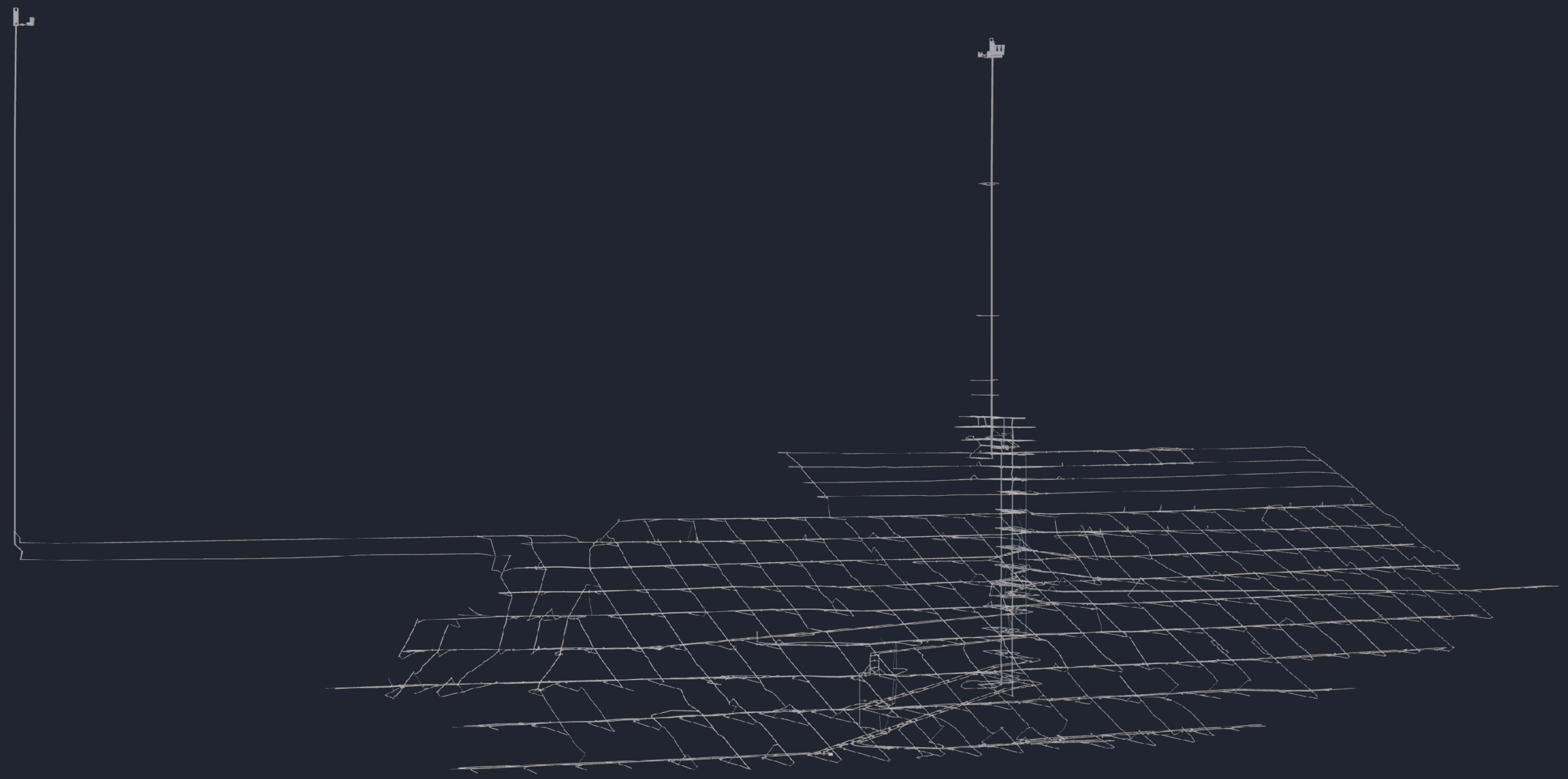
Energy savings achieved through compressed air valve control

