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EnOS™ Flex

Australia Residential Energy Price Arbitrage Challenge Report.

Discover the financial potential of residential Photovoltaic (PV) and Battery Energy Storage Systems (BESS) investments with this report. Learn how AI-driven predictive control software maximizes returns, unlocking optimal gains in the energy market.

Introduction

Australia stands out globally for its high penetration of residential photovoltaic (PV) systems, with nearly one in three homes equipped with solar panels. This trend shows no signs of slowing down, with an additional 10 GW projected to be installed in the coming years.[1]

This rapid expansion, while beneficial for renewable energy adoption, presents several challenges, particularly in managing the grid.

Excessive solar generation can lead to negative pricing, where operators are forced to pay consumers to use surplus electricity to prevent grid overload, especially during midday when solar output peaks. Addressing these challenges necessitates innovative solutions to enhance grid flexibility and stability.

Battery Energy Storage Systems (BESS) emerge as a critical component in this scenario. BESS can integrate seamlessly with renewable energy sources, providing demand-side flexibility and enabling energy shifting.

Beyond maintaining grid stability, BESS also offers lucrative opportunities for revenue generation through price arbitration. By storing energy durling off-peak periods and selling it during high-demand peak periods, users can take advantage of market price differentials to boost revenue.

Realizing these benefits, however, requires intelligent software solutions. This is where EnOS™ Flex comes into play. Leveraging AI-driven predictive control algorithms and data analytics, EnOS™ Flex enables users to navigate market volatilities effectively.

Through real-time experiments conducted on a typical Victorian house, this report offers insights into both planning and real-time optimization strategies and demonstrates the tangible financial benefits of this integration in terms of cost savings, efficiency gains and additional revenue.

Key Benefits

5.4
cents/ kWh

saved compared to conventional approaches

$123.50

extra revenue in a day secured during price shock events

A payback period of 12 months for Univers' EnOS Flex can be achieved, with 97.9% one-year ROI per year compared with conventional approaches.

[1] Clean Technica, 2023

Highlights

Australia's energy market faces rising volatility and intermittent power sources, requiring innovative management and optimization solutions.

EnOS™ Flex outperforms conventional methods, achieving additional savings of 80c/day or 5.4c/kWh based on simulations.

The Energy Security Board (ESB) is modernizing the national electricity market with Post-2025 reforms to incentivize flexible demand response. [2] [3]

During price shocks, EnOS™ Flex earned an extra $123.50 in a day, showcasing its rapid adaptability.

However, asset owners struggle to capitalize on arbitrage opportunities due to the dual demands of planning and real-time adaptation – solvable with the right intelligent control software.

EnOS™ Flex offers a payback period of 12 months and a one-year Return on Investment (ROI) of 97.9% when compared with conventional methods.

[2] Energy Security Board, 2022
[3] Energy Security Board, 2022

The Challenge

Operating Battery Energy Storage Systems (BESS) might sound straightforward — buy when prices are low, sell when they're high — but in practice, finding the right software and control solution is a major hurdle for BESS owners.

The complexity lies in the need for foresight to seize arbitrage opportunities, often 24 hours ahead, while also navigating the unpredictable nature of price fluctuations, energy demand, and intermittent generation in real-time. Existing solutions struggle to meet these demands effectively, leaving asset owners searching for a reliable and adaptable product.

