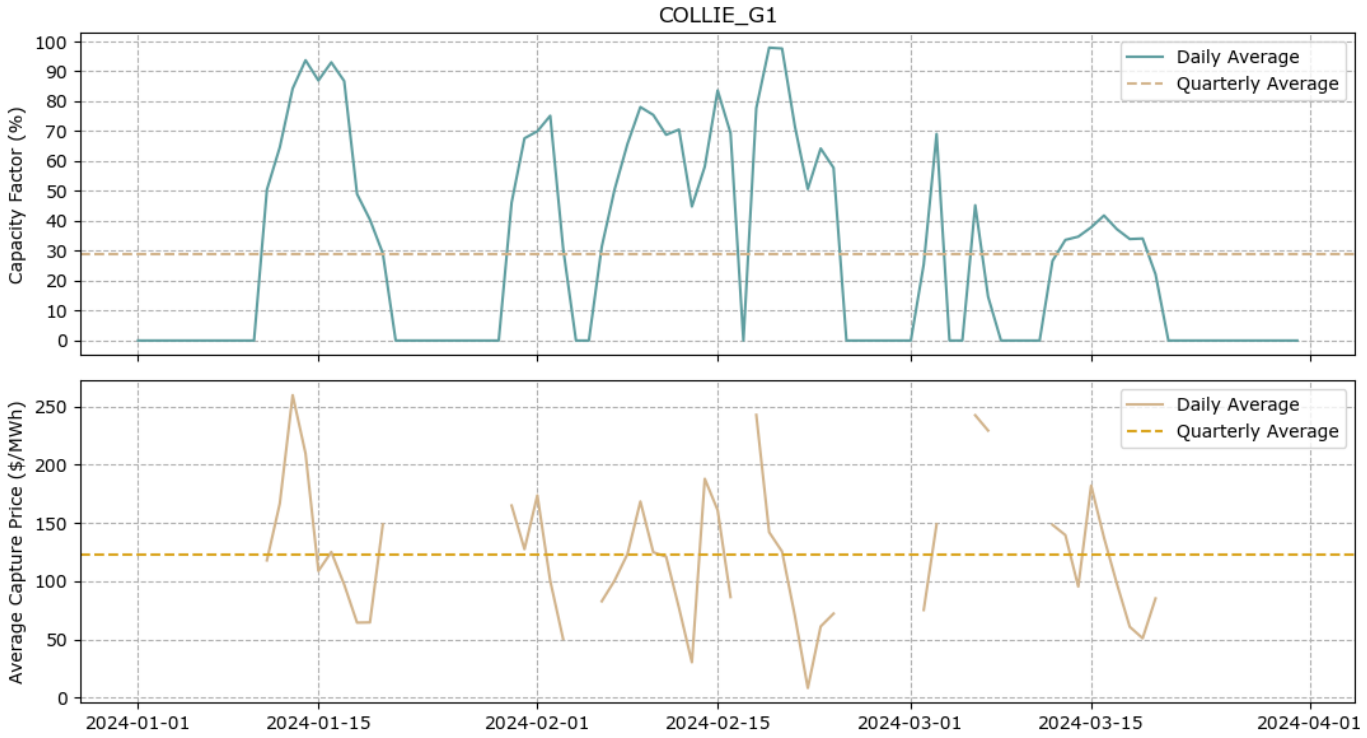
Collie Power Station G1

Coal-fired Scheduled Facility, 318.3 MW, Synergy

Facility Merchant Spot Revenue



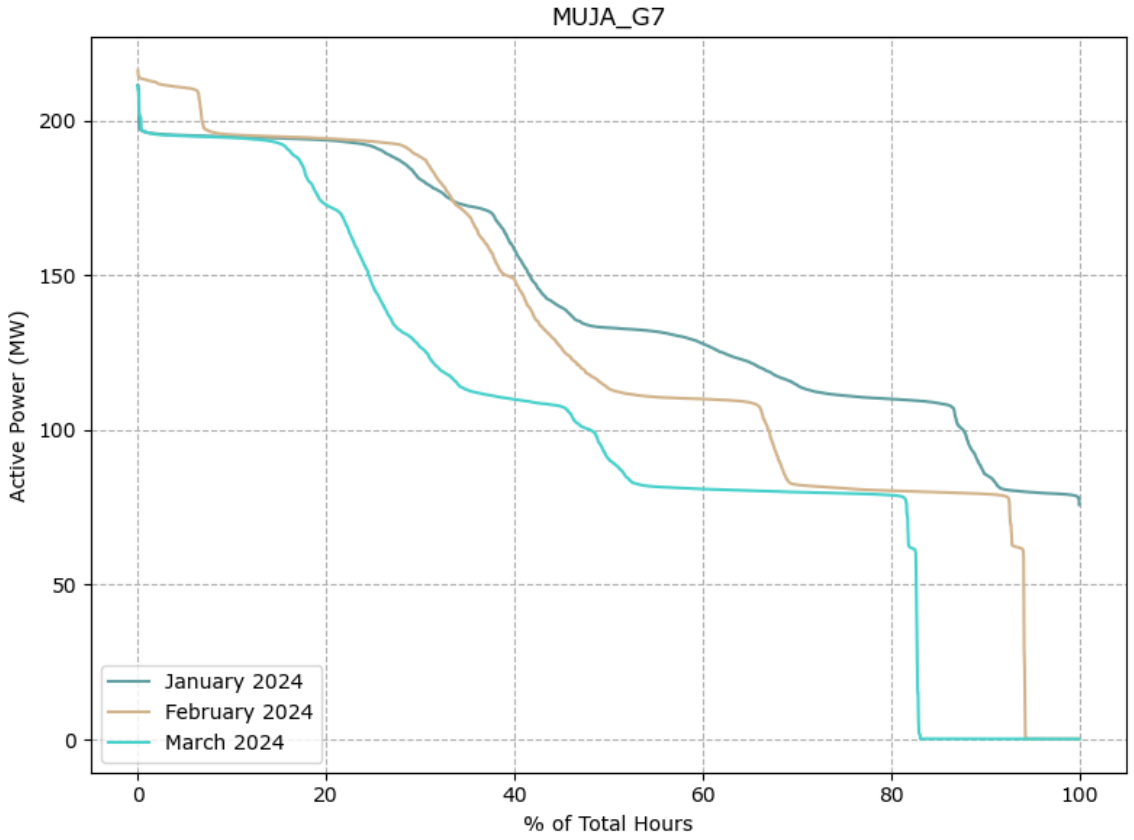
Daily Capacity Factor and Average Energy Capture Price



