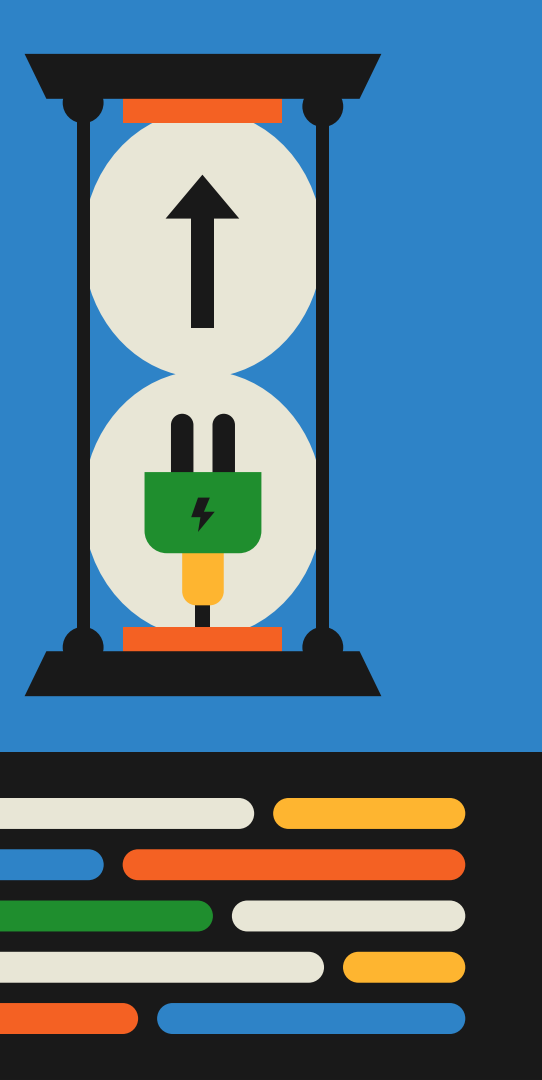
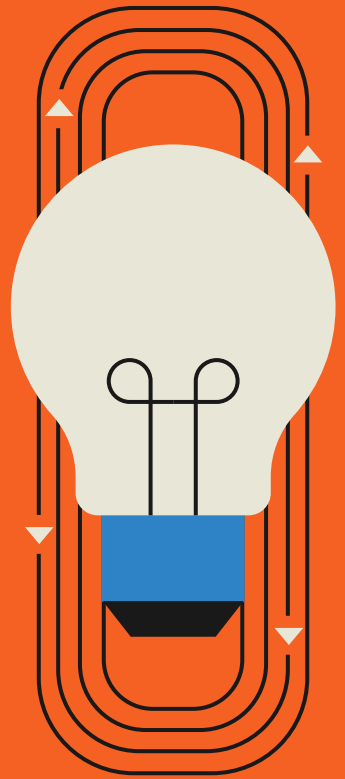
National Electricity Market (NEM)

Analysis & Recommendation

Group-22





Objectives

01 Emissions Trends Throughout NEM

02 Intra-daily Carbon Emission Intensity Patterns & Consumption Impacts

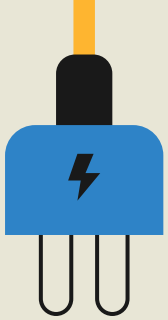
03 Generation Tech Comparisons

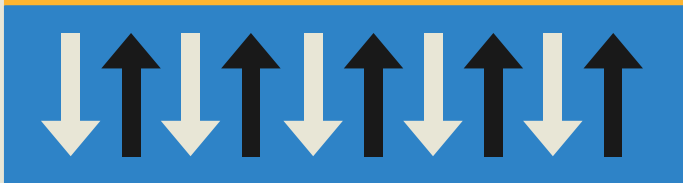
04 Bidding Behavior Analysis: 2019 vs 2025

05 Recommendations for Investors

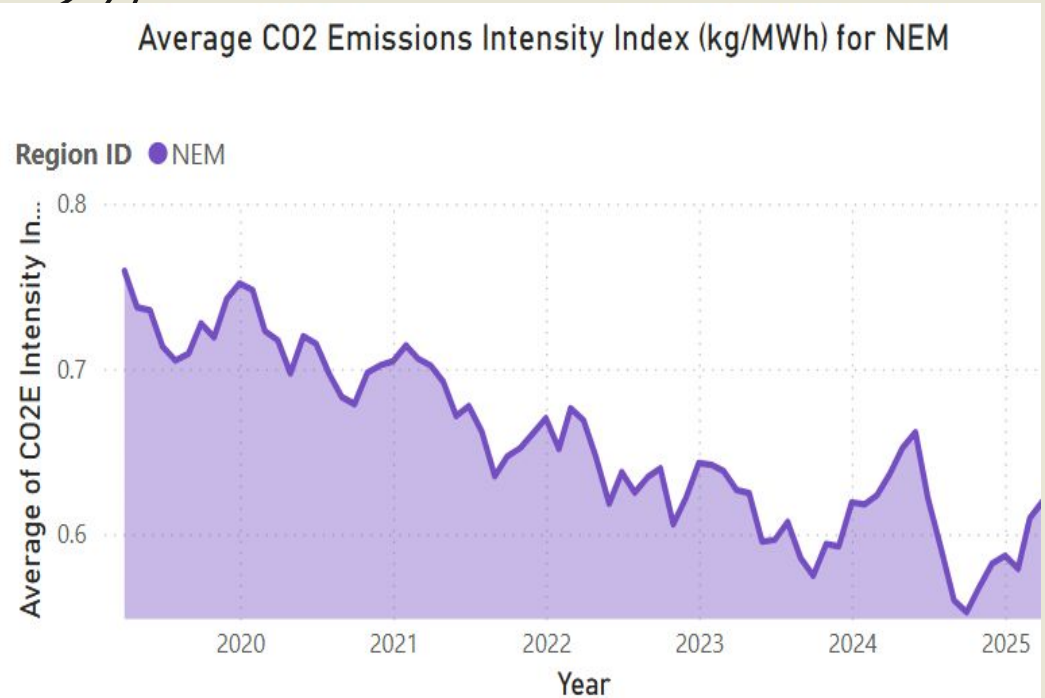
01

Emissions Trends Throughout NEM





Emissions: A National Transition Underway



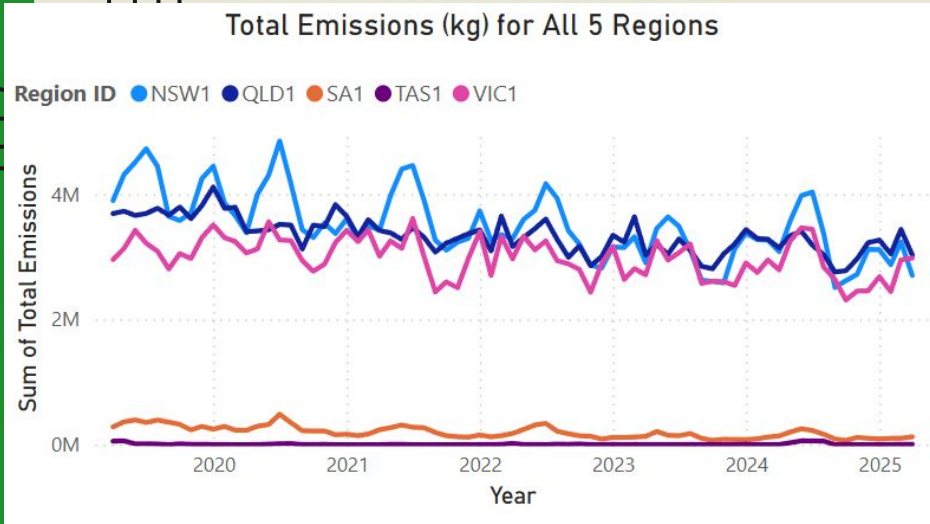
0.76 kg/MWh → **0.62 kg/MWh**

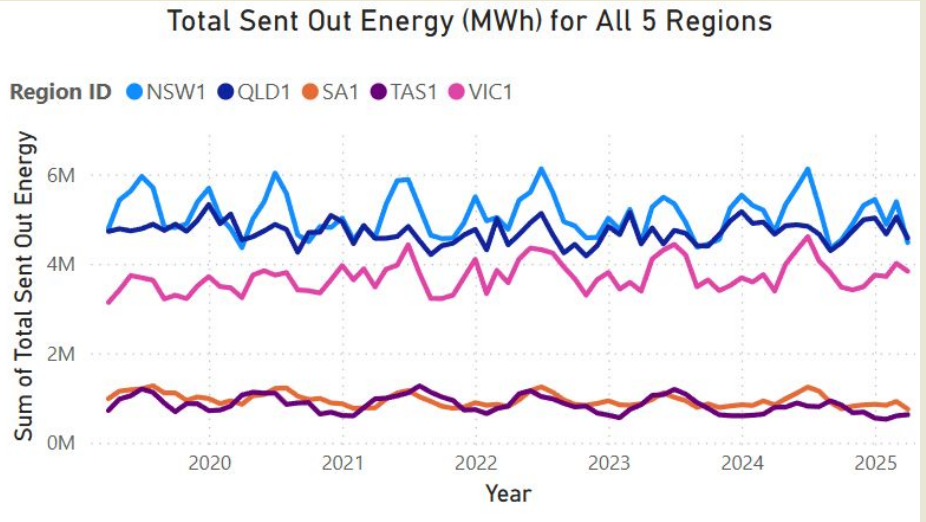
↓ **18.42%**

Why Emissions Trends Matter for Investment

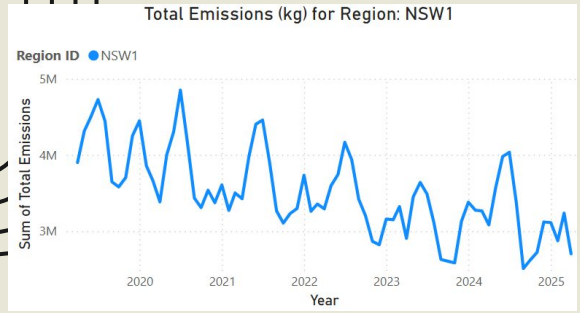
- Sets the baseline for energy market transformation.
- Reveals structural vs superficial change.
- Helps identify where clean energy is scaling, and where it is stuck.
- Informs risk-adjusted investment decisions.

