# THE COST ANALYSIS OF IMPLEMENTING SOLAR PHOTOVOLTAIC SYSTEM FOR CONSUMERS IN PENINSULAR MALAYSIA BASED ON CURRENT AVAILABLE SCHEMES

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A project report submitted in partial fulfilment of the requirements for the award of Master of Engineering (Electrical)

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April 2020

## DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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## APPROVAL FOR SUBMISSION

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#### ABSTRACT

With introduction of Net Energy Metering (NEM) and Self-consumption (SELCO) scheme, consumer able to generate own electricity for own usage by promoting renewable energy while reduces the electricity bill. However, it is difficult to determine the benefits it can offered without having promising outcome restraining the public especially the household residential to participate the scheme. In this project, the cost analysis of both schemes integrated into the imitation energy load profile obtained from five sample household are studied. Energy load profile of the household residential are determined and simulation done by using PVSYST to study the effects of integration of NEM and SELCO scheme with photovoltaic system. Energy analysis was done to determine the overall energy consumption from the photovoltaic system and the energy required from the grid after implementing both NEM and SELCO scheme to maintain the household load. The result obtained is the reduction of energy consumption from the grid is highly reduced by using NEM scheme. Levelized cost of electricity (LCOE) is used to determine the cost of electricity after implementing NEM and SELCO schemes. The comparison of the levelized cost of electricity among the schemes with the residential tariff cost to determine the cost benefits of the introduced schemes. One of the results obtained is that the levelized cost of electricity for NEM and SELCO scheme able to achieve at RM 0.20 / kWh and RM 0.44 / kWh. Besides that, from the results obtained, the cost spends on the electricity on the 20<sup>th</sup> year able to achieve 27% to 51% savings for NEM implemented compare with non-PV user. The PV system with NEM have shorter payback period of 6.5 to 7.5 years with conditional requirement of minimum monthly energy consumption of 830 kWh onwards.

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## LIST OF SYMBOLS / ABBREVIATIONS

kWh	Kilowatt-hour
MWh	Megawatt-hour
m	Meter
$m^2$	Area square meter
kW	Kilowatt
V	Voltage
AH	Ampere hour
COE	Cost of energy
NEM	Net Energy Metering scheme
SELCO	Self-consumption scheme
PV	Photovoltaic
SEDA	Sustainable Energy Development Authority
DOD	Depth of discharge
LCOE	Levelized cost of electricity
NPV	Net present value
ROI	Return of investment

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## **CHAPTER 1**

#### **INTRODUCTION**

## 1.1 General Introduction

Solar photovoltaic system is a system that uses solar panel to capture and convert sunlight energy into electrical energy. As the world is moving towards eco-friendly environment, the demand of opting solar photovoltaic (PV) system for energy production is gained as well. In 2019, Malaysia reintroduce Self-Consumption (SELCO) and Net Energy Metering (NEM) scheme to promote renewable energy growth in the country.

SELCO scheme is a scheme, where the electricity generated from solar photovoltaic system is purely for own consumption only. Main criterion for SELCO scheme is that, the electricity generated is not permissible to be exported into the grid.

NEM scheme is a scheme similar to SELCO scheme, which electricity generated from photovoltaic system can sustain own load system. The difference between NEM and SELCO scheme is the excessive electricity is permissible to export into the grid after sustaining own load system. The consumer that taken part into the scheme is identified as prosumer, which a person that produce and consume the electricity at the same time.

## **1.2** Importance of the Study

Electricity consumers are always seeking cheaper cost method to maintain cheaper electricity usage for their load consumption. With the study of cost analysis of implementing PV system for the consumers based on current available schemes, it can be beneficial for consumers, who are concerned of opting for eco-friendly solution that may bring no benefits after investments made. With the study conducted, the consumers can have sufficient information to decide whether the schemes introduced are beneficial.

### **1.3 Problem Statement**

With the promotion of renewable energy schemes by Sustainable Energy Development Authority (SEDA), it is target to cope with nationwide electricity power demand while able to help consumers to reduce electricity bill. However, without proper information and analysis being exposed to the public, it is difficult to judge whether it is benefits the consumer.

Different habits of electricity usage would have impact on the electricity bill being imposed. Energy planning is needed, so that the wastage electricity can be avoided hence the cost of electricity usage can be reduced. However, with the possibility of electricity tariff increases in the future, would directly impact the electricity bill of the consumers.

With vast of different sizes of PV system in the market, studies about household energy load are required to determine suitable PV system size that are available for residential usage. Economical PV system size is difficult to determine without sufficient household energy load profile.

## 1.4 Aims and Objectives

The aim of the study is to get cost analysis of implementing solar photovoltaic system for the residential consumers in Peninsula Malaysia based on current available schemes. The objectives of the study are per listed:

- > To investigate household energy consumption behaviour.
- To benchmark household energy load profile by obtain meter reading from household owner.
- To perform the cost analysis of current market solar photovoltaic system based on the customer demand and solar PV generation characteristic under current schemes.

## **1.5** Scope and Limitation of the Study

The study is mainly focus on residential consumer that consume electricity exceed 300 kwh per month. The meter reading data is logged manually and not using data logger devices due to device safety concern. The energy load profile created by PVSYST is to emulate similar sample as close as possible and the solar irradiance data used is based on available data from PVSYST software. Two sizes of the PV system are determined in the study based on the current available market for residential load.

## **1.6** Contribution of the Study

With the study of the cost analysis of implementing PV system for residential consumers, it can give clear picture of how much of savings can be achieve thru the new schemes introduced by SEDA. With more information that exposed to the public, the consumers can have sufficient information to decide whether to participate in the new schemes introduced by SEDA.

## **1.7** Outline of the Report

In the next chapter two literature review, the works done by different researchers in the relevant field will be discussed and determine the similarity or differences in the study. The methodology how the study being carried out will be listed under chapter three. The results obtained from the works will be discuss in chapter four. In the last part of the report chapter five, conclusion for the whole study and recommendation of future works will be made.

## **CHAPTER 2**

#### LITERATURE REVIEW

## 2.1 Introduction

Several factors that can affect the cost of the energy consumed in a residential home is being discussed in this chapter. One of the factors is the household energy consumption behaviour, which can affect overall total energy consumption. Besides that, other researcher paper related to the reintroduced NEM scheme, optimum battery depth of discharge and levelized cost of electricity are discussed too.

## 2.2 Household energy consumption behaviour

According to (Zhou & Yang, 2016), the behaviour on household energy usage can directly affect the total energy consumption of the household. In the paper written, the author discussed that the consumption behaviour can be influenced by various factors. The internal factor such as habit and environmental awareness influenced the decision on the energy consumption behaviour. The external factor such as demographic and luxurious lifestyle can affect the total assumption as well.

From the paper written by the author, it is agreed that there is high variance of energy consumption behavioural patterns that can lead to different total energy consumption. With the same kind of household appliances in two different houses, can have different total energy consumption because of the different behaviour of energy usage. Therefore, the study on the energy consumption behaviour on each household is crucial to determine the household total energy consumption.

According to survey done by (Aris et al., 2019), the air conditioners and water heaters are the main contributor to the household overall electricity consumption despite with the lower ownership rate. With the high electricity consumption by the two appliances, the usage duration of the appliances is significantly affecting the total electricity consumption. The impact on the household electricity consumption can be affected with the occupant behaviour such as setting the air conditioner timer.

In this project study, the total consumption of the household may have direct impact on the cost analysis of implementing PV system. Therefore, this behaviour factor will be one of the elements to determine the household load energy profile hence affecting total energy consumption.

## 2.3 NEM scheme

According to SEDA (*NEM – Renewable Energy Malaysia*, n.d.), the NEM scheme allows excessive energy generated by the consumer's solar PV to export to the grid after consumed by the consumer's load. The excessive energy exported to the grid would be given credit to offset with the energy taken from the grid on "one on one" basis. The "one on one" offset basis, would offset one unit of kWh of energy exported to the grid with one unit of kWh energy consumed from the grid. However, the credit obtained from energy exported to the grid, can only retained for 24 months and the credits obtained required to be offset within 24 months to avoid being forfeited after the duration.

With the latest NEM scheme being introduced, the medium and large residential household electricity consumer would be able to save more compared with low usage and non PV system user according to the paper written by (Razali et al., 2019). In the paper written by (Razali et al., 2019), direct comparison between initial NEM introduced in 2016 and the latest NEM scheme reintroduced, the latest NEM shows better results for large resident especially with 6 kW and 8 kW PV system.

However, the cost saving percentage shown in the paper written is based on the results tested from the Skudai, Johor state. It did not state whether the cost saving percentage are applicable to other states of Malaysia. With one same scheme, it may or may not have the same outcome for different parts of the Malaysia. Therefore, it can be study in this project whether similar results can be achieved throughout the study.

Besides that, the PV system price is getting cheaper, it can be assumed that the capital installation cost is reducing as well. Therefore, the cost saving percentage may be even higher and eventually benefits the small electricity user as well.

## 2.4 Optimum battery depth of discharge

Battery is one of the components that may or may not present in a PV system. In a stand-alone system, battery is one of the essential components but with grid connected system, it may not. In a modern world, battery technology comes with high cost. Depth of discharge is one of the factors that can affect the lifespan of a battery.

According to (Hlal et al., 2019), depth of discharge (DOD) is determined based on battery life cost. With high cost of a battery, it is required to determined optimum DOD to prolong the battery lifespan. In the paper written by the author, the DOD determined is 70% with the lowest cost of energy (COE) produced. With the 70% of DOD, it is cost effective with lead acid technology. In the paper written, the lowest COE able to be produced with 70% DOD is 0.20594 USD/kWh.

From the paper written by (Gomez-gonzalez et al., 2020), battery depth of discharge values affects the battery number of cycles, sizing capacity and the cost savings. With lower depth of discharge value, the number of cycles of the battery are higher, which translates to longer lifetime. However, the author stated that with lower depth of discharge, the sizing capacity of battery is smaller hence leads to smaller PV system size.

In this study, battery depth of discharge of 50% is being used. The reason is because to avoid stressing the battery with the maximum depth of discharge to prolong the battery lifespan. With battery depth of discharge lower than 50%, would require higher number of batteries need to be used in the PV system and leading to higher costing. Therefore, battery depth of discharge of 50% would be optimum choice of selection for the study.

## 2.5 Levelized cost of electricity

Levelized cost of electricity is a cost measurement of the electricity generated from the source. According to (Branker et al., 2011), declination of PV installation cost, and increases of grid electricity price, makes PV system become better economic benefits source of electricity. In the paper written by the author, it is stated that the summation of the present value of levelized cost of electricity multiplied with the energy generated is equivalent to present value net costs.

According to (Branker et al., 2011), the inputs for levelized cost of electricity need to be accurate as possible to achieve accurate outcome. With the lack of clear assumptions, the outcome of levelized cost of electricity can lead to higher outcome. The important inputs stated are system costs, financing, lifetime and loan term.

$$LCOE = \frac{\sum_{t=0}^{T} C_t / (1+r)^t}{\sum_{t=0}^{T} E_t / (1+r)^t}$$
(2.1)

Where,

Ct is present net value cost

E<sub>t</sub> is the rated energy output per year

r is discount rate t is time period

According to (Gan et al., 2014), the essential parameter to be considered in levelized cost of electricity are the system cost, inflation rate and degradation rate. It is stated that improvements in the annual energy output, extended system lifetime, lower inflation rate and operation maintenance cost could drive to lower levelized cost of electricity. With the lower levelized cost of electricity, the payback period would be reduced.

In this project study, the levelized cost of electricity would be used to determine the cost for both NEM and SELCO schemes to be compare with current residential electricity tariff. With the levelized cost of electricity calculation, alternative energy source can be taken into consideration.

## **CHAPTER 3**

## METHODOLOGY AND WORK PLAN

## 3.1 Introduction

The chapter explain the method to obtain energy load profile, simulation using PVSYST to emulate household load, and the analysis of the data obtained to compare cost beneficial based on the available scheme. Using causal-comparative method, the outcome of the cost analysis to be determined.



Figure 1: Flow chart of the project

### **3.2 Energy Load Profile**

In this study, meter reading records with the interval time of one hour is recorded for five numbers of household for a duration of one week. Five different household energy consumption can be used to study whether different pattern of energy consumption would have different outcome of the cost analysis for the schemes.

With the meter reading records, the hourly energy consumption can be obtained for the weekday and weekend load profile. The average value of the five days from Monday to Friday is obtained for weekday load profile and average value of Saturday and Sunday for the weekend profile.

Total numbers of people staying in all houses are different. With more people staying in a house, the energy consumption assumed to be higher than lesser people staying in the house. Besides that, simple interview is conducted to gain more information about the type and the usage duration of loads in a household to study and understand the behaviour of the household usage for simulating the household energy consumption.

	Number of persons stay in a house
House A	2
House B	4
House C	5
House D	8
House E	7

Table 3.1: Household Size

#### 3.3 System Design

Suitable PV system capacity that is available in the market, is obtained and use to simulate with the household load information collected. The area of PV module to be installed needed to be determined. The area size for the rooftop of the sample house is 59.5 m<sup>2</sup> with 8.5 m length (L) and 7 m wide (W) for one facet. The PV module used in this simulation is JA SOLAR JAM6-72-320/SI, and the inverter used are SUN2000L-5KTL and SUN2000L-8KTL by HUAWEI TECHNOLOGIES.

Two different sizes of PV system capacity, which are 6 KWp and 9 KWp used to simulate the effect of the NEM and SELCO scheme on the household load. For the PV system of 6 kW, twenty numbers of PV modules are used and for the PV system of 9 kW, twenty-eight numbers of PV modules are used.

For the PV design for SELCO scheme, the battery size of 24 V 784 AH is used for 6 kW system capacity and battery size of 36 V 784 AH is used for 9 kW system capacity. The reason 784 AH battery is chosen because it is the nearest value to 800 AH available in PVSYST. The battery depth of discharge is set at 50% for the simulation. This is to prolong the lifecycle of the battery by not fully discharge the battery. However, assumption made is that battery optimization is not conducted. The figures shown below are the parameters set in the PVSYST for simulation.

🎯 Orientation, Variant "Own house"			-		×
Field type Fixed T	ilted Plane	•			
Field parameters           Plane Tilt         5.0         -1         [°]           Azimuth         0.0         -1         [°]	Tilt 5°	West	Azimuth 0	)°	Faet
	•	West 1	South		Lusi
	Yearly meteo yiel	d			
Coptimization by respect to     Yearly irradiation yield     Summer (Apr-Sep)     Winter (Oct-Mar)	Transposition Factor Loss By Respect To Global on collector p	or FT Optimum plane <b>160</b>	1.00 0.0% 00 kWh/m²		
	Show	v Optimization			
		X Cance		ок 🗸	

Figure 2: Orientation of the PV module

lobal System configuration		Global system s	summary		
Number of kinds of sub-arrays		Nb. of modules	20	Nominal PV Power	6.4 kWp
	1	Module area	39 m²	Maximum PV Power	6.2 kWa
Simplified Schema		ND. of inverters	1	Nominal AC Power	5.0 KW2
/ Array					
Sub-array name and Orientation		Presizing Help			
Name PV Array		O No sizing	Enter plar	ned power 💿 6.0 k	Wp
Orient. Fixed Tilted Plane	Tilt 5 Azimuth 0	Resize	or available are	a(modules) C 37 m	12
Select the PV module					
Available Now 🔽 Filter All PV m	nodules 💌		Appr	ox. needed modules 19	
JA Solar	Si-mono JAM	6-72-320/SI	Since 2012	Manufacturer 2014 💌	👌 Open
Sizing	y voltages : Vmpp (60	°C) 31.9 V			
J Use Optimizer	VOC (-10	-() 31.3 V			
Select the inverter					▼ 50 Hz
Available Now   Output voltage	230 V Mono 50Hz				🔽 60 Hz
Huawei Technologies 💌 5.0 kW 90 ·	500 V TL 50/60	Hz SUN2000L-5KTL		Since 2017 🔹	🐴 Open
Nb of MPPT inputs 2	Operating Voltage:	90-500 V	Inverter power use	d <b>5.0</b> kWac	
Use multi MDDT feature	Input maximum voltac	e: 600 V	inverter with 2	мррт	
ose multi-rippi feature			inverter men z		
Design the array					
Number of modules and strings		Operating conditions			
	??	Vmpp (60°C) 319	v		
	1	Vmpp (20°C) 385	V		
Mod. in series 10 . I between 3 ar	nd 11	Voc (-10°C) 513	V		
Nbre strings 2 - I 🔽 only possibilit	y 2	tooo		Catholic Index	ere .
, .		mane irradiance 1000	W/m² May	operating power	57 100
Overload loss 0.0 % Show s	izing	mpp (STC) 17.1 A	Mdx	t 1000 W/m <sup>2</sup> and 50°C)	<b>3.7</b> KW
Pnom ratio 1.28	<u> </u>	30 (310) 10/0 M		and bo by	
who and the second second	20		A	Deven (CTC)	C . A 1444-

Figure 3: Parameters set for 6 kW rated power system



Figure 4: Module layout for 6 kW rated power system

## 3.4 **PVSYST Simulation**

The PVSYST software tool is used to simulate the five different household load consumption with NEM and SELCO scheme. The household load consumption is set for weekday and weekend load profile. Two separate simulation data will be simulated for each PV system according to two different load profile from weekday and weekend.

For the NEM scheme simulation, no battery parameter is included in the simulation. This is because NEM scheme is based on "one on one" offset basis. The NEM scheme simulation with the household load allows the remaining excessive energy after consumed by the household load to be export to the grid.

For the SELCO scheme simulation, battery parameter is needed to include in the simulation. This is because SELCO scheme is based on own load self-consumption basis. The SELCO scheme simulation with the household load set at not allowable produced energy transfer to the grid. The simulation results data such as annual energy production, energy consumption by the user from the solar and the grid are used to perform cost analysis based on the schemes.

### 3.5 Energy Analysis

For the energy analysis, simulation results obtained from PVSYST are analysed. Few information obtained from PVSYST such as annual energy production, energy consumption from PV and energy consumption from the grid are taking into analysis. The results obtained from the PVSYST are in annual basis and the analysis needs to be break into monthly basis because for the NEM and SELCO scheme able to compare directly with the cost of electricity bills, which obtained by monthly basis.

Few assumptions are made in this analysis to ease the studies to be carried out. For the first assumption, the irradiance data used in the PVSYST are assumed to be the same for the whole year. With this assumption made, the irradiance received on the PV module are the same for every month. Another assumption made for the analysis, is the monthly energy load consumption by the household are fixed constant. The assumption is made because it is to assume the difference on the changes of the monthly energy load consumption are not very high. Few information needed to be analysed and calculate from the results obtained from the PVSYST. Information that needed to be calculated are:

- i. Household monthly energy consumption.
- ii. Household monthly energy production.
- iii. Remaining monthly energy required from the grid.

The household total energy consumption for the month is calculated by using the information from the results obtained from PVSYST. The equation (3.1) shows the equation to determine household monthly energy consumption.

$$E_M = \frac{E_{CPV} + E_{CG}}{12} \times 1000 \tag{3.1}$$

Where,

 $E_M$  is household monthly energy consumption (kWh)  $E_{CPV}$  is annual energy consumption from PV (MWh)  $E_{CG}$  is annual energy consumption from the grid (MWh)

The equation to calculate household monthly energy production for NEM and SELCO scheme are different. For NEM scheme, the total annual energy that produced by the PV system can be taken into monthly average value because of NEM scheme allows the excessive energy after consumed by the load to be export to the grid. From the results obtained from PVSYST, the energy consumed from the grid can be taken

into consideration as some of the energy from the grid are exported from the PV system. Household monthly energy production for NEM scheme is shown as equation (3.2).

$$E_{MP\_NEM} = \frac{E_{AP}}{12} \times 1000 \tag{3.2}$$

Where,

 $E_{MP\_NEM}$  is monthly energy production (kWh)

E<sub>AP</sub> is annual energy production (MWh)

For SELCO scheme, the total energy production for the household is calculated solely based on the total energy consumption from the PV. Unlike NEM scheme, SELCO scheme does not allow any excessive energy after household consumption to be export to the grid. The energy produced from the PV system solely consumed by the household load and to charge up the battery storage if there is low demand energy usage from the load. Therefore, monthly energy production is equally to the monthly energy consumption as shown at equation (3.3).

$$E_{MP\_SELCO} = \frac{\sum E_{AC}}{12} \times 1000 \tag{3.3}$$

Where,

E<sub>MP\_SELCO</sub> is monthly energy production (kWh)E<sub>AC</sub> is annual energy consumption from the PV system and battery (MWh)

For the remaining monthly energy required from the grid, the calculated household monthly energy consumption deduct with the household energy production. The remaining monthly energy required from the grid, is the energy that is still required from the grid to help sustaining the household load after implementing PV system for both NEM and SELCO scheme. The equation (3.4) shows the equation for determine the remaining monthly energy required from the grid.

$$E_{RG} = E_M - E_{MP} \tag{3.4}$$

Where,

 $E_{RG}$  is remaining monthly energy required from grid (kWh)  $E_{M}$  is monthly energy consumption (kWh)  $E_{MP}$  is monthly energy production (kWh)

### 3.6 Cost Analysis

The analysis results obtained from Section 3.5 is used to perform cost analysis. The effects on the electricity bills can be compared between non-PV system user and the available schemes. Net present value (NPV) and levelized cost of electricity are being performed using the data obtained from the simulation and market research. The results of the levelized of cost electricity will be compared with the grid electricity cost for the residential to justify the outcome of the study.