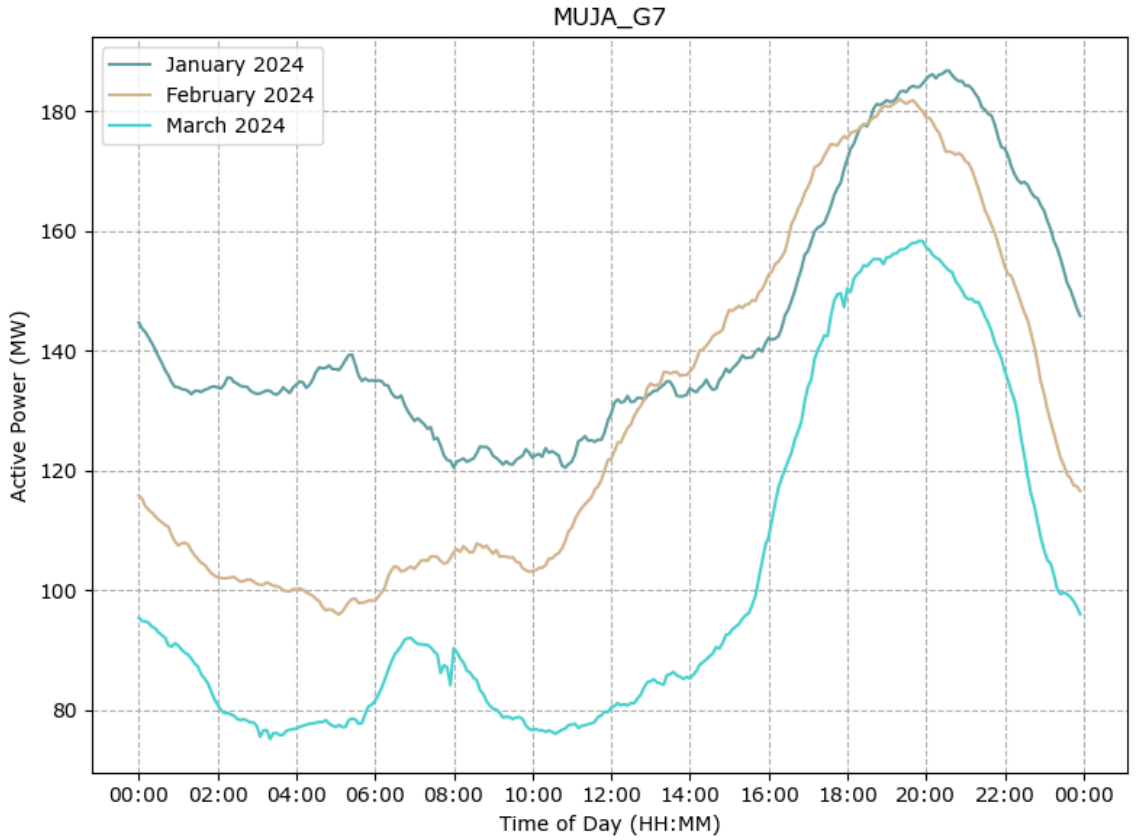
Muja Power Station G7

Coal-fired Scheduled Facility, 212.6 MW, Synergy

Generation Duration Curves



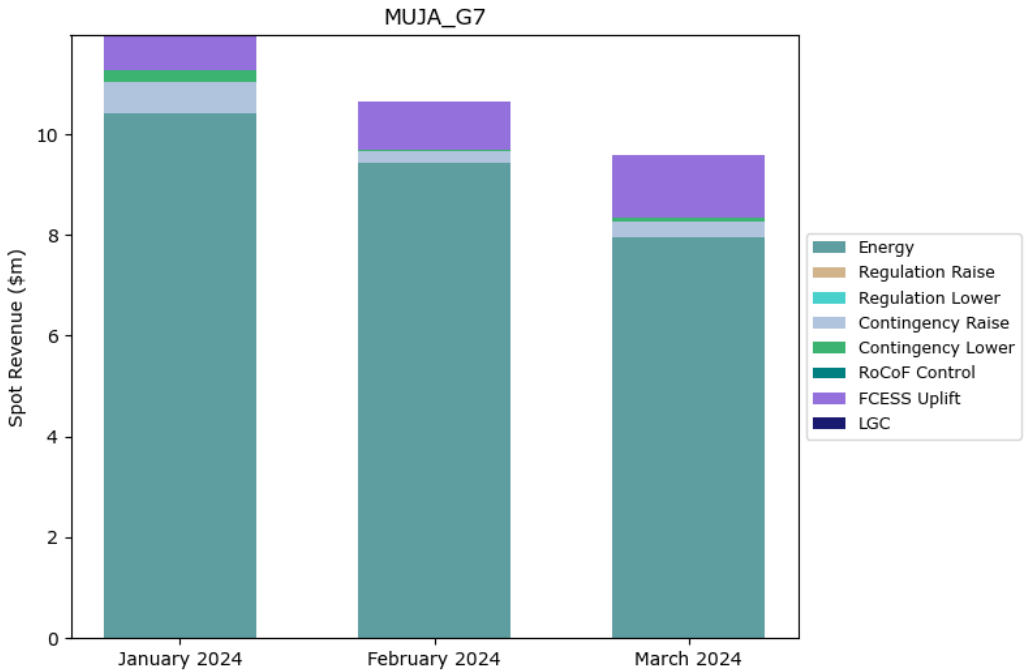
Average Time-of-Day Output



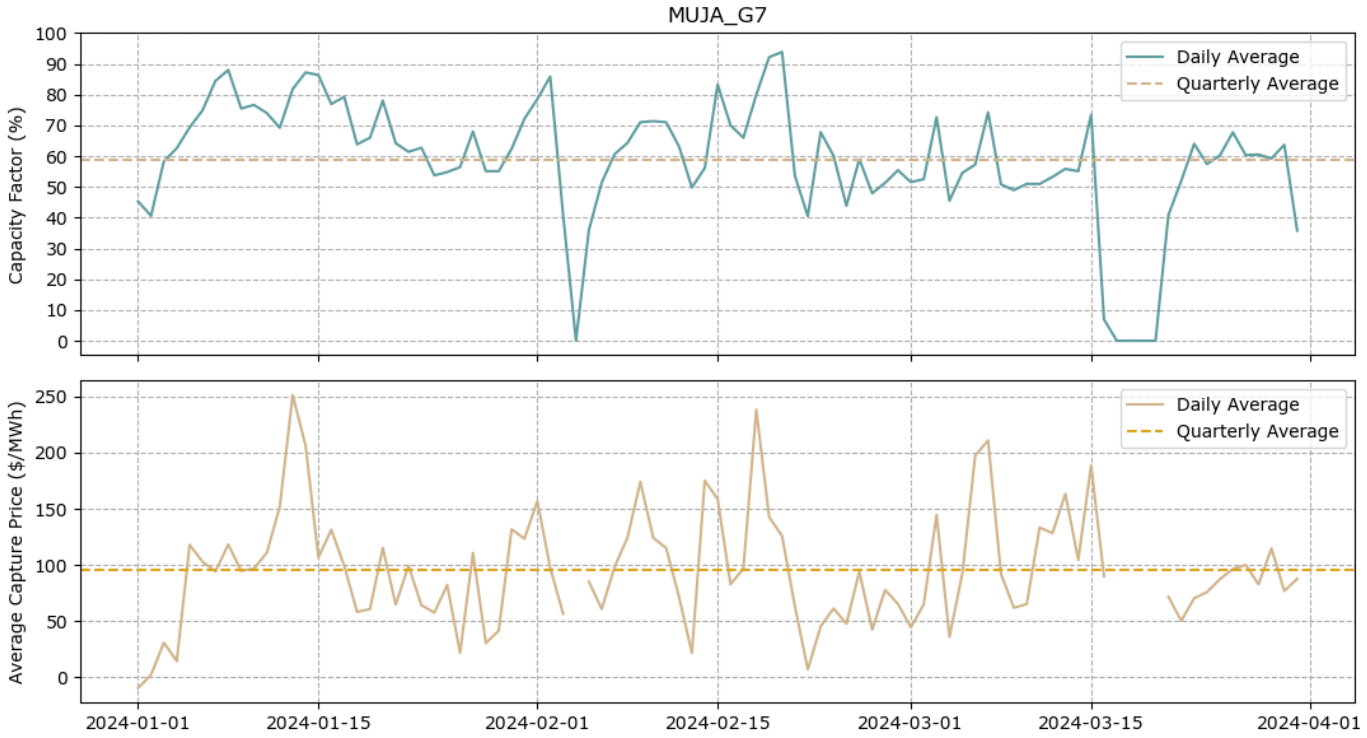
Muja Power Station G7

Coal-fired Scheduled Facility, 212.6 MW, Synergy

Facility Merchant Spot Revenue



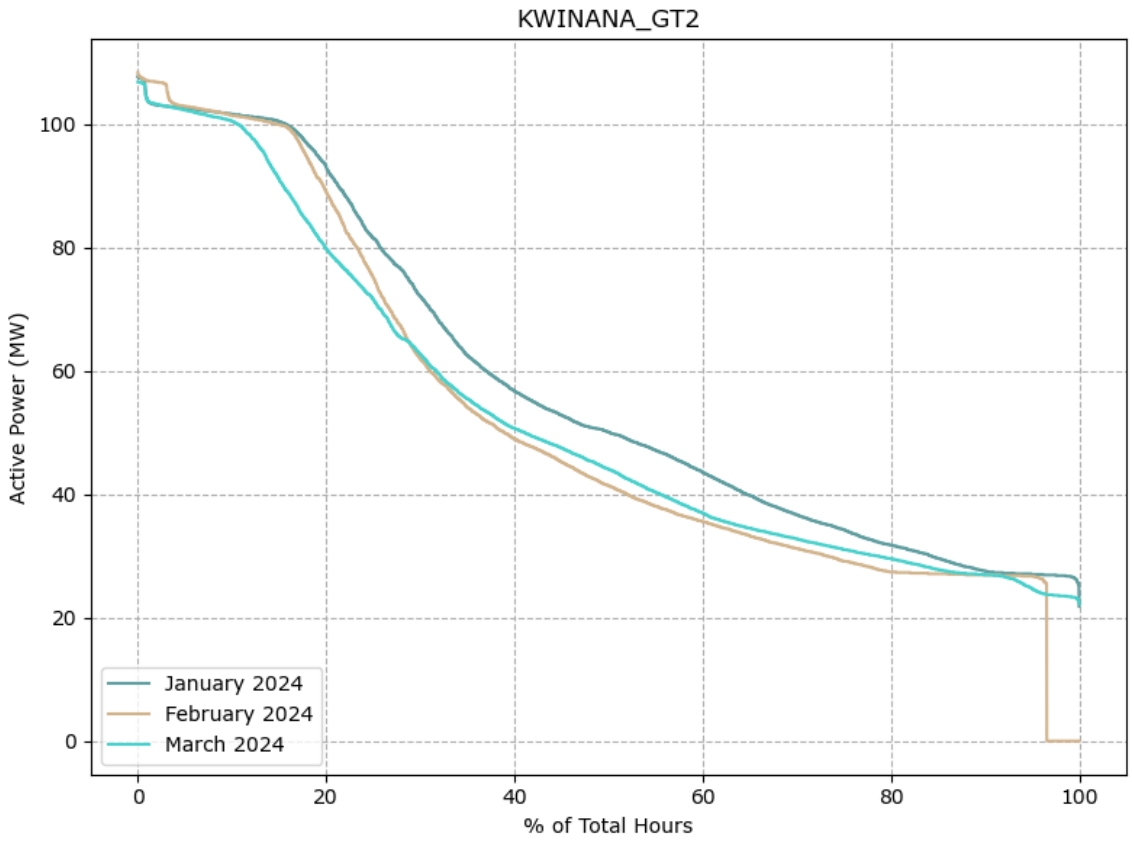
Daily Capacity Factor and Average Energy Capture Price



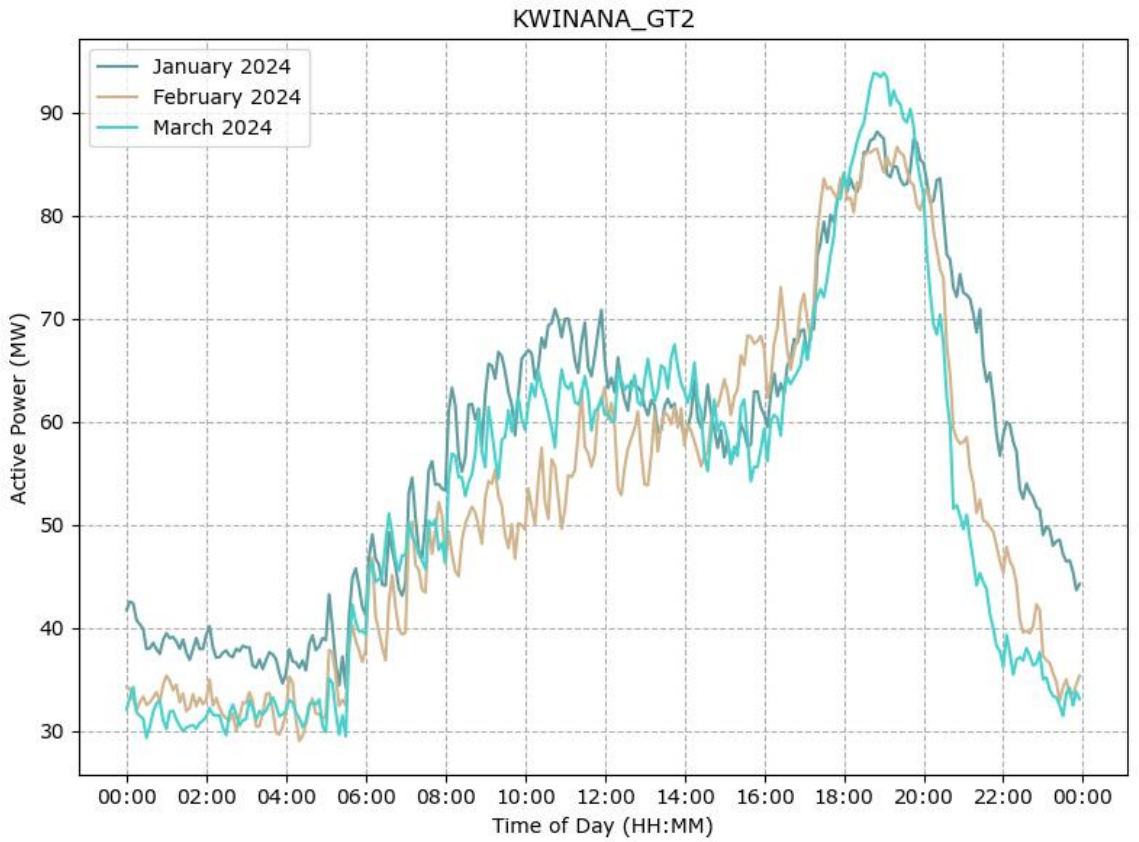
Kwinana Power Station GT2

Gas-fired Scheduled Facility, 103.94 MW, Synergy

Generation Duration Curves



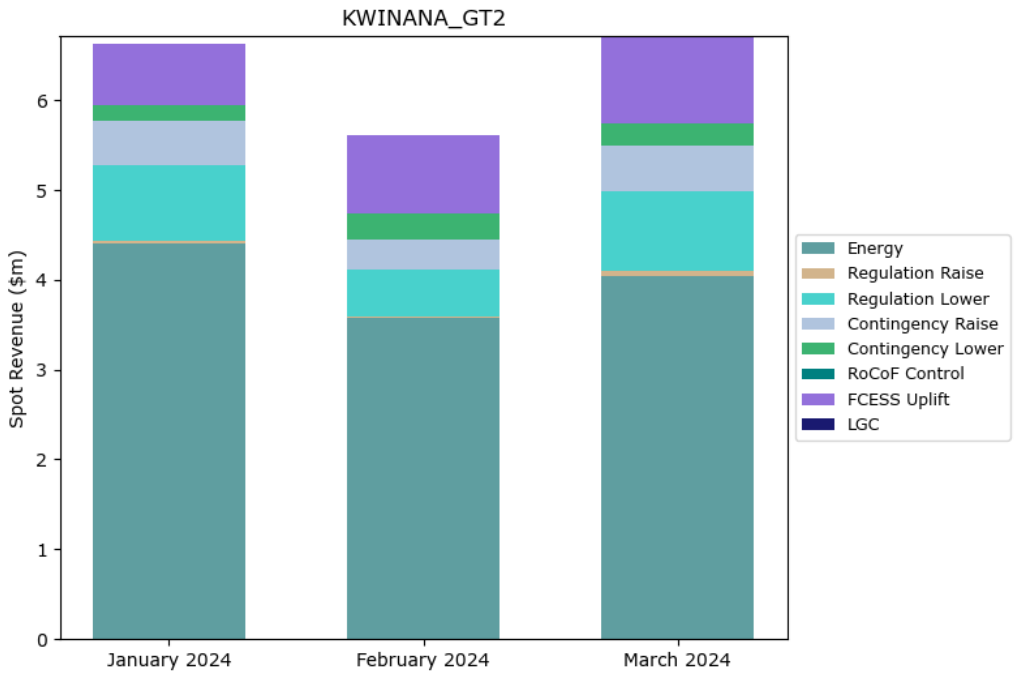
Average Time-of-Day Output



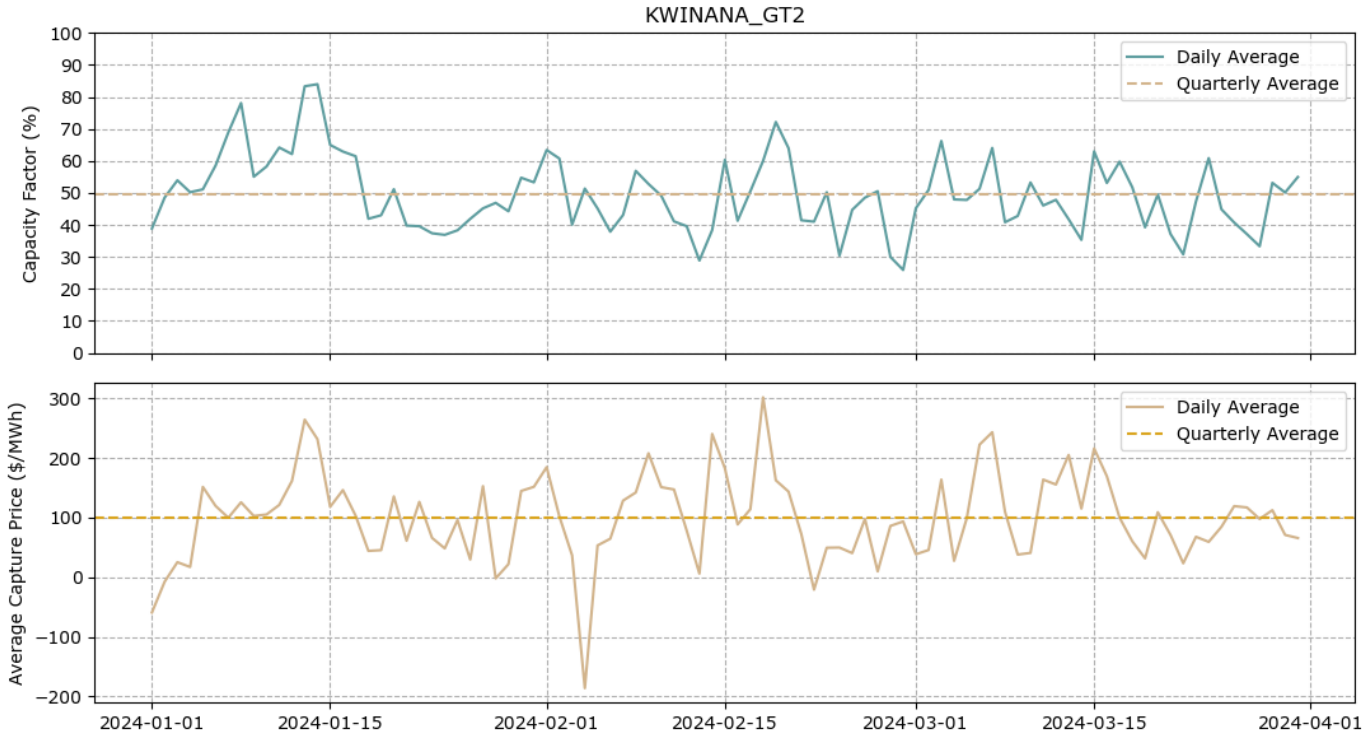
Kwinana Power Station GT2

Gas-fired Scheduled Facility, 103.94 MW, Synergy

Facility Merchant Spot Revenue



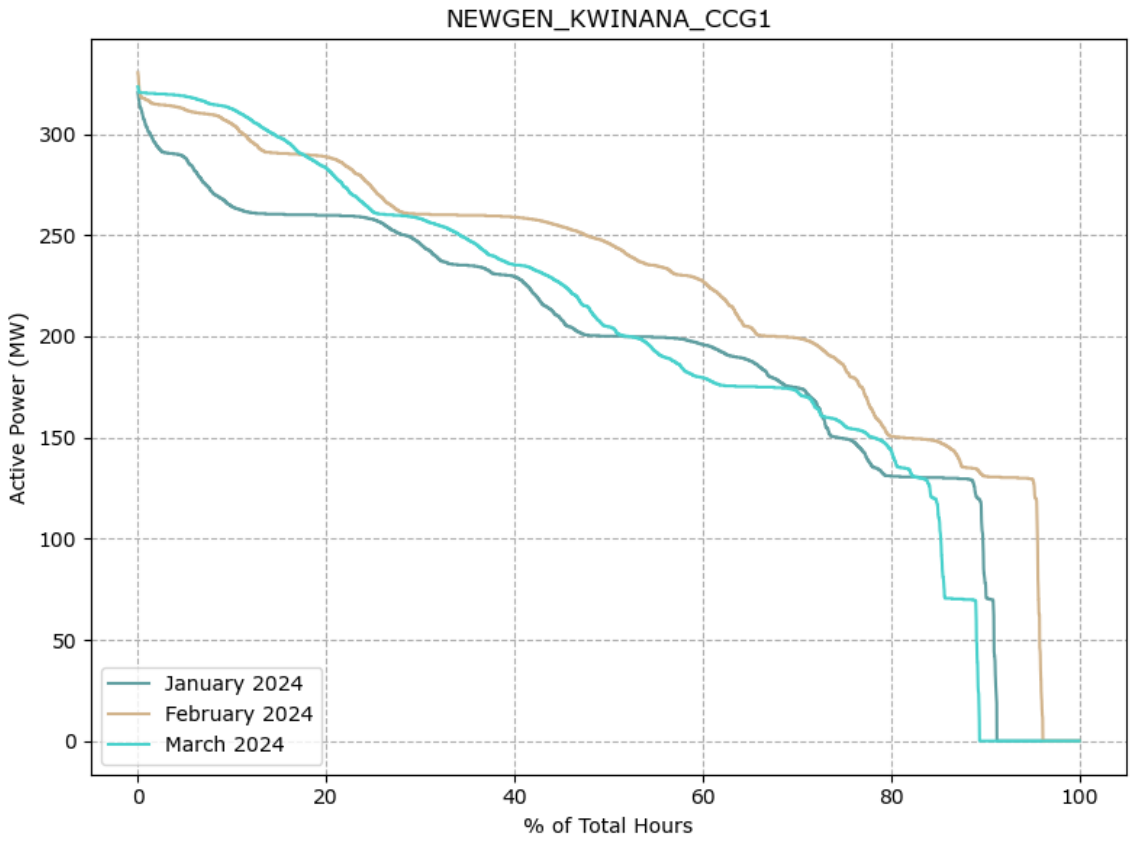
Daily Capacity Factor and Average Energy Capture Price



