Deloitte.

The Deloitte Climate & Engineering Case Competition (DCECC)

2024 NSW Winner

Chula Consulting

Alisa, Branda, Saniya, and Victoria.

Electrifying the future

Green Gully Resources


Alisa Achdiat


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Victoria Diep

Executive Summary

Our strategy will allow Green Gully Resources to implement sustainable initiatives that will **reduce emissions**

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CONSIDERATIONS

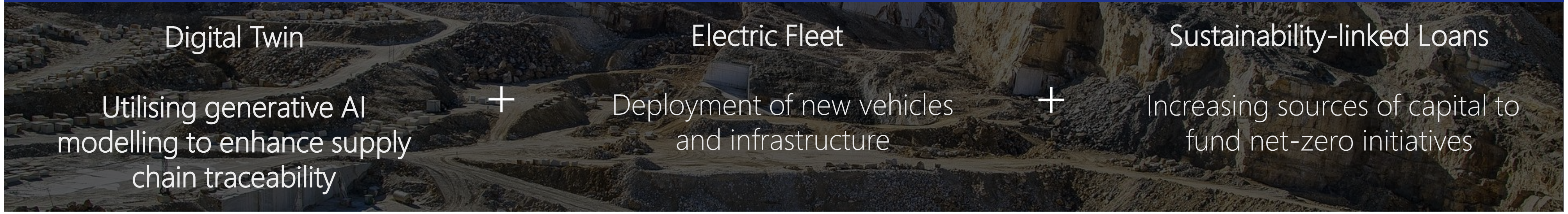
- Decreasing the current CO_2 emission to reach net zero
- How to fund the capital expenditure required
- Methods to improve current infrastructure

QUESTION

How can Green Gully Resources implement sustainability initiatives in the years leading up to 2034, especially during the rollout of new infrastructure, to minimise its carbon footprint and prepare for the introduction of electric haul trucks?

STRATEGY

Riding the Green Wave



IMPACT

50%	200GWh	21.6%
Emissions Reduced	Of Energy Saved	Energy Efficiency Increased

The company overview for Green Gully Resources reveals numerous practices that currently fall short of sustainability standards

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Green Gully Resources
End-to-end company processes

Phase 1
Planning

Phase 2
Construction

Phase 3
Extraction

Phase 4
Transportation

1 Unsustainable operation

- Diesel fuel may be used for site investigation
- Generators for temporary electricity supply, may be used extensively during the surveying

2 Fuel-Driven Process

- Diesel generators are common for temporary power solutions
- The extraction phase is highly energy-intensive
- High investment needed to electrify infrastructure

3 Diesel Trucks

- Diesel-powered trucks are used to transport ore from mine site to processing site
- Green Gully also have a fleet of trucks nearing the end of their lifecycle

GGR can leverage what competitors are currently doing to optimise their resources

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An analysis of key competitors…

AngloAmerican

RioTinto

BHP

Pilbara Minerals

NORTHERN STAR RESOURCES LIMITED

MINERAL RESOURCES

SOUTH32

…Allows us to look into industry best practices…

1. Tracking and reporting progress
Improving visibility through data analytics platforms

2. Partner with technology providers
Looking towards more sustainable energy options

3. Deployment of electric fleet
Moving towards more sustainable transportation methods

4. Financing options
Look towards securing grants and green bonds

…Leading to clear opportunities

1 Data Analytics

2 Deployable energy

3 Funding methods

Green Gully Resources (GGR) heavily relies on non-renewable energy, signalling a clear opportunity for sustainable energy transition

Current Position

1.3 million tones of CO_2
Haul trucks currently emitted CO_2, hindering the company from achieving their goal

50 Diesel Trucks
Current fleet consists of 50 diesel trucks, 30 of which are required to be replaced

Skill gap for EV
There is a need to address training in maintenance, planning, development and supply chain

Electrifying the Future

Desired Position

Net-zero goal
Replacement of diesel trucks along with energy filled processes will allow GGR to reach their goal

EV Trucks integrated
Phasing out the remaining 20 diesel trucks will ensure GGR carries a 100% EV fleet

Workforce is properly trained
Changes will be implemented with end-to-end visibility to ensure employees support the chance

How can GGR implement sustainability initiatives in the years leading up to 2028 to minimise its carbon footprint and prepare for the introduction of electric haul trucks?

1

Digital Twin

Enhancing oversight of operations and electric fleet transition through digital twin technology

2

Power Purchase Agreements

Building a reliable and efficient source of clean energy

3

Sustainability Linked Loans

Funding sustainability initiatives through green loans

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Our digital twin will enhance the oversight of GGR's operations leading to a reduction in emissions

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Digital Twin

Virtual representation of physical assets, processes, or systems, enabling real-time monitoring, analysis, and optimization

Key Features

Data Acquisition: collecting data from various sensor integrations; IoT devices; geospatial data

Data Integration: includes the process of aggregating and integrating diverse data streams to create a comprehensive digital representation

Analytics and Simulation: predictive analytics; machine learning models; simulation models; digital prototyping

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Supply Chain Process

Planning
Unsustainable Operations

Construction
Fuel-Driven Processes

Extraction
Fuel-Driven Processes

Transportation
Diesel Trucks

Key Features

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Supply Chain Process

Planning
Unsustainable Operations

Construction
Fuel-Driven Processes

Extraction
Fuel-Driven Processes

Transportation
Diesel Trucks

Key Features

Data Acquisition: geological surveys, exploration reports, and historical mining data to understand the terrain, mineral composition, and environmental factors

Data Integration: data from exploration activities, geospatial databases, and market trends provide a holistic view for strategic planning and decision-making

Analytics and Simulation: analytics tools analyse geological data to identify optimal locations for extraction, and simulate various mining scenarios to determine feasibility and optimize resource allocation

Our digital twin will enhance the oversight of GGR's operations leading to a reduction in emissions

CHULA CONSULTING

Supply Chain Process

Planning
Unsustainable Operations

Construction
Fuel-Driven Processes

Extraction
Fuel-Driven Processes

Transportation
Diesel Trucks

Key Features

Data Acquisition: collect data from engineering designs, equipment specifications, and construction plans to understand project requirements and constraints

Data Integration: integrated data from mine planning software, asset management systems, and sensor networks provide real-time visibility into extraction processes and facilitate data-driven decision-making

Analytics and Simulation: analytics algorithms analyse operational data to optimize extraction processes, predict equipment failures, and optimize production schedules; simulation models simulate different mining scenarios

