



FAKULTEIT INGENIEURSWESE  
FACULTY OF ENGINEERING



UNIVERSITEIT  
STELLENBOSCH  
UNIVERSITY

# PV Solar System Design and Analysis for a Domestic Swimming Pool Pump

Presentation

C Lewis

17006384

Supervisor: Prof TM Harms



# Contents

- Introduction
- Literature
- System Specifications
- Stand-Alone System Design Procedure
- Grid-Tied System Design Procedure
- Financial Performance
- Conclusion and Recommendation
- Summary





# Introduction

- Energy crisis – how can the general consumer contribute?
- Limitations – high initial costs & regulatory limits.
- 1 kW 220 V AC domestic swimming pool pump.
- Effectiveness and impact of optimized PV systems

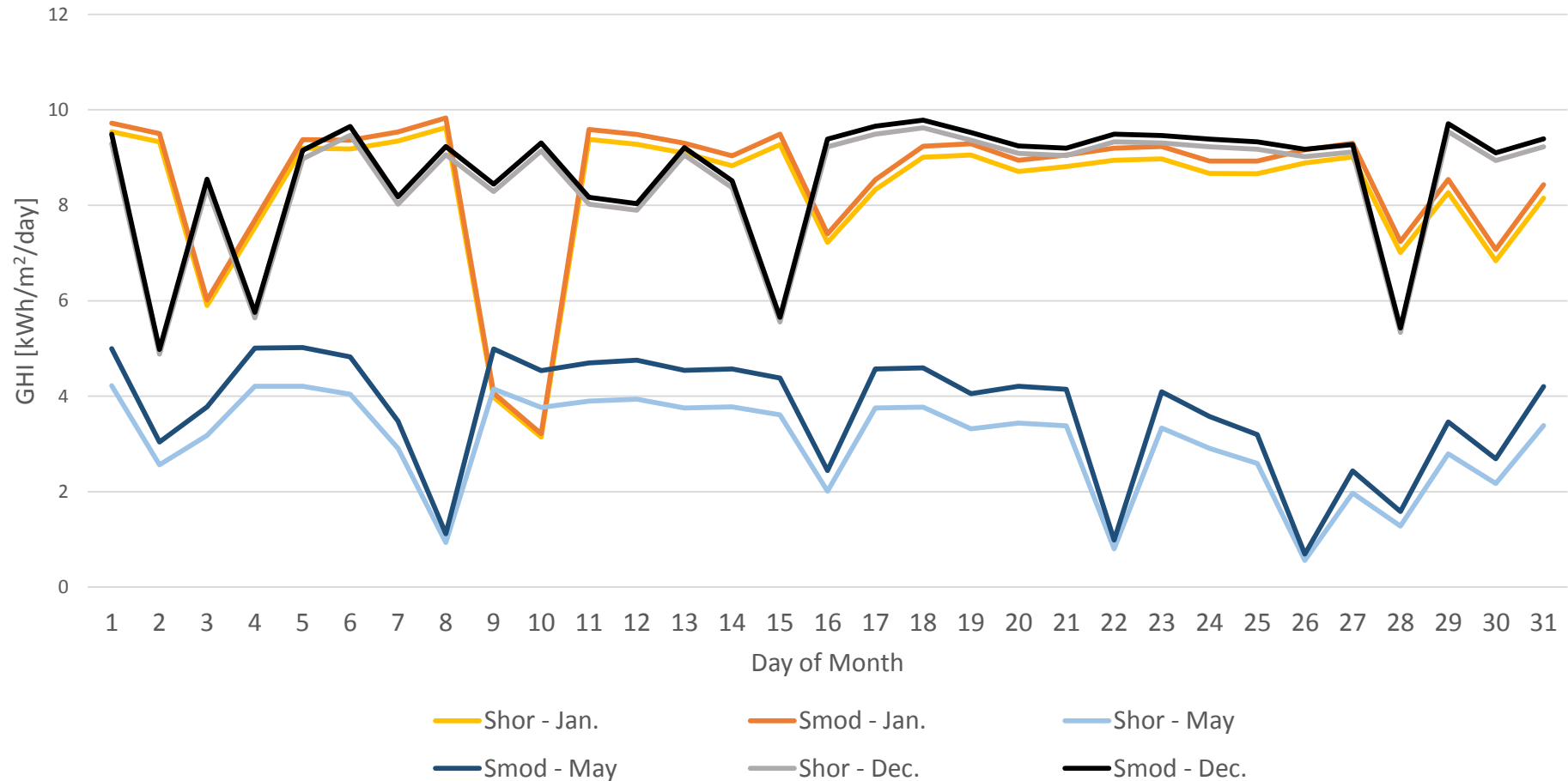


# Literature

- Pool Pump
  - Load difficult to predict
  - Inductive load
- Designs
  - Stand-Alone (No Storage)
  - Stand-Alone with Battery Bank
  - DC Pump Alternative
  - Grid-Tied
  - Grid-Tied (Pump Exculsion)