Our Product

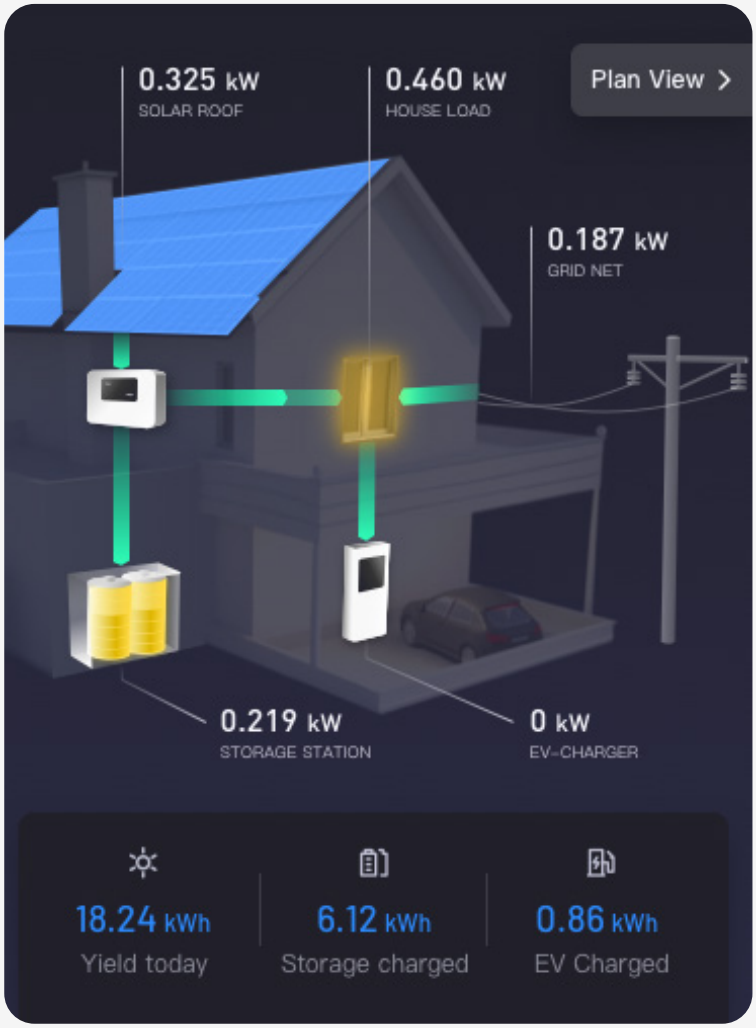
EnOS™ Flex is an AI-driven intelligent software to maximize the value of various distributed energy resources (DER) including BESS. It forecasts and orchestrates multiple DERs with seamless collaboration between cloud look-ahead optimization and real-time predictive control at edge.

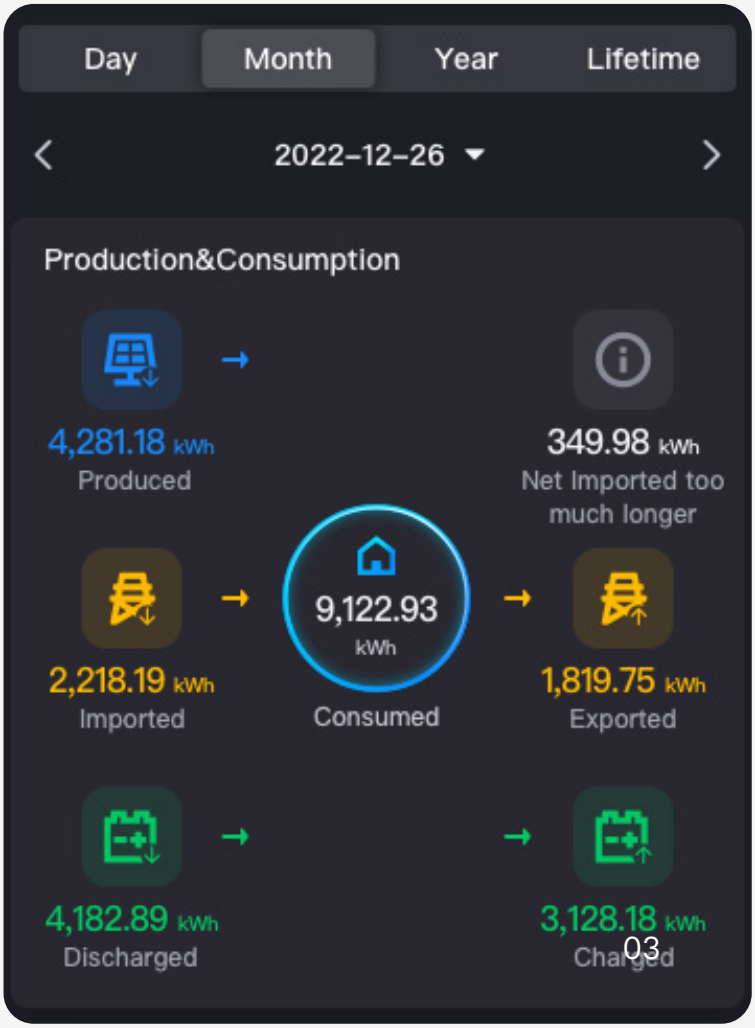
EnOS™ Flex enables smart control, allowing users to save costs and potentially earn revenue by efficiently managing energy usage and selling excess energy back to the grid. By utilizing real-time and intra-day planning, EnOS™ Flex forecasts future energy needs, optimizing resource usage based on factors like cost and potential revenue.

Additionally, it makes real-time decisions to prevent renewable curtailment and system overload, seamlessly integrating with larger energy systems such as virtual power plants to enhance overall efficiency and performance. Key features include customizable monitoring displays, AI forecasting algorithms, optimization for energy utilization, and real-time AI predictive control for smooth operation.

