Microeconomic Project

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1. Introduction

In this report, an economic analysis of Cryptohub (Pty) Ltd will be undertaken. Namely, the choice between implementing a solar/battery system or generator system as an alternative electricity source will be evaluated.

2. Problem identification

Without loadshedding, given a mining time per block of 8 hours (480 minutes), Cryptohub mines 3 Bitcoin blocks per day. Therefore, assuming the mining operations continue on a 24/7 basis due to the automated algorithmic GPUs, Cryptohub mines 1095 blocks per year.

However, due to the implementation of load-shedding by Eskom, Cryptohub have been prevented from mining for 40 hours during the first half of the 2021/2022 calendar. Extrapolating loadshedding hours to rest of the year translates to 10 blocks worth of potential income squandered during the year.

Moreover, Eskom's CEO, Andre de Ruyter has stated that South Africa will endure at least another five years of load shedding due to power shortfall [1]. Therefore, the loss of revenue will continue for the subsequent five years and needs to be mitigated through the use of an alternative electricity source.

3. Economic Analysis

Load-shedding poses a major threat to Cryptohub, as without a reliable source of electricity for the mining infrastructure, no revenue is possible. By implementing an alternative energy source, Cryptohub will be able recover 80 hours worth of block mining each year (assuming load shedding continues at 80 hours per year). Furthermore, assuming a 5% cash profit of invested capital per block mined, the additional 10 blocks will bring in a surplus of R1.9 million in revenue (refer to calculation (1) in appendix).

3.1 Solar System

Solar power can additionally reduce electricity costs during non-loadshedding periods. As shown in calculation (2) in appendix, the solar system's electricity savings comes to R607 919.90 per year. This calculation was obtained by firstly assuming the price of electricity being 213.53 $(\frac{c}{KWh})$ as per Eskom's official tariff booklet for the 2022/2023 year (an image has been provided from page 30) [2]. Secondly, it was assumed that the solar power and battery storage can be utilised for 12 hours per day. Therefore, assuming during the day the solar panels and batteries will work simultaneously to ensure constant power for 12 hours.

The electricity cost from the local authority/municipalities has increased by 8.61% for the 2022/2023 year by ESKOM [3]. Therefore, extrapolating this value, an increase of 8.61% per year was assumed for the amount saved for electricity costs.

Utilising the cash profit calculated in (1), the cost of maintenance for the solar system and the electricity cost savings of the solar/batter system, the cash flow statement in table 1 in the appendix was produced. The net cash flow for the first year is R2 457 920 and thereafter steadily increases per year, reflecting a positive cash inflow each year. Therefore, the solar project's potential profit and savings are substantially larger than the related costs. The payback period for the solar/ battery project can be seen in calculation (3) in the appendix, which shows that the initial investment can be recouped in 3 years.

Utilising the projected cash flow values in table 1, the net present value (NPV) of the project was calculated as shown in calculation (4) in appendix. A 16.50% required rate of return over the projected 5 years was assumed. The NPV value of R476 289 reflects a profitable current value of the future cash flows generated by the solar/battery system.

Moreover, using the net cash flow projected values, the internal rate of return (IRR), was calculated, shown in calculation (5) in appendix. The internal rate of return or rate of discount calculated shows that the solar project is projected to generate 19% growth per year. Therefore, the internal rate of return is greater than the rate required by Cryptohub's management.

3.2 Generator System

A generator system can also be used to mitigate the effects of loadshedding and maintain power during the 80 hours of load-shedding per year. Therefore, calculation (1) of cash profit will also be realized using the generator system. However, assuming the generator system can solely be utilized during load-shedding, no additional electricity cost savings can be projected.

Taking into account the cash profit and cost of maintenance, the cash flow projection in table 2 in the appendix was obtained. The net cash flow for each year is R1 800 000, reflecting a positive inflow each year. Therefore, the generator project's potential profit is substantially larger than the related costs. The payback period for the generator project can be seen in calculation (6) in the appendix. The calculation shows that the initial investment can be recovered in 3.33 years, which translates to three years and 4 months.

Thereafter, utilising the projected cash flow values in table 2, the net present value (NPV) of the generator project was calculated as shown in calculation (7) in appendix. A 16.50% required rate of return over the projected 5 years was assumed. The NPV value of -R174 364 reflects an unprofitable current value of the future cash flows generated by implementing the generator system.

