
National Electricity
Market of Singapore
MARKET
REPORT
2024

# CONTENTS

# 2024 AT A GLANCE

Total registered capacity of generators
↓5.2% to
12,343MW

15 new facilities were added in the market

2 new generators and
2 new wholesale market traders joined the market

Electricity consumption
↑4.2% to
57.3TWh

Generation supply
↑4.3% to
7,430MW

Annual value of products traded
↓31.3% to
$10.63 billion

Registered capacity of IGS facilities
↑24.6% to
1,028MW

Demand Response registered capacity
↑42.1% to
108MW

Demand Response payment
↓81.9% to
$5.1 million

Average Uniform Singapore Energy Price (USEP)
↓34.1% to
$163.18/MWh

Combined market share of top three generation companies fell to
51.1%

Market share of SP Services
↓4.2%pt to
25.4%

# ENERGY MARKET COMPANY: LETTER FROM THE CHAIRMAN

## Dear Industry Members

### 2024 in Review

Electricity demand in Singapore continued to grow in tandem with the country's economy, expanding 4.2 percent to 57.3 terawatt hour in 2024 while our GDP advanced 4.4 percent. After a two-year decline, electricity supply and the supply cushion recovered, partly due to an increase in combined-cycle gas turbine (CCGT)/ cogeneration/trigeneration supply from lower annual maintenance level and less frequent upstream gas curtailment. The annual generation supply increased 4.3 percent to 7,430 megawatts (MW) and the supply cushion rebounded from a record low in 2023 to 12.8 percent in 2024.

Increasing energy needs mean investment in Singapore's energy infrastructure must keep pace. Market participants such as Keppel, PacificLight Power, Sembcorp and YTL PowerSeraya are developing new hydrogen-ready facilities. This will help maintain the stability of our energy market as electricity demand continues to rise. Some of the CCGTs are scheduled to be ready by 2026.

The annual value of products traded in the wholesale electricity market fell 31.3 percent to $10.63 billion in 2024, maintaining the downtrend since the peak of 2022. This was largely due to the lower average Uniform Singapore Energy Price (USEP), which declined 34.1 percent to $163.18/MWh.

### Advancing the Energy Transition

The combined market share of renewable generation increased by 0.4 percentage point to 2.2 percent in 2024, reflecting Singapore's ongoing commitment to renewable energy.

Solar energy remains Singapore's most promising renewable energy source. With solar generation growing 24.6 percent and reaching 1,028MW or 1.468 gigawatt-peak (GWp) in 2024, Singapore is making great strides toward its 2030 target of 2GWp of solar energy. Nonetheless, the inherent intermittency of solar power, affected by weather and seasonal changes, continues to be a factor. Of the 13 Temporary Price Cap activations in 2024, six were caused by solar intermittency.

Solar power is inherently intermittent due to weather and seasonal changes. To further bolster Singapore's power grid resilience, maintain market stability and mitigate some of the risks associated with solar intermittency, EMA awarded PacificLight Power a contract to build and operate two 50MW Fast Start power generating units scheduled for completion by the second quarter of 2025. EMC is delighted to have played a part in this by supporting the first-ever competitive procurement of Fast Start Ancillary Services in Singapore. Our role as the independent wholesale electricity market operator allowed us to facilitate an open, fair and competitive procurement process.

# ENERGY MARKET COMPANY: LETTER FROM THE CHAIRMAN

Another of Singapore's energy transition strategies is to import 6GW of electricity from the region by 2035. EMA has issued Conditional Approvals to ten projects to import low-carbon electricity among which five projects have made substantive progress and were awarded Conditional Licences in September 2024. A key step in this direction is the Laos PDR-Thailand-Malaysia-Singapore Power Integration Project, which doubled its supply agreement in 2024 to a maximum of 200MW from a year earlier. This will enable EMC to fine-tune the existing market operations framework and explore new ways of modelling electricity imports into Singapore's wholesale electricity market.

With the successful completion of the Demand Side Management Sandbox in December 2024, five new facilities were registered and two new Demand Response (DR) providers joined the DR Programme, contributing to the 42.1 percent growth of registered curtailment capacity to 108.1MW. Despite the growth, the total curtailed load in 2024 fell 77.2 percent to 4,685MW, largely due to the moderate USEP.

## Charting a Sustainable and Brighter Future Together

The landscape of the energy sector is continuously evolving so I am grateful for the active participation of and engagement with our valued industry partners and colleagues in ensuring that the market is resilient. Efforts such as the successful implementation of new initiatives aimed at enhancing market transparency, improving demand-side management, and integrating electricity imports into the market underscore the significance of our collective effort in driving energy transition forward.

The journey towards a sustainable and resilient energy future will require even greater collaboration. Energy transition while beneficial and necessary poses complex and multifaceted challenges. The adoption of new technologies, development of low-carbon solutions, and adaptation to changing market dynamics calls for a concerted effort from all stakeholders.

Having just assumed the role of Chairman on 1 January 2025, I look forward to your support and partnership so that together, we can meet the challenges and opportunities that lie ahead.

In closing, I want to take this opportunity to express my deepest gratitude to our former Chairman, Agnes Koh, for her outstanding leadership and dedication. Agnes has been instrumental in guiding the market at the onset of the current energy transition and forging strong partnerships with the industry. I am confident that the foundation she has laid will serve us well as we ensure the energy market in Singapore remains resilient and effective.

**Tan Boon Gin**
**Chairman**
*Energy Market Company*


MARKET
OVERVIEW

# MARKET OVERVIEW: MARKET HISTORY

**The National Electricity Market of Singapore (NEMS) opened in January 2003 – the culmination of several structural reforms to Singapore's electricity industry.**

Singapore's journey to liberalisation traces back to October 1995, when industry assets were first corporatised. In 1998, the Singapore Electricity Pool, a day-ahead market, commenced operation to facilitate competitive bidding among power generation companies. By 2001, the introduction of a new legal and regulatory framework formed the basis for a new electricity market.

The NEMS is an integral part of Singapore's overall energy policy framework, which seeks to balance the three policy objectives of economic competitiveness, energy security, and environmental sustainability. The NEMS places Singapore alongside an international movement to introduce market mechanisms into the electricity industry so as to:

- increase economic efficiency through competition;
- attract private investment;
- send accurate price signals to guide production and consumption decisions;
- encourage innovation; and
- provide consumer choice.

## Market Reform Milestones

| | |
|---|---|
| **Corporatisation** | |
| **1995** | • Electricity functions of the Public Utilities Board corporatised<br>• Singapore Power formed as a holding company |
| **1996** | • Singapore Electricity Pool (SEP) design process began |
| **Singapore Electricity Pool (SEP)** | |
| **1998** | • SEP commenced<br>• PowerGrid is SEP Administrator and Power System Operator (PSO) |
| **National Electricity Market of Singapore (NEMS)** | |
| **2000** | • Decision for further reform to obtain full benefits of competition<br>• New market design process began |
| **2001** | • Electricity industry legislation enacted<br>• Energy Market Authority (EMA) established as industry regulator and PSO<br>• Energy Market Company (EMC) established as the NEMS wholesale market operator<br>• First phase of retail contestability (retail contestability threshold gradually lowered in subsequent years) |
| **2003** | • NEMS wholesale market trading began |
| **2004** | • Vesting contract regime introduced<br>• Interruptible loads (IL) began to participate in the reserves market |
| **2006** | • First wholesale market trader joined the market and commenced trading as IL provider<br>• First commercial generator since 2003 joined the market and started trading |
| **2008** | • Sale of Tuas Power to China Huaneng Group in March, Senoko Power to Lion Consortium in September, and PowerSeraya to YTL Power in December<br>• Embedded generators (EG) joined the market |
| **2009** | • New EGs, small generators and incineration plants joined and started trading |
| **2010** | • Vesting tender introduced to tender out a percentage of non-contestable electricity demand to generation companies for bidding |
| **2013** | • Singapore's Liquefied Natural Gas (LNG) terminal started commercial operations<br>• LNG vesting contract introduced |
| **2015** | • Electricity futures trading commenced |
| **2016** | • Demand Response programme introduced |
| **2018** | • Open Electricity Market (OEM) launched and rolled out in stages |
| **2019** | • Rollout of OEM across Singapore completed<br>• Vesting contract regime rolled back to LNG vesting contract level |
| **2021** | • First energy storage system (ESS) joined the market |
| **2022** | • Electricity imports trial commenced |
| **2023** | • NEMS completed 20 successful years of trading |

# MARKET OVERVIEW: INDUSTRY STRUCTURE

## Participants and Service Providers in the NEMS

| Generators | | | |
|---|---|---|---|
| ExxonMobil Asia Pacific | Meranti Power* | Sembcorp Solar Singapore | Taser Power |
| Keppel Merlimau Cogen | National Environment Agency | Senoko Energy | TP Utilities |
| Keppel Seghers Tuas Waste-to-Energy Plant (Tuas DBOO Trust) | PacificLight Power | Senoko Waste-to-Energy | Tuas Power Generation |
| Linde Gas Singapore* | Sembcorp Cogen | Shell Singapore | TuasOne |
| | Sembcorp Floating Solar Singapore | Singapore Refining Company | YTL PowerSeraya |

| Wholesale Market Traders | | | |
|---|---|---|---|
| Air Liquide Singapore | JE Green Solutions | Singapore LNG Corporation | Terrenus Energy SL1X |
| BEWGI-UE NEWater | LYS Genco Beta | SolarLand Alpha Assets | Terrenus Energy SL2 |
| Crystal Clear Environmental | PSA Corporation | Sunseap Commercial Assets* | Terrenus Energy SR3* |
| Green Power Asia | Public Utilities Board | Sunseap Leasing | |
| HSBC Institutional Trust Services (Singapore) | Singapore District Cooling | Sunseap Leasing Beta* | |

| Retailers | | | |
|---|---|---|---|
| Bioenergy | Flo Energy Singapore | Sembcorp Power | Tuas Power Supply |
| Cleantech Solar Singapore Assets | Just Electric | Senoko Energy Supply | Union Power |
| Diamond Electric | Keppel Electric | Seraya Energy | |
| Engie South East Asia | PacificLight Energy | Sunseap Energy | |

| Market Support Services Licensee | Market Operator | Power System Operator | Transmission Licensee |
|---|---|---|---|
| SP Services | Energy Market Company | Power System Operator | SP PowerAssets |

* *The following market participant changes took place in 2024:*
- *Sunseap Commercial Assets, Terrenus Energy SR3, Meranti Power and Linde Gas Singapore joined the market in February, April, October and December respectively.*
- *Sunseap Leasing Beta withdrew from the market in February.*

# MARKET OVERVIEW: INDUSTRY STRUCTURE

**Singapore's electricity industry is structured to facilitate competition in its wholesale and retail markets. Competitiveness is achieved by separating the ownership of the contestable parts of the industry from those with natural monopoly characteristics.**

## Market Participant Changes

In 2024, the NEMS welcomed two new generators (Meranti Power and Linde Gas Singapore) and two new wholesale market traders (Sunseap Commercial Assets and Terrenus Energy SR3). This brought the total number of market participants (MPs) in the NEMS to 50 at the end of 2024, comprising 19 generators, 17 wholesale market traders and 14 retailers.

## Generation Licensees

Generation licensees are companies with generating facilities of 10 megawatts (MW) or more that are connected to the transmission system and licensed by the Energy Market Authority (EMA) to trade in the wholesale electricity market.

## Wholesale Market Traders

Wholesale market traders are companies, other than generation licensees or retail licensees, that are licensed by the EMA to trade in the wholesale electricity market. Wholesale market traders include companies with generating facilities of less than 10MW, companies that offer their own loads to be interrupted, as well as companies that provide services to other consumers interested in offering their loads to be interrupted.

## Retail Electricity Licensees

Retail electricity licensees are companies that are licensed by the EMA to sell electricity to contestable consumers. Retail electricity licensees that are registered as MPs purchase electricity directly from the wholesale market.

## Market Support Services Licensee — SP Services

A Market Support Services Licensee (MSSL) is authorised to provide market support services. Such services include facilitating customer transfers between retailers, meter reading and meter data management. SP Services is the only MSSL. In addition to its market support services function, SP Services also facilitates access to the NEMS for contestable consumers who have not appointed a retailer, and supplies electricity to non-contestable consumers.

## Market Operator — Energy Market Company

Energy Market Company (EMC) operates and administers the wholesale market. This role includes calculating prices, scheduling generation, clearing and settling market transactions, and procuring ancillary services. EMC also administers the rule change process and provides resources that support the market surveillance and compliance, and dispute resolution processes.

## Transmission Licensee — SP PowerAssets

SP PowerAssets owns and is responsible for maintaining the transmission system.

## Power System Operator

The Power System Operator (PSO), a division of the EMA, is responsible for ensuring the security of electricity supply to consumers. The PSO controls the dispatch of generation facilities, co-ordinates scheduled outages, oversees power system emergency planning, and directs the operation of the high-voltage transmission system. The PSO also oversees the real-time operation of the natural gas transmission system.

## Regulator — Energy Market Authority

The EMA is the regulator of the electricity and gas industries and has the ultimate responsibility for the market framework and for ensuring that the interests of consumers are protected.

## Consumers

Consumers are classified as either contestable or non-contestable. Contestable consumers purchase electricity from a retailer or from the wholesale market. Non-contestable consumers purchase electricity from SP Services at the regulated tariff.

# MARKET OVERVIEW: MARKET FEATURES

**The NEMS has a number of features that drive efficiency and make its design truly world-class. These include:**

- **co-optimisation of energy, reserve and regulation products;**
- **security-constrained dispatch and nodal pricing;**
- **near real-time dispatch; and**
- **a Demand Response (DR) programme.**

## Co-optimisation of Energy, Reserve and Regulation Products

A sophisticated process involving about 50,000 different mathematical equations is used to determine the price and quantity of the energy, reserve and regulation products traded. Integral to this process is the concept of co-optimisation, wherein the market clearing engine (MCE) considers the overall costs and requirements of all products, and then selects the optimal mix of generation and load registered facilities to supply the market.

## Energy, Reserve and Regulation Products

| | Description | Purchaser | Seller |
|---|---|---|---|
| **Energy** | Generated electricity | Retailers | Generators |
| **Reserve** | Stand-by generation capacity or interruptible loads (ILs) that can be drawn upon when there is an unforeseen shortage of supply<br><br>Two classes of reserves are traded:<br>1) primary reserve (9-second response); and<br>2) contingency reserve (10-minute response) | Generators | Generators, Retailers and Wholesale Market Traders |
| **Regulation** | Generation that is available to fine-tune the match between generation and load | Generators and Retailers | Generators |

## Security-Constrained Dispatch and Nodal Pricing

To determine the prices for products traded on the wholesale market, offers made by generators and interruptible loads (ILs) are matched with the system demand forecast and system security requirements. The MCE produces a security-constrained economic dispatch by taking into account the:

- available generation capacity;
- ability of generation capacity to respond (ramping);
- relationship between the provision of energy, reserves and regulation (co-optimisation);
- power flows in the system;
- physical limitations on the flows that can occur in the transmission system;
- losses that are incurred as power is transported; and
- constraints in relation to system security.

This process is run half-hourly to determine the:

- dispatch quantity that each generation unit is to produce and each load facility in the DR programme is to curtail (see details of DR programme on page 9);
- reserve and regulation capacity that each generation unit is required to maintain;
- level of IL that is scheduled; and
- corresponding prices for energy, reserves and regulation in the wholesale market.

Energy prices – referred to as nodal prices – vary at different points on the network. The differences in nodal prices reflect both transmission losses and the physical constraints of the transmission system. This means that the true costs to the market of delivering electricity to each point on the electricity network are revealed.

The MCE models the transmission network and uses linear and mixed integer programming to establish demand and supply conditions at multiple locations (nodes) on the network. Modelling ensures that market transactions are structured in a physically feasible manner, given the capacity and security requirements of the transmission system. For each half-hour trading period, the MCE calculates the prices to be received by generators at the 115 injection nodes, and the prices at up to 900 withdrawal or off-take nodes[1] that are used as the basis for the price to be paid by customers. This method of price determination encourages economically efficient scheduling of generation facilities in the short term and provides incentives to guide new investment into the power system infrastructure in the long term.

EMC uses metered demand and generation from the MSSL and market prices to settle market transactions on a daily basis. Generators receive the market price for energy that is determined at their point of connection to the transmission network (injection node). Retailers pay the Uniform Singapore Energy Price (USEP) for energy, which is the weighted-average of the nodal prices at all off-take nodes.

Generators pay for reserves according to how much risk they contribute to the system. Regulation is paid for by retailers in proportion to their energy purchases and by dispatched generators up to a ceiling of five megawatt hours for each trading period.

[1] *Numbers of injection and withdrawal nodes are as at 31 December 2024.*

# MARKET OVERVIEW: MARKET FEATURES

## Near Real-Time Dispatch

Market prices and dispatch quantities for energy, reserves and regulation are calculated five minutes before the start of each half-hour trading period. This ensures that the market outcomes reflect prevailing power system conditions, the most recent offers made by generators, as well as the most recent bids made by demand response aggregators and/or retailers. The result of near real-time calculation of dispatched generation quantities ensures as little real-time intervention as possible and hence minimal deviation from a competitive market solution.

To support near real-time dispatch, EMC produces market forecast schedules up to a week ahead of the relevant trading period. These forecast schedules increase in frequency as the trading period approaches to ensure that MPs have the information they need to adjust their trading positions prior to physical dispatch.

## Demand Response Programme

In April 2016, a new milestone was reached in the NEMS. A DR programme was introduced to allow consumers to submit bids in the energy market for the purpose of providing load curtailments.

Loads located in the same zone can be aggregated and registered as a single load registered facility (LRF) in the market. These LRFs can submit energy bids if they satisfy the necessary requirements, and the MCE will schedule them for load curtailment in a given dispatch period. Scheduled and compliant load curtailments will receive incentive payments, which are calculated based on the estimated falls in the USEP across all non-regulatory loads. These incentive payments will be recovered from contestable consumers through the hourly energy uplift charges.

An ex-post assessment, comparing actual metering data with the expected consumption based on the LRFs' dispatch schedules, will be conducted. LRFs that are scheduled for curtailment have to reduce their consumption accordingly, while LRFs that are not scheduled for curtailment have to consume at their non-curtailed level. Financial penalties will be imposed on LRFs that are deemed to have deviated from their dispatch schedules, and all financial penalties collected will be returned to the market via the monthly energy uplift charges.


MARKET
GOVERNANCE

# MARKET GOVERNANCE: OVERVIEW

## Governing Documents and Institutions

The Energy Market Authority (EMA) was established under the Energy Market Authority of Singapore Act 2001. It is the electricity market regulator under the Electricity Act 2001 and is responsible for, among other mandates:

- creating the market framework for electricity and gas supply;
- promoting the development of the electricity and gas industries;
- protecting the interests of consumers and the public;
- issuing licences; and
- advising the Government on energy policies.

## Rule Change Process

The day-to-day functioning of the National Electricity Market of Singapore (NEMS) wholesale market is governed by the Singapore Electricity Market Rules.

The rule change process is the responsibility of the Rules Change Panel (RCP). Appointed by the Energy Market Company (EMC) Board, RCP members represent generators, retailers, wholesale market traders, the financial community, the Power System Operator (PSO), the Market Support Services Licensee (MSSL), the transmission licensee, electricity consumers and EMC, ensuring representation by all the key sectors of the industry.

The rule change process is designed to maximise transparency and opportunities for public involvement. Rule modifications recommended by the RCP require the support of the EMC Board and the EMA. When approving changes to the Market Rules, the EMA is required to consider whether the proposed rule modifications (i) unjustly discriminate in favour of, or against, a market participant (MP) or a class of MPs; or (ii) are inconsistent with the functions and duties of the EMA under subsection 3(3) of the Electricity Act.

The RCP is supported by EMC's Market Administration team, which provides economic analysis of rule modification proposals and makes recommendations to the RCP. Every year, EMC publishes the RCP's work plan on its website to ensure that stakeholders remain informed about the likely evolution of the market.

## Market Surveillance and Compliance

The Market Surveillance and Compliance Panel (MSCP) monitors and investigates the conduct of market entities, as well as the structure and performance of, and the activities in, the NEMS. Appointed by the EMC Board, the MSCP comprises professionals independent of the NEMS, whose extensive combined experience spans the areas of financial markets, law, power system operations and economics.

The MSCP is supported by EMC's Market Assessment Unit (MAU). The MAU evaluates activities which indicate breaches of or inefficiencies in the Market Rules, market manuals or System Operation Manual, and potential flaws in the NEMS' overall structure, presenting its findings and recommendations for the MSCP's determination.

Where the MSCP determines that a market entity is not compliant with the Market Rules, the MSCP may take enforcement actions such as imposing financial penalties and issuing non-compliance letters, directions and orders.

The MAU routinely submits the MSCP Market Watch — a comprehensive quarterly report encompassing monitoring, cataloguing and evaluation activities and analyses — to the MSCP. The MSCP provides a summary of investigative and monitoring activities to EMC in the MSCP Annual Report, which has been published since 2007.

## Dispute Resolution

The Market Rules set out the dispute resolution process for market entities in the NEMS, which consists of three progressive stages: negotiation, mediation, and arbitration. The process is designed to be a fair, efficient and cost-effective way of resolving disputes outside of the courts while maintaining relationships in the NEMS.

The dispute resolution process is managed by the Dispute Resolution Counsellor (DRC) who is appointed by the EMC Board. In addition, the DRC helps familiarise market entities with the dispute resolution and compensation regime, and appoints law professionals to serve on the mediation and arbitration panels, collectively known as the Dispute Resolution and Compensation Panel. The DRC is assisted by the MAU in facilitating dispute resolution in the NEMS, emphasising efficiency and fairness in the dispute resolution and compensation process.

# MARKET GOVERNANCE: LETTER FROM THE CHAIR, RULES CHANGE PANEL

## Dear Industry Members

As Singapore's electricity industry evolves with the introduction of diverse energy facilities, including imported energy, solar energy and battery energy storage systems (BESS), it increasingly relies on the support of and innovative ideas from industry players and stakeholders. The Rules Change Panel (RCP) has been instrumental in supporting market evolution by ensuring the market framework adapts to new technologies and practices. Your contributions to this work have been invaluable.

The National Electricity Market of Singapore's (NEMS) stability, trust and efficiency depend on its financial integrity and robustness. The Panel studied EMC's proposal regarding appropriate credit support types for the NEMS. It also considered a new tiered credit support arrangement for less liquid credit support to diversify the market's risk exposure further. The Panel endorsed EMC's recommendation to remove treasury bills, which are no longer suitable, and decided against introducing new forms of credit support or tiered arrangements due to a lack of industry interest at present. The EMA agreed with the RCP's decision and approved the Market Rules which took effect in November 2024.