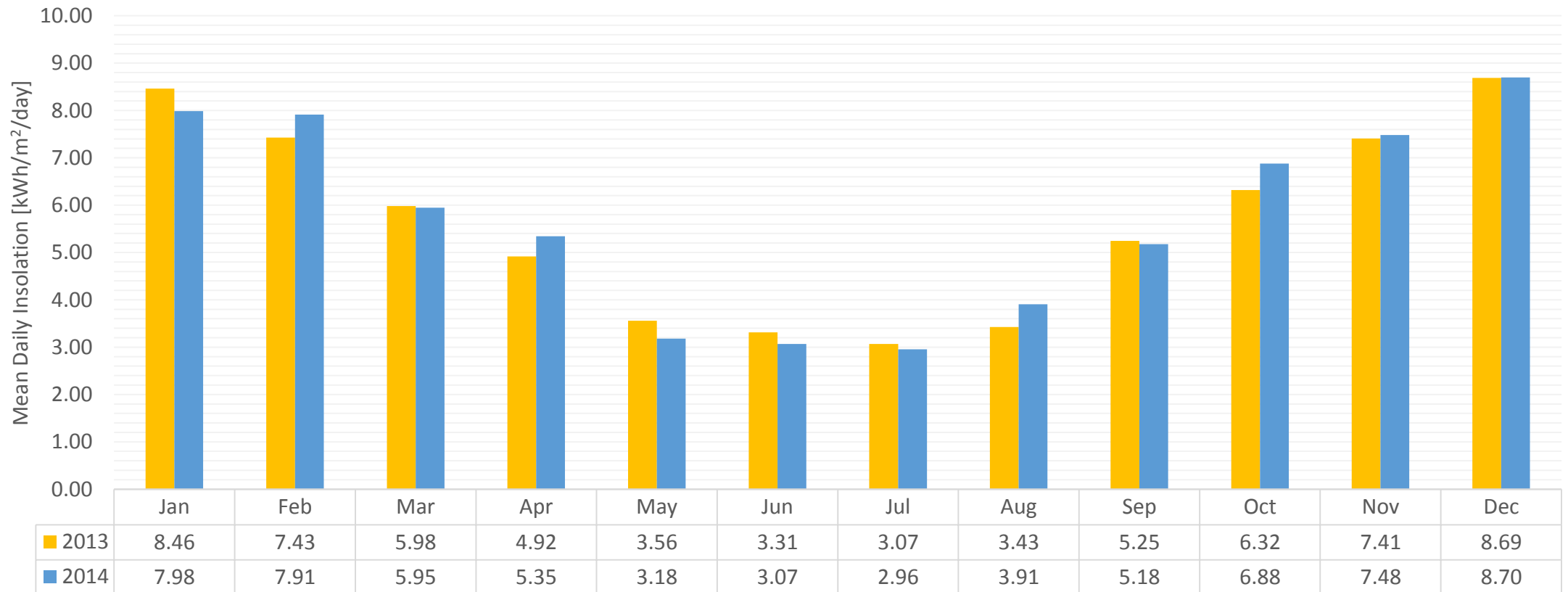
# System Specifications

Radiation Incident Horizontal Versus 10° Tilted Surface



# System Specifications

Mean Daily Insolation for 2013 and 2014



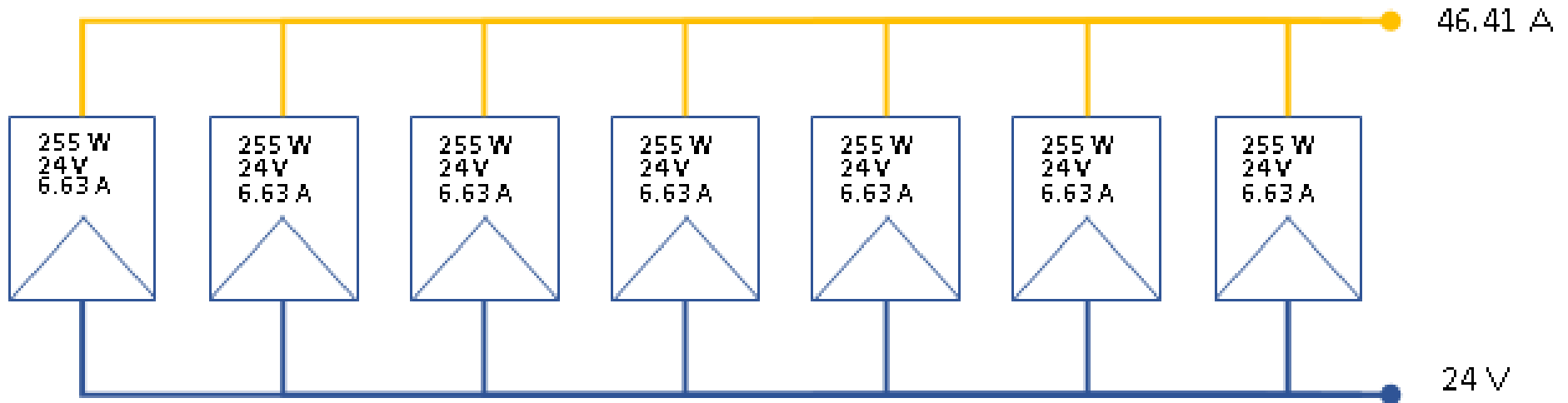
# Stand-Alone System Design

Total daily energy demand and system parameters

<b>1 kW 220 V/AC Pool Pump</b>	<b>Summer</b>	<b>Winter</b>
Maximum Hours Required per day	5	3
Max. Watt-Hours [Wh]	5 000	3 000
Add 25 % inefficiencies	6 250	3 750
Minimum Hours Required per day	4	2
Min. Watt-Hours [Wh]	4 000	2 000
Add 25 % inefficiencies	5 000	2 500
Daily Charge Req. Max. [Ah/day]	260.40	156.25
Charge Current Max. [A]	43.648	50.210