Net present value method is a method to determine the value invested into an investment with the present value. Net present value is inclusive of the initial setup cost for PV system and the lifetime operating and maintenance cost. The discount rate in net present value is set at 3%. Return of investment is benefits that can receive by a certain period of time after investment being made. The monthly saving electrical bill would be the return of the investment in this study. With the information of net present value and return of investment, the payback period for implementing PV system with current scheme can be determined.

Table 3.2: PV System Cost

System Size	System Cost	Maintenance Cost
6 kW system without battery	RM 30 000.00	RM 100 / year
9 kW system without battery	RM 41 000.00	RM 100 / year
6 kW system with battery 24 V 786 AH	RM 46 000.00	RM 100 / year
9 kW system with battery 36 V 786 AH	RM 65 000.00	RM 100 / year

Table 3.3: Electricity Tariff A – Domestic (From TNB)

For the first 200 kWh $(1 - 200 \text{ kWh})$ per month	RM 0.218 / kWh
For the first 100 kWh (201 – 300 kWh) per month	RM 0.334 / kWh
For the first 300 kWh (301 – 600 kWh) per month	RM 0.516 / kWh
For the first 300 kWh ( $601 - 900$ kWh) per month	RM 0.546 / kWh
For the next kWh (901 kWh onwards) per month	RM 0.571 / kWh
Minimum monthly charge	RM 3.00

$$NPV = \sum_{y=0}^{n} \frac{R_p}{(1+D)^y}$$
(3.5)

Where,

R<sub>p</sub> is savings or returns during single period, p

D is discount rate

y is number of periods

Levelized cost of electricity can be determined by using net present total cost over with total energy production for the lifetime of the PV system. The total energy production for the lifetime of the PV system requires to consider for the energy production degradation over the lifetime of the PV system. With the annual energy degradation of 1% for the PV system is considered, the total energy production for 20 years is determined. From a part of the cost analysis, a comparison of the monthly cost spends for non-PV user and PV user with the schemes to determine the overall cost benefits of the schemes.

$$LCOE = \frac{\sum_{t=0}^{T} NPV}{\sum_{t=0}^{T} E_t}$$
(3.5)

Where,

NPV is total net present value cost E<sub>t</sub> is total energy produced over PV system lifespan

Payback period (years) = 
$$\frac{\sum_{t=0}^{T} NPV}{ROI}$$
 (3.6)

## **CHAPTER 4**

## **RESULTS AND DISCUSSIONS**

#### 4.1 **Energy Load Profile**

The obtained hourly energy consumption for weekdays and weekend as shown below:

Table 4.	1: Weekday Hourly Energy Consumption
kdav	Energy usage (kWh)

Weekday	Energy usage (kWh)					
Time	House A	House B	House C	House D	House E	
12am to 1am	1	1	1	2	2	
1am to 2am	1	1	1	2	2	
2am to 3am	1	1	1	2	2	
3am to 4am	1	1	1	2	2	
4am to 5am	1	1	1	2	2	
5am to 6am	1	1	1	2	2	
6am to 7am	1	3	1	2	2	
7am to 8am	1	0	3	2	1	
8am to 9am	0	0	2	2	0	
9am to 10am	0	0	1	0	0	
10am to 11am	0	1	0	0	1	
11am to 12pm	0	0	1	1	0	
12pm to 1pm	0	0	0	0	0	
1pm to 2pm	0	1	1	1	1	
2pm to 3pm	0	0	0	1	0	
3pm to 4pm	0	0	0	0	0	
4pm to 5pm	0	1	1	1	1	
5pm to 6pm	0	0	1	1	1	
6pm to 7pm	1	1	3	2	2	
7pm to 8pm	2	3	4	6	6	
8pm to 9pm	1	3	5	6	5	
9pm to 10pm	1	3	3	4	6	
10pm to 11pm	2	2	2	3	3	
11pm to 12am	1	1	1	2	2	

Weekday	Energy usage (kWh)					
Time	House A	House B	House C	House D	House E	
12am to 1am	1	1	1	2	2	
1am to 2am	1	1	1	2	2	
2am to 3am	1	1	1	2	2	
3am to 4am	1	1	1	2	2	
4am to 5am	1	1	1	2	2	
5am to 6am	1	1	1	2	2	
6am to 7am	1	3	3	2	2	
7am to 8am	1	2	3	1	1	
8am to 9am	0	1	3	2	0	
9am to 10am	1	1	1	2	1	
10am to 11am	1	1	1	2	0	
11am to 12pm	0	1	1	1	1	
12pm to 1pm	1	1	1	1	0	
1pm to 2pm	1	1	1	1	1	
2pm to 3pm	1	1	1	1	0	
3pm to 4pm	0	1	1	2	1	
4pm to 5pm	1	1	1	2	1	
5pm to 6pm	1	1	1	2	1	
6pm to 7pm	1	1	2	2	2	
7pm to 8pm	2	3	3	6	6	
8pm to 9pm	2	3	3	6	5	
9pm to 10pm	1	3	3	4	5	
10pm to 11pm	2	3	3	4	4	
11pm to 12am	1	1	1	2	2	

Table 4.2: Weekend Hourly Energy Consumption



Figure 5: Weekday Energy Load Profile



Figure 6: Weekend Energy Load Profile

From the figure shown, the energy demand is higher during morning hour starting 6 am and after 6 pm in both weekday and weekend energy load profile. The higher energy consumption house appliances likely to operate frequently during this hour compared to other hours. Higher energy consumption on house D and E are because the numbers of house occupant are higher and the tendency to switch on more electrical appliances is higher, hence contribute to higher energy consumption especially in the between 6 pm to 10 pm period.

From the figure, it shows that the energy consumption during daytime between 8 am to 6 pm is lower compare to other time is because most of the house occupant is working and not in the house. With lesser occupant in the house, the tendency of the household appliance running is lower, which leads to the lower energy consumption at that period time as well.

## 4.2 Load Details

Table 4.3 shows the household load, which can have different energy consumption at one periodic time. Figure 7 to Figure 26 shows the load details and the hourly profile set at the PVSYST software to simulate the household load based on the energy load profile obtained on Section 4.1. However, it is unable to imitate the household load energy profile exactly 100%, there is minimal differences around 10% between the household load energy profile obtained from Section 4.1 and the imitation of the energy profile in PVSYST.

		Numł	per of Owne	rships	
Load	House A	House B	House C	House D	House E
Lights	20	26	28	30	30
TV / PC	1	2	2	3	3
Iron	1	1	1	1	1
Refrigerator	1	1	1	1	1
Washing machine	1	1	1	1	1
Instant water heater	1	1	2	2	1
Air conditioner	2	3	3	6	6

Table 4.3: Household Load

Daily cons	sumptions							
Number	Appliance	Power		Daily us	e	Hourly distrib	Daily en	ergy
20 -	Lamps (LED or fluo)	18	W/lamp	6.5	h/day	ОК	2340	Wh
1 :	TV / PC / Mobile	70	W/app.	6.0	h/day	OK	420	Wh
1 .	Iron	1200	W/app.	0.5	h/day	ОК	600	Wh
1 :	Fridge / Deep-freeze	3.00	kWh/day	24.0	h/day	OK	3000	Wh
1 .	Dish- & Cloth-washers	500.0	W aver.	1.0	h/day	ОК	500	Wh
1 .	Instant water heater	2000	W/app.	1.0	h/day	ОК	2000	Wh
2 :	Aircond	750	W/app.	4.5	h/day	OK	6750	Wh
	Stand-by consumers	1	W tot	24 h/d	ay 🔽	7 days/7	24	Wh
2 Appl	iances info			Total o	laily en	ergy	15634	Wh/day
				Total ı	nonthly	/ energy	335.0	kWh/month
Consump Year Seaso Month	ns	Veek-end ✓ Use or 5 ÷	<b>i or Week</b> hly during days in a	<b>ly use</b> week				

Figure 7: House A Weekday Consumption



Figure 8: House A Weekday Hourly Load Profile

umb	er Appliance	Power		Daily us	se	Hourly distrib	Daily en	ergy
20 -	Lamps (LED or fluo)	18	W/lamp	5.0	h/day	OK	1800	Wh
1 -	TV / PC / Mobile	70	W/app.	14.0	h/day	OK	980	Wh
1	· Iron	1200	W/app.	0.5	h/day	OK	600	Wh
1	Fridge / Deep-freeze	3.00	kWh/day	24.0	h/day	OK	3000	Wh
1	Dish- & Cloth-washers	500.0	W aver.	1.0	h/day	OK	500	Wh
1	Instant water heater	2000	W/app.	1.0	h/day	OK	2000	Wh
2	Aircond	750	W/app.	10.0	h/day	OK	15000	Wh
	Stand-by consumers	1	W tot	24 h/d	ay 🗆	7 days/7	24	Wh
2 4	opliances info			Total	daily en	ergy	23904	Wh/day
• •	ppidrices into			Total	monthly	energy	204.9	kWh/mont

Figure 9: House A Weekend Load Consumption



Figure 10: House A Weekend Hourly Load Profile

Consumptions Hourly	distribution						
Daily consumption	s						
Number Appliar	nce Power		Daily us	e	Hourly distrib	Daily en	ergy
ZG ÷ Lamps (L	ED or fluo) 18	W/lamp	5.0	h/day	ОК	2340	Wh
2 ÷ TV / PC /	Mobile 70	W/app.	9.0	h/day	OK	1260	Wh
1 · Iron	1200	W/app.	1.0	h/day	OK	1200	Wh
1 + Fridge / C	Deep-freeze 3.00	kWh/day	24.0	h/day	ОК	3000	Wh
1 - Dish- & C	loth-washers 500.0	W aver.	1.0	h/day	ОК	500	Wh
1 i Instant v	vater heater 2000	W/app.	1.5	h/day	ОК	3000	Wh
3 Aircond	750	W/app.	7.0	h/day	ОК	15750	Wh
Stand-by	consumers 1	W tot	24 h/da	y 🗆	7 days/7	24	Wh
? Appliances info	,		Total d Total n	aily en nonthly	ergy energy	27074 580.2	Wh/day kWh/month
Consumption defi Year Seasons Months	Week-en       ?     Week-en       5	d or Week	<b>:ly use</b> week				

Figure 11: House B Weekday Load Consumption



Figure 12: House B Weekday Hourly Load Profile

Nun	nber	Appliance	Power		Daily us	e	Hourly distrib	Daily en	ergy
26	÷	Lamps (LED or fluo)	18	W/lamp	5.0	h/day	OK	2340	Wh
2	÷	TV / PC / Mobile	70	W/app.	14.0	h/day	OK	1960	Wh
1	- 	Iron	1200	W/app.	1.0	h/day	OK	1200	Wh
1	÷	Fridge / Deep-freeze	3.00	kWh/day	24.0	h/day	OK	3000	Wh
1	÷	Dish- & Cloth-washers	500.0	W aver.	1.0	h/day	OK	500	Wh
1	÷	Instant water heater	2000	W/app.	1.5	h/day	OK	3000	Wh
3	÷	Aircond	750	W/app.	10.0	h/day	OK	22500	Wh
		Stand-by consumers	1	W tot	24 h/d	ay 🗆	7 days/7	24	Wh
2	Anoli	iances info			Total	laily en	ergy	34524	Wh/day
	OPPI	ances into			Total	nonthly	energy	295.9	kWh/mon

Figure 13: House B Weekend Load Consumption



Figure 14: House B Weekend Hourly Load Profile

	amps (LED or fluo) / / PC / Mobile	18	W/lamp	6.0	h/day	OK	3024	Wh
	/ / PC / Mobile	70	Milana	_				
1 - In			w/app.	10.0	h/day	OK	1400	Wh
•	on	1200	W/app.	1.0	h/day	ок	1200	Wh
1 ÷ Fr	idge / Deep-freeze	3.00	kWh/day	24.0	h/day	OK	3000	Wh
	ish- & Cloth-washers	500.0	W aver.	1.0	h/day	OK	500	Wh
2 ÷ In	stant water heater	2000	W/app.	2.0	h/day	OK	8000	Wh
3 ÷ Ai	rcond	750	W/app.	8.0	h/day	OK	18000	Wh
St	tand-by consumers	1	W tot	24 h/d	ay 🗂	7 days/7	24	Wh
2 Applian	res info			Total	daily en	ergy	35148	Wh/day
: Applian	Ces into			Total	monthly	energy	753.2	kWh/month

Figure 15: House C Weekday Load Consumption





	1		-	141.0	-		OV	2024	LAIL.
28		Lamps (LED or fluo)	18	vv/iamp	6.0	n/day	UK	3024	wn
2	÷	TV / PC / Mobile	70	W/app.	10.0	h/day	OK	1400	Wh
1	÷	Iron	1200	W/app.	1.0	h/day	OK	1200	Wh
1	÷	Fridge / Deep-freeze	3.00	kWh/day	24.0	h/day	OK	3000	Wh
1	-	Dish- & Cloth-washers	500.0	W aver.	1.0	h/day	OK	500	Wh
2	÷	Instant water heater	2000	W/app.	2.0	h/day	OK	8000	Wh
3	÷	Aircond	750	W/app.	9.5	h/day	OK	21375	Wh
		Stand-by consumers	1	W tot	24 h/d	ay 🗆	7 days/7	24	Wh
2 Appliances info				Total daily energy			38523	Wh/day	
Appliances into				Total monthly energy			330.2	kWh/month	





Figure 18: House C Weekend Hourly Load Profile

Num	iber	Appliance	Power		Daily u	se	Hourly distrib	Daily en	ergy
30	÷	Lamps (LED or fluo)	18	W/lamp	5.0	h/day	OK	2700	Wh
3	÷	TV / PC / Mobile	70	W/app.	14.0	h/day	OK	2940	Wh
1	÷	Iron	1200	W/app.	1.0	h/day	ОК	1200	Wh
1	÷	Fridge / Deep-freeze	3.00	kWh/day	24.0	h/day	ОК	3000	Wh
1	÷	Dish- & Cloth-washers	500.0	W aver.	1.5	h/day	ОК	750	Wh
2	÷	Instant water heater	2000	W/app.	2.0	h/day	ОК	8000	Wh
6	÷	Aircond	750	W/app.	6.0	h/day	OK	27000	Wh
Stand-by consumers 1 W to			W tot	24 h/day 🦳 7 days/7			24	Wh	
2 Appliances info				Total daily energy			45614	Wh/day	
					Total	monthly	energy	977.4	kWh/mont

Figure 19: House D Weekday Load Consumption



Figure 20: House D Weekday Hourly Load Profile

unit	er Appliance	Power		Daily us	se	Hourly distrib	Daily en	ergy
30	Lamps (LED or fluo)	18	W/lamp	5.0	h/day	OK	2700	Wh
3 -	TV / PC / Mobile	70	W/app.	14.0	h/day	OK	2940	Wh
1	· Iron	1200	W/app.	1.0	h/day	OK	1200	Wh
1	Fridge / Deep-freeze	3.00	kWh/day	24.0	h/day	OK	3000	Wh
1	Dish- & Cloth-washers	500.0	W aver.	1.5	h/day	OK	750	Wh
2 -	Instant water heater	2000	W/app.	2.0	h/day	OK	8000	Wh
6	Aircond	750	W/app.	8.0	h/day	OK	36000	Wh
	Stand-by consumers	1	W tot	24 h/d	lay 🔽	7 days/7	24	Wh
2 Appliances info			Total daily energy			54614	Wh/day	
Appliances into			Total monthly energy			468.1	kWh/month	

Figure 21: House D Weekend Load Consumption


Figure 22: House D Weekend Hourly Load Profile

unite	er Appliance	Power		Daily us	se	Hourly distrib	Daily en	ergy
30	Lamps (LED or fluo)	18	W/lamp	5.5	h/day	OK	2970	Wh
3	TV / PC / Mobile	70	W/app.	4.0	h/day	OK	840	Wh
1	Iron	1200	W/app.	1.0	h/day	OK	1200	Wh
1	Fridge / Deep-freeze	3.00	kWh/day	24.0	h/day	OK	3000	Wh
1	Dish- & Cloth-washers	500.0	W aver.	2.0	h/day	OK	1000	Wh
1	Instant water heater	2000	W/app.	1.0	h/day	OK	2000	Wh
6	Aircond	750	W/app.	7.0	h/day	OK	31500	Wh
	Stand-by consumers	1	W tot	24 h/d	lay 🗆	7 days/7	24	Wh
2 An	nliances info			Total	daily en	ergy	42534	Wh/day
: -+	pierices into			Total	monthly	energy	911.4	kWh/mont

Figure 23: House E Weekday Load Consumption



Figure 24: House E Weekday Hourly Load Profile

wun	nber	Appliance	Power		Daily us	se	Hourly distrib	Daily en	ergy
30	÷	Lamps (LED or fluo)	18	W/lamp	5.5	h/day	OK	2970	Wh
3		TV / PC / Mobile	70	W/app.	14.0	h/day	OK	2940	Wh
1	÷	Iron	1200	W/app.	1.0	h/day	OK	1200	Wh
1		Fridge / Deep-freeze	3.00	kWh/day	24.0	h/day	ОК	3000	Wh
1	÷	Dish- & Cloth-washers	500.0	W aver.	2.0	h/day	OK	1000	Wh
1	÷	Instant water heater	2000	W/app.	1.0	h/day	OK	2000	Wh
6	÷	Aircond	750	W/app.	7.0	h/day	OK	31500	Wh
		Stand-by consumers	1	W tot	24 h/d	ay 🔽	7 days/7	24	Wh
2	Anol	iances info			Total	daily en	ergy	44634	Wh/day
•	npp				Total	monthly	energy	382.6	kWh/mont

Figure 25: House E Weekend Load Consumption



Figure 26: House E Weekend Hourly Load Profile

# 4.3 Energy Analysis

Energy analysis is required to analyse each information obtained to determine the total energy required from PV system and the grid to sustain the load consumption. In the energy analysis, the results obtained from the PVSYST tool are analysed and discussed.

Description	Simulation Result (MWh) over the				ar
	House A	House B	House C	House D	House E
Annual energy	8.41	8.41	8.41	8.41	8.41
production					
Energy consumption	0.42	0.59	0.86	1.19	0.59
from PV (weekday)					
Energy consumption	3.66	6.47	8.32	10.72	10.51
from grid (weekday)					
Energy consumption	0.82	0.91	0.96	1.03	0.44
from PV (weekend)					
Energy consumption	1.69	2.71	3.09	4.71	4.25
from grid (weekend)					

Table 4.4: Results from PVSYST with 6 kW PV System for NEM scheme

From Table 4.4, it shows that with 6 kW PV system able to produce 8.41 MWh over the whole year. Monthly average energy consumption can be calculated for each house to be able to integrate with NEM scheme. Based on the NEM policy, the excessive energy produced after consumed by the house load can be export to the grid to be offset "one on one" basis with the energy consumed from the grid.

For house A, the total energy consumption for a whole year is 6.59 MWh. With the total energy production of 8.41 MWh, there is excessive of 1.82 MWh for a whole year. With monthly average energy production of 700 kWh and the monthly average consumption around 549 kWh. There are remaining of 151 kWh to export to the grid every month to be offset with the energy required from the grid. The result shows that the PV system of 6 kW capable of fully supply energy to the house A.

For the house B to house E, the energy consumption is higher than annual energy production. After deduct with NEM scheme "one on one" offset basis, remaining energy consumed from the grid is still charged by the utility company at a lower rate. Table 4.5 shows the remaining monthly energy required from the grid after offset with NEM scheme.

Description	House A	House B	House C	House D	House E
Annual energy	8.41	8.41	8.41	8.41	8.41
production (MWh)					
Annual energy	6.59	10.68	13.23	17.65	15.79
consumption (MWh)					
Monthly energy	700	700	700	700	700
production (kWh)					
Monthly load	549	890	1103	1470	1316
consumption (kWh)					
Remaining monthly	-152	189	402	770	615
energy required from	(excessive)				
grid (kWh)					

Table 4.5: Monthly Energy Analysis with NEM scheme

Table 4.6: Results from PVSYST with 9 kW PV System for NEM scheme

Description	Simulation Result (MWh) over the year				
	House B	House C	House D	House E	
Annual energy	11.78	11.78	11.78	11.78	
production					
Energy consumption	0.64	0.99	1.29	0.61	
from PV (weekday)					
Energy consumption	6.43	8.19	10.62	10.49	
from grid (weekday)					
Energy consumption	0.97	1.05	1.05	0.45	
from PV (weekend)					
Energy consumption	2.66	3.0	4.69	4.24	
from grid (weekend)					

Table 4.7: Monthly Energy Analysis with NEM scheme

Description	House B	House C	House D	House E
Annual energy	11.78	11.78	11.78	11.78
production (MWh)				
Annual energy	10.67	13.23	17.65	15.79
consumption (MWh)				
Monthly energy	983	983	983	983
production (kWh)				
Monthly load	890	1103	1471	1316
consumption (kWh)				
Remaining monthly	-93	120	488	333
energy required from	(excessive)			
grid (kWh)				

Table 4.6 show the energy production with 9 kW PV system for house B to house E. House A is not included for 9 kW PV system because from Table 4.5, it can see that the energy production from 6 kW PV system is supply excessive energy to the grid. It can see that the annual energy consumption for the house B is lesser than annual energy production, meanwhile the annual energy consumption for house C to house E are higher than their annual energy production. The study case for house B is similar with house A, where the energy produced by the PV system able to cope the total energy needed by the household load.