Moreover, using the net cash flow projected values, the internal rate of return (IRR), was calculated as shown in calculation (8) in appendix. The internal rate of return calculated shows that the generator is projected to generate 15% growth per year. However, this is below the required rate of return of 16.5%.

3.3 Financing

In order to finance the purchase of either the solar system or the generators, without diluting shareholder equity - a structured loan agreement is the financing option assumed.

Looking at the liquidity of the business, as shown by table 3 in the appendix, the current ratio of 0.64 and net working capital of -R200 000 both represent that the business is struggling to pay its short-term debt. However, the solvency of the company, shown in table 4, is 1.84 total assets to total liabilities (even though not optimal 2:1), the business is nonetheless solvent.

Therefore, longer term loan financing options for both projects have been calculated as shown in table 5 and 6. The assumption was made that the loan will be taken out on the prime lending rate of 9.75% [5]. Furthermore, monthly and yearly repayment options were illustrated using the PMT excel functionality. As shown in both table 5 and 6, by increasing the repayment period to the five year options ,the amounts payable are affordable given the respective net cash flows. Additionally , a 5 year payback period increases the cash liquidity of Cryptohub and thus matches the 5-year forecast.

In four years time, Cryptohub should be in a better position to refinance new mining rigs, given the projected surplus revenue and better track record through financing either of the respective projects.

4. Other Considerations

Environmental, social and current market considerations need to be taken into account when making the decision of which alternative energy system to implement.

4.1 Environmental

The use of oil/diesel to power the generator system is environmentally problematic. Burning oil/diesel gives rise to greenhouse gases, causing the impact of climate change. Moreover, oil/diesel pollution pose a threat to our oceans and environments. On the other hand, solar power is a clean renewable energy source, which will inevitably reduce Cryptohub's carbon footprint.

4.2 Social

Implementing the solar project will allow for Cryptohub to reduce their electricity consumption during the day. Therefore, helping to decrease the peak periods of demand of electricity in South Africa, thereby assisting in reducing the need for loadshedding.

4.3 Current Market Conditions

Currently, oil/diesel prices are experiencing high volatility and supplier instability. Some of the economic reasons behind these trends are due to the current war between Russia and Ukraine and fears of a recession. Therefore, being reliant on oil/diesel could pose a threat to the business.

5. Recommendations

In summary, Table 8 has been made to show the comparison between the key metrics obtained. The solar system provides a higher net cash flow throughout the 5-year prediction. The payback period for the solar system is shorter than that of the generator. The NPV of the solar system reflects a profitable R476 289 whereas the generator is unprofitable. The IRR of the solar system meets the required specification by management, whereas the generator system does not.

Additionally, looking at the environmental, social and current market conditions, the solar system is evidently recommended. Regarding financing, monthly repayments of the loan in a 5-year period is recommended as it will reduce liquidity concerns and is affordable due to the higher IRR and net cash flow of the solar project.

Therefore, after analysing the projected net cash flow of each project, the payback periods, NPVs, IRRs and taking into account environmental, social and current market conditions the solar system is recommended as the better choice of implementation.

Appendix

Cash Profit Calculation:

Total Shareholders' Equity + Total Liabilities= R3 800 000 R3 800 000 × 5% =R190 000 R190 000× 10 blocks= R1 900 000	(1)

Solar System Electricity Savings Calculation:

• Price of electricity in $(\frac{c}{KWh})$= 213.53 (VAT inclusive) [2] (Inclusive of Energy charge+ service charge + network demand charge= 186.91c+0.71c+25.91c) • Size of solar power= 650W× 100= 65000W • Operational time= 12 hours per day. $$E\frac{KWh}{day} = P(W) \times t(\frac{h}{day})/1000\ (\frac{W}{KW})$$ (65000× 12)/1000= 780 $\frac{KWh}{day}$ $$Cost\ \left(\frac{R}{day}\right) = \text{E}\ (\frac{KWh}{day})\ \times \text{Cost}(\frac{c}{KWh})/100(\frac{c}{R})$$ (780× 213.53)/100=$\frac{\text{R1665.53}}{day}$ R1665.53×365= R607 919.90 per year.	(2)