ETA Operations and Valterra Platinum

28-10-2025



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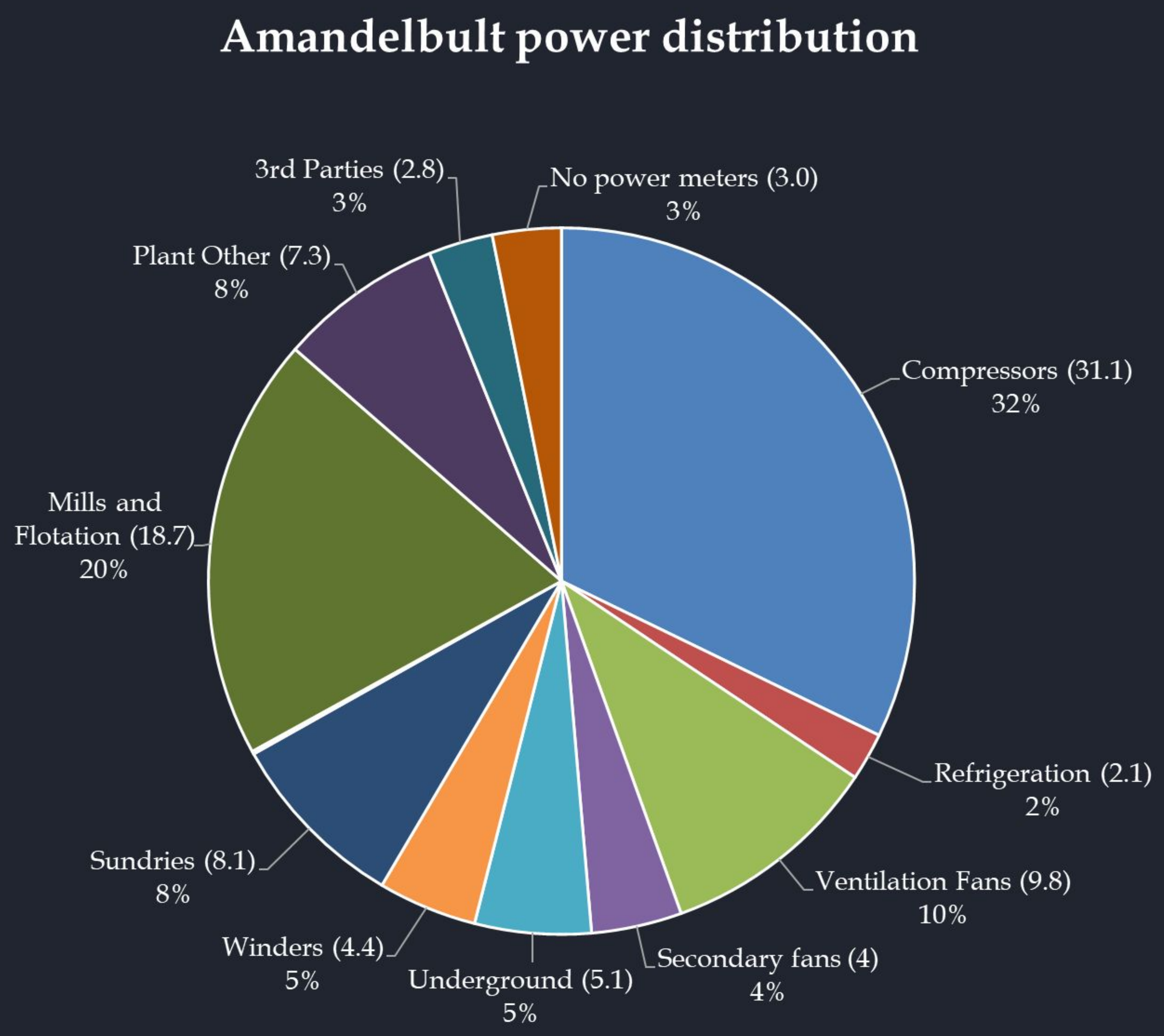


INTRODUCTION

Background

- Challenging South Africa's economic environment.
  - Eskom tariffs increased over 60% in the past five years.
  - Threat to operational sustainability and long-term viability.
- Amandelbult prioritised energy cost-saving initiatives.

Problem statement

- Compressed air represents 32% of total power.
- Compressed air systems are highly inefficient.
  - 50% of energy used for compressed air is lost through waste

Objective

- Reduce energy consumption and operational costs across the compressed air network by:
  - Reviving and optimising pressure control valves.
  - Optimising compressor scheduling.
  - Monitoring and reporting to sustain performance.
  - Reducing energy usage during Eskom's peak demand periods.
  - Lower overall energy costs and improve energy intensity.

Methodology

1. System Characterisation

– Evaluated the compressed air network configuration, pressure requirements, and system demand.

2. Control Valve Reinstatement

– Restored valve functionality to enable pressure regulation.

3. Pressure–Demand Alignment

– Match compressor air supply to actual operational requirements for optimised delivery

4. Compressor Scheduling

– Coordinated compressor operation based on system performance and real-time demand.

5. Tariff Strategy Alignment

– Adjusted valve control to coincide with low-tariff periods and minimise peak-cost exposure.

6. Simulation and Validation

– Applied digital simulation tools to test control strategies and validate energy-saving scenarios.

7. Baseline Assessment and Audit

– Conducted system audits and established baseline performance metrics.