The inherent flexibility and rapid responsiveness of BESS are crucial for maintaining power system stability amidst fluctuating energy supply and demand. As BESS becomes increasingly vital in the market, it is imperative to enhance the Market Clearing Engine (MCE) to more accurately reflect its operational capabilities. Guided by the collaborative efforts of the Technical Working Group (TWG), the Panel supported rule changes to integrate State of Charge (SOC) into the MCE, thereby improving dispatch efficiency and preventing real-time delivery failures due to insufficient charge.

I deeply appreciate the candid views shared and the constructive discussions during our panel meetings. Thanks to everyone's valuable contribution, the EMA has approved the Market Rules for modelling BESS in the MCE, and these will soon be implemented in the NEMS. This significant milestone underscores the power of our collective efforts in driving progress and shaping the future of Singapore's energy market.

I encourage all panel members to continue engaging in insightful dialogue regarding future market rule changes. The innovative ideas and perspectives we share will empower the industry to thrive and confidently navigate Singapore's evolving energy landscape.

Finally, I extend my heartfelt gratitude to the existing panel members for their contributions in 2024 and warmly welcome Teo Swee Teng to the Panel in 2025.

**Toh Seong Wah**
**Chair**
*Rules Change Panel*

# MARKET GOVERNANCE: MARKET EVOLUTION

## Rule Changes Considered by the RCP

As part of the Rules Change Panel's (RCP) continual effort to facilitate development of the wholesale electricity market, the following rule changes were discussed:

- RC389: Review of The Forms of Credit Support in the Singapore Wholesale Electricity Market;
- RC387: Enhancement of Fallback Mechanisms for StartGeneration and PriorScheduledPurchase;
- RC386: Incorporation of State-of-Charge in Market Clearing Engine (MCE) modelling of Energy Storage Systems (ESS); and
- RC383: Modelling of Energy Storage Systems (ESS).

## Review of the Forms of Credit Support in Singapore Wholesale Electricity Market

Credit support is essential for credit risk management in the Singapore Wholesale Electricity Market (SWEM). Low-risk and high-liquidity forms of credit support minimise losses and allow prompt payment to creditors in the event of a default.

This rule change paper reviewed the viability of current forms of credit support and considered the introduction of fit-for-purpose forms of credit support.

In addition to assessing current and potential forms of credit support, the paper also outlines a "tiered credit support" arrangement to enable retaining and/or accepting "good" credit support forms that are less liquid and cannot be paid within one business day, diversifying the market's risk exposure.

EMC consulted the industry on the above. The industry did not express strong interest in the proposed new forms of credit support and the tiered credit support arrangement. EMC also found that Treasury Bills (T-bills), an allowable form of credit support, require more than one business day to liquidate, rendering it unfit for purpose without a tiered credit support arrangement to accommodate less liquid forms of credit support.

Therefore, EMC recommended that the RCP:

1) Not support introducing the new forms of credit support and the tiered credit support arrangement at present; and
2) Support removing T-bills as an allowable form of credit support.

The RCP unanimously supported EMC's first recommendation and by majority vote supported EMC's second recommendation.

The EMA approved the Market Rules reflecting the RCP's decision and the approved rules took effect on 13 November 2024.

## Enhancement of Fallback Mechanisms for StartGeneration and PriorScheduledPurchase

The MCE's input parameters, StartGeneration and PriorScheduledPurchase, may affect dispatch schedules:

- StartGeneration values reflect the MW generation level of each generator ten minutes before each period.
- PriorScheduledPurchase values reflect the MW consumption level of each load at the start of each period.

Values for these two parameters are always required to generate dispatch schedules. If the usual data sources for the two parameters are unavailable, fallback values for StartGeneration and PriorScheduledPurchase are needed. Ideally, those fallback values should still reasonably reflect physical conditions (i.e., actual generation or consumption levels).

As such, EMC proposed enhancing the fallback mechanism for both parameters, StartGeneration and PriorScheduledPurchase, to provide more fallback values for each parameter based on previously generated schedules, thereby improving scheduling resiliency.

The RCP unanimously supported EMC's recommendations. The EMA has approved the Market Rules to implement RCP's decision.

## Incorporation of State-of-Charge in MCE modelling of ESS

State-of-Charge (SoC) refers to the percentage of stored energy in an energy storage facility.

As a follow up to RC383 on the Modelling of Energy Storage Systems (ESS), this paper proposed incorporating SoC data into the Market Clearing Engine, thus constraining ESS dispatch schedules and improving the deliverability of scheduled quantities for ESS.

There are currently no SoC-related constraints within the MCE. Existing modelling constraints largely reflect physical constraints applicable to gas generators; gas generators do not have SoC concerns. Thus, there is a risk that ESS facilities may not be able to deliver when scheduled, depending on their actual SoC levels in real-time.

EMC proposed rule modifications to:

- require the PSO to provide real-time SoC data for each ESS to EMC before each dispatch period; and
- constrain ESS dispatch schedules based on the real-time SoC data received.

The RCP unanimously supported EMC's recommendations. The EMA has approved the Market Rules to reflect the RCP's decision.

## Modelling of Energy Storage Systems

This paper proposed amending the MCE formulation so that dispatch schedules can better reflect the physical capabilities of ESS.

Currently, the MCE assumes that generators can only inject energy into the grid, without withdrawing any. As such, generator offer quantities are only allowed to be positive (to inject into the grid). However, when an ESS intends to charge from the grid, this should be reflected as a negative offer quantity (to withdraw from the grid).

Furthermore, existing MCE constraints related to scheduling of reserve and regulation quantities are largely based on the physical constraints of gas generators. However, these constraints do not apply to ESS which can ramp up or down rapidly and provide reserves and/or regulation even while charging.

EMC proposed rule modifications to:

- allow ESS to submit energy storage offers which can include both positive and negative offer quantities to indicate its willingness to discharge and charge, respectively; and
- introduce a different set of (relatively simplified) constraints for ESS' provision of reserve and regulation, to account for ESS' fast-ramping capability and ability to provide reserves and regulation when charging.

The RCP unanimously supported EMC's recommendations. The EMA has approved the Market Rules to reflect RCP's decision.

# MARKET GOVERNANCE: LETTER FROM THE DISPUTE RESOLUTION COUNSELLOR

## Dear Industry Members

## Dispute Resolution and Compensation Panel

The Dispute Resolution and Compensation Panel (DRCP) was established under the Market Rules to provide dedicated dispute resolution services to the participants of the National Electricity Markets of Singapore (NEMS) when required.

The DRCP members are:

### Mediation Panel

1. Chandra Mohan
2. Daniel John
3. Engelin Teh, Senior Counsel
4. Geoff Sharp
5. Associate Professor Joel Lee
6. Lim Lei Theng
7. Lim Tat
8. Professor Nadja Alexander
9. Dr Peter Adler
10. Robert Yu
11. Shirli Kirschner

### Arbitration Panel

1. Chelva Rajah, Senior Counsel
2. Giam Chin Toon, Senior Counsel
3. Gregory Thorpe
4. Kenneth Tan, Senior Counsel
5. Professor Lawrence Boo
6. N Sreenivasan, Senior Counsel
7. Naresh Mahtani
8. Philip Harris
9. Raymond Chan
10. Dr Robert Gaitskell, King's Counsel
11. Tan Chee Meng, Senior Counsel
12. Professor Tan Cheng Han, Senior Counsel

## Dispute Management System Contacts

Pursuant to the Market Rules, each market entity has nominated at least one Dispute Management System (DMS) contact to be the first point of engagement in the event of a dispute.

The current DMS contacts are:

1. Air Liquide Singapore – Lim Yong Yi
2. Bioenergy – David Leong
3. Cleantech Solar Singapore Assets – Andre Nobre
4. Diamond Electric – Olivier Veteau
5. Energy Market Company – Dominic Tan
6. Engie South East Asia – Floriane Jacquart
7. Engie South East Asia – Sharlin Khor
8. ExxonMobil Asia Pacific – Lim Li Fang
9. ExxonMobil Asia Pacific – Ma Xiu Yan
10. Flo Energy Singapore – Matthijs Guichelaar
11. Green Power Asia – Daniel Ma
12. JE Green Solutions – Chin Cherk Min
13. JE Green Solutions – Tan Kuen Jong
14. Just Electric – Wittman Wah
15. Keppel Electric – Joelyn Wong
16. Keppel Electric – Tay Hock Hai
17. Keppel Merlimau Cogen – Alvern Chong
18. Keppel Merlimau Cogen – Jeremy Lim

# MARKET GOVERNANCE: LETTER FROM THE DISPUTE RESOLUTION COUNSELLOR

19. LYS Genco Beta – Jonathan Chong
20. National Environment Agency – Sara Raeburn
21. National Environment Agency – Yap Hwee Tat
22. PacificLight Energy – Ng Zi Kang
23. PacificLight Power – Yang Jia Xin
24. Power System Operator – Lee Kim Hwee
25. Power System Operator – Loh Poh Soon
26. Public Utilities Board – Lee Si Jia
27. Sembcorp Cogen – Lai Kum Fai
28. Sembcorp Floating Solar Singapore – Fendy Nursalim
29. Sembcorp Floating Solar Singapore – Kenny Kee
30. Sembcorp Power – Tan Ying Li
31. Sembcorp Power – Yvonne Goh
32. Sembcorp Solar Singapore – Fendy Nursalim
33. Sembcorp Solar Singapore – Kenny Kee
34. Senoko Energy – Poo Siok Yin
35. Senoko Energy Supply – Michelle Lim
36. Senoko Waste-to-Energy – Lee Song Koi
37. Senoko Waste-to-Energy – Clifton Tan
38. Seraya Energy – Sarah Sum
39. Shell Eastern Petroleum – Wee Tien Ai
40. Shell Eastern Petroleum – Hu Yu
41. Singapore District Cooling – Dennis Chong
42. Singapore District Cooling – John Tan
43. Singapore LNG Corporation – Ho Jia Hua
44. Singapore Refining Company – Joel Chong
45. SP PowerAssets – Chan Hung Kwan
46. SP Services – Lee Chui Ping
47. Taser Power – Albert Siah
48. Taser Power – Kenrick Tan
49. Terrenus Energy SL1X – Charles Wong
50. Terrenus Energy SL1X – David Chan
51. Terrenus Energy SL2 – Charles Wong
52. Terrenus Energy SL2 – David Chan
53. TP Utilities – Daniel Lee
54. Tuas DBOO Trust – Lee Song Koi
55. Tuas DBOO Trust – Victor Fong
56. Tuas Power Generation – Priscilla Chua
57. Tuas Power Supply – Jazz Feng
58. Tuas Power Supply – Kessler Wong
59. TuasOne – Kwanwei Sim
60. TuasOne – Mitsuru Tada
61. Union Power – Ellen Teo
62. Union Power – Eric Lim
63. YTL PowerSeraya – Christina Lye Jia Yu
64. YTL PowerSeraya – Lee Si Jie

## Dispute Resolution Training

As an integral aspect of the responsibilities under my role, I am entrusted with the provision of training in dispute resolution matters tailored for the stakeholders within the DMS.

On 20 June 2024, I conducted a briefing and refresher session concerning the NEMS' dispute resolution process specifically designed for the DMS contacts. One of our Dispute Resolution and Compensation Panel (DRCP) members, Professor Nadja Alexander, conducted a negotiation skills workshop for the participants. This workshop was conducted with the support and coordination of Energy Market Company's Market Assessment Unit.

## Conclusion

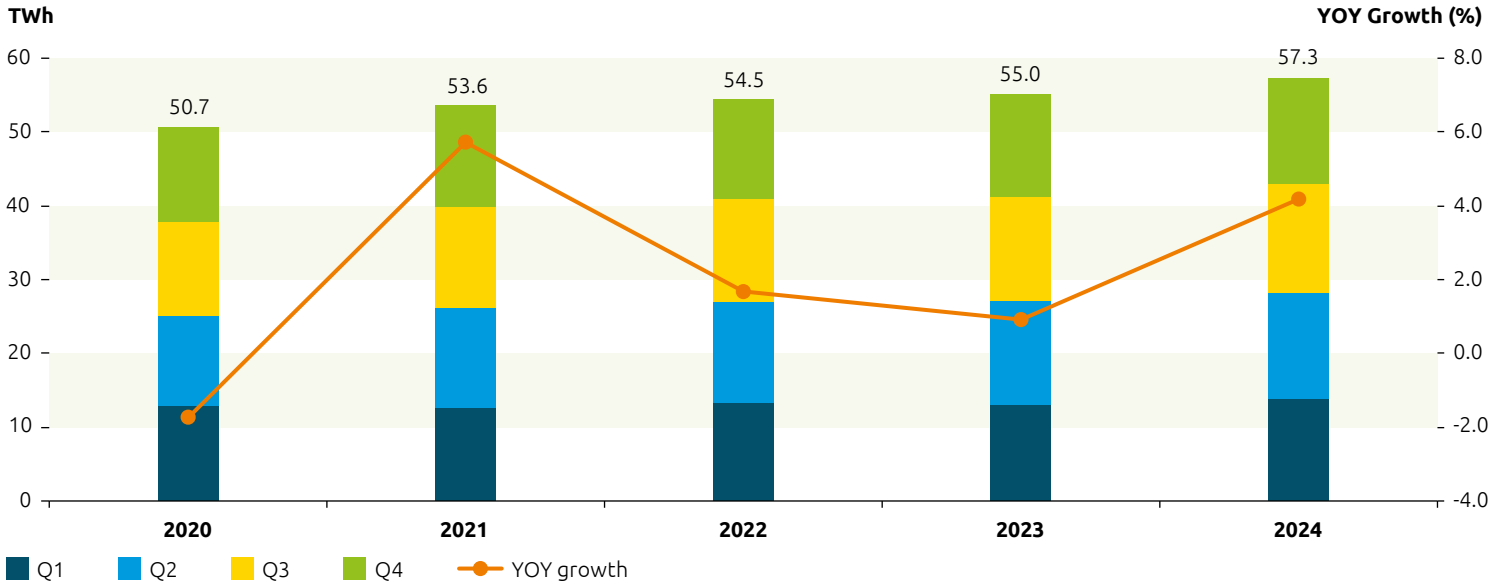
I am pleased to convey that no formal disputes were submitted to our office in 2024. I extend my gratitude to the esteemed members of the DRCP and the DMS contacts for their invaluable contributions. I anticipate the continuation of this collaborative effort and reaffirm my dedicated commitment to diligently address and support the dispute resolution requirements of all entities within the NEMS in the forthcoming year.

**George Lim**
**Senior Counsel**
*Dispute Resolution Counsellor*

# MARKET PERFORMANCE

# MARKET PERFORMANCE: OVERVIEW OF THE YEAR

## Annual Electricity Consumption 2020–2024




### Accelerating growth in electricity consumption in 2024

Electricity purchased by market participants (MP) is settled using electricity consumption data provided by the Market Support Services Licensee (MSSL).

In line with the 4.4 percent[2] growth in Singapore's economy, annual electricity consumption accelerated faster than in the previous two years to grow 4.2 percent year-on-year (YOY). Total electricity consumption stood at 57.3 terawatt hour (TWh), a new record high.

Electricity consumption expanded in all four quarters of 2024, with the first quarter recording the highest growth of 6.2 percent, while the following quarters saw YOY increase between 2.1 and 4.3 percent. Notably, electricity consumption across all quarters also reached their highest levels since the market's inception, correlating to the economic expansion, particularly the growth in wholesale trade and manufacturing sectors.

[2] *MTI Maintains 2025 GDP Growth at "1.0 to 3.0 Per Cent": Ministry of Trade and Industry, Singapore, 14 February 2025.*

# MARKET PERFORMANCE: OVERVIEW OF THE YEAR

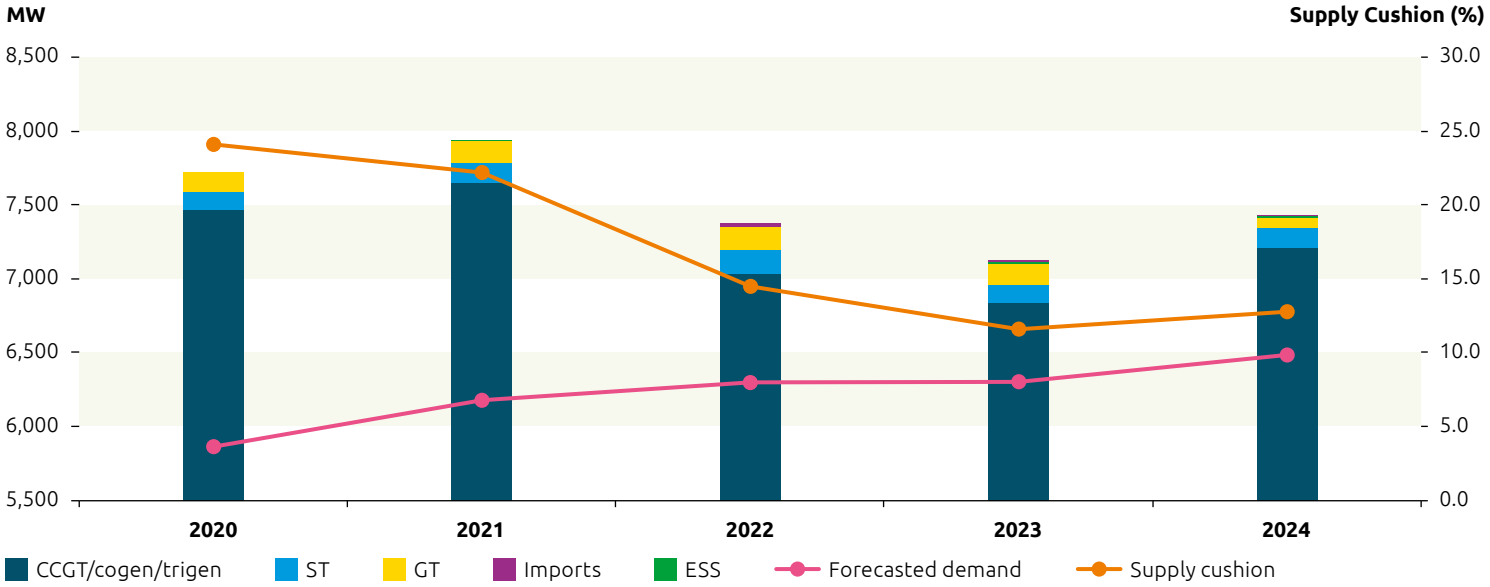
## Annual generation supply and supply cushion recovers after two-year decline

In 2024, the proportion of periods with upstream gas curtailment shrank from 23.6 percent in 2023 to 10.4 percent. Coupled with lower annual maintenance, the annual generation supply expanded by 4.3 percent to 7,430 megawatts (MW), rebounding from a two-year decline. The supply cushion[3] recovered from a record low in 2023 to 12.8 percent in 2024. Despite the slight expansion by 1.2 percentage points, the supply cushion for the year remained the second lowest since the market started.

The increase in overall generation supply was spurred by a 5.5 percent boost in combined-cycle gas turbine/cogeneration/trigeneration (CCGT/cogen/trigen) supply to 7,214MW. In addition, the CCGT/cogen/trigen supply was 11.2 percent above the forecasted demand, registering a 2.8 percentage point uptick from 2023.

Steam Turbine (ST) supply saw a similar boost of 4.7 percent to 134MW. On the other hand, Gas Turbine (GT) supply contracted 54.7 percent to 63MW, due to the de-registration of two GT facilities this year. Import supply fell from 9MW in 2023 to 0MW over the first three quarters in 2024 but recovered to 13MW in the last quarter with addition of new capacities. Energy Storage System (ESS) supply[4] remained at 16MW, unchanged from 2023.

### Annual Generation Supply by Plant Type 2020–2024

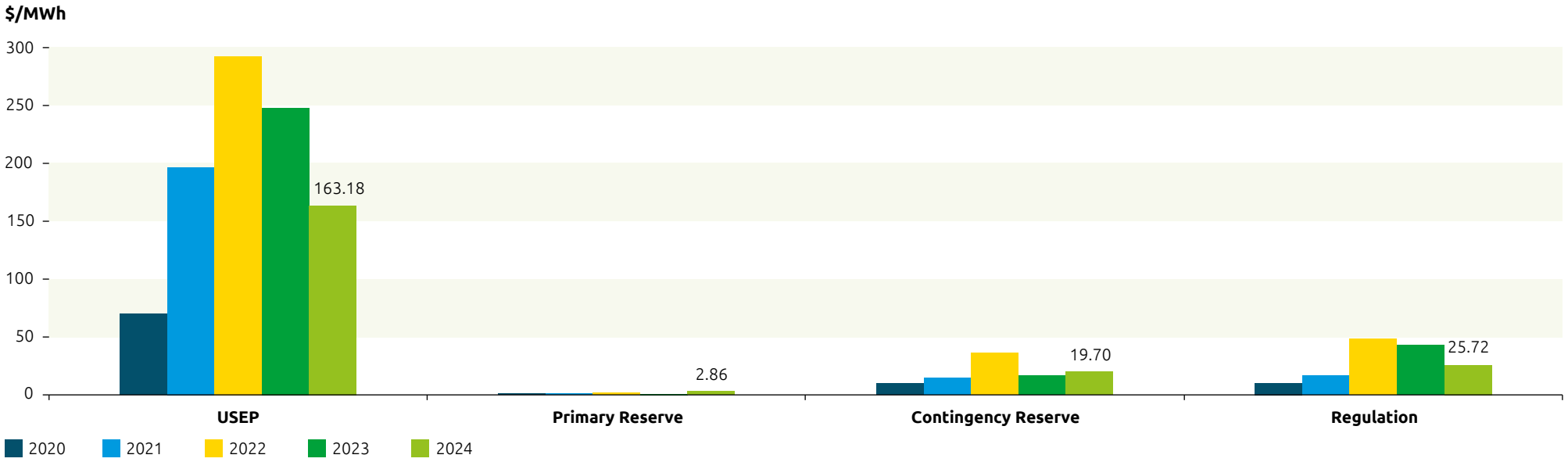



[3] *Supply cushion measures the percentage of total generation supply that is available after matching off forecasted demand. It is calculated by subtracting forecasted demand from total supply, over total supply.*

[4] *Based on modelled offer capacity.*

# MARKET PERFORMANCE: OVERVIEW OF THE YEAR

## Annual USEP and Ancillary Prices 2020–2024




### USEP and regulation prices fall while reserve prices rise

The annual average Uniform Singapore Energy Price (USEP) declined 34.1 percent to $163.18 per megawatt hour (MWh) in 2024 from $247.52/MWh in 2023. Notably, the average USEP for the year trended downwards for the second consecutive year since reaching its peak in 2022. The YOY drop in USEP resulted from the improved supply cushion this year. The annual USEP was 22.8 percent below the annual base vesting price (BVP)[5] of $211.26/MWh.

