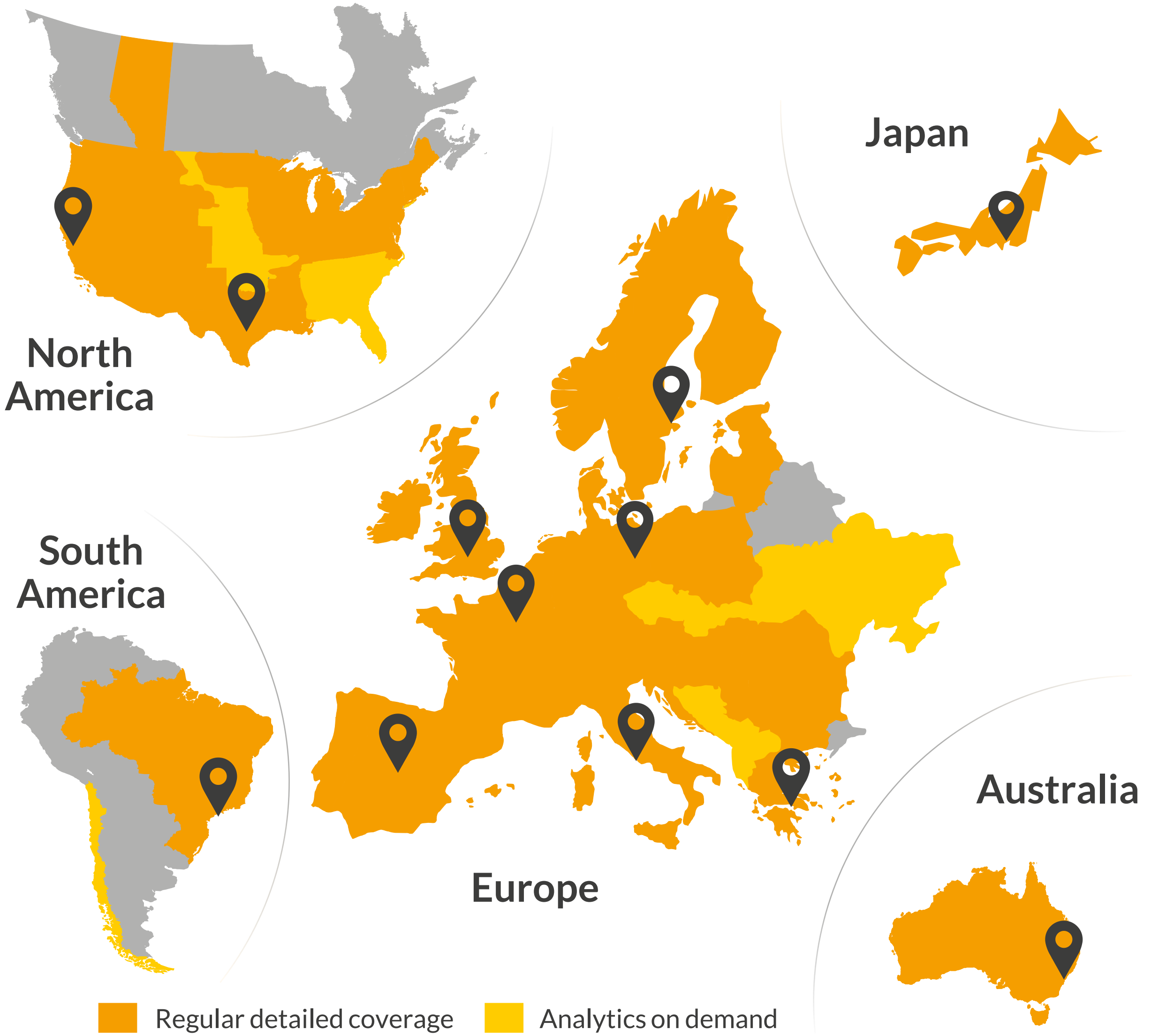
AURORA
ENERGY RESEARCH

GB Market Summary February 2024

Published March 2024

Aurora provides market leading forecasts & data-driven intelligence for the global energy transition

- Power markets
- Renewables
- Storage
- Electric vehicles
- Hydrogen H_2
- Carbon CO_2
- Natural gas



12 Offices
Oxford | Berlin | Madrid | Athens
Paris | Sydney | Austin | Oakland
Rome | Stockholm | Tokyo
São Paulo

500+
market experts

750+
subscribing companies

150+
transactions supported in 2022

Source: Aurora Energy Research

Executive Summary

- The average power price in February was £58.6/MWh, a 18.2% decrease since the average of £71.7/MWh in January and a 56.9% decrease year-on-year
- This was partially driven by a 14.8% reduction in the average gas price. The carbon price also fell 3.2%, to an average of £51.8/tCO_2 contributing to February's lower power price
- Transmission demand was 14.1% lower in February, and generation fell to match this reduced demand
- Low carbon generation was 5.3% lower month-on-month, whilst thermal generation was 38.6% lower, leading to grid carbon intensity falling 24.5%

		Monthly value[1]	Month-on-month change	Year-on-year change	Slide reference(s)
System Performance	**Power prices**, *£/MWh*	58.6	-13.1 (18.2%)	-77.2 (56.9%)	5, 6
	Gas prices, *£/MWh*	21.6	-3.8 (14.8%)	-24.2 (52.8%)	8
	Carbon[2] prices, *£/tCO_2*	51.8	-1.7 (3.2%)	-45.5 (46.8%)	9
	Transmission demand, *TWh*	21.8	-3.6 (14.1%)	+0.8 (3.9%)	12
	Low carbon[3] generation, *TWh*	13.9	-0.8 (5.3%)	+2.1 (17.8%)	13, 14
	Thermal[4] generation, *TWh*	5.9	-3.7 (38.6%)	-1.6 (21.6%)	13, 14
	Grid carbon intensity, *gCO_2e/kWh*	134.4	-43.6 (24.5%)	-40.0 (22.9%)	16
Capture Prices	**Offshore wind**, *£/MWh*	55.7	-12.4 (18.3%)	-70.4 (55.8%)	20
	Onshore wind, *£/MWh*	55.1	-10.4 (15.9%)	-75.7 (57.9%)	20
	Solar PV, *£/MWh*	59.5	-13.4 (18.4%)	-71.0 (54.4%)	20

		Monthly value[1]	Variance to historical monthly average[5]	Slide reference(s)
Load Factors	**Offshore wind**, *%*	49.5	-7.6 p.p.	19
	Onshore wind, *%*	37.9	-5.1 p.p.	19
	Solar PV, *%*	4.5	-1.8 p.p.	19

1) Values averaged over the calendar month. 2) Includes CPS and EU ETS until 18th May 2021 and UK ETS from 19th May 2021 onwards; 3) Includes renewables and nuclear generation 4) Includes CCGTs, coal and other fossil plants; 5) Comparing to the average of same month in the previous 5 years.

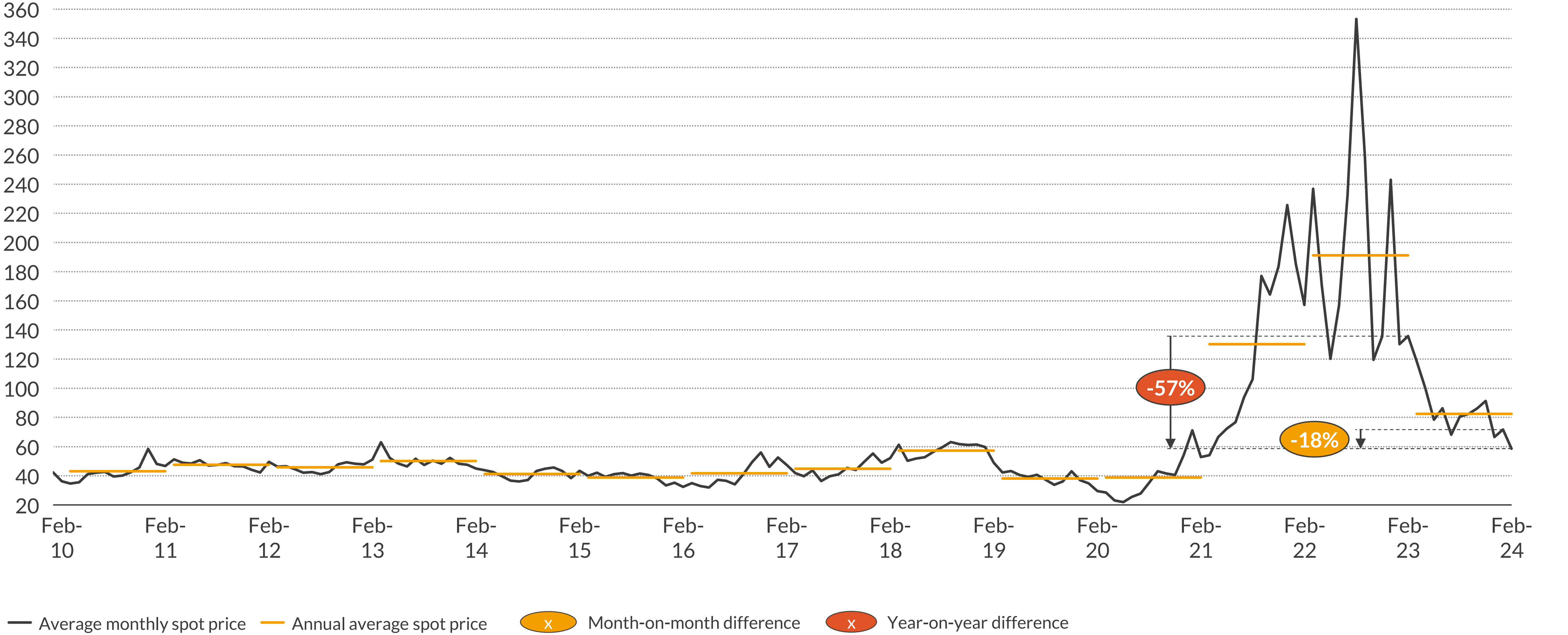
Sources: Aurora Energy Research, Thomson Reuters, National Grid, Ofgem, Elexon