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CHULA CONSULTING

Supply Chain Process

Planning
Unsustainable Operations

Construction
Fuel-Driven Processes

Extraction
Fuel-Driven Processes

Transportation
Diesel Trucks

Key Features

Data Acquisition: collect data from fleet management systems, vehicle telemetry, and logistics platforms to monitor transport routes, vehicle performance, and cargo status

Data Integration: transportation management systems, inventory databases, and geospatial mapping tools ensure efficient coordination between transportation activities and operational requirements

Analytics and Simulation: optimize route planning, minimize fuel consumption, and improve vehicle utilization. Simulation models simulate traffic patterns, vehicle movements, and loading/unloading processes

Our digital twin will enhance the oversight of GGR's operations leading to a reduction in emissions

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How digital twin makes GGR's operations more sustainable

RESOURCE OPTIMIZATION

By identifying inefficiencies and implementing corrective measures, digital twins help minimize resource waste and reduce the environmental footprint of mining operations

ENERGY EFFICIENCY

Through predictive analytics and simulation, digital twins help operators optimize energy usage, reduce reliance on fossil fuels, and integrate renewable energy sources into the operation

EMISSIONS REDUCTION

By analysing emissions data and identifying emission hotspots, digital twins support the implementation of mitigation measures to reduce emissions and improve air quality

Our digital twin will enhance the oversight of GGR's operations leading to a reduction in emissions

How digital twin makes GGR's operations more sustainable

How will digital twin help GGR with the rollout of electric fleets?

implementing corrective measures, digital twins help minimize resource waste and reduce the environmental footprint of mining operations

simulation, digital twins help operators optimize energy usage, reduce reliance on fossil fuels, and integrate renewable energy sources into the operation

identifying emission hotspots, digital twins support the implementation of mitigation measures to reduce emissions and improve air quality

The transition to electric fleets will be optimised by both a technological and operational approach in our implementation plan utilising our digital twin technology

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2024

TECHNOLOGICAL READINESS

Infrastructure Readiness

Assess the availability and capacity of charging infrastructure

Vehicle Selection & Procurement

Collaborate with equipment manufacturers to customize electric vehicles to meet specific operational requirements

Battery Technology & Management

Utilize hydrogen-powered batteries to ensure efficient operations

Operational Planning & Integration

Deployment plans, vehicle scheduling, task allocation, and operational workflows

Training & Skill Development

Provide training programs for operators, maintenance technicians, and other personnel to familiarize them with electric vehicle technology, safety procedures

2028

40 Electric Fleets

+ 50 Diesel-trucks nearing end of life

OPERATIONAL READINESS

The transition to electric fleets will be optimised by both a technological and operational approach in our implementation plan utilising our digital twin technology

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2024

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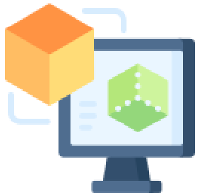
Digital Twin can assist with the planning of electric fleets.



Digital Twin

GGR can input various factors such as:
- ✓ Fleet metrics
- ✓ Battery capacity considerations
- ✓ Geographical factors

Predictive modelling can assist GGR with:
- ✓ Optimising transport routes
- ✓ Check out optimal locations for charging station
- ✓ Forecast demand and availability of electric trucks

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CHULA CONSULTING

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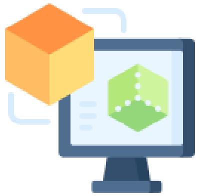
OPERATIONAL READINESS

Effective training is very critical in the mining industry and digital twin can help that.



Digital Twin

- ✓ Provide a safe and efficient training environment, allowing experienced personnel to pass on their knowledge while minimising risks of costly accidents or injuries.

- ✓ Can simulate emergency scenarios such as equipment failure, cave-ins, or gas leaks
- ✓ Enables workers to understand the practical implications of their actions
- ✓ Helps them respond more effectively and safely if such an event occurs.

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GGR needs Power Purchase Agreements (PPA) to source clean and reliable energy

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Power Purchase Agreements (PPA)

Power Purchase Agreements are contracts that allow buyers to purchase energy from renewable farms

Develop contract

Buyers purchase an agreement that lasts for 10-20 years at a fixed rate

Deploy Solar

Renewable energy generation is immediate to the site

Maintain Energy stream

A stable and cost-effective stream of energy is supplied

PPA's have stronger offerings than Utility services

- Price Stability
- Access to Renewable Energy
- No maintenance responsibility

Case Study:

NORTHERN STAR RESOURCES LIMITED

- ✓ Upon signing, has displaced 3.65 MT of Carbon
- ✓ PPA accounts for 56% of energy generated and used in the Gold mine
- ✓ Cost-efficient

GGR should form a long-term contract with nearby renewable suppliers to achieve their vision of fully electrified mines

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Merredin Solar farm

risen solar technology

Green Gully Resources

Why Merredin Solar Farm?

Market Leader In WA

- ✓ Rated the best performing Solar farm in Western Australia

Large Annual Production

- ✓ Has the capacity to produce 274GW of power annually

Precedence of Large Clients

- ✓ Past line of clients in Nickel refineries and other similar industries

How it is implemented into the operations and changing trucks

Planning

- ✓ Solar powered technology for scoping mine site

Construction

- ✓ Operative tools used for mine extraction and construction are powered by Solar

Transportation

- ✓ Electric Haul truck charging stations powered by electricity from PPA solar farm

Benefits

Efficient implementation
With immediate access to renewables
21.6% boost in efficiency

Sustainably Sourced
Sourced from Renewable Solar Farms
95% decreased off emissions

GGR should form a long-term contract with nearby renewable suppliers to achieve their vision of fully electrified mines

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Merredin Solar farm

risen solar technology

Green Gully Resources

How it is implemented into the operations and changing trucks

Planning | Construction | Transportation

How can we help GGR develop these initiatives and bring their sustainable vision to life?

In WA

- ✓ Rated the best performing Solar farm in Western Australia

Production

- ✓ Has the capacity to produce 274GW of power annually

Large Clients

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GGR will fund a greener future with Sustainably Linked Loans (SLL)

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SLLs are loan facilities where the borrower is incentivised through the loan pricing to achieve pre-agreed sustainability performance targets (SPTs). Where SPTs are achieved, the borrower is rewarded with a decrease in the applicable interest rate.