Prices for both primary reserve and contingency reserve increased as a result of fewer offers in the cheaper price tranches and higher requirements. The primary reserve price more than tripled to $2.86/MWh, from $0.78/MWh in 2023, while the contingency reserve price rose 19.3 percent from $16.51/MWh to $19.70/MWh, despite fewer periods with contingency reserve shortfall compared to 2023.

The regulation price declined 39.8 percent from $42.71/MWh in 2023 to $25.72/MWh in 2024 due to more offers in the cheaper tranches and fewer periods with regulation shortfall. The requirement was also revised downward from 117MW to 113MW, as of 1 February 2024.

[5] *The annual base vesting price for 2024 is calculated as the average of base vesting price from January to December 2024.*

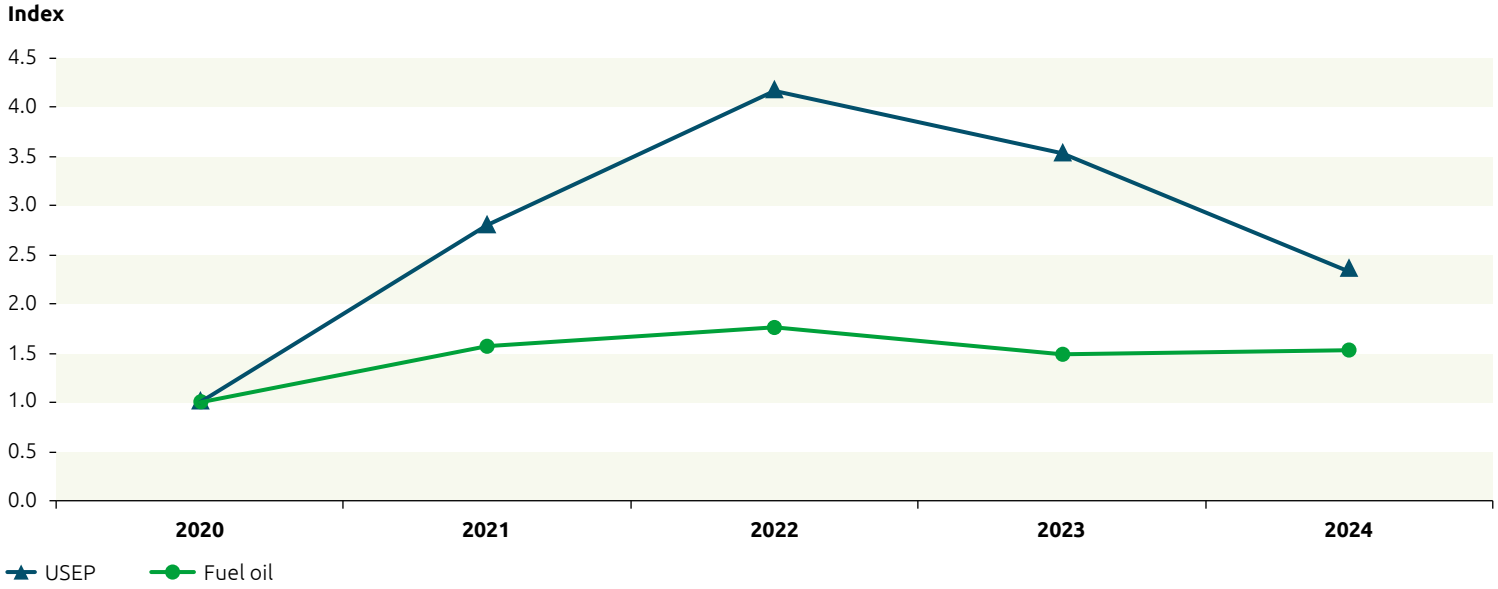
# MARKET PERFORMANCE: OVERVIEW OF THE YEAR

## USEP falls amid higher fuel oil price[6]

The USEP index[7] shifted downwards to 2.33 on the index while the fuel oil price index rose to 1.53 in 2024. Both indices moved in the opposite direction for the first time in five years.

The two consecutive years of decline in USEP index coupled with the marginal increase in fuel oil price index resulted in a narrower gap between the two indices in 2024.

### Annual USEP and Fuel Oil Price Movements 2020–2024

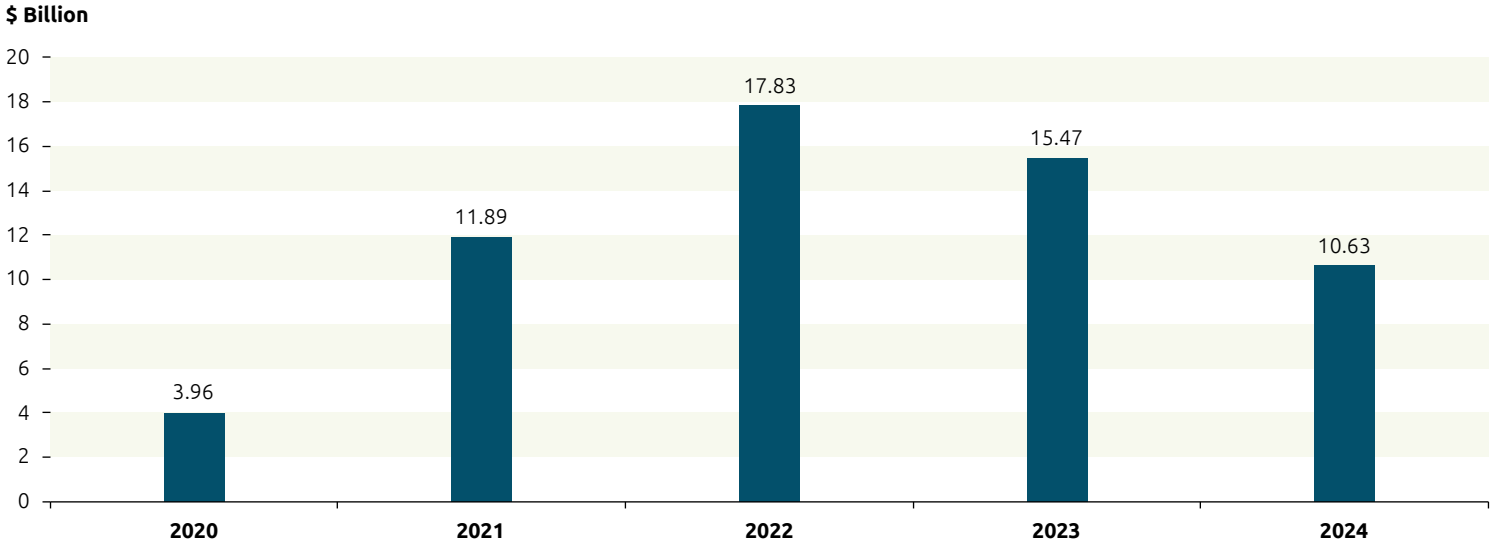



[6] *Used as a proxy for fuel oil price.*

[7] *The USEP index is computed using 2020 as the index base. Therefore, the USEP index in 2020 is 1, while the USEP index in 2024 is 2.33 (computed using the 2024 USEP of $163.18/MWh divided by the 2020 USEP of $70.01/MWh).*

# MARKET PERFORMANCE: OVERVIEW OF THE YEAR

## Annual Value of Products Traded 2020–2024




### Annual value of products traded extends its decline in 2024

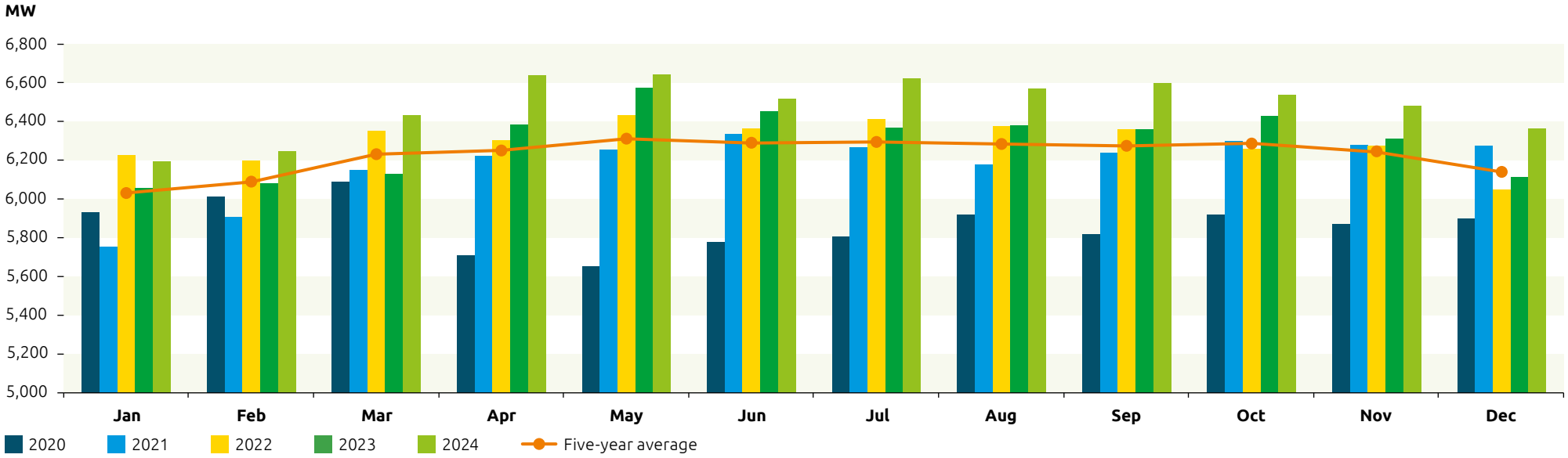
The value of products traded constitutes the transacted value of all products traded in the National Electricity Market of Singapore (NEMS), in the energy, reserves, and regulation markets. Energy Market Company (EMC) uses the metered demand and generation data from the MSSL as well as market prices in the NEMS to settle market transactions daily.

In 2024, the annual value of products traded fell 31.3 percent to $10.63 billion, due to lower market prices.

The energy market accounted for 98.9 percent of all products traded, while the reserve and regulation markets accounted for 0.8 percent and 0.3 percent respectively.

# MARKET PERFORMANCE: ENERGY DEMAND

## Monthly Forecasted Demand 2020–2024




### Forecasted demand reaches new heights in most months

Forecasted demand refers to the projected electricity consumption in Singapore. The forecast is provided in real time by the Power System Operator (PSO) and is a key component in determining the USEP.

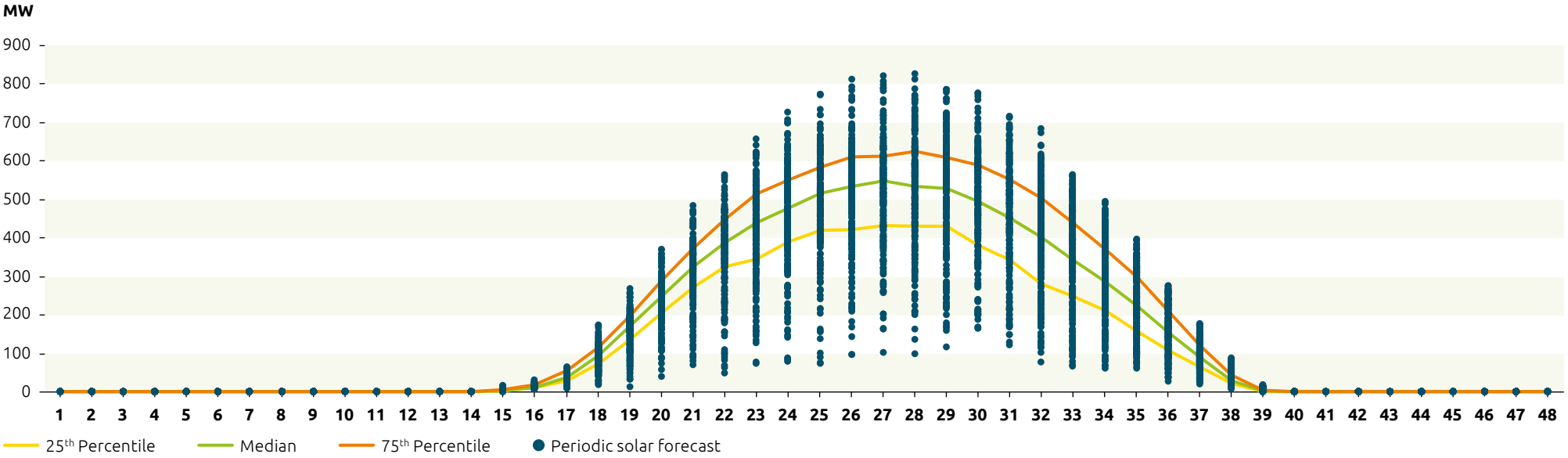
The annual forecasted demand rose 2.9 percent in 2024 to 6,486MW. The monthly forecasted demand soared to new heights in all months except January.

Forecasted demand was also stronger in all months of 2024, compared to 2023. The monthly average demand peaked in May for three consecutive years, registering a 1.0 percent YOY gain to 6,642MW in 2024. The higher forecasted demand in May was driven by the higher average temperatures, which exceeded 29.0 degrees Celsius during the month.

The monthly average demand registered the steepest YOY growth of 4.9 percent to 6,431MW in March, in line with the warmer weather. The average temperature in March was 29.8 degrees Celsius, the highest monthly average temperature recorded this year. Monthly average demand was lowest in January, despite registering a 2.3 percent YOY increase to 6,192MW.

# MARKET PERFORMANCE: ENERGY DEMAND

## Impact of Solar Generation on Forecasted Demand 2024




### First look at the solar generation profile since its incorporation (based on 2024 solar forecast[8])

Solar generation is driven by the availability of sunlight, where the generation profile exhibits a characteristic bell curve shape due to the solar irradiance periods. The solar generation typically starts low from 07:00, peaks in the middle of the day and dwindles towards 19:00. The half-hourly solar generation forecast peaks between Periods 26 to 29 (12:30 to 14:00).

However, solar generation is inherently intermittent, as it is susceptible to cloud cover, weather conditions and seasonal changes. These factors contribute to significant variability in solar generation, especially during peak periods. The maximum and minimum solar generation forecast were 826MW and 86MW during Periods 26 to 29, underlining a potential solar intermittency variance of over 700MW.

Solar generation quartiles further illustrate its output variability. The 25th percentile represents the lower bound of the solar generation, associated with low irradiance conditions. The 75th percentile reflects higher solar generation scenarios where the solar output is expected to generate within this level 75 percent of the time. Across Periods 26 to 29, the 25th percentile ranges between 421MW and 433MW, while the 75th percentile spans from 609MW to 625MW. The interquartile range is between 180MW and 195MW, indicating the spread in solar generation during these periods. The median output during Periods 26 to 29 exceeded 529MW, highlighting the most likely range of solar generation under daytime conditions.

[8] *Solar generation forecast is provided in real-time by the PSO and was incorporated into the Market Clearing Engine from 21 February 2024.*

# MARKET PERFORMANCE: ENERGY DEMAND

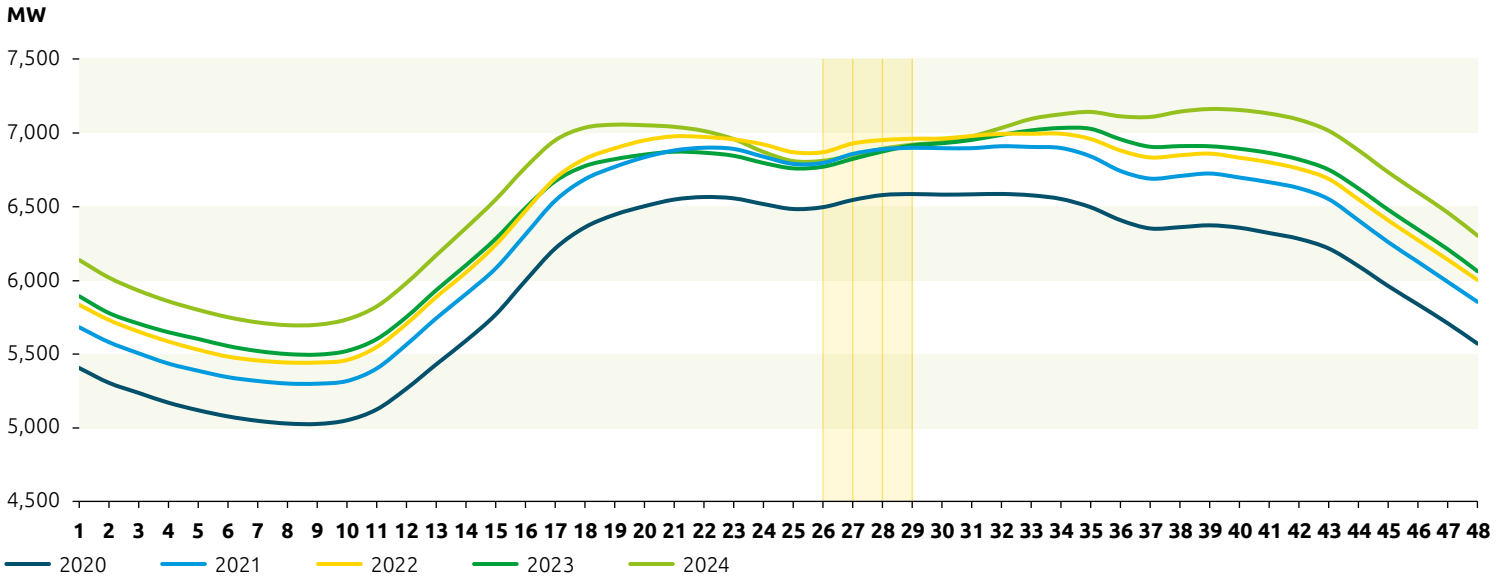
## Increasing influence from solar generation on forecasted demand

The increasing solar generation in the energy mix has shown significant impact on the periodic forecasted demand throughout the day. The dip in the periodic forecasted demand towards 2024 is increasingly noticeable during Periods 26 to 29, coinciding with the peak solar generation periods.

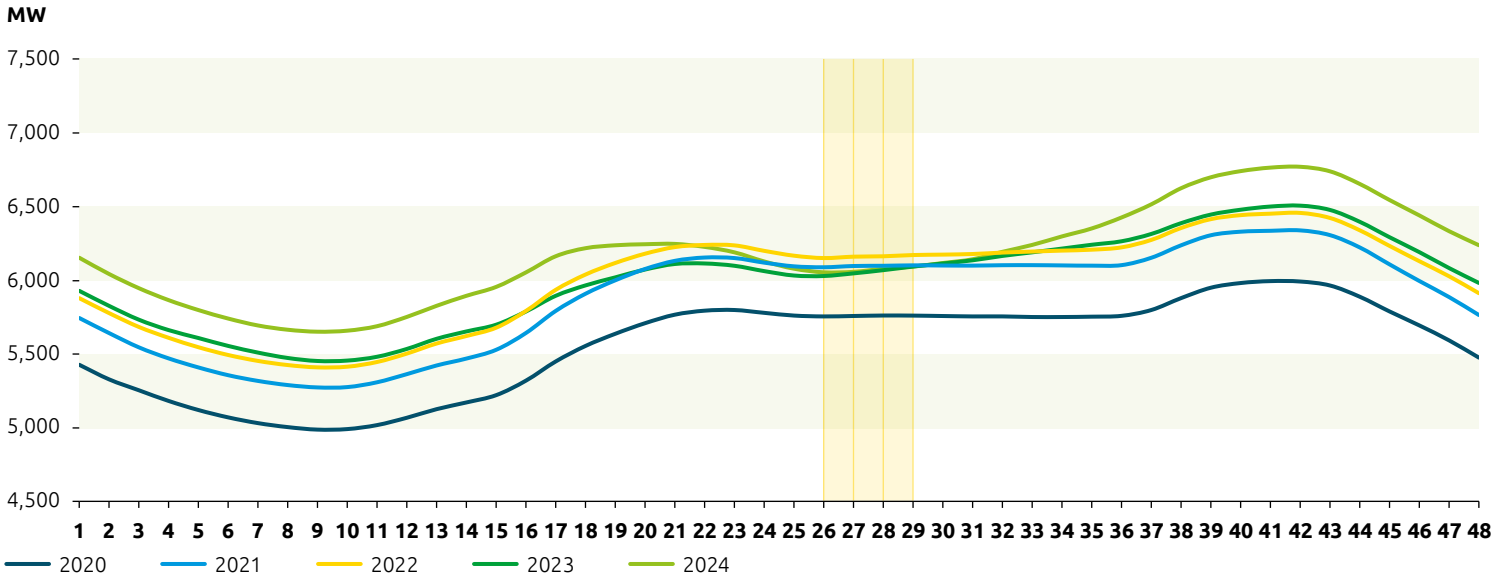
During the weekday, the half-hourly forecasted demand peaked in Period 32, averaging at 6,585MW in 2020. With the increasing solar generation in the recent years, the weekday peak half-hourly forecasted demand has shifted to Period 39 at average 7,161MW in 2024, underlining higher demand after solar irradiance periods (Periods 15 to 38).

In contrast, the weekend/public holiday half-hourly forecasted demand peaked in Period 41 at average 5,993MW in 2020 and Period 42 at average 6,769MW in 2024, suggesting lesser impact of solar generation on weekend/public holiday forecasted demand. Nevertheless, there was still a noticeable dip in forecasted demand between Periods 26 to 29 in the midday and sharp increase in forecasted demand from Period 39 after the solar irradiance periods in 2024.