Of particular importance for this study is the patented integration within EnOS™ Flex between its rolling intraday planning (EnOS™ Flex Intraday) and real-time optimization control (EnOS™ Flex Real-time). The intraday planning aspect continuously generates 24-hour plans every thirty minutes, utilizing forecasts to anticipate energy needs.

Meanwhile, the real-time optimization and control component adjusts BESS operations nearly instantaneously, leveraging the most up-to-date market and instrument data. This integration ensures dynamic and responsive management of energy resources, optimizing performance in fluctuating market conditions.





The Study

In this study, we compare the performance of EnOS™ Flex with a conventional rule-based approach for BESS operation. Figure 1 illustrates the optimization workflow in EnOS™ Flex, leveraging both real-time and forecast data to determine optimal setpoints for distributed energy resources (DERs). In contrast, the conventional rule-based approach, as shown in Figure 2, relies solely on real-time data, and lacks lookahead capability and market price considerations. It is worth noting that the rule-based approach requires customization whenever there is a setup change, such as incorporating different types of DERs, which adds complexity to the process.

We simulated the operation of a grid-connected 10kW rooftop solar system paired with a 5kW/10kWh Battery Energy Storage System (BESS) operated by EnOS™ Flex for a typical Victorian household consuming 430kWh of energy per month during January and February 2024. The simulation assumed that the BESS could both import and export energy to the grid at wholesale spot prices accessed through a retailer, creating opportunities for the customer to participate in price arbitrage.

The operation of the BESS was simulated using actual household load and photovoltaic (PV) generation data, along with historical price forecasts and actual wholesale spot prices provided by the Australian Energy Market Operator (AEMO).

The simulation period covered regular days without significant grid incidents, as well as a specific extreme price event on February 13th, 2024. To ensure realistic results, only market data available at the time of decision-making was utilized, preventing any hindsight optimization.

Figure 1. EnOS™ Flex Optimization Methodology.

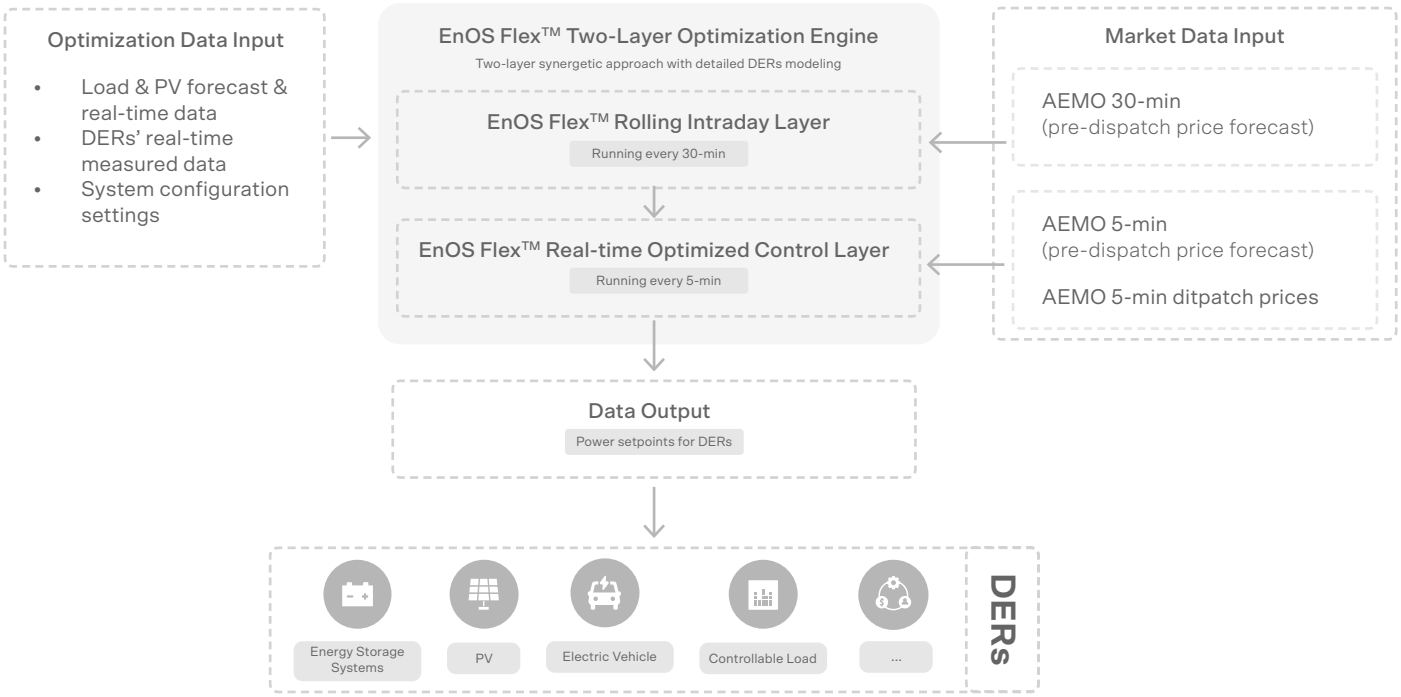


Figure 2. Conventional Rule-Based Approach.