8. Performance Monitoring

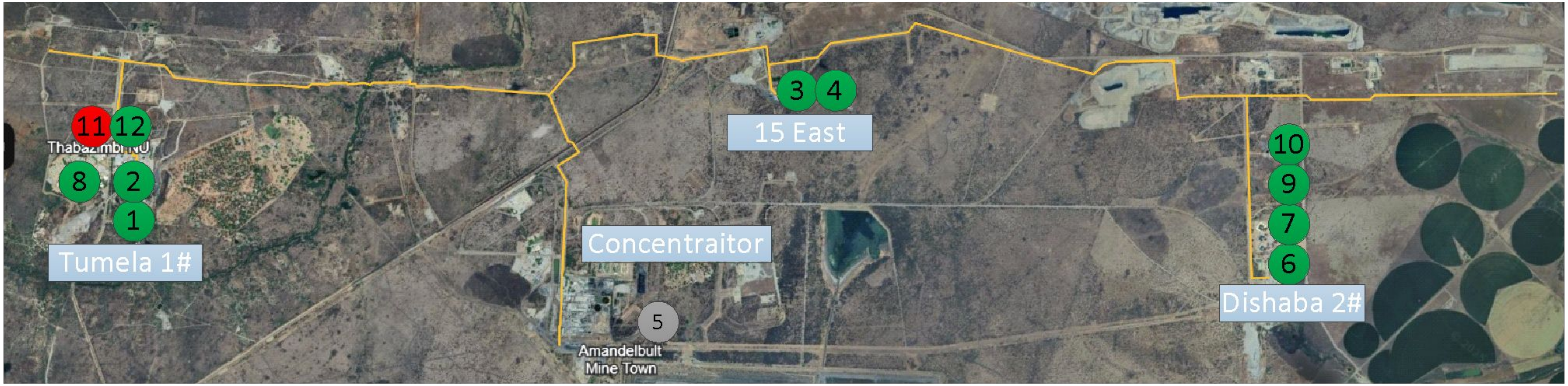
– Implemented ongoing tracking to verify improvements and sustain long-term efficiency.

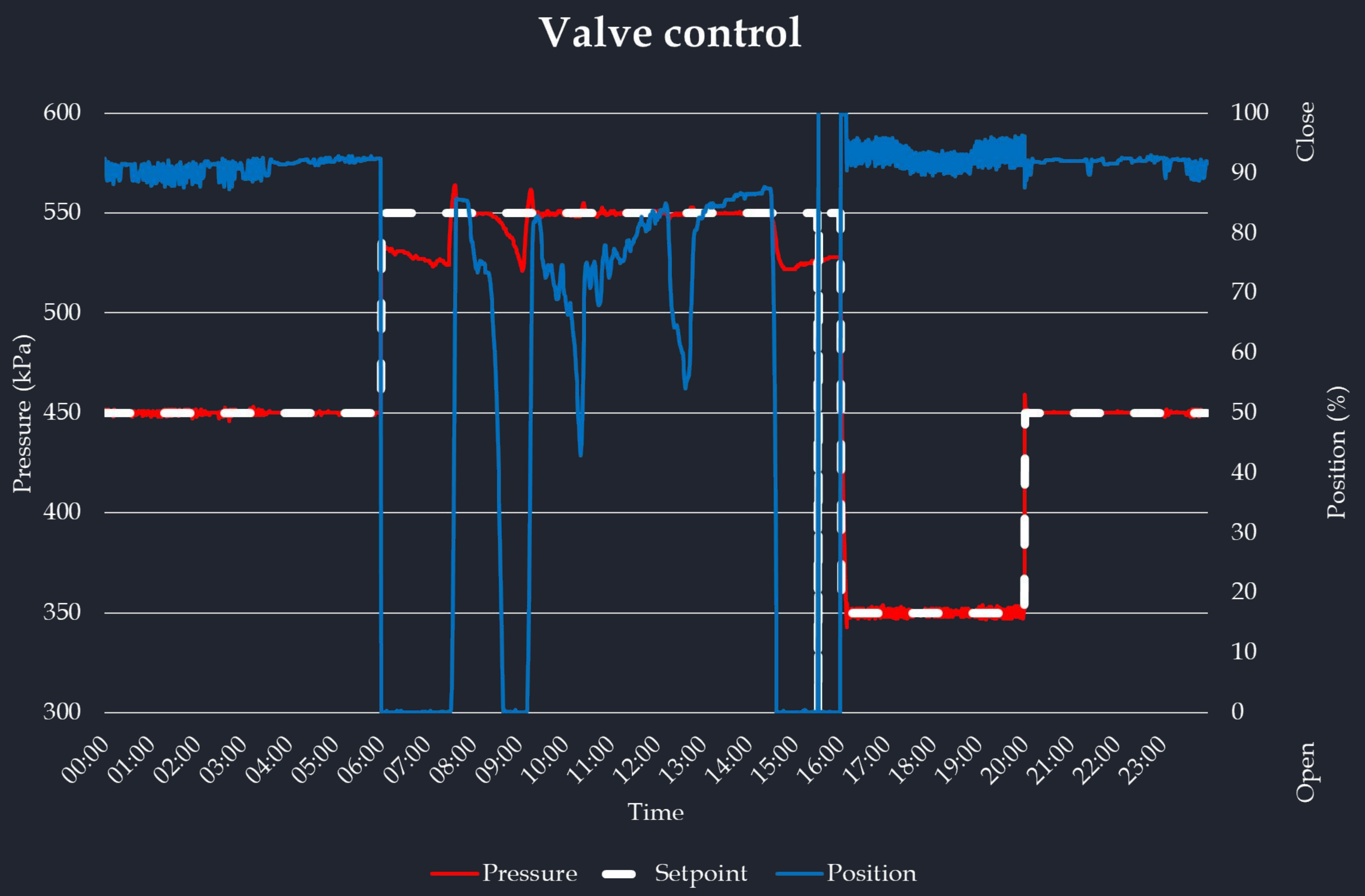
Methodology

System Characterisation

- Site: Amandelbult Mining Complex
- Compressed Air Capacity: 11 compressors
- Installed Power: 55.2 MW
- Rated Flow: 344 680 CFM
- System Pressure Requirement: 500 kPa
- Peak Demand: 170 000 CFM
- Network Length: >25 km of interconnected pipelines