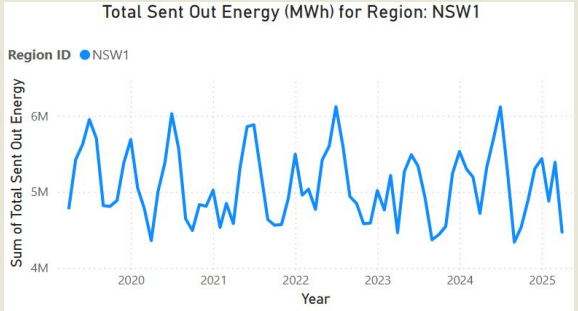
Emissions Are Dropping; But Demand Isn't

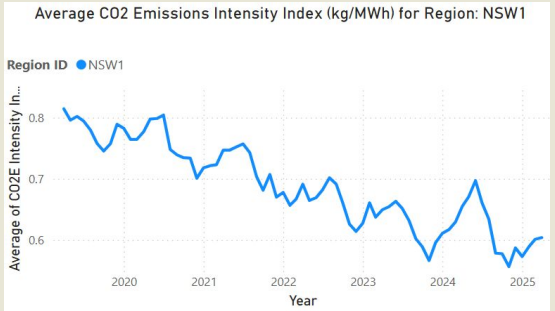




NSW: From Coal Exit to Clean Growth



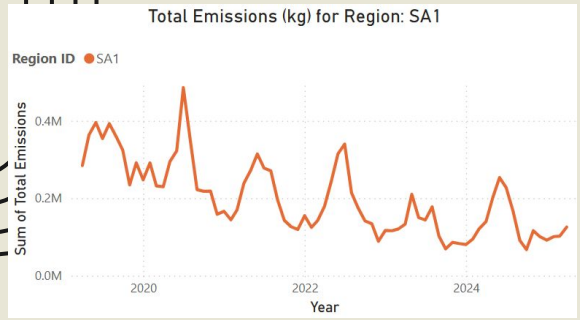


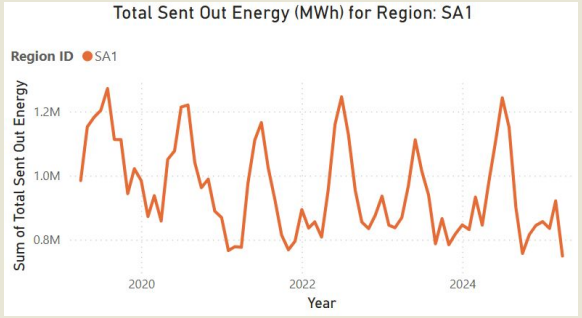


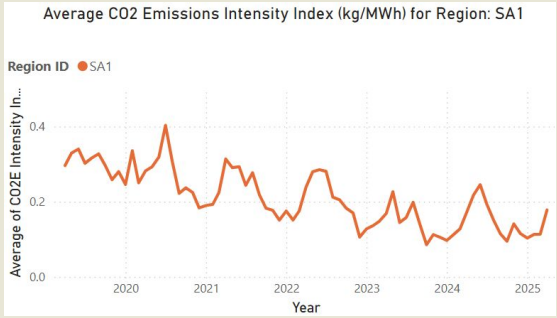
- 0.8 → 0.6 kg/MWh (25% drop)
- Liddell closure (mid-2023): 17% AGL cut
- 10.3 GW generation + 13.2 GW storage approved
- Waratah battery, policy certainty, firming support

Investor Signal: High-confidence market with clear policy and pipeline.

SA: Structural Shift to Net Zero



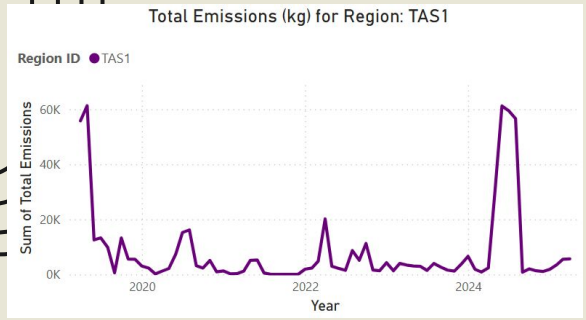


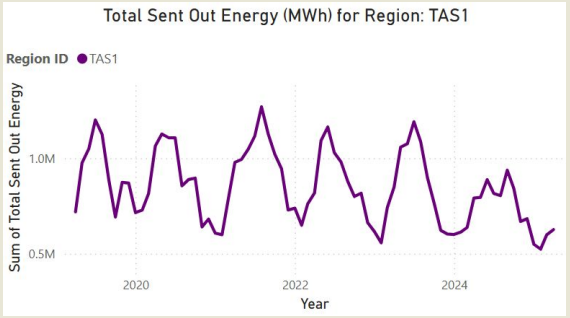


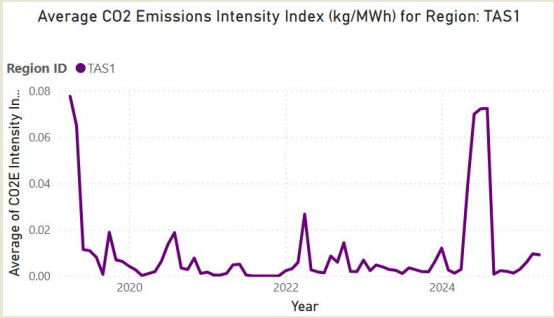
- 0.30 → 0.18 kg/MWh (40% drop)
- 289 days with 100% RE (2023)
- Firmed by batteries (Hornsdale, Blyth)
- EnergyConnect transmission
- Industrial load forecast + demand-led growth

Investor Signal: Clean energy success story attracting industrial capital.

TAS: Already There, Scaling Up



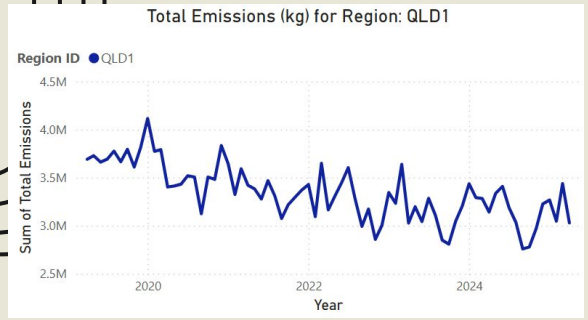


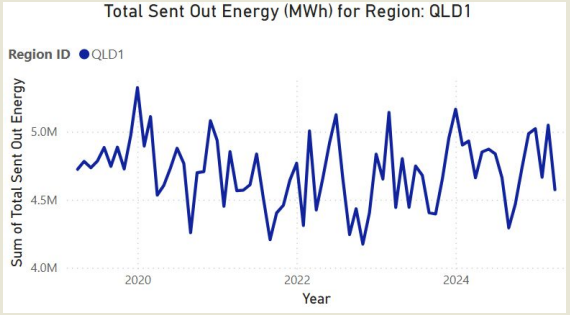


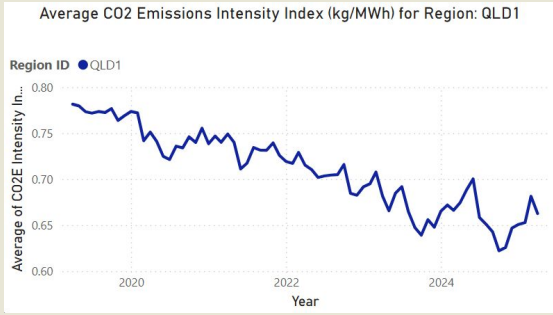
- 0.08 → 0.01 kg/MWh, flat and stable
- Hydro + wind baseline
- Green hydrogen, 200% RE target
- Fast-tracked approvals

Investor Signal: Stable base, export-ready; perfect for long-term clean energy investors.

QLD: Emissions Down, Risk Up



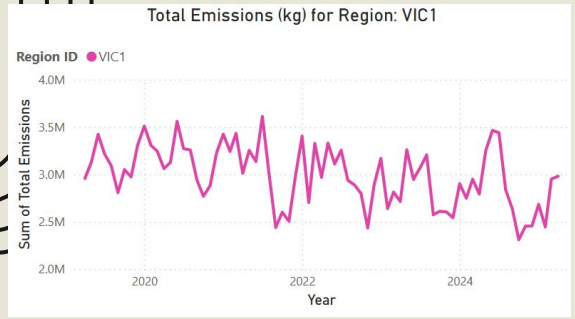


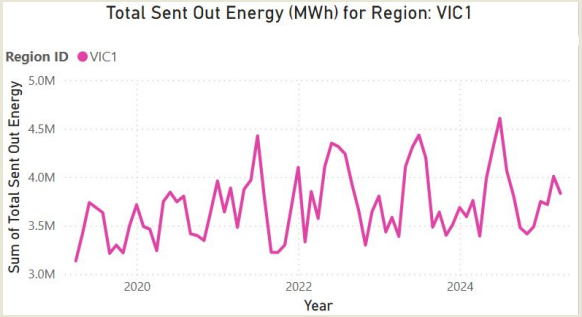


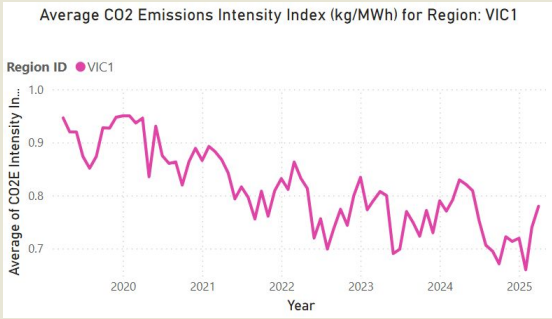
- 0.78 → 0.66 kg/MWh (15% drop)
- No coal exits, black coal dominant
- Extended Callide B, Clean Economy Bill watered down
- Cancelled wind farm (Moonlight Range)
- New red tape (SIAs, CBAs)

Investor Signal: Rising policy risk, volatile investment environment.

VIC: High Emissions, Stranded Renewables



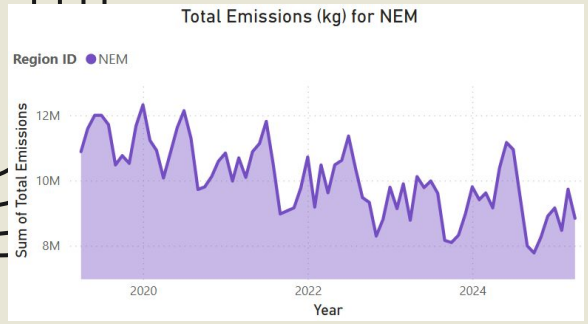


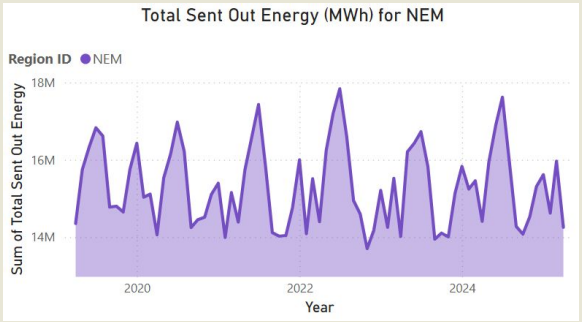


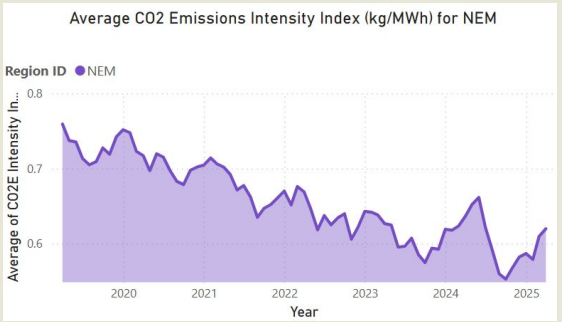
- 0.95 → 0.78 kg/MWh (highest intensity)
- Brown coal still dominant
- VNI West delay = curtailed renewables
- REZs planned but slow to execute

Investor Signal: High emissions + stranded capacity = risk unless transmission accelerates.