Table 4.7 shows the remaining of the energy required from the grid after NEM scheme offset to sustain the household load consumption. The result show that house B is oversupply 93 kWh monthly after NEM "one on one" offset with 9 kW PV system. Remaining energy consumption that required by house C to house E greatly reduced compared with the results shown on table 4.5. From the results shown, it can see that with higher capacity PV system with NEM scheme, the reduction of energy required from the grid is greatly reduced.

Description	Simulation Result (MWh) over the year				
	House A	House B	House C	House D	House E
Maximum annual	8.41	8.41	8.41	8.41	8.41
energy production					
(MWh)					
Energy consumption	3.04	3.27	3.45	3.69	3.12
from PV (weekday)					
Energy consumption	1.04	3.80	5.72	8.22	7.98
from grid (weekday)					
Energy consumption	1.99	2.17	2.2	2.18	1.71
from PV (weekend)					
Energy consumption	0.52	1.45	1.85	3.56	2.98
from grid (weekend)					

Table 4.8: Results from PVSYST with 6 kW PV System for SELCO scheme

Table 4.8 shows that the energy consumption directly from the PV system is higher compare with the results from Table 4.4. This is because of integration of battery system that required for SELCO scheme. In the event of no energy production occur, the battery system able to continue to supply to the house load until the depth of discharge reaches at 50% and switch into grid energy to be consume for house load.

Description	House A	House B	House C	House D	House E
Annual energy	5.03	5.44	5.65	5.87	4.83
produced based on					
load (MWh)					
Annual energy	5.03	5.44	5.65	5.87	4.83
consumption from PV					
(MWh)					
Monthly energy	419	453	470	489	402
production (kWh)					
Monthly load	549	890	1102	1470	1316
consumption (kWh)					
Remaining monthly	130	437	632	981	914
energy required from					
grid (kWh)					

Table 4.9: Monthly Energy Analysis of SELCO Scheme

Table 4.10: Results from PVSYST with 9 kW PV System for SELCO Scheme

Description	Simulation Result (MWh) over the year					
	House B	House C	House D	House E		
Maximum annual	11.78	11.78	11.78	11.78		
energy production						
(MWh)						
Energy consumption	4.64	4.91	5.18	4.53		
from PV (weekday)						
Energy consumption	2.43	4.26	6.72	6.58		
from grid (weekday)						
Energy consumption	2.83	2.94	3.01	2.43		
from PV (weekend)						
Energy consumption	0.8	1.11	2.73	2.26		
from grid (weekend)						

Description	House B	House C	House D	House E
Annual energy	7.47	7.85	8.19	6.96
produced based on				
load (MWh)				
Annual energy	7.47	7.85	8.19	6.96
consumption from PV				
(MWh)				
Monthly energy	622	654	682	580
production (kWh)				
Monthly load	890	1102	1470	1316
consumption (kWh)				
Remaining monthly	268	448	788	736
energy required from				
grid (kWh)				

Table 4.11: Monthly Energy Analysis of SELCO Scheme



Figure 27: Comparison among the schemes and non-PV system with 6 kW system



Figure 28: Comparison among the schemes and non-PV system with 9 kW system

From Figure 27 and Figure 28, it shows that with PV system running with NEM and SELCO schemes reduces the energy required from the grid to support the house load usage. Each house show reduction more than 50% on energy required from the grid for NEM scheme except house D on using 6 kW system shows 47% reduction on energy required from the grid. For NEM scheme case, there is a point where the energy produced are higher than the monthly consumption leads to zero energy require from the grid and supply the extra energy produced to the grid. This result can be seen on house A using 6 kW system and house B using 9 kW system. The excessive energy produced by the PV system can be export to the grid considering as energy storage and offset "one on one" energy consumed from the grid. This exchange enables the total energy generated by the PV system to be fully utilized.

For SELCO scheme, the reduction energy consumption from the grid shown on Figure 27 varies between 33% to 77% and Figure 28 varies between 45% to 70% among the houses. The variation of the reduction percentage is affected by the differences on the usage load during daytime, where the energy produced directly use for the house load usage. On the daytime where there is high energy consumption by the load, is beneficial because the energy produced can directly use for the load. On the contrast, during the daytime, where the energy consumption is low, the produced energy will charge the battery until full and stop produce the energy. The energy stored in the battery will be consumed once the PV module gain no sunlight to produce energy.

### 4.4 Cost Analysis

Cost analysis being carried out using the data obtained from the Section 4.3. The data of remaining energy required from the grid is used to calculate the electricity bill based on the residential electricity tariff.

	Electricity Bill Comparison (RM)					
	House A	House B	House C	House D	House E	
Without PV system	205.48	390.14	511.51	721.07	633.14	
NEM (6 kW)	3.00	41.20	129.63	324.62	239.99	
NEM (9 kW)	NA	3.00	26.16	174.52	94.54	
SELCO (6 kW)	28.34	147.70	249.27	441.85	403.59	
SELCO (9 kW)	NA	66.31	153.37	334.45	306.60	

Table 4.12: Electricity Bill Comparison Among Scheme



Figure 29: Electricity Bill Comparison Chart

Figure 29 shows the comparison electricity bill among the scheme with non-PV system installed. From the comparison, it shows that the highest reduction charges on the electricity bill is on NEM scheme with 9 kW system. Higher reduction effects on 9 kW system compared with 6 kW system is because of the higher energy produced by the larger capacity system. From the results shown, NEM scheme able to bring higher reduction on the electricity bill compared with SELCO scheme. Overall, both NEM and SELCO scheme capable to lower the electricity bill.

System Size	NPV Total Cost (RM)
6 kW system without battery	31 520.69
6 kW system with 24 V 784 AH battery	47 520.69
9 kW system without battery	42 520.69
9 kW system with 36 V 784 AH battery	66 520.69

Table 4.13: NPV Cost for 20 years

Table 4.14: Total Energy Production with NEM scheme for 20 years

System Size	Total Energy Production (KWh)
6 kW system without battery	153 140
9 kW system without battery	214 506

Table 4.15: Total Energy Production with SELCO scheme for 20 years

Sample House Load	Total Energy Production (kWh)						
	6 kW with battery system	9 kW with battery system					
House A	91 593	-					
House B	99 059	136 024					
House C	102 700	142 907					
House D	106 889	149 134					
House E	87 951	126 737					

From Table 4.14 and 4.15, it shows that the total energy produced for 20 years from both different schemes are different. For NEM scheme, the total energy production for 20 years entirely depends on the maximum energy that able to produce by the PV system. This is because the excessive energy produced after consumed by the house load, will directly feed into the grid and be offset "one on one" basis if the house load usage requires any additional energy from the grid.

For SELCO scheme, the total energy production for 20 years entirely depends the energy load profile. This can be seen on the results obtained in the table 4.15, the total energy production for house D is higher than house E, regardless the total energy consumption for house D is higher than house E. This is because the daytime energy consumption for house E is lower compared to house D, therefore the excessive energy produced will be stored on the battery storage sooner. At the period, where there is very low energy consumption during daytime, the PV system inverter will terminate the energy production to the house load when the battery storage is fully charge. In contrast with the house D, the scenario where the energy consumption during daytime is higher, the excessive energy produced after consumed by the higher house load will be stored at the battery storage with slower rate. This overall can fully utilized the maximum energy production of the PV system.

PV system with type of	Levelized Cost of Electricity (RM / kWh)				
scheme	А	В	С	D	Е
6 kW system (NEM)	0.21	0.21	0.21	0.21	0.21
9 kW system (NEM)	-	0.20	0.20	0.20	0.20
6 kW system (SELCO)	0.52	0.48	0.46	0.44	0.54
9 kW system (SELCO)	-	0.49	0.47	0.45	0.52

Table 4.16: Levelized Cost of Electricity



Figure 30: LCOE Comparison Chart

From the Table 4.16 and Figure 30, it shows each levelized cost of electricity for the both schemes comparing with the conventional grid user tariff. The comparison results shown that the levelized cost of electricity for NEM scheme is consistent for all five houses at RM 0.21 / kWh for 6 kW PV system and RM 0.20 / kWh for 9 kW PV system, which are lower than the cheapest block charges offer by the utility provider. This shows that with NEM scheme, the levelized cost of electricity is entirely depends on the PV system capacity size installed. As long as the PV system capacity size determined, the total amount of energy production able to predicted, the system able to fully produce the energy to be consume by the load and export the excess energy to the grid to be offset "one on one" basis if any energy usage taken from the grid.

The levelized cost of electricity for SELCO scheme is not consistent for all five houses. The results shown the levelized cost of electricity obtained for five houses in the range between RM 0.44 / kWh and RM 0.54 / kWh. The levelized cost of electricity obtained for SELCO scheme, is higher compared to the first block charges by the utility provider at the rate of RM 0.218 / kWh but is lower compared to the fourth block charges by the utility provider at the rate of RM 0.546 / kWh. The reason of this inconsistency of levelized cost of electricity is because of the differences of total energy consumption for different house load during daytime leading to the amount of excessive energy that able to store in the battery system. At the period, where battery is fully charged and no excessive energy allowable to export to the grid, the PV system will cut off the energy production, leading to total energy production is lesser as shown in Table 4.15.

PV system with scheme		Mont	hly costing	(RM)	
on a specific month	А	В	С	D	Е
Without PV system	205.48	390.14	511.51	721.07	633.14
6 kW system (NEM) on	136.33	174.53	262.96	457.95	373.32
1 <sup>st</sup> month					
6 kW system (NEM) on	136.33	216.01	325.40	524.02	439.93
240 <sup>th</sup> month					
9 kW system (NEM) on	-	182.16	205.32	353.68	273.70
1 <sup>st</sup> month					
9 kW system (NEM) on	-	196.38	253.16	443.17	361.94
240 <sup>th</sup> month					
6 kW system (SELCO)	228.34	347.70	449.27	641.85	603.59
on 1 <sup>st</sup> month					
6 kW system (SELCO)	244.60	388.46	494.04	690.39	643.56
on 240 <sup>th</sup> month					
9 kW system (SELCO)	-	345.47	432.53	613.61	585.76
on 1 <sup>st</sup> month					
9 kW system (SELCO)	-	395.38	491.35	678.19	640.36
on 240 <sup>th</sup> month					

Table 4.17: Comparison of The Cost on Specific Month



Figure 31: Comparison of Total Cost

The comparison of different month cost is needed because of energy degradation would affect the overall energy production over long time period. From results obtained at Table 4.17 and Figure 31, it shows that PV system with available

schemes able to reduce the cost spend on electricity for the first month after implementing PV system. It is noticeable that the cost spends on the 240<sup>th</sup> month, which equal to 20 years after implementing the PV system, the 240<sup>th</sup> month cost is higher compare to the first month of implementing the PV system.

For the NEM scheme, the cost of the 240<sup>th</sup> month is still lower compare with the non-PV system user. Overall reduction of the cost on the 240<sup>th</sup> month able to achieve in the between 27% to 51% for NEM scheme depending on the household load comparing with the non-PV system user. The reduction of the cost for the first month is expected to be higher because of the highest energy efficiency without any degradation.

For the SELCO scheme, the cost on the 240<sup>th</sup> month is varying depending on the household load. It is noticeable that the cost on the 240<sup>th</sup> month for household B and E are higher than the non-PV system user. With the energy degradation happens over long time period, the cost to operate PV system with SELCO scheme getting higher which may bring cost losses to the user.

Sample	Scheme	Monthly	Annual ROI	Payback
house		Savings	(RM)	period
load				(Years)
House A	6 kW system (NEM)	98.54%	2 429.76	13
	6 kW system (SELCO)	86.21%	2 125.68	22.4
House B	6 kW system (NEM)	89.44%	4 187.28	7.5
	9 kW system (NEM)	99.23%	4 645.68	9.2
	6 kW system (SELCO)	62.14%	2 909.28	16.3
	9 kW system (SELCO)	83.00%	3 885.96	17.1
House C	6 kW system (NEM)	74.66%	4 582.56	6.9
	9 kW system (NEM)	94.89%	5 824.20	7.3
	6 kW system (SELCO)	51.27%	3 146.88	15.1
	9 kW system (SELCO)	70.02%	4 297.68	15.5
House D	6 kW system (NEM)	54.98%	4 757.40	6.6
	9 kW system (NEM)	75.80%	6 558.60	6.5
	6 kW system (SELCO)	38.72%	3 350.64	14.2
	9 kW system (SELCO)	53.62%	4 693.44	14.3
House E	6 kW system (NEM)	62.10%	4 717.80	6.7
	9 kW system (NEM)	85.07%	6 463.20	6.6
	6 kW system (SELCO)	36.26%	2 754.60	17.3
	9 kW system (SELCO)	51.57%	3 918.48	17

Table 4.18: ROI and Payback Period

Table 4.18 shows the return of investment and payback period for the five houses with both NEM and SELCO scheme. From the results obtained, it can see that investment of PV system with NEM scheme able to have payback period in the range of 6.5 years to 7.5 years for the monthly load consumption from 830 kWh onwards. However, for the monthly load consumption of 549 kWh for house A have a longer payback period of 13 years regardless the monthly saving achieved 98.54%. This shows that for NEM scheme, there is a minimum limit of monthly energy consumption in order to have cost beneficial to the investment made. If the minimum limit of monthly energy consumption is not meet, the investment made will have longer payback period even with high monthly reduction electricity bill achieved.

From the table 4.18, it shows that PV system with SELCO scheme have a payback period between 14.2 years to 22.4 years. This is mainly because of the investment amount for the PV with battery system is very high while having a lower rate on total energy that can be consumed by the load. With the long duration payback period, the investment for the PV with battery system for SELCO unlikely brings any cost benefits.

#### **CHAPTER 5**

#### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Conclusions

Energy household behaviour affects the total energy consumption for the household. Total energy consumption for a household can be affected by household appliances usage duration, total number of household appliances running at a time and total number of occupants in the house. As the time usage of the appliances increases, the total energy consumed increases as well. The total number of appliances running at the same time, increases the demand of the energy required to run multiple loads at the same. The total number of occupants in the house leads to higher tendency to use any household appliances at any time, which leads to possibility of energy consumption.

The energy load profile is important to study the overall energy consumption of the load. The assumption made from this study is that the energy load profile on the monthly basis are assumed to be the same to ease the study, where in the real-world scenario the monthly energy load profile shall be slightly varies. The information of high and low energy demand at specific time can be obtained and analysed to ensure energy production of the PV system able to cope with the overall energy demand of the load. The energy load profile on weekday and weekend are different due to the different routine of household appliances usage. The energy consumption during the weekend tends to be higher due to the duration hour of the house occupant staying in the house is longer compared during the weekday.

NEM scheme allows the remaining excessive energy after consumed by the household can be export to the grid and offset "one on one" with the energy consumed from the grid. This exchange enables the total energy generated by the PV system belongs to the household to be fully utilized. With the PV system that is sufficient to supply the energy required for the load, it can reduce the energy consumption from the grid. It is noticeable that high reduction on the energy consumption required for the grid greatly reduce by integrate NEM scheme, hence leading to lower electricity bill charges.

SELCO scheme mainly for the household to fully consume own energy production without export any energy to the grid. SELCO scheme relies heavily on the battery size to store high capacity of energy to be consumed by the household load. During the daytime where there is household load consuming energy, the energy produced from the PV system can cater for the household load. During this operation, any remaining excessive energy after consumed by the household load, will be stored into the battery system until fully charged. At the period of time, where there is very low energy demand by the load and the battery storage is fully charged, the inverter of the PV system will cut off the energy production due to the regulation of no energy allowable to export to the grid. This leads to the reduction of the potential total amount of energy able to produce by the PV system. Overall, the reduction of energy consumption from the grid is lesser compared to the NEM scheme due to the limitation from the battery capacity.

For the cost analysis, it is noticeable that NEM scheme able to bring lower levelized cost of electricity compared to the tariff offered by the utility provider. This is greatly beneficial to the household as this can helps in reducing electricity bill charges. Meanwhile for SELCO scheme, the levelized cost of electricity is not as low as compared to NEM scheme, it can achieve at RM 0.44 / kWh depending on the household load consumption is in the range of the tariff charges by the utility provider, starting from RM 0.218 / kWh to RM 0.571 / kWh depending on the block. Overall, investment made for PV system with NEM scheme have shorter payback period from 6.5years to 7.5 years compared to SELCO scheme, it is needed to have minimum limit of monthly energy consumption in order to achieve short payback period.

## 5.2 **Recommendations for future work**

For the recommendations, the data of energy load profile and the irradiance data can be obtained for a twelve month to gain the overall changes of the household load that can bring closer results to the study. Besides that, the monthly energy production from the twelve-month information of irradiance data can be simulated using PVSYST software to have accurate monthly energy production. Another recommendation that is worth to consider is to simulate PV system with different capacity from 2 kW to 12 kW with 1 kW interval for NEM scheme to determine whether the levelized cost of electricity able to remain at low cost. Theoretically, with higher power rated PV system, higher reduction of energy consumption from the grid can be achieve, which can lead to low electricity bill charges. However, study on different power rated PV system is needed to determine whether the levelized cost of electricity can be remain low.

Another recommendation is that the battery depth of discharge for SELCO scheme can be increase to higher value to see the effect on the reduction energy from the grid. Theoretically, with higher battery depth of discharge, the energy that can be supply to the load from the battery is higher as well, which lead to reduction of energy consumption from the grid. However, study on this is required to determine whether the levelized cost of electricity for SELCO scheme can be further reduced.