Green Gully Resources
End-to-end company processes

Phase 1	Phase 2 & 3	Phase 4
1 Fuel Reliant operations	2 Energy intensive Processes	3 Electric Haul Trucks integration

Sustainably Linked Loans

Upskill workers

Educating current workers on the importance of sustainable operations, and utilizing updated equipment

Funding Digital Twins

Streamlining digital twin systems, to ensure a smooth integration of electric haul trucks

Enabling PPA's

Help fund sustainable futures for GGR, diverting from Fuel and adopting solar powered operations

Lower Pricing

- ✓ Competitively lower borrowing rates
- ✓ Lower debt rates

Sustainable Offerings

- ✓ Incentivizes sustainable practices and initiatives
- ✓ Long-term and can be applied to future projects

Increased Access

- ✓ Sustainable integration with external funding
- ✓ $5M budget from loan

Understanding key risks will ensure success

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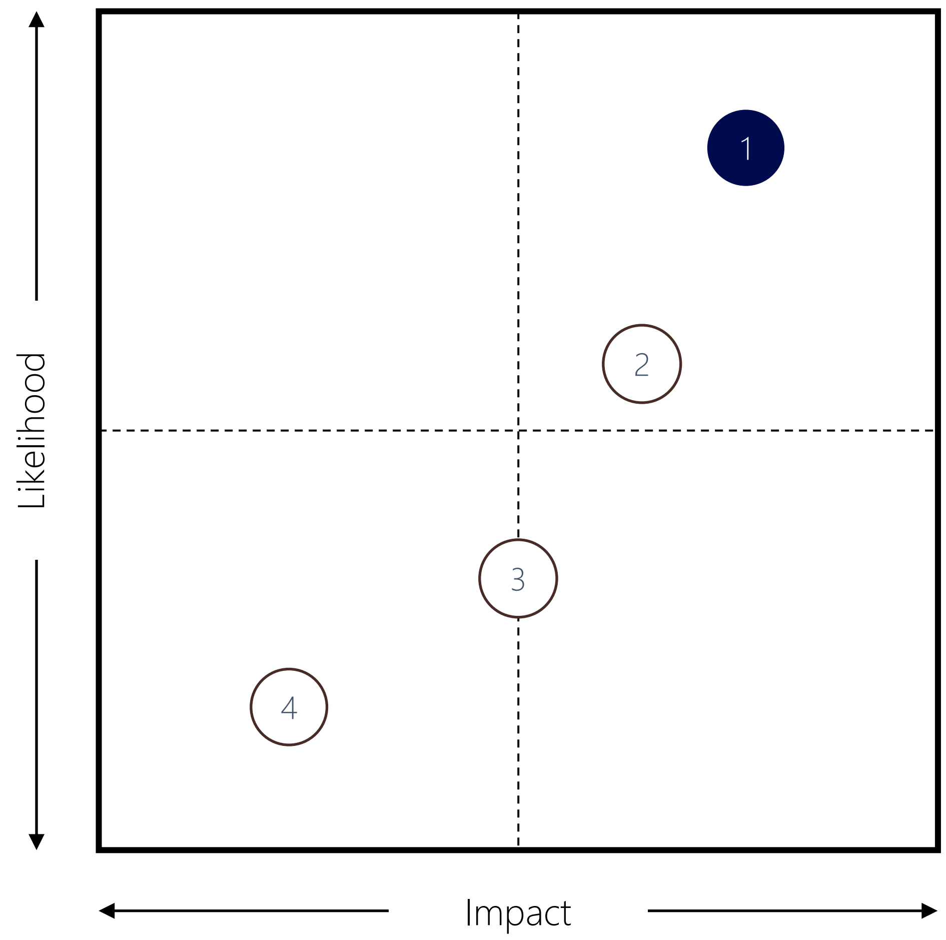
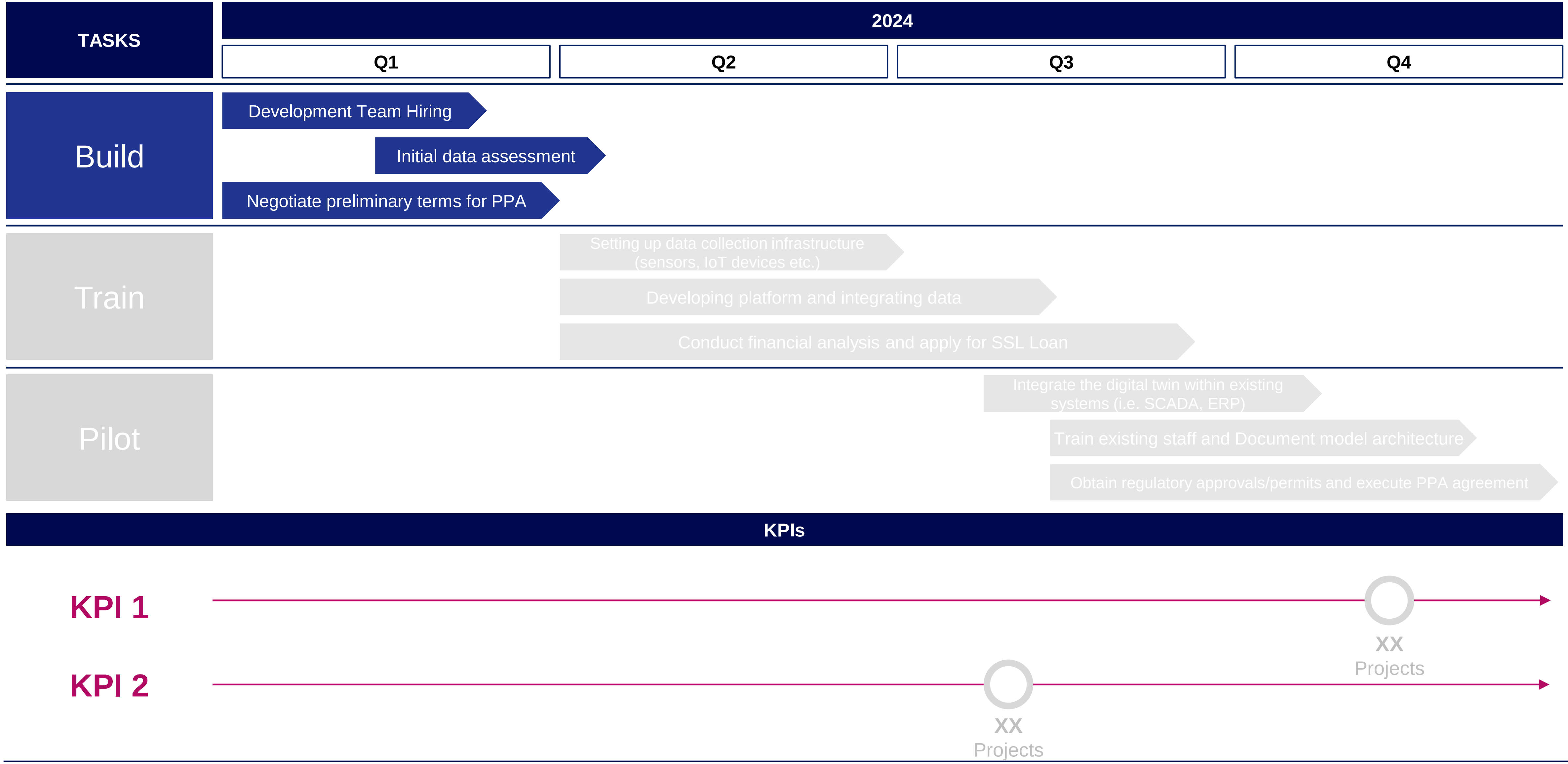