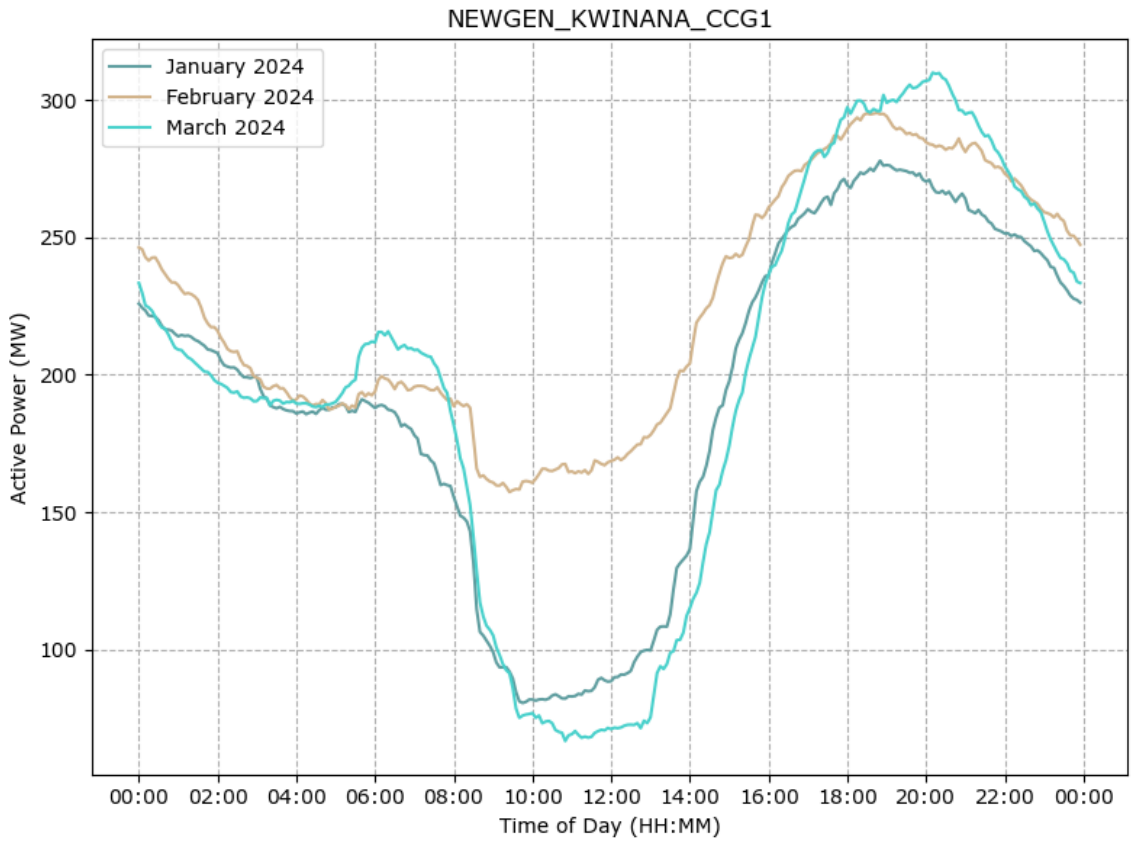
Newgen Kwinana Power Station

Gas-fired Scheduled Facility, 334.8 MW, Summit Southern Cross Power

Generation Duration Curves



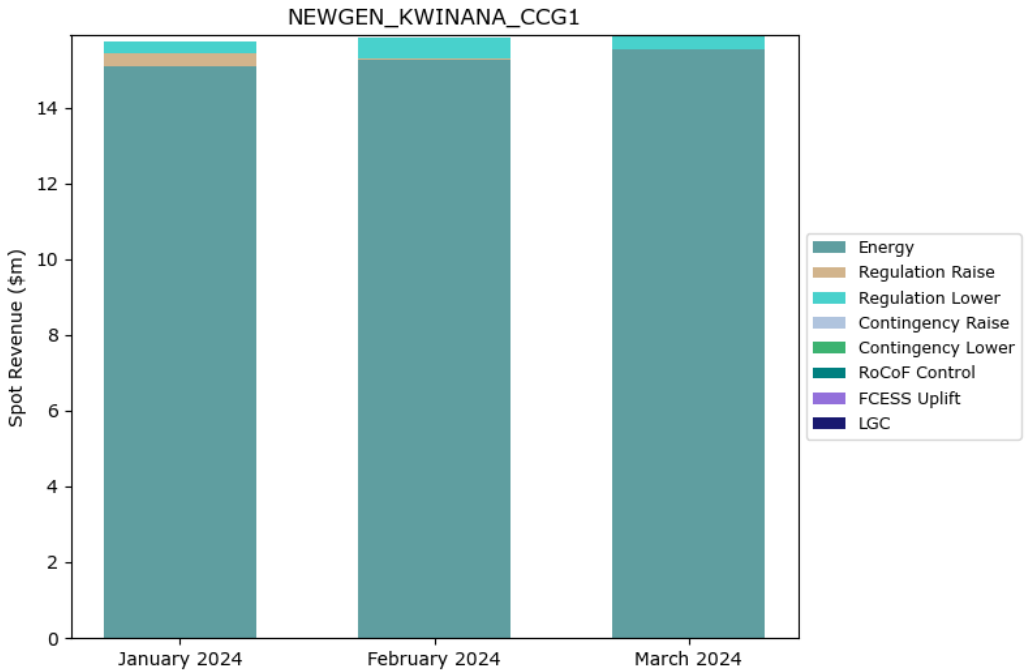
Average Time-of-Day Output



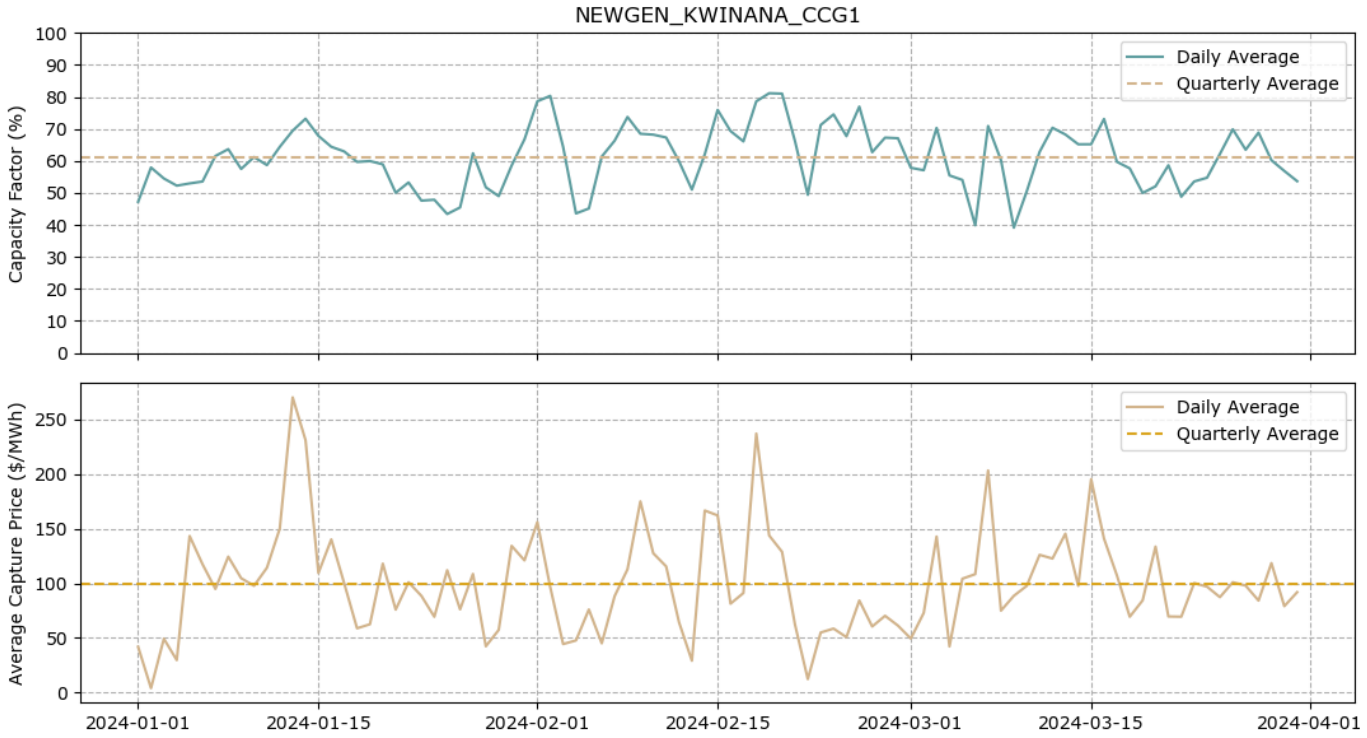
Newgen Kwinana Power Station

Gas-fired Scheduled Facility, 334.8 MW, Summit Southern Cross Power

Facility Merchant Spot Revenue



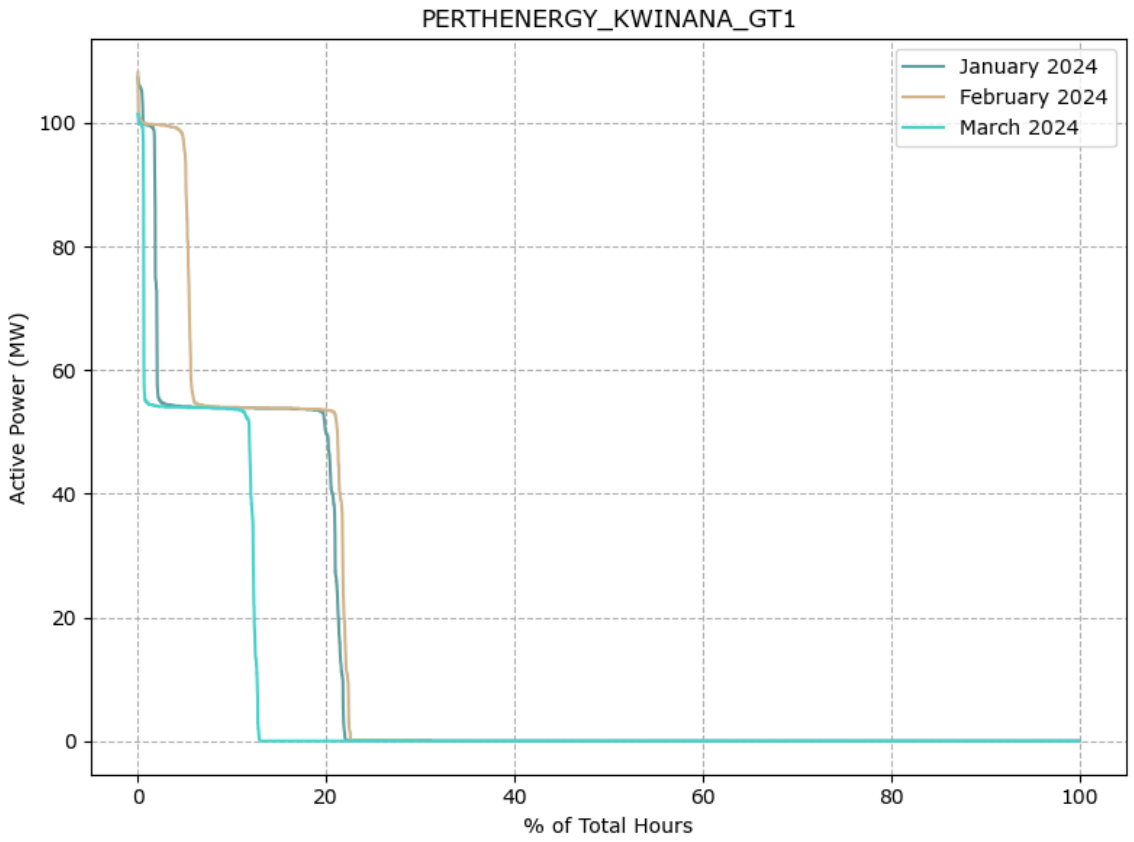
Daily Capacity Factor and Average Energy Capture Price



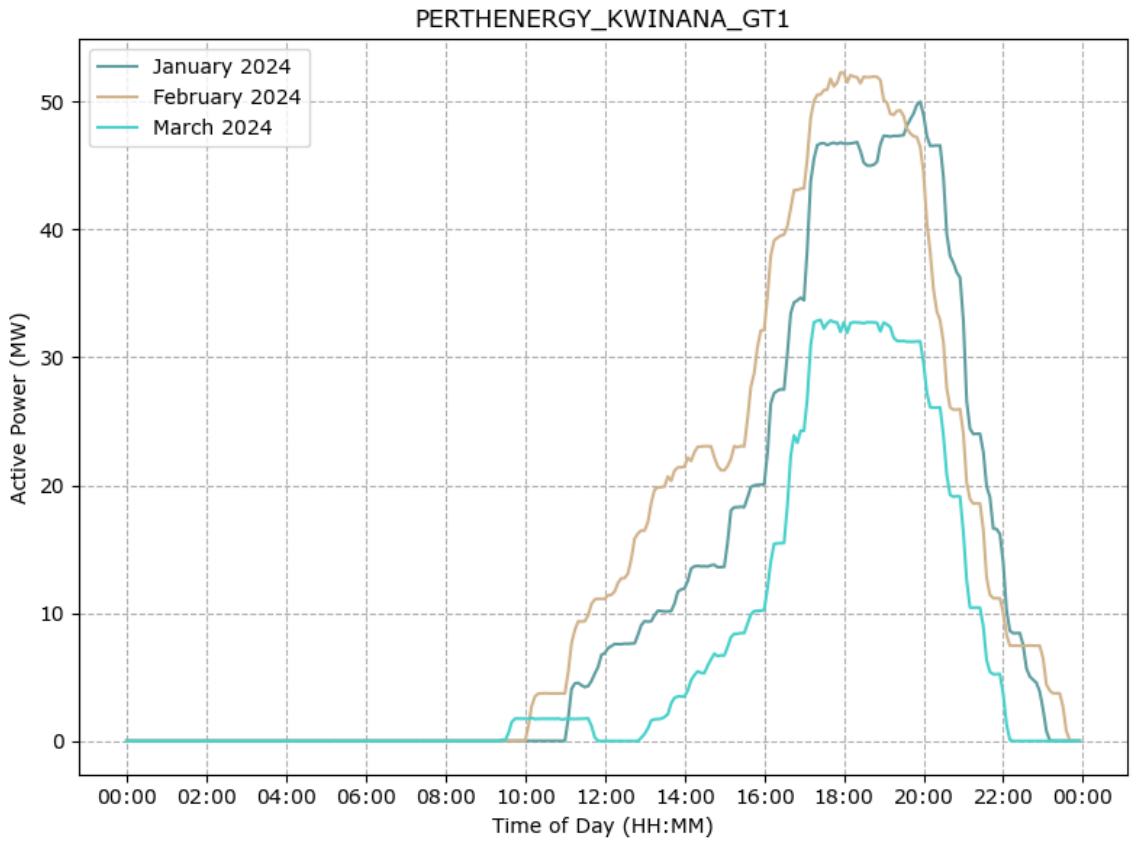
Kwinana Swift Power Station

Gas-fired Scheduled Facility, 109 MW, AGL (Perth Energy)