Agenda

Historic monthly average EPEX spot price

AURORA

Average EPEX spot price[1]
£/MWh



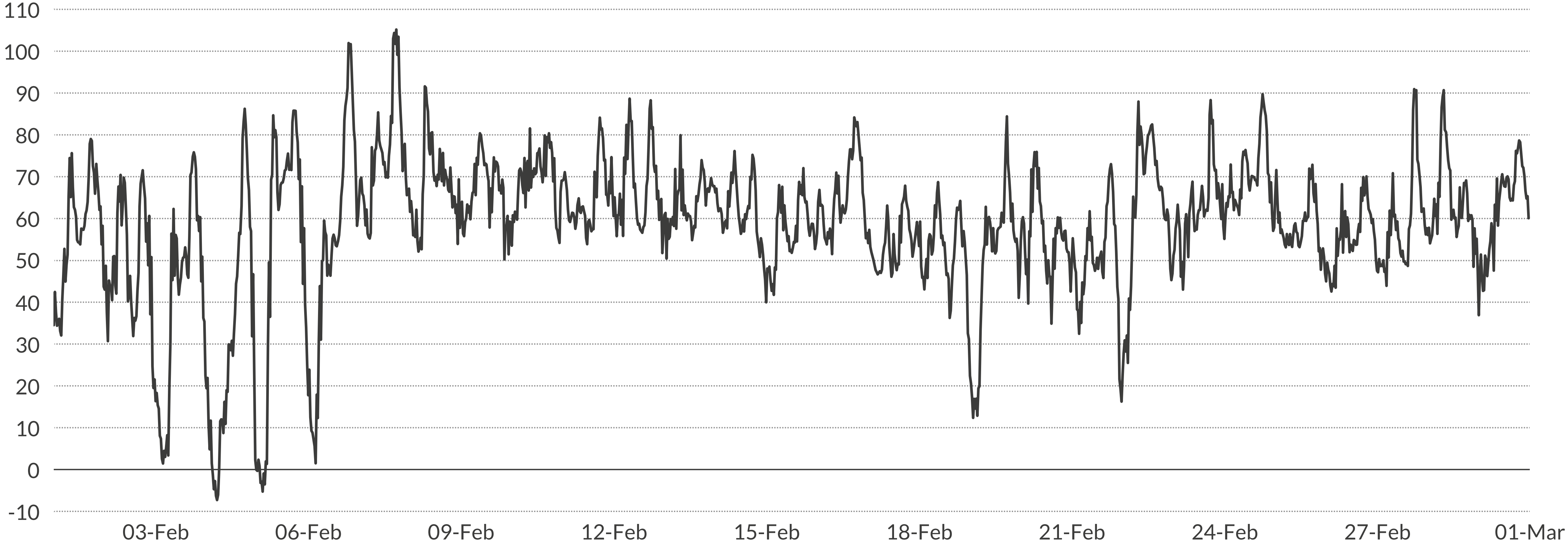
1) Average monthly EPEX is the average over the month of the volume-weighted reference prices for each half-hour interval.

Sources: Aurora Energy Research, Thomson Reuters

Half-hourly EPEX spot price for February

EPEX spot price[1]
£/MWh

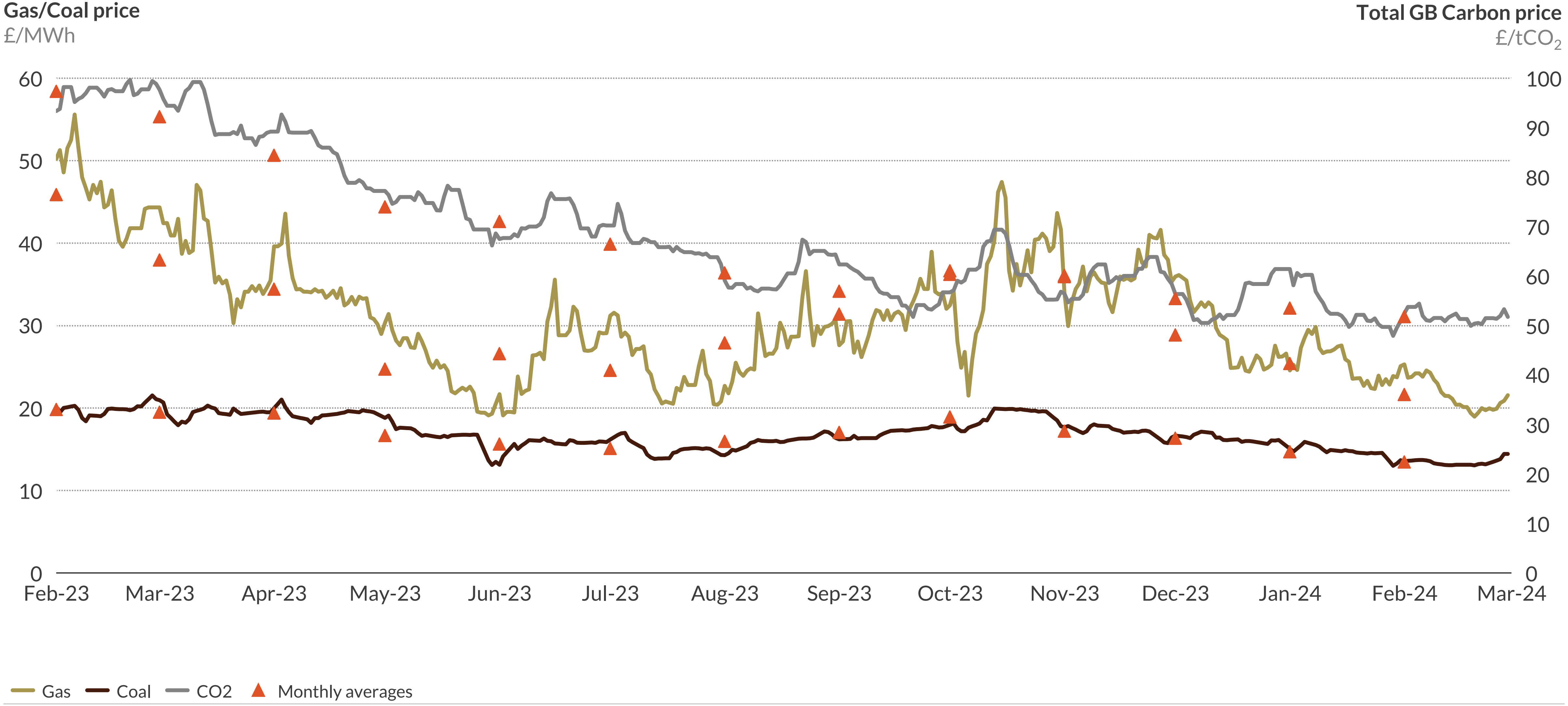
Monthly average price in February 2024: 58.62 £/MWh



1) Half-hourly EPEX is the volume-weighted reference price over that half-hour interval, as provided by EPEX Spot

Sources: Aurora Energy Research, Thomson Reuters

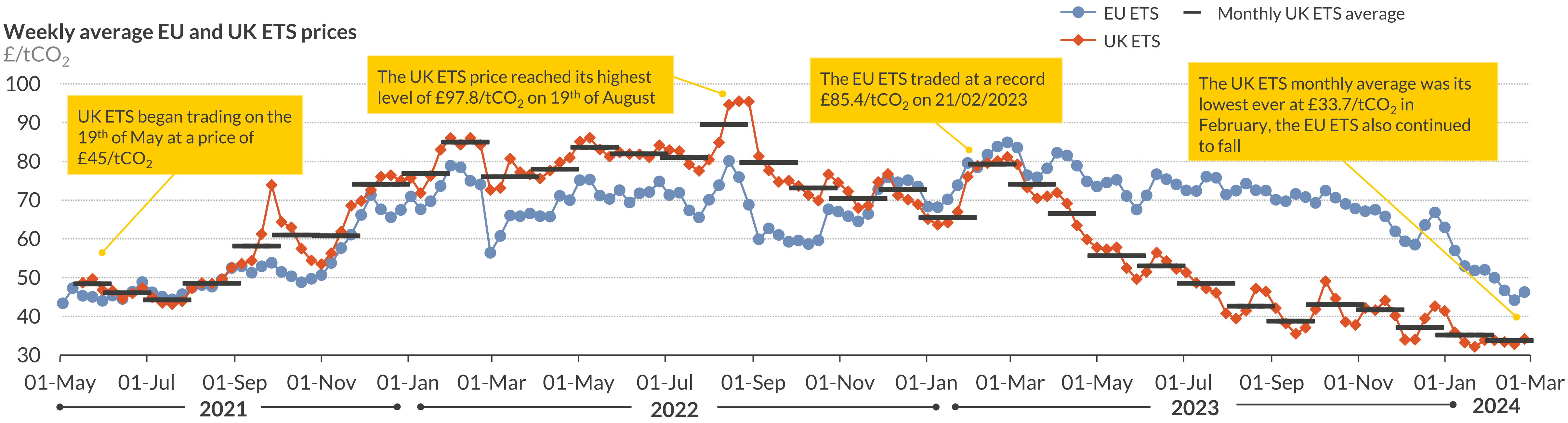
Historic fuel prices
Gas, Coal and Carbon daily prices