### Weekday Forecasted Demand Profile 2020–2024




### Weekend/Public Holiday Forecasted Demand Profile 2020–2024



# MARKET PERFORMANCE: ENERGY SUPPLY

## Generation and Load Facilities Registered, De-registered and Revised in 2024

### New Facilities Registered

| Month of Registration | Generation Type | Market Participant | Registered Capacity |
|---|---|---|---|
| January | 1 LRF unit | **Diamond Electric** | 3.800MW |
| February | 1 LRF unit | **Diamond Electric** | 8.000MW for load curtailment |
| May | 1 IGS unit | **Union Power** | 0.478MW |
| | 1 IGS unit | **Terrenus Energy SR3** | 0.270MW |
| June | 1 IGS unit | **Sunseap Commercial Assets** | 1.750MW |
| August | 1 IGS unit | **Sunseap Leasing** | 0.108MW |
| | 1 LRF unit | **Keppel Electric** | 4.000MW for load curtailment |
| September | 2 GT units | **Senoko Energy** | 131.000MW, 131.000MW |
| | 1 LRF unit | **Crystal Clear Environmental** | 0.100MW |
| | 1 IRF unit | **Keppel Electric** | 200.000MW[9] |
| October | 1 IGS unit | **Sembcorp Solar Singapore** | 0.120MW |
| November | 1 LRF unit | **Crystal Clear Environmental** | 0.300MW for load curtailment |
| December | 1 IGS unit | **Engie South East Asia** | 0.270MW |
| | 1 IRF unit | **Sembcorp Power** | 50.000MW |

### Facilities De-registered

| Month of De-registration | Generation Type | Market Participant | Registered Capacity |
|---|---|---|---|
| February | 4 IGS units | **Sembcorp Solar Singapore** | 0.516MW, 0.576MW, 0.816MW, 0.120MW |
| | 3 ST units | **YTL PowerSeraya** | 250.000MW, 250.000MW, 250.000MW |
| | 1 Others[10] | **Public Utilities Board** | 5.902MW |
| | 1 IGS unit | **Sunseap Leasing** | 3.600MW |
| May | 1 ST unit | **National Environment Agency** | 47.800MW |
| July | 1 CCGT/cogen/trigen unit | **Senoko Energy** | 425.000MW |
| | 1 NEIGF unit | **Public Utilities Board** | 1.900MW |
| October | 1 IGS unit | **Sunseap Leasing** | 1.518MW |
| | 2 GT units | **YTL PowerSeraya** | 90.000MW, 90.000MW |

### Capacity Revisions

| Generation Type | Market Participant | Revised Capacity |
|---|---|---|
| 1 LRF unit | **Diamond Electric** | 12.000MW |
| 1 CCGT/cogen/trigen unit | **ExxonMobil Asia Pacific** | 118.000MW |
| 2 LRF units | **Keppel Electric** | 11.000MW, 4.000MW for load curtailment |
| 1 CCGT/cogen/trigen unit | **PacificLight Power** | 415.000MW |
| 3 IGS unit | **Sembcorp Solar Singapore** | 11.408MW, 6.340MW, 2.288MW |
| 1 GT unit | **Senoko Energy** | 129.000MW |
| 1 IGS unit | **Singapore District Cooling** | 9.255MW |
| 1 CCGT/cogen/trigen unit (under ECIS[10]) | **SP Services** | 23.696MW |
| 2 IGS units (under ECIS[11]) | **SP Services** | 758.920MW, 23.560MW |
| 1 IGS unit | **Terrenus Energy SR3** | 8.080MW |
| 1 IGS unit | **Union Power** | 2.076MW |

### 15 new facilities registered in 2024

At the end of 2024, the total registered capacity[12] of generation facilities in the NEMS stood at 12,343MW. Of this, 82.1 percent or 10,138MW belonged to the CCGT/cogen/trigen category. As at 31 December 2024, there were 108 generation facilities, 15 load facilities, three import facilities and four ESS facilities registered in the NEMS.

During the year, 11 MPs added 15 new facilities to the market: two GT facilities, six IGS facilities, five load facilities, and two import facilities. In addition, three CCGT/cogen/trigen facilities, one GT facility, eight IGS facilities and three load facilities revised their registered capacity over the year.

A total of 15 facilities were de-registered in 2024: one CCGT/cogen/trigen facility, two GT facilities, four steam turbine (ST) facilities, seven IGS[13] facilities and one biogas power generation unit prior to its withdrawal from the market.

*CCGT/cogen/trigen = Combined-cycle gas turbine/cogeneration/trigeneration (combined category) | ESS = Energy storage systems | GT = Gas turbine | IGS = Intermittent generation sources | IRF = Import registered facilities | LRF = Load registered facilities | NEIGF = Non-exporting embedded intermittent generation facilities | ST = Steam turbine*

9 *Import capacity of Keppel Electric IRFs are capped at 200MW.*
10 *Biogas power generation unit.*
11 *Enhanced Central Intermediary Scheme for Embedded Generation.*
12 *Registered capacity included energy storage systems, imports and NEIGFs.*
13 *Includes one NEIGF.*

# MARKET PERFORMANCE: ENERGY SUPPLY

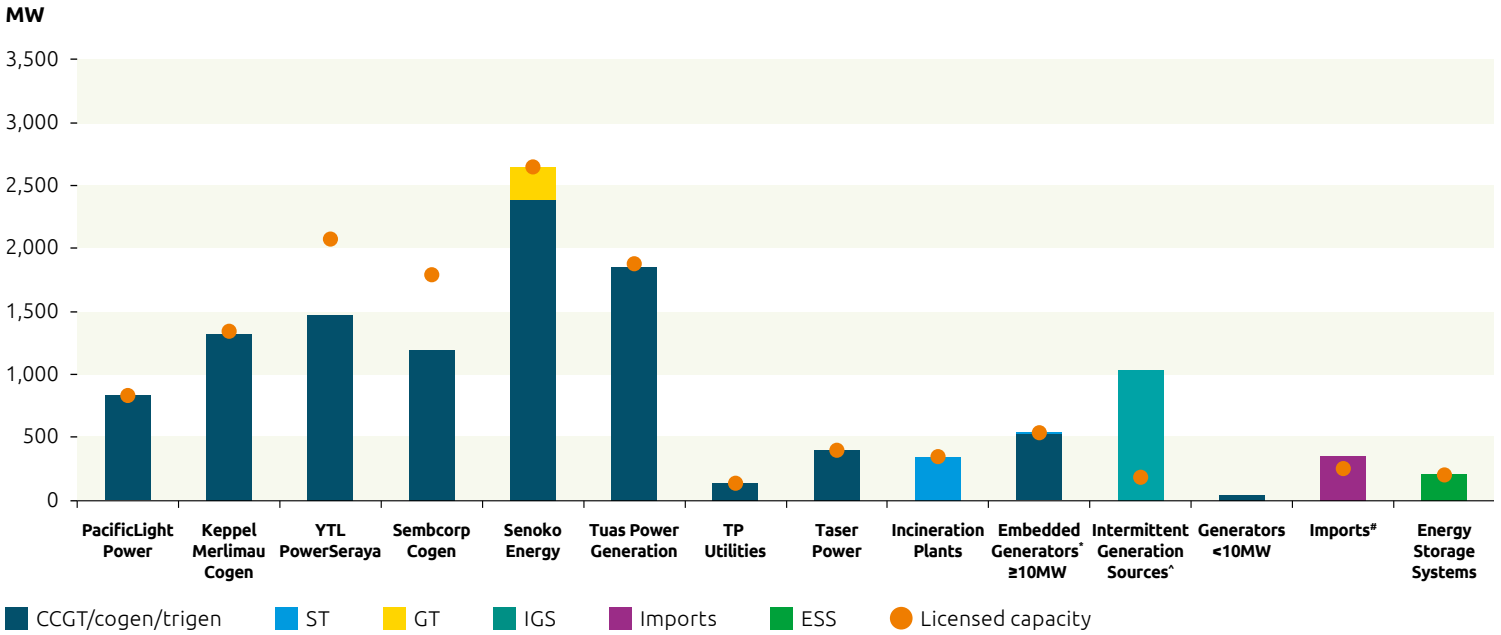
## Licensed and registered capacities decrease in 2024

Total licensed capacity[14] in the NEMS (which captures facilities with a generation capacity larger than or equal to 10MW) experienced a significant increase of 523MW to 12,591MW[15] in 2024. The increase in licensed capacity was primarily driven by the addition of 1,200MW from YTL PowerSeraya and Sembcorp Cogen for two upcoming CCGT/cogen/trigen facilities.

In addition, ExxonMobil Asia Pacific's and PacificLight Power's CCGT/cogen/trigen facility each expanded its generation capacity by 8MW and 15MW respectively. Keppel Electric's and Sembcorp Power's new import facility each contributed 200MW[16] and 50MW respectively. Meanwhile, IGS saw a 128MW increase in licensed capacity, supported by eight upcoming facilities from Sembcorp Solar. However, this overall increase was largely offset by the deregistration of five facilities from YTL PowerSeraya totaling 930MW, along with one facility from National Environment Agency at 48MW.

Total registered capacity[17] of generation facilities declined 5.2 percent from 13,015MW to 12,343MW in 2024. The decline mainly resulted from the deregistration of three ST and two GT facilities from YTL PowerSeraya and one incineration plant from National Environment Agency. The registered capacity of IGS including NEIGFs expanded significantly by 24.6 percent to 1,028MW, while Keppel Electric and Sembcorp Power registered two new import facilities amounting to 250MW, which offset the impact from the deregistered facilities.

### Generation Capacity as at 31 December 2024: Registered Versus Licensed



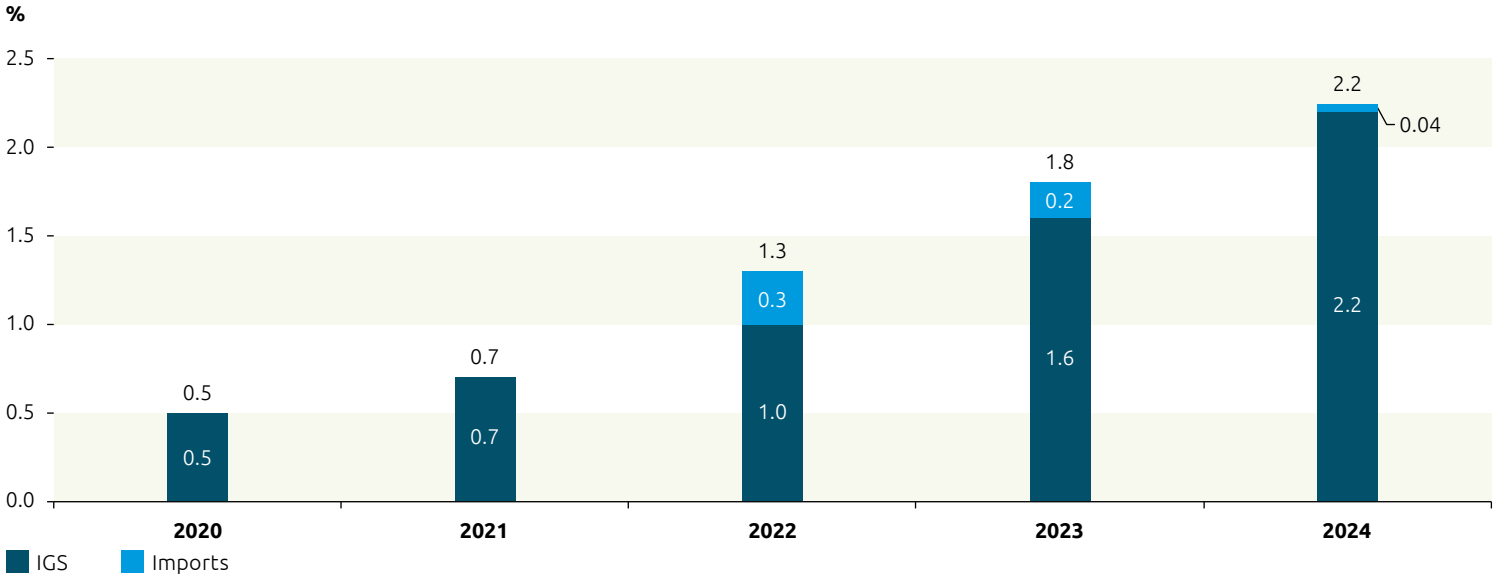

* *Embedded generators exclude TP Utilities.*
^ *Intermittent generation sources include NEIGFs.*
\# *Import capacity of Keppel IRFs is capped at 200MW.*
*Licensed capacity of generating units, including IGS, with name-plate ratings of less than 10MW is not publicly available and is therefore omitted in the determination of the license capacity of such generating units.*

CCGT/cogen/trigen facilities continued to account for majority – 82.1 percent – of total registered capacity in 2024. This was 1.1 percentage points larger than their share in 2023. ST's share decline 6.0 percentage points to 2.9 percent of total registered capacity, as other sources contribution increased. IGS', including NEIGFs, and Import's share each grew 2.0 percentage points to 8.3 percent and 2.8 percent of total registered capacity respectively. GT's share saw similar growth of 0.7 percentage point to 2.1 percent of total registered capacity, while the share of ESS marginally increased 0.1 percentage point to 1.7 percent.

[14] *Since 2020, the total registered capacity has been greater than the total licensed capacity. This was primarily due to increasing capacities of intermittent generation sources which were mostly excluded from the total licensed capacity.*
[15] *Licensed capacity included generation facilities ≥10MW and imports.*
[16] *Import capacity of Keppel Electric IRFs are capped at 200MW.*
[17] *Registered capacity included energy storage systems, imports and NEIGFs.*

# MARKET PERFORMANCE: ENERGY SUPPLY

## Renewable Generation Market Share 2020–2024 (Based on Metered Generation)

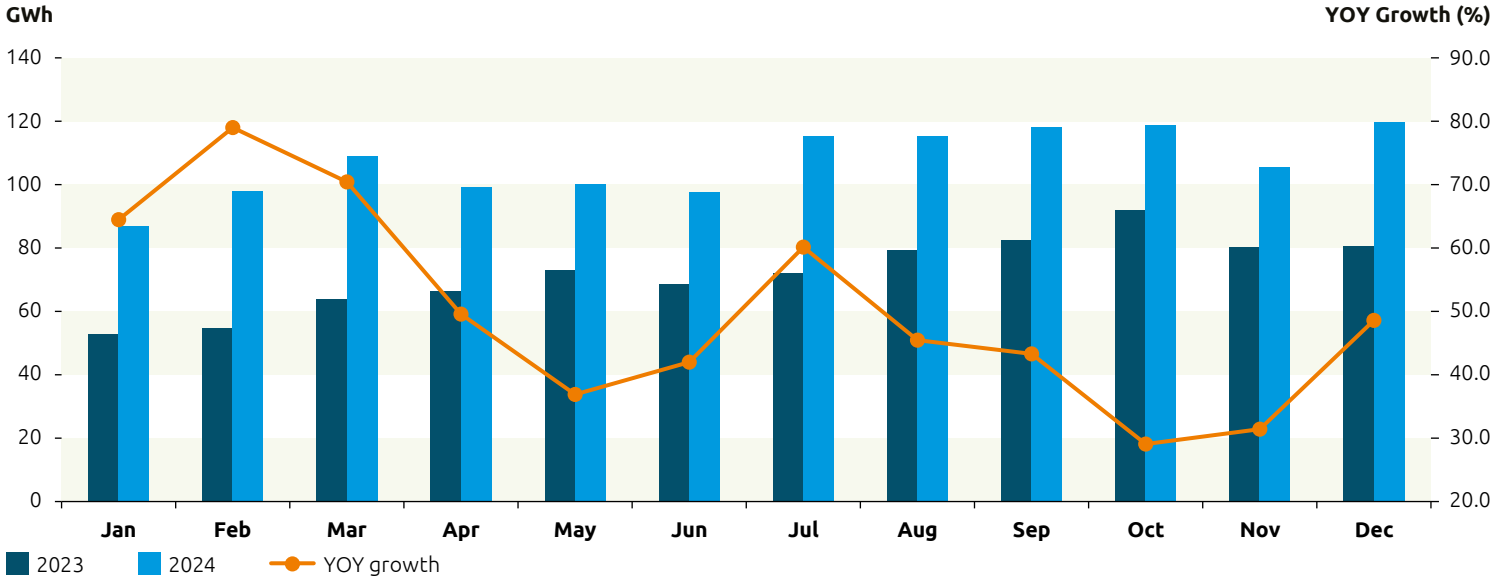



### Renewable generation market share increases steadily each year

The combined market share of renewable generation[18] rose 0.4 percentage point to 2.2 percent in 2024, driven primarily by IGS growth.

IGS continued to account for the majority of the combined market share increase, expanding by 0.6 percentage point from 2023. The steady YOY increase in IGS market share reflects the continued expansion of IGS capacity. The market share for Imports, however, contracted by 0.2 percentage point, due to reduced trading activities in the first three quarters of the year.

## Monthly IGS Generation 2023 Versus 2024



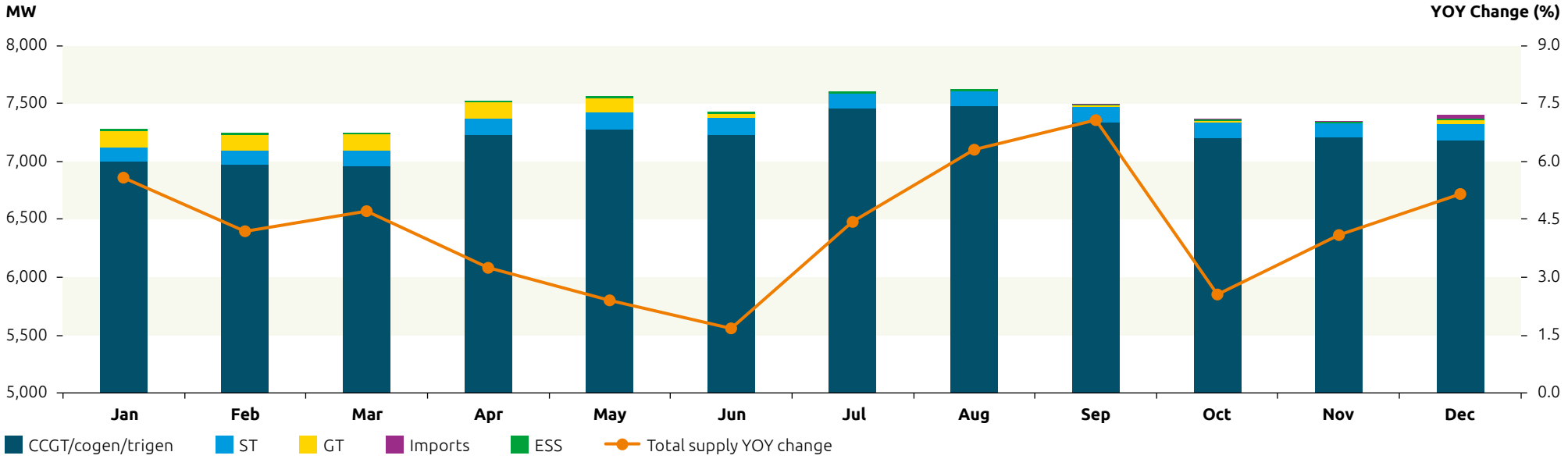

### Significant growth in IGS generation alongside rising registered capacity

The generation of IGS comprised solely of solar generation facilities. The monthly average IGS generation saw a substantial growth of 48.0 percent to 107GWh in 2024, in line with IGS registered capacity doubling from average 394MW to average 838MW this year. On a monthly basis, IGS generation demonstrated consistent YOY growth. The monthly IGS generation peaked in October at 119 GWh, up by 29.1 percent compared to 2023.

[18] *Includes renewable source from IGS and imports from low-carbon sources.*

# MARKET PERFORMANCE: ENERGY SUPPLY

## Monthly Supply by Plant Type 2024




### Total supply registered YOY growth in all months

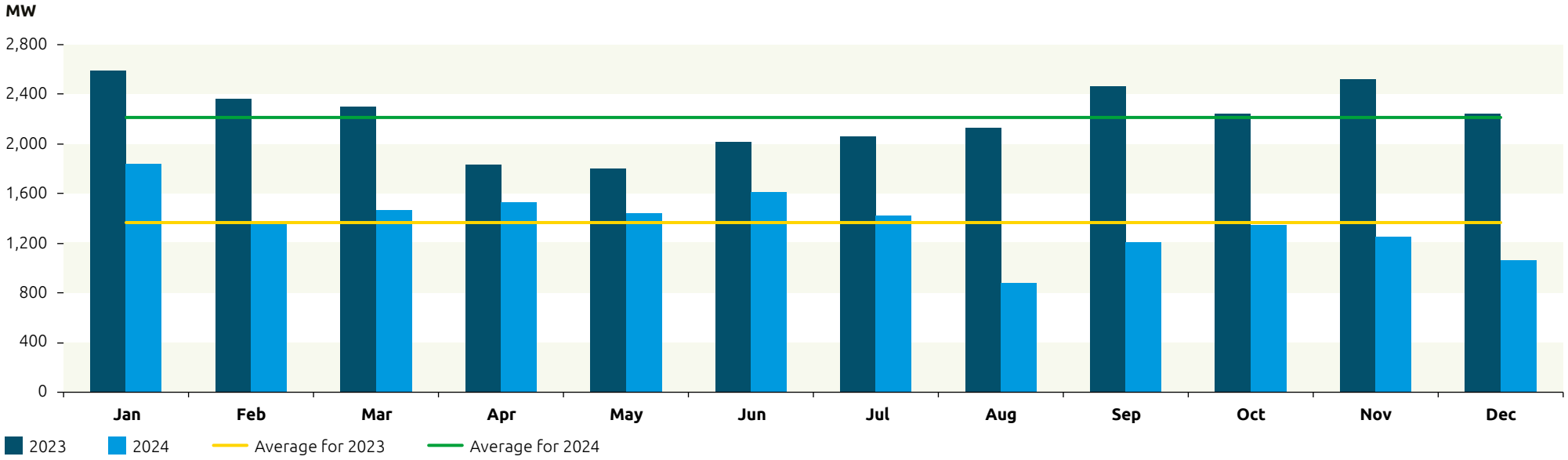
The total supply expanded 4.3 percent in 2024 with a YOY decline in maintenance level and less frequent upstream gas curtailment. Compared to 2023, total supply saw a steady increase, rising between 1.7 percent and 7.1 percent across all months.

The most efficient generation type – CCGT/cogen/trigen – continued to dominate the supply mix, accounting for 97.1 percent of total supply in 2024. This was 1.2 percentage points larger than its share in 2023. The proportion of ST supply remained at 1.8 percent, while that of GT supply shrank 1.1 percentage points to 0.9 percent. The proportion of ESS supply remained at 0.2 percent, while that of Import shrank 0.1 percentage point.

In 2024, gradual recovery in the monthly supply was observed, with monthly supply strengthening and surpassing the 7,500MW level for the first time since 2022. The monthly supply was the highest in August at 7,629MW, and lowest in March at 7,248MW. Compared to the first half of the year, the total supply averaged 1.3 percent higher in the second half of the year.

# MARKET PERFORMANCE: ENERGY SUPPLY

## Monthly Generation Maintenance 2023 Versus 2024




### Decline in generation maintenance activities in 2024

The annual average generation maintenance level[19] declined a sharp 38.4 percent to 1,364MW in 2024. The monthly generation maintenance levels were lower YOY across all months. The highest monthly average generation maintenance level of 1,834MW was in January, while the lowest level of 878MW was in August.