	Primary Risks	Mitigation
1	Integration of the Digital Twin Model	Doubling the average implementation timeline to account for mining operations complexities
2	Logistical Complexities	Developing a detailed implementation roadmap to ensure successful implementation of new technology
3	Centralised energy grid through PPA's	This will be accounted for in the contracting of the PPA agreement to ensure that the Energy provider is responsible for grid shortages
4	Unable to meet targets	Our modelling shows that GGR is already on its way to meet sustainability targets through electrification

GGR will need to implement our strategy in a timely yet feasible approach



GGR will need to implement our strategy in a timely yet feasible approach

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TASKS	2024			
	Q1	Q2	Q3	Q4

Build

- Development Team Hiring
- Initial data assessment
- Negotiate preliminary terms for PPA

Train

- Setting up data collection infrastructure (sensors, IoT devices etc.)
- Developing platform and integrating data
- Conduct financial analysis and apply for SSL Loan

Pilot

- Integrate the digital twin within existing systems (i.e. SCADA, ERP)
- Train existing staff and Document model architecture
- Obtain regulatory approvals/permits and execute PPA agreement

KPIs

KPI 1 — XX Projects

KPI 2 — XX Projects

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KPIs

KPI 1: **22%** Energy Efficiency Increase

KPI 2: **5** New staff

GGR will need to implement our strategy in a **timely yet feasible** approach

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TASKS	2024	2026	2028	2030
Build	Build			
Train	Train			
Pilot	Pilot			
Launch	Conduct pilot tests of recommendation system			
	Implement performance monitoring mechanisms to track the impact of recommendations on key metrics			
	Optimised fleet management			
Optimise			Iterative Optimization	

KPIs

KPI 1 — **XX** Projects

KPI 2 — **40** New Electric Fleet

GGR will need to implement our strategy in a timely yet feasible approach

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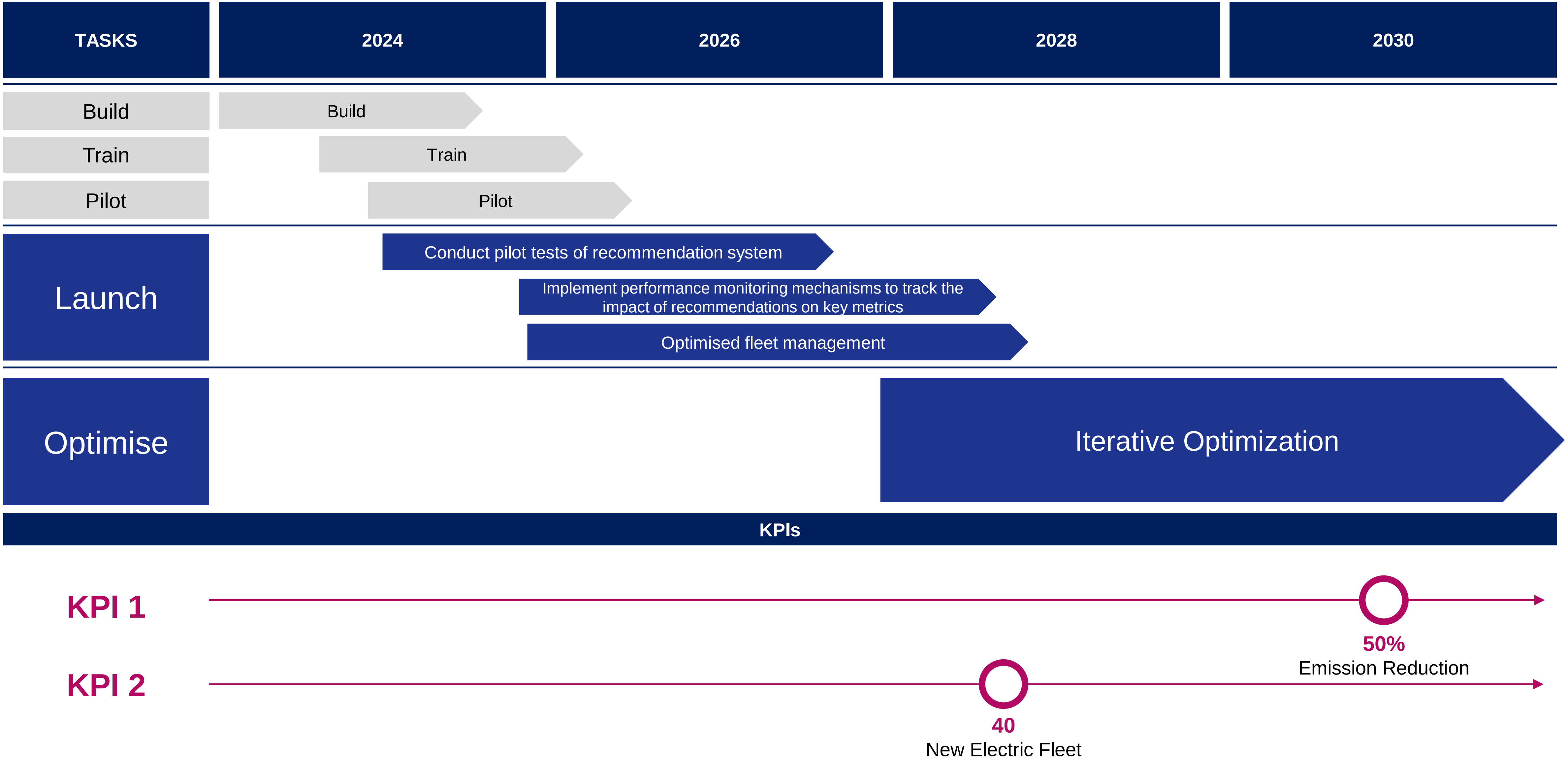