Generation Duration Curves



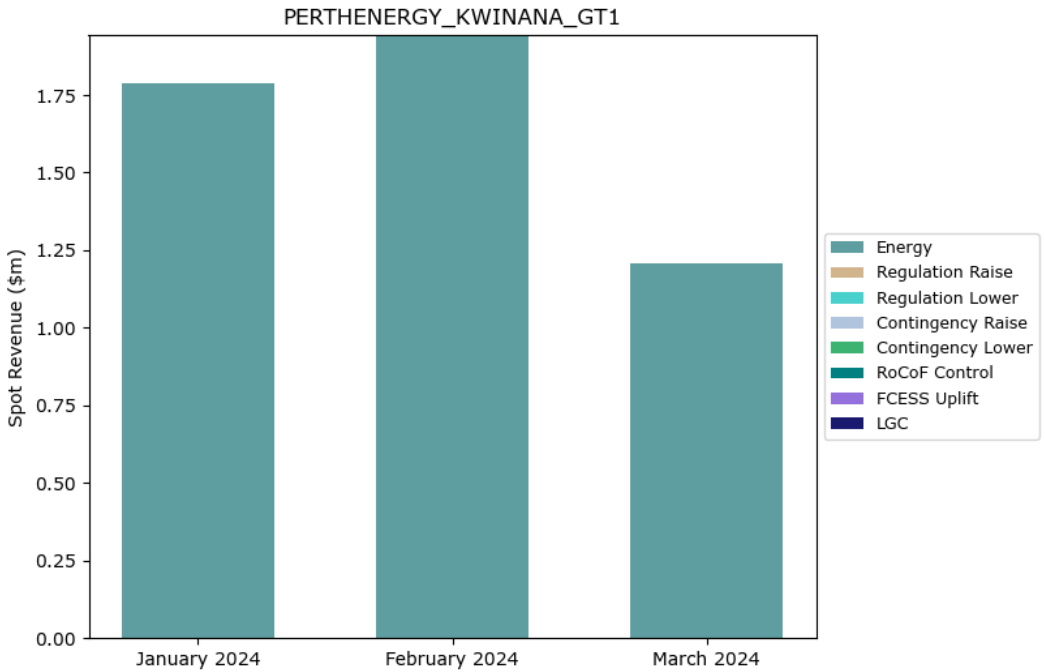
Average Time-of-Day Output



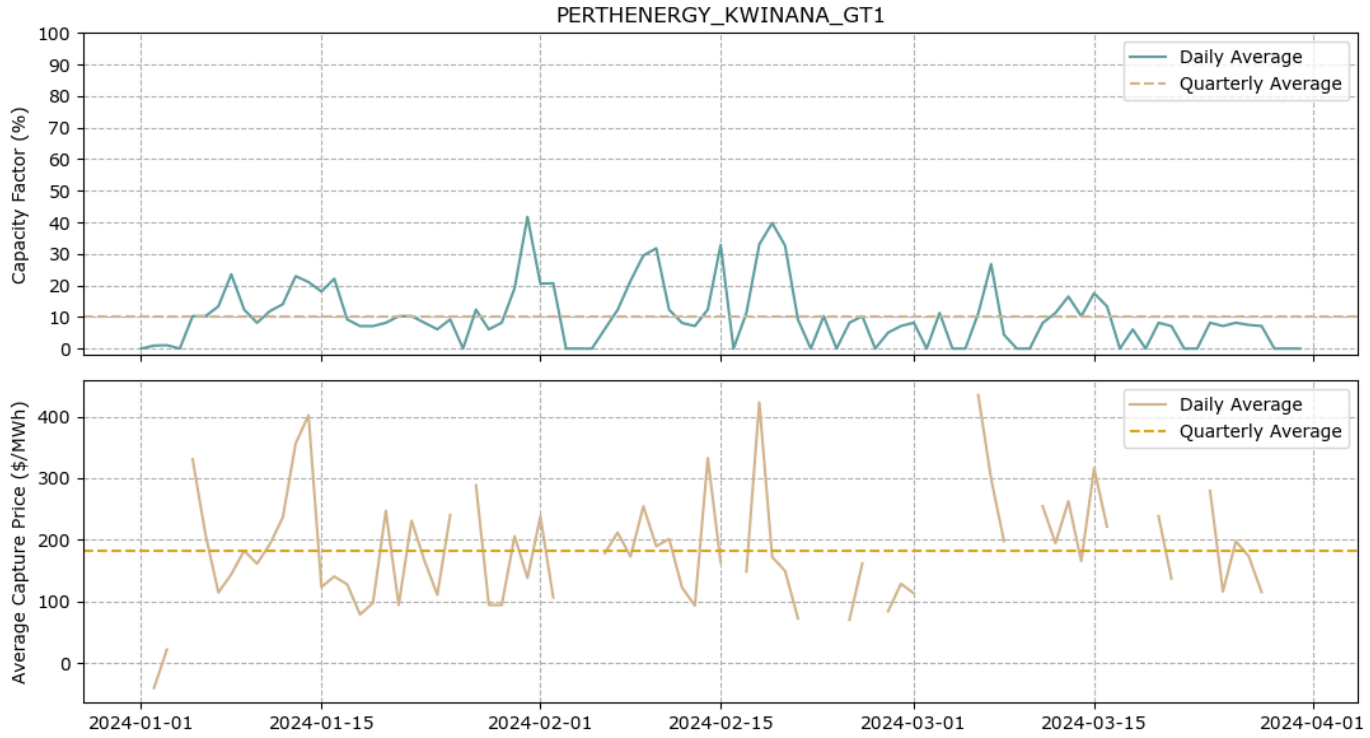
Kwinana Swift Power Station

Gas-fired Scheduled Facility, 109 MW, AGL (Perth Energy)

Facility Merchant Spot Revenue



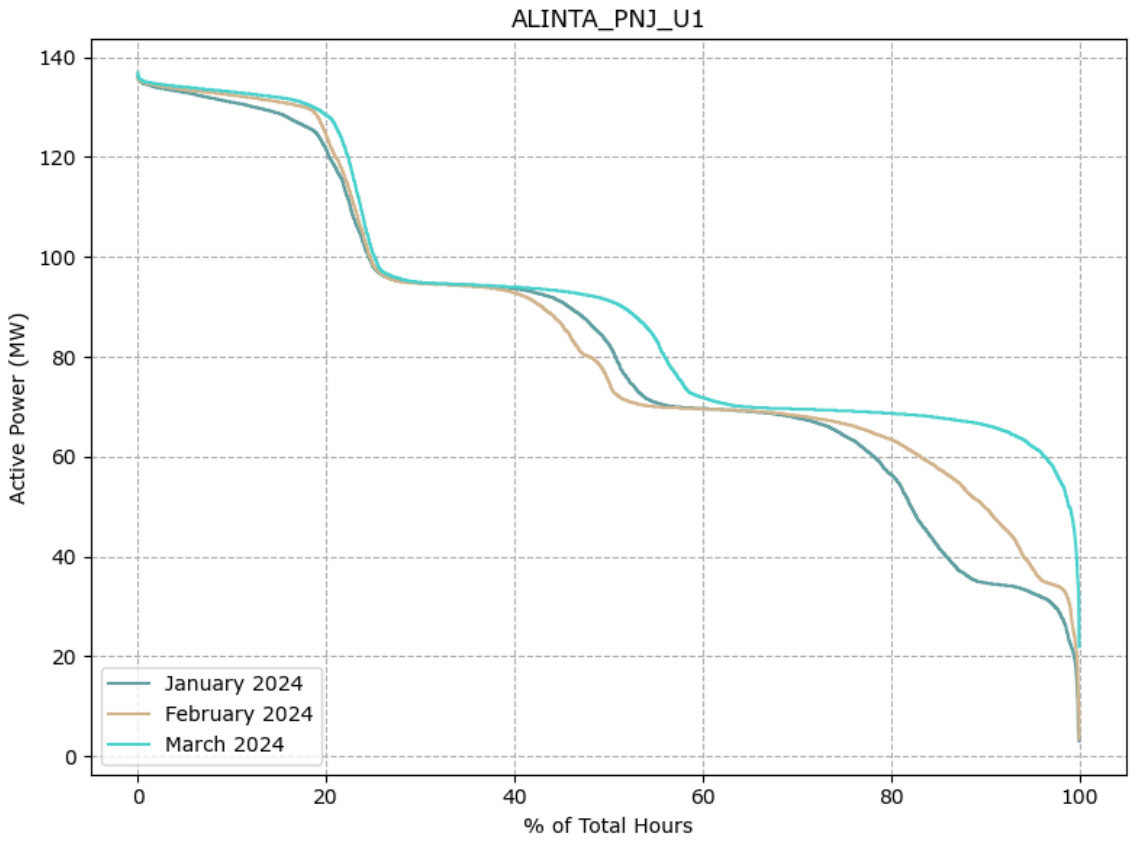
Daily Capacity Factor and Average Energy Capture Price