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# APPENDICES

APPENDIX A: PVSYST Simulation Reports

PVSYST V6.86					21/04/20	Page 1/7
	Grid-C	connected System	n: Simulation p	arameters		
Project :	Tama	n Midah (NEM)				
Geographical Si	te k	(uala Lumpur/Subang		Country	/ Malays	ia
Situation		Latitude	3.12° N	Longitude	۔ 101.55°	E
Time defined a	as	Legal Time	Time zone UT+8 Altitude 17 m			
Meteo data:	k	Albedo (uala Lumpur/Subang	0.20 MeteoNorm 7.2 sta	tion - Synthetic		
Simulation vari	ant : workii	n <mark>g couple (6kw)</mark>				
		Simulation date	21/04/20 17h34			
Simulation para	meters	System type	Sheds on ground			
<b>Collector Plane</b>	Orientation	Tilt	5°	Azimuth	n 0°	
Models used		Transposition	Perez	Diffuse	e Perez, I	Vleteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
User's needs :	Dail	y household consumers average	Constant over the y 11.2 kWh/Day	ear		
PV Array Charac PV module Original PVsyst Number of PV mo Total number of P Array global powe Array operating ch Total area Inverter Original PVsys Characteristics	teristics database dules V modules r haracteristics (50°	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) C) U mpp Module area Model Manufacturer Operating Voltage Nb. of inverters	JAM6-72-320/SI JA Solar 10 modules 20 U 6.40 kWp At 336 V 38.8 m <sup>2</sup> SUN2000L-5KTL Huawei Technologi 90-500 V U Max. 2 * MPPT 50 %	In parallel nit Nom. Power operating cond. I mpp Cell area es Init Nom. Power power (=>40°C) Total Power	<ul> <li>2 string:</li> <li>320 Wp</li> <li>5.75 kW</li> <li>17 A</li> <li>34.4 m<sup>2</sup></li> <li>34.4 m<sup>2</sup></li> <li>5.50 kW</li> <li>5.50 kW</li> </ul>	s /p (50°C) Vac Vac Vac
				Pnom ratio	0 1.28	
PV Array loss fac	ctors					
Thermal Loss fact	or	Uc (const)	20.0 W/m²K	Uv (wind)	) 0.0 W/n	n²K / m/s
Wiring Ohmic Los Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	ss Losses loss ASHRAE paramet	Global array res. rization IAM =	332 mOhm 1 - bo (1/cos i - 1)	Loss Fraction Loss Fraction Loss Fraction Loss Fraction bo Param.	n 1.5 % a n -0.8 % n 1.0 % a n 0.10 % . 0.05	t STC tt MPP



PVSYST V6.86					21/04/20	Page 3/7
C	rid-Connected 9	Svetor	n: Detailed Lise	r's poods		
		by stori	i. Detailed 030			
Project :	Taman Midah (NEN	/1)				
Simulation variant :	working couple (6k	w)				
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings				
PV Field Orientation		tilt Modol	5° IAM6-72-320/SI	azimuti	n 0° n 320.Wn	
PV Arrav	Nb. of r	nodules	20	Pnom tota	al <b>6.40 kV</b>	qV
Inverter		Model	SUN2000L-5KTL	Pnon	n 5.00 kV	√ ac
User's needs	Daily household cor	sumers	Constant over the ye	ear Globa	al 4080 k\	Wh/year
Daily household consume	rs, Constant over the	e year, av	verage = 11.2 kWh/d	lay		
		Annua	l values			
	Use 5 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		20	18 W/lamp	7 h/	/day 2	2340 Wh/day
TV / PC / Mobile		1	70 W/app	6 h/	/day	420 Wh/day
Iron		1	1200 W/app	1 h/	/day	600 Wh/day
Fridge / Deep-freeze		1		24 Wh	/day 3	3000 Wh/day
Dish- & Cloth-washers		1		1 Wh/	/day	500 Wh/day
Instant water neater			2000 W tot	I N/	/day 2	
Stand-by consumers		Ζ	750 W 101	24 h	/uay c /day	$\frac{3750}{24}$ Wh/day
Total daily energy			ļ	2711/	15	5634 Wh/day
	Laction of daily endo	Hourly	r profile	1 24		

VSYST V6.86									21/04/2	0 Pa	ge 4/
		Grid	-Conn	ected S	Svster	n: Mair	n resu	lts			
roject :	Т	aman Mi	idah (NE	=M)	,						
	10			_1V1 <i>)</i>							
imulation varian	t: w	orking c	ouple (6	ókw)							
lain system param	neters		Sy	stem type	Shed	s on grou	und				
ear Shadings			Linea	r shadings	5						
V Field Orientation				tilt	t 5°	70.000/0		azimut	h 0°	N/	
V modules V Array			Nh c	IVIODE IVIODE	I JAIVI6 20	-72-320/5	)I	Phon Phom tot:	m 320 V al <b>640</b> I	vp kWn	
verter			140.0	Mode	, 20 I SUN2	000L-5KT	Ľ	Pnor	m 5.00 l	kW ac	
ser's needs		Daily ho	usehold c	onsumers	Const	ant over t	he year	Globa	al 4080	kWh/yea	ar
ain simulation res	sults	Per	<b>Produce</b> formance	<b>ed Energy</b> e Ratio PR	<b>8.41</b>	<b>MWh/yea</b> %	i <b>r</b> Sp Solar F	ecific proc	d. 1314 F 10.23	kWh/kW %	'p/yea
Normalized productions	(per installed	d kWp): No	ominal powe	er 6.40 kWp			Pe	rformance R	atio PR		
		(2022			1		Performance F	Antio (Yf / Yr) · 0	823	1 1	1
Ls : System Los	ss (inverter,)	erter output)	0.07 kWh/kWp/da 3.6 kWh/kWp/da	ay v	0	.9					
[day]					0	.8					
/d// 4 -				<b>_</b>	원 전	.7					
EXMP					0 0	.6					
Energy 2					0 uance	.5					
					erforr	.4					
					0	.3					
ž 1-					0	.2					
					0	.1					
Jan Feb Mar A	Apr May Jur	Jul Aug	Sep Oct	Nov Dec	0	.0 <b>E</b> Jan Feb	Mar Apr	May Jun	Jul Aug S	L L Sep Oct N	ov De
				working	couple (6	okw)					
			Ba	alances ar	nd main	results					
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid	]
	kWh/m <sup>2</sup>	KWh/m <sup>2</sup>	О°С	KWh/m <sup>2</sup>	KWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh	-
January	133.0	82.20	28.10	136.3 127 4	131.2 122.9	0.726	0.360	0.039	0.673	0.321	
March	134.0	88.20	27.70	150.3	13∠.ŏ 144 9	0.737	0.344	0.033	0.751	0.279	
April	140.3	70.50	27.70	138.8	133.9	0.742	0.328	0.035	0.693	0.294	
May	140.3	78.60	28.60	136.9	131.7	0.734	0.360	0.039	0.680	0.320	
June	132.0	77.80	27.80	128.3	123.5	0.691	0.328	0.034	0.643	0.295	
July	134.4	87.20	27.80	131.1	125.8	0.710	0.344	0.037	0.660	0.307	
August	132.2	87.20	27.80	130.1	125.2	0.700	0.360	0.038	0.649	0.322	
September	129.2	/9.00	27.10	128.8	124.0	0.691	0.313	0.033	0.645	0.280	
November	117.6	02.00 79.20	27.40 26.70	140.4 119.8	135.5 115 <i>1</i>	0.754	0.300	0.033	0.700	0.320	
December	115.0	73.20	26.29	118.1	113.6	0.640	0.328	0.030	0.597	0.298	
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	4.080	0.417	7.992	3.663	1
<u> </u>	+	I	l	· · · · · · ·		l	ļ	ļ	ı – – I	ļ	4
Legends: Glob	oHor H	Horizontal g	lobal irradia	ation		GlobEff	Effect	ive Global,	corr. for IAN	M and shad	dings
Diffl	Hor H	Horizontal d	iffuse irradi	iation		EArray	Effect	ive energy a	at the outpu	ut of the a	rray
T_A	mb 1	Гamb.				E_User	Energ	y supplied t	o the user		
Glob	oinc (	Jobal incide	ent in coll. p	biane		E_Solar	Energ	y from the s	sun ato grid		
						E_GHU FFrGrid	Energ	y injected If	no griu arid		
									4.1.4		



	1								
PVSYST V6.86						21/04/20	Page 6/7		
		Grid-Co	nnected Sv	stem: Loss diagrar	m				
Project ·		Taman Midał							
Simulation var	iant ·	working cour	i (i¶⊏ini) ole (6kw)						
Main avatam na	romotoro			Shada an around					
Main system parameters			incor chodingo	Sneas on ground					
PV Field Orientat	ion	L	tilt	5°	azimutł	n 0°			
PV modules			Model	JAM6-72-320/SI	Pnon	n 320 Wp			
PV Array			Nb. of modules		nom tota	al <b>6.40 kV</b>	Vp		
User's needs		Dailv househ	old consumers	Constant over the year	Globa	1 5.00 kV	V ac Vh/vear		
		,		,					
			Loss diagram ov	ver the whole year					
F		1597 kWh/m²		Horizontal global irradiation	I				
				Clabel incident in call plans					
			-0.07%	Global incident below threshold	• 				
			0.00%	Near Shadings: irradiance loss					
			-3.67%	IAM factor on global					
	1538 k\	Nh/m <sup>2</sup> * 39 m <sup>2</sup> coll.		Effective irradiation on collectors					
	efficienc	y at STC = 16.53%	, D	PV conversion					
		9.85 MWh		Array nominal energy (at ST	TC effic.)				
			4-0.75%	PV loss due to irradiance level					
			-11.15%	PV loss due to temperature					
			+0.75%	Module quality loss					
			9-1.10%	Mismatch loss, modules and str	rings				
		50 N/14/	9-0.95%	Ohmic wiring loss					
	8.5	58 MWh		Array virtual energy at MPP					
			-1.88%	Inverter Loss during operation	(efficiency	)			
			₩0.00%	Inverter Loss over nominal inv.	power				
			→ 0.00%	Inverter Loss due to max. input	t current				
			90.00%	Inverter Loss over nominal inv.	voltage				
arid			→ 0.00%	Inverter Loss due to voltage thr	reshold				
consumption			→-0.05%	Night consumption					
	8.4	I1 MWh		Available Energy at Inverter	Output				
3.66 MWh 0.42 N	IWh 7.	.99 MWh		Energy injected into grid					
to user to us	ser	to grid							
from grid from s	solar	to grid							

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		Grid-Con	nected Syster	m <sup>.</sup> P50 - P90 ev	valuation		
Project ·		Taman Mi	dah (NEM)		laidation		
Simulation vari	ant :	working co	ouple (6kw)				
Main system na	rameters	g =	System type	Sheds on around			
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Daily hou	Linear shadings tilt Model Nb. of modules Model sehold consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the ye	azimut Pnor Pnom tota Pnor ar Globa	h 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kW al 4080 kW	<b>/p</b> / ac Wh/year
Evaluation of the	e Produc	tion probabi	lity forecast				
The probability dis on the meteo data	stribution a used for	of the system the simulatio	production forecast n, and depends on t	for different years is r the following choices:	mainly depen	dent	
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	e n ıbility	Year c	Kind leviation from aver. Variance	MeteoNorm 7.2 station Not defined 3 % 0.5 %	on Yea	ar 1995	
The probability dis Specified Deviatio	stribution on P Soil (meteo + s	variance is als V module mo Inverter eff ling and mism Degra system)	so depending on so delling/parameters iciency uncertainty latch uncertainties adation uncertainty Variance	me system parameter 1.0 % 0.5 % 1.0 % 1.0 % 1.9 % (0	s uncertaintie quadratic sum	s 1)	
Annual productior	n probabili	ity	Variability P50 P90 P95	0.15 MWh 7.99 MWh 7.80 MWh 7.75 MWh			
			Probability	distribution			
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 0.00 7400	P5 P90 = P95 = 774 7600 7800	0 = 7992 kWh E_Grid simul = 7992 k 7800 kWh 6 kWh 8000 8200	Wh		

E\_Grid system production kWh

PVSYST V6.86					21/04/20	Page 1/7	
	Grid	d-Connected System	n: Simulation p	arameters	;		
Project :	Та	man Midah (NEM)					
Geographical S	ite	Kuala Lumpur/Subang		Country	/ Malays	ia	
Situation		Latitude	3.12° N	Longitude 101.55° E			
Time defined	as	Legal Time Albedo	Time zone UT+8 Altitude 17 m				
Meteo data:		Kuala Lumpur/Subang	MeteoNorm 7.2 sta	tion - Synthetic	:		
Simulation var	iant : wo	orking couple (6kw)					
		Simulation date	21/04/20 17h39				
Simulation para	ameters	System type	Sheds on ground				
Collector Plane	Orientation	Tilt	5°	Azimuth	0° ו		
Models used		Transposition	Perez	Diffuse	e Perez, I	Neteonorm	
Horizon		Free Horizon					
Near Shadings		Linear shadings					
User's needs :		Daily household consumers average	Constant over the y 6.9 kWh/Day	ear			
PV Array Charac PV module Original PVsys Number of PV module Total number of P Array global power Array operating c Total area Inverter Original PVsys Characteristics Inverter pack	cteristics t database odules V modules er haracteristics	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) (50°C) U mpp Module area Model Manufacturer Operating Voltage Nb. of inverters	JAM6-72-320/SI JA Solar 10 modules 20 U 6.40 kWp At 0 336 V 38.8 m <sup>2</sup> SUN2000L-5KTL Huawei Technologie 90-500 V U Max. 1 2 * MPPT 50 %	In paralle nit Nom. Power operating cond. I mpp Cell area es Init Nom. Powe power (=>40°C Total Powe Pnom ratic	I 2 strings r 320 Wp 5.75 kW 0 17 A a 34.4 m <sup>2</sup> r 5.00 kW ) 5.50 kW r 5.0 kW 0 1.28	s /p (50°C) /ac /ac ac	
<b>PV Array loss fa</b> Thermal Loss fac Wiring Ohmic Lo Module Quality L Module Mismatch Strings Mismatch Incidence effect,	ctors tor ss oss o Losses o loss ASHRAE para	Uc (const) Global array res. umetrization IAM =	20.0 W/m²K 332 mOhm 1 - bo (1/cos i - 1)	Uv (wind) Loss Fractior Loss Fractior Loss Fractior Loss Fractior bo Param	) 0.0 W/n n 1.5 % a n -0.8 % n 1.0 % a n 0.10 % . 0.05	n²K / m/s t STC t MPP	



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G	rid-Connected S	Sveton	n: Detailed Lls	er's needs		
		Jysten	n. Detailed 03			
Project :		/1)				
Simulation variant :	working couple (6k	w)				
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear s Nb. of r Daily household cor	hadings tilt Model modules Model nsumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the y	azimuth Pnom Pnom total Pnom /ear Global	0° 320 Wp <b>6.40 kV</b> 5.00 kV 2510 kV	<b>/p</b> / ac Wh/year
Daily household consume	ers, Constant over the	e year, av	verage = 6.9 kWh/d	lay		
		Annua	l values			
	Use 2 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		20	18 W/lamp	5 h/o	day 1	800 Wh/day
TV / PC / Mobile		1	70 W/app	14 h/o	day	980 Wh/day
Iron		1	1200 W/app	1 h/o	day	600 Wh/day
Fridge / Deep-freeze		1		24 Wh/o	day 3	000 Wh/day
Dish- & Cloth-washers		1		1 Wh/0	day	500 Wh/day
Instant water heater			2000 W tot	1 h/0	day 2	2000 Wh/day
Aircona Stand by consumers		2	750 W 101	10 n/0	day 15	24 Wb/day
Total daily energy				2411/0	23 23	<u>24 Wh/day</u> 3904 Wh/day
	2500 2000 1500 0 0 3	Hourly Hourly Hourly	<b>/ profile</b>	21 24		

PVSYST V6.86									21/04/2	) Pag	ge 4/7
		Grid	-Conn	ected \$	Syster	n: Maiı	n resul	ts			
Project :	Та	aman Mi	dah (NE	EM)	,						
Simulation variant	: w	orkina c	ouple (f	, 6kw)							
Main system param	eters		Sv:	stem type	Shed	s on arou	Ind				
Near Shadings			Linear	r shadings		5 en g.e.					
PV Field Orientation			Linea	til	t 5°			azimut	h 0°		
PV modules			NU	Mode	I JAM6	-72-320/S	i -	Pnor	n 320 V	Vp	
PV Array Inverter			IND. O	modules Mode	5 20 I SUN2	000I -5KT	1	Phom tota Phor	n 5.00	kwp «Wiac	
User's needs		Daily hou	usehold c	onsumers	Const	ant over t	he year	Globa	al 2510	kWh/yea	ır
Main simulation res System Production	ults	Per	<b>Produce</b> formance	<b>d Energy</b> Ratio PF	<b>8.41</b> 8 82.32	<b>MWh/yea</b> %	r Sp Solar F	ecific proc	d. 1314 F 32.49	kWh/kW %	p/year
Normalized productions (	Normalized productions (per installed kWp): Nominal power 6.40 kWp Performance Ratio PR										
6 Lc : Collection Lc	I I oss (PV-array los	I I sses) (	III ).7 kWh/kWp/day	/ -	1		I I : Performance F	atio (Yf / Yr): 0.4	823	1 1	
5 - Yf : Produced use	s (inverter,) eful energy (inve	erter output)	).07 kWh/kWp/da 3.6 kWh/kWp/da	y -	0	.8					
(Wp/da)				]	0	.7					
					Catio P	.6					
6 3 -					0 guille	.5					
					Perforr	.4					
Norma				-	0	.3					
1-					0	.2					
					0		1 1				
Jan Feb Mar Ap	or May Jun	n Jul Aug	Sep Oct	Nov Dec	Ū	Jan Feb	Mar Apr	May Jun	Jul Aug S	ep Oct N	ov Dec
				working	couple (6	bkw)					
			Ba	alances ar	nd main	results					
	GlobHor	DiffHor kWh/m <sup>2</sup>	T_Amb °C	GlobInc kWh/m <sup>2</sup>	GlobEff kWh/m <sup>2</sup>	EArray MWb	E_User	E_Solar	E_Grid MWb	EFrGrid MWb	
Januarv	133.0	82.20	28.10	136.3	131.2	0.726	0.239	0.080	0.632	0.159	1
February	134.6	67.90	27.70	137.4	132.8	0.737	0.191	0.067	0.656	0.124	
March	149.8	88.20	28.00	150.3	144.9	0.804	0.191	0.066	0.723	0.125	
April	140.3	70.50	27.70	138.8 126.0	133.9	0.742	0.215	0.072	0.656	0.143	
lune	140.3	77.80	20.00	128.3	123.5	0.734	0.213	0.007	0.031	0.140	
July	134.4	87.20	27.80	131.1	125.8	0.710	0.239	0.081	0.615	0.158	
August	132.2	87.20	27.80	130.1	125.2	0.700	0.191	0.056	0.630	0.136	
September	129.2	79.00	27.10	128.8	124.0	0.691	0.191	0.061	0.616	0.130	
October	138.8	82.60	27.40	140.4	135.5	0.754	0.239	0.079	0.660	0.160	
November	117.6	79.20	26.70	119.8	115.4	0.648	0.191	0.058	0.577	0.134	
December	115.0	/3.20	26.29	118.1	113.6	0.640	0.215	0.067	0.560	0.148	ł
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	2.510	0.816	7.593	1.694	ļ
Logondo, Clab	Hor '	Jorizoptal a	obal irradia	tion		ClobEff	Effort	vo Clobal	corr for M	1 and char	linas
DiffHor Horizontal diffuse irradiation					FArray Effective energy at the output of the array				nnys rav		
T_Amb T amb.					E_User	Energy supplied to the user					
Globi	Inc C	Global incide	ent in coll. p	lane		E_Solar	Energ	y from the s	sun		
						E_Grid	Energ	y injected ir	nto grid		
						EFrGrid	Energ	from the g	grid		



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Grid-Connected System: Loss diagram										
Project :	_	Taman Midah	h (NEN	<b>/</b> )						
Simulation variant : working couple (6kw)										
Main system parameters			Syste	em type	Sheds on ground					
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs		Linear shadings tilt Model Nb. of modules Model Daily household consumers		5°azimuth0°JAM6-72-320/SIPnom320 Wp20Pnom total <b>6.40 kWp</b> SUN2000L-5KTLPnom5.00 kW acConstant over the yearGlobal2510 kWh/year						
			Loss d	iagram ov	ver the whole year					
					·					
Γ		1597 kWh/m²			Horizontal global irradiatior	ı				
				-0.07% -0.07% 0.00% -3.67%	Global incident in coll. plane Global incident below threshold Near Shadings: irradiance loss IAM factor on global	e d				
1538 kWh/m <sup>2</sup> * 39 m <sup>2</sup> coll.					Effective irradiation on coll	ectors				
efficiency at STC = 16.53%		,		PV conversion						
		9.85 MWh		)-0.75% }-11.15%	Array nominal energy (at S PV loss due to irradiance level PV loss due to temperature	TC effic.)				
8			(+0.	75%	Module quality loss					
		.58 MWh	9-1.1 9-0.9	0% 5%	Mismatch loss, modules and st Ohmic wiring loss Array virtual energy at MPP	rings				
	)			8% % % %	Inverter Loss during operation Inverter Loss over nominal inv Inverter Loss due to max. inpu Inverter Loss over nominal inv. Inverter Loss due to power thr	(efficiency) . power t current voltage eshold				
grid consumption	on     > 0.00%     Inverter Loss due to voltage threshold       on     > -0.05%     Night consumption       8.41 MWh     Available Energy at Inverter Output									
1.69 MWh 0.82	MWh	7.59 MWh			Energy injected into grid					
to user to u from grid from	iser solar	to grid								

PVSYST V6.86						21/04/20	Page 7/7				
		Grid-Conr	nected Syster	m <sup>.</sup> P50 - P90 ev	valuation						
Project ·		Taman Mic	lab (NEM)		aldation						
Simulation varia	ant ·										
	ant .	working co									
Main system par	ameters		System type	Sheds on ground							
Near Shadings	on		Linear shadings	۶°	azimut	h 0°					
PV modules	OIT		Model	JAM6-72-320/SI	Pnor	m 320 Wp	)				
PV Array			Nb. of modules	20	Pnom tota	al <b>6.40 kV</b>	Vp				
Inverter		Daily hour	Model	SUN2000L-5KTL	Pnor Ar Globy	m 5.00 kV al 2510 kV	√ac Nb∿ear				
Usel s fieeds											
Evaluation of the	e Produc	tion probabil	ity forecast								
The probability dis	stribution	of the system	production forecast	t for different years is n	nainly depen	dent					
on the meteo data	used for	the simulation	n, and depends on	the following choices:							
Meteo data source	Э			MeteoNorm 7.2 static	on .						
Meteo data	n	Vear d	Kind	Not defined	Yea	ar 1995					
Year-to-year varial	bility	i cai u	Variance	0.5 %							
The probability dia		verience in ele				-					
Specified Deviation	n P	Variance is als V module mod	o depending on so lelling/parameters	1.0 %	suncertaintie	es .					
opcomed Deviation		Inverter effi	ciency uncertainty	0.5 %							
	Soi	ling and mism	atch uncertainties	1.0 %							
Global variability (	meteo +	Degra	dation uncertainty	1.0 %	uadratic sun	<b>)</b>					
Giobal variability (	ineleo + a	system	vanance	1.9 /0 (Y	uauratic Suri	1)					
Annual production	n probabili	ity	Variability	0.14 MWh							
			P50 P90	7.59 MWh 7.41 MWh							
			P95	7.36 MWh							
Probability distribution											
		<sup>0.50</sup> F				-					
		0.45		P50 - 7502 kWb							
		0.40		$E_Grid simul = 75$	93 kWh						
		0.35		/							
	≥	0.30	/	$^{\prime}$							
	pbabili	0.25		$\backslash$							
	Pro	0.20	P90 =	= 7411 kWh							
		0.15			<b>\</b>	1					
		0.10	P95 = 736	0 kWh	$\mathbf{i}$	1					
		0.05				1					
		0.00 7100 7200	7300 7400 7	500 7600 7700 780	00 7900	<b>8</b> 000					

