**Generators**

More than 80 per cent of Australia's electricity production relies on burning fossil fuels - coal, gas and oil

The NEM supplies around 200 TWh (terawatt hours) of energy to businesses and households each year. There are three key markets that underpin this system: the National Electricity Market, the Retail Market, and the Financial Market.

The **National Electricity Market (NEM)** is a wholesale market involving exchanges between electricity producers (generators) and retailers (companies that purchase electricity from generators and then sell it to homes and businesses).  
  
The **Retail Market** involves electricity retailers selling the energy they have purchased wholesale (via the NEM) to homes and businesses.  
  
The **Financial Market** describes various contracts set up between electricity producers, retailers and investors, which act as insurance policies by reducing the significant risk of financial exposure faced by market participants due to electricity price volatility that can occur. These financial contracts may lock in a firm price for electricity that will be produced or consumed at a given time in the future.

A diagram of a company

Description automatically generated

**The National Electricity Market (NEM)**

The National Electricity Market (NEM) is a wholesale market that supplies electricity to retailers and end-users in Queensland, New South Wales, the Australian Capital Territory, Victoria, South Australia and Tasmania. Electricity bought and sold in the NEM is transported along the interconnected power system.

**AEMO**  
AEMO's primary responsibility is to balance the demand and supply of electricity by dispatching the generation necessary to meet demand.

AEMO manages the NEM and the power system from two control centres in different states. Both centres operate around the clock, and are equipped with identical communication and information technology systems. The entire NEM, or individual regions within it, can be operated from either or both centres. This arrangement ensures continuous supply despite the risks posed by natural disasters or other critical events, and provides AEMO with the flexibility to respond quickly to dramatic changes in the market or the power system.

**The centrally co-ordinated dispatch process**

To enable AEMO's systems to facilitate supply, generators must submit, to AEMO, offers indicating the volume of electricity they are prepared to produce for a specified price.

There are three types of bids or offers to supply — daily bids, re-bids and default bids. Daily bids are submitted before 12:30pm on the day before supply is required. Generators may submit re-bids until approximately five minutes prior to dispatch. Re-bids allow generators to change the volume of electricity stated in the original offer, but they cannot change the offer price.

From the bids submitted, AEMO's market systems determine which generators are required to satisfy demand, at what time, and their production levels in a process called scheduling. AEMO stacks the bids in order of rising price, and then schedules them for dispatch into production. Using the rising price stack means that more expensive generators are only scheduled into production as total demand for electricity increases.

At times, the technical capacity of the transmission network may determine which generators are scheduled to meet demand. In these situations, generators may be scheduled out of price order so that demand in a particular area can be satisfied.

**The spot market**

Wholesale trading in electricity is conducted as a spot market where supply and demand are instantaneously matched in real-time through a centrally-coordinated dispatch process.

Generators offer to supply the market with specific amounts of electricity at particular prices. Offers to produce electricity are received by AEMO and stacked in ascending price order for each dispatch period, which is every 5 minutes. AEMO then progressively schedules generators into production to meet the forecast demand, starting with the least-cost option. Once the demand forecast has been matched with sufficient generation, AEMO calculates the spot price for that 5-minute dispatch interval.

AEMO uses this spot price as the basis for the settlement of financial transactions for all electricity traded in the NEM.

The National Electricity Rules set a maximum spot price, also known as a Market Price Cap. This is the maximum price at which generators can bid, and is also the price automatically triggered when AEMO directs network service providers to interrupt customer supply in order to keep supply and demand in balance.

AEMO is responsible for calculating the financial liabilities of market participants on a daily basis and for settling transactions weekly for all trade in the NEM. This means that AEMO collects from Market Customers all money due for electricity purchased from the pool, and pays generators for the electricity they produced. The spot price is the basis for all of these transactions.

**Recent changes to the spot market**

Prior to 1 October 2021, the NEM was settled in 30-minute intervals. A dispatch price was determined every five minutes, and the six dispatch prices within a half-hour period were averaged to determine the spot price for each NEM region.

The implementation of Five-Minute Settlements on 1 October 2021 saw the alignment of the dispatch price and the spot price at 5-minute intervals.

**The Retail Market**

The Retail Market involves electricity retailers and end-users (homes and businesses). End-users purchase power from their electricity retail supplier, who in turn purchases power from the NEM pool.

The amount the end-user pays for their electricity is made up of several charges including the cost of the electricity transmission and distribution networks. The cost of the electricity itself is based on the market spot price.

Electricity is purchased by the retailer and transported to home and businesses.

Electricity is purchased by the retailer from the NEM (the pool). It is transported via the power system to our homes and businesses.

The cost of this electricity is determined by the spot price. This is constantly changing so the retail supplier takes on the risk of this volatile market.

The retail supplier signs up end-users to their customer base, usually on a contract. These contracts need to cover potential fluctuations in the spot price, otherwise the retail supplier loses money.

The final bill received by end-users takes into account the cost of the transmission and distribution network.

