SOUTHERN INSTITUTE OF TECHNOLOGY
TE WHARE WANANGA O MURIHIKU

Sustainable Cryptocurrency Mining

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INTRODUCTION

Introduction

Blockchain

- A technology to store data in decentralized format (Peer-to-peer or Serverless).
- Uses one-way encryption (*hashing*) function for security.
- It involves multiple peers to validate the data processes.

Applications: Health, education, manufacturing, and e-government etc.

Introduction

Cryptocurrency

- One of a renown application of Blockchain

Examples: Bitcoin, Ethereum, Dogecoin, etc.

- Miners run nodes (computers/machines) to confirm transactions.
- Miners are rewarded for their efforts, time and energy consumed, in the form of cryptocurrency coins.
- These coins can be used in shopping and buying services.

Businesses: Microsoft, PayPal and Starbucks, etc.

Cryptocurrencies

Introduction

Energy Consumption

- Mining rely on large number of active nodes.
- Nodes consumes significant amount of energy.
- Global Bitcoin mining: **~80 TWh**
  (2 x New Zealand electric generation)

Perhaps renewable energy systems (RES) might improve the sustainability-related challenges with bitcoin mining.

LITERATURE REVIEW

Literature Review

In the literature, there is a dearth of studies related to RES-powered cryptocurrency mining.

- ✓ Govender [1] performed a theoretical study on sustainable cryptocurrency mining as a concept and identified the potential business models that could be considered eco-innovative.

- ✓ Rehman [2] stated that solar energy is free, green, abundant, and renewable. Also, compared to other RES technologies, it is available at most places.

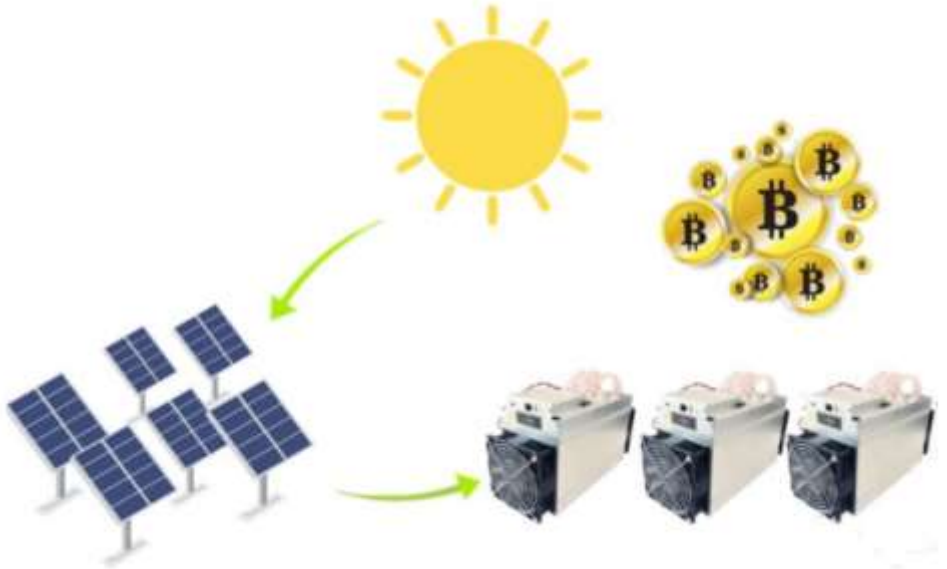
Literature Review

- ✓ Lippman and Ekblaw [3] developed the Avalon Nano ASIC Miner that was used to build a micro-mining setup, which was powered by a 30-Watt PV panel to produce bitcoin dust, which is an untransactable amount.
- ✓ Purnama [4] developed a micro-mining system based on an Asus Tinker Board CPU, GPU miners and a Futurebit Moonlander 2 ASIC miner. The system was powered by a 20-Watt PV panel
- ✓ Zhai [5] explored the use of solar energy to construct a sustainable and profitable business model exclusively for commercial mining setups.