E\_Grid system production kWh

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Grid-Connected System: Simulation parameters								
Project :	Tar	nan Midah (NEM)						
Geographical Si	te	Kuala Lumpur/Subang		Country	/ Malays	ia		
Situation Time defined a	as	Latitude Legal Time Albedo	3.12° N Time zone UT+8 0.20	Longitude Altitude	e 101.55° e 17 m	E		
			Meteonorm 7.2 Sta	ation - Synthetic				
Simulation vari	ant : Sm	all family - 6kw						
		Simulation date	21/04/20 17h17					
Simulation para	meters	System type	Sheds on ground					
Collector Plane	Orientation	Tilt	5°	Azimuth	n 0°			
Models used		Transposition	Perez	Diffuse	e Perez, I	Veteonorm		
Horizon		Free Horizon						
Near Shadings		Linear shadings						
User's needs :	[	Daily household consumers average	Constant over the y 19.4 kWh/Day	vear				
PV Array Charac PV module Original PVsyst Number of PV mo Total number of P Array global powe Array operating ch Total area Inverter Original PVsys Characteristics	teristics database dules V modules r naracteristics ( t database	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) 50°C) U mpp Module area Model Manufacturer Operating Voltage Nb. of inverters	JAM6-72-320/SI JA Solar 10 modules 20 L 6.40 kWp At 336 V 38.8 m <sup>2</sup> SUN2000L-5KTL Huawei Technologi 90-500 V L Max. 2 * MPPT 50 %	In parallel Init Nom. Power operating cond. I mpp Cell area es Jnit Nom. Power power (=>40°C) Total Power Pnom ratic	I 2 string 320 Wp 5.75 kW 17 A 34.4 m <sup>2</sup> 5.50 kW 5.50 kW 5.0 kW 0 1.28	s /p (50°C) Vac Vac ac		
PV Array loss fac	ctors							
Thermal Loss fact	or	Uc (const)	20.0 W/m <sup>2</sup> K	Uv (wind)	) 0.0 W/n	n²K / m/s		
Wiring Ohmic Los Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	ss Losses loss ASHRAE para	Global array res. metrization IAM =	332 mOhm 1 - bo (1/cos i - 1)	Loss Fraction Loss Fraction Loss Fraction Loss Fraction bo Param	n 1.5 % a -0.8 % n 1.0 % a n 0.10 % . 0.05	t STC It MPP		


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(	Grid-Connected S	System	n. Detailed I Is	er's needs	I	
Destants			i. Detailed 05			
Project :	Taman Midan (NEN	/1)				
Simulation variant :	Small family - 6kw					
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear s Nb. of r Daily household cor	hadings tilt Model modules Model nsumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the y	azimuth ( Pnom 3 Pnom total 6 Pnom 5 year Global 7	)° }20 Wp <b>5.40 kWp</b> 5.00 kW ac 7066 kWh/year	
Daily household consum	ers Constant over the	vear av	verage = 19.4 kWb/	/dav		
Daily nousenoid consult	iers, constant over the	e year, av	verage = 15.4 KWII	lay		
		Annua	l values			
	Use 5 days a week	Number	Power	Use	Energy	
Lamps (LED or fluo)		26	18 W/lamp	5 h/day	2340 Wh	/day
TV / PC / Mobile		2	70 W/app	9 h/day	1260 Wh	/day
Iron		1	1200 W/app	1 h/day	1200 Wh	/day
Fridge / Deep-freeze		1		24 Wh/day	3000 Wh	/day
Dish- & Cloth-washers		1		1 Wh/day	500 Wh	/day
Instant water heater		1	2000 W tot	2 h/day	3000 Wh	/day
Aircond		3	750 W tot	7 h/day	15750 Wh	/day
Stand-by consumers				24 h/day	24 Wh	/day
Total daily energy					27074 Wh	/day
	3500 2500 1500 0 0 3 3000 2500 1000 0 3 3	Hourly Hourly 6 9	profile	21 24		

PVSYST V6.86									21/04/2	D Page 4/7
		Grid	-Conn	ected \$	Syster	n: Maiı	n resul	ts		
Project :	Та	iman Mi	dah (NE	EM)	,					
Simulation variant	t: Sr	nall fam	ilv - 6kw	, <b>,</b>						
Main system param	eters		Sv	stem type	Shed	s on grou	und			
Near Shadings			Linear	r shadings	3	U				
PV Field Orientation			Linda	til	t 5°			azimut	h 0°	
PV modules				Mode	I JAM6	-72-320/S	il .	Pnor	m 320 V	Vp
PV Array			Nb. o	f modules	5 20 I SUND		- 1	Pnom tota	al <b>6.40</b> I	kWp
User's needs		Daily hou	usehold c	onsumers	Const	ant over t	∟ he year	Globa	al 7066	kWh/year
Main simulation res	ults						-			
System Production		Per	Produce formance	d Energy Ratio PF	<b>8.41</b>	MWh/yea %	r Spe Solar F	ecific prod raction S	d. 1314 F 8.37 <sup>o</sup>	kWh/kWp/year %
Normalized productions (	per installed	i kWp): No	minal powe	r 6.40 kWp	1	0	Per	formance R	atio PR	
Lc : Collection L Ls : System Los	.oss (PV-array los s (inverter,)	sses) (	IIII ).7 kWh/kWp/day ).07 kWh/kWp/da	/ - ay	0	.9 E PR	: Performance R	atio (Yf / Yr): 0.	823	
5 Yf : Produced us	seful energy (inve	erter output)	3.6 kWh/kWp/day	/ -	0	.8				
				<b>_</b>	전 전	.7				
					0 0	.6				
CE 3					0 mance	.5				
					Perfor	.4				
Norma					0	.3				
1 -					0	.2				
					0	.1				
0 Jan Feb Mar A	pr May Jun	Jul Aug	Sep Oct	Nov Dec	0	.0 Jan Feb	Mar Apr	May Jun	Jul Aug S	ep Oct Nov Dec
				Small fa	amily - 6	kw				
			Ba	alances ar	nd main	results				
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	0.726	0.623	0.055	0.656	0.567
March	134.0 149.8	67.90 88.20	27.70	137.4	132.8 144 9	0.737	0.541	0.048	0.675	0.493
April	140.3	70.50	20.00	138.8	133.9	0.742	0.569	0.049	0.679	0.520
May	140.3	78.60	28.60	136.9	131.7	0.734	0.623	0.054	0.665	0.569
June	132.0	77.80	27.80	128.3	123.5	0.691	0.569	0.047	0.630	0.522
July	134.4	87.20	27.80	131.1	125.8	0.710	0.596	0.051	0.645	0.544
August	132.2	87.20	27.80	130.1	125.2	0.700	0.623	0.053	0.634	0.570
September	129.2	79.00	27.10	128.8	124.0	0.691	0.541	0.046	0.632	0.496
October	138.8	82.60	27.40	140.4	135.5	0.754	0.623	0.048	0.692	0.575
November	117.6	79.20	26.70	119.8	115.4	0.648	0.596	0.043	0.591	0.552
December	115.0	73.20	26.29	118.1	113.6	0.640	0.569	0.043	0.584	0.525
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	7.066	0.592	7.817	6.475
						01 1 5 5				
Legends: Glob	Hor H	iorizontal gl	iobal irradia	tion		GIODEff	Effecti	ve Global,	corr. tor IAI	vi and shadings
	יטר F mb ד	iurizontal d	muse irradi	ลแบก		EAFray	Effecti	ve energy a	at the uppr	at of the array
	lino (	dIIID.	nt in coll n	lano		E_USEr	Energy	y supplied t	u the user	
GIOD	unic G		ан на сон. р	ndrie		E_Suiar F Grid	Energy	/ injected in	suu nto arid	
						L_0110	Linergy	, injected li	no griu	

EFrGrid

Energy from the grid



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		Grid-Co	nnected Sv	vstem: Loss diagram		
Project ·		Taman Midal	n (NFM)	,		
Simulation val	riant :	Small family -	6kw			
Main system na	arameters	<u> </u>	System type	Sheds on around		
Near Shadings	arameters	1	inear shadings	oneus on ground		
PV Field Orienta	tion		tilt	5° azim	uth 0°	
PV modules PV Arrav			Model Nb. of modules	JAM6-72-320/SI Pn 20 Pnom to	om 320 Wp otal <b>6.40 kV</b>	) Vp
Inverter			Model	SUN2000L-5KTL Pn	om 5.00 kV	Vac
User's needs		Daily house	old consumers	Constant over the year Glo	bal 7066 k	/Vh/year
			Loss diagram o	over the whole year		
Γ		1597 kWh/m <sup>2</sup>		Horizontal global irradiation		
			→-0.07%	Global incident in coll. plane		
			→ -0.07%	6 Global incident below threshold Near Shadings: irradiance loss		
			-3.67%	6 IAM factor on global		
	1538 k	Wh/m <sup>2</sup> * 39 m <sup>2</sup> coll.		Effective irradiation on collectors		
F	efficien	cy at STC = 16.53%	, 	PV conversion		
		9.85 MWh	-0.75%	Array nominal energy (at STC effic PV loss due to irradiance level	.)	
			-11.15%	6 PV loss due to temperature		
			+0.75%	Module quality loss		
			9-1.10%	Mismatch loss, modules and strings		
	8	.58 MWh	9-0.95%	Ohmic wiring loss Array virtual energy at MPP		
	-					
			→-1.88% →0.00%	Inverter Loss during operation (efficien Inverter Loss over nominal inv. power	cy)	
			→ 0.00%	Inverter Loss due to max. input current		
			→-0.01%	Inverter Loss due to power threshold		
grid consumption			→ 0.00% → -0.05%	Inverter Loss due to voltage threshold		
concumption	8	.41 MWh		Available Energy at Inverter Output	t –	
	1					
6.47 MWh 0.59	NWh	7.82 MWh	J	Energy injected into grid		
to user to u	iser	to grid				
from grid from	solar					

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	Grid-Connected Syster	m: P50 - P90 evaluation	า	
Project ·	Taman Midah (NFM)			
Simulation variant :	Small family - 6kw			
Main system parameters	System type	Sheds on ground		
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear shadings tilt Model Nb. of modules Model Daily household consumers	5° azim JAM6-72-320/SI Pn 20 Pnom to SUN2000L-5KTL Pn Constant over the year Glo	uth 0° om 320 Wp otal <b>6.40 kV</b> om 5.00 kV bal 7066 k <sup>1</sup>	V <b>p</b> Vac №h/year
Evaluation of the Produc	tion probability forecast			
The probability distribution	of the system production forecast	for different vears is mainly depe	ndent	
on the meteo data used for	the simulation, and depends on t	the following choices:		
Meteo data source Meteo data Specified Deviation Year-to-year variability	Kind Year deviation from aver. Variance	MeteoNorm 7.2 station Not defined Y 3 % 0.5 %	∋ar 1995	
The probability distribution Specified Deviation F So Global variability (meteo +	variance is also depending on so V module modelling/parameters Inverter efficiency uncertainty ling and mismatch uncertainties Degradation uncertainty system) Variance	me system parameters uncertaint 1.0 % 0.5 % 1.0 % 1.0 % 1.9 % (quadratic su	ies Im)	
Annual production probabil	ity Variability P50 P90 P95	0.15 MWh 7.82 MWh 7.63 MWh 7.58 MWh	,	
	Probability	distribution		
Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 P50 = 781 P50 = 7630 kWh	7 kWh E_Grid simul = 7817 kWh		