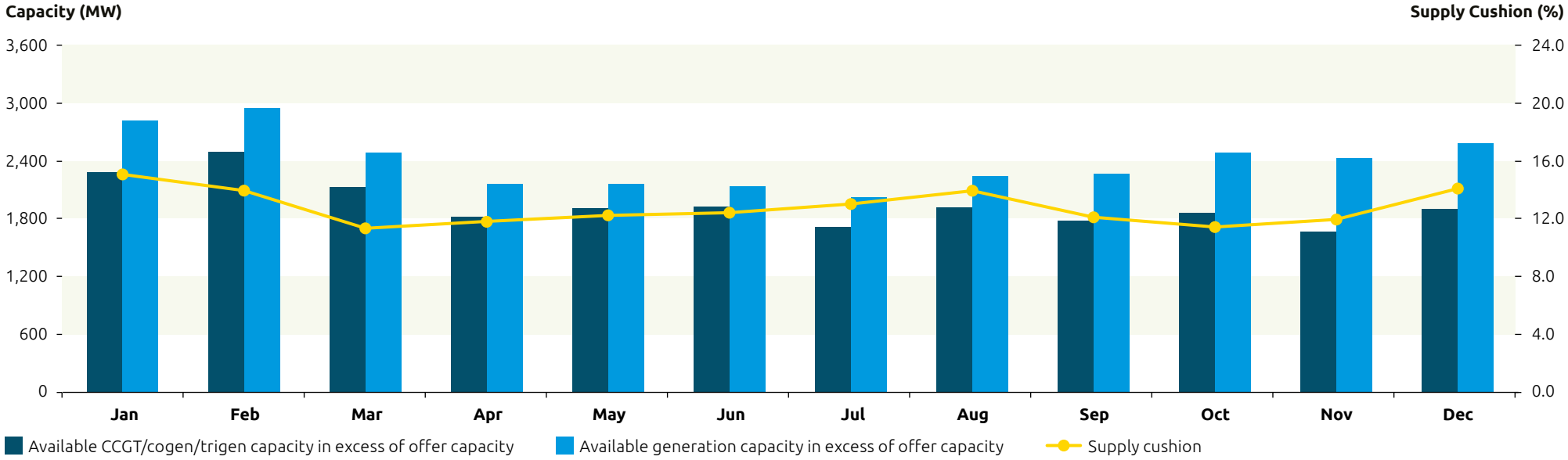
The standard deviation of monthly generation maintenance fell slightly from 257MW in 2023 to 251MW in 2024, indicating a narrower range in the monthly generation maintenance level.

The ratio of generation maintenance to registered capacity fell from 17.0 percent in 2023 to 11.1 percent in 2024.

[19] *Generation maintenance refers to the overhaul and retrofitting of generation facilities. Generation maintenance levels are calculated based on the Annual Generator Outage Programme (AGOP) provided by the PSO.*

# MARKET PERFORMANCE: ENERGY SUPPLY

## Monthly Supply Cushion and Available Generation Capacity in Excess of Offer Capacity 2024




### Higher available generation capacity in excess of offer capacity in the first quarter of the year

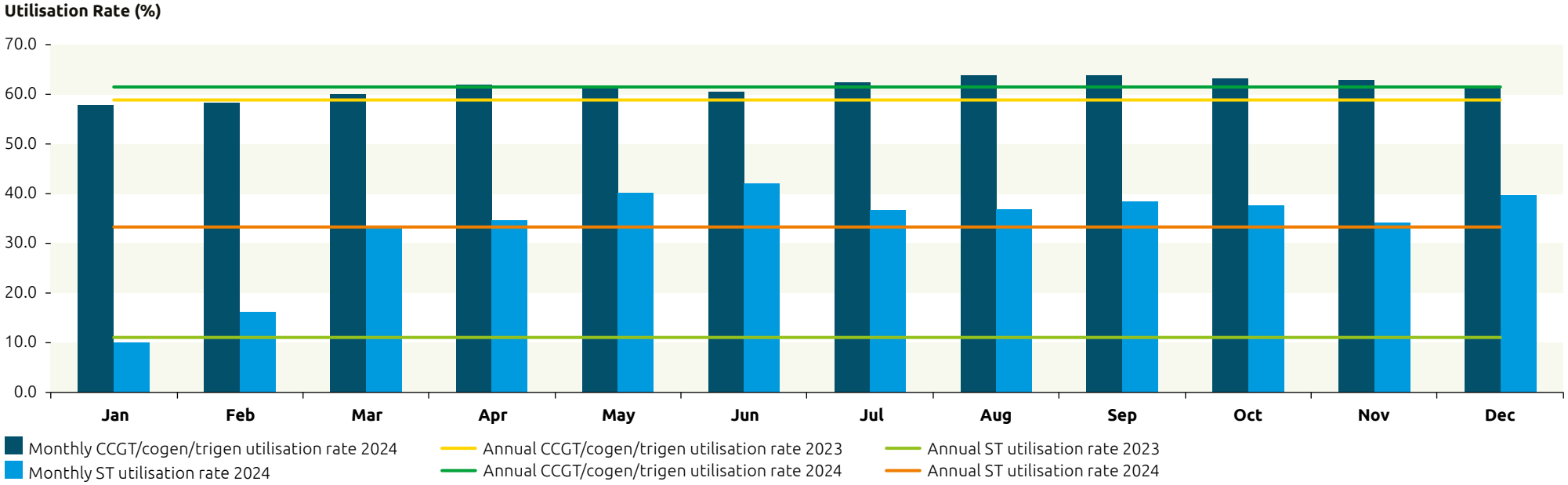
The movements in the available CCGT/cogen/trigen capacity in excess of offer capacity were mostly in line with those of the available generation capacity in excess of offer capacity throughout the year.

This refers to the generation capacity which is not on maintenance and not being offered to the market. The available generation capacity in excess of offer capacity peaked at 2,946MW in February. Correspondingly, the available CCGT/cogen/trigen capacity in excess of offer capacity also peaked at 2,492MW in the same month.

On a YOY comparison, the available generation capacity in excess of offer capacity averaged 3.6 percent higher at 2,747MW in the first quarter of the year, driven by a greater reduction in maintenance levels compared to the increase in generation offers. In contrast, the available generation capacity in excess of offer capacity remained lower in the subsequent quarters, declining between 4.4 percent and 23.8 percent YOY. The supply cushion increased in all quarters, ranging between 0.1 percentage point and 0.2 percentage point YOY, indicating a slight expansion on the supply throughout the year.

# MARKET PERFORMANCE: ENERGY SUPPLY

## Monthly Utilisation Rate by Plant Type 2024




### Increase in annual utilisation rates

CCGT/cogen/trigen and ST utilisation rate is the ratio of the scheduled energy to the registered capacity.

In 2024, the annual CCGT/cogen/trigen utilisation rate rose 2.6 percentage points to 61.5 percent, while the annual ST utilisation rate rose a significant 22.2 percentage points to 33.3 percent. The sharp increase in ST utilisation rate was primarily due to a reduction in registered capacity with the deregistration of four ST facilities.

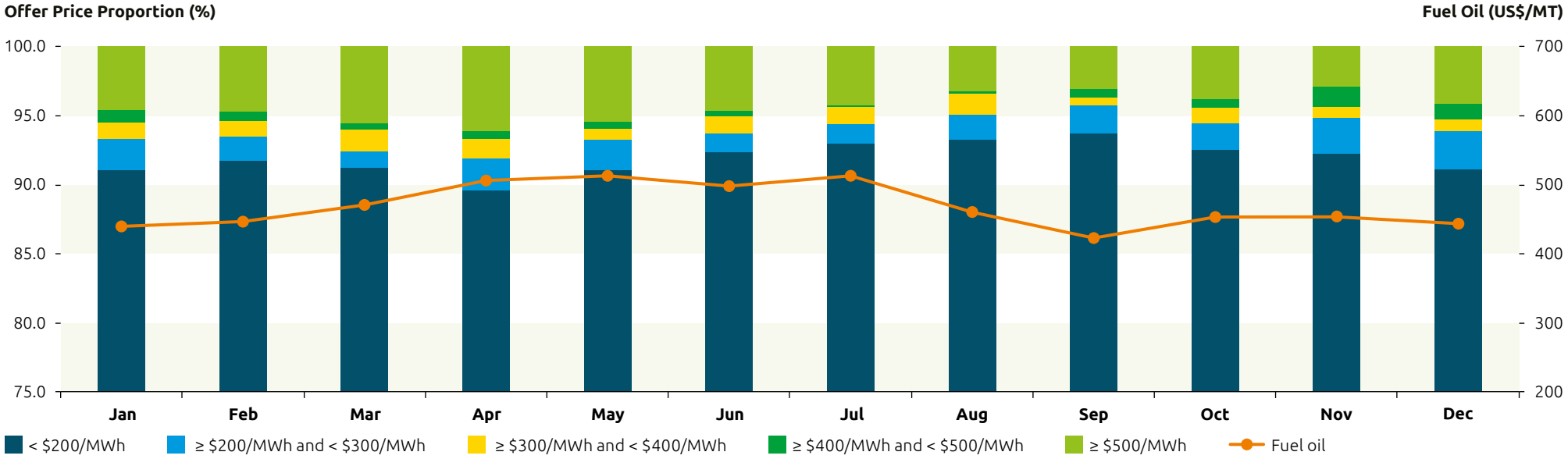
On a monthly basis, the CCGT/cogen/trigen utilisation rate ranged between 57.9 percent in January and 63.9 percent in September, while that of ST ranged between 10.1 percent in January and 42.0 percent in June.

Compared to 2023, the CCGT/cogen/trigen utilisation rate was higher in all months except June, with the largest increase of 4.3 percentage points recorded in September. The ST utilisation rate was higher in all months except January, with the largest increase of 33.3 percentage points seen in June. Notably, three ST facilities with a total registered capacity of 750MW were deregistered in February.

On a separate note, the annual GT utilisation rate increased by 0.4 percentage point to 0.6 percent in 2024, driven by the registration of two GT facilities in the year.

# MARKET PERFORMANCE: ENERGY SUPPLY

## Monthly Energy Offer Price Proportion and Fuel Oil Price 2024




### Energy offer prices trends with fuel oil prices in most months

In 2024, the highest monthly fuel oil price of US$512.55/MT was recorded in May, while the lowest price of US$422.38/MT was recorded in September.

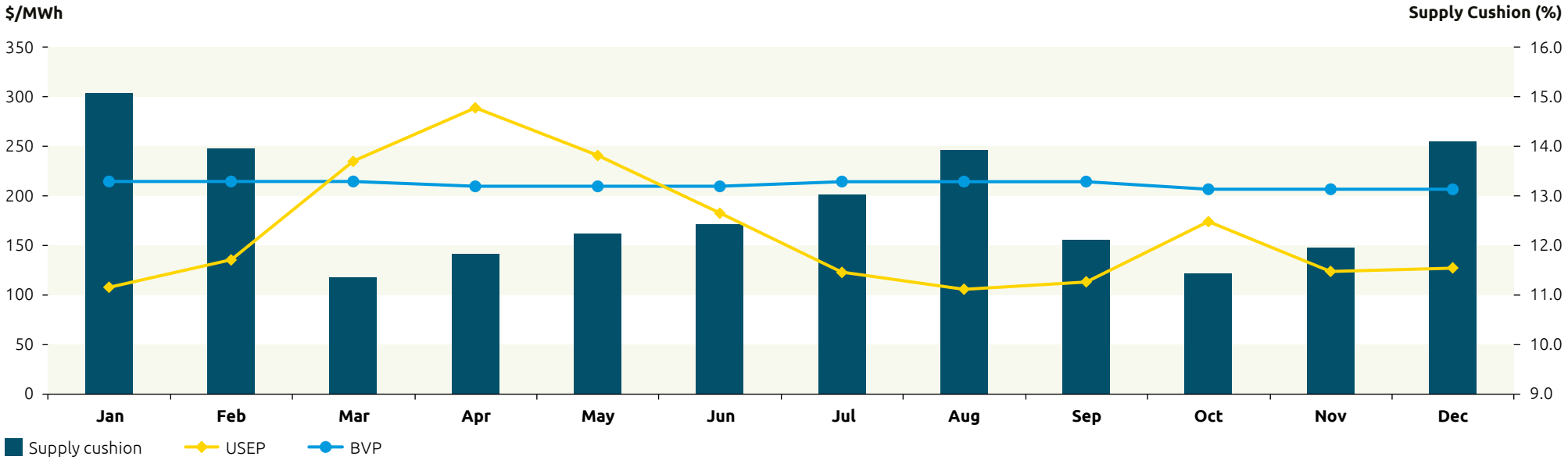
Fuel oil prices rose steadily from US$439.34/MT in January to above US$500.00/MT between April and July, except for a brief dip to $497.53/MT in June. Fuel oil prices fell below US$500.00/MT for the rest of the year. Compared to 2023, the fuel oil prices were higher in all months except August to November, underlining increased fuel demand amid ongoing geopolitical tensions.

The proportion of energy offers moved largely in line with fuel oil prices throughout the year. Except for April, over 90.0 percent of energy offers were below $200.00/MWh, with the proportion ranging from 91.1 percent to 93.7 percent. The proportion of energy offers below $200.00/MWh was highest in September, where fuel oil prices was lowest in the year.

Notably, the proportion of energy offers below $200.00/MWh was at its lowest in April, coinciding with a 7.5 percent month-on-month (MOM) increase in fuel oil price The highest USEP in 2024 was also recorded in April, at $288.71/MWh.

# MARKET PERFORMANCE: ENERGY PRICES

## Monthly USEP, Base Vesting Price ("BVP")[20] and Supply Cushion 2024




### USEP falls below BVP for most months

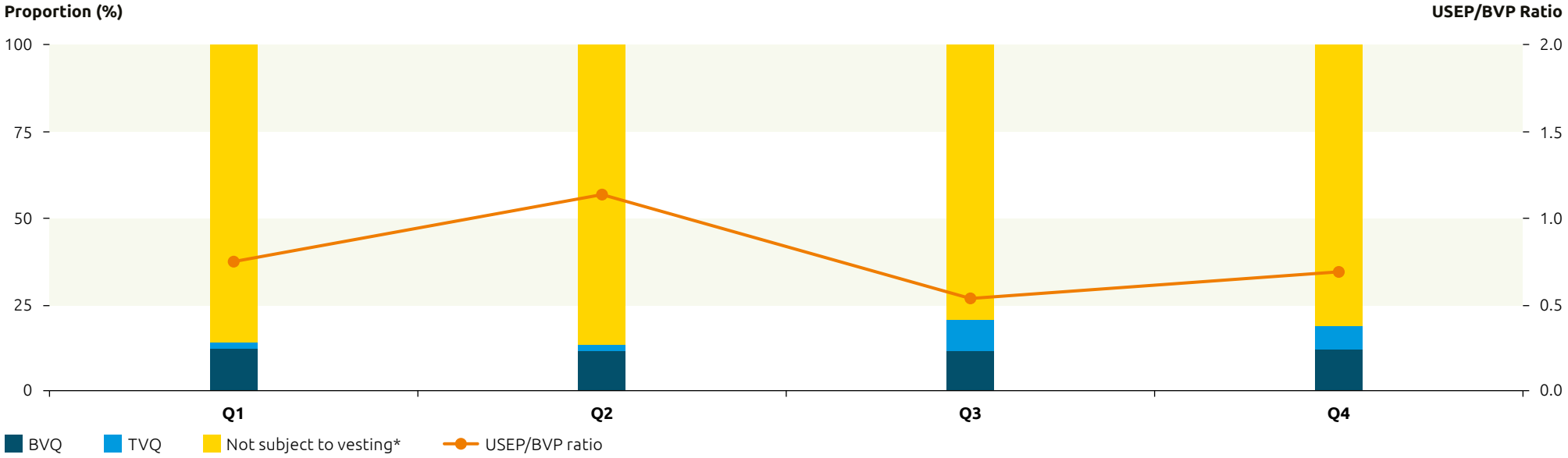
In 2024, the average USEP registered below the BVP in all months except March, April and May, ranging from 12.8 percent to 50.6 percent lower. The largest absolute gap between the monthly USEP and the monthly BVP was in August, when the USEP was $108.43/MWh lower than the BVP.

The lower USEP observed in 2024 was due to the higher supply cushion recorded. The annual average supply cushion increased 1.2 percentage points YOY to 12.8 percent, recovering from last year's record low supply cushion. Except for March and April, the monthly supply cushion was higher in all months compared to 2023, averaging between 11.3 percent and 15.1 percent.

[20] *The BVP is set by EMA in accordance with the procedures for calculating the components of the vesting contracts published on the EMA website.*

# MARKET PERFORMANCE: ENERGY PRICES

## Quarterly Vesting Quantities Proportion 2024




* *Adjustments arising from residual vesting scheme are not considered.*

### Proportion of vesting quantities increases as USEP trends lower

The comparison of USEP relative to BVP serves as an indicator of how energy prices trends align with benchmarked generation cost. A consistently low ratio suggests that spot prices are trading below the generator's long-run marginal cost (LRMC), while a high ratio indicates the opposite.

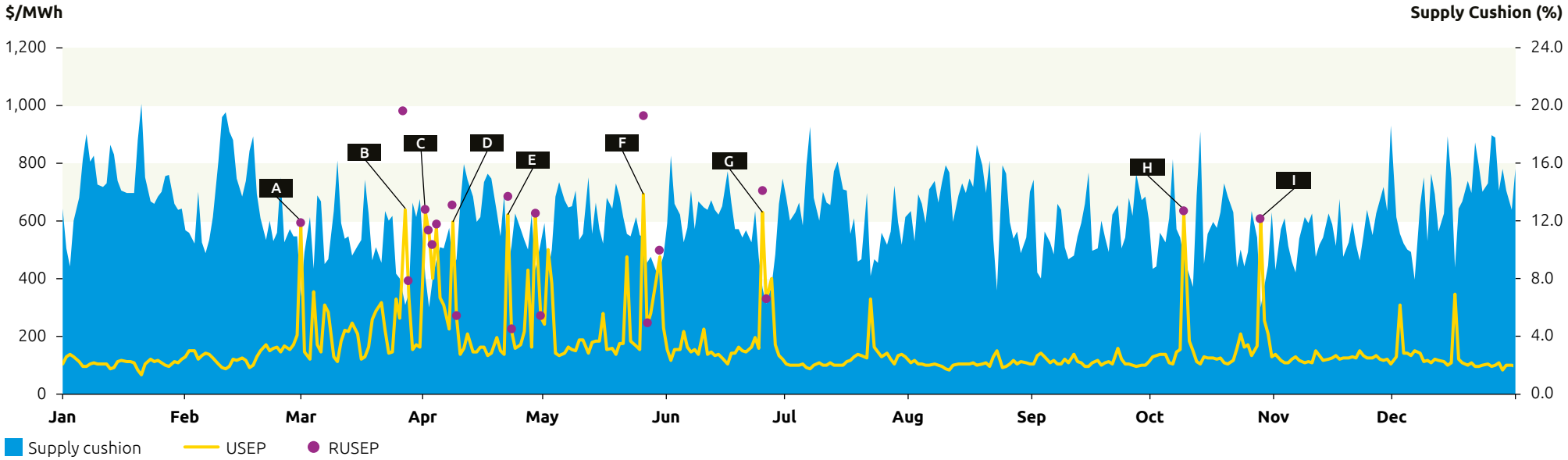
Under the five-year Vesting Regime Framework which took effect on 1 July 2023, the Energy Market Authority allocates the Base Vesting Quantity (BVQ) and may, from time to time, tender out portions of the Non-Contestable Consumer (NCC) load, referred to as the Tender Vesting Quantity (TVQ). The primary objective of these measures is to hedge against price fluctuations, ensuring that the cost of energy procured by SP Services supplying to NCCs remains stable and aligned with regulated pricing.

In the first half of the year, the proportion of BVQ ranged between 11.6 and 12.0 percent and the proportion of TVQ ranged between 1.9 and 2.0 percent. The ratio of USEP to BVP trended upwards from 0.7 in the first quarter to 1.1 in the second quarter, as the average USEP in the second quarter registered above the BVP. This suggests that spot prices were trading above the benchmark LRMC during this period.

In the subsequent two quarters of the year, the proportion of BVQ trended downwards to 11.5 percent in the third quarter before rising slightly to 11.7 percent in the last quarter. Meanwhile, the proportion of TVQ jumped 7.1 percent quarter-on-quarter (QOQ) to 9.0 percent in the third quarter, before falling to 6.9 percent in the fourth quarter. The ratio of USEP to BVP decreased in the second half of the year, to 0.5 in the third quarter and 0.7 in the fourth quarter as the average USEP registered below the BVP in the last two quarters.

# MARKET PERFORMANCE: ENERGY PRICES

## Daily USEP, RUSEP and Supply Cushion 2024




In 2024, the supply cushion expanded by 1.2 percentage points YOY to 12.8 percent, driven by a larger increase in total supply relative to forecasted demand. The improved supply cushion along with the implementation of the Temporary Price Cap (TPC) mechanism led to a 34.1 percent decline in the annual average USEP $163.18/MWh in 2024.

On a daily basis, the USEP rose above $500.00/MWh 13 times in 2024, down from 28 times in 2023. This marked the lowest number of such surges in the past three years. In the past, USEP spikes are largely driven by reduction in total supply. However, with higher penetration of solar generation, the effects of solar intermittency during periods of high demand have become more pronounced, leading to sudden price surges.

Points A, C, D, E and I highlight instances where price fluctuations due to solar intermittency were more apparent, leading to sudden increases in the periodic forecasted demand, which subsequently resulted in periodic USEP spikes. TPC events were also activated on those days, with daily average USEP ranging between $580.49/MWh and $631.25/MWh. Of the five days, the daily average USEP was highest on 1 April (Point C). During this day, the periodic USEP surged between $911.16/MWh and $3,107.04/MWh in Periods 27 to 35. The solar generation forecast was 22.4 percent to 51.9 percent lower than the year's periodic average during Periods 27 to 35, underlining weaker solar generation. Correspondingly, the forecasted demand increased between 7,136MW and 7,410MW, driving the supply cushion below 5.0 percent during these periods. A TPC event was activated from Period 36 as a result of the Moving Average Price (MAP)[21] exceeding the Moving Average Price Threshold (MAPT)[22] of $564.60/MWh in Period 35.

Points B, F, G, H highlight instances where significant price surges were attributed to the decline in total supply, due to unplanned forced outages of CCGT/cogen/trigen. TPC events were activated on all four days, with daily average USEP ranging between $627.14/MWh and $693.49/MWh. On 26 May (Point F), the daily USEP reached its highest in the year, averaging at $693.49/MWh. A forced outage of one CCGT unit was recorded in Period 34 during this day, leading to tightened supply cushion, which ranged between 0.7 percent and 4.8 percent from Periods 36 to 42. The USEP surged to levels between $3,073.14/MWh and $4,101.72/MWh during these periods, driving the MAP to surpass the MAPT of $588.87/MWh in Period 42. Consequently, a TPC event was activated from Period 43.

Among the TPC activations, the average RUSEP[23] was highest on 27 March (Point B), registering at $979.87/MWh. Notably, the USEP on this day was the second highest this year, averaging at $638.04/MWh. This indicates a price difference of over $300.00/MWh due to the applied TPC.