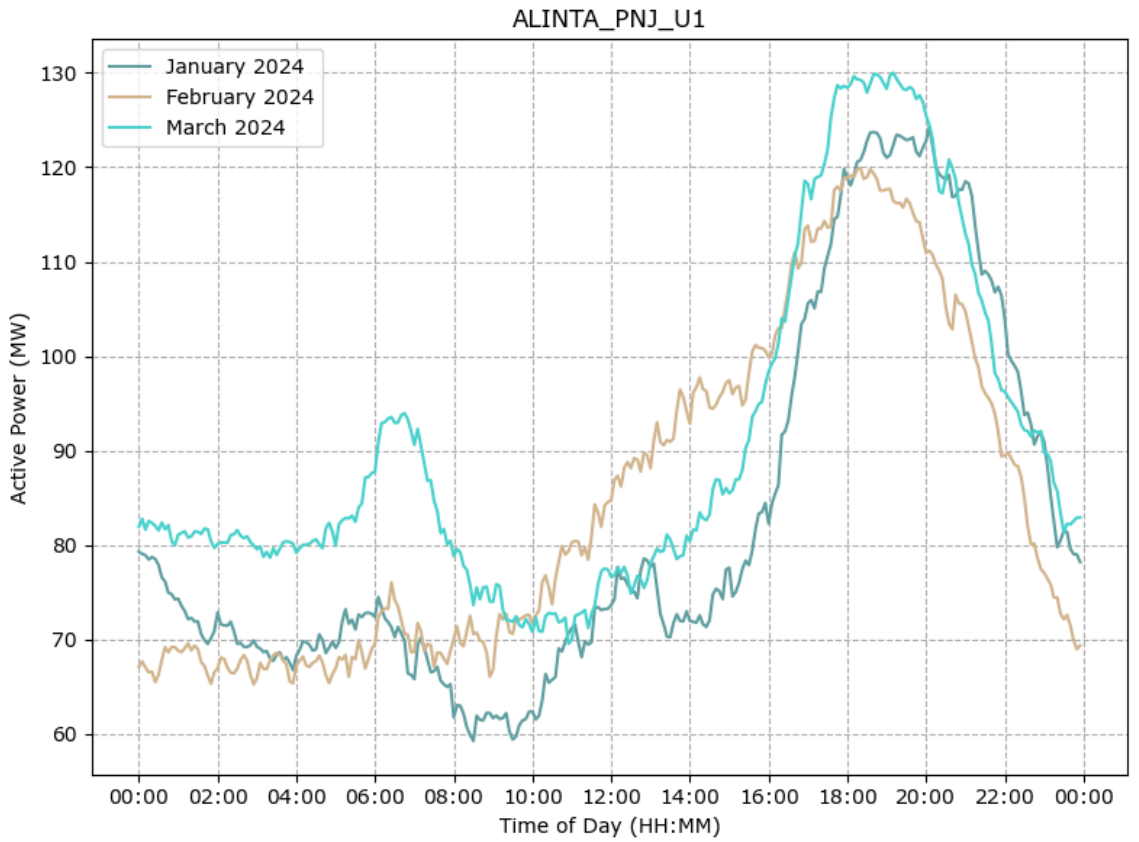
Pinjarra Power Station U1

Gas-fired Scheduled Facility, 143 MW, Alinta Energy

Generation Duration Curves



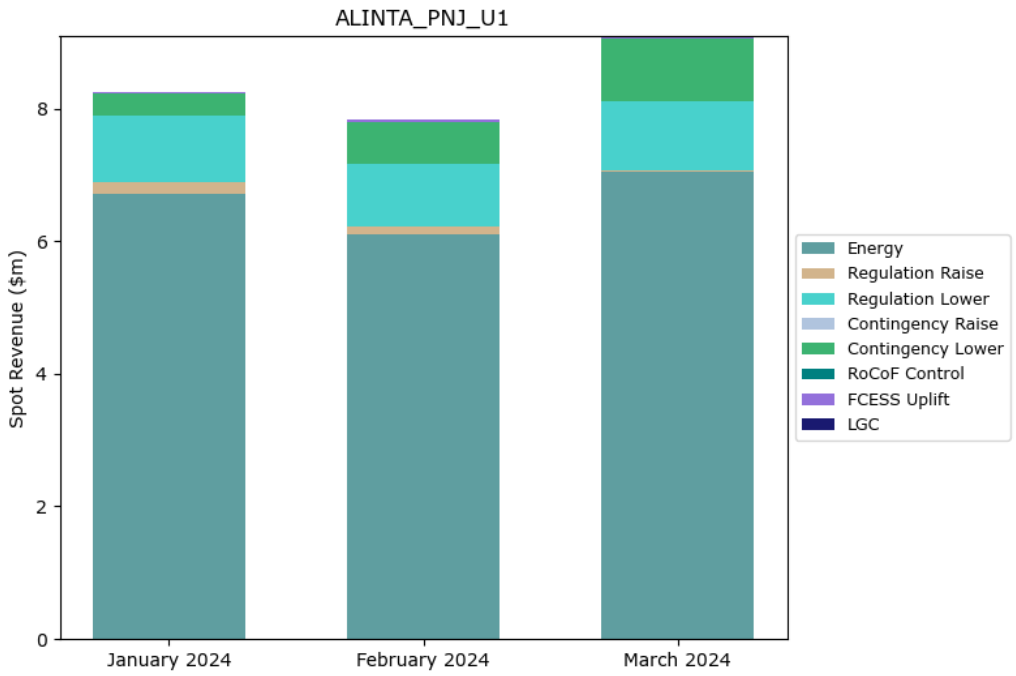
Average Time-of-Day Output



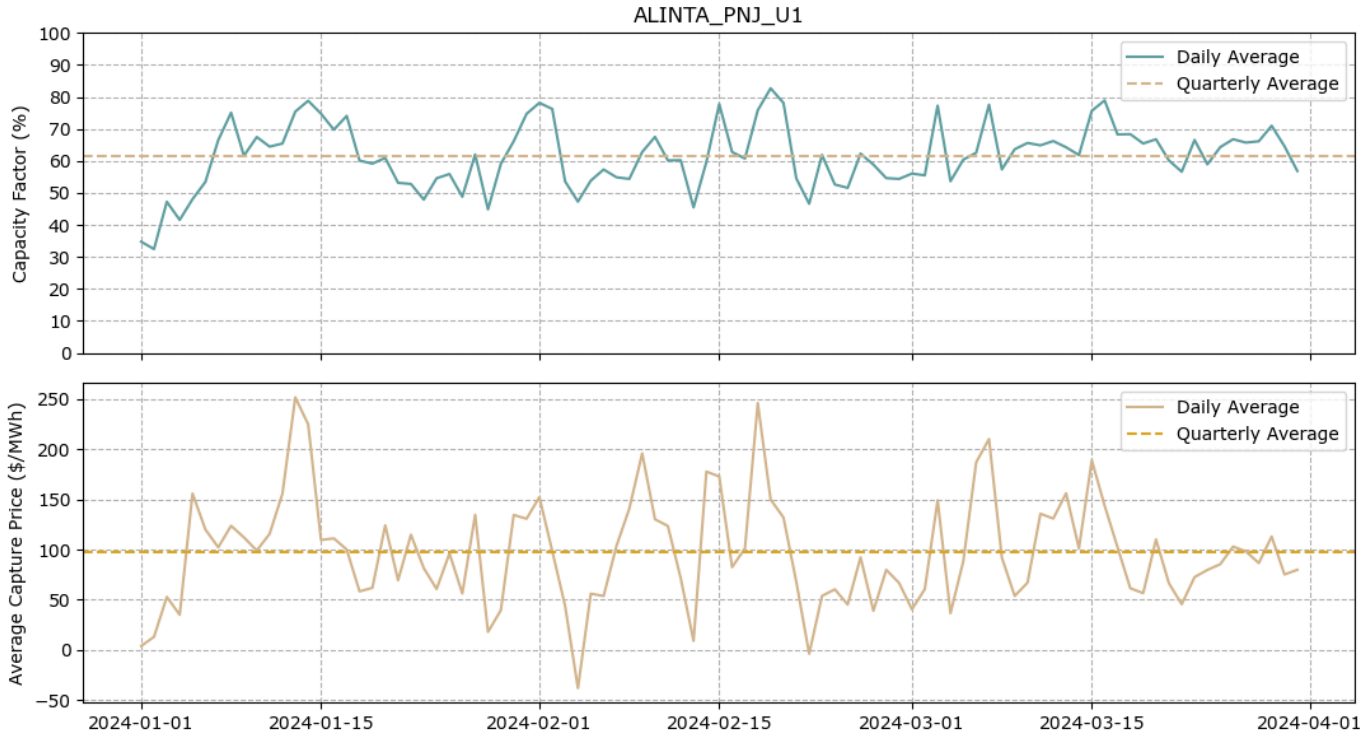
Pinjarra Power Station U1

Gas-fired Scheduled Facility, 143 MW, Alinta Energy

Facility Merchant Spot Revenue



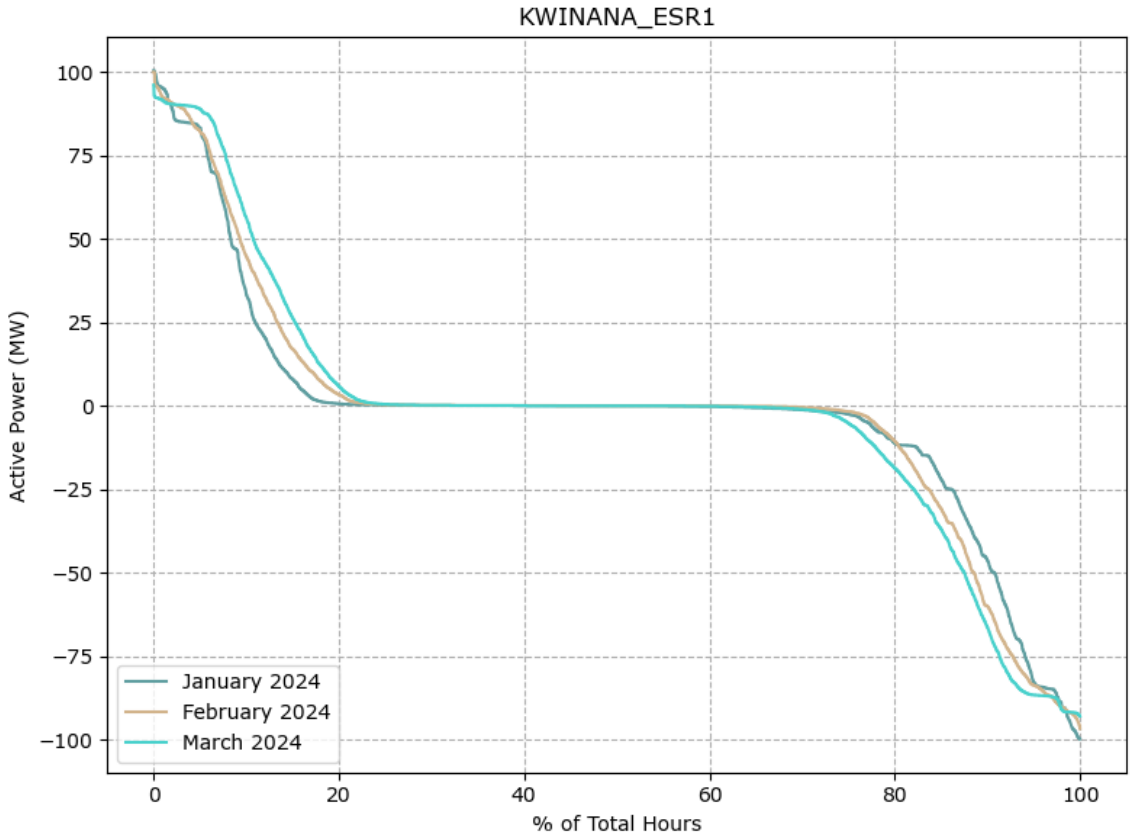
Daily Capacity Factor and Average Energy Capture Price



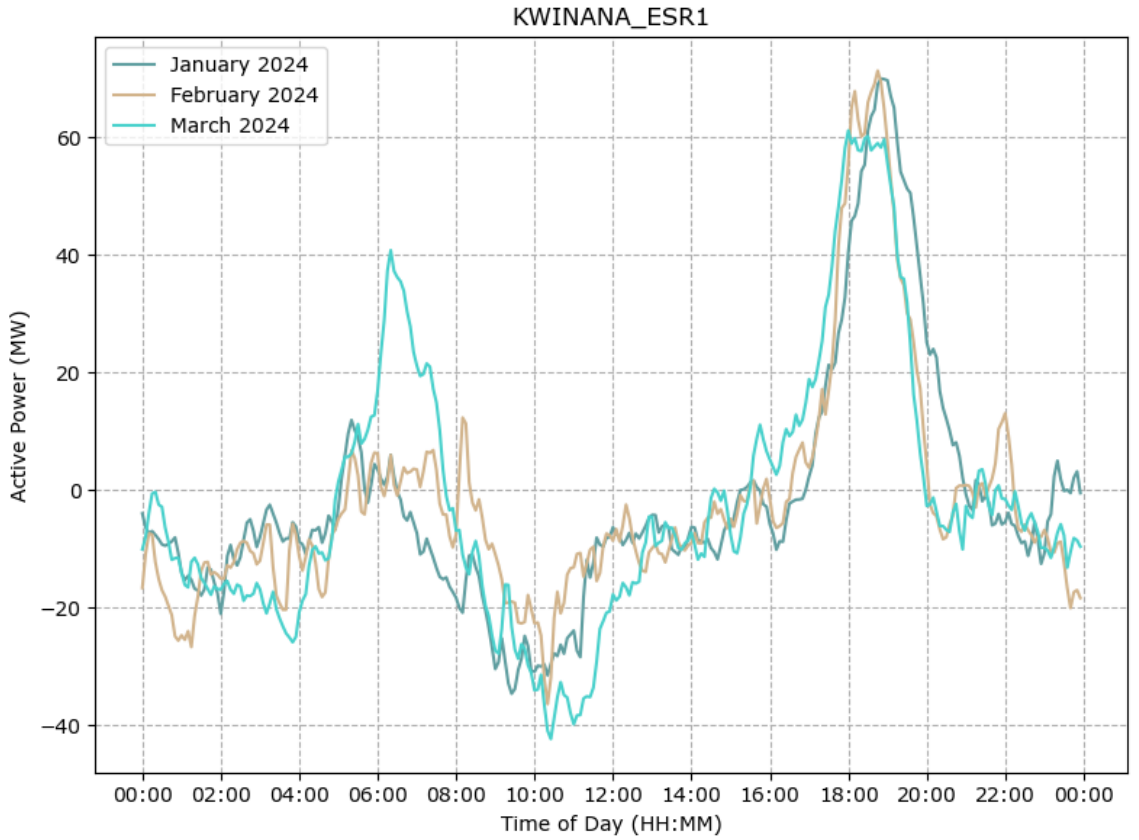
Kwinana BESS 1

Energy Storage Scheduled Facility, 200 MW, Synergy

Generation Duration Curves



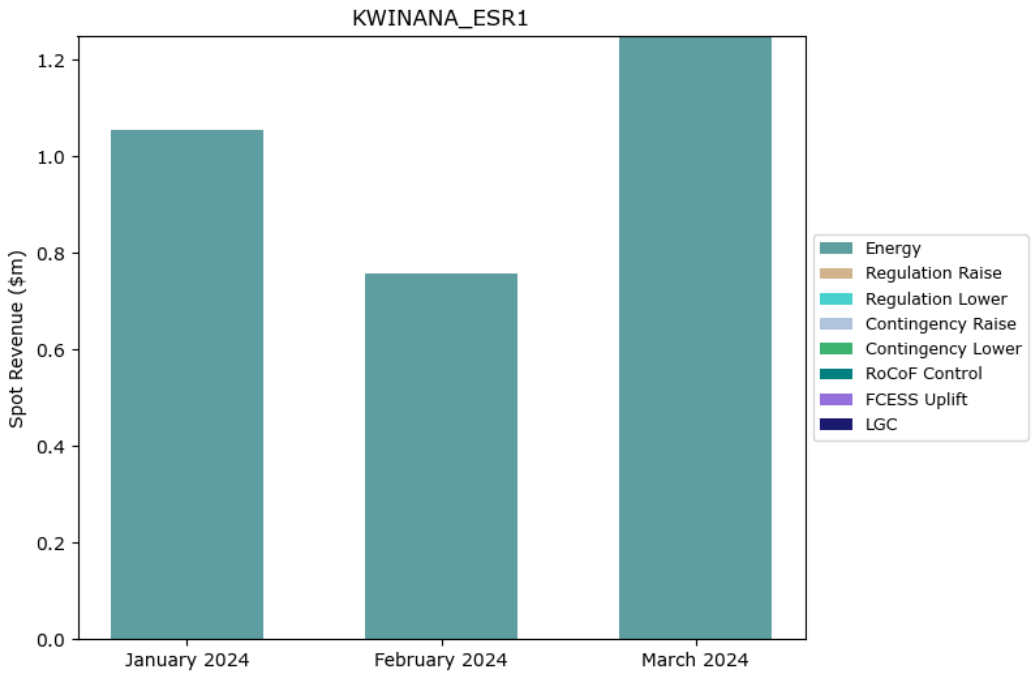
Average Time-of-Day Output



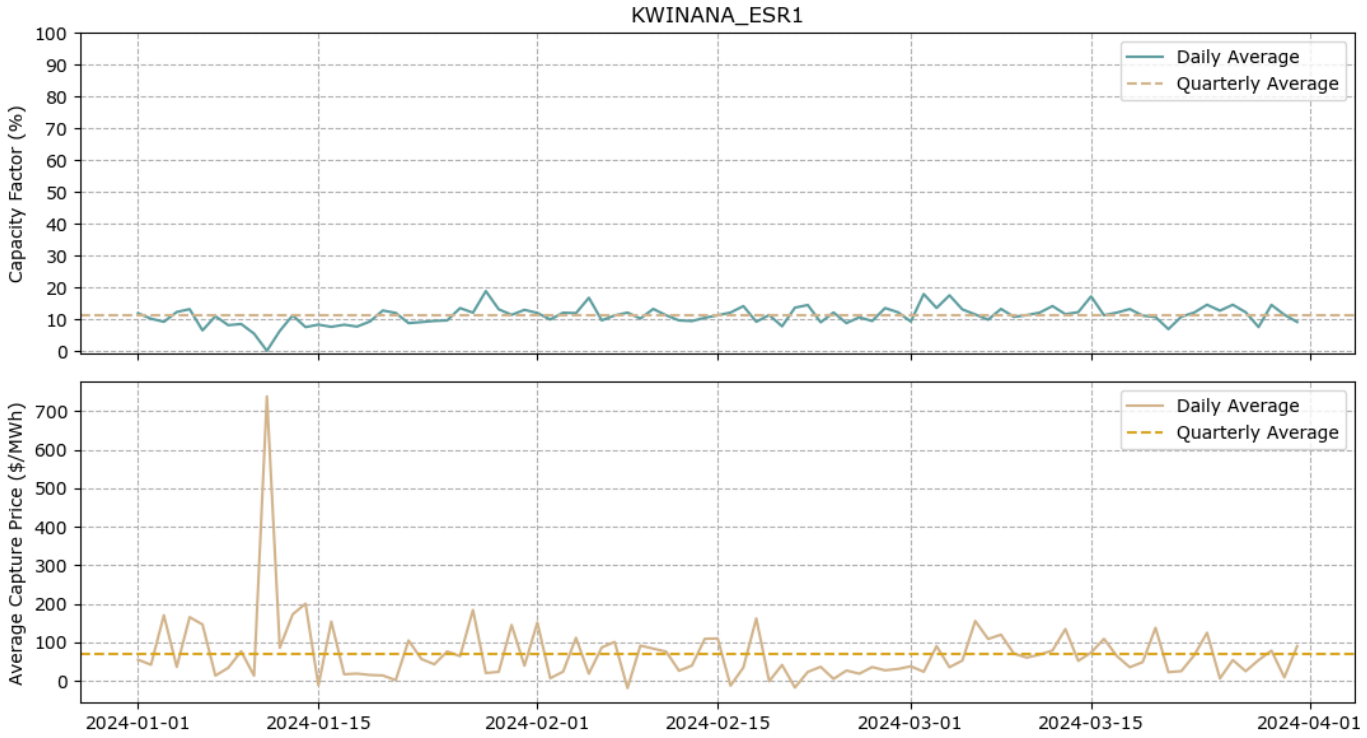
Kwinana BESS 1

Energy Storage Scheduled Facility, 200 MW, Synergy

Facility Merchant Spot Revenue



Daily Capacity Factor and Average Energy Capture Price

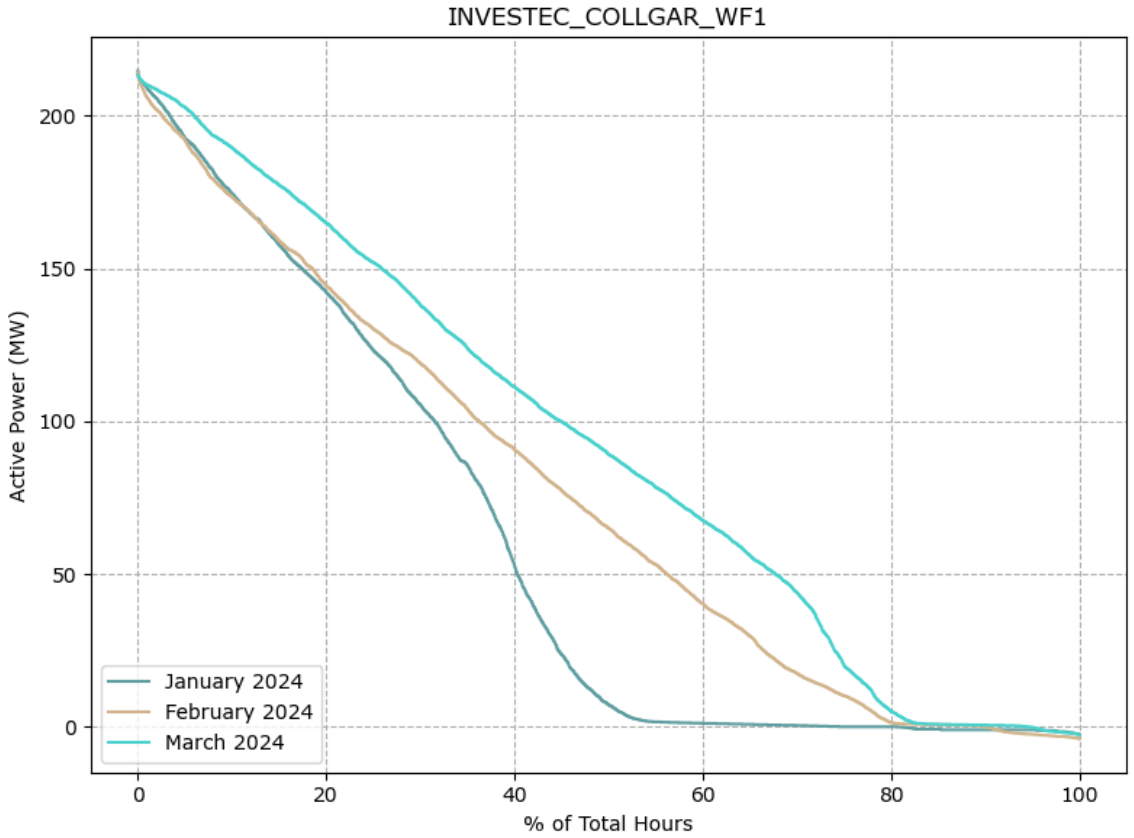


Note that the average energy capture price includes both charging and discharging