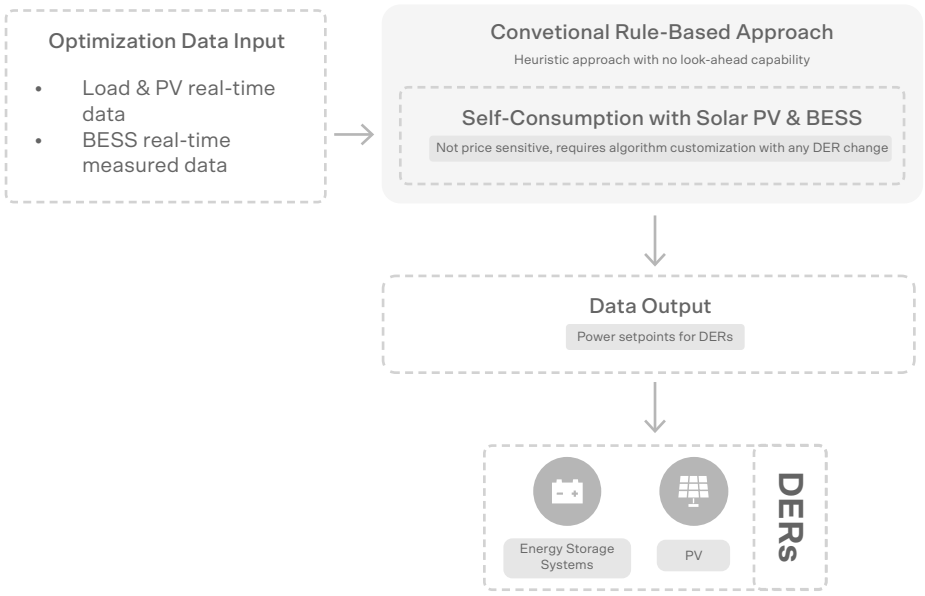


Figure 3. EnOS™ Flex Revenue vs. Rule-Based Approach
(Jan-Feb 2024, excluding Feb 13th extreme price event).

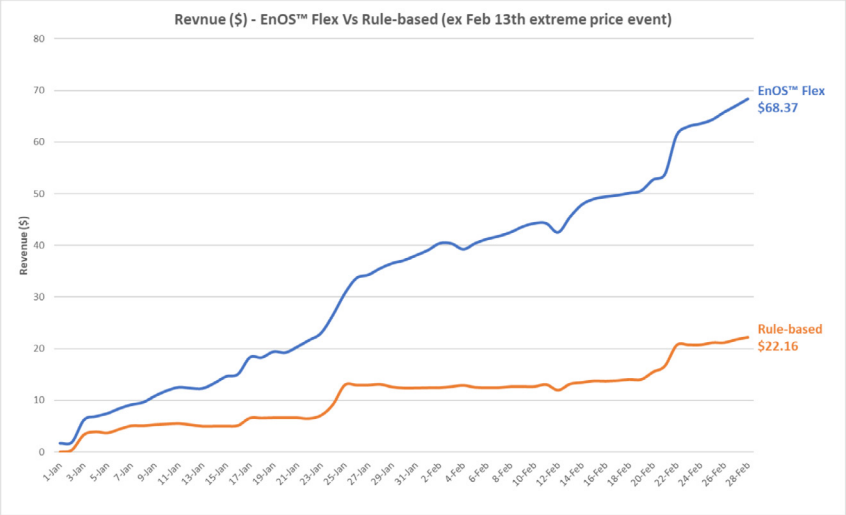


Figure 3 illustrates the cumulative revenue secured with EnOS™ Flex compared to the conventional rule-based approach during the same period, excluding the extreme price event on February 13th. EnOS™ Flex enables additional savings of 80 cents per day or 5.3 cents per kilowatt-hour (kWh) compared to conventional rule-based approaches for BESS operation. Moreover, by adapting to real-time volatilities, EnOS™ Flex captures an additional $123.50 in revenue during the extreme price shock of February 13th.

Detailed results highlighting the synergy between EnOS™ Flex's intra-day and real-time optimization over normal days and extreme price events can be found in the Appendix.