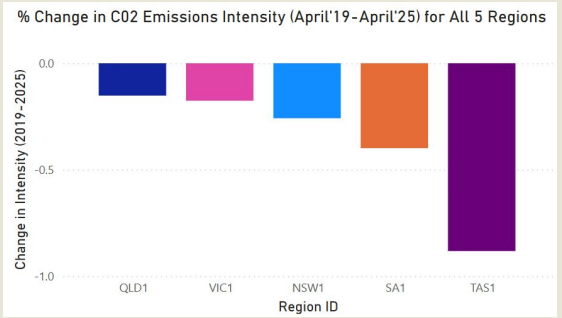
NEM: Driven by a Few, Dragged by Others







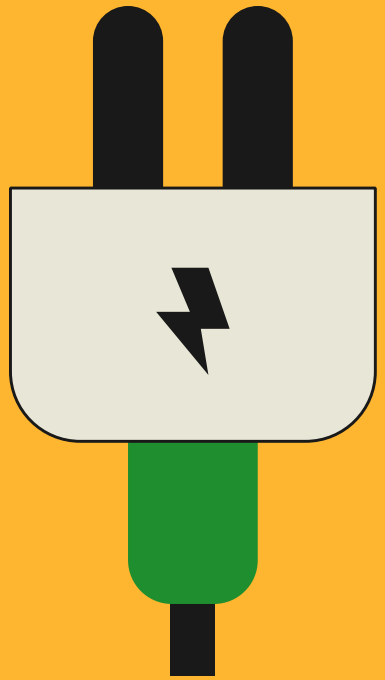
- NEM drop driven by NSW, SA, TAS
- VIC and QLD slow national gains
- Curtailment, grid delay, policy flip-flops still drag system-wide progress



Investor Signal: Invest where state policy and infrastructure align, and avoid regions where they conflict.

Summary: What Emissions Trends Tell Us

Region	Emission Trend	Structural Drivers	Investor Signal
NSW	↓ 25%	Liddell closure, firming, storage approvals	Stable, high-confidence transition
SA	↓ 40%	100% RE days, batteries, industrial demand growth	Fast-moving, clean-demand-driven opportunity
TAS	↔ (Near-zero)	Hydro/wind base, green hydrogen plan	Mature base, scaling up exports
QLD	↓ 15% (flat post-2023)	No coal exits, political risk	Policy-volatile, high emissions intensity
VIC	↓ 18% (still highest)	Brown coal, transmission delays	Stranded renewables, needs infra acceleration



02 Intra-daily Carbon Emission Intensity & Consumption Impacts

2.1 Trend Overtime

Annual intra-daily curves by yea for all regions (2019–2025)

Year-on-year decline:

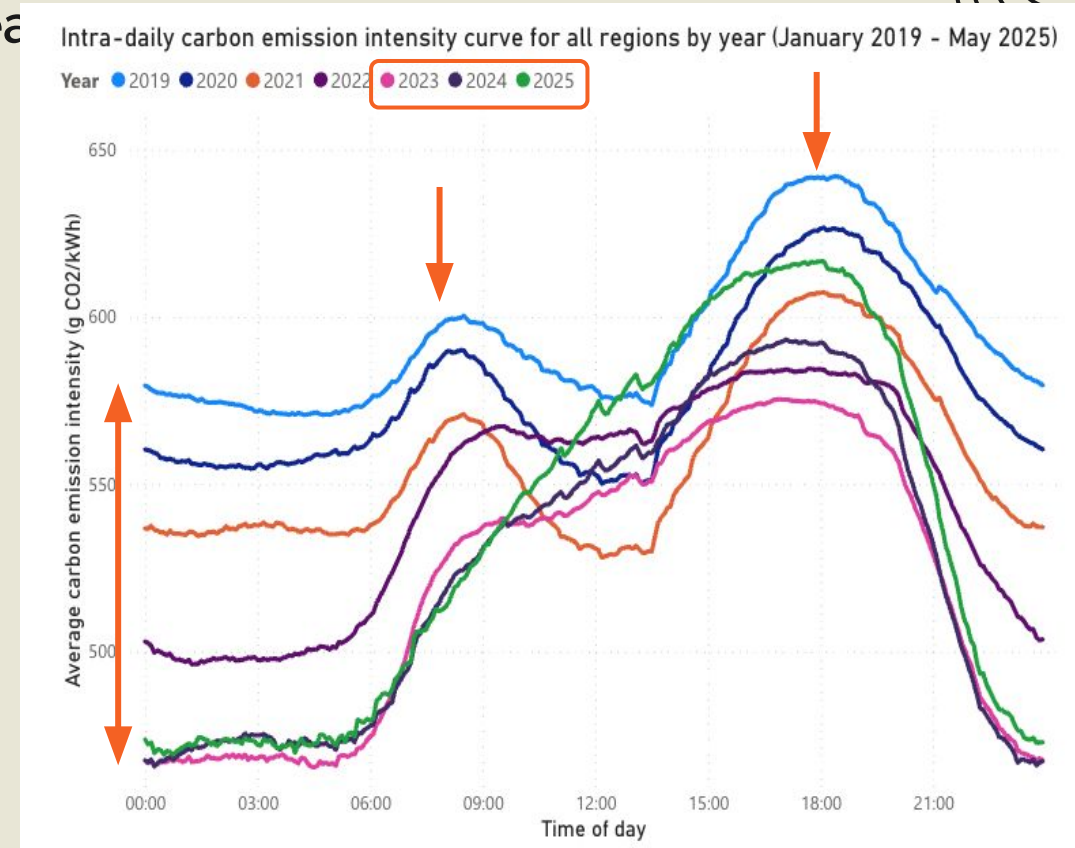
gradual lowering of the entire curve,

especially midday

Persistence of peaks:

morning/evening peaks only modestly reduced

→ highlights need for storage & flexible dispatch



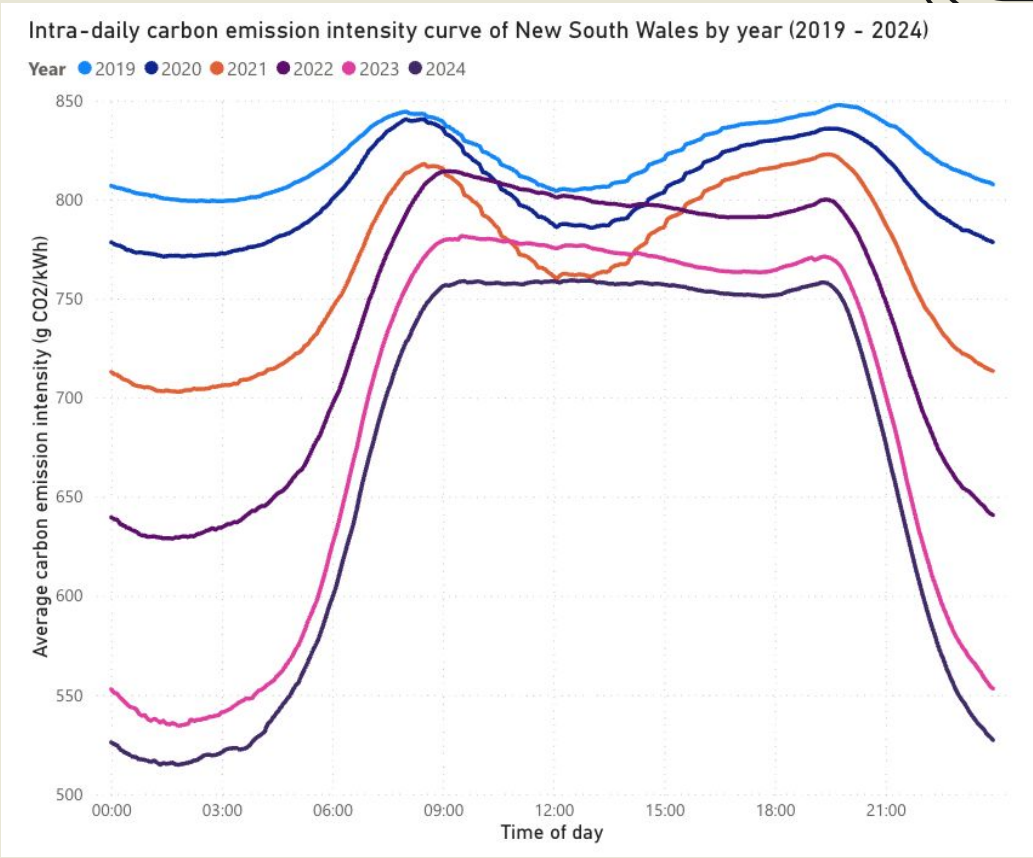
Annual intra-daily curves by year (2019–2024) for NSW