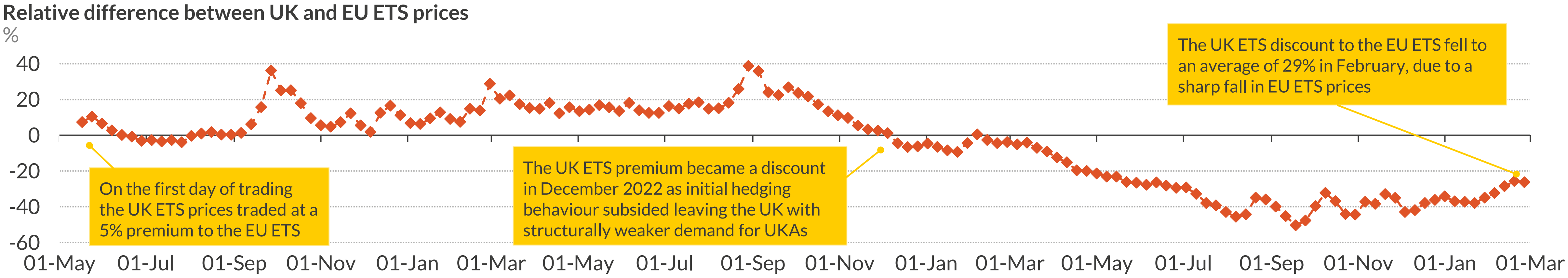


Sources: Aurora Energy Research, Thomson Reuters

Historic weekly UK ETS and EU ETS Prices

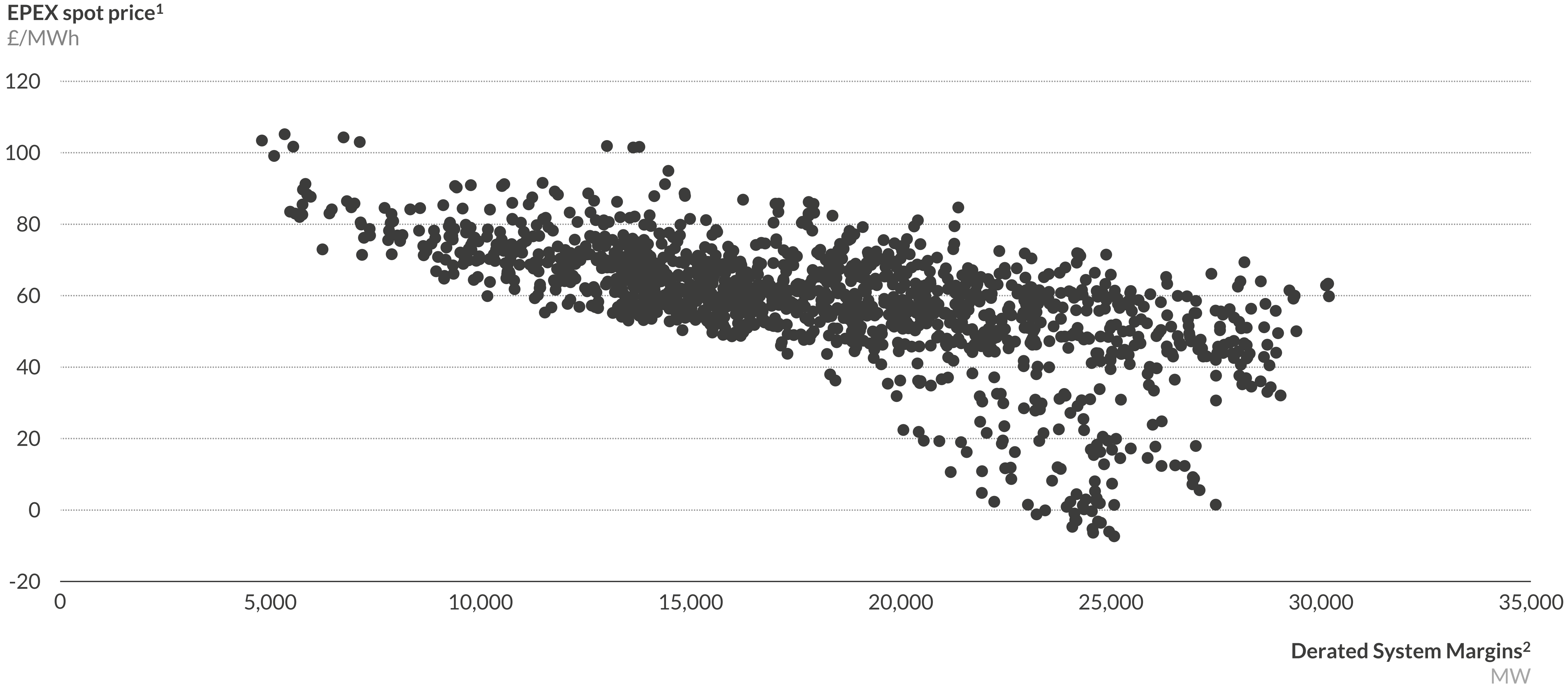
AURORA





Sources: Aurora Energy Research, ICE Futures, Bank of England

Half-hourly spot prices against half-hourly system margins for February

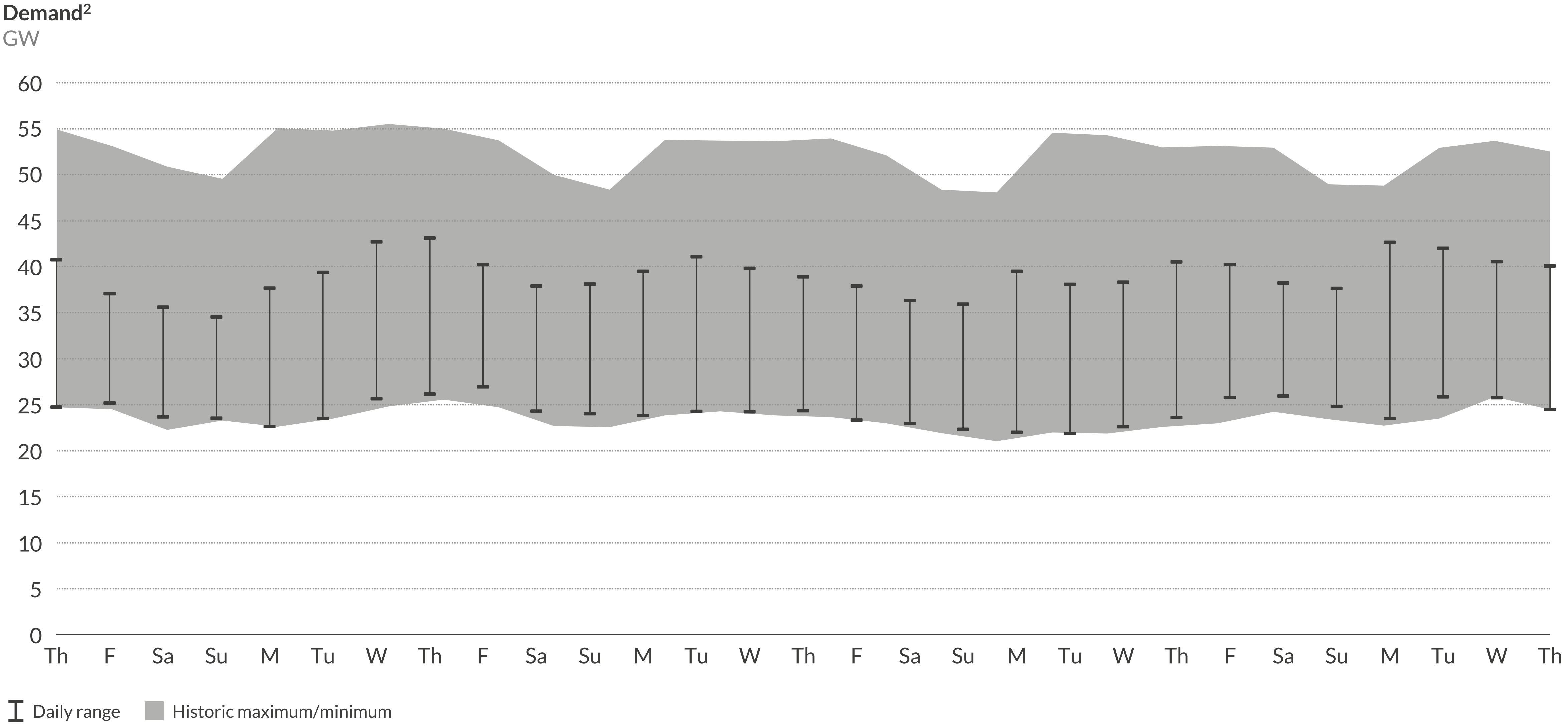


1) Half-hourly EPEX is the volume-weighted reference price over that half-hour interval, as provided by EPEX Spot. 2) De-Rated Margin Forecast calculated in accordance with the Loss of Load Probability Calculation Statement from Elexon.

Sources: Elexon, National Grid, Thomson Reuters, Aurora Energy Research

Daily February max and min demand

Relative to historic February max and min demand since 2010[1]



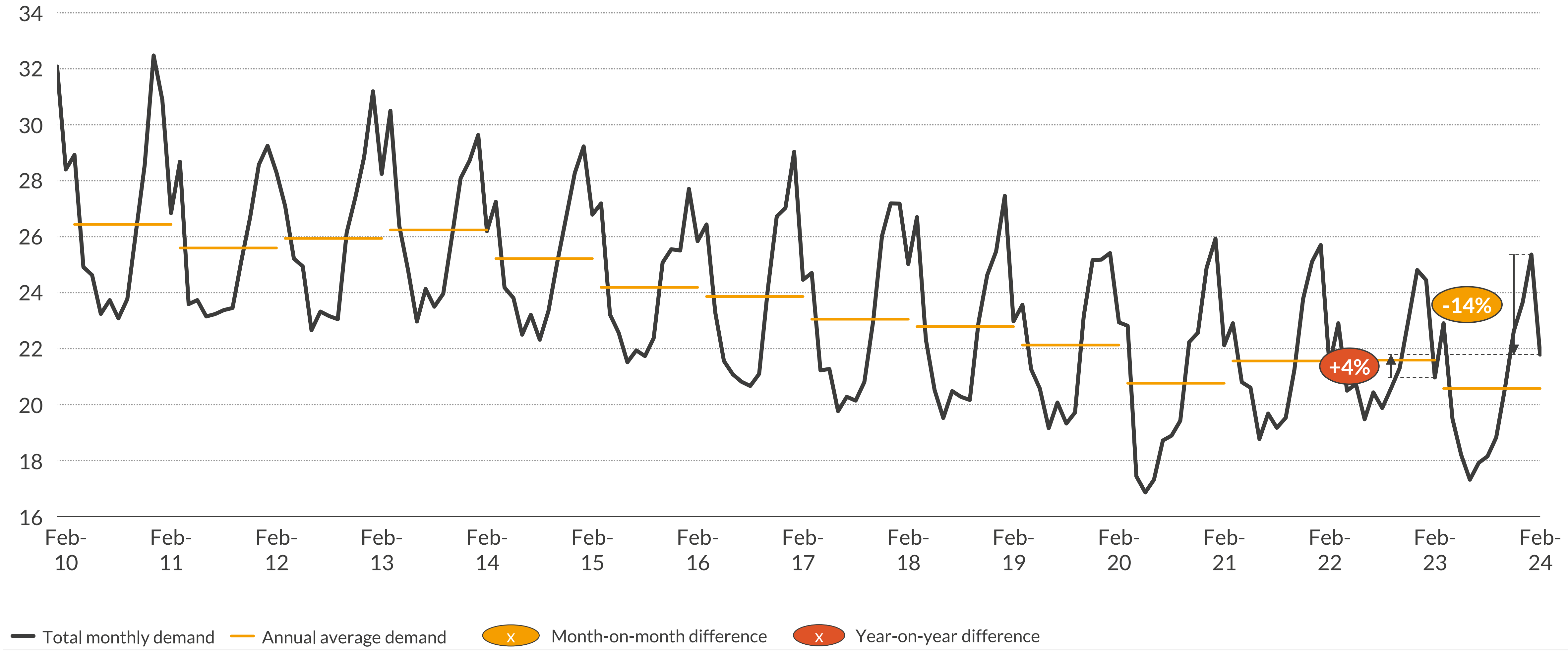
1) Data from previous years is matched to the nearest weekday within the current month, to maintain the weekly demand pattern. 2) Demand data presented here is Initial Transmission System Demand Out-Turn, and does not include embedded demand.