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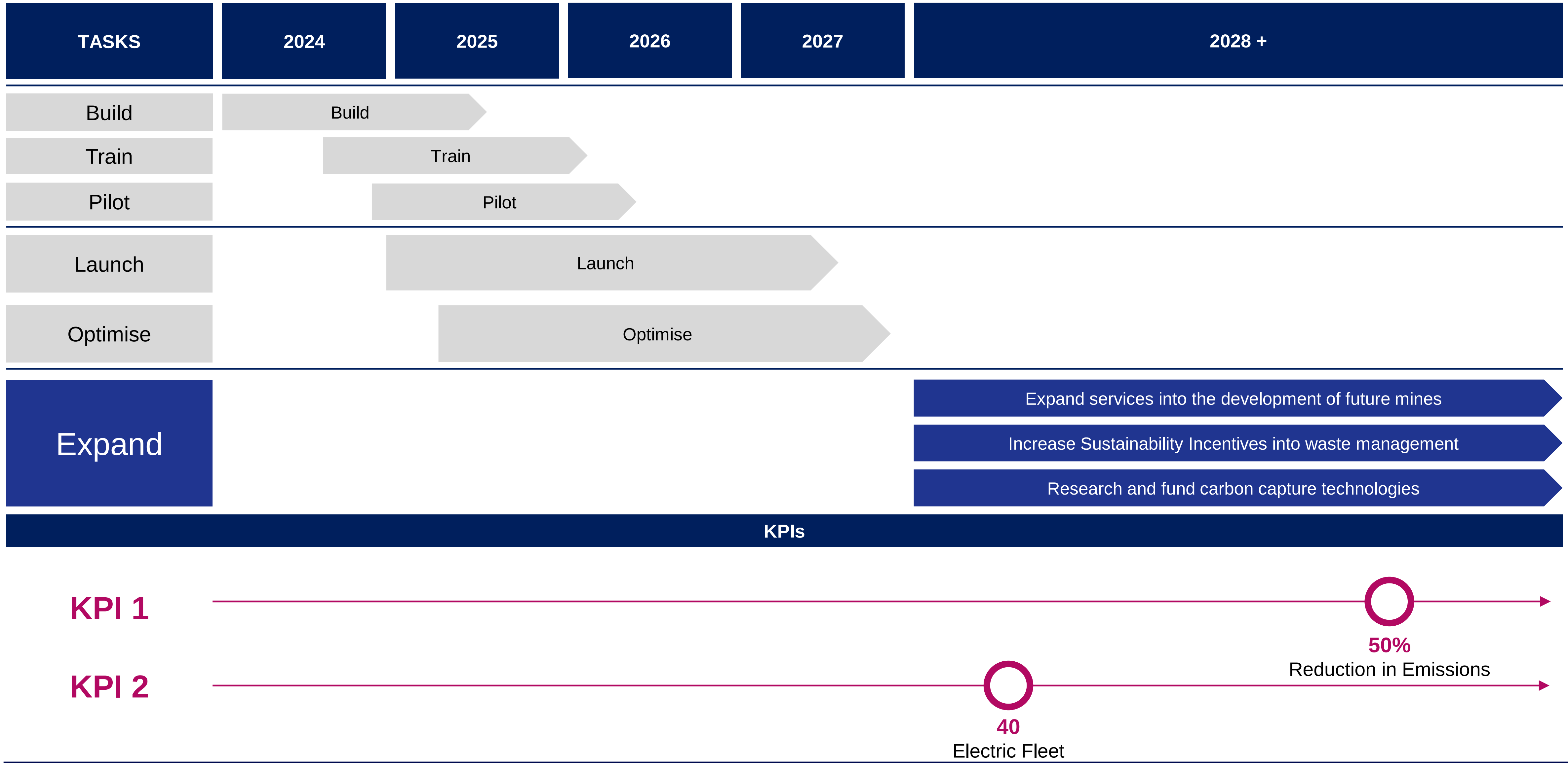

GGR can revolutionise their sustainability impacts through our strategy

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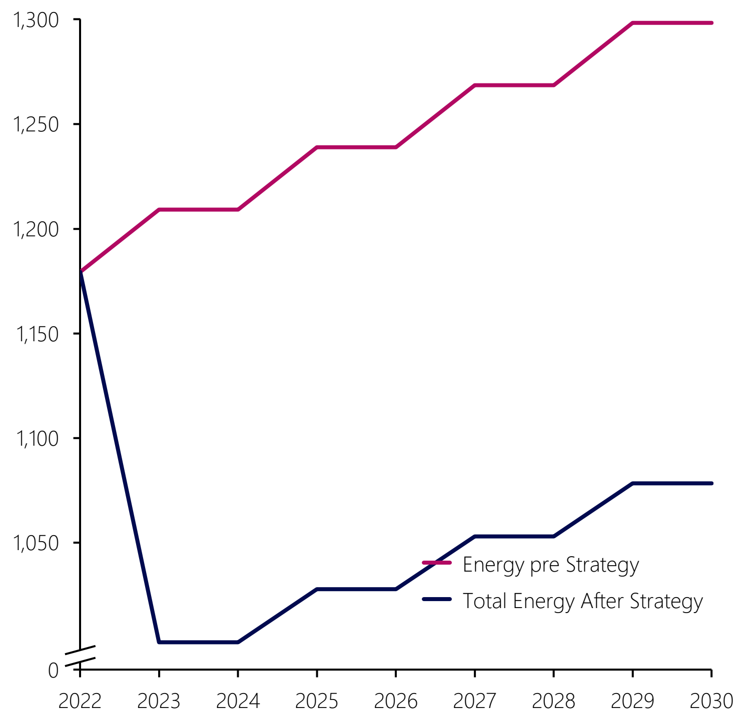
Energy Required