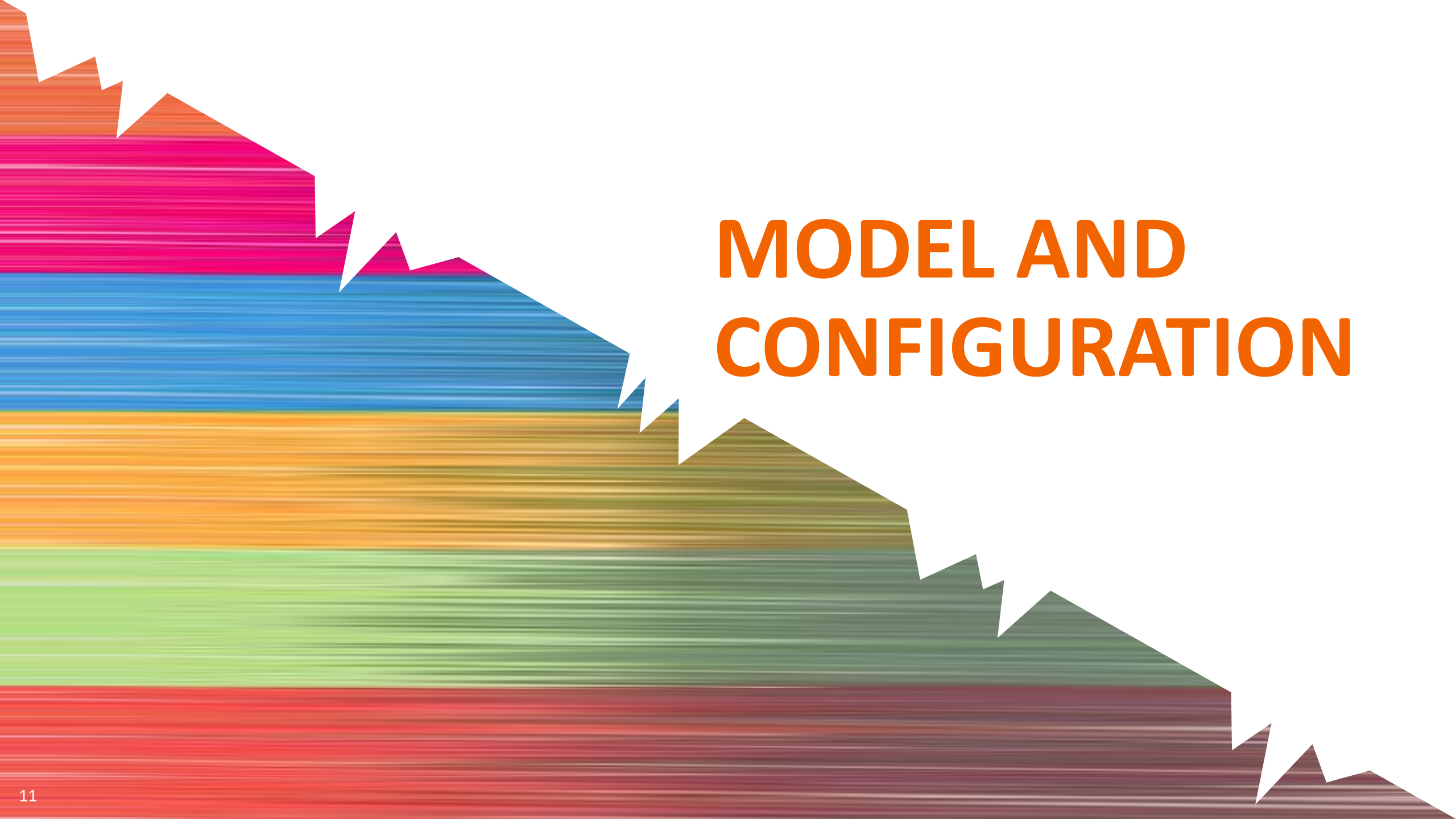
The existing researches focus on the build-and-test approach, which is risky. However, our approach was to develop a model to evaluate the numerical results.