These findings underscore the effectiveness of EnOS™ Flex in optimizing energy usage and maximizing cost savings for households.

Cost Benefit Analysis

The cost benefit analysis comparing EnOS™ Flex compared with the rule-based approach is presented in Table 1. EnOS™ Flex is evaluated against the rule-based approach.

EnOS™ Flex demonstrates an impressive payback period of 12 months for software setup. Compared with rule-based approach, a 91.9% ROI per year can be achieved. The payback periods and ROI are calculated based on the following assumption:

- With rule-based approach, the annual revenue of selling electricity is 472 AUD
- With EnOS™ Flex, the annual revenue of selling electricity is 713 AUD
- The annual SaaS fee of EnOS™ Flex is assumed to be 90 AUD, and the one-time set up cost is 150 AUD.

Table 1. Cost benefit analysis for EnOS™ Flex compared with Rule-Based Approach.

Increase in energy selling revenue	Payback period	ROI per year
29%	12 months	97.9%

By using EnOS™ Flex, the payback periods for BESS and PV system can be reduced by 17%, compared with rule-based approach.

The Importance of Real-time Predictive Optimization and Control

During a power outage in Victoria on February 13th, EnOS™ Flex showcased its ability to adapt in real-time, yielding significant benefits. While operating under normal conditions, EnOS™ Flex generated an additional $123.50 in revenue during the outage.

Figure 4 illustrates the discrepancy between pre-dispatch (forecast) prices and dispatch (actual) prices during this period of heightened volatility. Figure 5 provides a detailed insight into EnOS™ Flex's operations during the outage, where prices surged to over $16,000/MWh at 1:20 pm, then reverted to substantial negative prices before stabilizing around 4:30 pm.

Without real-time monitoring and optimization, relying solely on pre-dispatch prices could have resulted in significant costs exceeding $15 within just a few hours, as indicated by the green lines in Figure 5. However, by leveraging real-time optimization and responding to dispatch prices (indicated by the blue lines in Figure 3), EnOS™ Flex successfully captured $123.50 in additional revenues, highlighting the critical importance of real-time adaptation in optimizing energy management strategies.

Figure 4. Lag between Forecast and Actual Prices during Feb 13th outage.

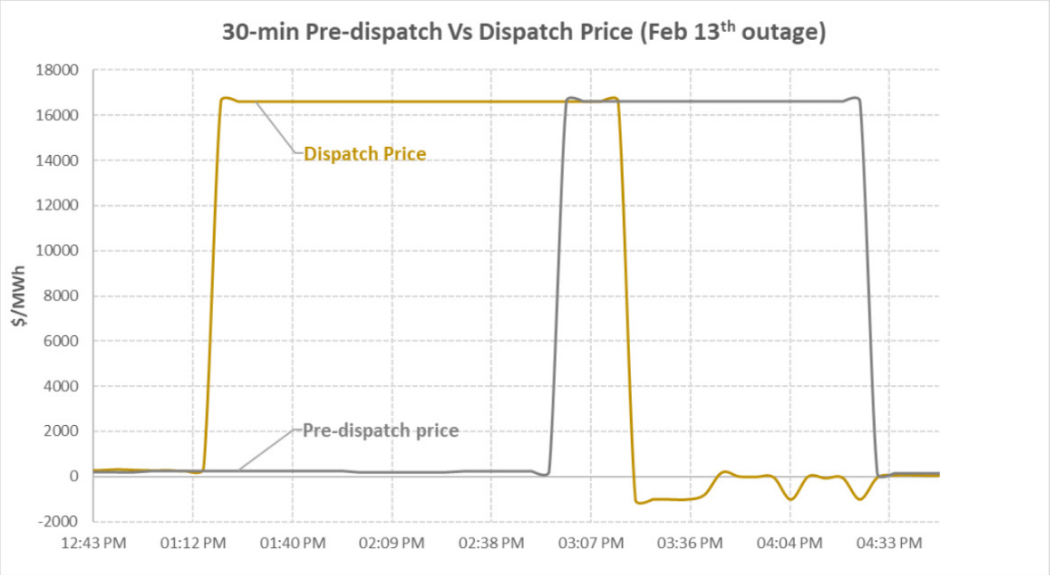
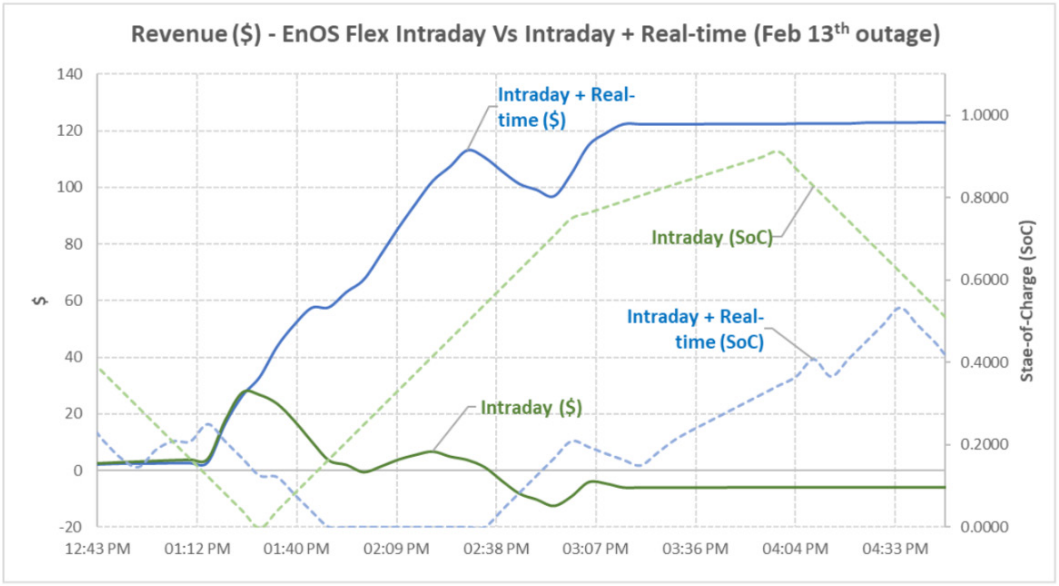