💡 *The system supplies compressed air to both surface and underground operations, making it one of the largest single energy consumers at the complex.*

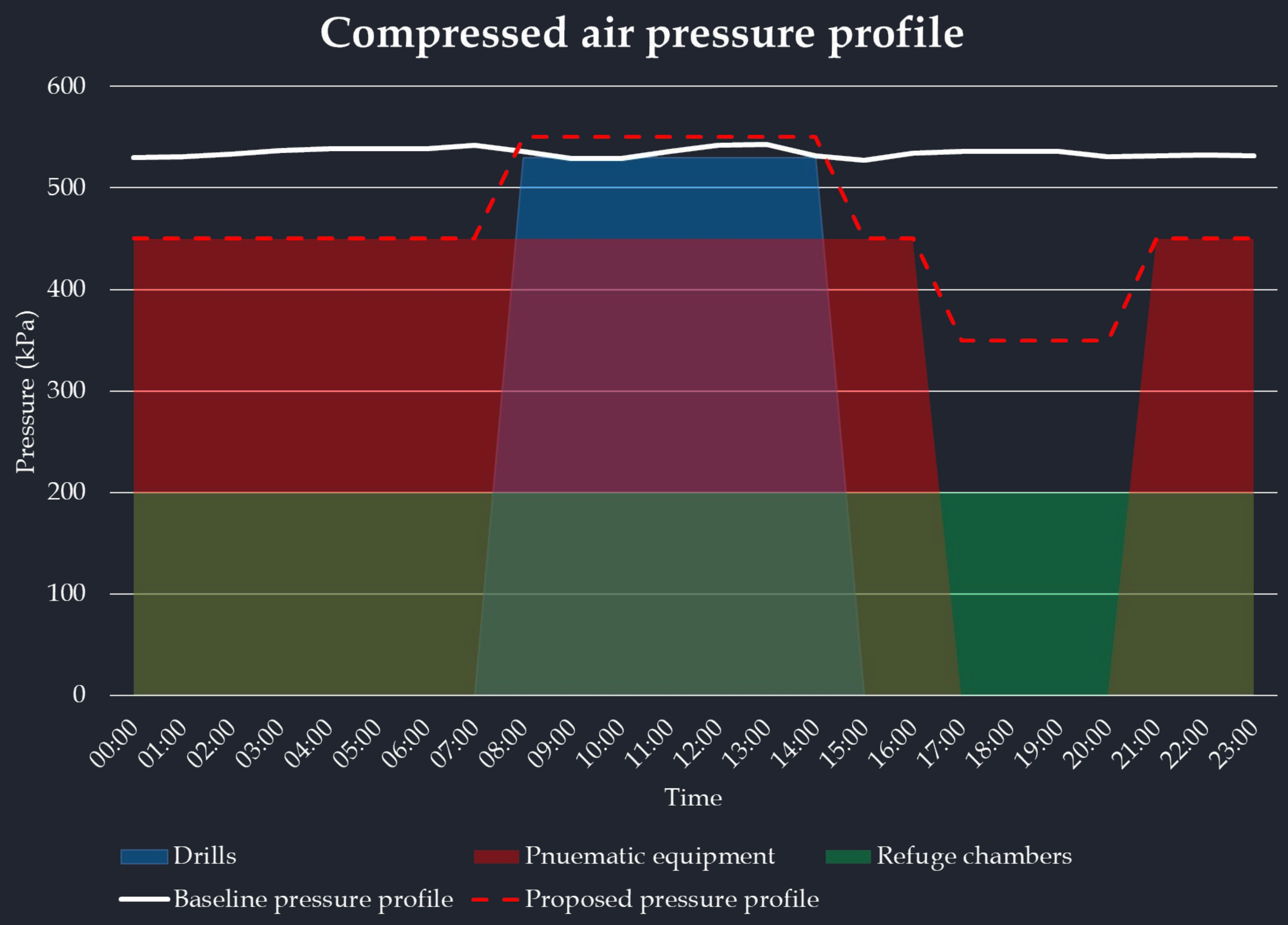




Methodology

Reinstatement of old control valves

- Control valves at multiple locations to be reinstated and commissioned.
- Control valves enable dynamic adjustment of the supply air pressure to meet changing demand.
- Benefits:
  - Maintains optimal pressure
  - Reduces air leaks
  - Improves energy efficiency
- The valves are operated pneumatically based on a pressure setpoint.