RESEARCH
QUESTION

Research Question

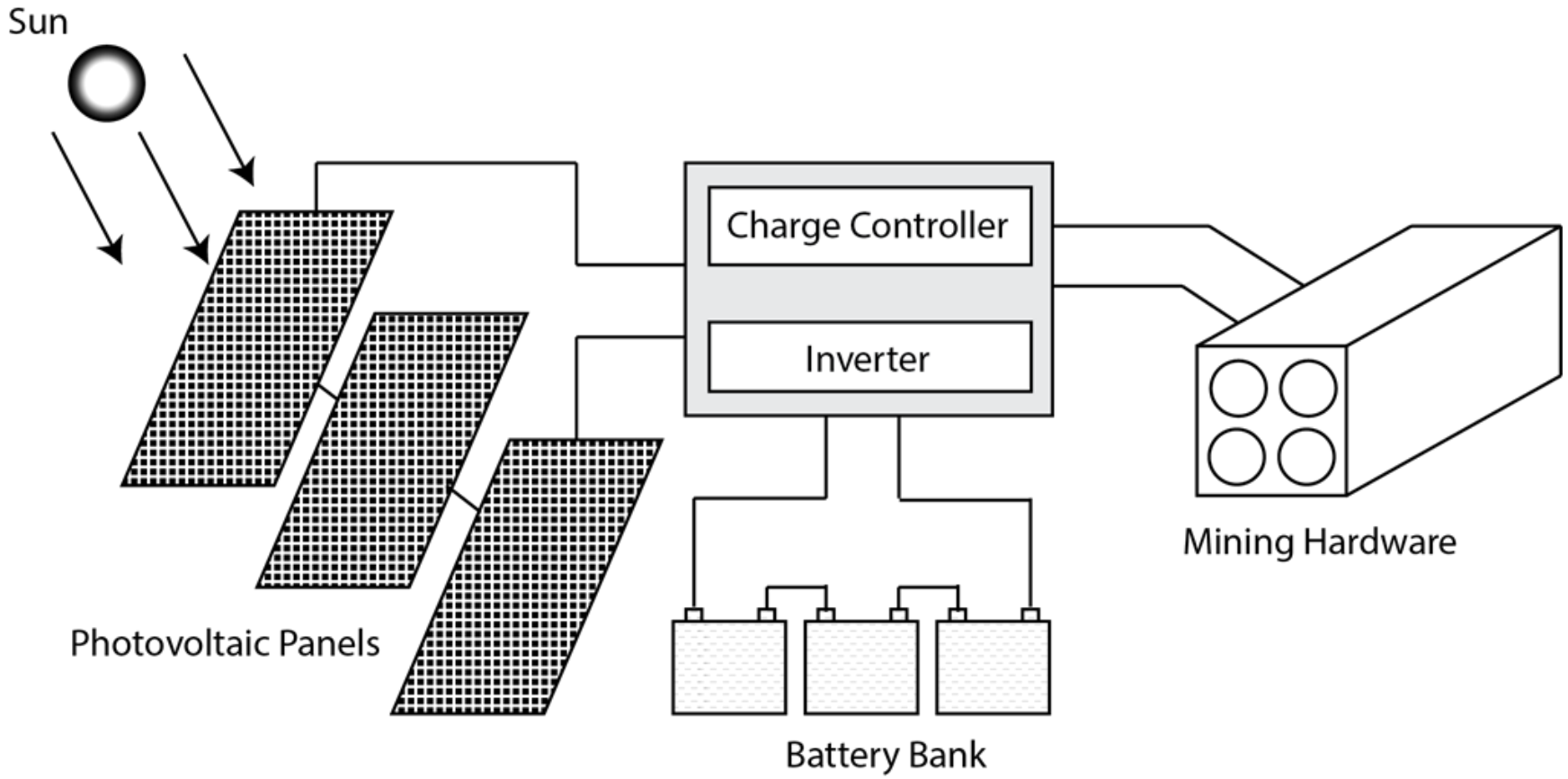


Whether the cryptocurrency mining can be performed sustainably while remaining profitable using solar energy systems?