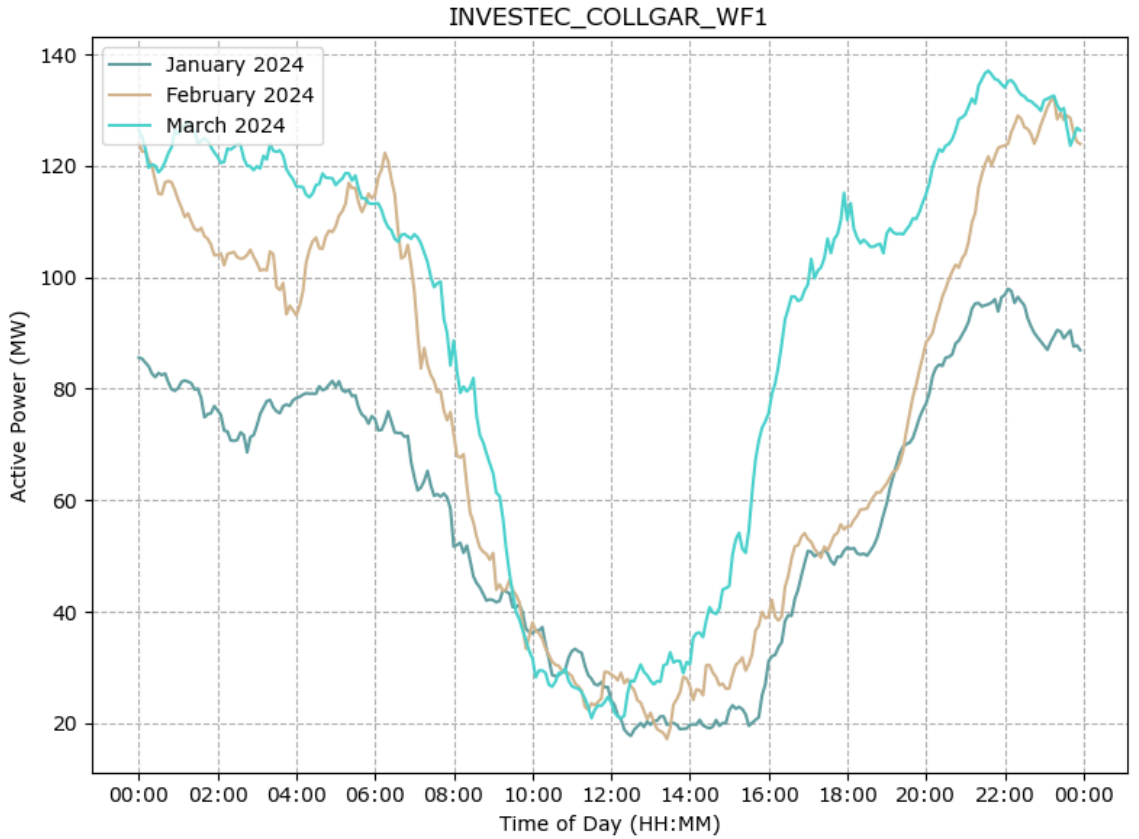
Collgar Wind Farm

Wind Semi-Scheduled Facility, 218.5 MW, Collgar Renewables

Generation Duration Curves



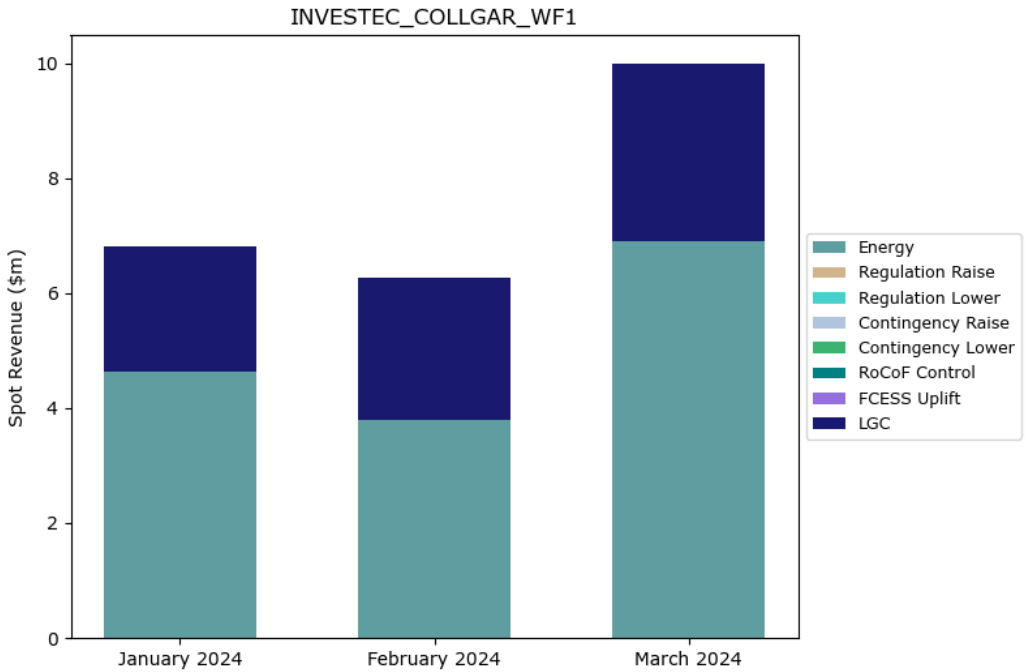
Average Time-of-Day Output



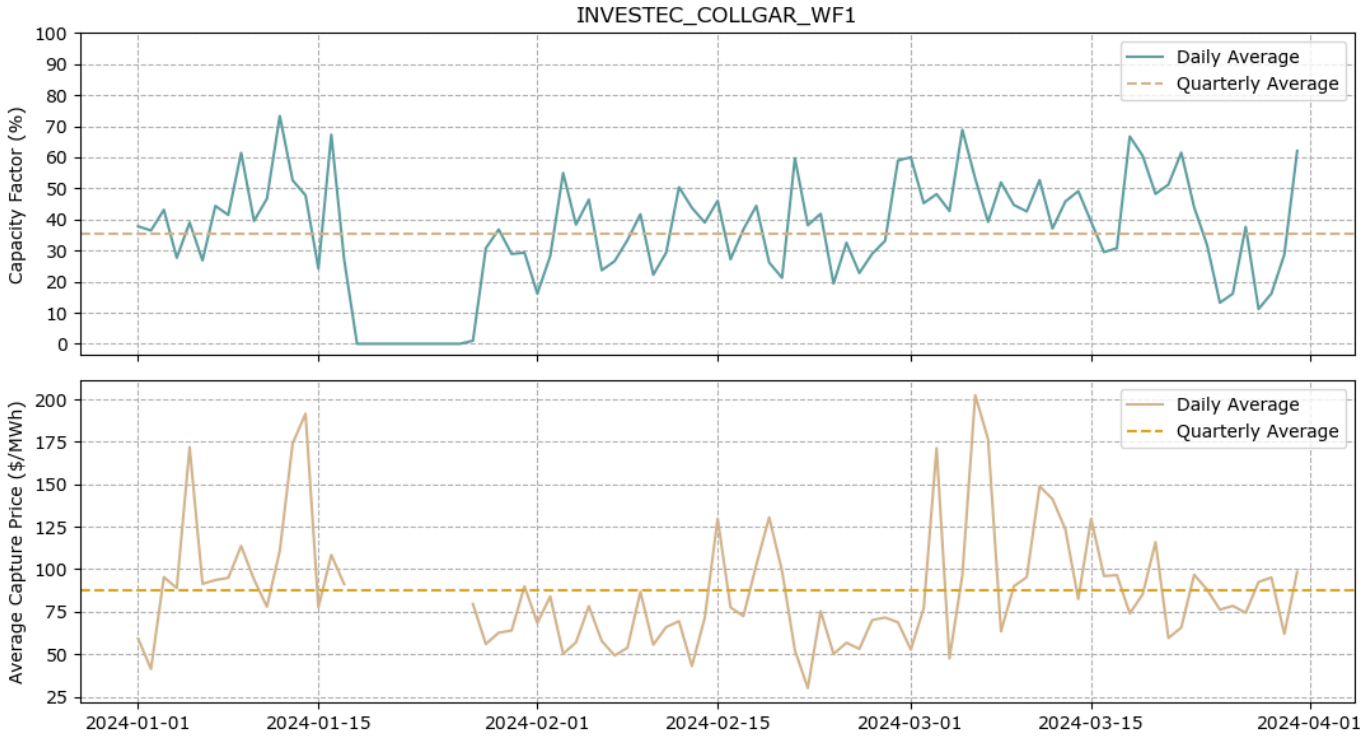
Collgar Wind Farm

Wind Semi-Scheduled Facility, 218.5 MW, Collgar Renewables

Facility Merchant Spot Revenue



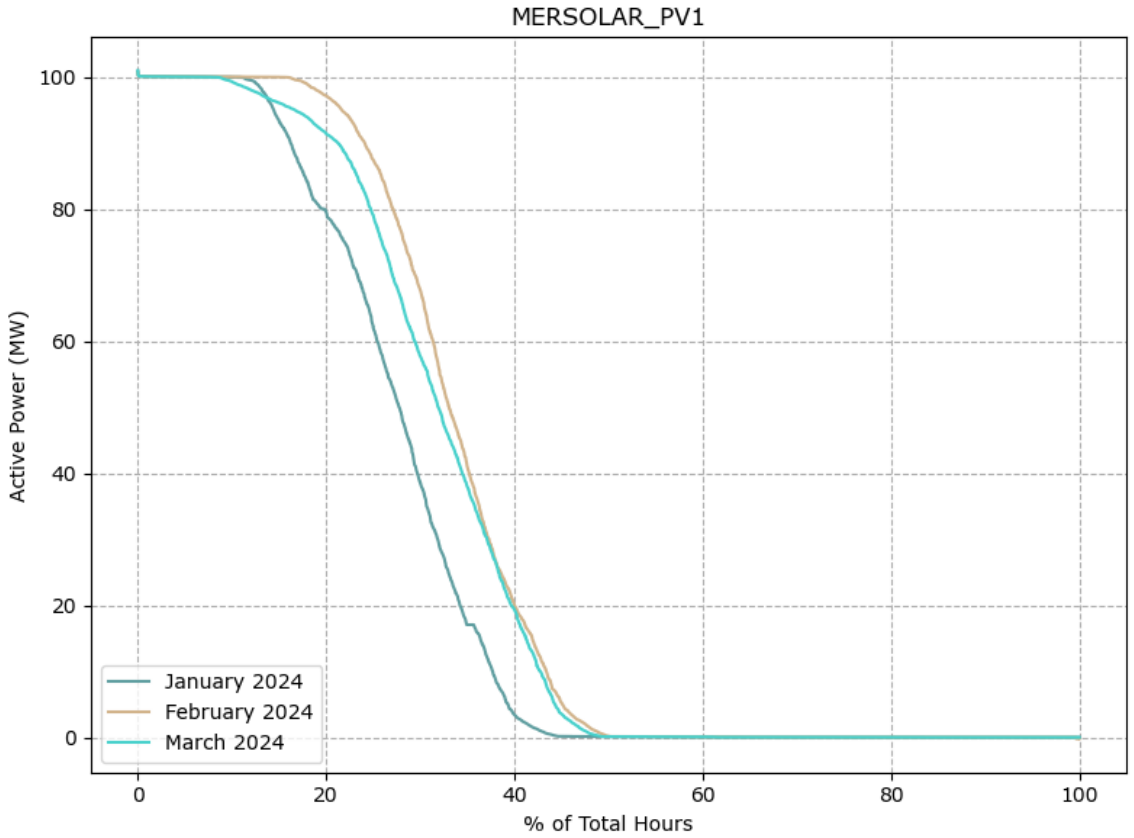
Daily Capacity Factor and Average Energy Capture Price