Reduced midday carbon-intensity by ~ 19%

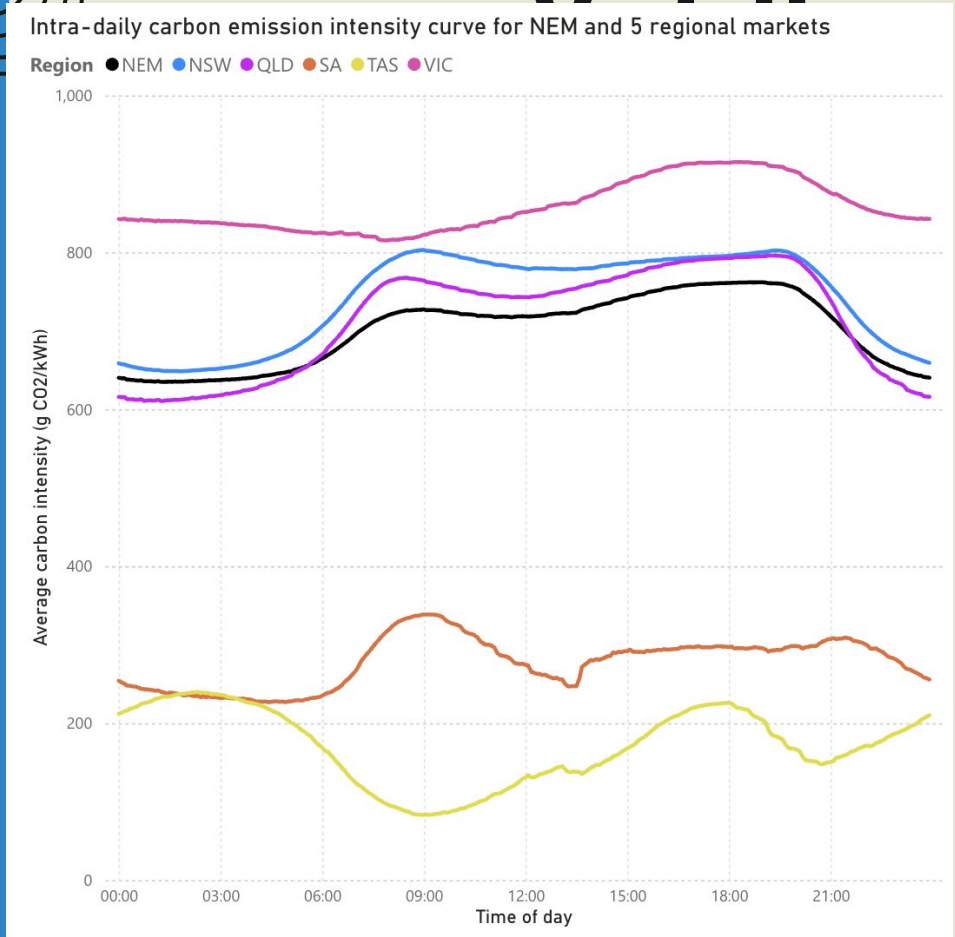
driven by rapid solar power that deepens the 10AM - 2PM dip.

Early morning & evening peaks remain prominent,

indicating reliance on non-renewable energy generation during these periods.



2.2 Shape & Regional



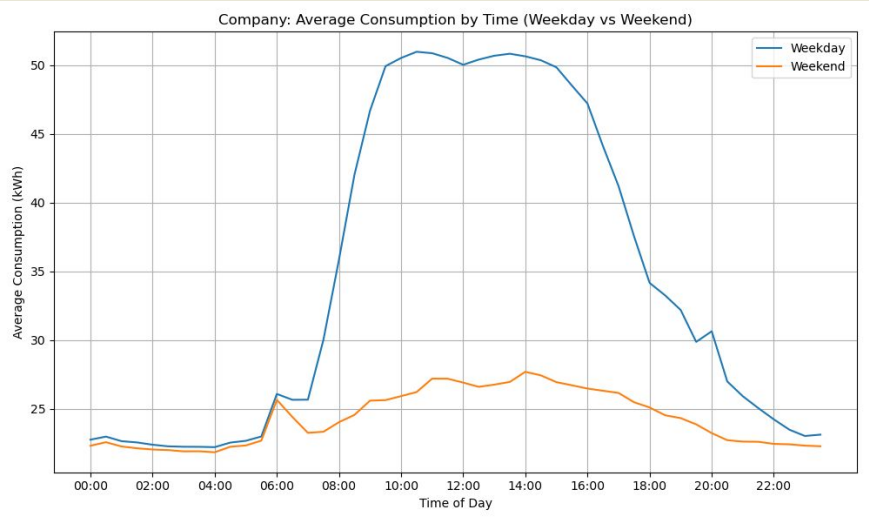
Intra-daily curve for NEM & 5 regions (Apr 2024-Apr 2025)

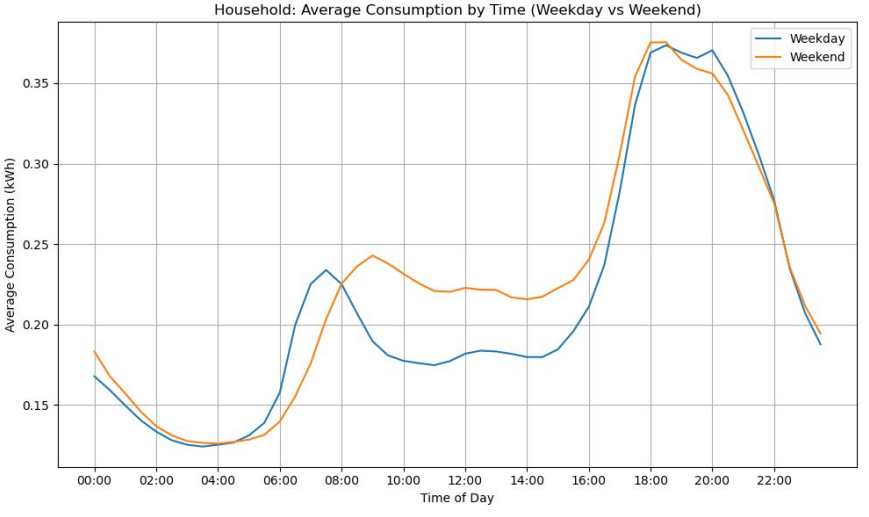
Twin-peak "U-shape"

Regional spread:

Highest intensities: Victoria (brown coal), NSW, Queensland

Lowest intensities: South Australia, Tasmania





2.3 Consumption Patterns

Household vs Company intra-daily consumption profiles

Company profile:

Sharp rise at 7 AM; peak 9 AM–5 PM; low overnight/weekends

Household profile:

Morning spike ≈ 7 AM; evening spike ≈ 6–9 PM; midday low

Alignment with grid intensity:

Companies consume when grid is “cleanest”

Households consume when grid is “dirtiest”

2.4 Weighted Average Emission Intensity

Average gCO_2/kWh: Company vs Household

```
=== OVERALL SUMMARY FOR NSW ===

Household Total Emissions:   1108228.80 gCO₂
Household Total Consumption: 253.25 kWh
Household Average Intensity: 4376.04 gCO₂/kWh

Company Total Emissions:     144547508.54 gCO₂
Company Total Consumption:   33911.31 kWh
Company Average Intensity:   4262.52 gCO₂/kWh
```

Result: Companies ≈ 3 % lower than households

Reason:

Daylight business hours coincide with high renewable output

Households peak at high-emission times

Average gCO_2/kWh: Company vs Household (Monthly breakdown)

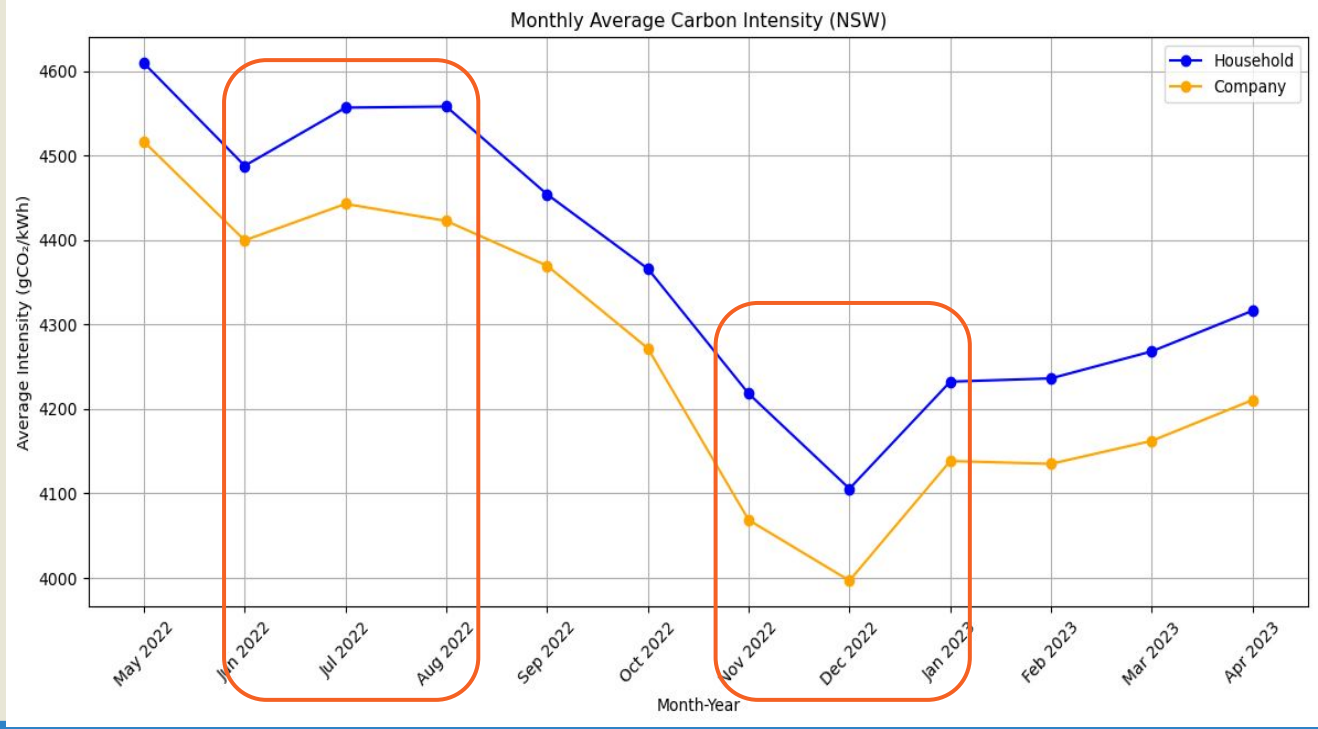
Result: Households ~150-200 gCO_2/kWh > companies on average

Peak in winter & Dip in summer

Reason: Seasonal supply

Summer solar lowers CO2 intensity, winter demand with less sunny days drive it up

Companies show a slightly lower-volatility profile by leaning more on daytime (lower-carbon) consumption.