Sources: National Grid, Aurora Energy Research

Monthly historical demand on the transmission system

AURORA

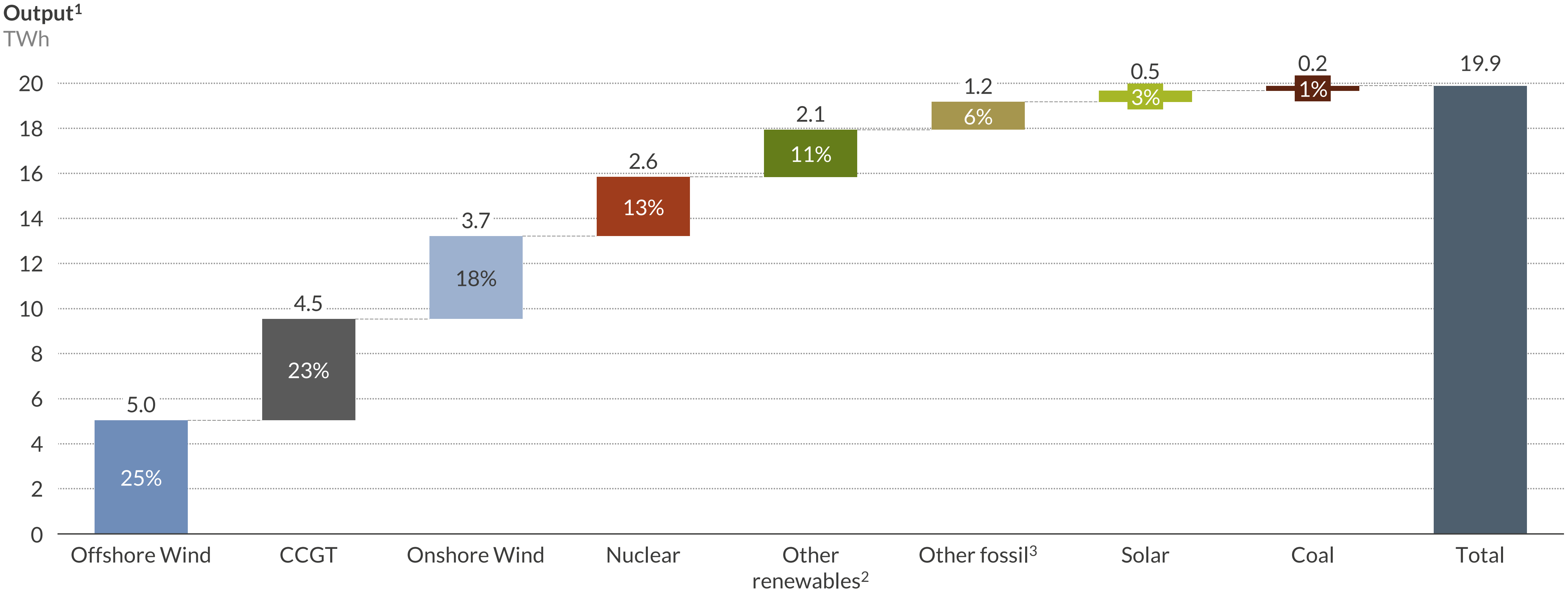
Total demand[1]
TWh



1) Demand data presented here is Initial Transmission System Demand Out-Turn, and includes station transformer load, pumped storage demand and interconnector demand, but does not include embedded demand.

Sources: National Grid, Aurora Energy Research

Monthly fuel mix breakdown



Load factor
%

Offshore Wind	CCGT	Onshore Wind	Nuclear	Other renewables	Other fossil	Solar	Coal
50	23	38	59	62	16	4	9

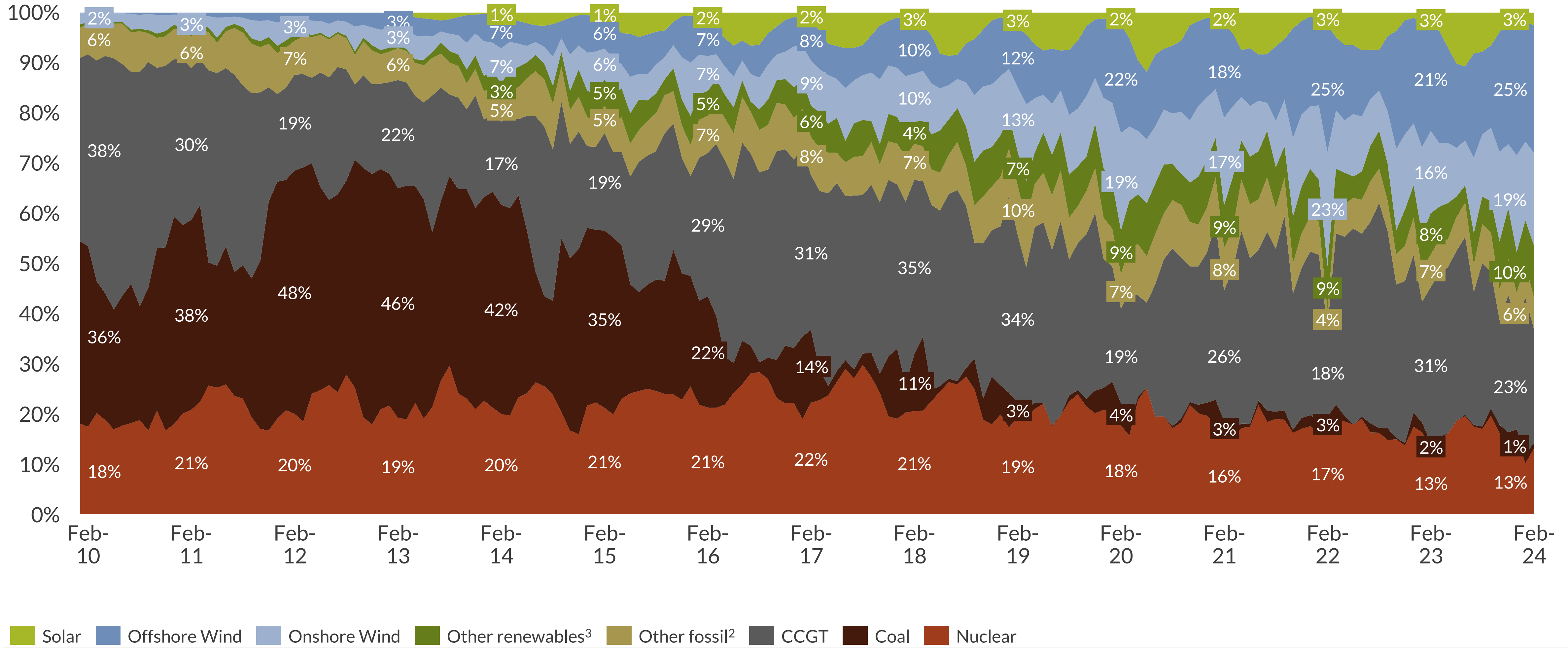
1) Includes outputs from generators registered as BM Units as well as embedded wind and solar PV assets. All numbers are rounded to 0.1 TWh which means that subtotals may not sum to total value. 2) Other renewables includes biomass and hydro 3) Other fossil includes oil, CHP-CCGT and OCGT.