[21] *Moving Average Price (MAP) refers to the moving average price of 48 periods.*
[22] *Moving Average Price Threshold (MAPT) is set by the Energy Market Authority (EMA) to be a multiplier times CCGT LRMC.*
[23] *USEP is capped at the TPC energy price cap when the Reference USEP (RUSEP) is above the TPC energy price cap. RUSEP refers to the uncapped counterfactual USEP when the Temporary Price Cap (TPC) is in effect.*

# MARKET PERFORMANCE: ENERGY PRICES

## Temporary Price Cap Statistics 2024

| S/N | TPC Activation Date | TPC Activation Period | No. of Periods Activated | No. of Periods Capped | Average Energy Price Revision (%) | Change in Coefficient of Variance for Energy Price (%) |
|---|---|---|---|---|---|---|
| 1 | 1 March | 36 | 48 | 2 | -4.9 | -13.1 |
| 2 | 27 March | 39 | 52 | 14 | -48.8 | -69.9 |
| 3 | 1 April | 36 | 48 | 13 | -2.5 | -3.2 |
| 4 | 2 April | 48 | 48 | 11 | -22.0 | -62.6 |
| 5 | 4 April | 35 | 48 | 4 | -2.2 | -5.0 |
| 6 | 8 April | 33 | 48 | 3 | -14.7 | -57.6 |
| 7 | 22 April | 36 | 48 | 6 | -19.6 | -55.0 |
| 8 | 29 April | 40 | 48 | 6 | -3.2 | -11.0 |
| 9 | 26 May | 43 | 48 | 9 | -48.9 | -65.7 |
| 10 | 30 May | 20 | 48 | 4 | -7.1 | -26.4 |
| 11 | 25 June | 36 | 48 | 7 | -20.1 | -53.8 |
| 12 | 9 October | 21 | 48 | 2 | -1.5 | -4.5 |
| 13 | 28 October | 24 | 48 | 5 | -2.3 | -5.6 |

In 2024, there were 13 instances of TPC activation, triggered primarily by high USEP. Notably, nine out of 13 TPC activations occurred in the second quarter of the year, in line with the higher USEP observed in the second quarter. To evaluate the impact of TPC on energy prices, two key metrics were utilised to measure the effects.

The Average Energy Price Revision[24] measures the percentage change in energy prices arising from TPC activation. It reflects how much prices were revised during the period of high price volatility. The largest reduction of 48.9 percent occurred on 26 May, coinciding with the highest USEP recorded for the year.

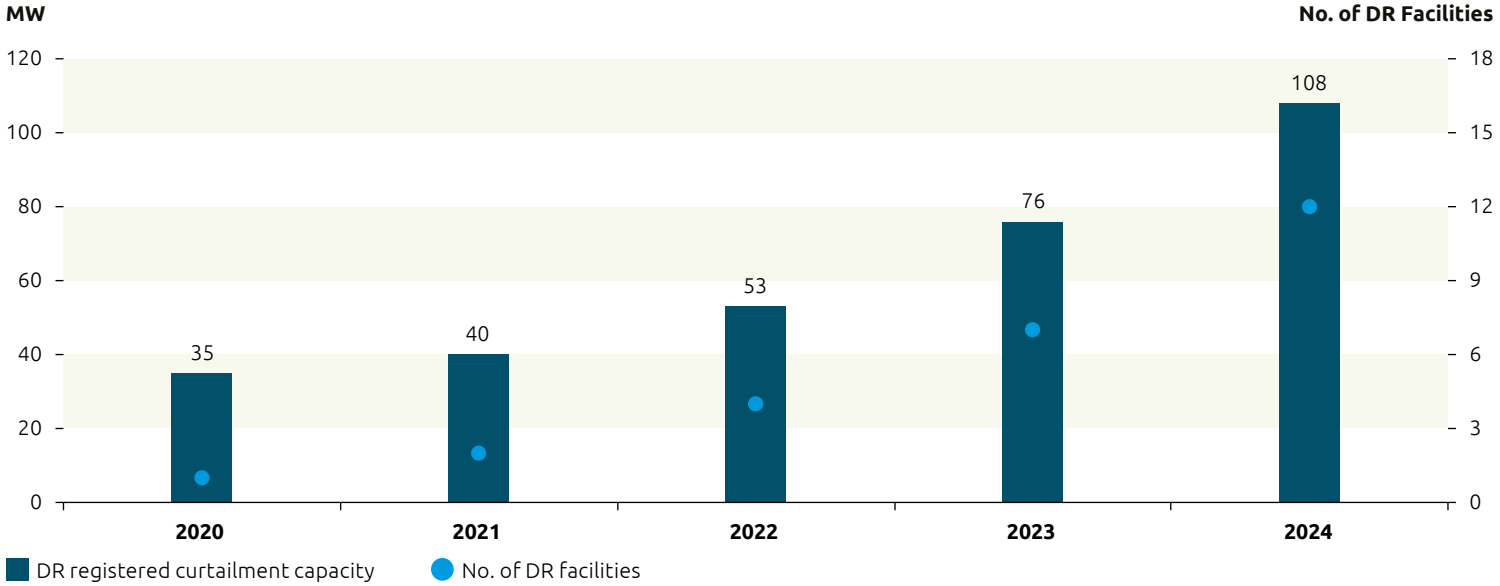
The Change in Coefficient of Variance for Energy Price[25] indicates the magnitude of price fluctuation after the TPC activation in percentage. A negative value represents improved price stability with lesser fluctuations. Out of the 13 TPC activations, the Change in Coefficient of Variance for Energy was lowest on 27 March at -69.9 percent, coinciding with the second highest daily USEP recorded this year.

[24] *Average Energy Price Revision is calculated by subtracting the average RUSEP from the average USEP, over the average RUSEP, for periods TPC was activated.*

[25] *Change in Coefficient of Variance for Energy Price is calculated by subtracting the Coefficient of Variance of RUSEP from the Coefficient of Variance of USEP, over the Coefficient of Variance of RUSEP. The Coefficient of Variance is calculated as the ratio of the Standard Deviation of respective price over its mean.*

# MARKET PERFORMANCE: DEMAND RESPONSE

## Annual Demand Response Registered Curtailment Capacity 2020–2024




### Rapid expansion in Demand Response curtailment capacity

The Demand Response (DR) programme was introduced in 2016 to enable contestable consumers to participate directly in the wholesale market by reducing their electricity demand voluntarily in response to market conditions. This is particularly during periods of high wholesale market prices or when the supply condition is tight.

To encourage more participation in the DR programme, a Demand Side Management (DSM) Sandbox was introduced from 1 January 2023 to 31 December 2024. During the sandbox period, the threshold for non-compliance was lowered from 95 to 80 percent. The penalty regime is further relaxed such that no penalties are incurred for the first two instances of under-delivery. Upon the fifth instance of under-delivery, the DR participant would be administratively suspended from the sandbox.

Since the introduction of the sandbox programme in 2023, the registered DR curtailment capacity has consistently grown at a YOY rate exceeding 40.0 percent. As at 31 December 2024, the number of DR facilities increased from seven facilities in 2023 to 12 facilities, while the number of DR providers increased from three to five. The increase in DR facilities drove a 42.1 percent YOY increase in the DR registered curtailment capacity to 108MW.

# MARKET PERFORMANCE: DEMAND RESPONSE

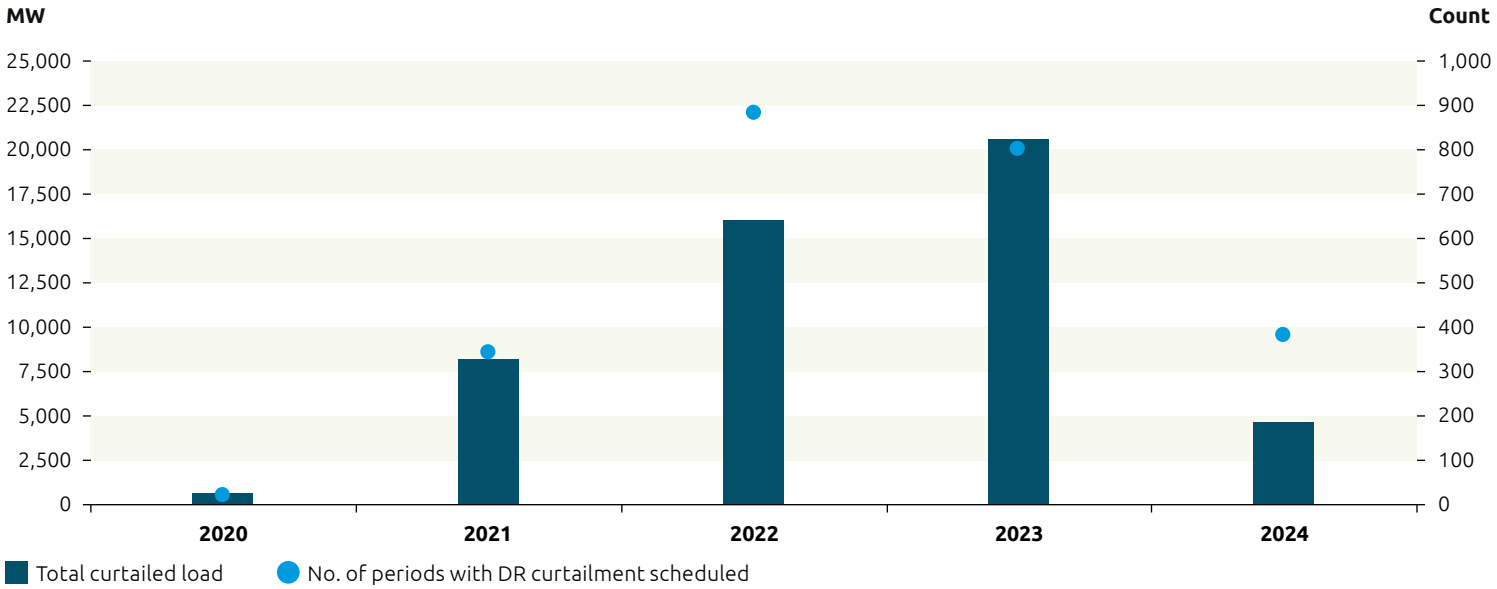
## Periods with DR curtailment scheduled and total curtailed load plunges significantly

The number of periods with DR curtailment dropped sharply to 382 in 2024 from 801 in 2023. This decline was due to the lower USEP observed in 2024, and consequently the number of trading periods with USEP exceeding the $500.00/MWh decreased significantly by 49.7 percent to 450 in 2024 from 895 in 2023.

On a half-yearly basis, the number of periods of DR curtailment in the first half of the year was significantly higher at 358, compared to 24 such periods in the second half of the year. This was in line with the higher occurrence of trading periods with USEP exceeding $500.00/MWh in the first half of the year, which amounted to 408, compared to 42 in the latter half of the year.

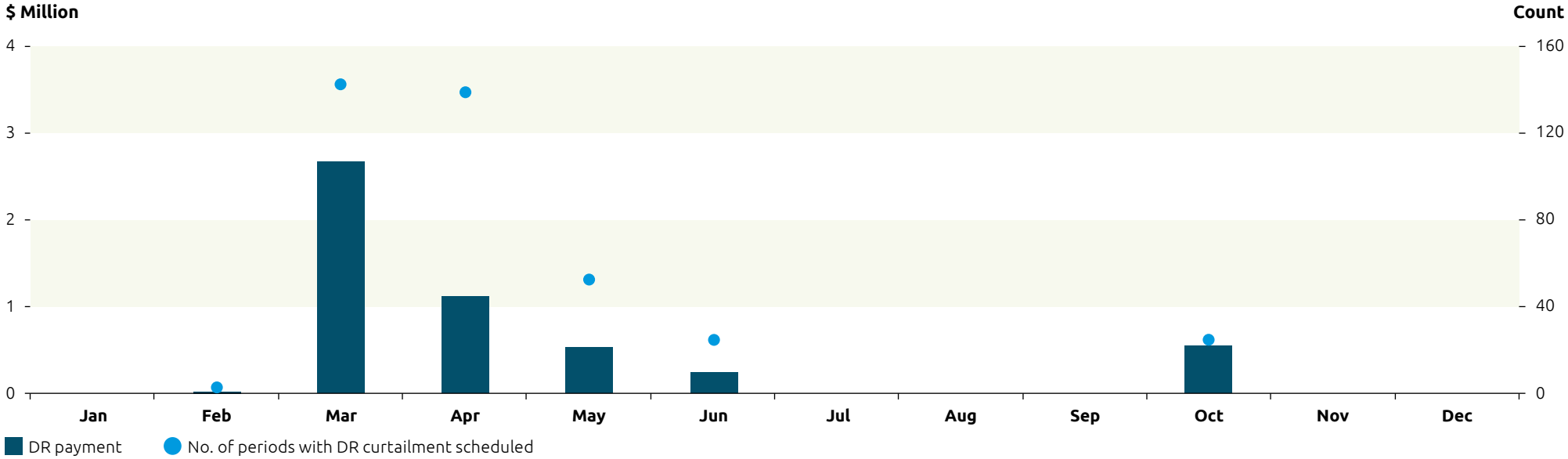
Despite the growth in the DR registered curtailment capacity, the total curtailed load in 2024 declined by 77.2 percent to 4,685MW.

### Annual Demand Response Curtailment Scheduled 2020–2024



# MARKET PERFORMANCE: DEMAND RESPONSE

## Monthly Demand Response Payment 2024




### DR payment amount reduces with lower load curtailed

Compared to 2023, the spread between the Counterfactual Uniform Singapore Energy Price (CUSEP) and USEP (or RUSEP[26], during TPC activations) in 2024 narrowed to between -$78.86/MWh and $3,494.84/MWh and averaged lower at $95.65/MWh.

This indicates that with each MW, consumers benefitted less from the lower estimated average cost savings of $95.65/MWh in 2024, compared to $176.39/MWh for each MW in 2023.

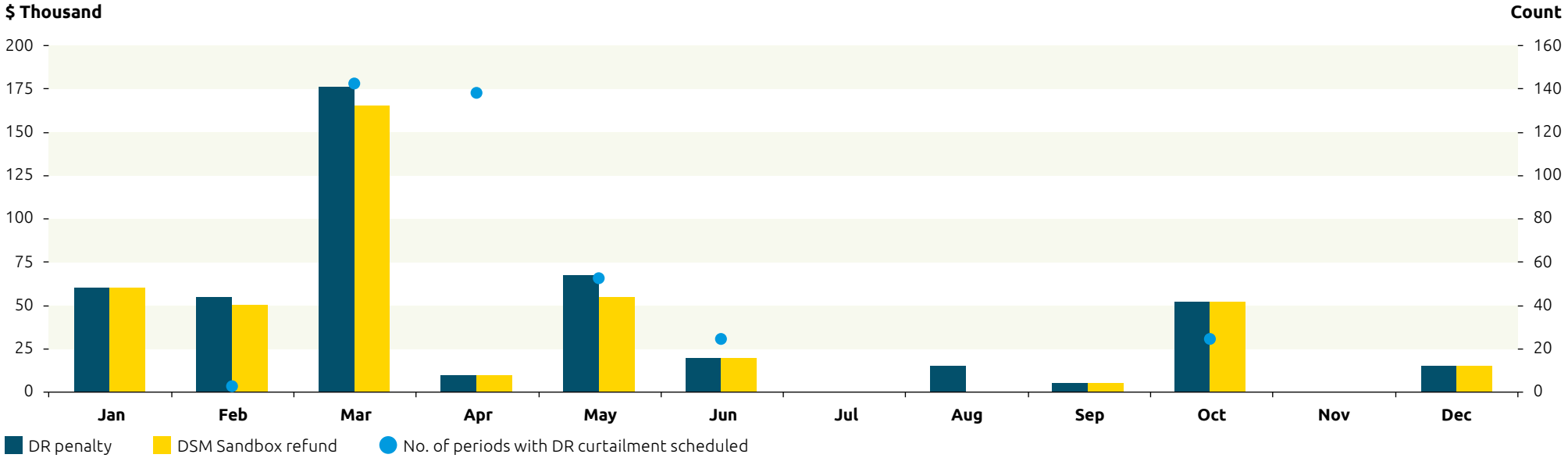
The annual DR payment in 2024 amounted to $5.1 million in 2024, a sharp 81.9 percent decrease from $28.4 million in 2023. There were only DR payments in six months this year, compared to all 12 months in 2023.

March was the month with the largest number of periods with DR curtailment, 142, and the highest DR payment of $2.7 million. In April, the DR payment was less than half of March's amount, despite having the second largest number of periods with DR curtailment at 138. The decline was driven by a 39.1 percent reduction in total curtailed load compared to March. Notably, February recorded the lowest monthly DR payment, amounting to $251.44, with only two DR curtailment periods.

[26] *From 1 July 2023, the Reference USEP (RUSEP) was used as a comparison when the TPC mechanism was introduced.*

# MARKET PERFORMANCE: DEMAND RESPONSE

## Monthly Demand Response Penalty and Demand Side Management Sandbox Refund 2024



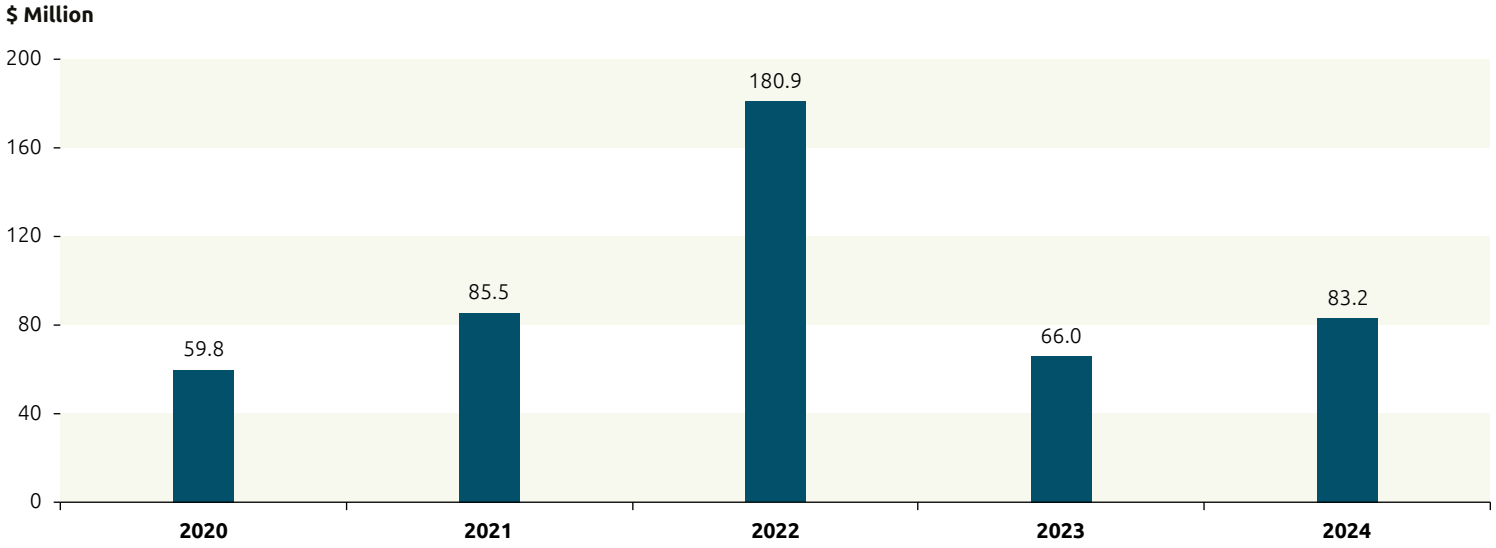

### DR penalty amount decreases with lower load curtailment

Before accounting for DR penalty refunds under the DSM sandbox, the annual DR penalty amount fell 34.8 percent, from $728,489.57 in 2023 to $475,053.82 in 2024. The decrease in DR penalty coincided with a lower number of DR curtailments scheduled in 2024. The DR penalty amount peaked in March at $175,969.62, marking the highest monthly DR penalty amount recorded since 2019. DR penalties were imposed in ten months of 2024, compared to all 12 months in 2023.

Under the sandbox, the penalty threshold for non-compliance was lowered from 95 to 80 percent. As such, DR participants can request for a refund of the DR penalty imposed. The total annual DSM sandbox refund amount was $432,914.78 in 2024, which accounts for 91.1 percent of the total annual DR penalty. DR penalties (under the 95 percent compliance threshold) were imposed in January, August, September and December due to deviations from its scheduled load, despite having no DR curtailment scheduled. However, except for August, these penalties were later refunded under the sandbox framework. After accounting for DR penalty refunds, the net 2024 annual DR penalty amount is $42,139.04, 3.3 percent higher than that of 2023.

# MARKET PERFORMANCE: ANCILLARY MARKETS

## Annual Reserve Payment 2020–2024




### Rise in reserve payments driven by higher prices

Reserves serve as a backup in the electricity market for unexpected outages caused by generators tripping. The amount of reserves required is determined by the amount needed should the largest online generator trip. In the NEMS, two reserve products are traded: primary and contingency reserves. Each reserve has its own price and response time, the latter being nine seconds for primary reserve and ten minutes for contingency reserve. The generators bear the cost of procuring the reserves.

The reserve costs in 2024 increased 26.0 percent YOY to reach $83.2 million. This was primarily driven by higher reserve prices. The primary reserve price more than tripled to $2.86/MWh while contingency reserve price rose 19.3 percent to $19.70/MWh.

# MARKET PERFORMANCE: ANCILLARY MARKETS

## Reserve providers improve in effectiveness

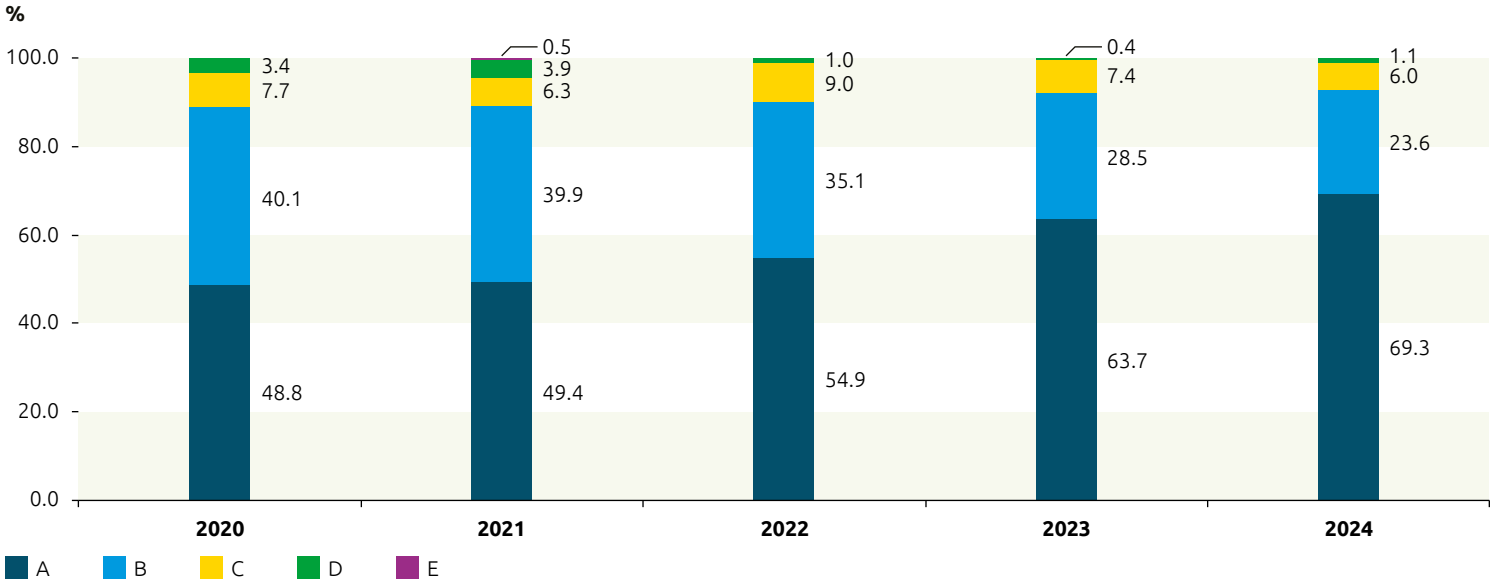
Reserve providers in the NEMS are classified into five groups: Group A reflects reserve providers with the highest level of responsiveness and Group E reflects those with the lowest level of responsiveness. A higher level of responsiveness attracts a higher proportion of reserve price.