BUSINESS RATE Local Authority charges

Businessrate - Local Authority

	Energy charge [c/kWh]	VAT incl	Ancillary service charge [c/kWh]	VAT incl	Network demand charge [c/kWh]	VAT incl	Network capacity charge [Rf POD/day]	VAT incl	Service and administration charge [Rf POD/day]	VAT incl
Businessrate 1	162,53	186,91	0,62	0,71	22,53	25,91	R 32,30	R 37,15	R 27,66	R 31,81
Businessrate 2	162,53	186,91	0,62	0,71	22,53	25,91	R 54,48	R 62,65	R 27,66	R 31,81
Businessrate 3	162,53	186,91	0,62	0,71	22,53	25,91	R 94,14	R 108,26	R 27,66	R 31,81
Businessrate 4	437,39	503,00	0,62	0,71	22,53	25,91				

[2]

Table 1 of the Solar and Battery Cash Flow Projection:

Solar/Battery Cash Flow Statement Projection					
Item	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Cash Profit	R1 900 000	R1 900 000	R1 900 000	R1 900 000	R1 900 000
Maintenance	-R50 000	-R50 000	-R50 000	-R50 000	-R50 000
Electricity Savings	R607 919,90	R660 261,80	R717 110,34	R778 853,55	R845 912,84
Net Cash Flow	R2 457 920	R2 510 262	R2 567 110	R2 628 854	R2 695 913

Calculation for Payback Period for the Solar/Battery System.

Payback Period = Cost of Investment ÷ Average Net Cash Flow

Average Net Cash Flow= $\frac{\text{R2 457 920+2 510 262+2 567 110+2 628 854+2 695 913}}{5}$=R2 572 012

Payback Period= R7 790 000÷ R2 572 012= 3.028≈ 3 years. (3)

Net Present Value (NPV) of Solar/Battery System:

$$NPV = \frac{Cash\ Flow}{(1+i)^t} - initial\ investment$$ (4)

Therefore:

$$\left[\frac{2\,457\,920}{(1+16.5\%)^1} + \frac{2\,510\,262}{(1+16.5\%)^2} + \frac{2\,567\,110}{(1+16.5\%)^3} + \frac{2\,628\,854}{(1+16.5\%)^4} + \frac{2\,695\,913}{(1+16.5\%)^5}\right]$$

-R7 790 000

=R476 289

Calculation for Internal Rate of Return (IRR) for the Solar/Battery system

$$NPV = 0 = \frac{Cash\ Flow}{(1+IRR)^t} - initial\ investment$$ (5)

$$\left[\frac{2\,457\,920}{(1+IRR)^1} + \frac{2\,510\,262}{(1+IRR)^2} + \frac{2\,567\,110}{(1+IRR)^3} + \frac{2\,628\,854}{(1+IRR)^4} + \frac{2\,695\,913}{(1+IRR)^5}\right] - 7\,790\,000 = 0$$

Therefore, IRR= 19%

Solar	
Rate of Return	16,50%
Initial Investment	-7 790 000
Year 1	2 457 920
Year 2	2 510 262
Year 3	2 567 110
Year 4	2 628 854
Year 5	2 695 913
IRR	19%
NPV	R476 289

Figure 1: Showing Excel Spreadsheet used to calculate NPV and IRR of Solar Project

Table 2 of the Generator Cash Flow Projection:

Generator Cash Flow Statement Projection					
Item	Year 1	Year 2	Year 3	Year 4	Year 5
Cash Profit	R1 900 000	R1 900 000	R1 900 000	R1 900 000	R1 900 000
Operating Costs	-R100 000	-R100 000	-R100 000	-R100 000	-R100 000
Net Cash Flow	R1 800 000	R1 800 000	R1 800 000	R1 800 000	R1 800 000

Calculation for Payback Period for the Generator System.