7800 8000

0.00 7400

7600

E\_Grid system production kWh

8200

8400

Grid-Connected System: Simulation parameters:         Projec:       Taman Midah (NEM)         Secographical Site       Kuala Lumpur/Subang       Country       Malaysia         Situation       Latitude       3.12* N       Longitude       101.55* E         Time defined as       Lagal Time       Time zone UT+8       Altitude       101.55* E         Situation       Kuala Lumpur/Subang       MeteoNorm 7.2 station - Synthetic       17       Time         Simulation parameters       System type       Sheds on ground       Collector Plane Orientation       Tit       5*       Azimuth       0*         Models used       Transposition       Perez       Diffuse       Perez, Meteonorm         Ner's Shedings       Linear shadings       User's needs:       JAM6-72-320/SI       James         Original PVsyst database       Manufacturer       JA Solar       In parallel       2 strings         Total number of PV modules       Ns. modules       Ja Solar       Unit Nom. Power       200 Wp         Array operating characteristics       Gore of PV modules       Ns. modules       Strings       306 V       Imp         Original PVsyst databases       Manufacturer       Module area       38.8 m²       Cell area       34.4 m²         I	PVSYST V6.86					21/04/20	Page 1/7
Project:       Taman Midah (NEM)         Geographical Site       Kuala Lumpur/Subang       Country       Malaysia         Situation       Legitude       3.12" N       Longitude       101.55" E         Time defined as       Legat Time       Maleo data       11.8"       11.8"         Meteo data:       Kuala Lumpur/Subang       MeteoNorr 7.2 station - Synthetic       17.8"         Simulation variant:       Small family - 6kw       Simulation data       21.04/20 17h21       1         Simulation parameters       System type       Sheds on ground       0"       Perez, Meteonorm         Collector Plane Orientation       Titt       5"       Azimuth       0"         Models used       Transposition       Perez       Diffuse       Perez, Meteonorm         Near's needs:       Daily household consumers       Consumers       Content over the year       32.9"         Y Array Characteristics       Namodules       In series       10 modules       In parailel       2. strings         Original PVsyst database       Manufacturer       Module area       38.8 m²       Cellarea       5.00 KWac         Array operating characteristics       OPerating Voltage       Marufacturer       38.8 m²       Cellarea       5.00 KWac         Arr		Gric	d-Connected System	n: Simulation p	arameters	5	
Geographical Site       Kuala Lumpur/Subang       Country       Malaysia         Situation       Latitude       3.12 ° N       Longlitude       101.55° E         Time defined as       Kuala Lumpur/Subang       Meteo data:       17 m         Meteo data:       Kuala Lumpur/Subang       MeteoNorm 7.2 station - Synthetic         Simulation variant:       Small family - 6kw       21/04/20 17h21         Simulation parameters       System type       Sheds on ground       0°         Collector Plane Orientation       Titl       5°       Azimuth       0°         Models used       Transposition       Perez       Diffuse       Perez, Meteonorm         Horizon       Free Horizon       Constant over the year       9.9 kWh/Day       9.9 kWh/Day         Veray Characteristics       Si-mono       Model       JAM6-72-320/SI       JA With 20 y       3.0 Wp         Original PVsyst database       Nb. models       Nb. models       JA With 20 y       Inmp 17 A       3.20 Wp         Array operating characteristics (50°C)       U mp 236° Ump 20 y       Jame 72-320/SI       Jame 72-320/SI       Jame 72-320/SI       Jame 72-320/SI         Inverter       Module area       Si-mono Model       JAM6-72-320/SI       Ja Solar       Ja Wp       Solar       Ja	Project :	Та	man Midah (NEM)				
Situation       Latitude       3.12° N       Longitude       101.55° E         Time defined as       Lagal Time       Time zone UT+8       Altitude       17 m         Meteo data:       Kuala Lumpur/Subang       MeteoNorr 7.2 station - Synthetic         Simulation variant:       Small family - 6kw       Simulation date       21/04/20 17h21         Simulation parameters       System type       Sheds on ground       0°         Collector Plane Orientation       Titt       5°       Azimuth       0°         Models used       Transposition       Perez       Diffuse       Perez, Meteonorm         Horizon       Free Horizon       Near Shadings       Linear shadings       Constant over the year       9.9 kWh/Day         Verray Characteristics       Daily household consumers average       9.9 kWh/Day       9.9 kWh/Day       2.0 tims         PV Array Characteristics       Monimal (STC)       6.40 kWp       At operating cond.       5.50 kWp (GrC)         Array operating characteristics (50°C)       Ump       Model       SUN2000L-5KTL       House To Nominal (STC)       6.40 kWp       At operating cond.       5.50 kWac         Inverter       Model       Nb. of inverters       2* MPPT 50 %       Total area       3.0 kWn       Inverter       0.0 W/mPK / m/s	- Geographical Si	ite	Kuala Lumpur/Subang		Country	/ Malays	ia
Time defined as       Legal Time       Time zone UT+8       Altitude       17 m         Meteo data:       Kuala Lumpur/Subang       MeteoNorm 7.2 station - Synthetic         Simulation variant :       Small family - 6kw       21/04/20 17h21         Simulation parameters       System type       Sheds on ground         Collector Plane Orientation       Titl       5*       Azimuth       0*         Models used       Transposition       Perez       Diffuse       Perez, Meteonorm         Horizon       Fire Horizon       Fire Horizon       Name Prez       Diffuse       Perez, Meteonorm         Varay Characteristics       Daily household consumes       Constant over the year       9.9 kWh/Day       PV         PV module       Si-mono       Model       JAM6-72-320/SI       Ja Solar       Ja Solar         Nominal (STO)       Manifacturer       JA Solar       Ja Solar       Ja Solar       Ja Solar         Normizel prover       Nominal (STO)       G40 kWp       At toperating cond.       5.5 KWp (GrC)       Ja Solar         Array operating characteristics (50°C)       Um pp       17 A       38.6 m²       Cell area       3.4 m²         Inverter       Model       SUN2000L-SKTL       Hower (=>40, SV KWac       Max. power (=>40, C)	Situation		Latitude	3.12° N	Longitude	e 101.55°	E
Meteo data:       Kuala Lumpur/Subarg       MeteoNorm 7.2 station - Synthetic         Simulation variant:       Small family - 6kw       Simulation date       21/04/20 17h21         Simulation parameters       System type       Sheds on ground       Collector Plane Orientation       Tit         Models used       Transposition       Fire Horizon       Perez       Diffuse       Perez, Meteonorm         Models used       Transposition       Fire Horizon       Constant over the year       3.9 kWh/Day         Vers's needs:       Daily household consumers average       Solar       JAM6-72-320/SI       Jame         PV module       Si-mono       Model       JAM6-72-320/SI       Jame       Jame         Number of PV modules       Nb. modules       Jame       Jame       320 Wp       320 Wp       320 Wp         Array operating characteristics (50°C)       U mpp       10 module area       364 V       I mpp       17 A       336 V       I mpp       17 A         Total number of PV modules       Nb. finverters       Solo       Vulit Nom. Power S.00 Wac       5.0 kWac         Inverter       Module       Sumulatione       Sumulatione       2.1 MPPT 50 %       Total Power S.00 kWac       1.28         PV Array loss factors       Nb. of inverters       2	Time defined	as	Legal Time	Time zone UT+8	Altitude	e 17 m	
Simulation variant: Small family - 6kw         Simulation parameters       System type       Sheds on ground         Collector Plane Orientation       Tit       5°       Azimuth       0°         Models used       Transposition       Perez       Diffuse       Perez, Meteonorm         Horizon       Free Horizon       Constant over the year       9.9 KWh/Day       Perez, Meteonorm         Vers's needs:       Daily household consumers average       Constant over the year       9.9 KWh/Day       Perez, Meteonorm         PV module       Si-mono       Model       Manfacturer       JAM6-72-320/SI       James       James         Number of PV modules       Nb. modules       In series       20       Uit Nom. Power       320 Wp         Array operating characteristics (50°C)       U mpp       36.8 m²       Cell area       34.4 m²         Inverter       Module area       Sis8 m²       Cell area       34.4 m²         Inverter pack       Nb. of inverters       2°.00 V       Sio0 V       Marea       1.28         PV Array loss factors       Coss Fraction       1.5% at STC       Module Mismatch Loss       1.5% at STC         Module Mismatch Losses       Global array res       320 Mm       Loss Fraction       1.5% at STC      <	Meteo data:		Kuala Lumpur/Subang	MeteoNorm 7.2 sta	ition - Synthetic	;	
Simulation parameters       System type       Sheds on ground         Collector Plane Orientation       Titl       5°       Azimuth       0°         Models used       Transposition       Perez       Diffuse       Perez, Meteonorm         Horizon       Free Horizon       Constant over the year       9.9 kWh/Day       Perez       Diffuse       Perez, Meteonorm         Version       Daily household consumers average       0.9 kWh/Day       9.9 kWh/Day       Perez	Simulation vari	iant : Sm	nall family - 6kw				
Simulation parametersSystem typeSheds on groundCollector Plane OrientationTranspositionPerezDiffusePerez, MeteonormModels usedTranspositionPerezDiffusePerez, MeteonormHorizonFree HorizonConstant over the yearPerezNear ShadingsLinear shadingsUser's needs :Daily household consumersConstant over the year9.9 kWh/DayPV Array CharacteristicsSi-monoModelJAM6-72-320/SIPV moduleSi-monoModelSolarNumber of PV modulesNb. modulesIn parallel2 stringsTotal number of PV modulesNb. modules10 modulesIn parallel2 stringsArray gobal powerNominal (STC)GowJAM6-72-320/SI320 WpArray operating characteristics (50°C)U mp17 A33.8 m²Cell areaInverterModelSUN2000L-SKTLHuawei Technologies5.00 kWacCharacteristicsOperating VoltageSUN2000L-SKTLVianor (back of the string)Inverter packNb. of inverters2.1 MPPT 50 %Total Power5.00 kWacNotif operating VoltageGlobal array res322 mOhmLoss Fraction1.5 % at STCModule Quality LossGlobal array resJaveLoss Fraction0.0 %Nodule Wismatch LossGlobal array res322 mOhmLoss Fraction0.0 %Notal Power Strings Mismatch LossLoss Fraction1.0 % at MPPLoss Fraction0.0 %Module Wismatch LossLoss F			Simulation date	21/04/20 17h21			
Collector Plane OrientationTitl5°Azimuth0°Models usedTranspositionPerezDiffusePerez, MeteonormHorizonFree HorizonPerezDiffusePerez, MeteonormNear ShadingsLinear shadingsConstant over the year9.1User's needs :Daily household consumers averageConstant over the year9.1PV Array CharacteristicsSi-monoModel MondulesJAM6-72-320/SI JA SolarJame-72-320/SI 	Simulation para	meters	System type	Sheds on ground			
Models usedTranspositionPerezDiffusePerez, MeteonormHorizonFree HorizonNear ShadingsLinear shadingsUser's needs :Daily household consumers averageConstant over the year 9.9 kWh/DayPV Array CharacteristicsSi-monoModel MonufacturerNumber of PV modulesNb. modulesIn series 10 modulesArray global powerNb. module Nominal (STC)JAM6-72-320/SI JA SolarArray operating characteristicsNb. module Nominal (STC)10 modulesArray operating characteristicsManufacturer Nominal (STC)6.40 kWp 38.6 m²At operating cond.Array operating characteristicsOperating Volte 38.6 m²Solar 2.00 U int Nom. Power32.0 Wp 36.0 VInverterModule area ManufacturerSUN2000L-SKTL Huawei TechnologiesSola KWac 2.50 kWacInverter packNb. of inverters2.* MPPT 50 % 2.00 VTotal Power5.00 kWac 5.00 kWacInverter packNb. of inverters2.* MPPT 50 % 2.00 V/m²KLoss Fraction 1.28PV Array loss factorsUc (const) Using Ohmic Loss2.0.0 W/m²K / m/s Sizeron2.5% km2 2.0.0 K/m²KThermal Loss factorUc (sonst) Loss Fraction1.0 % at STC Loss Fraction0.0 % int 0.0 %Module Quality LossGlobal array res Loss Fraction3.32 mOhm Loss Fraction1.0 % at STC 0.0 %Module Quality LossLoss Fraction Loss Fraction0.0 %1.0 % at STC Loss Fraction0.0 %Module Quality Loss<	<b>Collector Plane</b>	Orientation	Tilt	5°	Azimuth	0° ו	
HorizonFree HorizonNear ShadingsLinear shadingsUser's needs :Daily household consumers averageConstant over the year 3.9 kWh/DayPV Array Characteristics PV moduleSi-monoModel ManufacturerPV Array Characteristics PV modulesSi-monoModel ManufacturerArray global powerSi-monoModel ManufacturerJAM6-72-320/SIVarray oberating condSi-monoModel ManufacturerJAM6-72-320/SIPV moduleSi-monoModel ManufacturerJAM6-72-320/SIArray global powerNo. modulesIn parallel2 stringsTotal areaModule area38.9 m²Cell area34.4 m²Inverter CharacteristicsModule areaSUN2000L-SKTL Module areaImage in the parallelStringsInverter CharacteristicsModule areaSUN2000L-SKTL Maueri TechnologiesStol KWacInverter packNb. of inverter2.1 MPPT 50 %Total areaStol KWacPV Array loss factors Module Quily LossGlobal array res Loss Fraction2.0 W/m²K / m/s332 mOhmLoss Fraction0.0 W/m²K / m/sModule Mismatch Losses Indidence effect, ASHRAE parametrizationIAM1 - bo (1/cos i - 1)bo Param.0.05	Models used		Transposition	Perez	Diffuse	e Perez, I	Veteonorm
Near Shadings       Linear shadings         User's needs:       Daily household consumers average       Constant over the year average       Sumon Survey average       Constant over the year average       Survey average	Horizon		Free Horizon				
User's needs :       Daily household consumers average       Constant over the year 9.9 kWh/Day         PV Array Characteristics       Si-mono       Model         PV module       Si-mono       Model         Original PVsyst database       Manufacturer       JAM6-72-320/SI         Total number of PV modules       Nb series       10 modules       In parallel       2 strings         Array operating characteristics (50°C)       U mpp       A00 kWp       At paraling cond. 5.75 kWp (50°C)       5.75 kWp (50°C)         Array operating characteristics (50°C)       U mpp       38.8 m²       Cell area       34.4 m²         Inverter       Module area       Module area       88.8 m²       Coll area       34.4 m²         Inverter       Module area       Module area       90-500 V       Unit Nom. Power       5.00 kWac         Characteristics       Operating Voltage       90-500 V       Unit Nom. Power       5.00 kWac         Inverter pack       Nb. of inverters       2 * MPPT 50 %       Total Power       5.0 kWac         Inverter pack       Nb. of inverters       2 * MPPT 50 %       Total Power       5.0 kWac         Phormatic Loss       Global array res.       322 mOhm       Loss Fraction       1.5 % at STC         Module Quality Loss       Loss Fr	Near Shadings		Linear shadings				
PV Array Characteristics PV module       Si-mono       Model Manufacturer       JAM6-72-320/SI         Original PVsyst database       Manufacturer       JA Solar       In parallel       2 strings         Number of PV modules       In series       10 modules       In parallel       2 strings         Array global power       Nominal (STC)       6.40 kWp       At operating cond.       5.75 kWp (50°C)         Array operating characteristics (50°C)       U mpp       336 V       I mpp       17 A         Total area       Module area       88 m²       Cell area       34.4 m²         Inverter       Modula area       SUN2000L-SKL       Huawei Technologies       5.00 kWac         Characteristics       Operating Voltage       90-500 V       Unit Nom. Power       5.00 kWac         Characteristics       Operating Voltage       90-500 V       Unit Nom. Power       5.00 kWac         Inverter pack       Nb. of inverters       2 * MPPT 50 %       Total Power       5.00 kWac         Inverter pack       Nb. of inverters       20.0 W/m²K       Wo (wind)       0.0 W/m²K / m/s         Yiring Ohmic Loss       Global array res       332 mOhm       Loss Fraction       1.5 % at STC         Module Quality Loss       Loss Fraction       1.0 % at MPP       Loss	User's needs :		Daily household consumers average	Constant over the y 9.9 kWh/Day	rear		
PV Array loss factors         Thermal Loss factor         Uc (const)       20.0 W/m²K         Uv (wind)       0.0 W/m²K / m/s         Wiring Ohmic Loss       Global array res.         332 mOhm       Loss Fraction         1.5 % at STC         Module Quality Loss         Module Mismatch Losses         Strings Mismatch loss         Incidence effect, ASHRAE parametrization         IAM =         1 - bo (1/cos i - 1)         bo Param.         0.05	PV Array Charac PV module Original PVsyst Number of PV mo Total number of P Array global powe Array operating ch Total area Inverter Original PVsys Characteristics	eteristics t database odules V modules er maracteristics t database	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) (50°C) U mpp Module area Model Manufacturer Operating Voltage	JAM6-72-320/SI JA Solar 10 modules 20 U 6.40 kWp At 336 V 38.8 m <sup>2</sup> SUN2000L-5KTL Huawei Technologie 90-500 V U Max.	In paralle Init Nom. Power operating cond. I mpp Cell area es Init Nom. Power power (=>40°C	I 2 string r 320 Wp 5.75 kW o 17 A a 34.4 m <sup>2</sup> r 5.00 kV ) 5.50 kW	s /p (50°C) Vac Vac
PV Array loss factors         Thermal Loss factor       Uc (const)       20.0 W/m²K       Uv (wind)       0.0 W/m²K / m/s         Wiring Ohmic Loss       Global array res.       332 mOhm       Loss Fraction       1.5 % at STC         Module Quality Loss       Loss Fraction       -0.8 %         Module Mismatch Losses       Loss Fraction       1.0 % at MPP         Strings Mismatch loss       Loss Fraction       0.10 %         Incidence effect, ASHRAE parametrization       IAM =       1 - bo (1/cos i - 1)       bo Param.       0.05	Inverter pack		Nb. of inverters	2 * MPP1 50 %	Pnom ratio	r 5.0 kW b 1.28	ac
Module Quality LossLoss Fraction-0.8 %Module Mismatch LossesLoss Fraction1.0 % at MPPStrings Mismatch lossLoss Fraction0.10 %Incidence effect, ASHRAE parametrizationIAM = 1 - bo (1/cos i - 1)bo Param.0.05	PV Array loss fac Thermal Loss fac Wiring Ohmic Los	ctors tor SS	Uc (const) Global array res.	20.0 W/m²K 332 mOhm	Uv (wind) Loss Fractior	) 0.0 W/r n 1.5 % a	n²K / m/s t STC
	Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	oss Losses Ioss ASHRAE para	ametrization IAM =	1 - bo (1/cos i - 1)	Loss Fractior Loss Fractior Loss Fractior bo Param	n -0.8 % n 1.0 % a n 0.10 % . 0.05	ıt MPP



Grid-Connected System: Detailed User's needs Project : Taman Midah (NEM) Simulation variant : Small family - 6kw Main system parameters System type Sheds on ground Near Shadings PV Field Orientation PV modules Nodel JAM6-72-320/SI Promodules PV Array Nb. of modules 20 Promotal 6.40 kWp Promotal 6.40	PVSYST V6.86				21/	04/20	Page 3/7
Project : Taman Midah (NEM) Simulation variant : Small family - 6kw Main system parameters System type Sheds on ground Near Shadings Linear shadings PV Field Orientation Model JAM6-72-320/Si Prom 320 Wp PV modules Daily household consumers SUN2000L-5KTL Prom 5.00 kW ac User's needs Daily household consumers Constant over the year Global 3625 kWh/year Daily household consumers, Constant over the year, average = 9.9 kWh/day Total Guo r fluo) 26 18 W/lamp 5 h/day 2340 Wh/day Prom 1 1200 W/ap 14 h/day 1960 Wh/day Prom 1 1200 W/ap 14 h/day 1960 Wh/day Prom 1 1200 W/ap 24 Wh/day 3000 Wh/day Dish. & Cloth-washers 1 200 W tot 2 h/day 3000 Wh/day Stand-by consumers 2 Source 1 24 h/day 24 Wh/day Total daily energy 34524 Wh/day Total daily energy 34524 Wh/day	6	Srid-Connected 9	Svetor	n. Detailed Lls	er's needs	I	
Project : I aman Midan (NEW) Simulation variant : Small family - 6kw Main system parameters System type Sheds on ground Near Shadings Linear shadings PV Field Orientation tilt 5° azimuth 0° PV modules JAM6-72-320/SI Pnom 320 Wp PV Array Nb. of modules 20 Promot tail 6.40 KWp Inverter Model JUN2000L-5KTL Pnom 5.00 KW ac User's needs Daily household consumers Constant over the year Global 3625 KWh/year Daily household consumers, Constant over the year, average = 9.9 kWh/day Annual values	Ducient		a)	i. Detailed 03	ci s necus		
Simulation variant : Small family - 6kw         Main system parameters       System type       Sheds on ground         Near Shadings       Linear shadings       azimuth       0°         PV Field Orientation       till       5°       azimuth       0°         PV modules       Model       JAM6-72-320/SI       Pnom       320 Wp         PV array       Nb. of modules       20       Pnom       5.00 kW ac         User's needs       Daily household consumers       Constant over the year       Global       3625 kWh/year         Daily household consumers, Constant over the year       Constant over the year       Global       3625 kWh/year         Lamps (LED or fluo)       26       18 W/lamp       5 h/day       2340 Wh/day         Tr/       PC / Mobile       2       70 W/app       1 h/day       1960 Wh/day         Iron       1       1200 W/app       1 h/day       3000 Wh/day         Priore       2       70 W/app       1 h/day       3000 Wh/day         Instant water heater       1       2000 W tot       2 h/day       3000 Wh/day         Instant water heater       1       2000 W tot       2 h/day       34524 Wh/day         Jamp       10 h/day       22500 Wh/day <td< th=""><td>Project :</td><td>Taman Midan (NEN</td><td>/1)</td><td></td><td></td><td></td><td></td></td<>	Project :	Taman Midan (NEN	/1)				
Main system parametersSystem typeSheds on groundNear Shadings PV Field OrientationLinear shadings Modelazimuth0° PnomPV Field OrientationModelJAM6-72-320/SI SUN2000L-5KTLPnom320 Wp PnomPV Array InverterNb. of modules20 Point total6.40 kWp Pnom5.00 kW ac GlobalBaily household consumers, Constant over the year, average = 9.9 kWh/dayDaily household consumers, Constant over the year, average = 9.9 kWh/dayDaily household consumers, Constant over the year, average = 9.9 kWh/dayConstant over the year, average = 9.9 kWh/dayArnual valuesLamps (LED or fluo) TV / PC / MobileTV / PC / Mobile26 1Iron1 1200 W/app14 h/day 1200 Wh/daySitand-by consumers1 200 Wh/dayDish- & Cloth-washers1 1 200 W totStand-by consumers2 200 Wh/dayTotal daily energy34524 Wh/dayAverage parametersAverage parametersAverage parametersAverage parametersPowerUseEnergy 1 b/day1 1 200 W/app1 1 200 W/app1 h/day24 Wh/day3000 Wh/day25 Wh/day3000 Wh/day26 Tab daily energy34524 Wh/day27 O Wapp1 h/day28 Option29 Option29 Option20 Option29 Option <t< th=""><td>Simulation variant :</td><td>Small family - 6kw</td><td></td><td></td><td></td><td></td><td></td></t<>	Simulation variant :	Small family - 6kw					
Near Shadings PV Field OrientationLinear shadings tiltazimuth 0° Pnom 320 Wp Pnom S20 Wp Pnom to 320 Wp Pnom to 4.40 kWp Pnom total0° e Aray 6.40 kWp 	Main system parameters	Syste	em type	Sheds on ground			
PV Field Orientation tilt 5° azimuth 0° PV modules Model JAM6-72-320/SI Pnom 320 Wp Pnom total 6.40 kWp Inverter Model SUN2000L-5KTL Constant over the year Constant over the year Daily household consumers, Constant over the year, average = 9.9 kWh/day Annual values	Near Shadings	Linear s	hadings				
PV modules       Model       JAM6-72-320/SI       Pnom       320 V/p         PV Array       Nb. of modules       20       Pnom total       6.40 kWp         Inverter       Model       SUN2000L-5KTL       Pnom       5.00 kW ac         User's needs       Daily household consumers       Constant over the year       Global       3625 kWh/year         Daily household consumers, Constant over the year, average = 9.9 kWh/day         Annual values         Use 2 days a week       Number       Power       Use       Energy         Lamps (LED or fluo)       26       18 W/lamp       5 h/day       2340 Wh/day         Iron       1       1200 W/app       1 h/day       1960 Wh/day         Jish- & Cloth-washers       1       2000 W tot       2 h/day       3000 Wh/day         Jish- & Cloth-washers       1       2000 W tot       2 h/day       22500 Wh/day         Stand-by consumers       1       2000 W tot       2 4 h/day       24 Wh/day         Model       Jish       3       750 W tot       10 h/day       22500 Wh/day         Jistant water heater       1       2000 W tot       2 4 h/day       24 Wh/day         Jistand-by consumers       1       10 model	PV Field Orientation		tilt	5°	azimuth	0°	
PY Array Inverter       No. or inductes       20       Phom total       6.40 kWp         Inverter       Daily household consumers       Constant over the year       Global       3625 kWh/year         Daily household consumers, Constant over the year, average = 9.9 kWh/day         Annual values         Lamps (LED or fluo)       26       18 W/lamp       5 h/day       2340 Wh/day         TV / PC / Mobile       2       70 W/app       14 h/day       1960 Wh/day         Iron       1       1200 W/app       1 h/day       1960 Wh/day         Dish- & Cloth-washers       1       2000 W tot       2 h/day       3000 Wh/day         Instant water heater       1       2000 W tot       2 h/day       22500 Wh/day         Total daily energy       3       750 W tot       10 h/day       22500 Wh/day         Mourly profile         Mourly profile         1       10       10 h/day       24 Wh/day         Mourly profile         1       10       10 h/day       24 Wh/day         3       750 W tot       10 h/day       24 Wh/day         Mourly profile         1       10       10 h/day       24 Wh/day	PV modules	Nih of i	Model	JAM6-72-320/SI	Pnom .	320 Wp	1
Indicision       Daily household consumers       Constant over the year       Finding       Sub KW due         Daily household consumers, Constant over the year, average = 9.9 kWh/day       Annual values       Annual values         Image: LED or fluo)       Use 2 days a week       Number       Power       Use       Energy         TV / PC / Mobile       26       18 W/lamp       5 h/day       2340 Wh/day         Iron       1       1200 W/app       14 h/day       1960 Wh/day         Iron       1       1200 W/app       1 h/day       1200 Wh/day         Instant water heater       1       2000 W tot       2 h/day       3000 Wh/day         Aircond       3       750 W tot       10 h/day       22500 Wh/day         Stand-by consumers       36000       10 h/day       24 Wh/day       34524 Wh/day         30000       10000       100000       1000000       1000000000       10000000000000000	PV Array	IND. OF I	Model	20 SUN20001-5KTI	Phom total Phom	5.40 KV	/p / ac
Daily household consumers, Constant over the year, average = 9.9 kWh/day Annual values Use 2 days a week Number Power Use Energy Lamps (LED or fluo) TV / PC / Mobile 2 70 W/app 14 h/day 1960 Wh/day Iron 1 1200 W/app 1 h/day 3000 Wh/day Stand-by consumers 1 2000 W tot 2 h/day 3000 Wh/day Stand-by consumers 2 1 2000 W tot 2 h/day 3000 Wh/day Total daily energy 34524 Wh/day Multiplane 1 2000 W tot 2 h/day 22500 Wh/day Dish- & Cloth-washers 1 2000 W tot 2 h/day 3000 Wh/day Stand-by consumers 2 34524 Wh/day Multiplane 1 2000 W tot 2 h/day 24 Wh/day Multiplane 2 34524 Wh/day Multiplane 2 34524 Wh/day	User's needs	Daily household cor	sumers	Constant over the y	/ear Global	3625 kV	Vh/year
Annual values Use 2 days a week Number Power Use Energy Lamps (LED or fluo) TV / PC / Mobile 2 Iron 1 Fridge / Deep-freeze 1 Dish- & Cloth-washers 1 Instant water heater 1 Aircond 2 Stand-by consumers 1 Total daily energy 3 Total d	Daily household consume	ers, Constant over the	e year, av	verage = 9.9 kWh/d	lay		
Use 2 days a weekNumberPowerUseEnergyLamps (LED or fluo)2618 W/lamp5 h/day2340 Wh/dayTV / PC / Mobile270 W/app14 h/day1960 Wh/dayIron11200 W/app1 h/day1200 Wh/dayShridge / Deep-freeze124 Wh/day3000 Wh/dayDish- & Cloth-washers11 Wh/day500 Wh/dayInstant water heater12000 W tot2 h/dayAircond3750 W tot10 h/day22500 Wh/dayStand-by consumers224 Wh/day34524 Wh/dayTotal daily energy30009 12 15 18 21 24			Annua	l values			
Lamps (LED or fluo) TV / PC / Mobile Iron Fridge / Deep-freeze Dish- & Cloth-washers Instant water heater Aircond Stand-by consumers Total daily energy Total daily energy Lamps (LED or fluo) TV / PC / Mobile 2 Total daily energy Lamps (LED or fluo) TV / PC / Mobile 2 Total daily energy Lamps (LED or fluo) TV / PC / Mobile 2 Total daily energy Lamps (LED or fluo) TV / PC / Mobile 2 Total daily energy Lamps (LED or fluo) TV / PC / Mobile 2 Total daily energy Lamps (LED or fluo) TV / PC / Mobile 2 Total daily energy Lamps (LED or fluo) TV / PC / Mobile 2 Total daily energy Lamps (LED or fluo) TV / PC / Mobile 2 Total daily energy		Use 2 days a week	Number	Power	Use		Energy
TV / PC / Mobile270 W/app14 h/day1960 Wh/dayIron11200 W/app1 h/day1200 Wh/dayFridge / Deep-freeze124 Wh/day3000 Wh/dayDish- & Cloth-washers11 Wh/day500 Wh/dayInstant water heater12000 W tot2 h/dayAircond3750 W tot10 h/dayStand-by consumers224 Wh/dayTotal daily energy34524 Wh/day	Lamps (LED or fluo)		26	18 W/lamp	5 h/day	<sup>,</sup> 2	340 Wh/day
Iron11200 W/app1 h/day1200 Wh/dayFridge / Deep-freeze1124 Wh/day3000 Wh/dayDish- & Cloth-washers112000 W tot2 h/day3000 Wh/dayInstant water heater12000 W tot2 h/day3000 Wh/dayAircond3750 W tot10 h/day22500 Wh/dayStand-by consumers124 h/day24 Wh/dayTotal daily energy34524 Wh/day34524 Wh/day	TV / PC / Mobile		2	70 W/app	14 h/day	r 1	960 Wh/day
Fridge / Deep-freeze124 Wh/day3000 Wh/dayDish- & Cloth-washers112000 W tot2 h/day500 Wh/dayInstant water heater12000 W tot2 h/day3000 Wh/dayAircond3750 W tot10 h/day22500 Wh/dayStand-by consumers24 h/day24 Wh/dayTotal daily energy34524 Wh/day	Iron		1	1200 W/app	1 h/day	' 1	200 Wh/day
Dish- & Cloth-washers111Wh/day500 Wh/dayInstant water heater12000 W tot2 h/day3000 Wh/dayAircond3750 W tot10 h/day22500 Wh/dayStand-by consumers24 h/day24 Wh/dayTotal daily energy34524 Wh/day	Fridge / Deep-freeze		1		24 Wh/day	/ 3	000 Wh/day
Instant water heater Aircond Stand-by consumers Total daily energy Hourly profile Instant water heater Instant water Instant water	Dish- & Cloth-washers		1		1 Wh/day	'	500 Wh/day
Aircond 3 750 W tot 10 h/day 22500 Wh/day Stand-by consumers 24 h/day 24 Wh/day Total daily energy 34524 Wh/day	Instant water heater		1	2000 W tot	2 h/day	' 3	000 Wh/day
Total daily energy 34524 Wh/day 34524 Wh/day 0 0 0 0 0 0 0 0 0 0 0 0 0	Aircond		3	750 W tot	10 h/day	22	500 Wh/day
Hourly profile Hourly profile	Stand-by consumers				24 h/day	24	24 Wh/day
		Hraction of daily energy of the first state of the	Hourly	12 15 18	21 24		