Figure 5. EnOS Flex Intraday vs. Intraday + Real-time optimization during Feb 13th outage.



Conclusion

This report underscores the critical role of integrating Battery Energy Storage Systems (BESS) with rooftop solar in addressing the challenges of the Australian National Energy Market (NEM). Our exploration of the EnOS™ platform demonstrates its ability to navigate market complexities, exploit price arbitrage opportunities, and mitigate forecast uncertainties, offering tangible cost savings and additional revenue streams.

Unlock Cost Benefits

With EnOS™, customers can unlock new revenue streams from energy arbitrage while optimally managing storage and renewable assets. Benefits include: maximizing revenue from energy price fluctuations; reducing overall energy procurement costs; monetizing energy storage investments; and supporting renewable energy integration.

EnOS™ offers a payback period of 12 months for its one-time set-up cost, compared with traditional rule-based control. Additionally, the Return on Investment (ROI) for one year stands at 97.9%. By creating additional revenues compared with traditional rule-based approach, EnOS™ Flex can reduce the payback period of BESS and PV system by 17%.

Operational Benefits

Beyond the financial dimension, the report also shows that substantial operational advantages can be secured with the adoption of EnOS™ Flex. Through simulation and analysis, we've shown the significant benefits when it comes to real-time optimization during both normal operations and extreme price shocks.

Crucially, our study emphasizes the importance of coordinating intraday planning with real-time optimization to maximize efficiency and performance in dynamic market conditions.

EnOS™ Flex stands as a prime example of efficiency and resilience, paving the way for a smarter, more sustainable energy future within the Australian energy market and beyond.

To learn more, contact us at Univers.com/contact-us.

With EnOS™ Flex, users get **more than just a product** – they get a complete energy management solution that's ahead of the curve.

Ready to Take Control?

Contact us at **Univers.com/contact-us** to discover how Univers can revolutionize your energy management strategy.

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Univers provides the world's leading decarbonization system. With over 240 million devices connected and 600 GW of renewable energy managed, our platform serves a global community of over 800 clients. With our extensive experience and broad reach, Univers is the trusted partner in your journey toward Net Zero.

Appendix

Optimizing Intraday Planning for Real-Time Success

Between January 25th and 28th, detailed operations (See figures 6 and 7) illustrate how our intraday planning integrates with real-time optimization to maximize BESS charging capacity during anticipated periods of deep negative prices. This is evidenced by a low State of Charge (SoC) before negative prices, followed by significant revenue increases for both intraday planning and combined intraday + real-time optimization strategies.

Despite facing significant volatilities and forecast errors (Figure 8), real-time optimization further enhances revenue gains by leveraging these conditions.

Figure 6. EnOS Flex Intraday vs. Intraday + Real-time Optimization Operations (Jan 25-28).