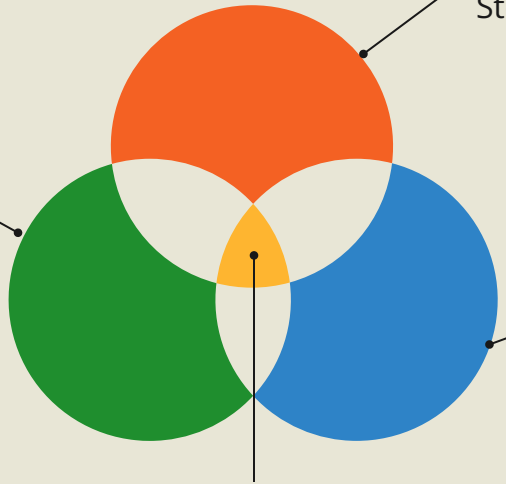
Key Takeaways

Intra-daily curves

Steadily decreasing over the years

Corporate consumption

aligns with low-emission periods
→ lower average intensity than households



Regional differences

driven by generation mix
SA/TAS lead; VIC/NSW lag

IMPLICATIONS

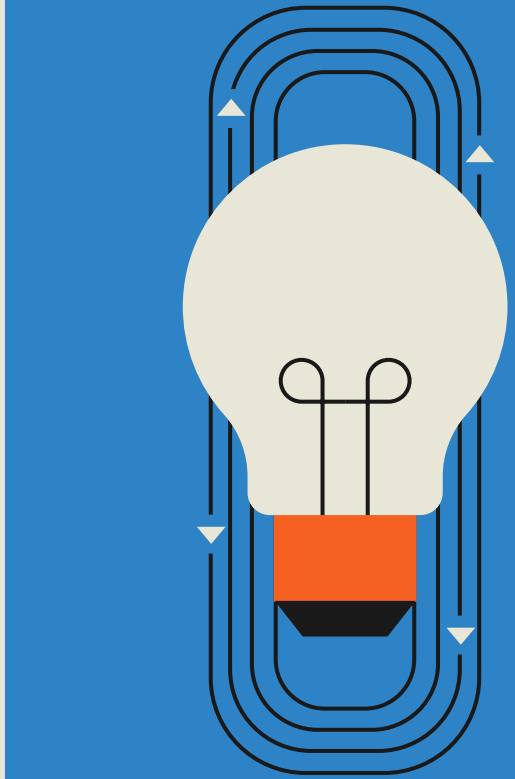
Shift non-essential electric use to daylight hours

Invest in storage and flexible capacity to smooth peaks

03

Generation Tech Comparisons

Comparing Generation Types w.r.t to Bidding Behavior, Supply Curves and Price of the Day.



Comparative Analysis

Generation Types comparison w.r.t to bidding behaviour and supply curves:

OCGT:

- Often peaking generators used only when demand spikes or during price volatility.
- Guaranteeing dispatch during high-demand intervals only.
- Active at min prices only when baseload or renewable supplies are insufficient.
- Min price offers are price sensitive- capitalise on peak demand periods.
- Max prices offer represent availability rather than dispatch.
- Strategic bidding behaviour at max prices.

Black Coal:

- Guaranteed dispatch in the merit-order system
- strategic withholding; bidding a portion of capacity at the market cap so it's only dispatched when prices spike.
- Total offered volume is sizable, indicating base-load behavior.
- Base-load generators or contracts with obligations
- Market intent is secure dispatch at min prices and extracting higher margins at max prices.
- Minimum Price Offers = Base Supply Strategy
- Maximum Price Offers = Opportunistic Strategy

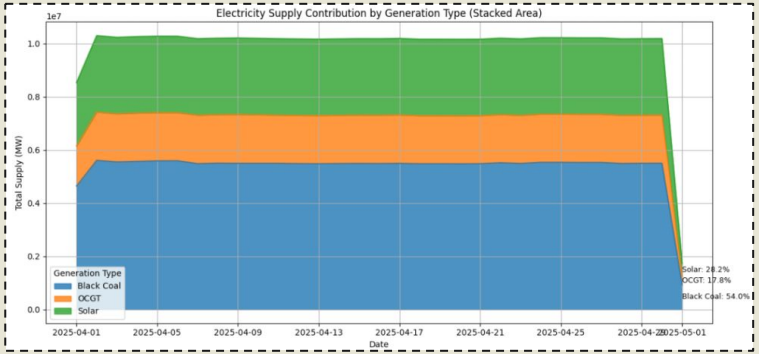
Solar:

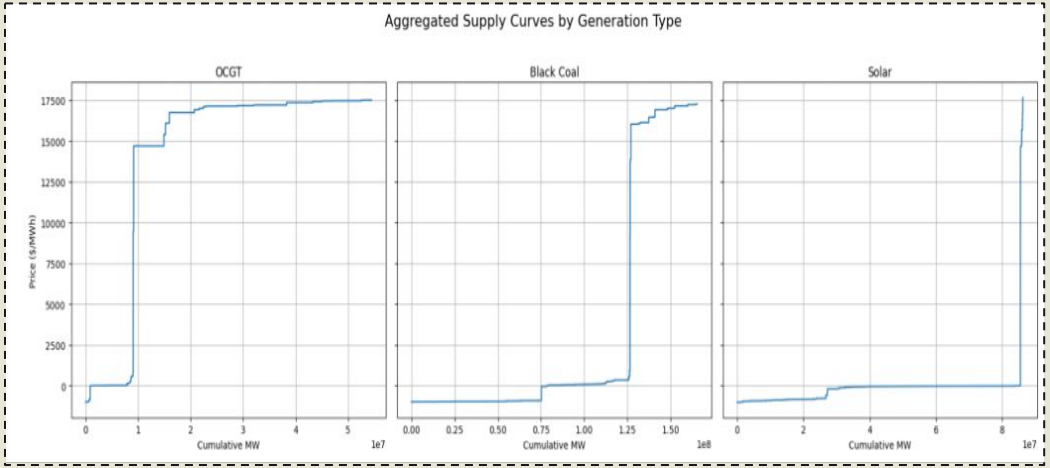
- Bid at at $0/MWh or negative to ensure dispatch.
- Marginal cost ≈ $0, so bids are often at -$1,000 to $0/MWh.
- Highly variable, depending on weather.
- Supply limitations at causes prices to be constant at earlier dispatches.
- After price jumps, supply is inelastic (insensitive to prices) due to resource exhaustion.

BLACK COAL **54%**

SOLAR **28%**

OCGT **18%**





Supply Distribution by Price Percentile

☀️ Solar

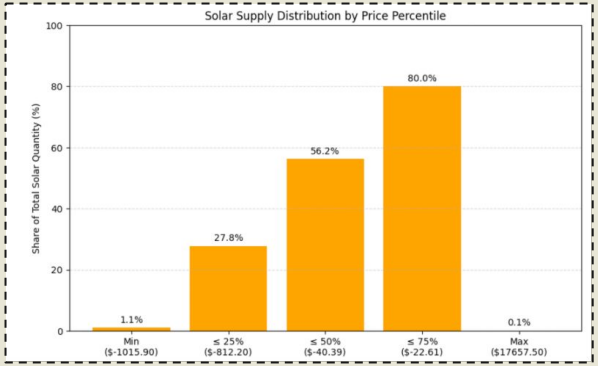
- 100% of MWs offered at **negative/minimum prices**.
- ~56% at or below **median prices**; **28%** at or below **25th percentile**.
- Almost **zero MWs** offered at **maximum price** levels.
- Strategy: **Price-taker** behavior; ensures dispatch by bidding low.

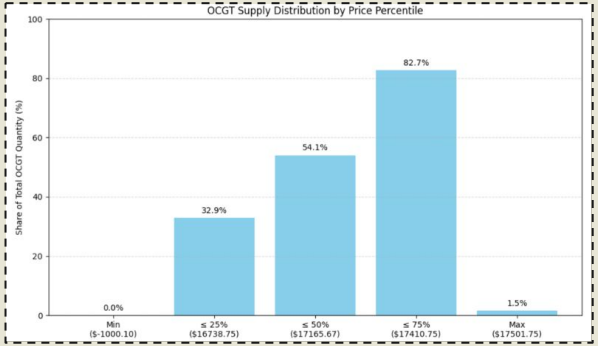
⚡ OCGT (Peaker)

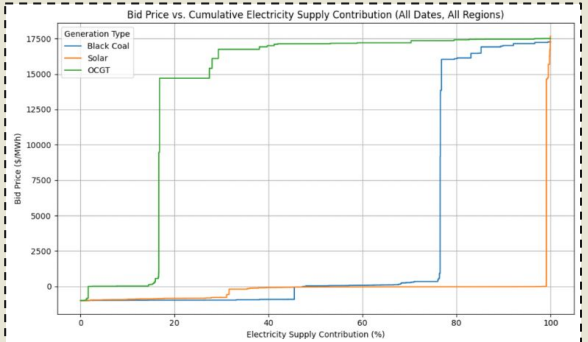
- Majority of MWs bid at **high price bands** (above ~$500).
- Virtually no offers at **negative/minimum price** levels.
- Strategy: Bids **only when profitable**; reflects **peaking usage** pattern.

🏭 Black Coal

- ~30% of electricity supplied at **high price levels**.
- ~70% of MWs supplied at **zero or negative prices**.
- Strategy: Mix of **baseload reliability** and **price-exploitative** bidding.







Time of the Day Dependencies

🔋 OCGT – Peaking Generator Behavior

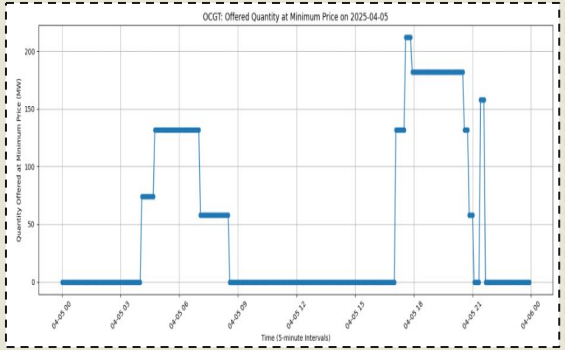
- Minimal bids at min price except in morning (05:00–08:00) and evening (17:00–21:00).
- Sharp reactive spikes (~210 MW) indicate use during peak demand.
- Consistently high volumes offered at maximum price (~5700–6200 MW).
- **Strategic intent:** Rarely dispatched unless prices spike; acts as supply ceiling.

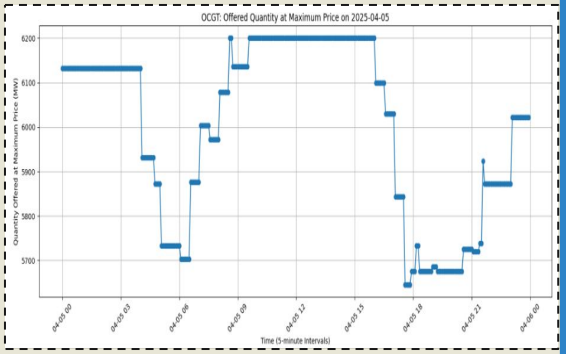
☀️ Solar – Price-Taker & Opportunist Mix

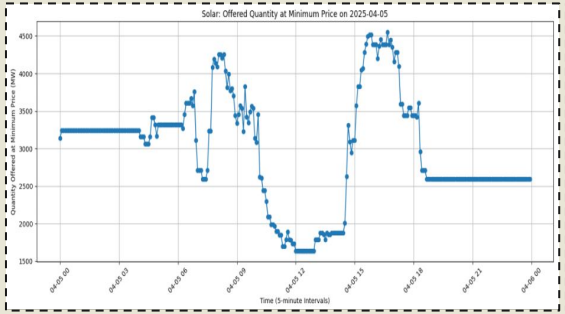
- Majority of output bid at minimum price (~1700–4500 MW) to ensure dispatch.
- Midday spike in max price offers (peaking ~520 MW), aligning with solar output.
- Low/no offers during non-sunlight hours.
- **Strategy:** Base capacity at min price for dispatch; opportunistic high-price bids during peak generation.