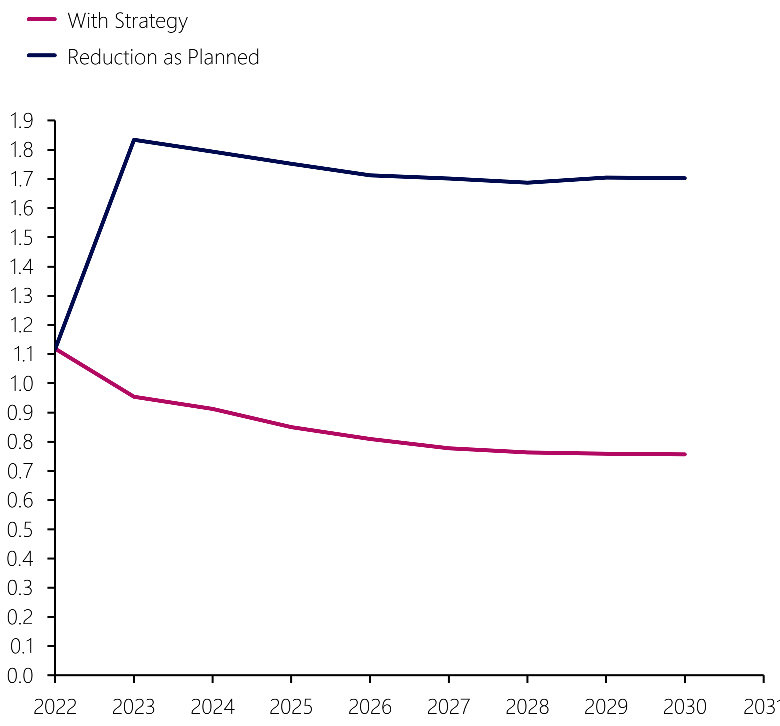


17%
Energy Usage Reduced

202GWh
Of Energy Saved through Digital Twin

63%
Reduction in Emissions due to energy

Emissions $MtCO_2$

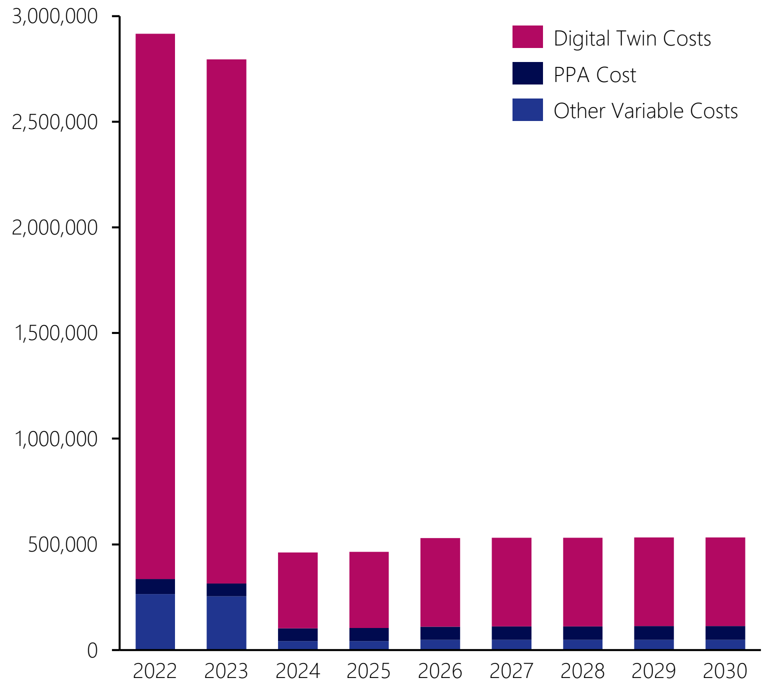


21.6%
Energy Efficiency Increase

95%
Energy emissions will be reduced through PPAs

$1MtCO_2$
Reduced by the end of 2034

Costs Overview



95%
Off Emissions through Energy reduced through PPAs

5M
Initial Boost Required that will be offset by loan

7%
Of initial Cost come from Strategy

Green Gully Resource will exceed its emission targets by 2034, achieving its sustainability goals

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Electrifying the Future

The impact of the incoming new fleet of haul trucks is not enough

Through our digital twin, PPA and SLL loans we will reduce emissions to meet our sustainability targets

By the end of 2034 Green Gully Resource will reduce carbon emissions by 68%

Impacts

15%

Reduction in Emissions due to new trucks

+

35%

Reduction in Emissions due to our strategy

=

50%

Reduction in Emissions due to our strategy

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Case Study: All-electrified Mining Operation – Newmont Goldcorp (CANADA)

CASE STUDY

NEWMONT GOLDCORP

Canada's first all-electric operation and the world's first diesel-free hard rock mine:
Newmont Goldcorp's Borden mine

SANDVIK

MacLean

Maestro Digital Mine

Replaced all of its underground diesel fleet of trucks with Battery Electric Vehicles, making it one of the first all-electric underground mines in Canada

Battery-operated drilling and blasting equipment, to electric bolters, personnel carriers and, ultimately, a 40-metric-tonne battery-powered haul truck, eliminate all GHG emissions associated with the movement of ore and waste rock

Utilises IoT Sensors by Maestro

- Reduction in annual greenhouse gas (GHG) emissions of 70%
- Improved staff well-being
- Reduced megawatt hours of 33,000 per year because of the huge decrease in ventilation requirements by 50%
- Improved safety performance

Digital Twin Supplier/Operator and Key Features

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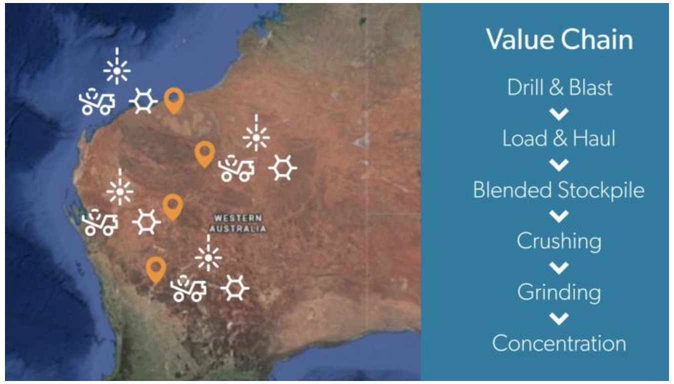
PETRA MAXTA

1. Creation of centralised dashboard

2. Various digital twin applications throughout supply chain



3. Predictive modelling

Case Study: Digital Twin in Gold Mining Operation

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CASE STUDY

PANAUST

In 2018, **PanAust's Ban Houayxai gold-silver operation** in northern Laos faced a challenging issue: infrequent episodes of very poor gold recovery, often falling below 50%.