# Stand-Alone System Design

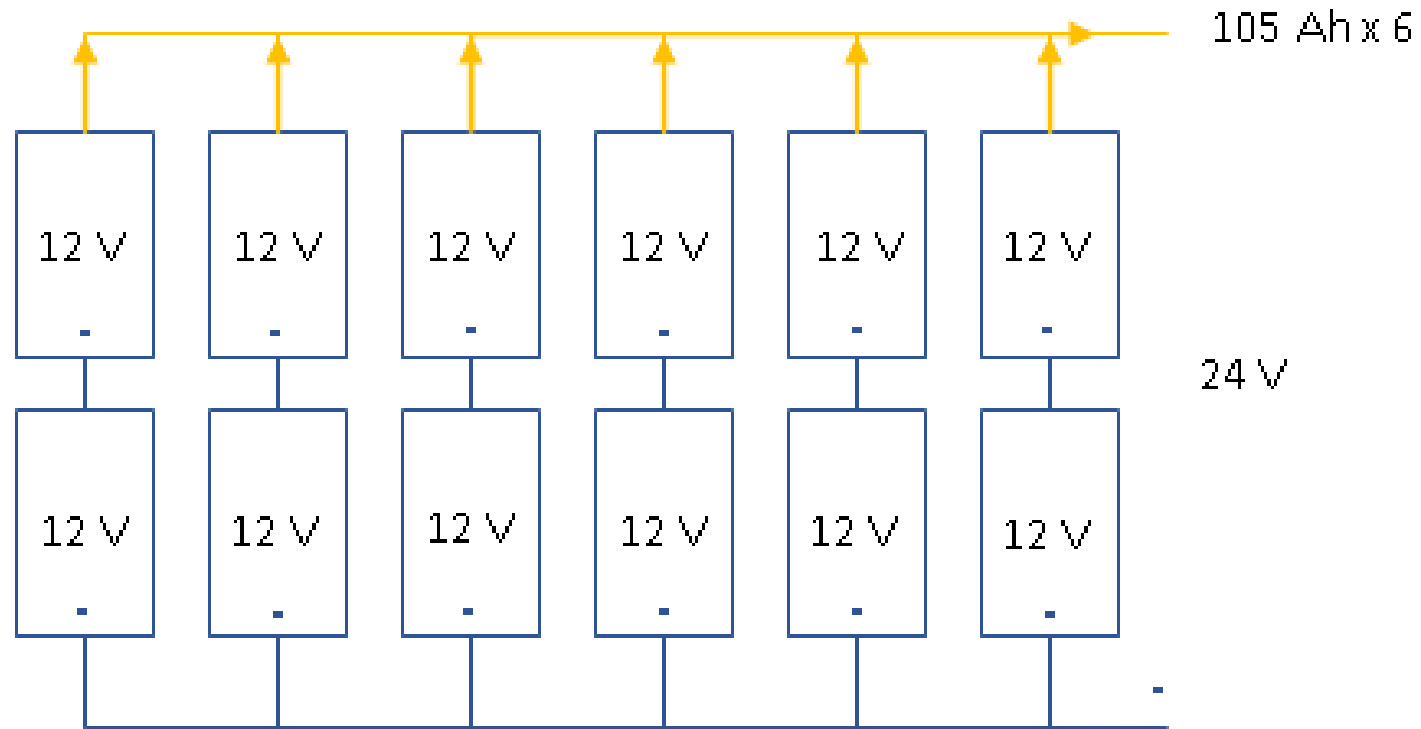
Solar Module Connection: Renesol Virtus II Modules