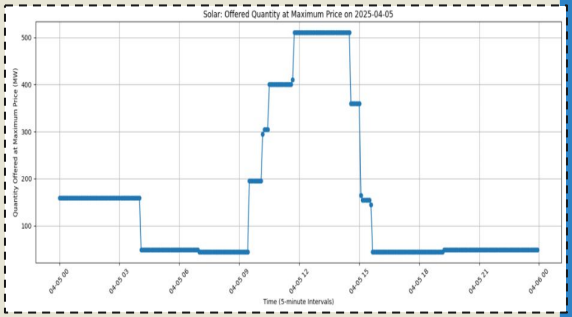
🏭 Black Coal – Strategic Baseload Player

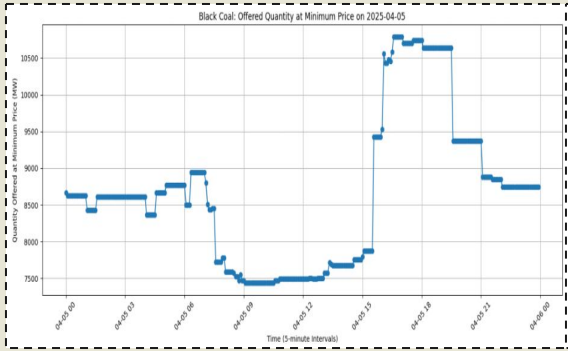
- Steady minimum price bids (~8500–10600 MW), with midday peak.
- Max price bids ramp up early morning and hold till ~15:00 (up to 6200 MW), then decline.
- **Dual strategy: Min price:** Ensure constant dispatch (baseload).
  Max price: Exploit peak pricing opportunities.
- Reflects flexibility to balance market reliability and profit margins.

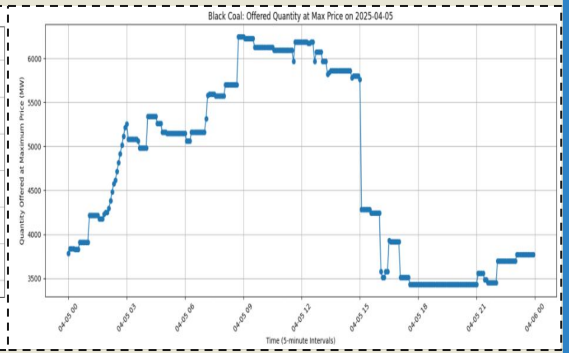










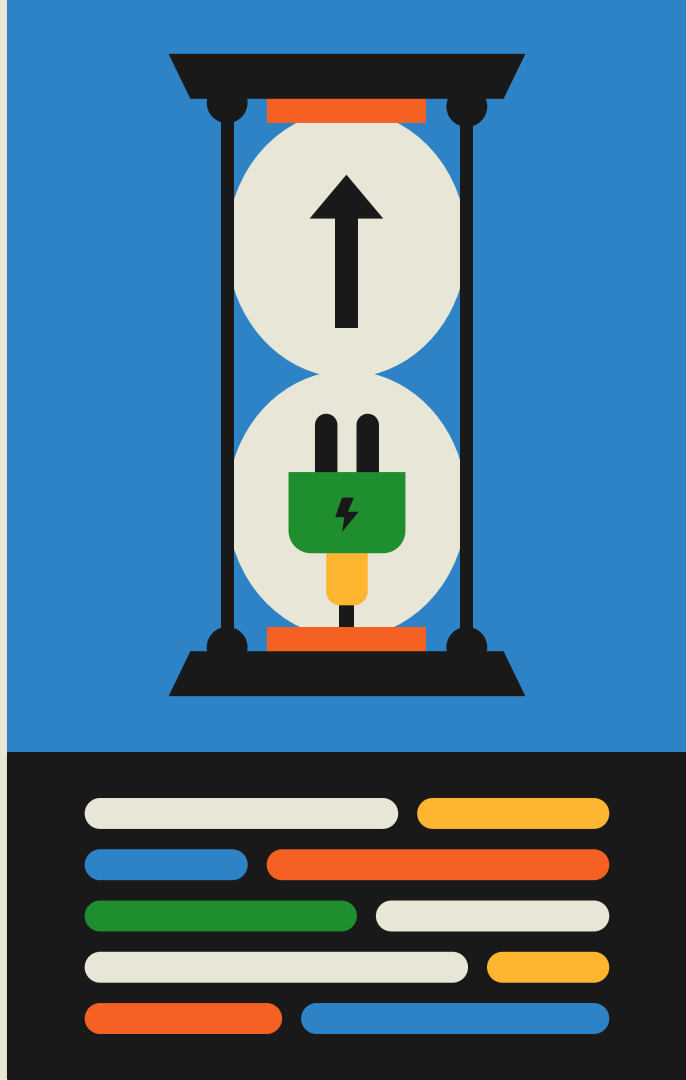


Black Coal Strategic Takeaways

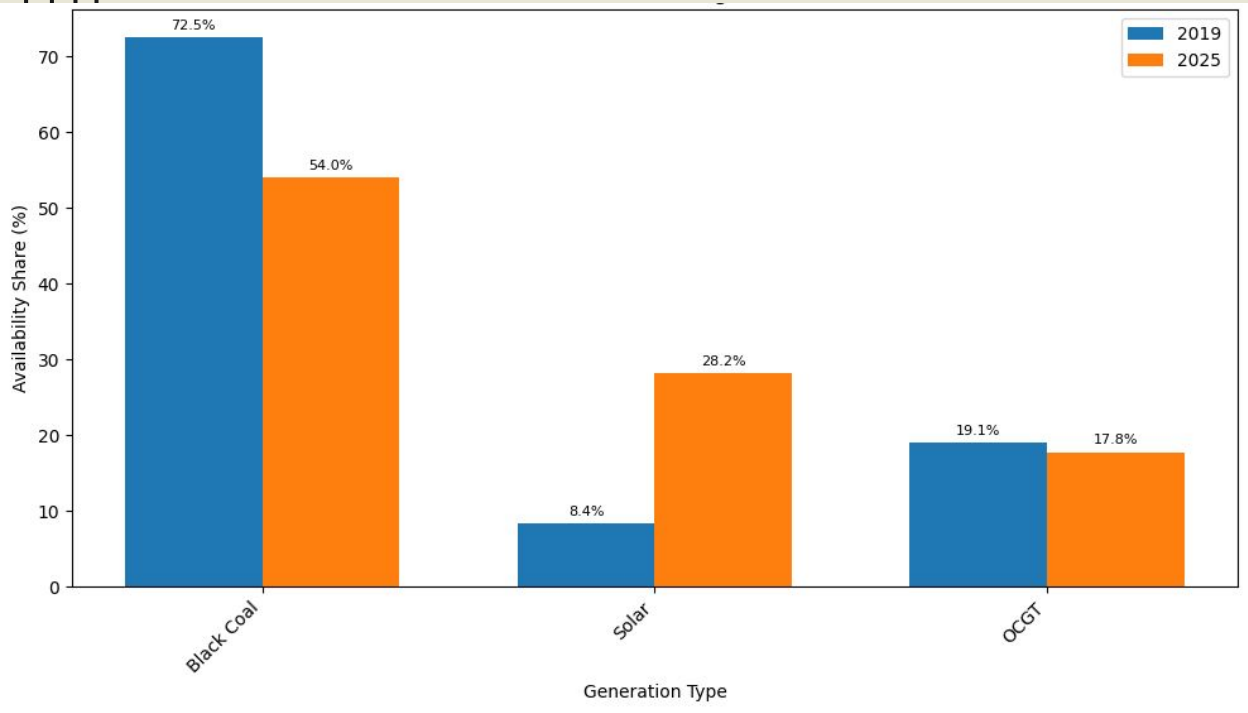
PERSPECTIVES	STRATEGIC OBJECTIVES	
	Minimum Price Bidding	**Maximum Price Bidding**
Market Intent	Secure dispatch	Extract higher margins
Time Sensitivity	Low–Moderate (mostly steady)	High (peaks in daylight/peak hours)
Typical Users	Base-load generators or contracts with obligations	Traders or generators with flexible units