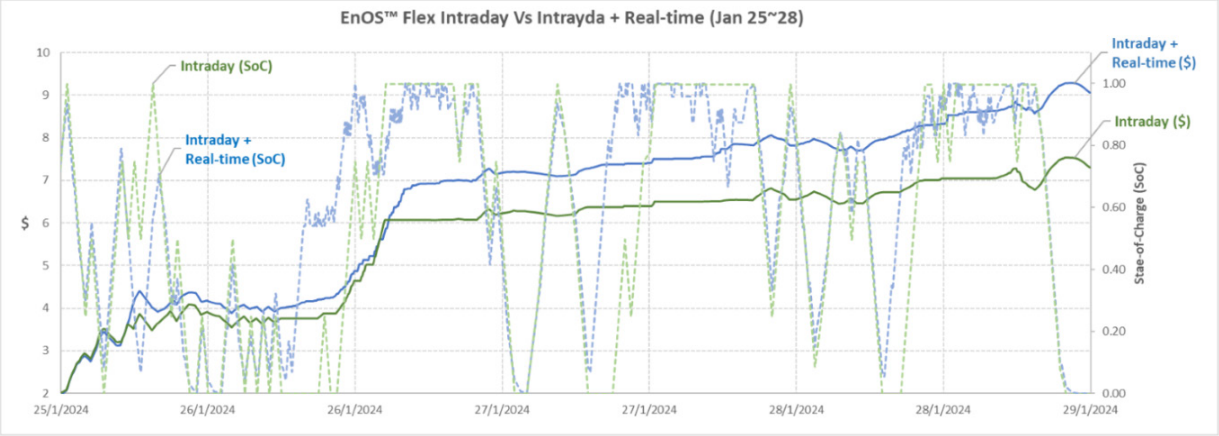
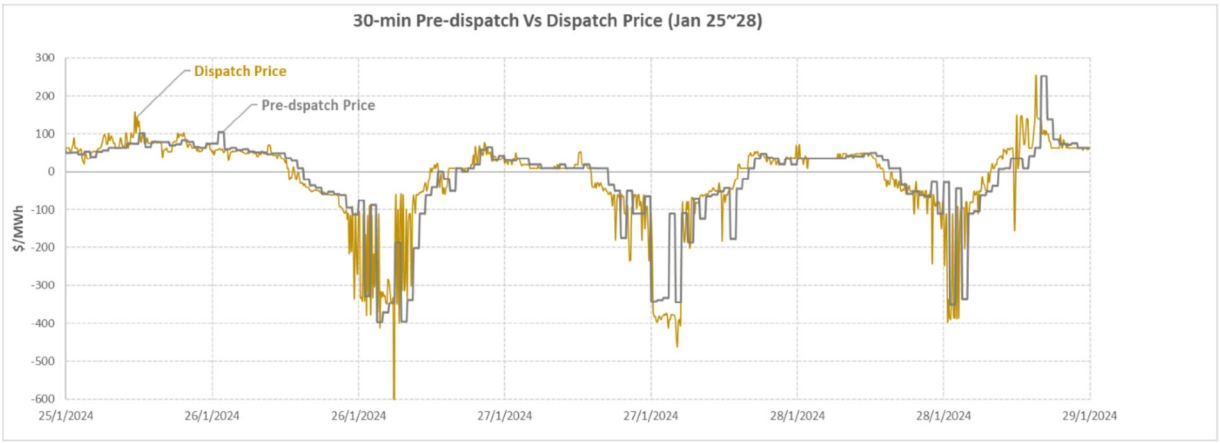
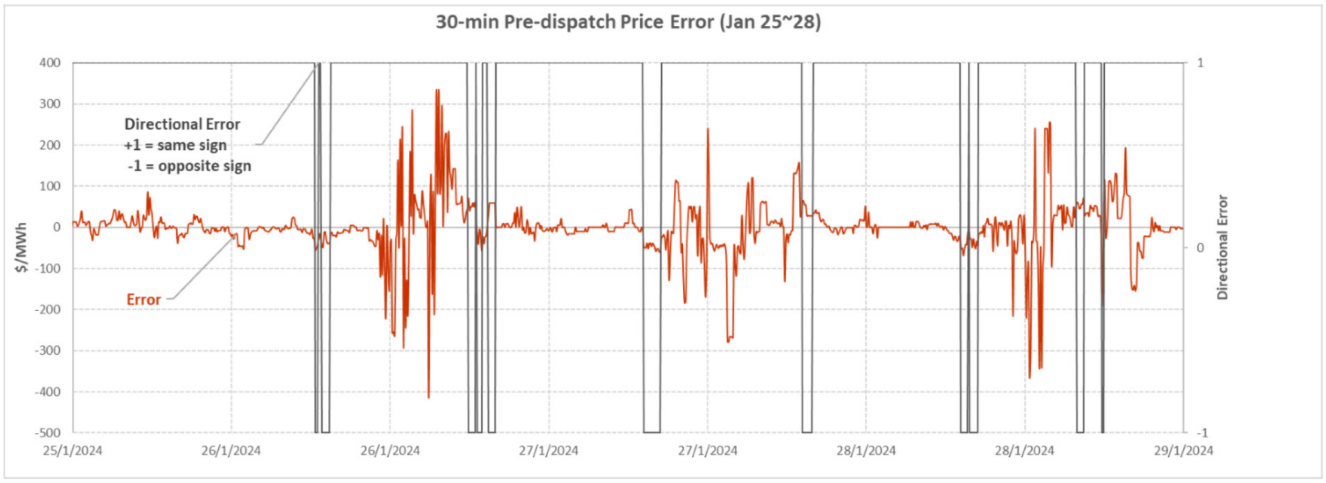