In 2024, some of the reserve providers in Groups B and C moved into Group A. The percentage of reserve providers in Group A increased 5.6 percentage points, while that for Groups B and C decreased 4.9 and 1.4 percentage points respectively. Additionally, the shift of one reserve provider from Group A to Group D, resulted in a 0.7 percentage point increase in the proportion of Group D. Since 2022 there have been no reserve providers in Group E. Notably, Group A's proportion of 69.3 percent in 2024 was the highest since the market started.

Overall, the reserve providers' effectiveness improved in 2024. The proportion of reserve providers in the more responsive Groups A and B improved slightly from 92.2 to 92.9 percent, while the proportion of reserve providers in the less responsive Groups C, D and E fell from 7.8 percent to 7.1 percent.

All contingency reserve providers were classified in Group A.

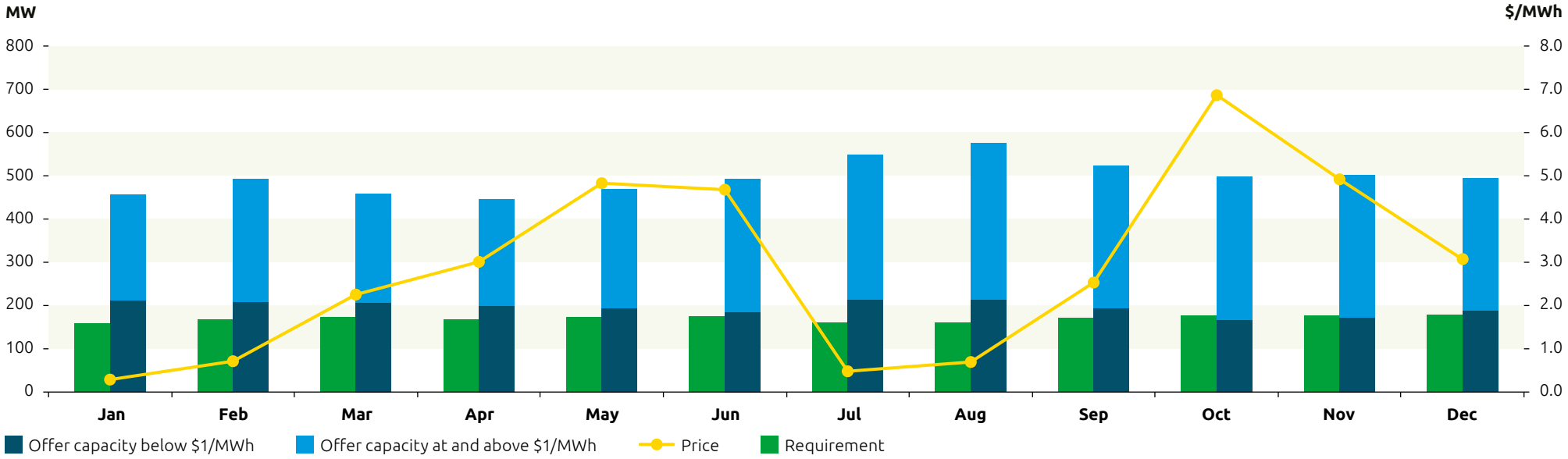
### Reserve Provider Group Effectiveness for Primary Reserve Class (Aggregate) 2020–2024




*Statistics exclude IL providers.*

# MARKET PERFORMANCE: ANCILLARY MARKETS

## Monthly Primary Reserve Price, Requirement and Supply 2024




### Primary reserve price triples with more expensive offers

In 2024, the annual average primary reserve price more than tripled to $2.86/MWh from $0.78/MWh in 2023, amid more expensive offers and a 3.7 percent increase in requirement. The proportion of primary reserve offers below $1.00/MWh reduced 12.5 percentage points to 40.0 percent this year.

The lowest monthly average price of $0.29/MWh was observed in January and the highest monthly average price since December 2022 was $6.87/MWh in October. The price spikes in May, June and October were due to fewer offers in the cheaper tranches.

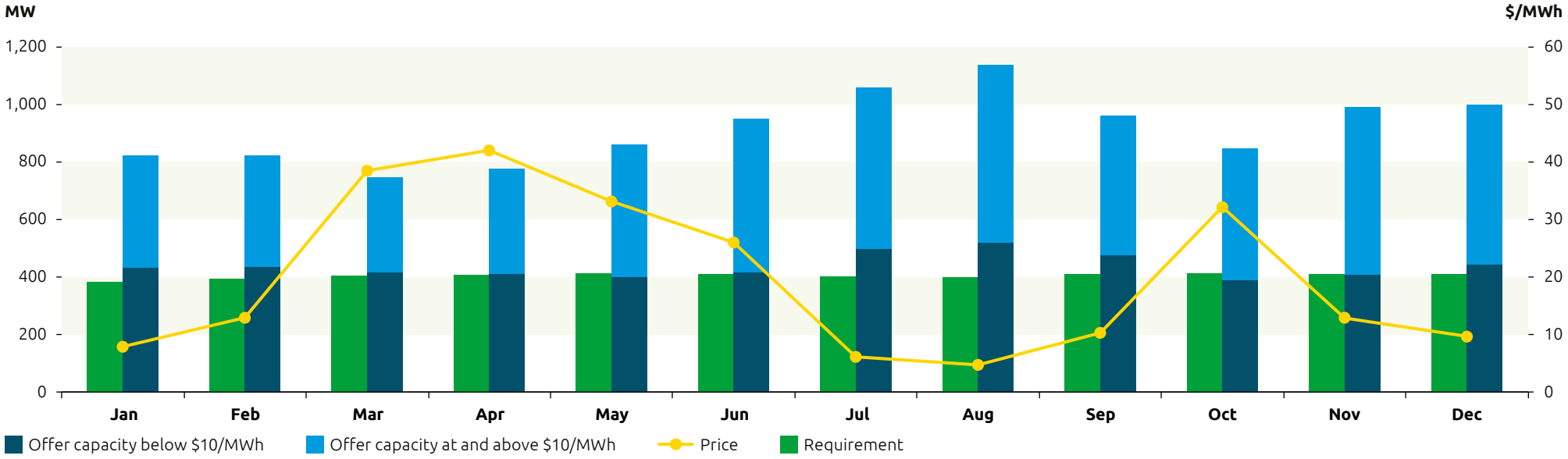
The annual average primary reserve requirement increased to 170MW in 2024 from 164MW in 2023, while the annual primary reserve offers grew 9.3 percent to 496MW.

On a monthly basis, the primary reserve requirement ranged between 158MW and 180MW, with the lowest level seen in January, and the highest level in December. The monthly primary reserve offers were lowest in April at 445MW and highest in August at 576MW. The proportion of primary reserve offers below $1.00/MWh remained under 50.0 percent in all months of 2024, compared to only three months last year. The proportion varied between 33.4 percent and 46.5 percent throughout 2024.

As had been the case in 2023, there were no intertie disconnections and adjustments to the Risk Adjustment Factor (RAF) in 2024. The RAF remained at 1.0. There was no primary reserve shortfall in 2024 as in 2023.

# MARKET PERFORMANCE: ANCILLARY MARKETS

## Monthly Contingency Reserve Price, Requirement and Supply 2024




### Contingency reserve price rises with more expensive offers

The annual average contingency reserve price increased from $16.51/MWh in 2023 to $19.70/MWh in 2024. The highest monthly average price of $42.05/MWh was observed in April while the lowest was registered in August at $4.71/MWh.

Compared to 2023, the proportion of contingency reserve offers below $10.00/MWh reduced 7.9 percentage points to 47.8 percent in 2024. Although lower priced offers were available, market constraints led to higher priced offers to be cleared, contributing to the overall contingency price increase. The average contingency reserve requirement rose 2.3 percent to 404MW, while the annual average contingency reserve offers increased by 10.0 percent to 915MW.

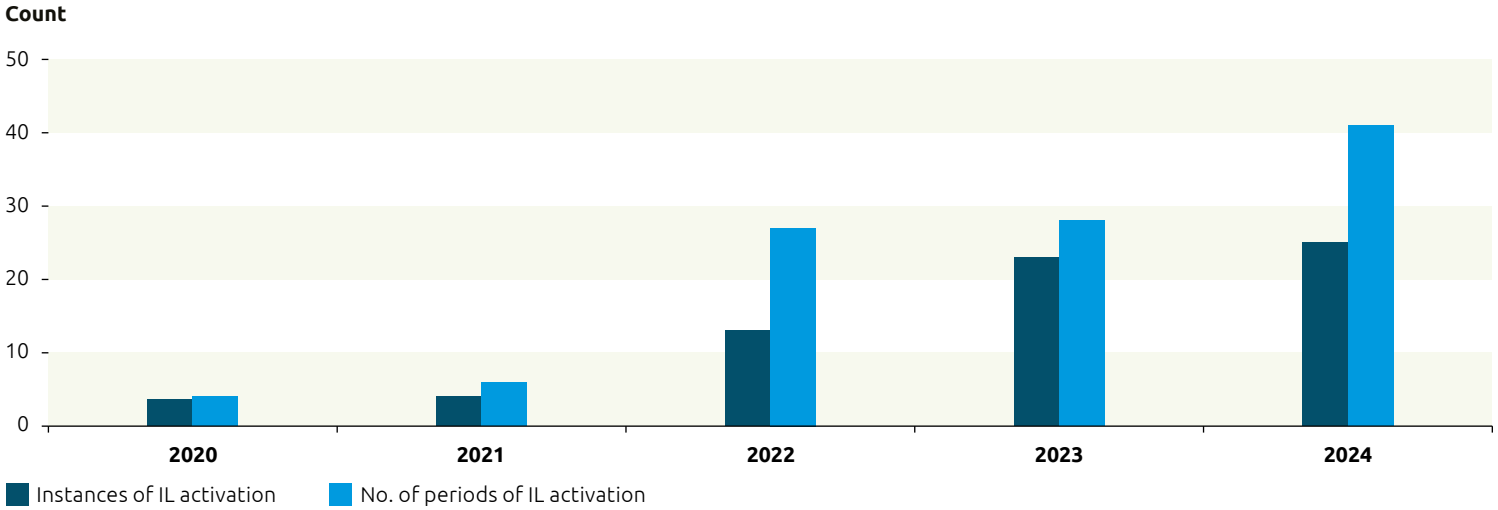
On a monthly basis, the contingency reserve requirement hovered above 400MW in all months, except January, February and August. The lowest contingency reserve requirement of 383MW was recorded in January, while the highest, 412MW, was seen in October.

The contingency reserve offers were at their lowest in March and April, declining below 800MW in both months. The drop in contingency reserve offers resulted in the two highest contingency reserve prices registered this year. On the flipside, contingency reserve offers increased above 1GW in July and August, driving the price downwards. Notably, July and August registered the two lowest prices this year.

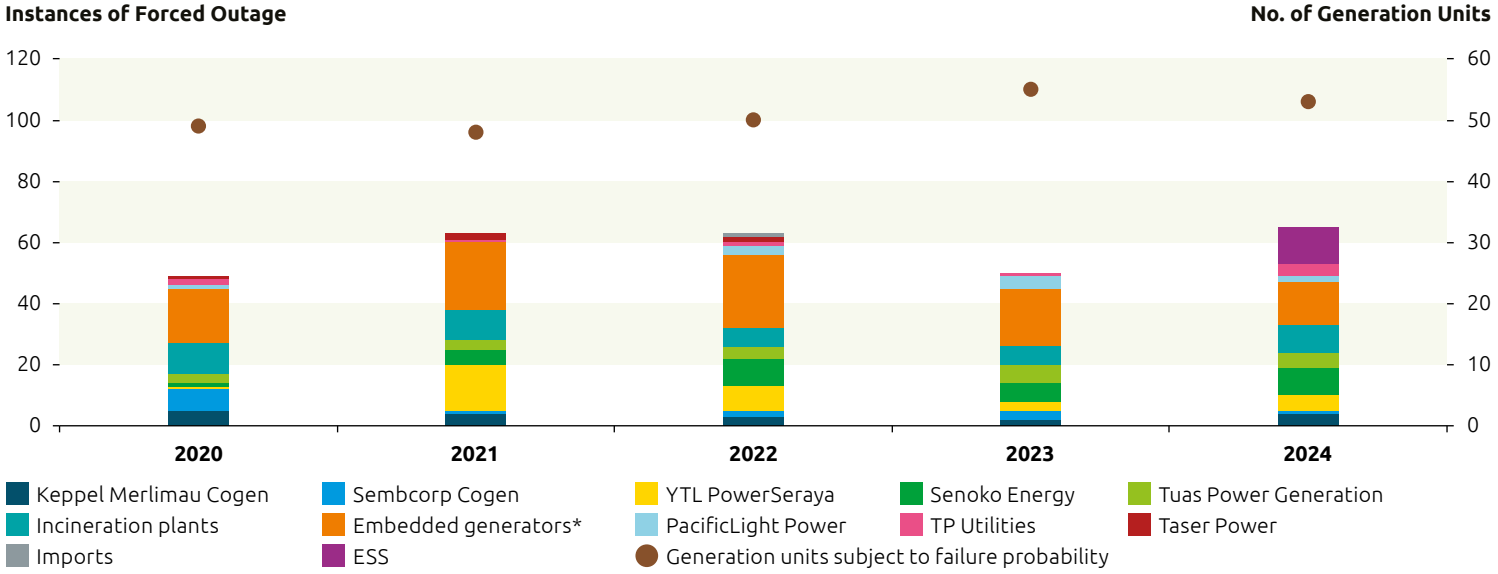
The total number of periods with contingency reserve shortfall fell to 58 in 2024 from 81 in 2023. The first half of the year had recorded 49 periods of contingency reserve shortfall, while the second half of the year had nine periods of contingency reserve shortfall. This trend aligns with the higher average USEP, and tighter supply observed during the first half of the year.

# MARKET PERFORMANCE: ANCILLARY MARKETS

## Annual Interruptible Load Activations for Contingency Reserve Market 2020–2024




## Annual Forced Outages by Generation Companies 2020–2024




*The number of generation units refers to the number of generation units registered in the NEMS which are subject to reserve responsibility share.*
** Embedded generators exclude TP Utilities.*

### More frequent interruptible load activations with prolonged durations

As at 31 December 2024, there was no registered capacity for interruptible load (IL) for primary reserve. For contingency reserve, the total IL registered capacity rose 15.7 percent, from 24.9MW to 28.8MW.

In 2024, the number of IL activations for contingency reserve edged up from 23 to 25, while the total number of periods when IL was activated for contingency reserve spiked from 28 to 41. This meant that 0.23 percent of the total number of periods in 2024 saw IL activation.

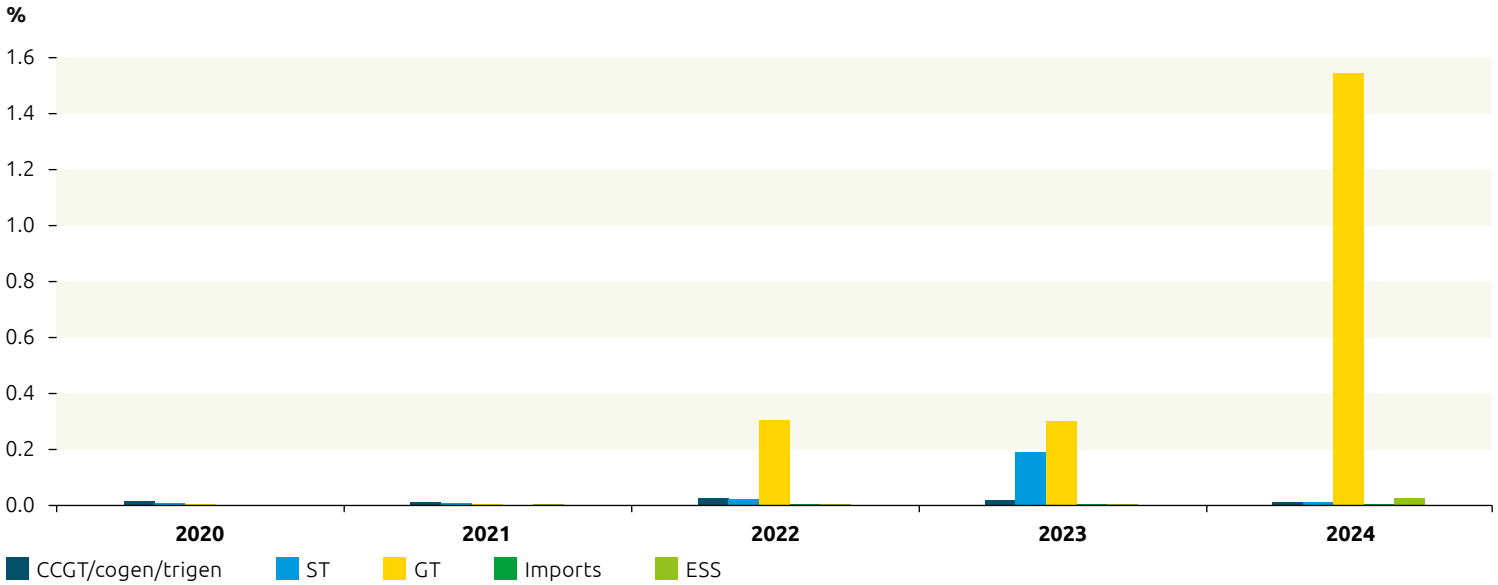
IL was activated most frequently in March, with a total of 13 instances. Notably, the IL activation extended over ten periods on 27 March, making it the longest continuous duration seen in 2024.

### Total number of forced outages increases

In 2024, 53 generation units were subject to failure probability and 65 forced outages occurred, up from 50 in 2023. With the exception of four, the generation companies experienced either the same number or more forced outages in 2024, compared to 2023.

# MARKET PERFORMANCE: ANCILLARY MARKETS

## Average Failure Probability 2020–2024




### Reliability of CCGT/cogen/trigen and ST improves while that of GT weakens

The average failure probability for a generation registered facility (GRF) is the probability that after being dispatched by the PSO for a settlement interval, the GRF will either cease operating, disconnect from the transmission system, or both, during that settlement interval, even if no other GRF fails. A generation facility with a lower failure probability will be allocated less reserve cost compared to one with a higher failure probability.

In short, failure probability is a measure of the reliability of the generation facility. The lower the failure probability, the higher the reliability of the generation facility.

The average failure probabilities of CCGT/cogen/trigen, ST and GT facilities were 0.010 percent, 0.100 percent and 1.544 percent respectively in 2024. Compared to 2023, the failure probability of CCGT/cogen/trigen and ST facilities improved while that of GT declined. Meanwhile, the average failure probability of energy storage systems rose to 0.024 percent, the highest since their entry into the market, whereas the failure probability of import facilities remained unchanged at 0.001 percent in 2024.

The performance of CCGT/cogen/trigen and ST facilities was aligned with the fewer forced outages they had experienced in the year. On the other hand, the performance of GT facilities was aligned with the increase in GT forced outages in the year. Overall, the average failure probabilities were higher for 13 facilities and lower for 28 facilities.

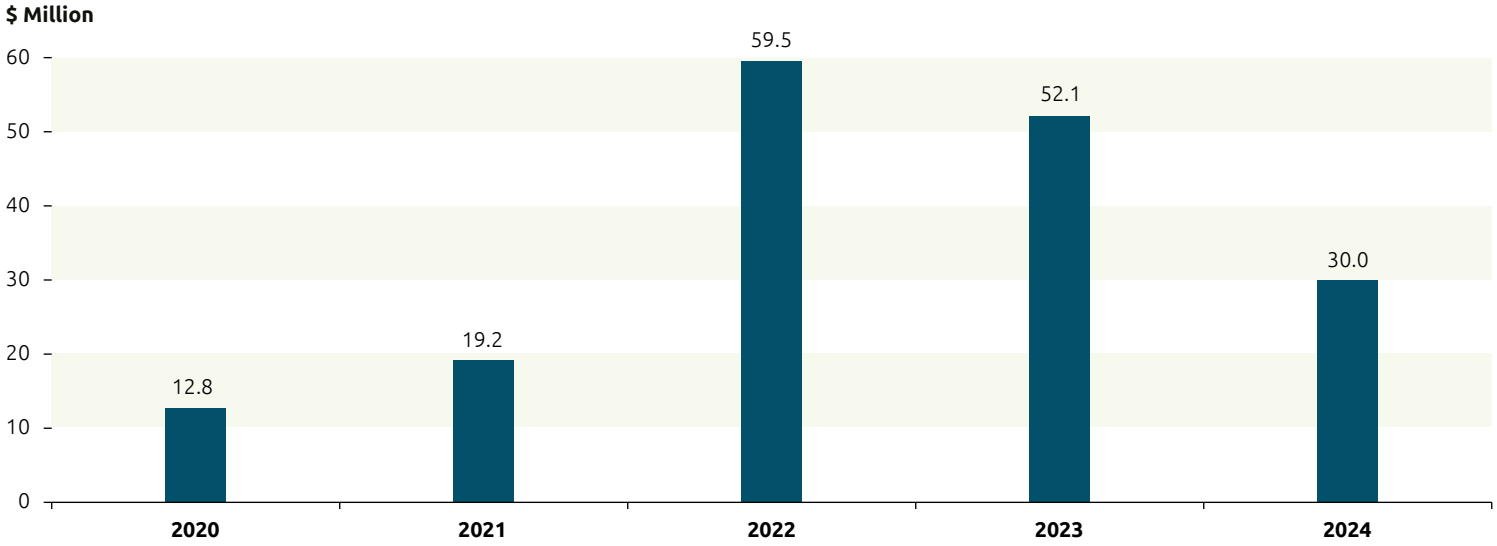
# MARKET PERFORMANCE: ANCILLARY MARKETS

## Regulation payment continues to fall for the second consecutive year

Regulation payment dropped a sharp 42.5 percent to $30.0 million in 2024. This was due to a 39.8 percent fall in the regulation price to $25.72/MWh. In addition, the regulation requirement decreased from 117MW to 113MW which took effect on 1 February 2024.