Sources: Elexon, Sheffield Solar, National Grid, Aurora Energy Research

Historical fuel mix breakdown

AURORA

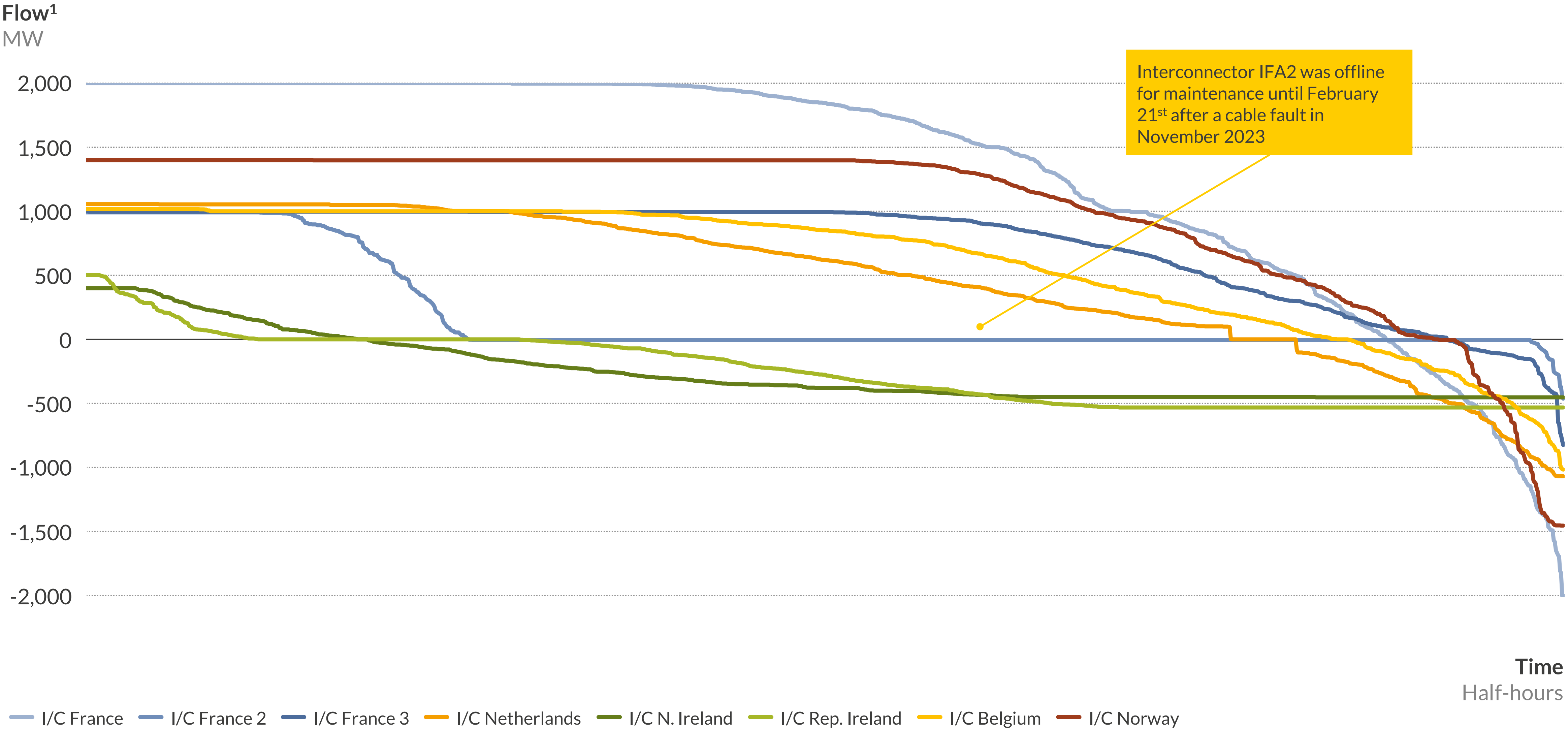
Output[1]
% of total



1) Includes outputs from generators registered as BM Units as well as embedded wind and solar PV. 2) Other fossil includes oil, CHP-CCGT and OCGT. 3) Other renewables includes biomass and hydro.

Sources: Elexon, Sheffield Solar, National Grid, Aurora Energy Research

Monthly interconnector flow duration curve
Flow in each half-hour for GB interconnectors

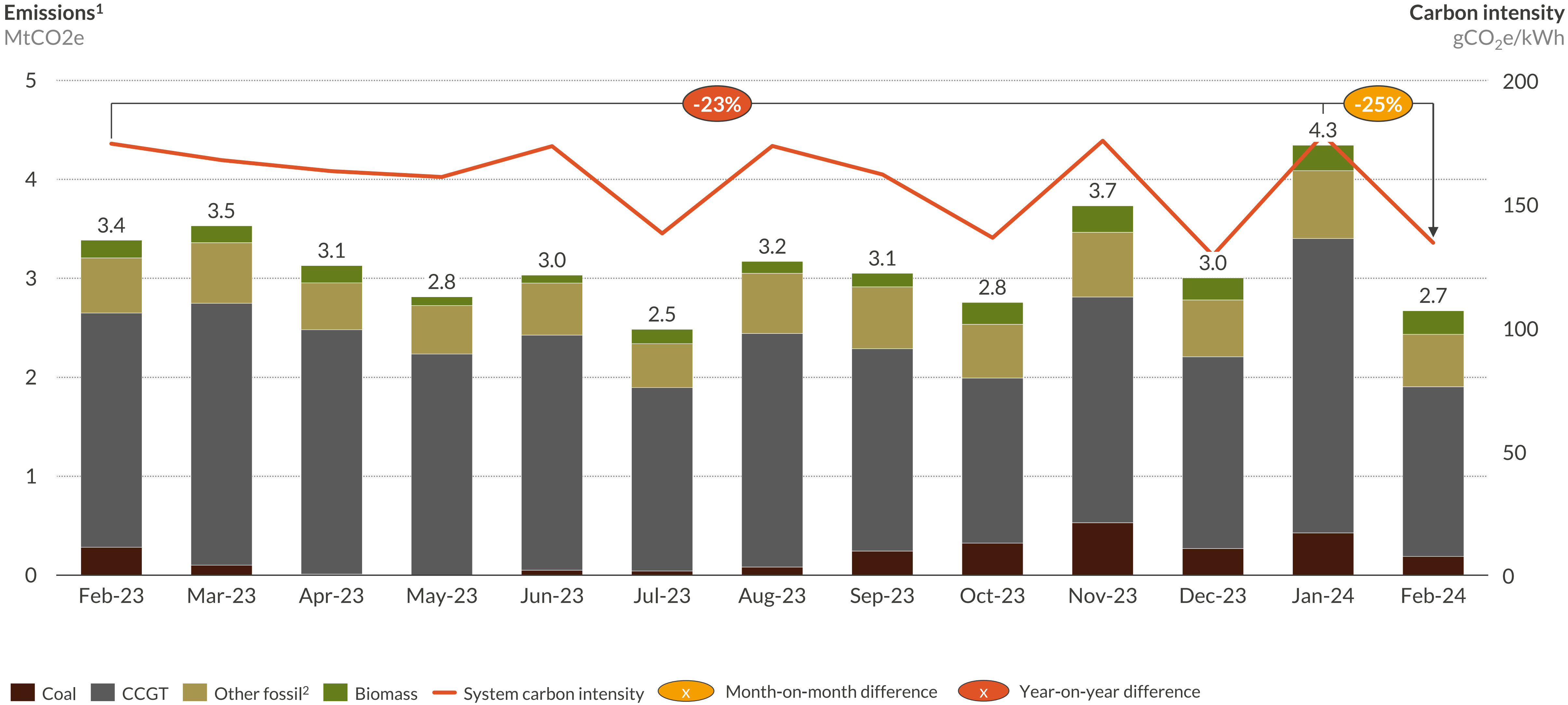


1) Positive flow is imports into GB, negative flow is exports.

Sources: Elexon, National Grid, Aurora Energy Research

Monthly emissions by technology

AURORA



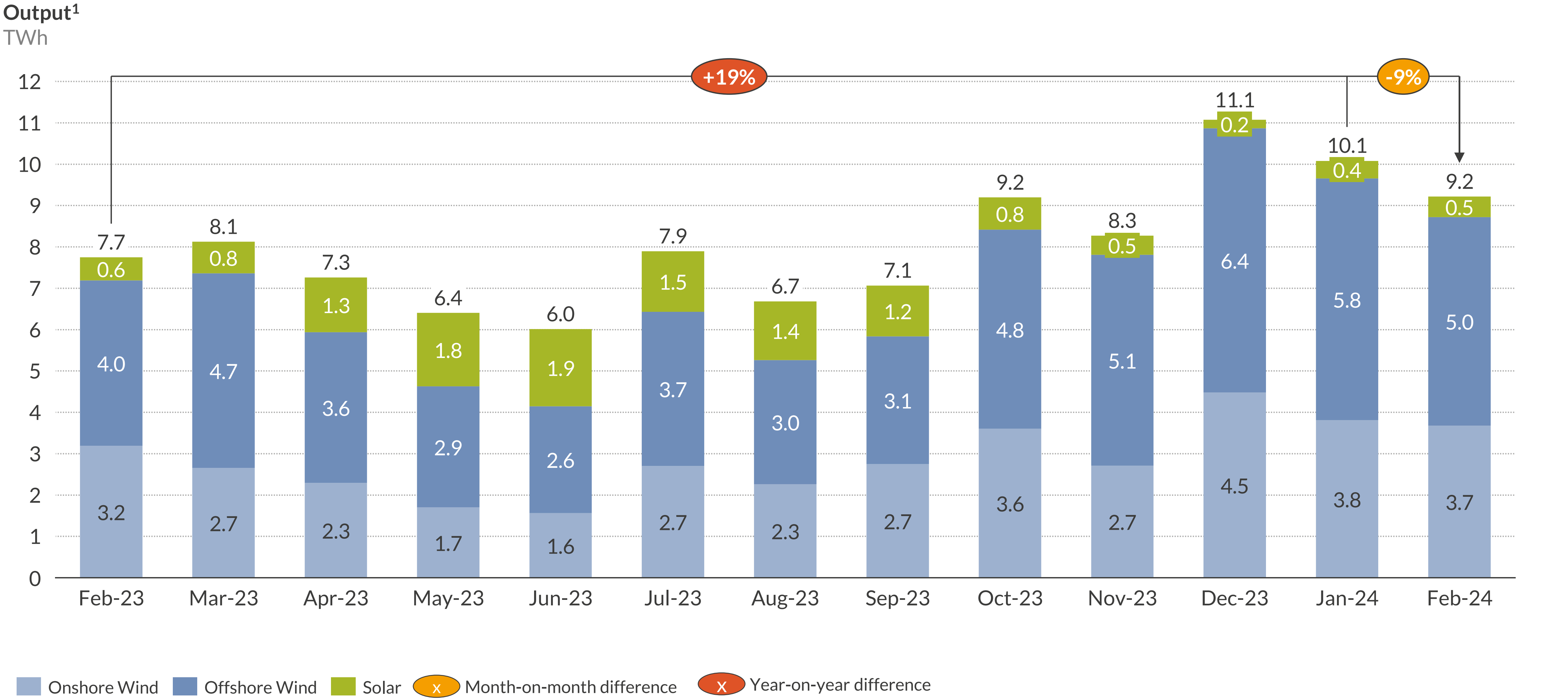
1) Please refer to Appendix for details of methodology employed to calculate emission amounts. Includes all Balancing Mechanism plants. 2) Other fossil includes oil, OCGT and gas CHP-CCGT.