Methodology

Pressure supply and demand matching

- Previously: air supplied at an average of 550 kPa to the main ring.
- With control valves: pressure regulated based on demand.
- End-user pressure requirements are critical when reducing system pressure
- Key air consumers:
  - Drilling operations
  - Refuge chambers
  - Pneumatic equipment (e.g., loaders)

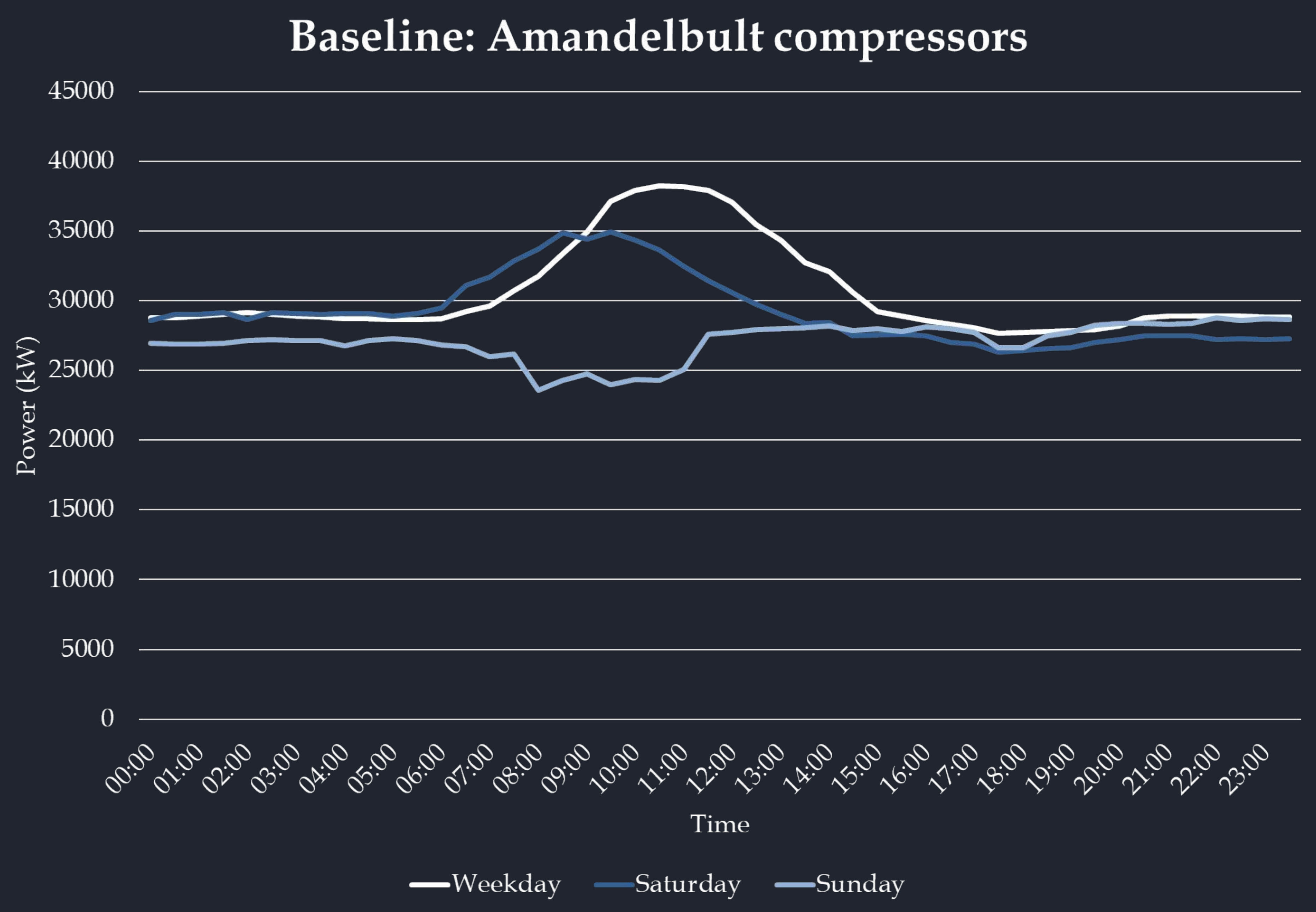
Methodology

Compressor scheduling

- Each site independently controlled its compressors.
- Interconnected network: actions at one site affect the entire system
- Issues without coordination:
  - Oversupply of compressed air
  - Unnecessary cycling of compressors
  - Higher energy consumption
- Reinstated control valves changed system dynamics.
- Reduced air demand creates energy-saving opportunities.
- Only achievable through adjusted compressor schedule
- Compressor scheduling adapted to:
  - Daily and weekly shifts
  - Seasonal and production changes

Amandelbult complex compressor start and stop guidelines

Shaft	COMPRESSOR	START TIME	STOP TIME	RUN TIME
TUMELA	1	09:15	12:30	03:15
	2	Off	Off	(Alternating 1 and 2)
	8	Baseload		-
15 East	3	Baseload		-
	4	Baseload		-
Dishaba	5	Baseload		-
	6	Baseload		-
	7	07:30	13:45	06:15
	9	08:30	11:30	03:00
	10	Off	Off	(Alternating 9 and 10)