04

Bidding Behavior Analysis: 2019 vs 2025

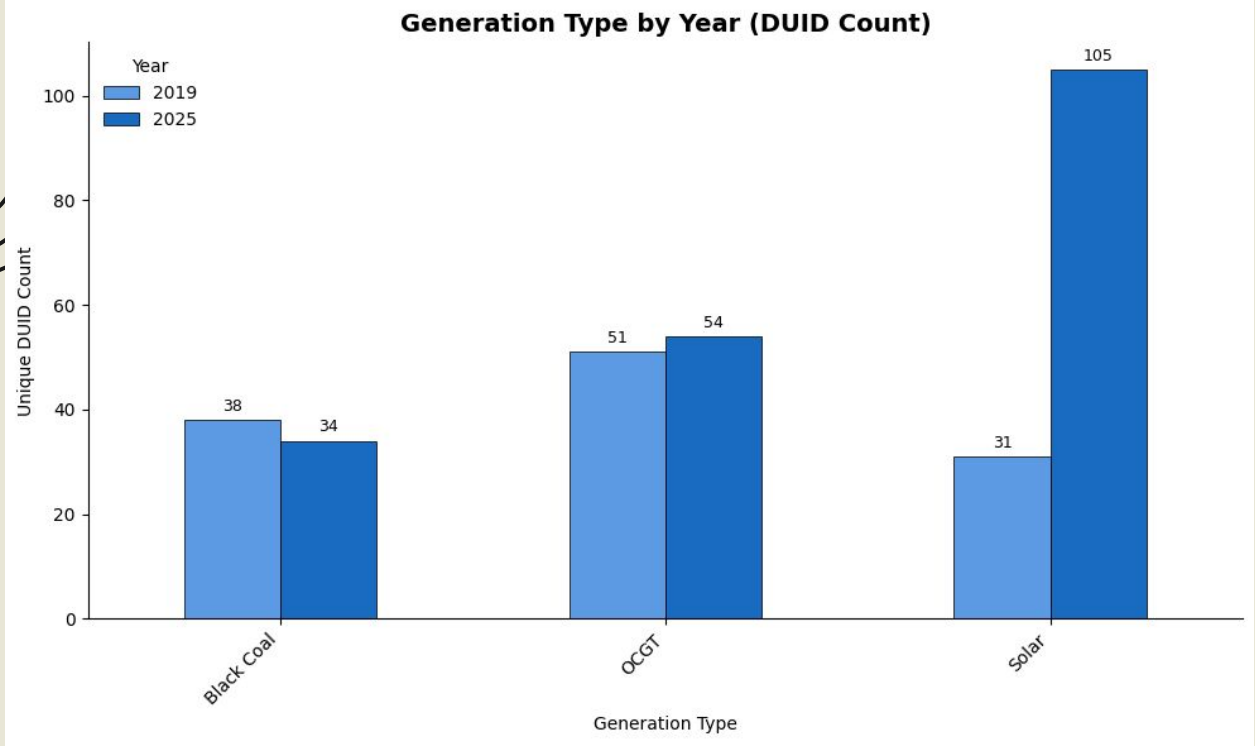


Market Share of total supply by Generation Type



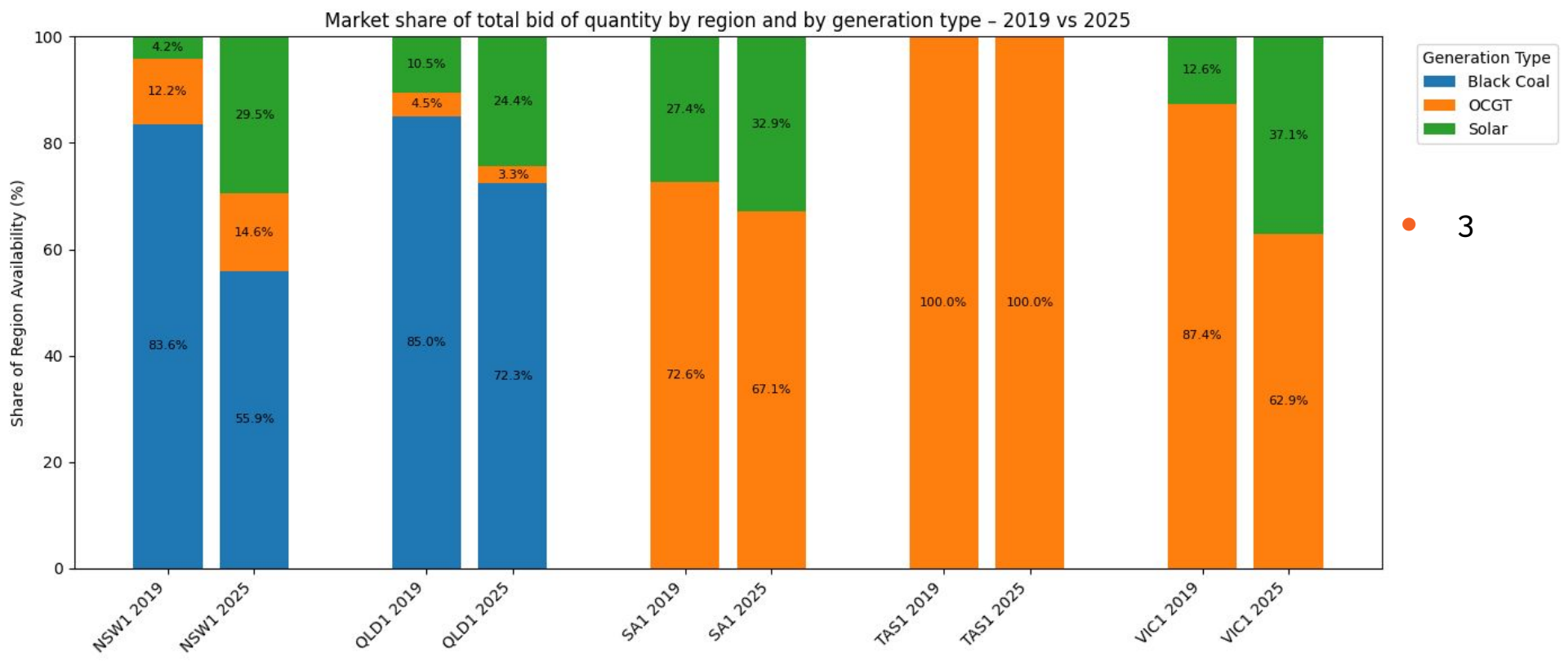
- Solar's bid share more than triples from 8 → 28 %.
- Coal's share drops by almost 19%

Why Solar's market share increased

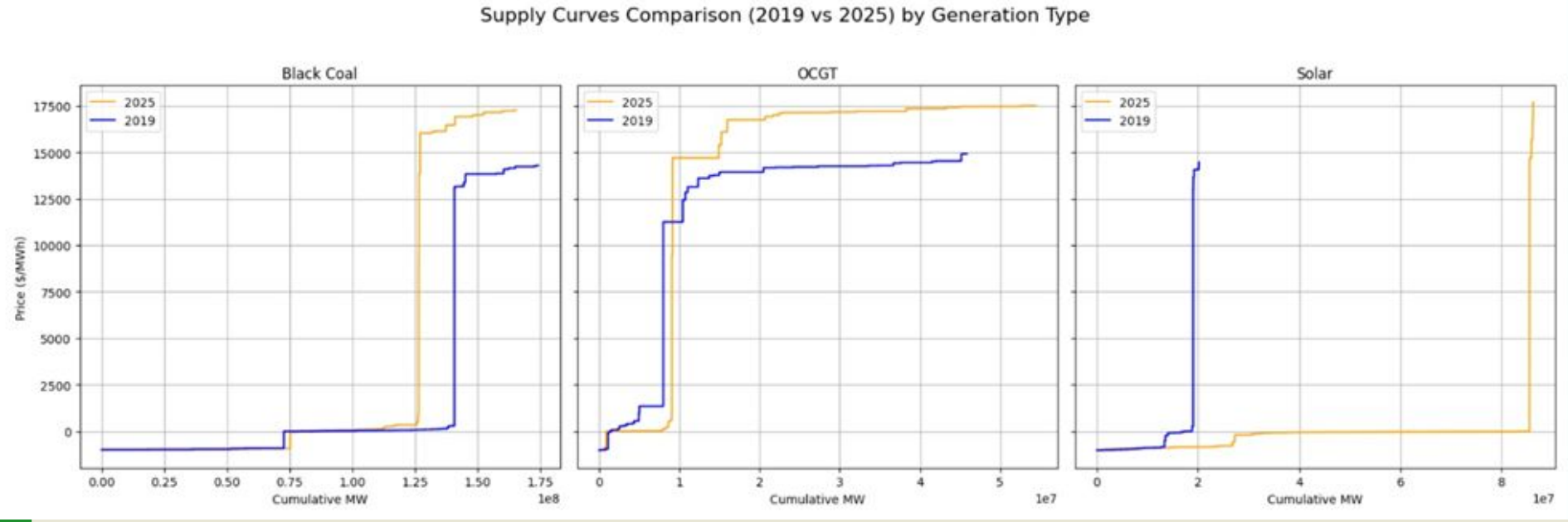


- 3X solar units = the muscle behind the market-share leap.
- Black Coal's and OCGT's number of DUIDs is quite stable