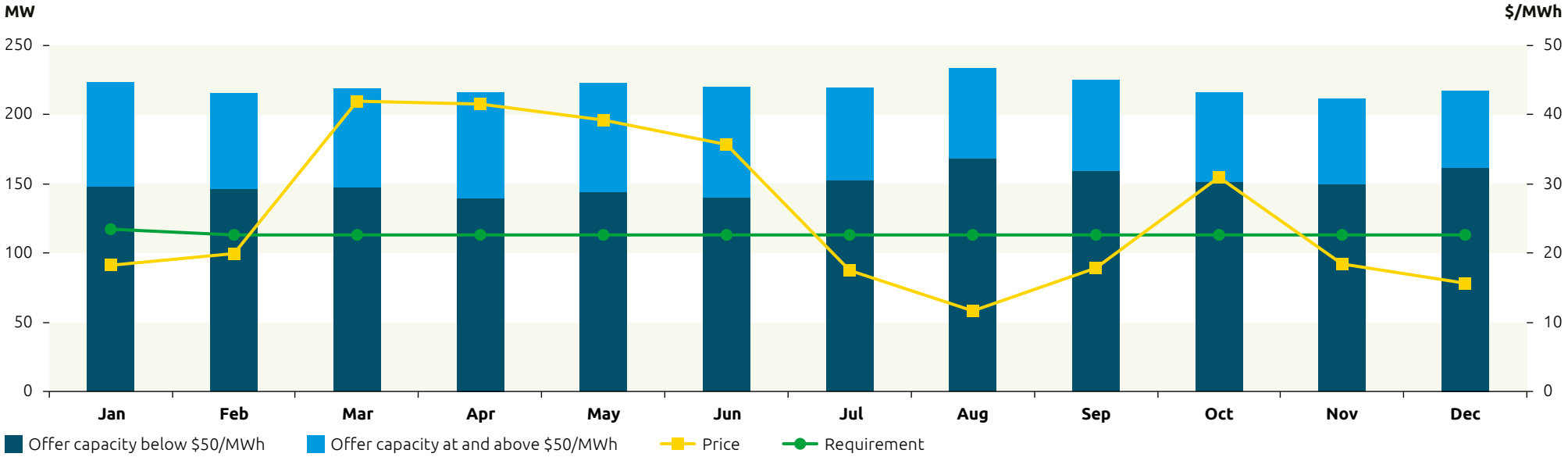
Compared to 2023, monthly regulation payment decreased between $1.1 million and $4.2 million for all 12 months in the year. March's monthly regulation payment of $4.2 million was the highest for 2024 but also marked the steepest YOY decline as 2023's highest monthly regulation payment of $6.6 million was also recorded in March 2023.

### Annual Regulation Payment 2020–2024



# MARKET PERFORMANCE: ANCILLARY MARKETS

## Monthly Regulation Price, Requirement and Supply 2024




### Lower regulation prices accompanied by fewer shortfalls

In 2024, the annual average regulation price decreased to $25.72/MWh from $42.71/MWh in 2023. The lower price was due to the reduction in annual regulation requirement from 117MW to 113MW as of 1 February 2024 and the increase in annual average regulation offers by 9.3 percent, to 220MW. The highest monthly average price was $41.96/MWh in March, while the lowest monthly average of $11.65/MWh was observed in August.

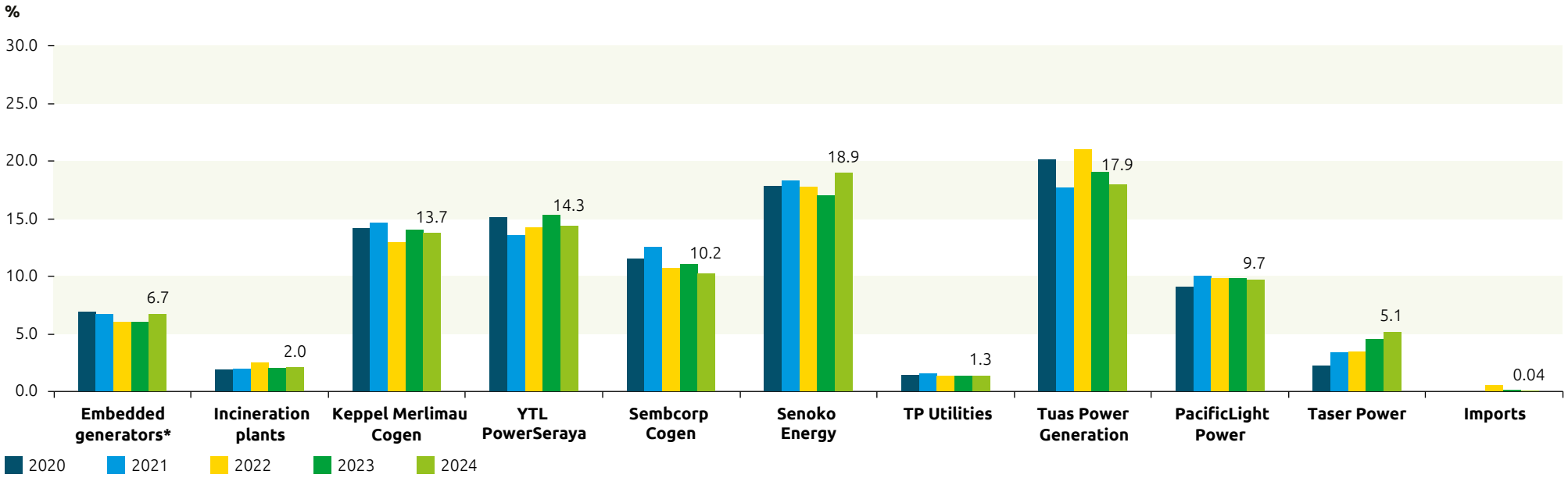
In addition, the proportion of regulation offers below $50.00/MWh increased 3.1 percentage points to 68.7 percent this year from 65.6 percent in 2023, underlining cheaper offer prices. On a monthly basis, the regulation offers ranged between 1.3 percent and 18.4 percent and increased in all months except October, with the largest increase recorded in February. The proportion of regulation offers below $50.00/MWh ranged between 63.7 percent and 74.4 percent.

Regulation prices were higher from March to June and in October, ranging between $30.98/MWh and $41.96/MWh. These months coincided with greater USEP volatility, during which all TPC activations took place. In July to September, the regulation prices took a dip, ranging between $11.65/MWh and $17.84/MWh. The proportion of regulation offers below $50.00/MWh ranged between 69.5 percent and 72.0 percent during these months.

The total number of periods with regulation shortfall declined from 49 in 2023 to 20 in 2024. Of these, seven occurred in March, which remained the month with the highest number of such periods. This also coincided with March's average price being the highest in the year.

# MARKET PERFORMANCE: COMPETITION IN THE GENERATION AND RETAIL MARKETS

## Annual Market Share by Generation Company 2020–2024 (Based on Scheduled Generation)




* *Embedded generators exclude TP Utilities.*

### Position of the top three generation companies falls as combined market share reduced

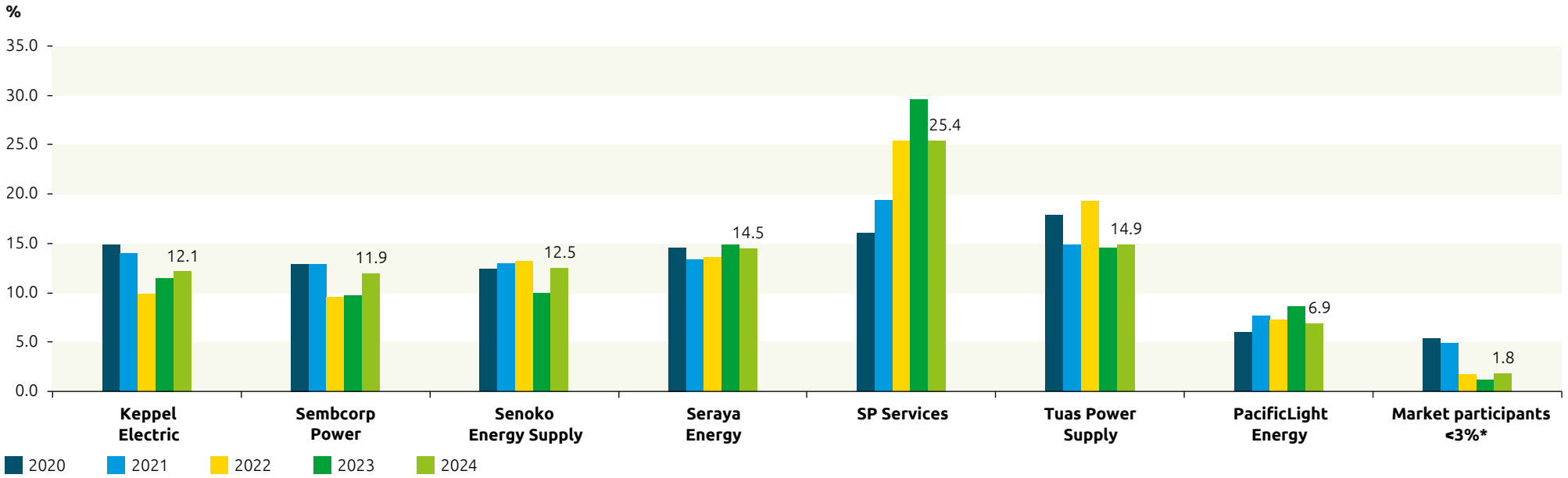
In 2024, Senoko Energy, Tuas Power Generation, and YTL PowerSeraya remained as the top three generation companies with the largest annual market share. The combined market share of these three leading generation companies slipped 0.2 percentage point to 51.1 percent.

Senoko Energy recorded the largest gain of 1.9 percentage points and overtook Tuas Power Generation to hold the largest market share. Tuas Power Generation, meanwhile, experienced the largest contraction of 1.1 percentage points. Other generation companies which saw pullbacks included YTL PowerSeraya and Sembcorp Cogen, whose market shares shrank 1.0 percentage point and 0.8 percentage point respectively.

Taser Power extended its market share gains for a third consecutive year, adding 0.6 percentage point for a 5.1 percent market share. Among the remaining generation companies, Keppel Merlimau Cogen and PacificLight Power saw small reductions of 0.3 percentage point and 0.1 percentage point respectively in their market shares, while TP Utilities' market share remained at 1.3 percent.

# MARKET PERFORMANCE: COMPETITION IN THE GENERATION AND RETAIL MARKETS

## Annual Market Share of Market Support Services Licensee and Retailers 2020–2024 (Based on Withdrawal Energy Quantity)




* *Market participants <3% refers to Bioenergy, Cleantech Solar Singapore Assets, Diamond Electric, Engie South East Asia, Flo Energy Singapore, Just Electric, Sunseap Energy and Union Power.*

### Market share of SP Services declines as other retailers expand

In the Open Electricity Market (OEM), the consumption of residential consumers who have switched from SP Services to retailers and who selected the Load Profiling (LP) metering option (LP consumers) is included as part of the system residual load which will be wholly settled by SP Services in the NEMS. SP Services bilaterally settles the consumption of each retailer's aggregated LP consumers outside the NEMS.

To better reflect the market share of the retailers, the consumption of these LP consumers needs to be allocated back to their respective retailers. This allocation has been done and reflected in the retailers' market share figures since 2019.

In 2024, SP Services market share shrank for the first time after three consecutive years of increase. Despite slipping 4.2 percentage points, its market share of 25.4 percent remained the largest by a significant margin. Among the larger retailers[27], Senoko Energy Supply overtook Keppel Electric, joining Seraya Energy and Tuas Power Supply in the top three positions.

Keppel Electric's, Tuas Power Supply's, Senoko Energy Supply's and Sembcorp Power's market shares expanded by 0.6, 0.3, 2.6 and 2.2 percentage points respectively. PacificLight Energy's market share fell 1.7 percentage points, followed by Seraya Energy, whose market share decreased by 0.4 percentage point.

In the 'Market participants <3%' category, which comprises retailers that each hold a market share under 3.0 percent. The market share of this category gained 0.6 percentage point to 1.8 percent.

[27] *Excludes consumers who purchase from SP Services.*

# MARKET PERFORMANCE: SETTLEMENT, PRUDENTIAL MANAGEMENT, AUTOMATIC FINANCIAL PENALTY SCHEME AND MINIMUM STABLE LOAD COMPENSATION SCHEME

**EMC is the financial clearing house for the wholesale market and settles the following transactions:**

- **energy;**
- **ancillary market products — two classes of reserve (primary and contingency) and regulation;**
- **bilateral and vesting contracts;**
- **uplift charges;**
- **financial adjustments;**
- **fee recovery of EMC and the PSO administration costs; and**
- **contracted ancillary services not provided through the ancillary market (black-start services).**

The market is well secured. To cover the exposure of a debtor and the time required to manage a default, all retailers must provide on-going collateral to EMC. This credit support protects EMC and other MPs from payment defaults. EMC reviews the risk exposure of MPs daily.

## Margin Calls and Notices of Default – 1 January to 31 December 2024

A margin call is issued when a retailer's estimated net exposure reaches a value that is equivalent to or greater than 55.0 percent of its level of credit support for MPs, or 60.0 percent of its level of credit support for the MSSL. There was no margin call issued in 2024. A notice of default[28] is issued when an MP is unable to remit to the EMC settlement clearing account by the end of the business day following its payment due date. In 2024, there was no default notice[29] issued by EMC.

## Automatic Financial Penalty Scheme (AFPS) and Minimum Stable Load (MSL) Compensation Scheme – 1 January to 31 December 2024

The Automatic Financial Penalty Scheme (AFPS) is a penalty scheme that was introduced in November 2015 and applied to all GRFs that deviate from their dispatch schedules by more than 10MW. The intent is to discourage the GRFs from non-compliance of dispatch instructions. The AFPS was subsequently extended to include all load registered facilities (LRFs) under the DR programme introduced in April 2016, and now applies to all LRFs with restricted energy bids that deviate from their dispatch schedules.

In 2024, there were 139 periods when the AFPS kicked in, including 100 periods for deviating LRFs. The total penalty collected was $744,163.95. The penalty collected was returned to the market via the monthly energy uplift charges.

The Minimum Stable Load (MSL) compensation scheme compensates participating GRFs when they are constrained for energy at their MSLs and their offer prices are higher than the marginal clearing price. It was implemented in November 2015 to enhance system security and create financial certainty for these facilities over the recovery of costs. In 2024, $61,325.42 was paid out for a total of nine periods under the MSL compensation scheme. The amount paid out was funded by the market via the monthly energy uplift charges.

[28] *A notice of default is issued to a defaulting market participant up till the market participant is suspended.*
[29] *Default notices relating to settlement payments.*

# MARKET PERFORMANCE: CONTRACTED ANCILLARY SERVICES

**In addition to the co-optimised energy, reserve and regulation markets, EMC negotiates and enters into ancillary services contracts on behalf of the PSO, to ensure the reliable operation of Singapore's power system. If these services cannot be procured competitively due to a limited number of available suppliers, for example, their prices are regulated.**

From 1 April 2024 to 31 March 2025, the only contracted ancillary service required was black-start capability.

Black-start services ensure that there is initial generation to supply electric power for system restoration following a complete blackout. Based on the PSO's operational requirements, EMC procured 88.848MW of black-start services at a cost of $11.4 million for the period from 1 April 2024 to 31 March 2025. The capability was sourced from YTL PowerSeraya, Senoko Energy, Tuas Power Generation, and Keppel Merlimau Cogen.

## Contracted Ancillary Services – 1 April 2024 to 31 March 2025

| Contract Period | Cost of Ancillary Services (including GST) | Total MW Contracted |
|---|---|---|
| **1 April 2024 to 31 March 2025** | $11,366,797.30 | 88.848 |

# MARKET PERFORMANCE: MARKET FEES

**The costs associated with the wholesale functions of the NEMS are recovered directly from the wholesale market through fixed fees as well as variable fees that are proportionate to the quantity of energy that the MPs trade.**

## EMC Fees – 1 July 2024 to 30 June 2025

| | |
|---|---|
| **Market Participant (MP) Fee** | $10,000 per MP (annual) |
| **MP Registration Fee** | $5,000 per registration (one-off) |
| **RSA Hardware Token Fee** | $350 per token (once every three years from 6th token onwards per MP)<br><br>$110 per token (replacement fee for lost or damaged token) |
| **EMC Fee per MWh ($/MWh)** | 0.3686 |

## PSO Fixed Fees – 1 July 2024 to 30 June 2025

| | |
|---|---|
| **MP Fee** | $3,500 per MP (annual) |
| **MP Registration Fee** | $1,650 per legal entity registration (one-off) |

## PSO Net Fees – 1 April 2024 to 31 March 2025

| | |
|---|---|
| **PSO Net Fees ($'000)** | 35,584 |

# ADDITIONAL INFORMATION

# ADDITIONAL INFORMATION: GLOSSARY

### ancillary services
The additional services needed to ensure the security and reliability of the power system. The ancillary services traded competitively on the wholesale market are regulation and the two classes of reserves (primary and contingency). The black-start ancillary service is contracted by Energy Market Company (EMC) on behalf of the Power System Operator (PSO) on an annual basis.

### base vesting quantity
The quantity (in MWh) for the purpose of hedging non-contestable consumer (NCC) load under the Base Vesting Scheme. Under the Liquefied Natural Gas (LNG) Vesting Scheme from July 2013 to June 2023, a certain percentage of the total allocated vesting quantity is pegged to LNG. The remaining percentage pegged to piped natural gas is known as the balance vesting quantity.

### battery energy storage system (BESS)
Battery Energy Storage System (BESS) is an electrochemical energy storage system where stored chemical energy can be converted to electrical energy when required.

### black-start ancillary service
A service to ensure that there is initial generation of power, without using power from the grid, so as to restore systems following a complete blackout.

### co-optimisation
The process used by the market clearing engine (MCE) to ensure that the most inexpensive mix of energy, reserves and regulation is purchased from the market to meet electricity demand in each dispatch period.

### demand response (DR)
This enables contestable consumers to voluntarily reduce their electricity demand in response to market conditions, particularly during periods of high wholesale market prices or when system reliability is adversely affected.

### dispatch schedule
A schedule produced by the market clearing engine (MCE) every half-hour. It is the basis for the supply and consumption of energy, and the supply of reserve and regulation in the market.

### embedded generators (EG)
Generation units that generate electricity to their on-site load principally for self-consumption.

### event of default
The failure of a market participant (MP) to fulfil its payment obligations or other basic obligations under the Market Rules. An event of default, if not remedied, will trigger a suspension procedure on the defaulting MP. For a full list of events of default, please refer to the Market Rules.

### intermittent generation sources (IGS)
Sources of energy whose output depends on environmental factors and weather conditions, such as solar and wind energy. While there are IGS facilities connected to the grid in Singapore, IGS are not scheduled for dispatch by the Power System Operator (PSO) in the wholesale market because the power output cannot be controlled or varied at will.

### interruptible load (IL)
The amount of electricity that a consumer makes available for interruption in the event of a system disturbance in exchange for reserve payment. The Power System Operator (PSO) controls the activation of interruptible loads.

### licensed capacity
This denotes the capacity of a facility licensed by the Energy Market Authority (EMA).

### market clearing engine (MCE)
The linear programme computer application used to calculate spot market quantities and prices.

### market participant (MP)
A person or entity which has an electricity licence issued by the Energy Market Authority (EMA) and has been registered with Energy Market Company (EMC) as a market participant to trade in the wholesale electricity market.

### metered demand
The electricity consumption that is proxied by the withdrawal energy quantity (WEQ).

# ADDITIONAL INFORMATION: GLOSSARY

### nodal pricing
A market structure in which prices are calculated at specific locations, or nodes, in the power system to reflect the demand and supply characteristics of each location, taking into consideration transmission losses and congestion. Nodal pricing is also commonly referred to as locational marginal pricing. In the settlement reports, this is termed the market energy price.

### open electricity market (OEM)
An initiative by the Energy Market Authority (EMA) to enable all business consumers and households to buy electricity from a retailer of their choice at a price plan that best meets their needs or remain on the regulated tariff rate.

### reference uniform Singapore energy price (RUSEP)
The uncapped counterfactual USEP when the Temporary Price Cap (TPC) is in effect. Similar to USEP, it is the weighted-average of the uncapped nodal prices at all off-take nodes.

### registered capacity
This denotes the capacity of a facility registered with the National Electricity Market of Singapore (NEMS). Registered capacity may differ from licensed capacity.

### regulation
Generation that is on standby to fine-tune or correct frequency variations or imbalances between demand and supply in the power system.

### retail market
The transactions made between retail companies and end consumers.

### retailer of last resort (RoLR)
The one or more retailers who will take responsibility for the customers of a retailer that is no longer able to, or has lost the right to, retail electricity to its customers.

### supply cushion
This measures the percentage of total supply available after matching off demand.

### tender vesting quantity
The quantity (in MWh) for the purpose of hedging non-contestable consumer (NCC) load over and above the balance vesting quantity.

### uniform Singapore energy price (USEP)
The weighted-average of the nodal prices at all off-take nodes.

### vesting contract
An instrument issued by the Energy Market Authority (EMA) to hedge the price of energy to be procured from the Singapore Wholesale Electricity Market (SWEM) for supply to non-contestable consumers. The vesting contracts are structured as bilateral two-way contract-for-differences between the Market Support Services Licensee (MSSL) and a holder, which is typically a commercial generation company. A vesting contract requires these generators to sell a specified quantity of electricity at a specified price.

### vesting contract hedge price (VCHP)
This is the price used by Energy Market Company (EMC) to settle the vesting quantity between the Market Support Services Licensee (MSSL) and the generation companies. VCHP is determined using the long-run marginal cost of the most efficient generation technology in the Singapore power system, i.e., the combined-cycle gas turbine.

### withdrawal energy quantity (WEQ)
This is measured in megawatt hour and refers to the amount of electricity withdrawn by load facilities. It is provided by the Market Support Services Licensee (MSSL), SP Services.

### wholesale market
The transactions made between generation companies and retail companies.

## Notice and Disclaimer



This publication is meant only for general information and nothing in it may be construed as advice. Whilst EMC has taken reasonable care in the preparation of this publication, EMC does not warrant its suitability for any purpose. You should always consult your professional advisers before making any decision.

If you have any specific queries about this publication, you can write to info@emcsg.com.

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