Methodology

Baseline Data Collection and Audit

- Historical data was used to create the baselines.
  - 2023/01/03 up until 2023/9/11
  - Days where significant data loss occurred were excluded
- Baseline established before system improvements.
  - Compressors 9,10, 11 and 12 were not yet installed.
  - Compressor 5 was operational at the time.
- Used to measure energy savings and performance impact.
- Power profiles created for:
  - Weekdays
  - Saturdays
  - Sundays
- For public holidays, a Sunday average power profile is recommended.
  - Each public holiday will be evaluated, and an appropriate baseline will be used.

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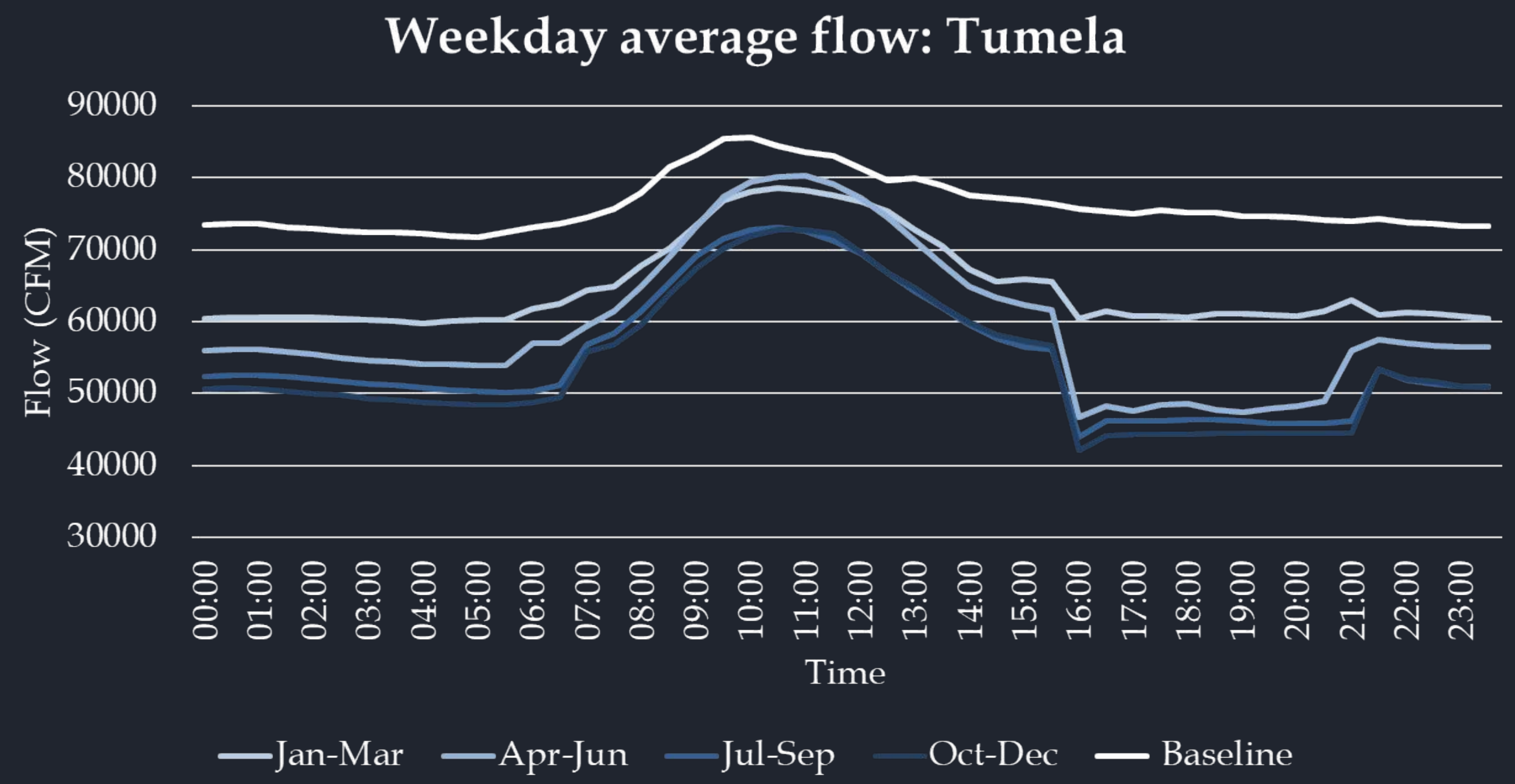
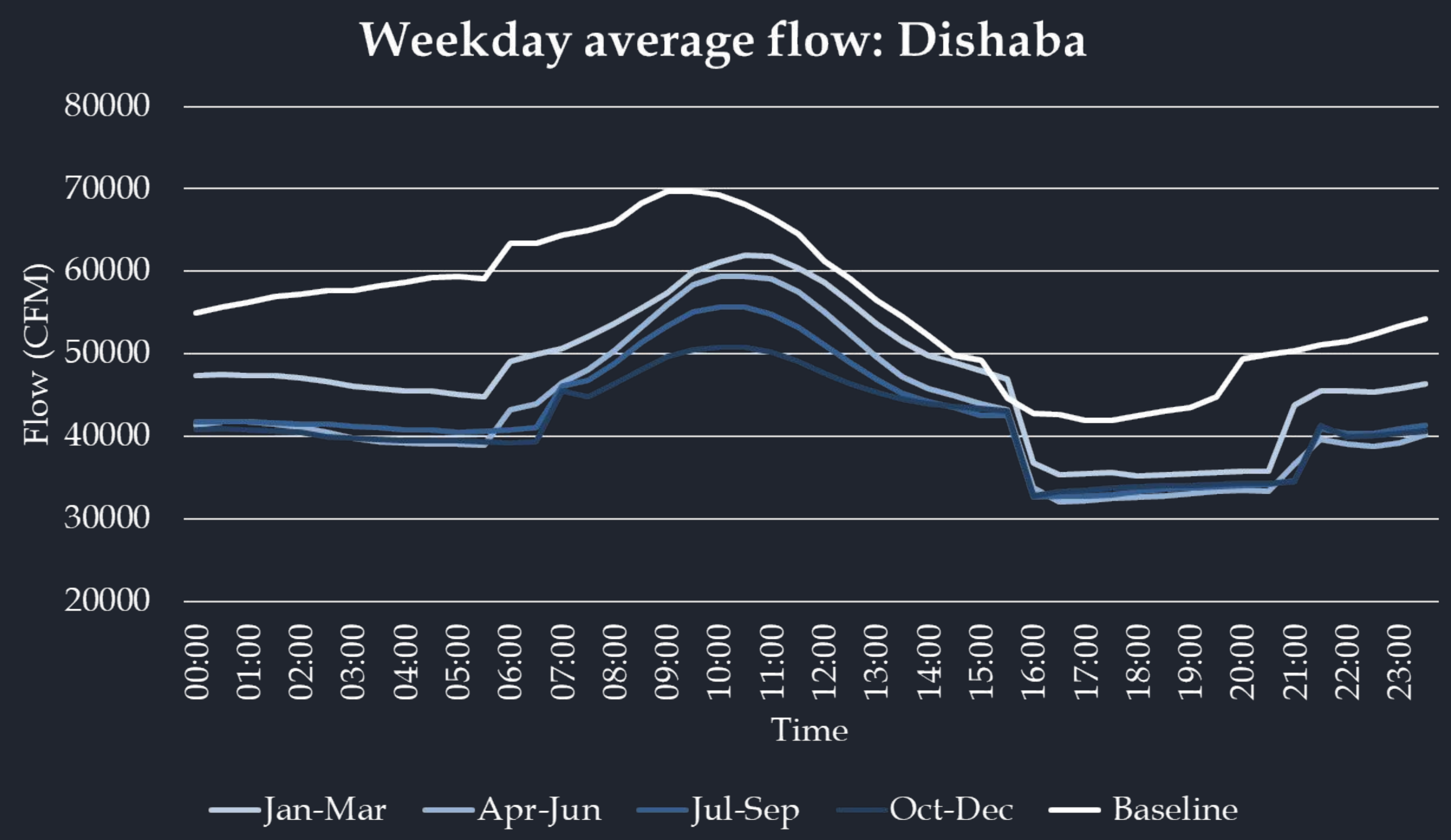