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		Grid	-Conn	ected S	Svsten	n: Mair	n resu	lts			
Project :	Та	man Mi	dah (NE	с с с с с = NЛ \							
	1a 4. Cm			_ 111)							
Simulation varian	t: Sn	nall fam	ily - 6kw								
Main system param	eters		Sys	stem type	Sheds	s on grou	und				
Near Shadings			Linear	shadings	5						
PV Field Orientation				tili	t 5°	70.000/0		azimut	h 0°		
PV modules PV Array			Nh o	MODE f modules	I JAM6-	-72-320/5	)I	Phor Pnom tot:	n 320 v al <b>6 40</b>	vp kWn	
Inverter			NO. U	Mode	SUN2	000L-5KT	Ľ	Pnor	n 5.00	kW ac	
Jser's needs		Daily hou	usehold c	onsumers	Const	ant over t	he year	Globa	al 3625	kWh/yea	r
Main simulation res System Production	sults	Per	<b>Produce</b> formance	<b>d Energy</b> Ratio PR	<b>8.41  </b> 8 82.32	<b>MWh/yea</b> %	ı <b>r</b> Sp Solar F	ecific proc	d. 1314 F 25.20	kWh/kWj 9 %	o/year
Normalized productions	(per installed	i kWp): No	minal powe	r 6.40 kWp			Pei	rformance Ra	atio PR		
6 Lc : Collection L	I I Loss (PV-array los	II sses) (	).7 kWh/kWp/day	, ' ]	1		I I : Performance F	1 I I Ratio (Yf / Yr): 0.4	823	- 1 - 1 -	
Ls : System Los 5 - Yf : Produced u	ss (inverter,) seful energy (inve	( erter output)	).07 kWh/kWp/da 3.6 kWh/kWp/day	y –	0			_	_		
/p/day]			_ 8	-	0	.7					
4- 					2 O	6					
± - 6 3-					e Kati	.5					
E					o prmano	4					
2 -					Derte	3					
				-	0						
1 -					0	.2					
				-	0	.1					
Jan Feb Mar A	Apr May Jun	Jul Aug	Sep Oct	Nov Dec	0	.0 Jan Feb	Mar Apr	May Jun	Jul Aug S	Sep Oct No	v Dec
				Small fa	amily - 6	kw					
			Ba	lances ar	nd main i	results					
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid	
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh	
January	133.0	82.20	28.10	136.3	131.2	0.726	0.345	0.090	0.622	0.255	
February	134.6	67.90	27.70	137.4	132.8	0.737	0.276	0.078	0.645	0.198	
March	149.8	88.20	28.00	150.3	144.9	0.804	0.276	0.076	0.712	0.200	
April	140.3	70.50	27.70	138.8	133.9	0.742	0.311	0.080	0.648	0.231	
lune	140.3	78.60 77 90	28.6U 27.80	130.9 128.2	131./ 122 F	0.734 0.601	0.311	0.075	0.644	0.236	
July	134.4	87.20	27.80 27.80	120.3 131.1	125.5	0.710	0.270	0.000	0.604	0.210	
August	132.2	87.20	27.80	130.1	125.2	0.700	0.276	0.062	0.624	0.214	
September	129.2	79.00	27.10	128.8	124.0	0.691	0.276	0.067	0.610	0.209	
October	138.8	82.60	27.40	140.4	135.5	0.754	0.345	0.091	0.649	0.255	
November	117.6	79.20	26.70	119.8	115.4	0.648	0.276	0.062	0.572	0.214	
December	1150	73 20	26.29	118 1	112 6	0.640	0.311	L 0 073			
	115.0	73.20	20.27		113.0	0.040		0.073	0.554	0.237	
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	3.625	0.914	0.554 7.495	2.712	
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	3.625	0.914	0.554 7.495	2.712	
Year Legends: Glob	1597.2 Hor H	953.59 lorizontal gl	27.58	1596.2	1537.5	8.575 GlobEff	3.625 Effect	0.914 ive Global, d	0.554 7.495 corr. for IAI	0.237 2.712 M and shad	ings
Year Legends: Glob Diffl	Hor Hor H	953.59 lorizontal gl	27.58 lobal irradia	tion tion	1537.5	GlobEff EArray	3.625 Effect Effect	0.914 ive Global, ( ive energy a	7.495 7.495 corr. for IAI	2.712 2.712 W and shad ut of the ar	ings ray
Year Legends: Glob Diffl T_A	HIS.U 1597.2 Hor H Hor H mb T	953.59 lorizontal gl lorizontal d	27.58 obal irradia iffuse irradi	tion tion	1537.5	6.040 8.575 GlobEff EArray E_User E_Solar	3.625 Effect Effect Energ	0.914 ive Global, o ive energy a y supplied to	7.495 7.495 corr. for IAI at the output o the user	2.712 2.712 M and shad ut of the ar	ings ray
Year Legends: Glob Diffl T_A Glob	Hor H Hor H mb T Dinc G	953.59 Iorizontal gl Iorizontal d amb. Global incide	27.58 obal irradia iffuse irradi	1596.2 tion ation lane	1537.5	GlobEff EArray E_User E_Solar E_Grid	3.625 Effect Effect Energ Energ	0.914 ive Global, o ive energy a y supplied to y from the s	0.554 7.495 corr. for IAI at the output the user sun	2.712 M and shad ut of the ar	ings ray



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		Grid-Co	nnected Sy	/stem: Loss diagram		
Project :		Taman Midah	ı (NEM)			
Simulation va	riant :	Small family -	6kw			
Main system pa	arameters		System type	Sheds on ground		
Near Shadings PV Field Orienta PV modules PV Array Inverter User's needs	ation	L Daily househ	inear shadings tilt Model Nb. of modules Model iold consumers	5° azimu JAM6-72-320/SI Proc 20 Pnom to SUN2000L-5KTL Proc Constant over the year Glob	th 0° m 320 Wp tal <b>6.40 kW</b> m 5.00 kW pal 3625 kW	<b>/p</b> / ac Vh/year
			Loss diagram o	ver the whole year		
			-			
Γ		1597 kWh/m²		Horizontal global irradiation		
			-0.07% -0.07% 0.00% -3.67%	Global incident in coll. plane Global incident below threshold Near Shadings: irradiance loss IAM factor on global		
	1538 k	Wh/m <sup>2</sup> * 39 m <sup>2</sup> coll.		Effective irradiation on collectors		
_	efficienc	y at STC = 16.53%		PV conversion		
		9.85 MWh	-11.15%	Array nominal energy (at STC effic.) PV loss due to irradiance level PV loss due to temperature		
			+0.75%	Module quality loss		
	8.	58 MWh	-1.10% -0.95%	Mismatch loss, modules and strings Ohmic wiring loss Array virtual energy at MPP		
			) -1.88% ) 0.00% ) 0.00% ) 0.00% ) -0.01%	Inverter Loss during operation (efficiency Inverter Loss over nominal inv. power Inverter Loss due to max. input current Inverter Loss over nominal inv. voltage Inverter Loss due to power threshold	)	
grid consumption	8.4	41 MWh	→ 0.00% → -0.05%	Inverter Loss due to voltage threshold Night consumption Available Energy at Inverter Output		
2.71 MWh 0.91	MWh	7.50 MWh		Energy injected into grid		
to user to u from grid from	user solar	to grid				

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		Crid Conn	acted System		aluation		
		Gna-Conne	ected Syster	m: P50 - P90 eva	aluation		
Project :		Taman Mida	h (NEM)				
Simulation vari	ant :	Small family	- 6kw				
Main system par	rameters		System type	Sheds on ground			
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Daily house	Linear shadings tilt Model Nb. of modules Model hold consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the year	azimut Pnor Pnom tota Pnor Globa	n 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kV al 3625 kV	<b>Vp</b> √ ac Wh/year
Evaluation of the	e Produc	tion probability	y forecast				
The probability dis on the meteo data	stribution a used for	of the system pr the simulation,	roduction forecast and depends on t	t for different years is mather the following choices:	ainly depend	dent	
Meteo data source Meteo data Specified Deviatio Year-to-year varia	e n ıbility	Year dev	Kind viation from aver. Variance	MeteoNorm 7.2 station Not defined 3 % 0.5 %	n Yea	ır 1995	
The probability dis Specified Deviatio	stribution on P Soi	variance is also V module mode Inverter effici ling and mismat Degrada	depending on so lling/parameters ency uncertainty ch uncertainties ation uncertainty	me system parameters 1.0 % 0.5 % 1.0 % 1.0 % 1.0 %	uncertaintie	S	
Global variability (	(meteo +	system)	variance	1.9 % (qu	ladratic sur	)	
Annual productior	n probabil	ity	Variability P50 P90 P95	0.14 MWh 7.50 MWh 7.32 MWh 7.27 MWh			
			Probability	distribution			
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05	P50 P90 = 7316 P95 = 7265 kWh	0 = 7495 kWh E Grid simul = 7495 kWl kWh	• • • •		

0.00 7100

E\_Grid system production kWh

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	Grid-Con	nected System	n: Simulation p	arameters	i	
Project :	Taman M	idah (NEM)				
Geographical S	ite Kual	a Lumpur/Subang		Country	/ Malays	ia
Situation Time defined	as	Latitude Legal Time Albedo	3.12° N Time zone UT+8 0.20	Longitude Altitude	e 101.55° e 17 m	E
Meteo data:	Kual	a Lumpur/Subang	MeteoNorm 7.2 stat	tion - Synthetic		
Simulation var	ant : small fam	ily - 9kw				
		Simulation date	21/04/20 17h22			
Simulation para	meters	System type	Sheds on ground			
Collector Plane	Orientation	Tilt	5°	Azimuth	n 0°	
Models used		Transposition	Perez	Diffuse	e Perez, I	Veteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
User's needs :	Daily ho	usehold consumers average	Constant over the year 19.4 kWh/Day	ear		
PV Array Charac PV module Original PVsys Number of PV mo Total number of F Array global powe Array operating cl Total area Inverter Custom param Characteristics Inverter pack	eteristics Si- t database odules V modules er naracteristics (50°C) eters definition	<ul> <li>Model Manufacturer In series Nb. modules Nominal (STC) U mpp Module area</li> <li>Model Manufacturer Operating Voltage</li> <li>Nb. of inverters</li> </ul>	JAM6-72-320/SI JA Solar 14 modules 28 Ur 8.96 kWp At o 470 V 54.3 m <sup>2</sup> SUN2000L-8KTL Huawei Technologie 200-850 V Ur Max. p 2 * MPPT 50 %	In parallel nit Nom. Power operating cond. I mpp Cell area es nit Nom. Power oower (=>40°C) Total Power Pnom ratic	I 2 string: 320 Wp 8.05 kW 17 A 48.2 m <sup>2</sup> r 8.00 kV 8.80 kV r 8.0 kW 5 1.12	s /p (50°C) Vac Vac ac
<b>PV Array loss fa</b> Thermal Loss fac Wiring Ohmic Los Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	ctors tor ss oss Losses loss ASHRAE parametriza	Uc (const) Global array res. tion IAM =	20.0 W/m²K 465 mOhm 1 - bo (1/cos i - 1)	Uv (wind) Loss Fraction Loss Fraction Loss Fraction Loss Fraction bo Param	) 0.0 W/n 1.5 % a 0.8 % 1.0 % a 0.10 % 0.05	n²K / m/s t STC ıt MPP



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	Srid-Connected 9	Sveton	n: Detailed Lls	er's needs		
Dura in a f		a)	i. Detailed 03			
Project :	Taman Midan (NEN	/1)				
Simulation variant :	small family - 9kw					
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings				
PV Field Orientation		tilt	5°	azimuth	0°	
PV modules	Nb of r		JAM6-72-320/SI	Pnom S	320 wp	In
Inverter		Model	SUN2000L-8KTL	Pnom	8.00 kW	ac
User's needs	Daily household cor	nsumers	Constant over the y	year Global	7066 kV	Vh/year
Daily household consume	ers, Constant over the	<b>year, a</b> v Annua	verage = 19.4 kWh/ I values	/day		
	Use 5 davs a week	Number	Power	Use	F	
Lamps (LED or fluo)		26	18 W/lamp	5 h/day	, 2	340 Wh/day
TV / PC / Mobile		2	70 W/app	9 h/day	1	260 Wh/day
Iron		1	1200 W/app	1 h/day	/ 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh/day	3	000 Wh/day
Dish- & Cloth-washers		1		1 Wh/day	,	500 Wh/day
Instant water heater		1	2000 W tot	2 h/day	/ 3	000 Wh/day
Aircond		3	750 W tot	7 h/day	ı 15	750 Wh/day
Stand-by consumers				24 h/day	/	24 Wh/day
Total daily energy					27	074 Wh/day
	1500 1000 500 0 3 3 3 3 3 3 3 3 3 3 3 3 3	Hourly	<b>r profile</b>	21 24		

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		Grid	-Conn	ected	Syster	n: Maiı	n resul	ts			
Project :	Та	aman Mi	dah (NE	= MA)	5						
Simulation varian	t: sn	nall fami	ly - 9kw								
Main system param	eters		Sy	stem type	Shed	s on grou	und				
Near Shadings PV Field Orientation PV modules			Linea	r shadings til Mode	s t 5° I JAM6 <sup>,</sup>	-72-320/S	51	azimut Pnor	h 0° n 320V	Vp	
PV Array			Nb. c	of modules	s 28		-, F	Pnom tota	al <b>8.96</b>	kWp	
Inverter User's needs		Daily hou	isehold c	Mode onsumers	SUN2	000L-8KT ant over t	L he vear	Pnor Globa	n 8.00 al 7066	<vv ac<br="">kWh/vear</vv>	
		Dully not							1000	kivii, you	
Main simulation resultsSystem ProductionProduced Energy11.78 MWh/yearSpecific prod.1315 kWh/kWp/yearPerformance Ratio PR82.40 %Solar Fraction SF8.99 %											
Normalized productions	per installed	d kWp): No	minal powe	r 8.96 kWp			Per	formance Ra	atio PR		
6 Lc : Collection L Ls : System Los	oss (PV-array loss (inverter,)	sses) (	).7 kWh/kWp/day	/ av	1	.0 F PR	Performance R	II atio (Yf / Yr):0.4	824		
5 - Yf : Produced u (fop/dw//uw) 60	pr May Jur	Jul Aug	3.6 kWh/kWp/da	y	0 Performance Ratio PR 0 0 0 0 0 0	.8 .7 .6 .5 .4 .3 .2 .1 .0 Jan Feb	Mar Apr	I I May Jun	Jul Aug S	iep Oct Nov Dec	
				small f	amily - 9	<\\/					
			Ba	alances a	nd main	results					
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid	
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh	
January	133.0	82.20	28.10	136.3	131.2	1.016	0.623	0.061	0.937	0.562	
February	134.6	67.90	27.70	137.4	132.8	1.031	0.541	0.053	0.961	0.489	
March	149.8	88.20	28.00	150.3	144.9	1.125	0.596	0.060	1.046	0.536	
April	140.3	/0.50	27.70	138.8	133.9	1.039	0.569	0.053	0.967	0.516	
May	140.3	/8.60	28.60	136.9	131.7	1.027	0.623	0.058	0.950	0.564	
June	132.0	11.80	27.80	128.3	123.5	0.967	0.569	0.050	0.899	0.518	
July	134.4	07.20 87.20	27.8U 27.00	131.1	125.8 125.0	0.994	0.570		0.920	0.540	
Sentomber	120.2	70 00	27.0U 27.10	120.1	120.2	0.900	0.023	0.037	0.905	0.000	
October	138 R	82.60	27.10	140.0	124.0	1 056	0.541	0.050	0.900	0.573	
November	117.6	79.20	27.40 26.70	119.4	115.4	0.907	0.596	0.030	0.907	0.551	
December	115.0	73.20	26.29	118.1	113.4	0.896	0.569	0.045	0.834	0.523	
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	7.066	0.635	11.149	6.431	
Legends: Glob Diffl	Hor H	lorizontal gl lorizontal d	obal irradia iffuse irradi	ition	_	GlobEff EArray	Effecti	ve Global, o ve energy a	corr. for IAI	M and shadings ut of the array	

DiffHor T\_Amb GlobInc Horizontal diffuse irradiation T amb. Global incident in coll. plane Effective Global, corr. for IAM and shadings Effective energy at the output of the array Energy supplied to the user Energy from the sun Energy injected into grid Energy from the grid

E\_User

E\_Solar

E\_Grid

EFrGrid



	-							
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		Grid-Co	nnec	ted Sv	stem: Loss diagra	am		
Project :		Taman Midal			etern. Leee alagre			
Simulation var	iant ·	small family -	9kw	vi <i>)</i>				
Main avatam na			Curet		Chada an anaund			
Main System parameters			Syst	em type	Sneas on ground			
PV Field Orientat	tion			tilt	5°	azimut	h O°	
PV modules			Model		JAM6-72-320/SI 28	Pnor Pnom tot:	n 320 Wp a <b>896 kv</b>	Vn
Inverter			ND. OI	Model	SUN2000L-8KTL	Pnor	n 8.00 kV	V ac
User's needs		Daily household consumers Constant over the year Glo					al 7066 k\	Nh/year
			Loss o	liagram ov	ver the whole year			
Γ		1597 KVVh/m <sup>2</sup>		1	Horizontal global irradiatio	on		
				→-0.07% →-0.07%	Global incident in coll. plan Global incident below thresho	n <b>e</b> Id		
			k	0.00%	Near Shadings: irradiance los	S		
				∕]-3.67%	IAM factor on global			
1538 kWh/m² * 54 m² coll.					Effective irradiation on co	llectors		
efficiency at STC = 16.53%			~ 		PV conversion	STC offic )		
		13.79 1010011		≒ -0.75%	PV loss due to irradiance leve	el enic.)		
				)-11.15%	PV loss due to temperature			
			+(	).75%	Module quality loss			
			<b>→</b> -1	.10%	Mismatch loss, modules and s	strings		
	1:	2.01 MWh	\$ -0.	95%	Ohmic wiring loss Array virtual energy at MP	Р		
				000/			,	
			$\rightarrow 0.0$	80% 0%	Inverter Loss during operation	n (eπiciency v. power	)	
			$\rightarrow 0.0$	)% )%	Inverter Loss due to max. inp	ut current		
			>0.0	0%	Inverter Loss due to power th	reshold		
grid consumption			>0.0	0% )4%	Inverter Loss due to voltage t Night consumption	hreshold		
	11	1.78 MWh			Available Energy at Inverte	er Output		
	1							
6.43 MWh 0.64 I	1Wh 1	1.15 MWh			Energy injected into grid			
to user to u	ser	to grid						
from grid from	solar							