MODEL AND CONFIGURATION

Model



A typical off-grid solar powered cryptocurrency mining setup

Model

FEASIBILITY MODEL FOR SOLAR-POWERED CRYPTOCURRENCY MINING SETUPS

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Abstract

This paper presents a model for assessing the financial viability of cryptocurrency mining setups powered by off-grid solar photovoltaic (PV) systems. The model considers the features of mining hardware, the network attributes, the price of virtual currency and the solar potential of the installation site, to predict the payback period of the investment in months. As a case study, the feasibility of mining using various state-of-the-art Application-Specific Integrated Circuits (ASICs) and Graphics Processing Units (GPUs), powered by PV installed in New Zealand has been investigated. The results show that for ASICs setups, the initial cost is very high compared to GPU setups. However, considering the best-performing cryptocurrencies, the payback period for ASICs is much shorter than for GPU setups. This work will help to improve the sustainability of cryptocurrency mining businesses by reducing their dependence on exhaustible energy resources and their impact on the environment.

Keywords: Blockchain; Off-grid PV; Proof-of-Work; Renewable Energy; Payback

Feasibility Model For Solar-powered Cryptocurrency Mining Setups

Rehman, N.U., Yap, M., Afzal, M., Rehman, A. and Horasia, C. (2021)

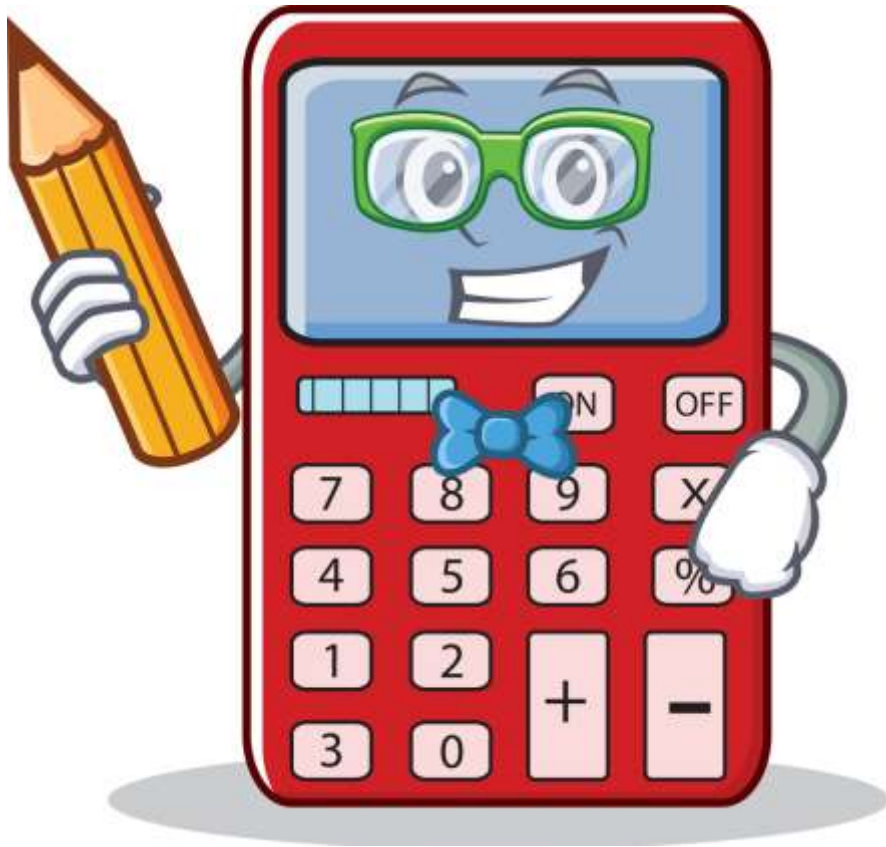
Southern Institute of Technology Journal of Applied Research (SITJAR)

https://www.sit.ac.nz/sitjar

Model

The model comprise of the following variables:

- The daily energy required by the mining equipment.
- Energy that can be supplied by the PV panels.
- Cost of various components of the setup such as panels, batteries and miner, etc.
- The revenue depends upon the market price of coin, the miner speed and the network parameters.
- The payback period depends upon the setup cost and the revenue.



Configuration

Table I. Mining hardware characteristics [9]

Hardware	Type	Coin	Cost*	Hash rate	Power
Antiminer E9	ASIC	ETH	US$ 30,000	3.0 Th/s	2,600 W
AMD Radeon RX 6800	GPU	ETH	US$ 2,143	64 Mh/s	150 W

* Ganti, 2021; MightyApe, n.d.