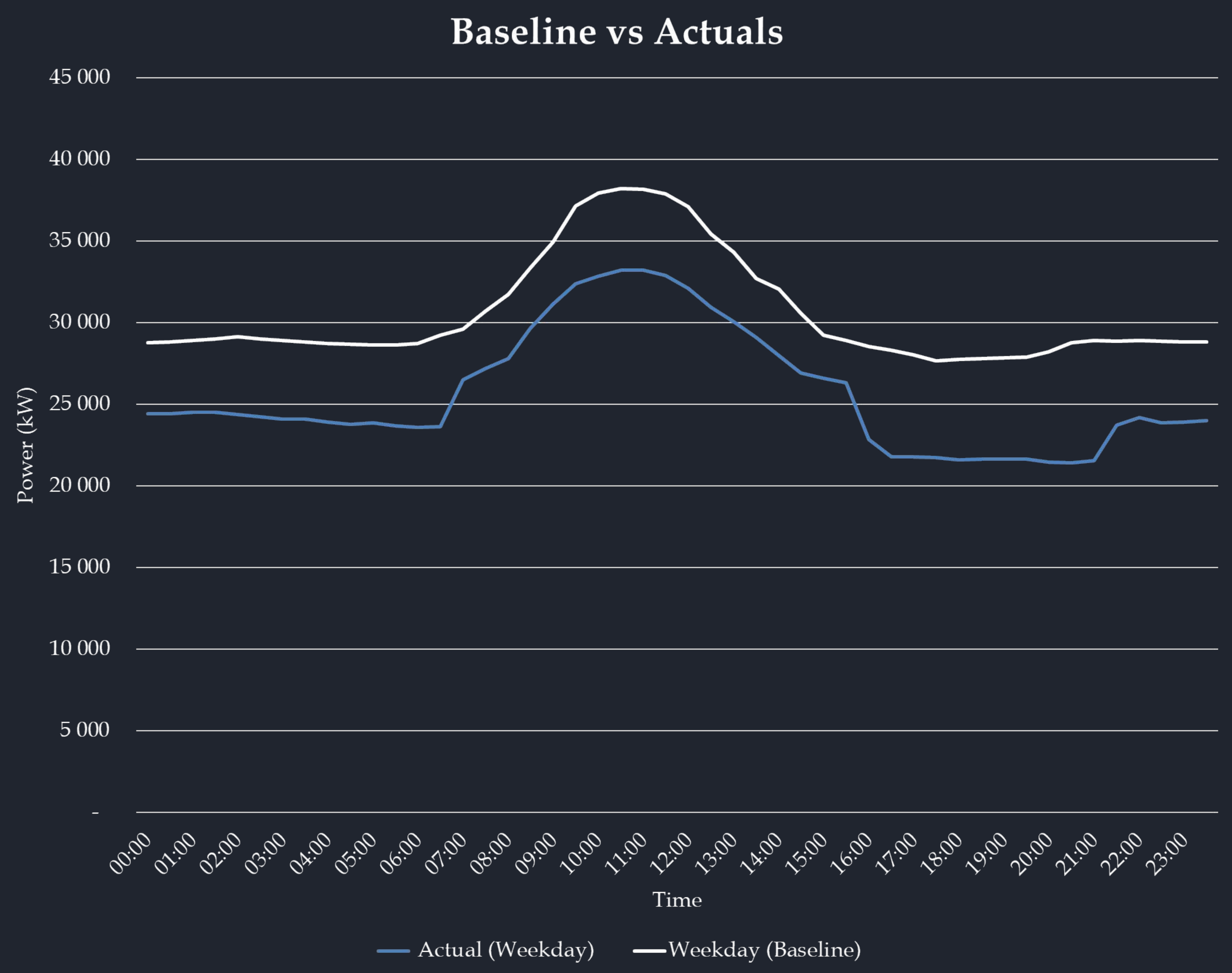
Results

Control Valve Commissioning

- Phased implementation approach
  - Prioritised areas with the highest compressed air usage.
- Focus areas:
  - Tumela 1#: 8L to 16L
  - Dishaba 2#: 10L to 19L
  - Surface installations at key points

Pressure setpoint reduction

- Daily pressure supply was reduced based on mining demand
  - Drilling shift: 550 kPa
  - Blasting shift: 350 kPa.
  - Cleaning shift: 450 kPa
- Valve setpoints reduced to 350kPa during low-demand periods
  - (pay weekends, Sundays, off-Saturdays, December break).
- Due to valve and pipe sizing, pressure cannot be reduced below 300 kPa



Results

Compressor Schedule Adjustments

- Dynamic compressor schedule to align with system changes.
- Additionally, the system configuration changes
  - Compressor 5 at the concentrator was decommissioned.
  - Four new compressors commissioned:
  - Dishaba: Compressors 9 & 10
  - Tumela: Compressors 11 & 12

Energy reduction

- Energy usage from the compressors reduced significantly
  - Especially during the low demand periods
- Total energy saved: **27.3 GWh**
- Total cost saving: **R51.9 million** per annum

Monitoring

- Continuous performance tracking through daily monitoring
- Real-time data ensures quick response to operational deviations
- Enables sustained efficiency and long-term energy management

Discussion

Technical insights

- The use of control valves introduced flexibility previously unavailable in a rigid compressed air setup. It allowed operations to transition from a “supply-dominant” to a “demand-driven” system.

Challenges encountered

- Ageing valve infrastructure
  - Older valves are prone to mechanical failure, constant maintenance and full replacements needed.
- Change management:
  - Shifting operational practices from long-standing methods proved challenging
- Surface pressure requirements
  - Certain pneumatic equipment located on the surface required higher operating pressures than the optimized setpoints allowed.

Lessons learned

- Involving operational staff in planning and acceptance of the system.
- Daily monitoring dashboards were essential in detecting and addressing faults.
- Pressure control, when paired with demand analysis, yields significant gains.

Future work

- Further optimisation of the control valves
- Reduced impact on compressors with control valve schedules
- Reduce the limitations of the valve's control abilities
- Reduction of demand pressure requirements during low-demand periods
- Implementation of a centralised control system on the compressors

Conclusion

- This initiative demonstrates the value of focusing on energy reduction initiatives.
- The compressed air system was optimised through:
  - Implementation of compressed air control valves
  - Supply of compressed air based on demand
  - Improved compressor scheduling
- Project outcomes:
  - Total cost reduction of **R51.9 million**
  - Built technical and organizational momentum toward broader energy efficiency practices

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