Sources: Elexon, Ofgem, Aurora Energy Research

Agenda

Monthly renewables output

AURORA



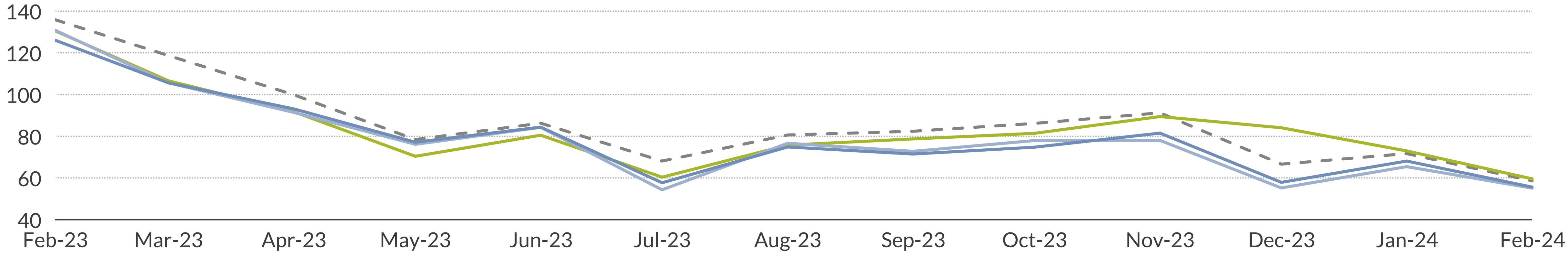
1) Includes outputs from wind generators registered as BM Units as well as embedded wind and solar PV

Sources: Aurora Energy Research, Elexon, Ofgem, Sheffield Solar

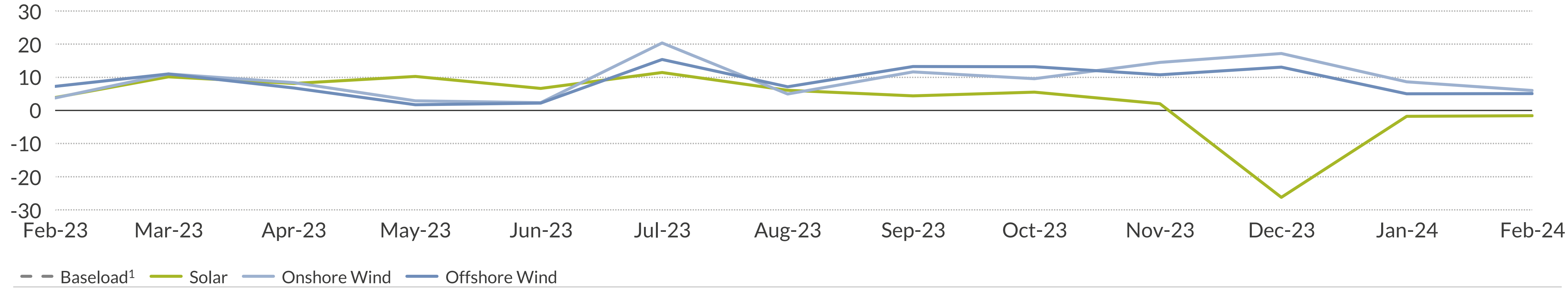
Capture price versus baseload APX price

AURORA

Intraday Price[1,2]
£/MWh



Technology capture discount[2] to baseload
%

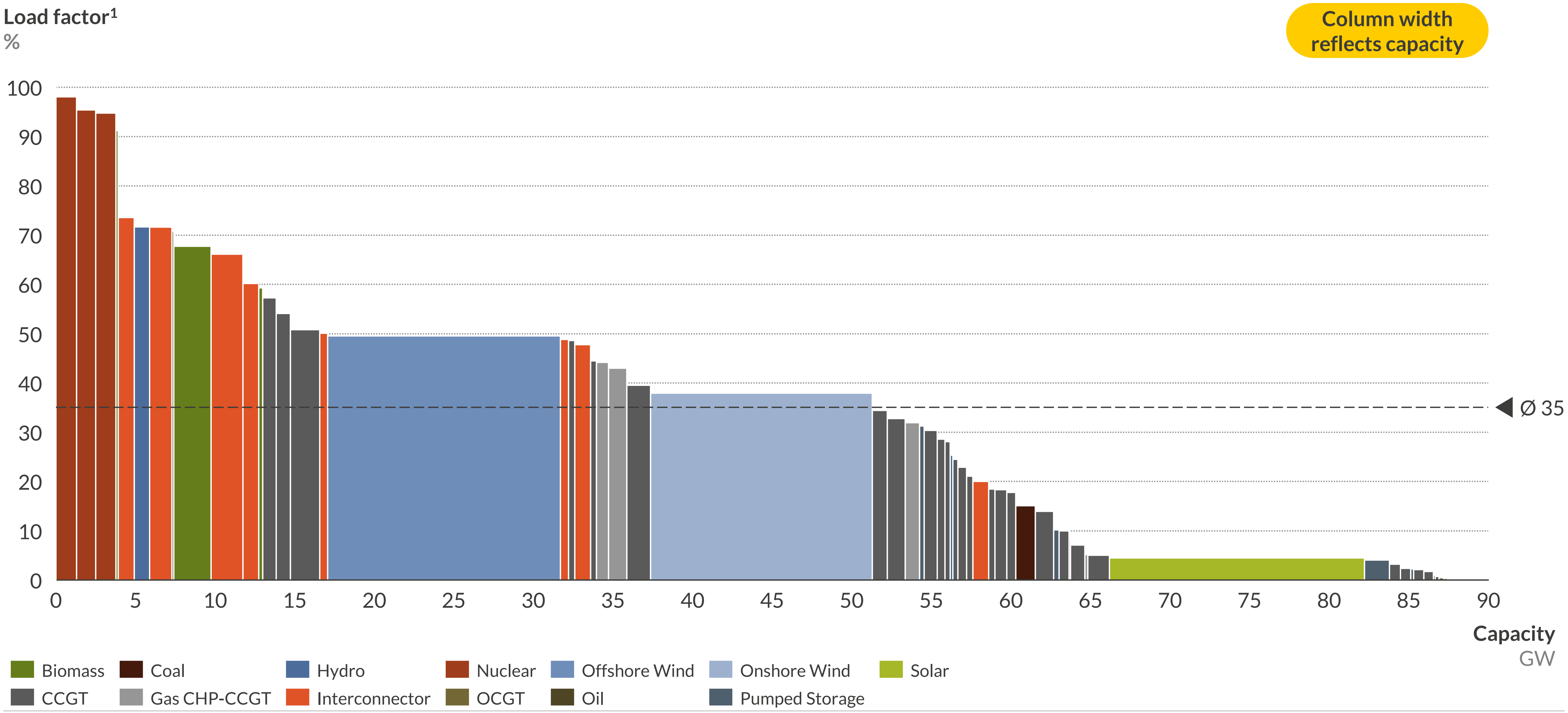


1) The baseload price is the average monthly APX spot price. The capture price of a technology is the load-weighted monthly average APX price across all half-hourly periods; 2) Includes generators registered as BM Units as well as embedded wind

Sources: Aurora Energy Research, Elexon, EPEX Spot

Agenda

Plant utilisation – load factors by plant for February



1) Represents 60 plants with highest capacity according to the Balancing Mechanism (BM) database, as well as aggregated data for wind and solar. Capacity of each plant represents the sum of capacities of all its generators that have been active at least once in the last three months. Please refer to Appendix for a detailed description of the data used and categories presented

Sources: Aurora Energy Research, Elexon, BEIS

Agenda

AURORA

I. Wholesale market summary

II. Renewable performance (redacted)

III. Plant performance (redacted)

IV. Balancing mechanism summary

The Balancing Mechanism (BM) is used for last minute adjustments to match supply to demand

AURORA

Market description

- The BM is used to satisfy balancing requirements of the Transmission System (i.e. Supply = Demand) in real time.
- Parties submit notices to either generate more or less than initially contracted (FPN[1]), in the form of:

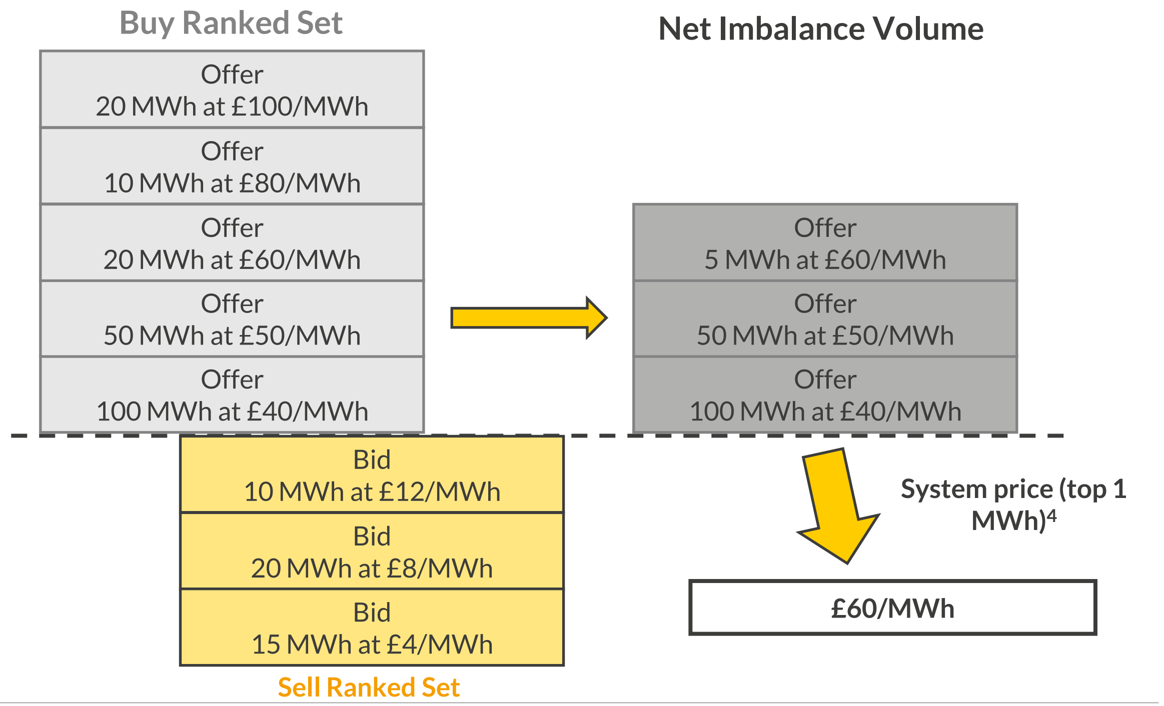
Offers	Increase generation/reduce demand
Bids	Reduce generation/increase demand

- Parties can submit up to 10 Bid-Offer pairs at different volumes and prices.
- BM bids and offers are defined in half-hourly Settlement Periods and are pay-as-bid.
- Parties that are out of balance (with metered generation deviating from FPN) are charged the resulting imbalance prices[2] calculated from procured balancing actions.
- The Net Imbalance Volume (NIV) signals the direction in which the system is out of balance, which then identifies parties liable for balancing costs/credit
- The imbalance price is the price applied to all parties out of balance, scaled by the magnitude of deviation from contracted volumes.