Configuration

Table II. Ethereum market price and its network Parameters [30][11][21]

Parameter	Value
Market Price	4,469.97 USD/ETH
Net Hash	523 Th/s
Block Time	13.57 s/block
Block Reward	2.38 Coins

Configuration

Table III. Design Parameters for the Solar Photovoltaic (PV) Systems	
Days of Autonomy	2 days
System Voltage	48 V
PV panel Rated Power	445 watts (aasolar.co.nz)
PV panel Surface Area	2.17 m^2
PV panel Voltage	48 V
Battery Capacity	440 Ah
Battery Voltage	24 V
PV panel Temperature Coefficient	-0.37%/℃
PV panel Tolerance	±1%
PV panel Dirt Related Losses	2%
Inverter Losses	10%
Battery Losses	5%
Witing Losses	5%
Losses to Suboptimum Tilt and Orientation Angles and Shadowing	3%

Configuration

Table IV. Solar Photovoltaic (PV) System Components' Pricing

Component	Unit Price
PV panel	0.7 $/watt
Inverter	0.31 $/watt
Charge Controller	3.5 $/A
Battery	1.0 $/A

Configuration

Table V. Financial Assumptions	
Parameter	**Assumption**
Down payment (Upfront Payment)	**10%**
Mortgage Interest	**30%**
Mortgage Tenure	**2**