Figure 7. Forecasted and Actual Prices Comparison (Jan 25-28).



The true value of real-time optimization within EnOS™ Flex lies in its seamless coordination with intraday planning, enabling proactive decision-making to capitalize on forecasted price fluctuations.
This coordination provides the foresight necessary to exploit opportunities such as anticipated price peaks in the mornings and evenings, as well as potential negative pricing during the day. Without this, the system would miss critical opportunities for maximizing revenue.

Figure 8. Forecast errors (Jan 25-28).



Additional Benefits During Extreme Price Shocks

During an extreme price shock in Victoria on February 13th, EnOS™ Flex showcased its real-time adaptability, yielding significant benefits. Including this event in the results, EnOS™ Flex generated an additional $123.50 in revenue.

Figure 9 illustrates the gap between forecasted (pre-dispatch) and actual (dispatch) prices during this period of heightened volatility. Figure 10 details EnOS™ Flex's operations during this event, where prices surged to over $16,000/MWh at 1:20 pm, then dropped to substantial negative prices before stabilizing around 4:30 pm.

Without real-time monitoring and optimization, relying solely on pre-dispatch prices could have resulted in significant costs exceeding $15 within a few hours, as indicated by the green lines in Figure 10. However, by leveraging real-time optimization and responding to dispatch prices (indicated by the blue lines in Figure 10), EnOS™ Flex successfully captured an additional $123.50 in revenue. This highlights the critical importance of real-time adaptation in optimizing energy management strategies.

Figure 9. Lag between Forecast (pre-dispatch) and Actual (dispatch) Prices during extreme price event.

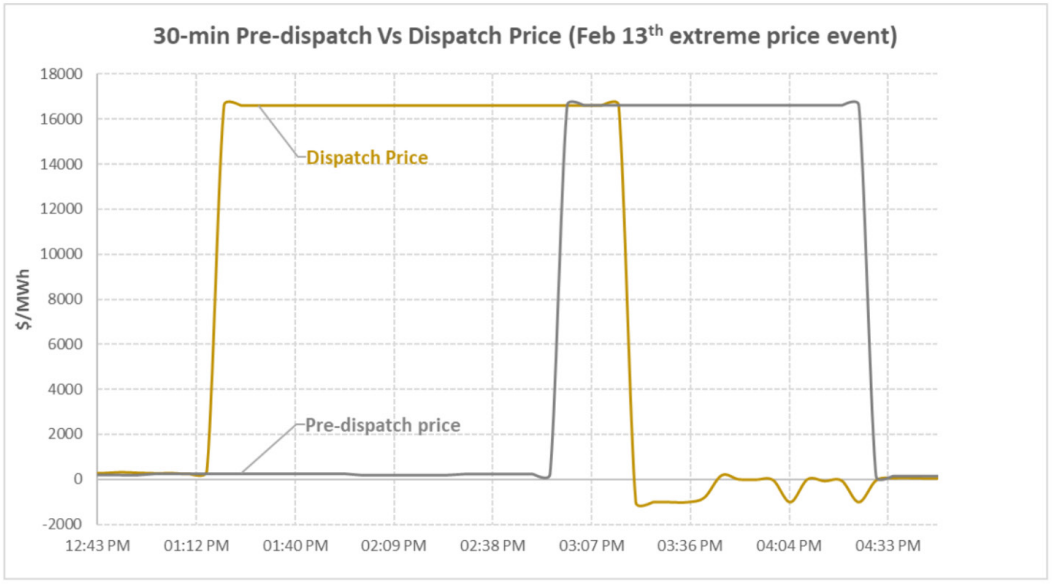


Figure 10. EnOS™ Flex Intraday vs. Intraday + Real-time optimization during extreme price event.