Payback Period = Cost of Investment ÷ Average Net Cash Flow Average Net Cash Flow= R1 800 000 Payback Period= R6 000 000÷ R1 800 000= 3.33 years	(6)

Net Present Value (NPV) of Generator System:

$$NPV = \frac{Cash\ Flow}{(1+i)^t} - initial\ investment \qquad (7)$$

Therefore:

$$\left[\frac{1\,800\,000}{(1+16.5\%)^1} + \frac{1\,800\,000}{(1+16.5\%)^2} + \frac{1\,800\,000}{(1+16.5\%)^3} + \frac{1\,800\,000}{(1+16.5\%)^4} + \frac{1\,800\,000}{(1+16.5\%)^5}\right]$$

-R6 000 000

=- R174 364

Calculation for Internal Rate of Return (IRR) for the Generator System

$$NPV = 0 = \frac{Cash\ Flow}{(1+IRR)^t} - initial\ investment \qquad (8)$$

$$\left[\frac{1\,800\,000}{(1+IRR)^1} + \frac{1\,800\,000}{(1+IRR)^2} + \frac{1\,800\,000}{(1+IRR)^3} + \frac{1\,800\,000}{(1+IRR)^4} + \frac{1\,800\,000}{(1+IRR)^5}\right] - 6\,000\,000 = 0$$

Therefore, IRR= 15%

Generator	
Rate of Return	16,50%
Initial Investment	-R6 000 000
Year 1	R1 800 000
Year 2	R1 800 000
Year 3	R1 800 000
Year 4	R1 800 000
Year 5	R1 800 000
IRR	15%
NPV	-R174 364

Figure 2: Showing Excel spreadsheet used to calculate Generator Project's NPV and IRR

Table 3 showing Liquidity Ratios for Cryptohub (Pty) Ltd

	Ratio	Formula	2021/2022
1.	Current Ratio	Current Assets/Current Liabilities	0.64
2.	Net Working Capital	Current Assets -Current Liabilities	-R200 000

Table 4 showing Solvency Ratio for Cryptohub (Pty) Ltd

	Ratio	Formula	2021/2022
1.	Solvency Ratio	Total Assets/Total Liabilities	1.84

Table 5 showing loan repayment options for the generator project

Choice of Payback Periods for Generator (1 – 5 years)					
Loan Amount	Interest Rate	Number of years	Number of Payments	Monthly Payment	Annual Payment
R6 000 000	9,75%	1	12	-R526 797,94	-R6 585 000,00
R6 000 000	9,75%	2	24	-R276 177,75	-R3 445 548,27
R6 000 000	9,75%	3	36	-R192 899,65	-R2 402 077,12
R6 000 000	9,75%	4	48	-R151 456,15	-R1 882 591,36
R6 000 000	9,75%	5	60	-R126 745,46	-R1 572 688,92

Table 6 showing loan repayment options for the solar system project

Choice of Payback Periods for Solar System (1-5 years)					
Loan Amount	Interest Rate	Number of years	Number of Payments	Monthly Payment	Annual Payment
R7 790 000,00	9,75%	1	12	R683 959,33	R8 549 525,00
R7 790 000,00	9,75%	2	24	R358 570,77	R4 473 470,17
R7 790 000,00	9,75%	3	36	R250 448,04	R3 118 696,79
R7 790 000,00	9,75%	4	48	R196 640,56	R2 444 231,12
R7 790 000,00	9,75%	5	60	R164 557,86	R2 041 874,45

Table 7 of Cost Comparison of the solar system and the generators

Comparison of Solar System and Generator		
Cost	**Solar System Price per year**	**Generator Price per year (Rm)**
Installation	R7 790 000	R6 000 000
Maintenance	R50 0000	R100 000
Total	R7 840 000	R6 100 000

Table 8 Summary comparison between key metrics of solar and generator projects

Comparison of Key Metrics of Solar and Generator Projects		
Metric	**Solar**	**Generator**
Payback Period	3 years	3.33 years
Net Present Value (NPV)	+R476 289	- R174 364
Internal Rate of Return (IRR)	19%	15%

References

[1] Writer, S., 2021. Expect 5 more years of load shedding for South Africa – these charts show why. BusinessTech. Available at: https://businesstech.co.za/news/energy/475990/expect-5-more-years-of-load-shedding-for-south-africa-these-charts-show-why/ [Accessed September 16, 2022].

[2] ESKOM, 2022. Tariff books. Distribution. Available at: https://www.eskom.co.za/distribution/5189-2/ [Accessed September 27, 2022].

[4] ESKOM, 2022. Tariffs and charges. Distribution. Available at: https://www.eskom.co.za/distribution/tariffs-and-charges/ [Accessed September 27, 2022].

[5] South African Reserve Bank, Current market rates. Available at: https://www.resbank.co.za/en/home/what-we-do/statistics/key-statistics/current-market-rates [Accessed September 29, 2022].