Tender

- BM bids and offers are procured up to Gate Closure[3] by virtue of price and volume; Accepted notices are pay-as-bid
- Accepted bid and offer volumes are net off to produce a Net Imbalance Volume (NIV)
  - Positive NIV = System was Short; More generation was required
  - Negative NIV = System was Long; Less generation was required

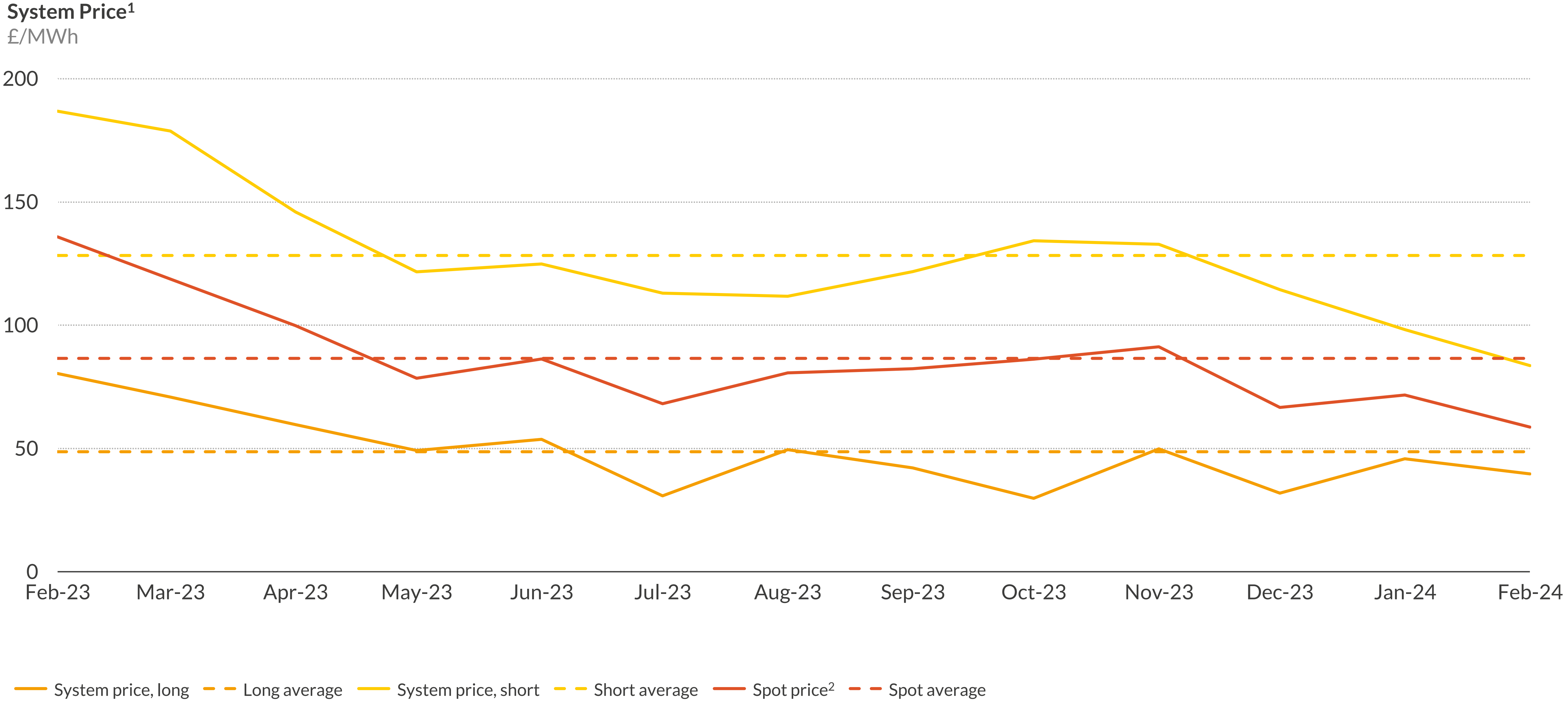
Calculation of Net Imbalance Volume (NIV) and Imbalance Price



1) Final Physical Notification: A locked offer for generation or demand; 2) Volume-weighted price of the most expensive 1 MWh, as changed in November 2018; 3) 1 hour before Settlement Period; 4) Calculated at PAR1 (as of Nov-2018) – price of most expensive 1 MWh

Sources: National Grid, Elexon, Aurora Energy Research

Monthly average system prices for the last 13 months

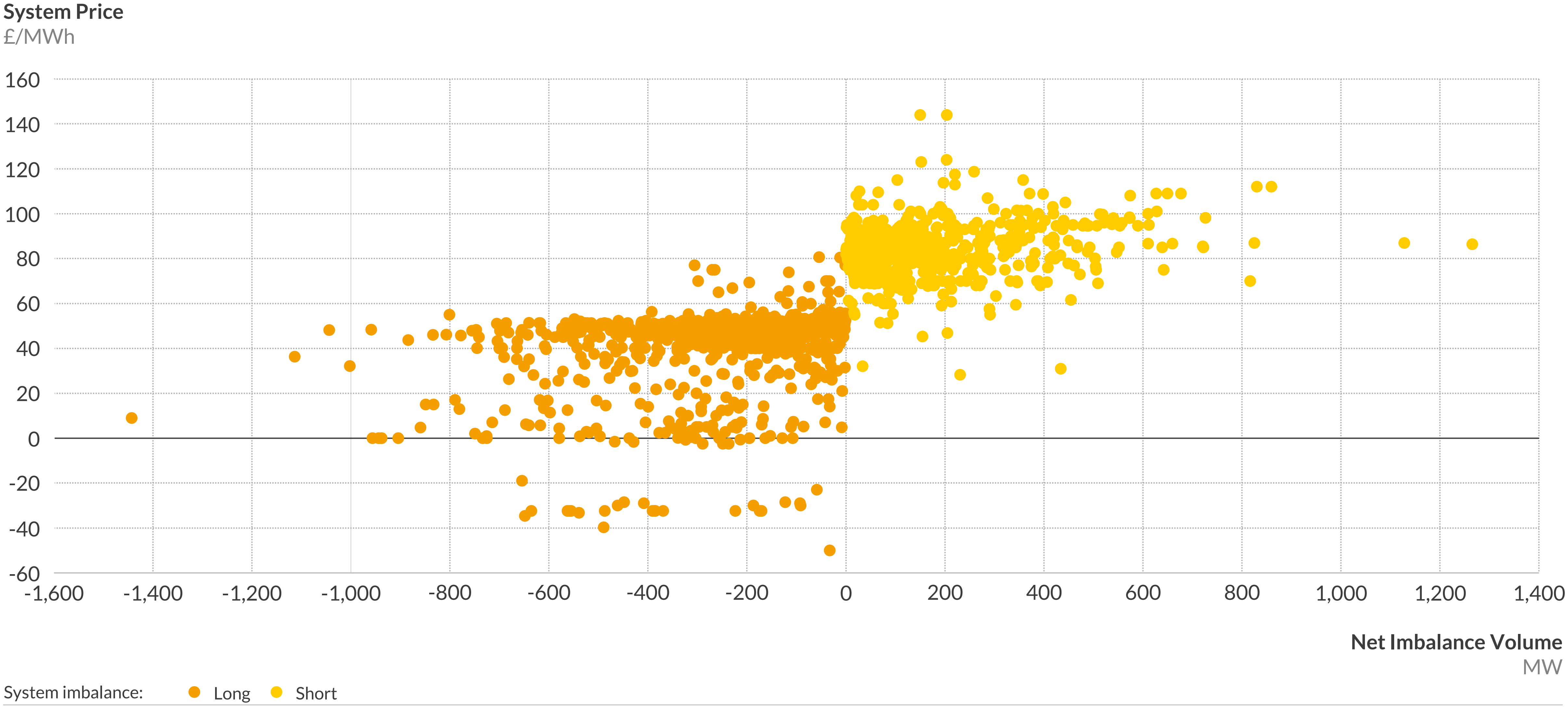


1) Monthly average; 2) Half-hourly wholesale spot price is the volume-weighted reference price over that half hour interval, as provided by APX Power UK