PETRA MAXTA

PanAust turned to PETRA and its MAXTAGeomet application, a groundbreaking orebody learning **powered by AI for mine value-chain optimisation**

MAXTAGeomet utilises operational data to **predict plant performance**, making it an ideal choice for the Ban Houayxai project, using geological data for input to digital twin model

The PETRA team integrated this data into the MAXTA software, **creating a predictive model** that could be applied to the mine's block model for **historical reconciliation analysis and future predictions**

MAXTAGeomet successfully identified conditions leading to high levels of locked gold and poor recovery

Following the successful Ban Houayxai project, MAXTA found applications across iron-ore, copper-gold, and gold operations worldwide

Its capabilities expanded beyond geometallurgy, encompassing product quality, comminution energy consumption, and crusher, beneficiation, milling throughput maximisation

This approach quantified mining risk, supplying valuable data for cost improvement studies, analyses, and simulations for various scenarios.

PPA – Potential Long-term contract partners

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Green Power

- ✓ Diverse Renewable Energy Portfolio:
  - ✓ managing a substantial renewable energy portfolio, operating three power plants with a combined capacity of around 310 MW.
- ✓ Strategic Partnership and Expansion:
  - ✓ focusing on growth by entering into a strategic partnership, transferring a 50% stake of Enel Green Power Australia to INPEX
- ✓ Contribution to Sustainable Development:
  - ✓ Enel Green Power Australia is at the forefront of supporting Australia's sustainable development

- ✓ Innovative Renewable Energy Investment:
  - ✓ Sun Metals has demonstrated a commitment to renewable energy by investing $200 million in constructing a 143MWAC solar farm.
- ✓ Large-scale Solar Infrastructure:
  - ✓ housing around 1.26 million solar PV modules and 52 large-scale outdoor inverters.
- ✓ Leadership in Energy Market Transformation:
  - ✓ Sun Metals has been a driving force in the adaptation of the Queensland and Australian energy markets to new electricity network requirements.

Financials

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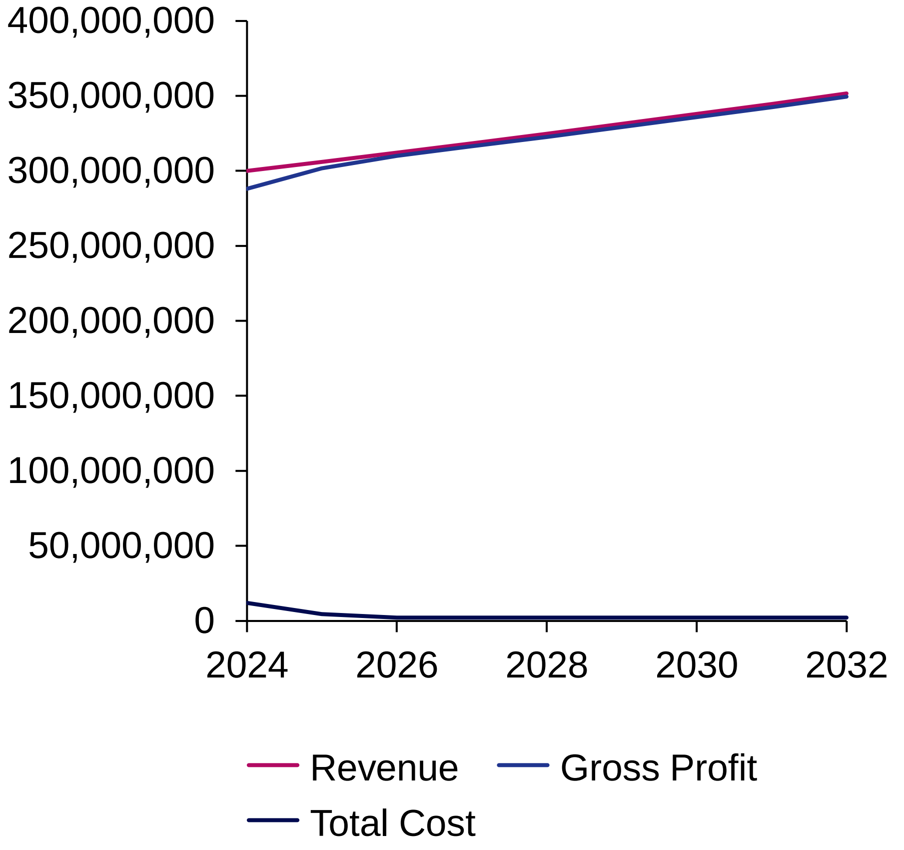
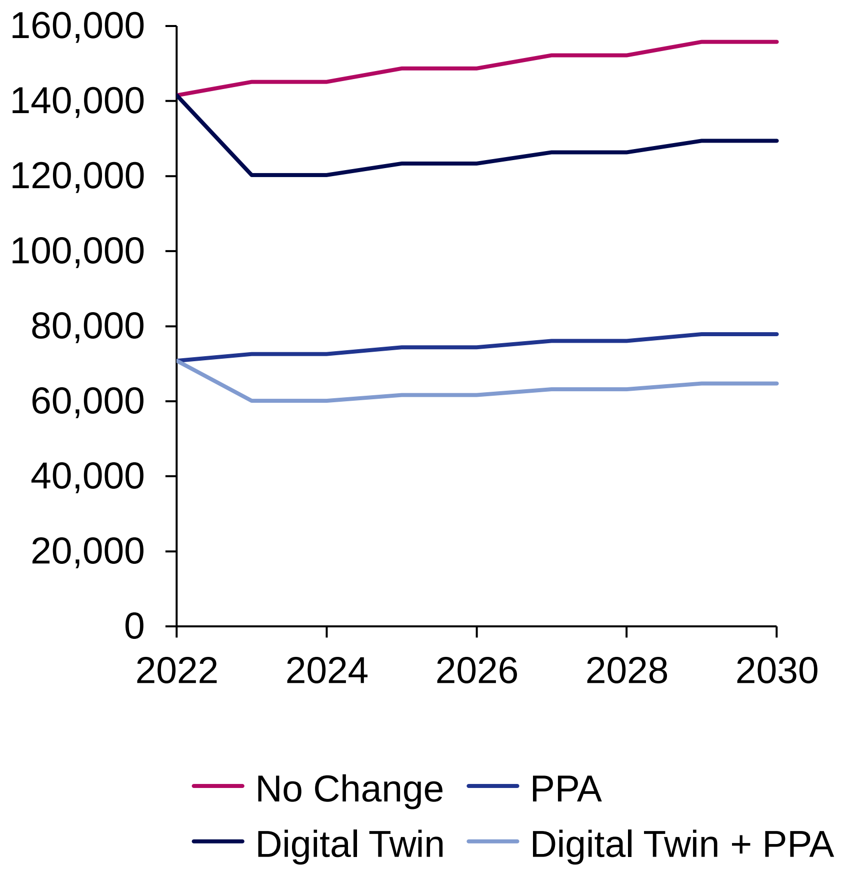
Revenue vs Total Costs