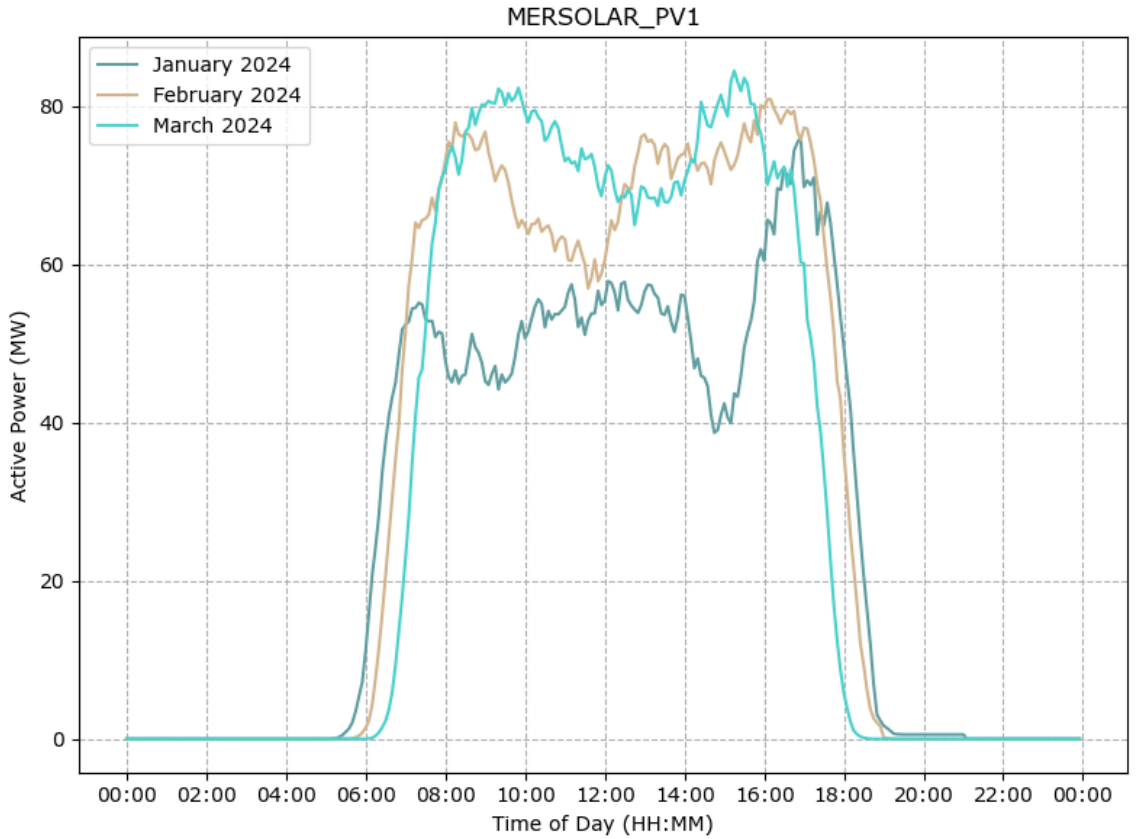
Merredin Solar Farm

Solar PV Semi-Scheduled Facility, 100 MW, SUN Energy

Generation Duration Curves



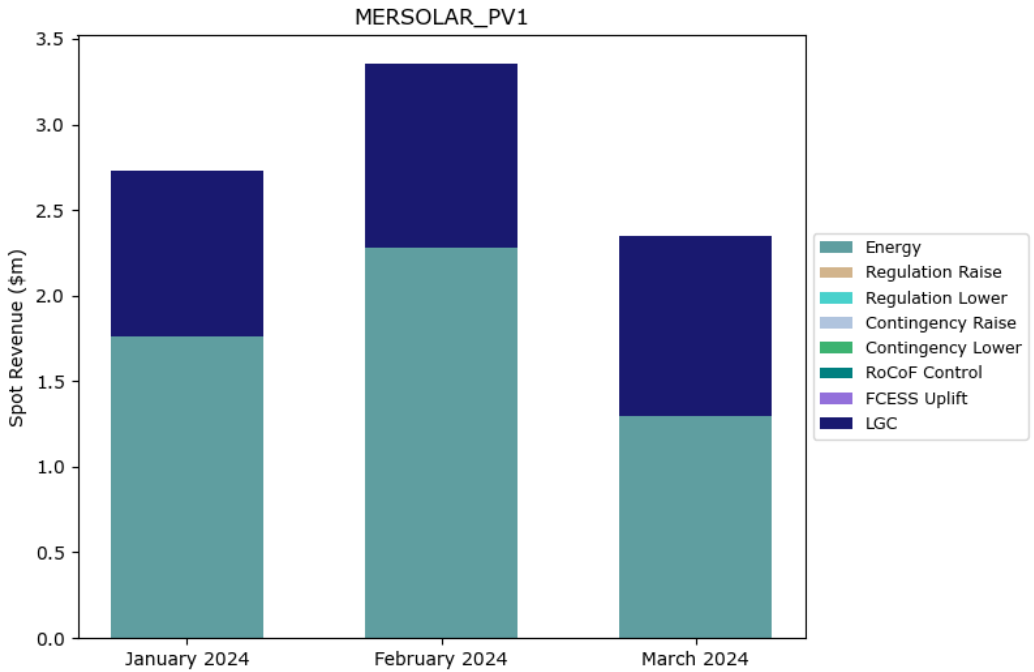
Average Time-of-Day Output



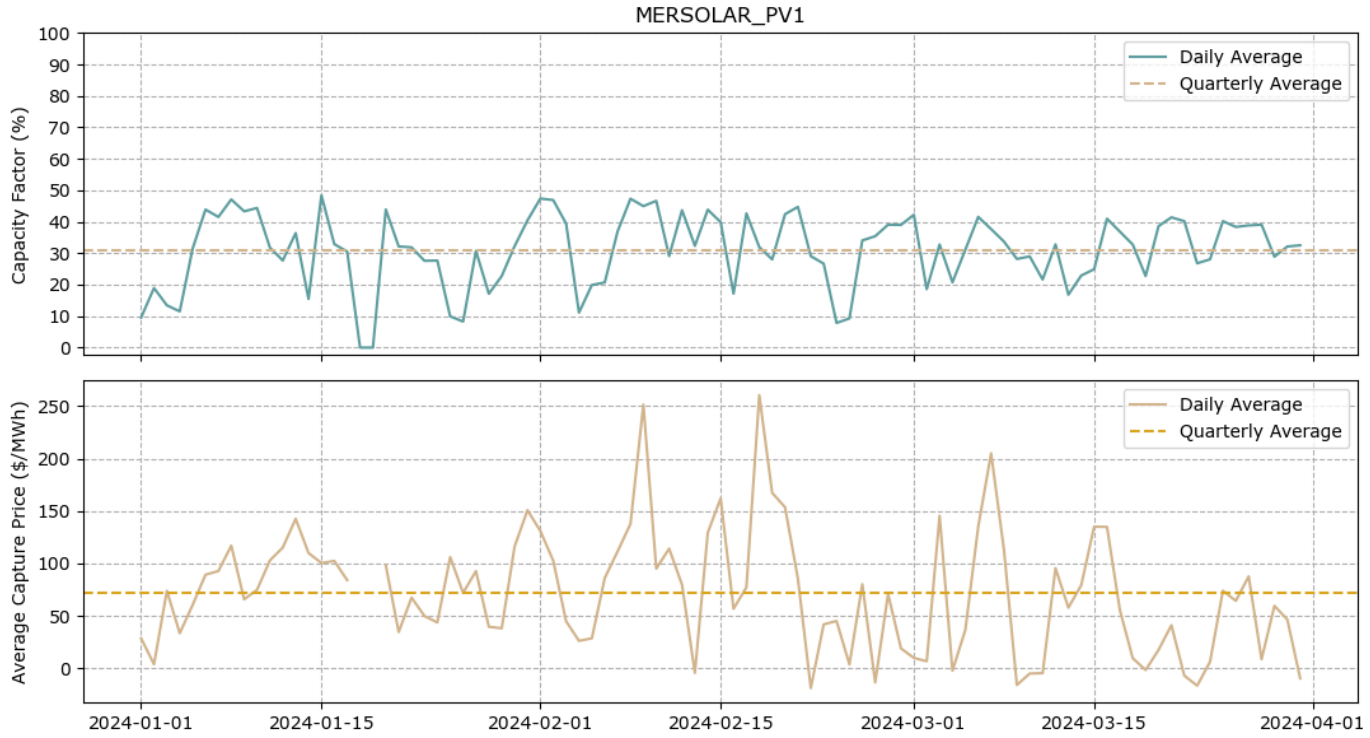
Merredin Solar Farm

Solar PV Semi-Scheduled Facility, 100 MW, SUN Energy

Facility Merchant Spot Revenue



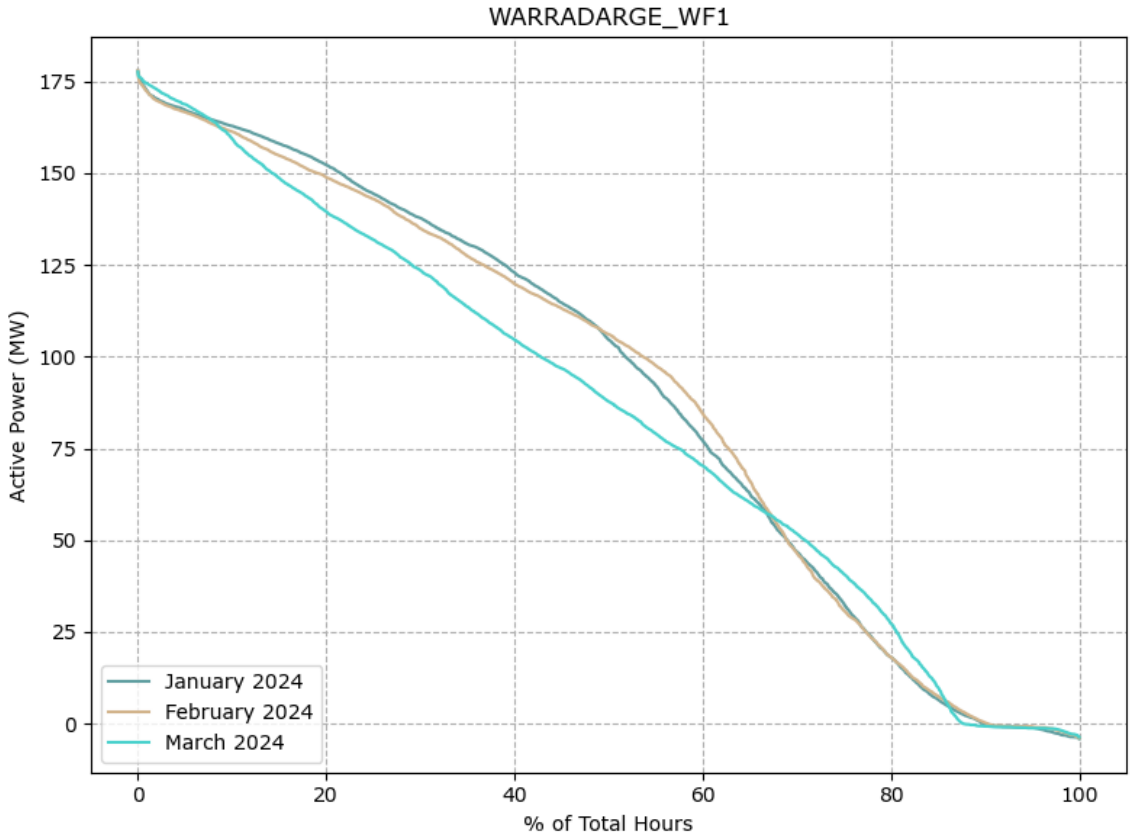
Daily Capacity Factor and Average Energy Capture Price