**Full retail competition**

Since the NEM commenced, electricity consumers have progressively gained the right to choose their own supplier. This right to choose is known as Full Retail Competition. Delivering full retail competition has required new information technology systems to process customer transfers between registered retailers in the NEM. These systems are operated by AEMO, and contain one of the largest metering databases in the world. They accept data from a variety of electricity meter types and can process information from up to 11 million meters.

Retailers are billed on the total electricity consumed at a particular network connection point; if a customer changes their electricity retailer, this is recorded in AEMO's database so that all subsequent consumption is charged to the new retailer.

**The financial market**

Fluctuating spot prices for electricity create substantial risk for parties who trade in the NEM's spot market. When the price is low, generators may not be fully compensated for the power they supply. On the other hand, retail customers will not want to pay for energy which is priced too high. The Financial Market uses hedge contracts to mitigate these risks by benefiting both parties in times of price volatility.

Hedge contracts are typically agreements between generators and market customers. These contracts operate independently of both the NEM and AEMO's administration. The details of hedge contracts are not factored into the balancing of supply and demand and are not regulated under the National Electricity Rules.

Hedge contracts are financial instruments that market participants can use to manage the financial risk that results from potential volatility of the spot price.

For example, the most common type of contract, a *Swap* contract, exists where two parties agree to exchange cash against a spot price outcome in the NEM so that a defined quantity of electricity over a nominated period is effectively valued at an agreed strike price. Under such an agreement, generators pay market customers the difference when the spot price is above the strike price. When the spot price is below the strike price, market customers pay generators the difference.

**NEM spot pricing and dispatch**

All wholesale electricity is traded by market participants through a central pool comprising a number of pre-defined pricing regions.

The spot price, used to settle trading participants located in a particular region, is the dispatch price calculated for that region every five minutes. The dispatch price is set at the value where competitive offers to supply electricity match demand.

All electricity generated and consumed within a region is paid for at the regional spot price. Trading in the wholesale electricity market can be risky because the spot price can be volatile.

**What is the electricity pool?**

The electricity pool is made up of a set of rules and procedures managed by AEMO in conjunction with generators, customers and network service providers. This set of rules acts to centrally operate the power system and balance electricity supply and demand.

Electricity is traded using this pool arrangement to allow competition to exist. Electricity can not be stored within the power system for future use, so supply must vary dynamically to match changing demand; and one unit of electricity is indistinguishable from any other unit, so it is impossible to determine which generator produced which electricity.

Electricity supply and demand must be balanced and matched instantaneously to provide a safe supply at acceptable quality standards.

**Submitting bids to supply**

For AEMO's systems to facilitate supply, scheduled and semi-scheduled generators must submit bids and offers (collectively referred to as bids or bidding) to AEMO specifying the volume of electricity their generating units are prepared to produce for a specified price.

A bid covers a trading day, which is 4:00am to 4:00am AEST. Generators can submit bids, using up to 10 price bands, breaking up the total capacity of the generator into one or more of those price bands. Bids submitted after 12:30pm AEST for the next trading day are called rebids and must be accompanied by a reason. All bids for the current and (after 12:30pm AEST) next trading day are also reflected in pre-dispatch schedules. Pre-dispatch is an indicative forecast of dispatch and pricing for the current trading day (and next trading day, after 12:30pm AEST) to a half-hourly resolution, and updated every 30 minutes. Pre-dispatch shows at a five minute resolution for the next hour.

A graph of a graph

Description automatically generated with medium confidence

**Submitting bids for demand**

Each day, market customers with price-sensitivity or the ability to adjust demand, provide AEMO with a bid for each of their scheduled loads. This bid indicates how much electricity a scheduled load is prepared to buy from the pool at a certain price, for each 5-minute dispatch interval of the relevant trading day.

**Central dispatch process**

AEMO manages the central dispatch process and pricing cycle which automatically runs every five minutes.

The central dispatch process determines, based on a least-cost optimisation of all bids submitted for supply (and demand), the production required from each generating unit to meet AEMO's forecast of demand at the end of each dispatch interval. This process is called 'scheduling'.

Bids to supply are stacked in order of rising price (along with any bids to reduce demand, in reverse price order), with sufficient generation scheduled to meet the net demand. This results in more expensive generators being scheduled into production only as demand increases.

Dispatch instructions are then issued to scheduled and semi-scheduled generating units and to scheduled loads (collectively called 'scheduled plant'), to produce or consume the instructed amount of energy by the end of the dispatch interval.

At the same time, the central dispatch process optimally determines, based on bids from ancillary service providers, the capacity reserves required to handle the potential loss of a generating unit, load or transmission network element (refer to Module 6).

The results of the optimisation are used to determine the dispatch price and ancillary service prices for each region.

**How does the central dispatch process determine dispatch targets?**

ln normal circumstances, the central dispatch process starts with the generator who has the lowest priced bid then, in sequence of increasing bid price, schedules enough generation to meet demand, subject to generation capacity and network transfer limits. In other words, scheduled plant is dispatched on an economic or merit order basis.