Electricity Cost Savings



Energy Reduction

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Energy Required		2024	2025	2026	2027	2028	2029	2030	2031	2032
BASE LINE:										
Western Australia Mineral Mining:										
Iron Ore	*Mt*	761								
Lithium	*Mt*	3								
Alumina	*Mt*	13								
Others	*Mt*	10								
Total	*Mt*	787								
No Mines in Western Australia		125								
Average Mineral Amount per mine		6								
Green Gully Resources:										
Mines in total		10								
Mt of minerals produced	*Mt*	63								
Energy intensity Per Mt	*kWh/tonne*	11								
Energy due to minerals	*GWh*	674								
No of fleet		0	10	10	20	20	30	30	40	40
Available trucks		0	9	9	18	18	26	26	35	35
Utilised trucks		0	6	6	11	11	17	17	23	23
distance travelled per fleet per day	*km*	250								
distance travelled per fleet per year	*km*	65000								
distance travelled by fleet per year	*km*	0	371800	371800	743600	743600	1115400	1115400	1487200	1487200
Energy per 100km	*kWh*	80								
Energy used by fleet	*GWh*	0	30	30	59	59	89	89	119	119
Energy due to processing	*GWh*	337								
Energy due to support infrastructure	*GWh*	168								
Total Energy Used	*GWh*	1179	1209	1209	1239	1239	1269	1269	1298	1298
WITH STRATEGY										
Servicable Addressible Energy Usage	*GWh*	505	535	535	565	565	595	595	624	624
Digital Twin:										
Optimization of Transport	*GWh*	0	4	4	9	9	13	13	18	18
Optimization of Machinery	*GWh*	67								
Optimization of Processing	*GWh*	51								
Optimization of Support Infrastructure	*GWh*	84								
Total Reduction in Energy from Digital Twin	*GWh*		207	207	211	211	216	216	220	220
Total Energy after Strategy	*GWh*	1179	1002	1002	1028	1028	1053	1053	1078	1078

Emission Reduction

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Emissions Reduced		2024	2025	2026	2027	2028	2029	2030	2031	2032
Base Line	*MtCo_2*	1.3								
Direct Emisssions	*%*	40								
Diesel and Other Fuel	*tCo_2*	0.2600	0.2080	0.1664	0.0998	0.0599	0.0240	0.0096	0.0019	0.0004
Process Emissions		0.208								
Energy Emissions Percentage	*%*	20								
Emissions per kWh	*kg*	0.85								
Energy Emissions	*tCo_2*	0.26	0.51	0.51	0.53	0.53	0.54	0.54	0.55	0.55
Other Emissions Percentage	*%*	30								
Other Emissions	*tCo_2*	0.39								
Total Emissions with out hual truck change	*MtCo_2*	1.12	1.37	1.37	1.38	1.38	1.40	1.40	1.41	1.41
Total Emissions	*MtCo_2*	1.12	1.32	1.28	1.22	1.18	1.16	1.15	1.15	1.15
With Strategy										
Energy Emission Reduction										
Power Purchase Agreement										
Emissions Reduction for PPA's percentage	*%*	75								
Reducation Emissions for PPA's	*MtCo_2*		0.385	0.386	0.395	0.395	0.405	0.405	0.414	0.414
Emissions Reduction for Renewable per MW	*kg*	0.95								
Reduction from energy efficiency	*MtCo_2*		0.3662	0.3663	0.3753	0.3753	0.3843	0.3843	0.3933	0.3933
Total Emissions after strategy		1.12	0.95	0.91	0.85	0.81	0.78	0.76	0.76	0.76

Cost Breakdown

CHULA CONSULTING

Cost Anaylsis		2024	2025	2026	2027	2028	2029	2030	2031	2032
Fixed Costs:										
Charging Infrastructure	$	1500000								
Delivery Costs	$	5000000								
Disposal of Old Assets	$	200000								
Trucks Cost x10	$	6000000								
Total Fixed Costs	$	12700000								
Digital Twin Costs:										
Data Collection and Integration	$	100000								
Model Development	$	2000000	2000000							
Software Team	$	240000	240000	360000	360000	420000	420000	420000	420000	420000
Deployment and User Training	$	240000	240000							
Total	$	2580000	2480000	360000	360000	420000	420000	420000	420000	420000
PPA Cost per MW	$	60								
PPA Cost	$	70762	60148	60148	61665	61665	63182	63182	64699	64699
PPA Cost without energy efficency	$	70762	72546	72546	74331	74331	76116	76116	77900	77900
Other Vairable Costs										
Maintenance Cost	$	1000000	1000000	1000000	1000000	1000000	1000000	1000000	1000000	1000000
Misc. Costs	$	162801	348000	136000	136000	142000	142000	142000	142000	142000
Total other Vairable Costs	$	1162801	1348000	1136000	1136000	1142000	1142000	1142000	1142000	1142000
Total Costs	$	16442802	3828002	1496002	1496002	1562002	1562002	1562002	1562002	1562002
Cost of just strategy	$	3742802	3828002	1496002	1496002	1562002	1562002	1562002	1562002	1562002
Cost Reduction										
Sustainability Linked Loan	$	-5000000								
Annual Interest Rate	%	1.99								
Annual Payment		556341	556341	556341	556341	556341	556341	556341	556341	556341
Total Cost	$	$11,999,143.16	4384343	2052343	2052343	2118343	2118343	2118343	2118343	$2,118,343.15

Revenue		2024	2025	2026	2027	2028	2029	2030	2031	2032
Natural Revenue Growth Rate	%	2								
Baseline Revenue	*Million*	300	306	312	318	325	331	338	345	351
Cost Saving:										
Original Cost of Electricity per MW (0.12 kWh)	$	120								
Cost of electrcity without energy efficiency		141523	145093	145093	148662	148662	152231	152231	155800	155800
Cost of Electricity with energy efficiency	$	141523	120296	120296	123330	123330	126364	126364	129398	129398