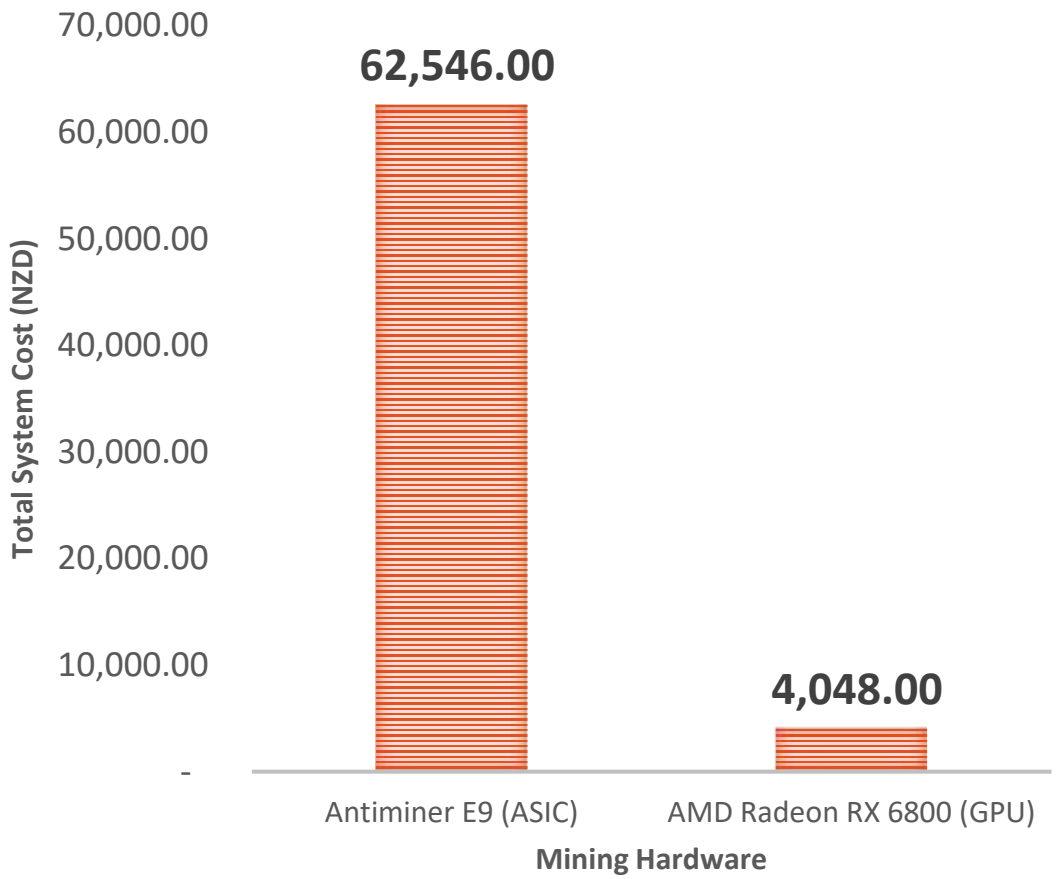
RESULTS

Result

Table VI. Photovoltaic (PV) System Design		
Design Parameters	**Antiminer E9 (ASIC)**	**AMD Radeon RX 6800 (GPU)**
Daily Energy Demand	**90 kWhr/day**	**4 kWhr/day**
PV Array Peak	**22 kW**	**1kW**
PV panels	**51**	**3**
Inverter	**25 kW**	**1.5 kW**
Charge Controller	**460A**	**25A**
Battery Bank Capacity	**7325Ah**	**370Ah**
Number of Batteries	**18**	**2**

Results

Total system cost for solar-powered cryptocurrency mining setups



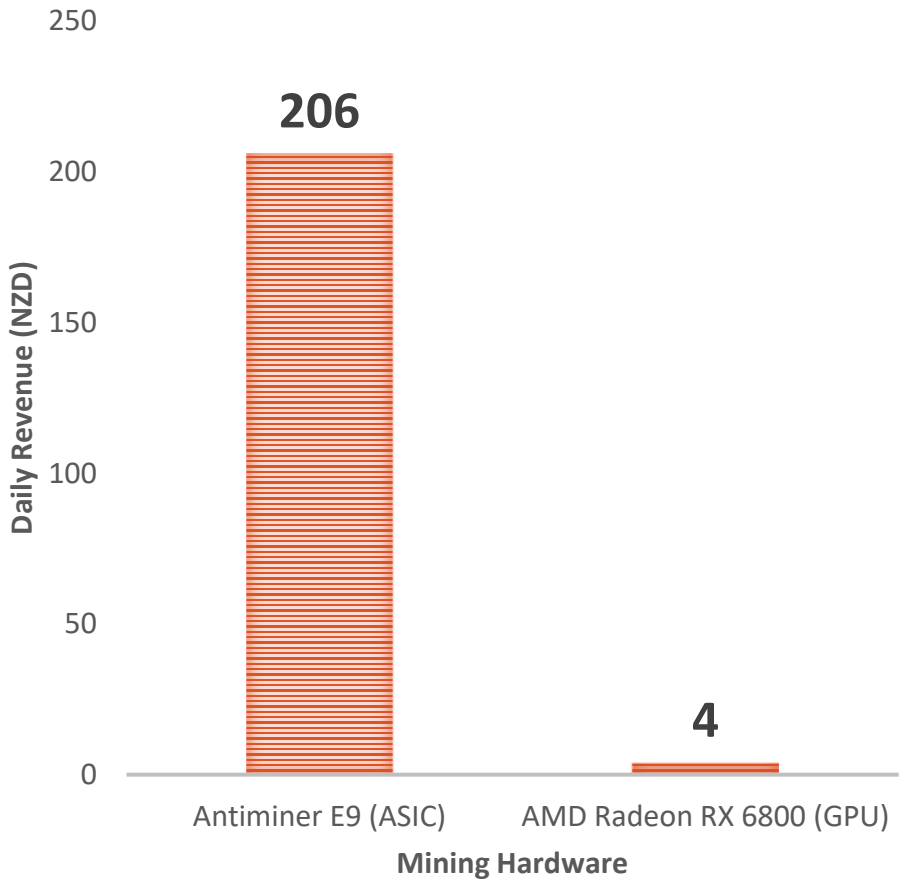
The total system cost of ASIC is

~15x

more than GPU.