Electricity demand fluctuates in each five-minute period throughout the day, and the amount of generation scheduled for production also varies. When demand is low, generators with the lowest bid price are in production and when demand is high the more expensive generators are brought into production. This provides an optimal, or least-cost, solution for power supply allocation to meet demand.

A diagram of a five minute dispatch cycle

Description automatically generated

**The spot market and spot price**

The spot market is where market generators are paid for the electricity they sell to the pool and market customers pay for their electricity consumption from the pool. All electricity is traded through the pool at the spot price. The pool is divided into a number of pre-defined regions.

A spot price for each region is determined every five minutes. AEMO uses the spot price to settle all actual energy traded in the NEM.

Historically, NEM settlements were calculated in 30-minute intervals, where the six dispatch prices in a half-hour period were averaged to determine the regional spot price for that half-hour trading interval. With the implementation of five-minute settlements in the NEM from 1 October, 2021, the dispatch price and spot price became aligned at five minutes.

Market price cap

The Rules set a maximum spot price, called the Market Price Cap (MPC). This is also the maximum bid price.

Since 1 July 2012, the National Electricity Rules have required the AEMC to update the values for the market price cap and cumulative price threshold each year by applying consumer price index information, published by the Australian Bureau of Statistics. In 2023-24 the MPC is $16,600

The Rules set a minimum spot price, called the market floor price. This is also the minimum bid price.  
  
The market floor price is -$1,000 per megawatt hour. The AEMC's Reliability panel reviews the market price cap and market floor price settings every four years.

**Pricing during mandatory restrictions**

Mandatory restrictions (MRs) can be imposed by a government jurisdiction to reduce electricity demand in a region and avert situations where there would otherwise be insufficient supply to meet forecast demand.

The reduction in demand results in lower market prices than would otherwise occur had MRs not been declared and had a much tighter supply/demand balance prevailed. The Rules prescribe a process for pricing during MRs which restores this supply scarcity signal.

MR arrangements do not apply to voluntary restrictions.

**Intro to the Australian Electricity Physical Market**

**The Australian National Electricity Market (NEM) physical (i.e. spot) market**

The National Electricity Market (NEM) is an interconnected grid comprising several connected regional networks and approximately 45,900 MW of installed generation. The NEM spot pool market is operated by AEMO and operates across the eastern states of the mainland, and includes the state grids of (QLD), New South Wales (NSW), Victoria (VIC) and South Australia (SA). Tasmania (TAS) is connected to the other NEM regions via an undersea inter-connector to Victoria. Futures and options contracts are listed on the 4 major regions (VIC, SA, QLD and NSW).

AEMO publishes a half-hourly spot pool price for electricity in each region based on a gross pool merit order dispatch system. All retailers and market customers purchase their power from the spot pool market in their relevant region and pay the spot market price to AEMO (i.e. the spot price determines the retailer's supply cost). All generators that supply power to the regional pool market during this time receive the spot market price from AEMO (i.e. the spot price determines the generator's revenue). Free realtime spot market data is available from www.aemo.com.au. A more detailed overview of the Australian physical and financial electricity market is provided by the Australian Energy Regulator's annual "State of the Energy Market Report" available from www.aer.gov.au . The spot pool price varies from $-1,000/MWh to +$16,600/MWh, so retailers and generators hedge this floating price risk by locking in a fixed power price rate by buying or selling derivative contracts (contracts for differences).

The spot price (and the price of futures contracts used to "lock in" long term revenues or costs at a fixed rate) provide the market signals for investment in new generation and competitive responses from new entrant retail suppliers. This market-driven investment signaling benefits energy consumers in the long term. i.e. high spot prices and futures prices (e.g. if the power supply/demand balance is tight) signal new generation investment seeking higher revenues thereby ensuring the security of power supply. Conversely, low spot prices and futures prices signal new retailer competitors and energy intensive industry to enter the relevant regional market to take advantage of lower power supply costs.

**The Electricity Futures and Options Market**

It is against the published pool price that all derivative products, such as futures are (cash) settled on contract expiry. Base load futures are cash settled with reference to the average of every half hour of the relevant quarter, while peak load futures are cash settled with reference to the average of only those half hours during the quarter between 7am to 10pm on working weekdays.

The Australian market is one of the few purely cash settled electricity markets (i.e. financial contracts do not involve physical delivery of electricity) which enables participants such as and banks to participate in the financial market and contribute to market liquidity without a requirement to own physical generation assets.

Electricity futures contracts are listed on a calendar quarter basis out to 4 years ahead and also trade in 1 year tranches via defined Calendar Year and Financial Year Strip Products. Products traded include exchange traded swap futures (also $300 cap futures) and options on swap futures, providing the facility for credit-clean option position taking.

A large volume of OTC negotiated business is brought to the ASX for clearing and registration by brokers and/or trading clients via the ASX Block Trading mechanism. Additionally, the exchange-for-physical (EFP) mechanism enables OTC hedge contracts to be switched into futures via registration on the ASX Clear (Futures), to eliminate OTC credit default risk.