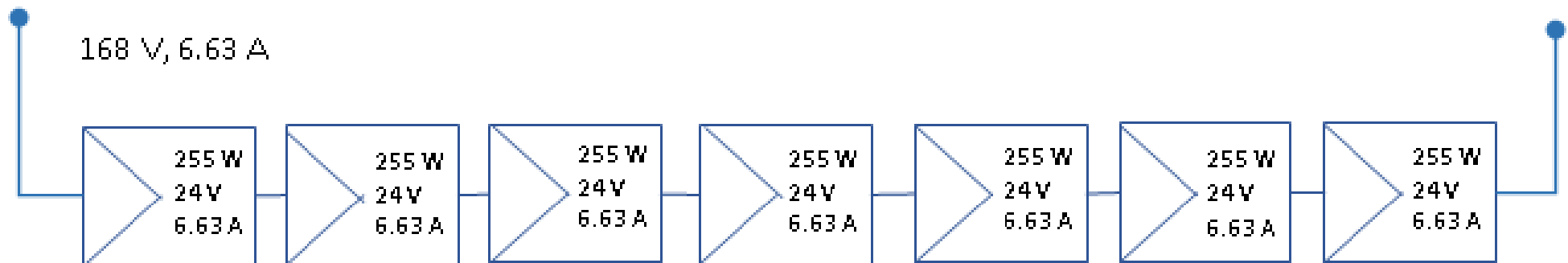
# Stand-Alone System Design

Batter Bank Connection: Deltec Calcium Alloy Batteries



# Grid-Tied System Design

Solar Module Connection: Renesol Virtus II Modules



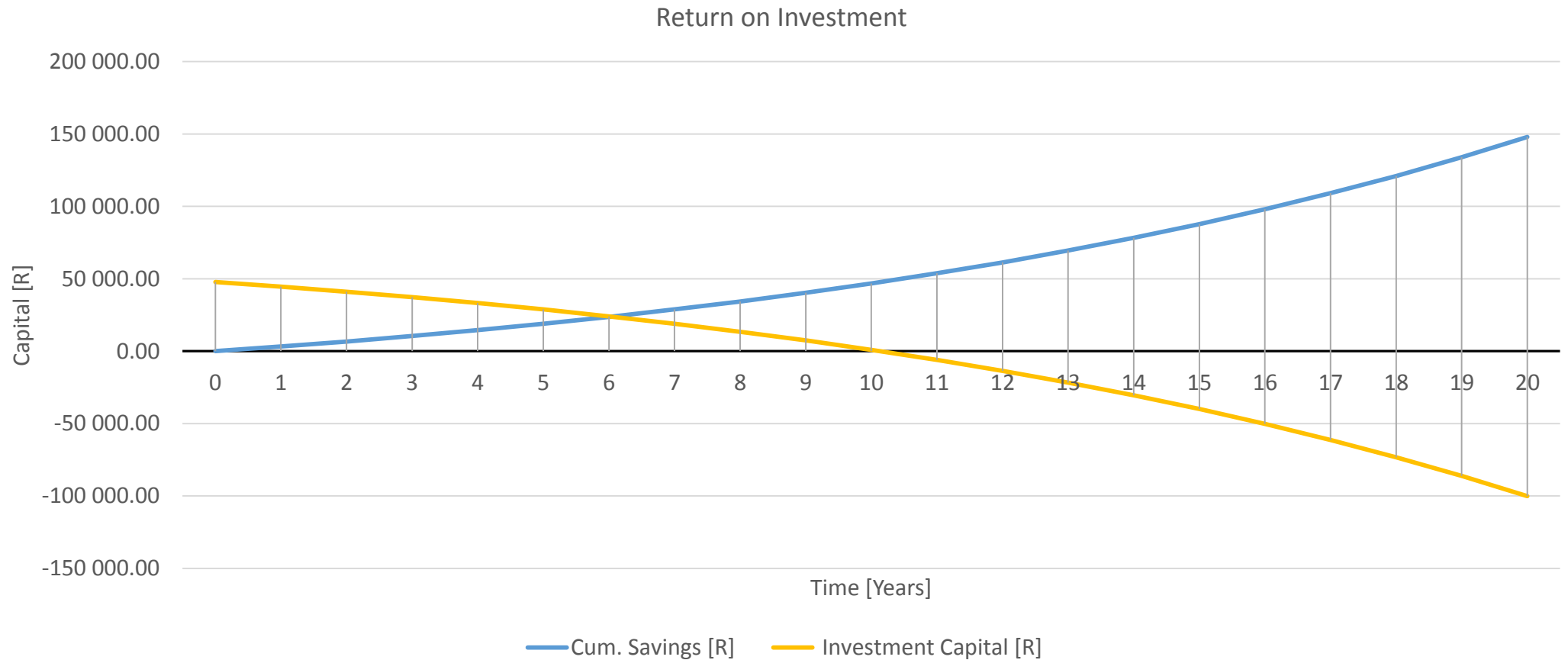
# Financial Performance

Inverter investment depreciation according to the diminishing-balance method, over 7 years

Date [Year]	Cost Price [R]	Calculation of Depr. [R]	Annual Depr. [R]	Accumulated Depr. [R]	Net Amount [R]
Inverter	19 902.00	-	-	-	19 902.00
1	19 902.00	50 % x 19 902.00	9 951.00	9 951.00	9 951.00
2	19 902.00	50 % x 9 951.00	4 975.50	14 926.50	4 975.50
3	19 902.00	50 % x 4 975.50	2 487.75	17 414.25	2 487.75
4	19 902.00	50 % x 2 487.75	1 243.88	18 658.13	1 243.88
5	19 902.00	50 % x 1 243.88	621.94	19 280.06	621.94
6	19 902.00	50 % x 621.94	310.97	19 591.03	310.97
7	19 902.00	50 % x 310.97	155.48	19 746.52	155.48
			19 746.52		

# Financial Performance

Return on investment of a 1.785 kW system



# Conclusion and Recommendation

- South Africa – great solar potential
- Customization of system – minimum cost, maximum yield
- Increased installations – increased accessibility
  
- Most advantageous system cannot be installed yet