Sources: Aurora Energy Research, Elexon, EPEX Spot

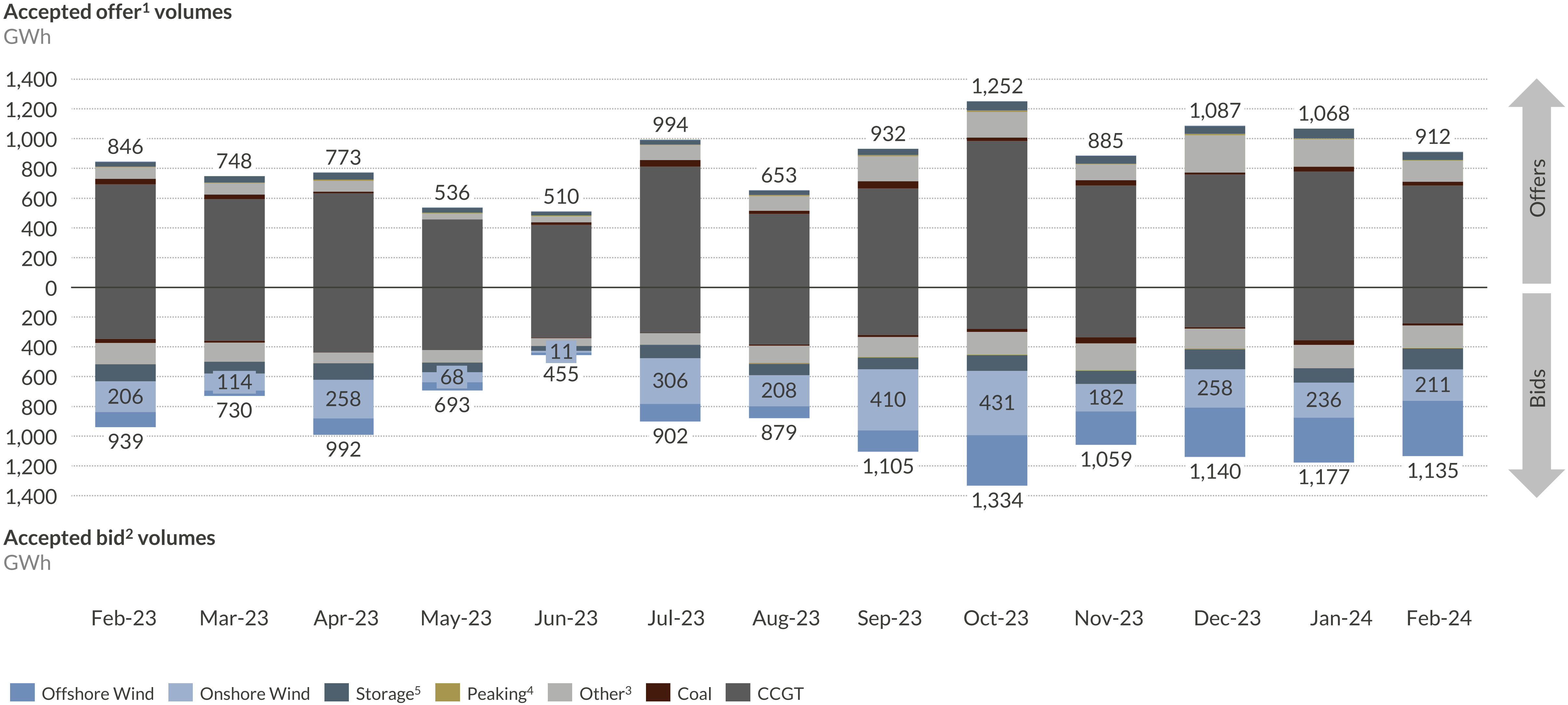
Half-hourly System Price against Net Imbalance Volume for February

AURORA



Sources: Aurora Energy Research, Elexon

Bid-offer acceptance volumes breakdown by technology for the last 13 months



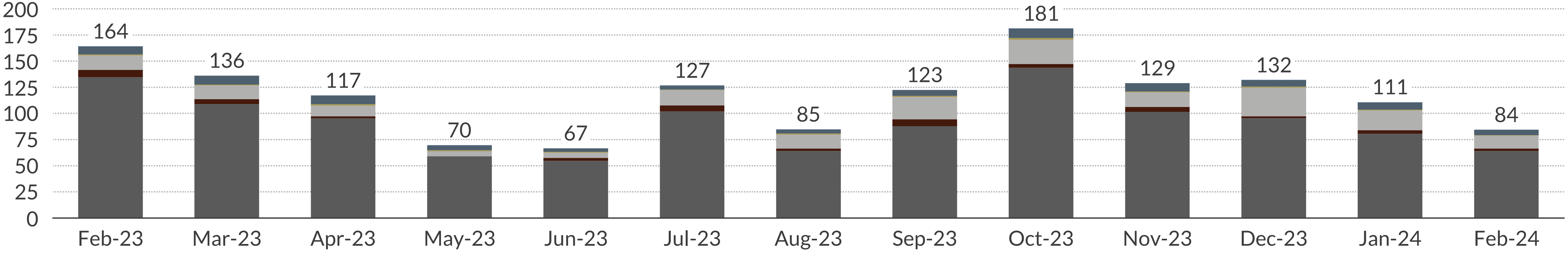
1) Offers to increase generation or reduce demand; 2) Bids to reduce generation or increase demand; 3) Other includes oil, CHP-CCGT, biomass and hydro; 4) Peaking includes OCGT, reciprocating engines and DSR; 5) Storage includes batteries and pumped storage

Sources: Aurora Energy Research, Elexon

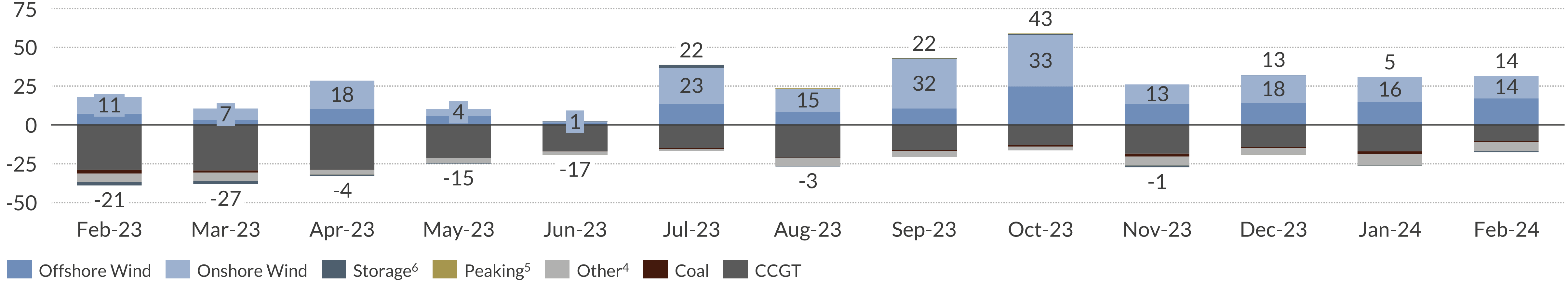
Bid-offer payments breakdown by technology for the last 13 months

AURORA

Accepted offer[1] payments[3]
£million



Accepted bid[2] payments[3]
£million



1) Offers to increase generation or reduce demand; 2) Bids to reduce generation or increase demand; 3) Positive cashflow means payment to generators, negative is payment to National Grid; 4) Other includes oil, CHP-CCGT, biomass and hydro; 5) Peaking includes OCGT, reciprocating engines and DSR; 6) Storage includes batteries and pumped storage

Sources: Aurora Energy Research, Elexon

Appendix

AURORA

Data used

- Output values used in this summary reflect the sum of Final Physical Notifications (FPN) submitted by all BM Units of a given plant that have been active over the last three months.
- Capacity values used in this summary reflect the sum of capacities of individual BM Units, as reported to the Balancing Mechanism, that have been active over the last three months. They reflect long-term capacities and exclude temporary fluctuations due e.g. to plant failures or scheduled maintenance.
- Prices used in this summary are the EPEX half-hourly Reference Prices for half-hourly, two-hourly and four-hourly spot products.

Categories presented

- Full-load hours represent the plants' load factors, calculated as the ratio of the output produced in a given month to the maximum possible output given the plants' capacity.
- Running hours represent the proportion of time in a given month when a plant has been active, i.e. when at least one of its BM Units produced output greater than zero.
- Capture prices (or average output-weighted prices) are calculated as an average of EPEX half-hourly prices per MWh weighted by the plants' corresponding half-hourly outputs for all periods.
- Average gross margins are calculated as a sum of the uplift and inframarginal rent. Uplift is calculated as the difference between the EPEX price and the system marginal cost (SMC). SMC is the maximum marginal cost of all the plants with at least one generator producing above 80% of its installed capacity in a given half-hour.
- Emissions are calculated as plant output divided by electrical efficiency, multiplied by theoretical carbon content of the fuel input. The carbon content of fuel inputs is sourced from BEIS's Greenhouse gas reporting – Conversion factors 2016. System carbon intensity is calculated as the total emission divided by total electricity generated.

Source: Aurora Energy Research

Disclaimer and Copyright

AURORA

General Disclaimer

This document is provided "as is" for your information only and no representation or warranty, express or implied, is given by Aurora Energy Research Limited and its subsidiaries Aurora Energy Research GmbH and Aurora Energy Research Pty Ltd (together, "**Aurora**"), their directors, employees agents or affiliates (together, Aurora's "**Associates**") as to its accuracy, reliability or completeness. Aurora 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 investigations and sound judgment. The information contained in this document reflects our beliefs, assumptions, intentions and expectations as of the date of this document and is subject to change. Aurora assumes no obligation, and does not intend, to update this information.

Forward-looking statements

This document contains forward-looking statements and information, which reflect Aurora's current view with respect to future events and financial performance. When used in this document, the words "believes", "expects", "plans", "may", "will", "would", "could", "should", "anticipates", "estimates", "project", "intend" or "outlook" or other variations of these words or other similar expressions are intended to identify forward-looking statements and information. Actual results may differ materially from the expectations expressed or implied in the forward-looking statements as a result of known and unknown risks and uncertainties. Known risks and uncertainties include but are not limited to: risks associated with political events in Europe and elsewhere, contractual risks, creditworthiness of customers, performance of suppliers and management of plant and personnel; risk associated with financial factors such as volatility in exchange rates, increases in interest rates, restrictions on access to capital, and swings in global financial markets; risks associated with domestic and foreign government regulation, including export controls and economic sanctions; and other risks, including litigation. The foregoing list of important factors is not exhaustive.