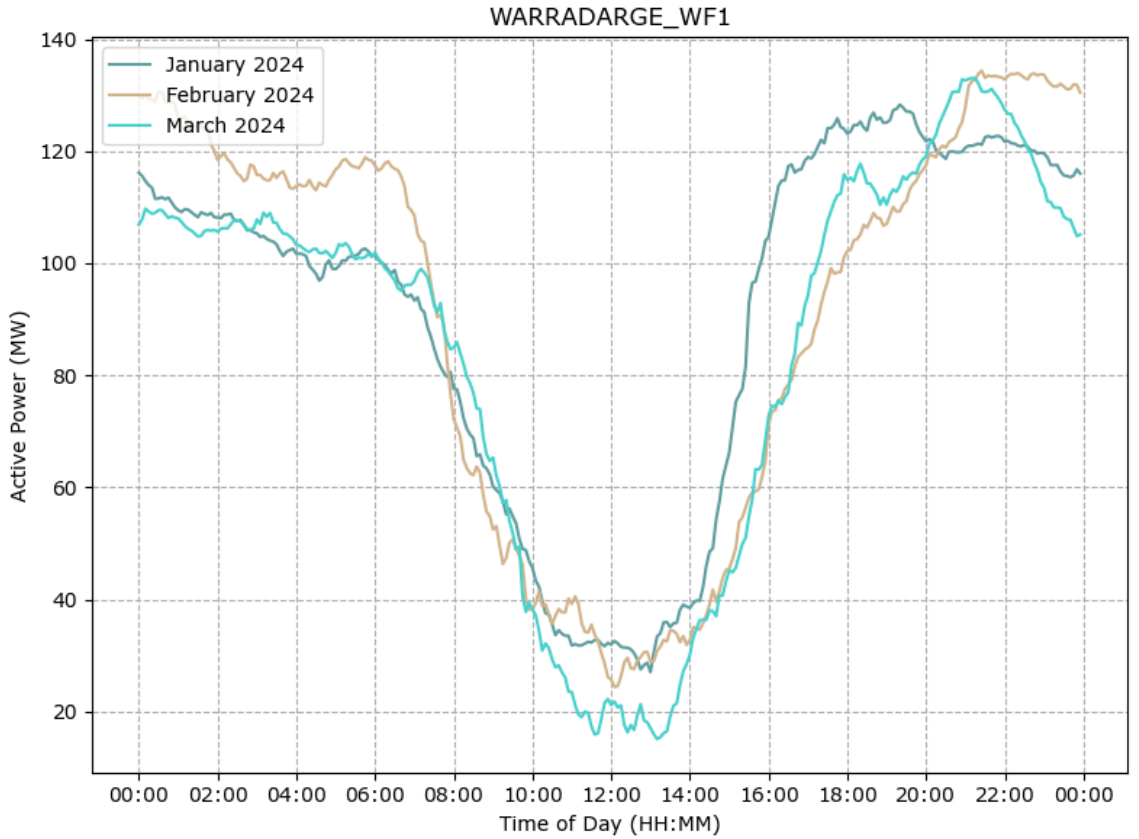
Warradarge Wind Farm

Wind Semi-Scheduled Facility, 180 MW, Bright Energy Investments

Generation Duration Curves



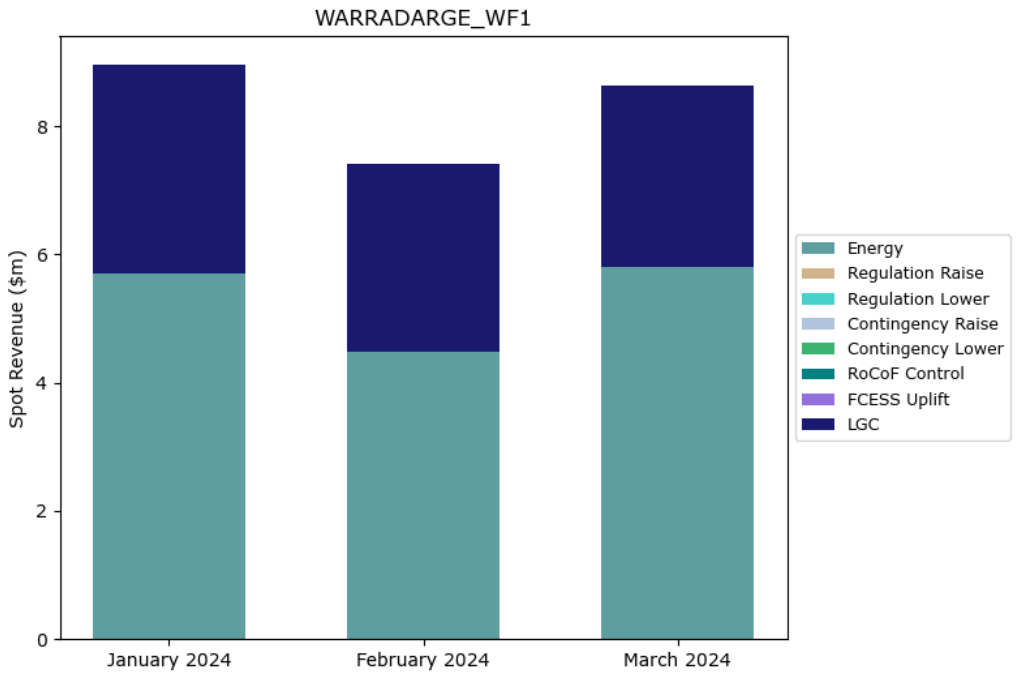
Average Time-of-Day Output



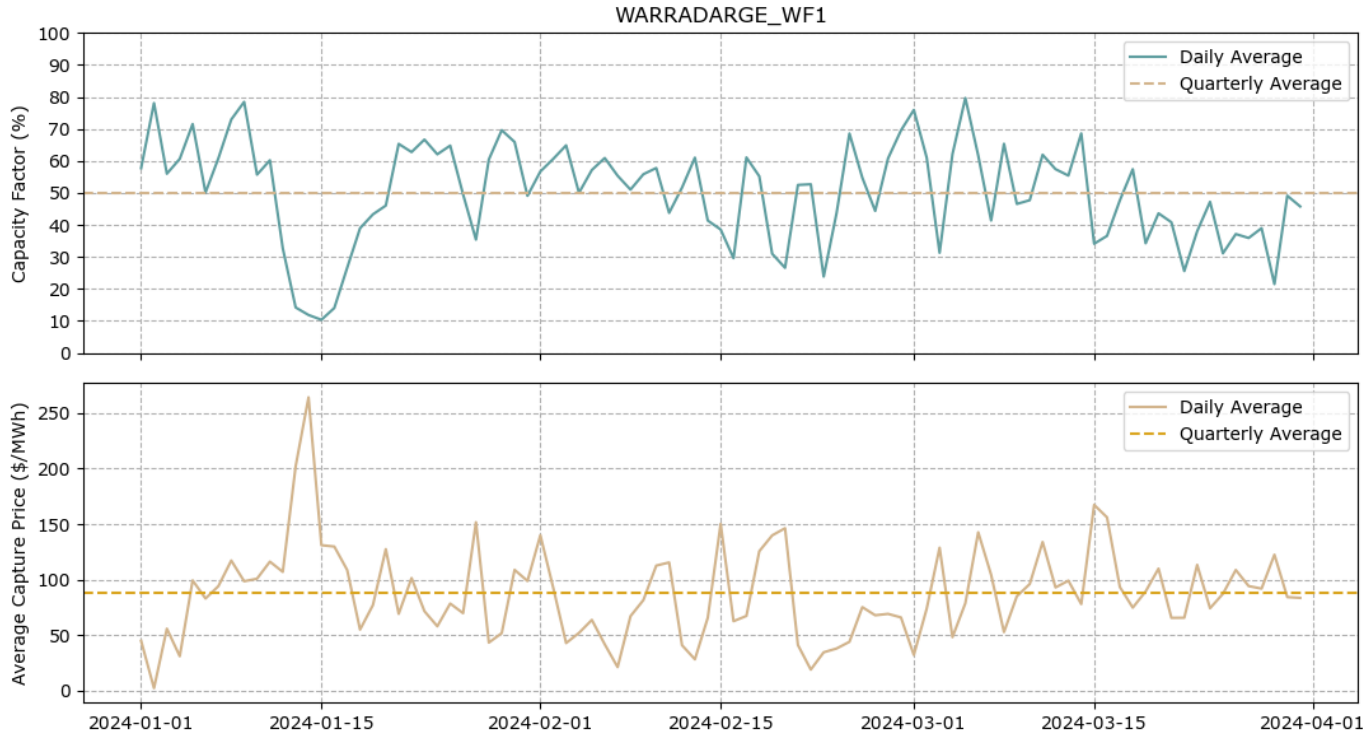
Warradarge Wind Farm

Wind Semi-Scheduled Facility, 180 MW, Bright Energy Investments

Facility Merchant Spot Revenue



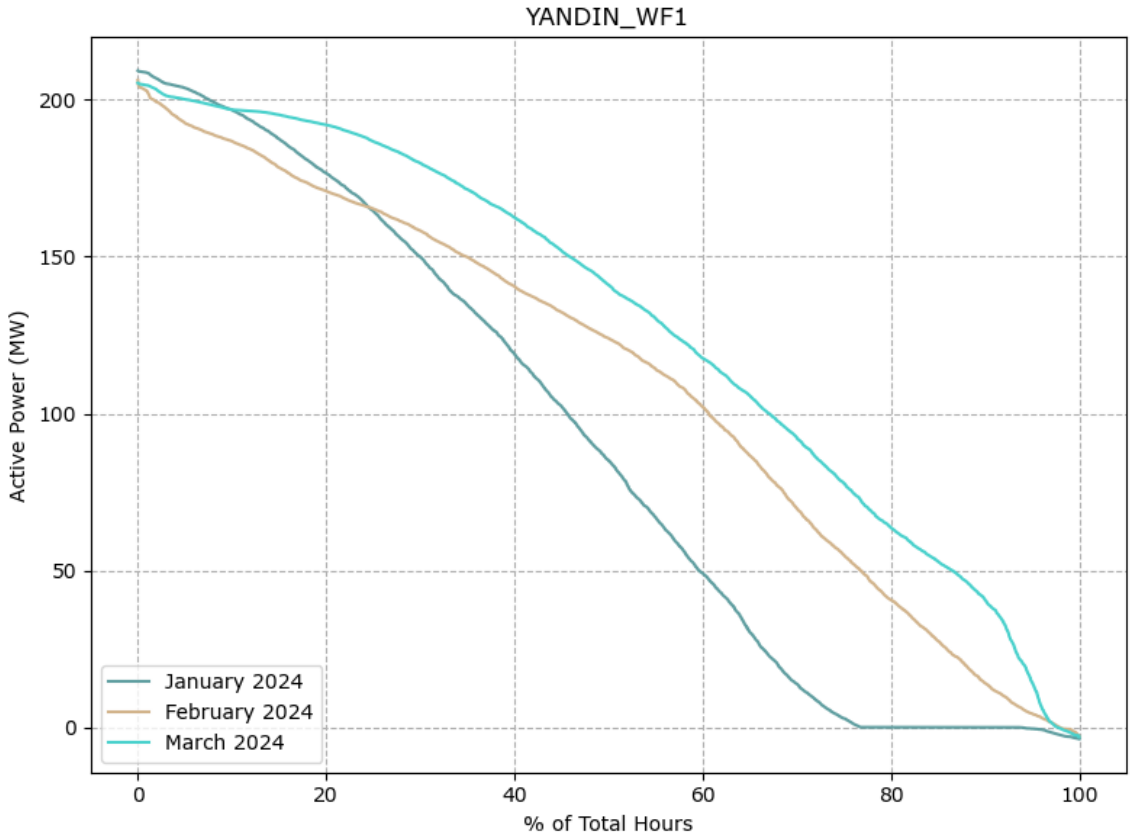
Daily Capacity Factor and Average Energy Capture Price



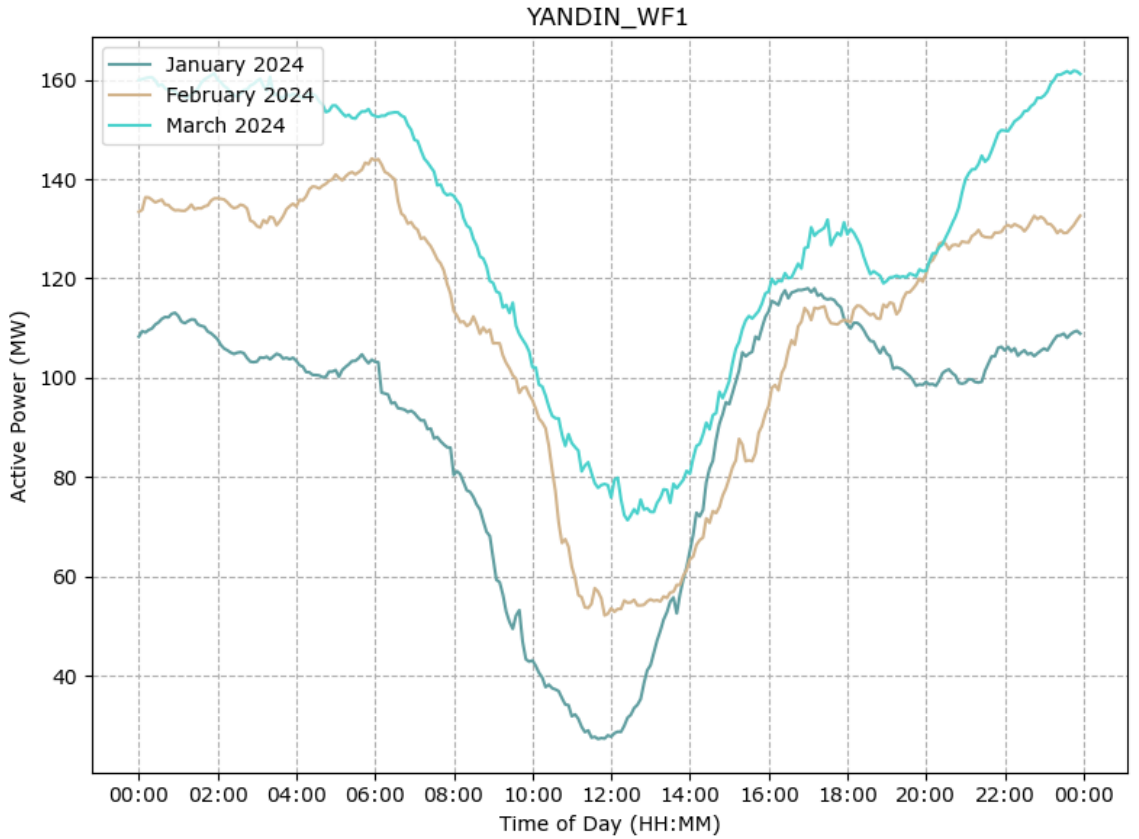
Yandin Wind Farm

Wind Semi-Scheduled Facility, 214.2 MW, Alinta Energy

Generation Duration Curves



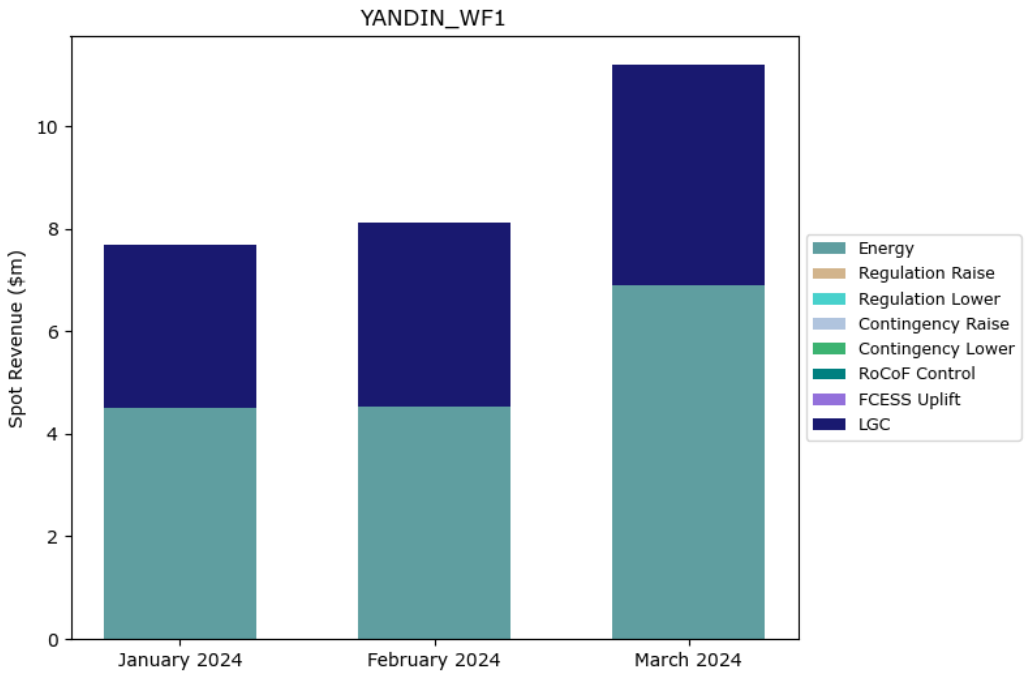
Average Time-of-Day Output



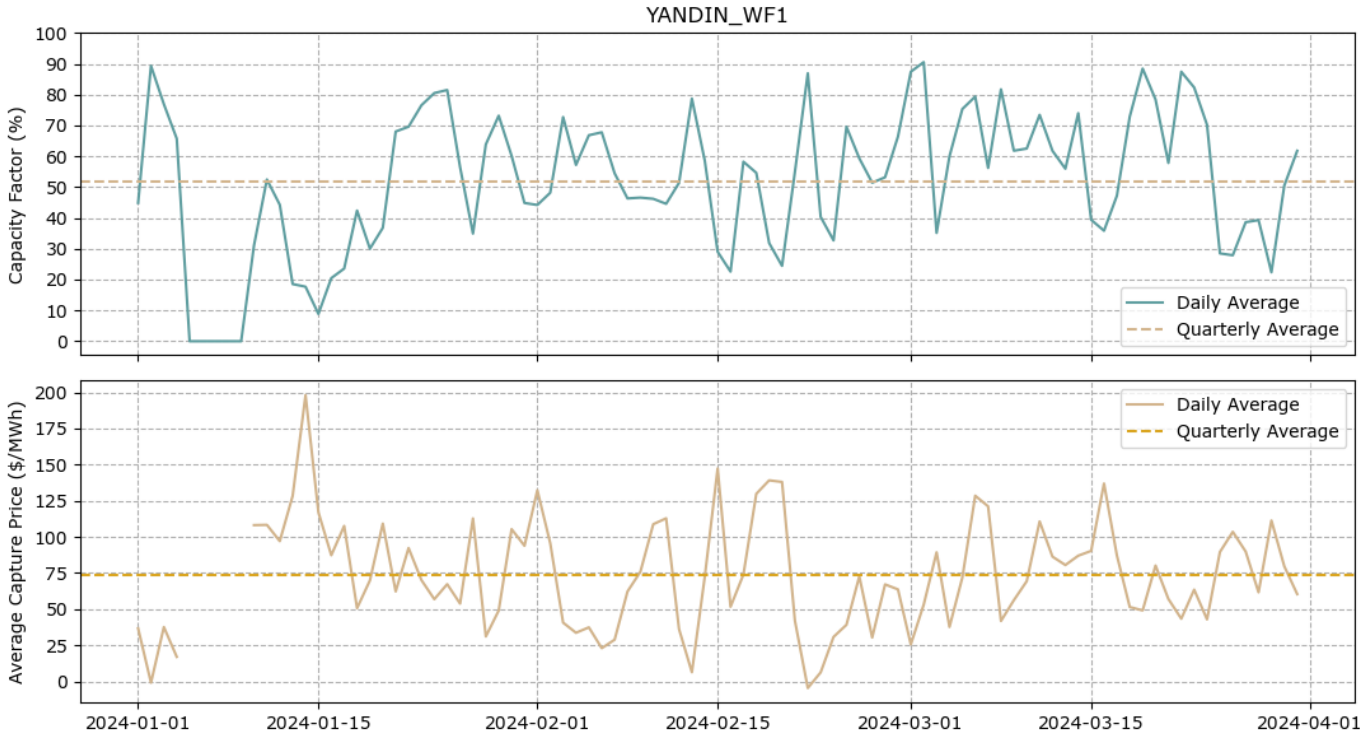
Yandin Wind Farm

Wind Semi-Scheduled Facility, 214.2 MW, Alinta Energy

Facility Merchant Spot Revenue



Daily Capacity Factor and Average Energy Capture Price



For more WEM resources, please visit:
https://amperelabs.com.au/wem/

Or reach out for more information:
wem@amperelabs.com.au

Disclaimer and Copyright

This document is provided “as is” for your information only and no representation or warranty, express or implied, is given by Ampere Labs Pty Ltd (“Ampere Labs”), its directors, employees, agents or affiliates (together its “Associates”) as to its accuracy, reliability or completeness. Ampere Labs and its Associates assume no responsibility, and accept no liability for, any loss arising out of your use of this document. This document is not to be relied upon for any purpose or used in substitution for your own independent analyses and sound judgment. The information contained in this document reflects Ampere Labs’ views, assumptions and expectations as at the date of this document and may be subject to change.