Market share by region and by generation type



Aggregated supply Curve



Black Coal

sharp increase in price at 125 million megawatt

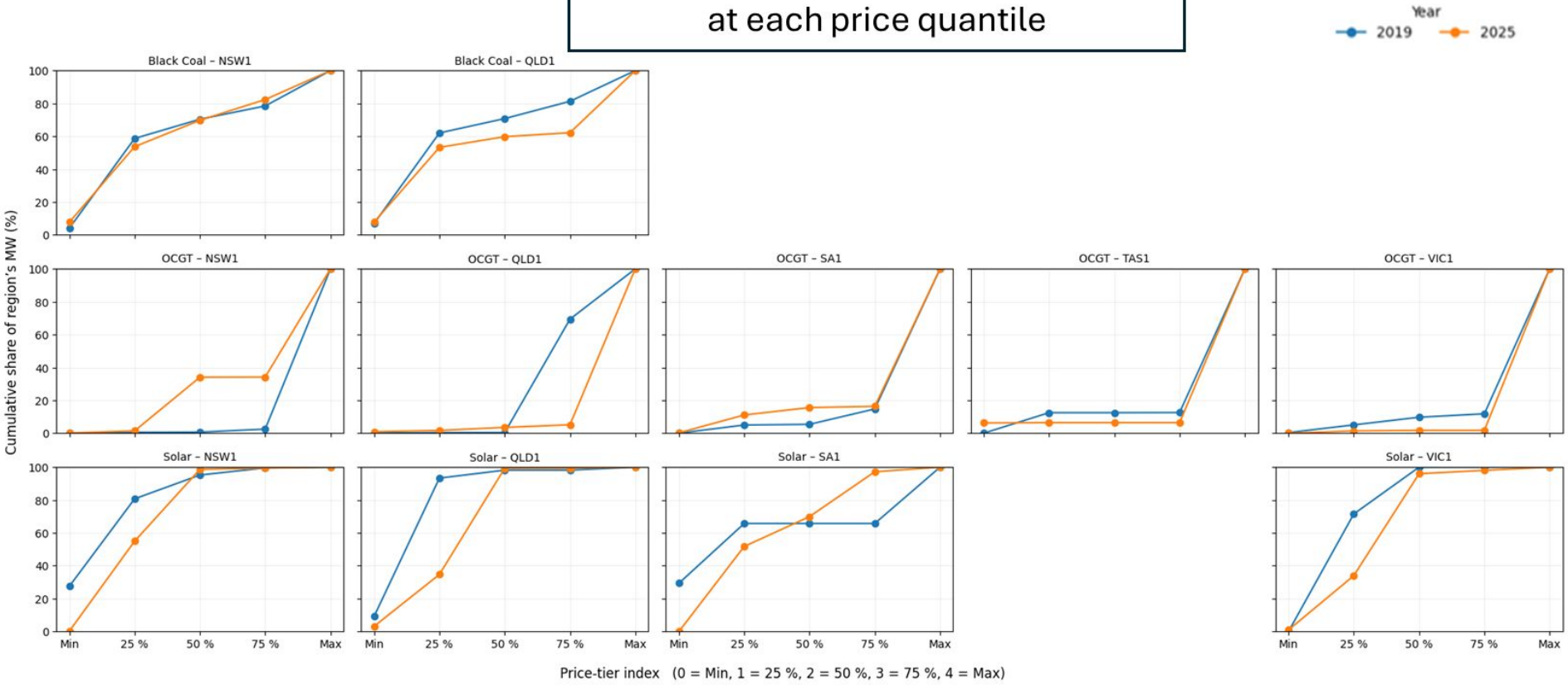
OCGT

Price increase for the same quantity supplied throughout

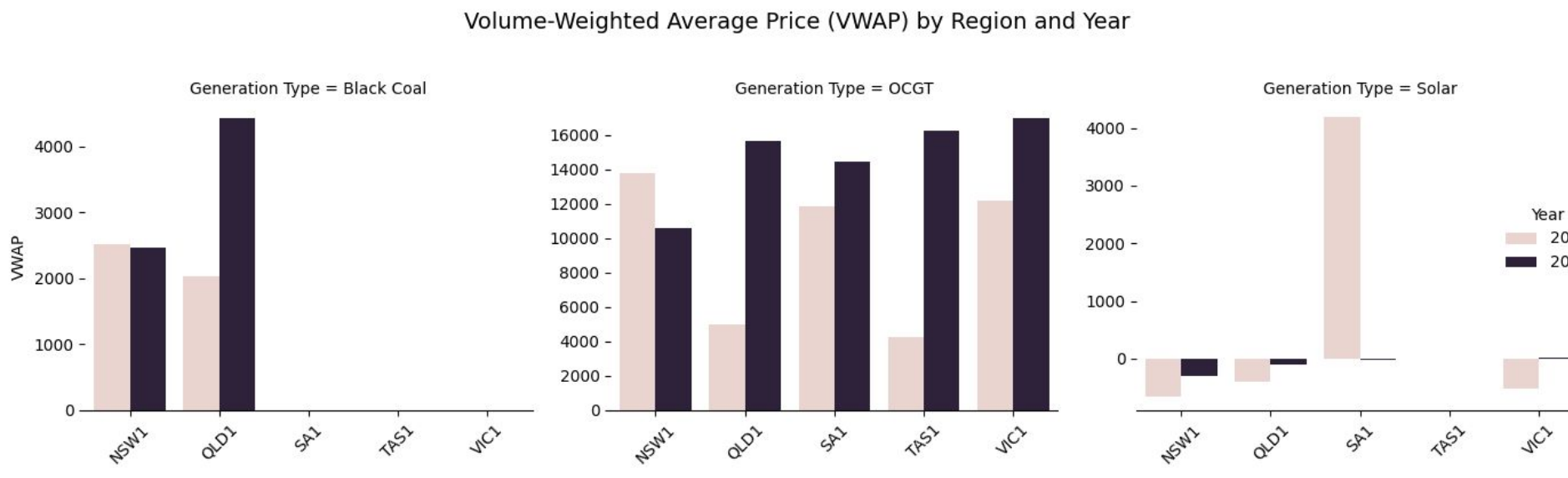
Solar

Still price insensitive but quantity supplied increased

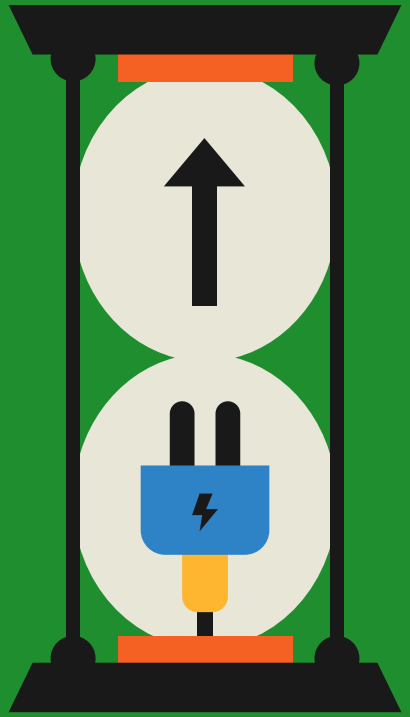
Percent of Quantity supplied (y axis) at each price quantile



Volume Weighted Average Price



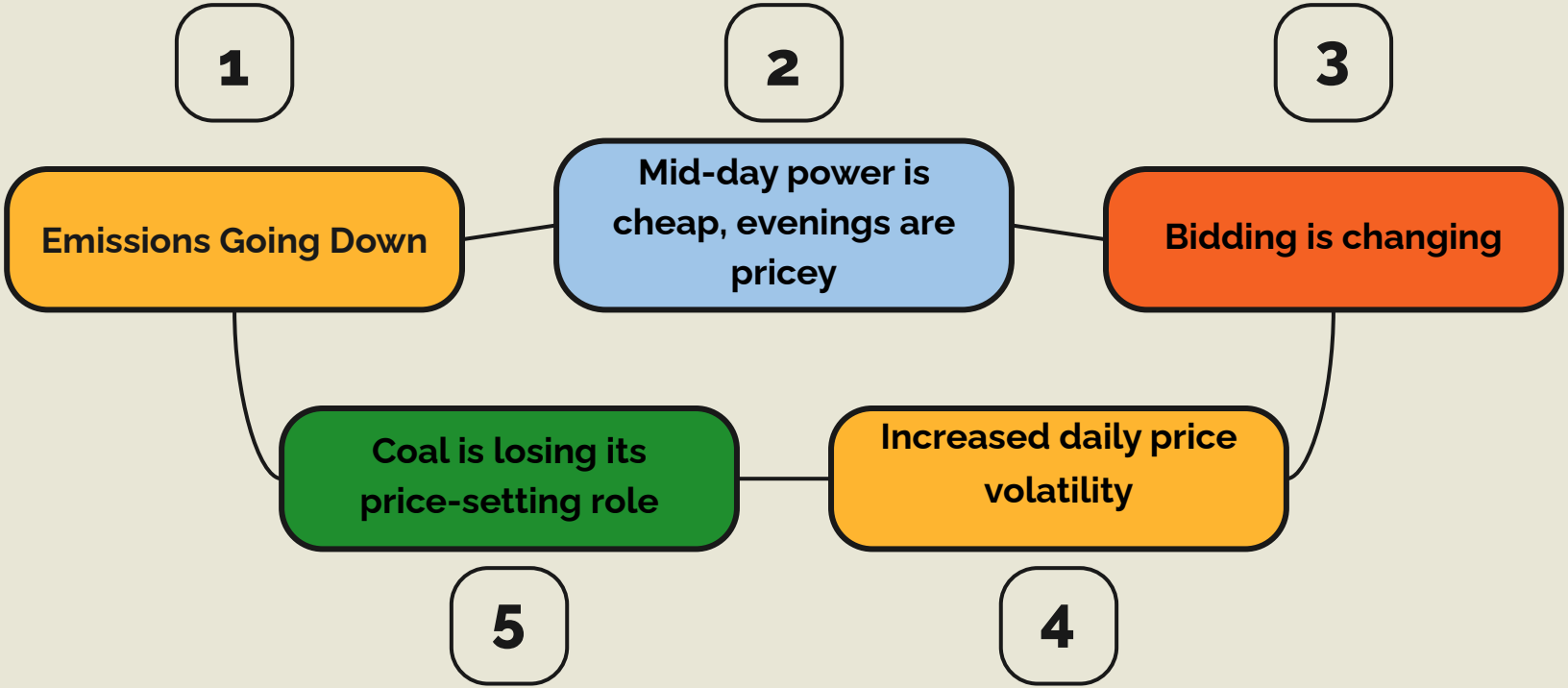
- VWAP follows the trend we have been discussing
- OCGT price increased significantly
- Solar continues to supply at negative price but prices have positively increased significantly



05

Recommendations for Investors

Recap


1
Emissions Going Down
2
Mid-day power is cheap, evenings are pricey
3
Bidding is changing
5
Coal is losing its price-setting role
4
Increased daily price volatility

Solar

- Have at-least a 4 hour storage capacity to supply during peak demand
- Invest in Renewable projects situated within REZs to get the connection queues approved faster
- Negotiate smarter PPAs with Floor Sweeps that favour renewable energy
- Recommended to spend 80-90% of their portfolio in renewable energy

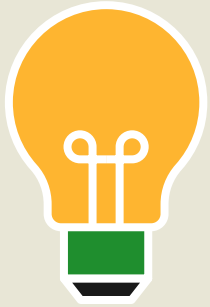
Solar Cont'd

Pair Storage with Transmission

Mid-day prices and emissions crash when solar floods the grid, but they roar back after sunset

Negotiate Floor Sweeps

Negotiate with Resellers to ensure a constant supply at an agreed upon price to avoid selling at negative prices



Smarter PPAs

Include clauses that pay extra for firm evening delivery or bundle storage so you are not hit by the mid-day “solar cannibalisation” effect.

Locate in REZs

Favour declared Renewable energy zones or REZs with committed transmission lines to avoid curtailment and poor marginal loss factors.

Gas Fired Plants

- Invest only in modern open-cycle turbines that can ramp up in short notice
- Capitalise on peak demand, at high prices
- Lock in flexible gas supply contracts
- Use cap options that pay out above a strike, to cover the peaker fuel bill
- Invest only 10-15% of the portfolio, as fuel and carbon cost continue to rise

Gas Fired Plants Cont'd

Open Cycle Generators

Designing for <10-minute start and minimal warm-up fuel aligns the plant with those short scarcity windows.

Investment Ratio

A portfolio slice of roughly 10 % fast-start gas is enough to capture the spike while avoiding idle the risk of mitigating carbon costs

Negotiate CAPs

Covers the rare spikes that a gas peaker relies on. It guarantees enough cash to pay the extra fuel when you must start the turbine.

Flexible Gas supply

Arrange "take-if-called" gas or swap to spot-indexed supply so you pay only when you run

Final Recommendations

Allocate capital:

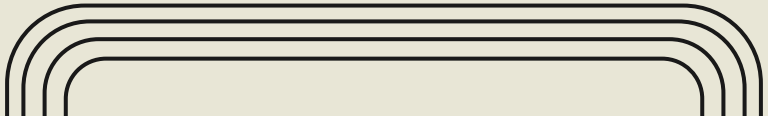
- 80-90 % to firmed renewables in well-connected Renewable Energy Zones (REZs)
- Each project backed by 4-hour storage and shape-aware PPAs

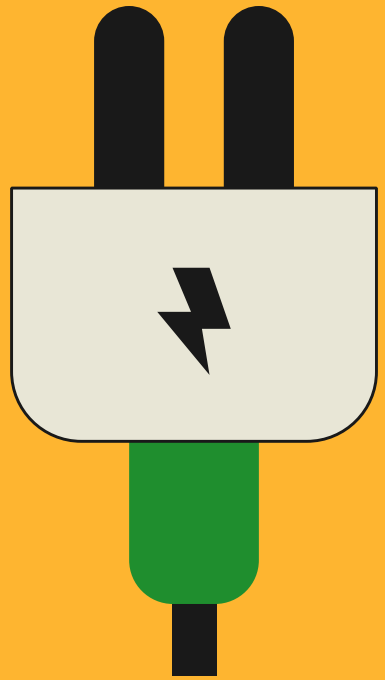
Reserve 10 % for ultra-flexible gas peakers:

- Fast-start units sized for short, high-price peaks
- Secure interruptible fuel and enrol in capacity-firming schemes

Price carbon internally:

- Apply ≥ A$50 / t CO_2-e today, rising to A$80–105 / t by 2030
- Ensures storage-backed solar and efficient gas turbines





THANK YOU!