Results

Daily revenue from the solar-powered cryptocurrency mining setups



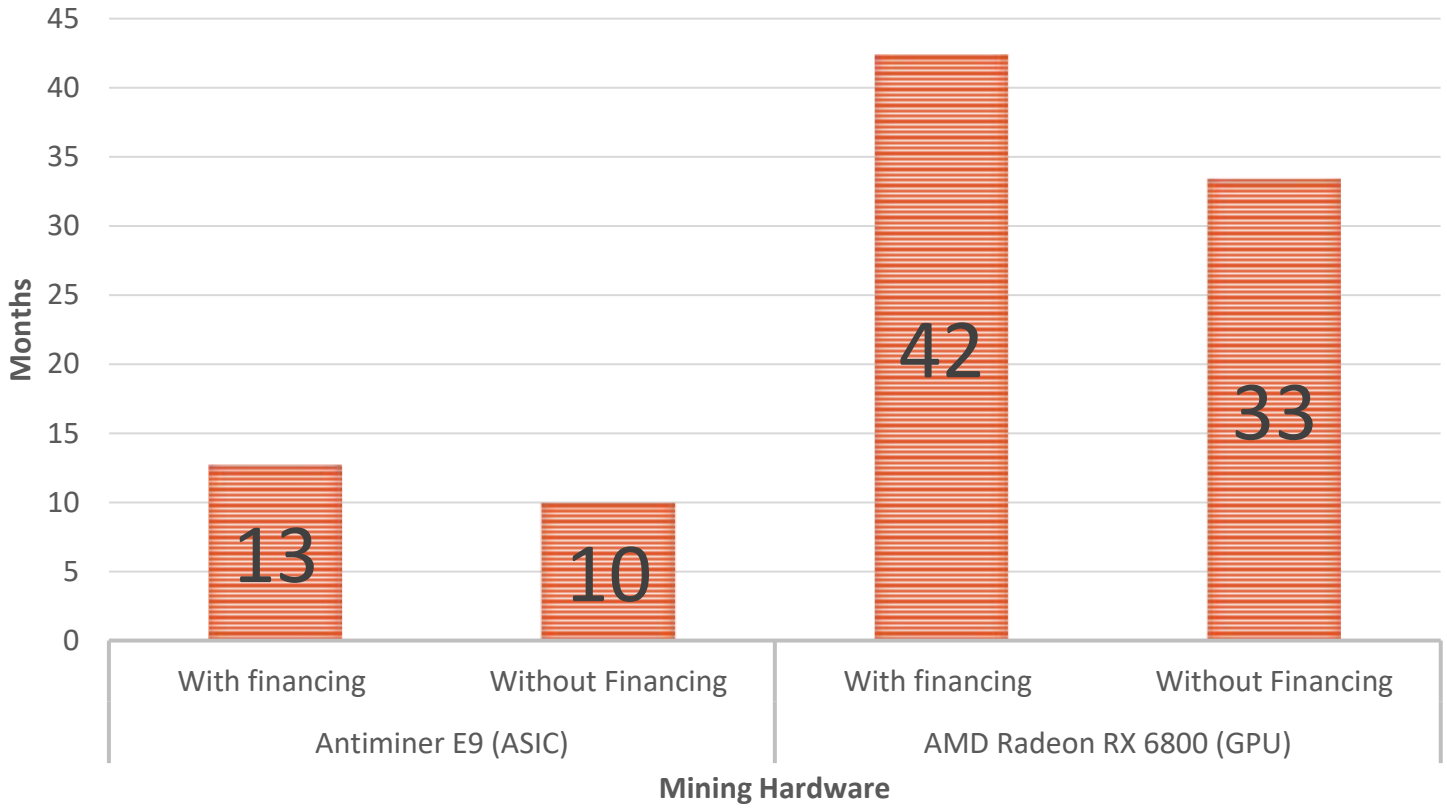
The daily revenue from ASIC is

~51x

more than GPU.

Results

Payback period of solar-powered cryptocurrency mining setups



The payback period of ASIC is

~3x

faster than GPU both with or without finance.

CONCLUSION

Conclusion

ASIC setup is found to be better than GPU in terms of both the daily revenue and the payback period.

Bitman Antminer E9 (ASIC)

AMD Radeon RX 6800 (GPU)

DISCLAIMER

Disclaimer

There are risks associated with investing in solar-powered cryptocurrency mining.

We recommend you seek advice from your financial adviser before taking any action.

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Thank you!

Questions & Answers

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