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		Grid-Connected Syste	m: P50 - P90 eva	luation					
Project :		Taman Midah (NEM)							
Simulation vari	iant :	small family - 9kw							
Main system par	rameters	System type	Sheds on ground						
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Linear shadings tilt Model Nb. of modules Model Daily household consumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the year	azimutl Pnor Pnom tota Pnor Globa	n 0° n 320 Wp n <b>8.96 kV</b> n 8.00 kV n 7066 kV	<b>Vp</b> √ ac Nh/year			
Evaluation of the	e Produc	tion probability forecast							
The probability dis	stribution	of the system production forecas	t for different years is mai	inly depend	dent				
on the meteo data	a used for	the simulation, and depends on	the following choices:	5					
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	e on ability	Kind Year deviation from aver. Variance	MeteoNorm 7.2 station Not defined 3 % 0.5 %	Yea	r 1995				
The probability dia Specified Deviatio	stribution on P Soi (meteo + s	variance is also depending on so V module modelling/parameters Inverter efficiency uncertainty ling and mismatch uncertainties Degradation uncertainty system) Variance	ome system parameters u 1.0 % 0.5 % 1.0 % 1.0 % 1.9 % (qua	ncertaintie dratic sum	s )				
Annual productior	n probabil	ity Variability P50 P90 P95	0.21 MWh 11.15 MWh 10.88 MWh 10.81 MWh						
Probability distribution									
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 P95 = 108	P50 = 11149 kWh E_Grid simul = 11149	kWh					

0.00 L

E\_Grid system production kWh

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	Grid-Conne	ected System	n: Simulation p	arameters	i	
Project :	Taman Mid	ah (NEM)				
Geographical Si	te Kuala	Lumpur/Subang		Country	/ Malays	ia
Situation Time defined	as	Latitude Legal Time Albedo	3.12° N Time zone UT+8 0.20	Longitude Altitude	e 101.55° e 17 m	E
Meteo data:	Kuala	Lumpur/Subang	MeteoNorm 7.2 stat	tion - Synthetic		
Simulation vari	ant : small family	/ <b>- 9kw</b>				
		Simulation date	21/04/20 17h24			
Simulation para	meters	System type	Sheds on ground			
<b>Collector Plane</b>	Orientation	Tilt	5°	Azimuth	n 0°	
Models used		Transposition	Perez	Diffuse	e Perez, I	Veteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
User's needs :	Daily hous	ehold consumers average	Constant over the ye 9.9 kWh/Day	ear		
PV Array Charac PV module Original PVsyst Number of PV mo Total number of P Array global powe Array operating ch Total area Inverter Custom param Characteristics Inverter pack	teristics Si-m database dules V modules r haracteristics (50°C) eters definition	ono Model Manufacturer In series Nb. modules Nominal (STC) U mpp Module area Model Manufacturer Dperating Voltage Nb. of inverters	JAM6-72-320/SI JA Solar 14 modules 28 Ur 8.96 kWp At o 470 V 54.3 m <sup>2</sup> SUN2000L-8KTL Huawei Technologie 200-850 V Ur Max. p 2 * MPPT 50 %	In parallel nit Nom. Power operating cond. I mpp Cell area es nit Nom. Power oower (=>40°C) Total Power Pnom ratic	I 2 string 320 Wp 8.05 kW 17 A 48.2 m <sup>2</sup> r 8.00 kW 8.80 kW r 8.0 kW 5 1.12	s /p (50°C) Vac Vac ac
<b>PV Array loss fac</b> Thermal Loss fact Wiring Ohmic Los Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	ctors or is iss Losses loss ASHRAE parametrization	Uc (const) Global array res. n IAM =	20.0 W/m²K 465 mOhm 1 - bo (1/cos i - 1)	Uv (wind) Loss Fraction Loss Fraction Loss Fraction Loss Fraction bo Param	) 0.0 W/n n 1.5 % a n -0.8 % n 1.0 % a n 0.10 % . 0.05	n²K / m/s t STC tt MPP



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	Srid-Connected S	System	n <sup>.</sup> Detailed I Is	er's needs	I	
Droinot :	Taman Midah (NEN	<i>a</i> v	n. Detailed 03			
		<i>n</i> )				
Simulation variant :	small family - 9kw					
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings				
PV Field Orientation		tilt	5°	azimuth (	)°	
PV modules PV Array	Nb of r	nodules	JAM6-72-320/SI 28	Pnom com com com com com com com com com c	320 vvp 3 <b>.96 kWp</b>	
Inverter		Model	SUN2000L-8KTL	Pnom 8	3.00 kW ac	
User's needs	Daily household cor	nsumers	Constant over the y	/ear Global 3	3625 kWh/year	
Daily household consum	ers, Constant over the	e year, av	verage = 9.9 kWh/d	lay		
		Annua	l values			
	Use 2 days a week	Number	Power	Use	Energy	
Lamps (LED or fluo)		26	18 W/lamp	5 h/day	2340 Wh/	day
TV / PC / Mobile		2	70 W/app	14 h/day	1960 Wh/	day
Iron		1	1200 W/app	1 h/day	1200 Wh/	day
Fridge / Deep-freeze		1		24 Wh/day	3000 Wh/	day
Disn- & Cloth-Washers			2000 W/ tot	I Wh/day	500 Wh/	day
Aircond		3	750 W tot	10 h/day	22500 Wh/	dav
Stand-by consumers		5	750 W lot	24 h/day	22300 Wh/	dav
Total daily energy		ļ	ļ		34524 Wh/	day
	Hadding of the second s	Hourly 6 9	<b>y profile</b>	21 24		

Grid-Connected System: Main resultsProject :Taman Midah (NEM) isimulation variant :Taman Midah (NEM) isimulation variant :Taman Midah (NEM) isimulation variant :Main system parametersSystem (yp)Sheds on ground the shadings Develop United DrientationSystem (yp)Sheds on ground it to sheds on ground United States and the shadings 28PV modulesSystem (yp)Sheds on ground States and the shadings 28Promotical Pomotical 8.06 WW ac 8.06 WW ac 0.06 WW ac 
Project :: Taman Midah (MEM) Sinda or ana initial service in mail family - 9 km Marcin Advance in the formation initial of the formation initial
Project. Final mixed recently Simulation variant : small family - 9kw Main system parameters System type Sheds on ground Linear shadings EV Field Orientation User's needs Daily household consumers Constant over the year Global 3625 kWh/year Derivative States Daily household consumers Constant over the year Global 3625 kWh/year Model SUN2000L-8KTL Prior total 8.96 kWp EV Array Nb. of modules 28 Produced Energy 11.78 MWh/year Specific prod. 1315 kWh/kWp/year System Production Specific prod. 1315 kWh/kWp/year System Production (per installed kWp): Nominal power 8.96 kWp of the Constant over the year Origon Daily household consumers Constant over the year Origon Daily household
Simulation variant :         small family - 9kw           Main system parameters         System type         Sheds on ground           Near Shadings         Linear shadings         Promodiles         Subscription         <
Main system parameters         System type         Shels on ground           New Shadings PV Field of instation         Linear shadings Model         57         azimuth         0"           PV Field of instation         Nb. of modules         JAM6-72-320/SI         Pnom         320 Wp           PV Array         Nb. of modules         JAM6-72-320/SI         Pnom         320 Wp           PV Array         Nb. of modules         SUS200L-8KTL         Pnom         325 KWh/year           Main simulation results         Produced Energy         11.78 MWh/year         Specific prod.         1315 KWh/kWp/year           System Production         Forduced Energy         11.78 MWh/year         Specific prod.         1315 KWh/kWp/year           Ordunation results         Forduced Energy         11.78 MWh/year         Specific prod.         1315 KWh/kWp/year           Ordunation results         Forduced Energy         11.78 MWh/year         Specific prod.         1315 KWh/kWp/year           Ordunation results         Forduced Energy         11.78 MWh / Specific prod.         1315 KWh/kWp/year           Ordunation results         Fordunation results         Fordunation results         1315 KWh/kWp/year           State Productions for installed KMp: module         State Production for installed KMp: Tordunation results         Production foresult installe
New Shadings PV Field OrientationLinear shadings the shadings PV andulesLinear shadings the shadings ModelJAM6-72-320/SI JAM6-72-320/SI Pnom tailPnom tail 8.96 kWp Pom tails A8.96 kWp Pom tailsMain imulation results System ProductionProduced Energy Performance Ratio PR11.78 MWh/year Solar Fraction SFSpecific prod. 1315 kWh/kWp/yearMomilized productions (pri installed Wp): Mom and power 8.96 kWp Performance Ratio PR11.78 MWh/year Bala 0 %Specific prod. Solar Fraction SF1315 kWh/kWp/year 2.06.8 %Normalized productions (pri installed Wp): Mom and power 8.96 kWp Performance Ratio PR11.78 MWh/year Bala 0 %Specific prod. Bala 0 %1315 kWh/kWp/yearNormalized productions (pri installed Wp): Mom and power 8.96 kWp Performance Ratio PR11.78 MWh/year Bala 0 %Specific pri installed Wp/interprint Bala 0 %Performance Ratio PRNormalized productions (pri installed Wp): Mom and power 8.96 kWp Performance Ratio PRSpecific pri installed Wp/interprint 
$\frac{PV \ \text{relation}}{PV \ \text{modules}} = \frac{V \ \text{index}}{V \ \text{modules}} = \frac{V \ \text{index}}{V \ \text{modules}} = \frac{V \ \text{modules}}{V \ \text{modues}} = \frac{V \ \text{modules}}{V \ \text{modues}} = \frac{V \ \text{modues}}{V \ \text{modues}} = \frac{V \ \text{modues}}}{V \ \text{modues}} = V $
$\frac{1}{10000} = \frac{1}{100000} = \frac{1}{10000000000000000000000000000000000$
$\frac{1}{128 \text{ merter}} = \frac{1}{128 \text{ model}} = \frac{1}{128 \text{ model}}$
User's needs         Daily household consumers         Constant over the year         Global         3625 kWh/year           Main simulation results System Production         Produced Energy Performance Ratio PR         11.78 MWh/year         Specific prod.         1315 kWh/kWp/year           Normaliced productions (per installed WP): Noninal power 8.95 kW         Image: Specific prod.         1315 kWh/kWp/year         Performance Ratio PR           Image: Specific prod.         Image: Specific prod.         Image: Specific prod.         Image: Specific prod.         1315 kWh/kWp/year           Image: Specific prod.         Image: Speci
$\begin{array}{c} \text{System Production} & \textbf{Produced Energy} \\ \text{Beformance Ratio PR} & \textbf{11.78} \ \textbf{My}/\text{year} & \textbf{Specific prod.} \\ \text{Solar Fraction SF} & \textbf{13.15} \ \textbf{KW}/\text{kW}/\text{Wy}/\text{year} \\ \textbf{26.68} \\ \end{array} \\ \hline \textbf{Momelized productions (per installed KWp): Noninal power 8.96 KWp \\ \hline \textbf{My} \hline \textbf{My} \\ \hline My$
$ \frac{\text{Normalized productions (per installed kWp): Nominal power 8.96 kWp}}{\int \frac{1}{12} \int \frac{1}{12} \int$
$\frac{1}{10^{-1}  marked productions (private last) (private last)$
$\int_{a} \int_{a} \int_{a$
$\int_{a_{1}}^{a_{1}} \int_{a_{2}}^{a_{1}} \int_{a_{1}}^{a_{2}} \int_{a_{2}}^{a_{2}} \int_{a_{2}}^$
$\frac{1}{9} \int_{\frac{1}{9}} \int_{\frac{1}{$
$\frac{1}{90} \int_{-\frac{1}{9}}^{0} \int_{-\frac{1}{9}}$
$\frac{1}{999} \int_{-9}^{0} \int_{-9}^{0}$
$ \frac{1}{9} \int_{-\frac{1}{9}}^{0} \int_{-\frac{1}{9}}$
$\int_{a_{1}}^{b_{2}} \int_{a_{2}}^{a_{1}} \int_{a_{2}}^{a_{2}} \int_{a_{2}}^$
$\int_{a_{1}}^{a_{2}} \int_{a_{2}}^{a_{2}} \int_{a_{2}}^$
$\frac{1}{2} \int_{0}^{2} \int_{an}^{a} Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec} \int_{0}^{2} \int_{an}^{0} \int_{0}^{2} \int_{an}^{a} Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec} \int_{0}^{2} \int_{an}^{0} \int_{an}^{2} Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec} \\ Small family - 9kw Balances and main results \\ \frac{1}{2} \int_{an}^{2} $
Definition of the first
Image: Constraint of the state of the s
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec         Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec         small family - 9kw         Balances and main results         main fight of the state of
small family - 9kw         Balances and main results         matrix       GlobHor       DiffHor       T_Amb       GlobInc       GlobErf       EArray       E_User       E_Solar       E_Grid       EFrGrid         January       133.0       82.20       28.10       136.3       131.2       1.016       0.345       0.095       0.902       0.250         February       134.6       67.90       27.70       137.4       132.8       1.031       0.276       0.081       0.933       0.196         March       149.8       88.20       28.00       150.3       144.9       1.125       0.276       0.079       1.026       0.197         April       140.3       70.50       27.70       138.8       133.9       1.039       0.311       0.085       0.926       0.226         May       140.3       78.60       28.60       136.9       131.7       1.027       0.311       0.082       0.926       0.229         June       132.0       77.80       27.80       128.3       123.5       0.967       0.276       0.070       0.879       0.206         July       134.4       87.20       27.80       131.1       125.8<
small family - 9kwBalances and main resultsImage: colspan="6">GlobHorDiffHorT_AmbGlobIncGlobEftEArrayE_UserE_SolarE_GridEFrGridFrGridJanuary133.082.2028.10136.3131.21.0160.3450.0950.9020.250February134.667.9027.70137.4132.81.0310.2760.0810.9330.196March149.888.2028.00150.3144.91.1250.2760.0791.0260.197April140.370.5027.70138.8133.91.0390.3110.0850.9350.226May140.378.6028.60136.9131.71.0270.3110.0820.9260.229June132.077.8027.80128.3123.50.9670.2760.0700.8790.206July134.487.2027.80130.1125.20.9800.2760.0660.8960.210September132.279.0027.10128.8124.00.9680.2760.0730.8770.203October138.882.6027.40140.4135.51.0560.3450.0940.9430.251
small family - 9kw         Balances and main results         matrix       GlobHor       DiffHor       T_Amb       GlobInc       GlobEff       EArray       E_User       E_Solar       E_Grid       EFrGrid         January       133.0       82.20       28.10       136.3       131.2       1.016       0.345       0.095       0.902       0.250         February       134.6       67.90       27.70       137.4       132.8       1.031       0.276       0.081       0.933       0.196         March       149.8       88.20       28.00       150.3       144.9       1.125       0.276       0.079       1.026       0.197         April       140.3       70.50       27.70       138.8       133.9       1.039       0.311       0.085       0.935       0.226         May       140.3       70.50       27.80       131.7       1.027       0.311       0.082       0.926       0.229         June       132.0       77.80       27.80       128.3       123.5       0.967       0.276       0.070       0.879       0.206         July       134.4       87.20       27.80       131.1       125.2       0.980<
Balances and main results           GlobHor         DiffHor         T_Amb         GlobInc         GlobEff         EArray         E_User         E_Solar         E_Grid         EFrGrid           January         133.0         82.20         28.10         136.3         131.2         1.016         0.345         0.095         0.902         0.250           February         134.6         67.90         27.70         137.4         132.8         1.031         0.276         0.081         0.933         0.196           March         149.8         88.20         28.00         150.3         144.9         1.125         0.276         0.079         1.026         0.197           April         140.3         70.50         27.70         138.8         133.9         1.039         0.311         0.085         0.926         0.229           June         132.0         77.80         27.80         131.7         1.027         0.311         0.085         0.935         0.226           July         134.4         87.20         27.80         131.1         125.8         0.967         0.276         0.070         0.879         0.206           July         134.4         87.20         27.80
GlobHor kWh/m2DiffHor °CT_Amb kWh/m2GlobInc °CGlobEff kWh/m2EArray MWhE_User 
kWh/m2kWh/m2°CkWh/m2kWh/m2MWhMWhMWhMWhMWhMWhJanuary133.082.2028.10136.3131.21.0160.3450.0950.9020.250February134.667.9027.70137.4132.81.0310.2760.0810.9330.196March149.888.2028.00150.3144.91.1250.2760.0791.0260.197April140.370.5027.70138.8133.91.0390.3110.0850.9350.226May140.378.6028.60136.9131.71.0270.3110.0820.9260.229June132.077.8027.80128.3123.50.9670.2760.0700.8790.206July134.487.2027.80131.1125.80.9940.3450.0970.8780.248August132.287.2027.80130.1125.20.9800.2760.0660.8960.210September129.279.0027.10128.8124.00.9680.2760.0730.8770.203October138.882.6027.40140.4135.51.0560.3450.0940.9430.251
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February134.667.9027.70137.4132.81.0310.2760.0810.9330.196March149.888.2028.00150.3144.91.1250.2760.0791.0260.197April140.370.5027.70138.8133.91.0390.3110.0850.9350.226May140.378.6028.60136.9131.71.0270.3110.0820.9260.229June132.077.8027.80128.3123.50.9670.2760.0700.8790.206July134.487.2027.80131.1125.80.9940.3450.0970.8780.248August132.287.2027.80130.1125.20.9800.2760.0660.8960.210September129.279.0027.10128.8124.00.9680.2760.0730.8770.203October138.882.6027.40140.4135.51.0560.3450.0940.9430.251
IMarcn       149.8       88.20       28.00       150.3       144.9       1.125       0.2/6       0.0/9       1.026       0.197         April       140.3       70.50       27.70       138.8       133.9       1.039       0.311       0.085       0.935       0.226         May       140.3       78.60       28.60       136.9       131.7       1.027       0.311       0.082       0.926       0.229         June       132.0       77.80       27.80       128.3       123.5       0.967       0.276       0.070       0.879       0.206         July       134.4       87.20       27.80       131.1       125.8       0.994       0.345       0.097       0.878       0.248         August       132.2       87.20       27.80       130.1       125.2       0.980       0.276       0.066       0.896       0.210         September       129.2       79.00       27.10       128.8       124.0       0.968       0.276       0.073       0.877       0.203         October       138.8       82.60       27.40       140.4       135.5       1.056       0.345       0.094       0.943       0.251
April       140.3       70.30       27.70       138.8       133.9       1.039       0.311       0.085       0.935       0.226         May       140.3       78.60       28.60       136.9       131.7       1.027       0.311       0.085       0.935       0.229         June       132.0       77.80       27.80       128.3       123.5       0.967       0.276       0.070       0.879       0.206         July       134.4       87.20       27.80       131.1       125.8       0.994       0.345       0.097       0.878       0.248         August       132.2       87.20       27.80       130.1       125.2       0.980       0.276       0.066       0.896       0.210         September       129.2       79.00       27.10       128.8       124.0       0.968       0.276       0.073       0.877       0.203         October       138.8       82.60       27.40       140.4       135.5       1.056       0.345       0.094       0.943       0.251
Mdy       140.3       70.00       20.00       130.7       131.7       1.027       0.311       0.002       0.920       0.229         June       132.0       77.80       27.80       128.3       123.5       0.967       0.276       0.070       0.879       0.206         July       134.4       87.20       27.80       131.1       125.8       0.994       0.345       0.097       0.878       0.248         August       132.2       87.20       27.80       130.1       125.2       0.980       0.276       0.066       0.896       0.210         September       129.2       79.00       27.10       128.8       124.0       0.968       0.276       0.073       0.877       0.203         October       138.8       82.60       27.40       140.4       135.5       1.056       0.345       0.094       0.943       0.251
July       134.4       87.20       27.80       131.1       125.8       0.994       0.345       0.097       0.878       0.248         August       132.2       87.20       27.80       130.1       125.2       0.980       0.276       0.066       0.896       0.210         September       129.2       79.00       27.10       128.8       124.0       0.968       0.276       0.066       0.896       0.210         October       138.8       82.60       27.40       140.4       135.5       1.056       0.345       0.094       0.943       0.251
August         132.2         87.20         27.80         130.1         125.2         0.980         0.276         0.066         0.896         0.210           September         129.2         79.00         27.10         128.8         124.0         0.968         0.276         0.073         0.877         0.203           October         138.8         82.60         27.40         140.4         135.5         1.056         0.345         0.094         0.943         0.251
September         129.2         79.00         27.10         128.8         124.0         0.968         0.276         0.073         0.877         0.203           October         138.8         82.60         27.40         140.4         135.5         1.056         0.345         0.094         0.943         0.251
October   138.8   82.60   27.40   140.4   135.5   1.056   0.345   0.094   0.943   0.251
November 117.6 79.20 26.70 119.8 115.4 0.907 0.276 0.067 0.822 0.209
December 115.0 73.20 26.29 118.1 113.6 0.896 0.311 0.078 0.801 0.232
Year         1597.2         953.59         27.58         1596.2         1537.5         12.005         3.625         0.967         10.817         2.658
Legends: GlobHor Horizontal global irradiation GlobEff Effective Global, corr. for IAM and shadings
Diffuse Instantial diffuse instantian Example Effective county of the start of
DiffHor Horizontal diffuse irradiation EArray Effective energy at the output of the array

E\_Grid

EFrGrid

Energy injected into grid

Energy from the grid

Γ



PVSYST V6.86					21/04/20	Page 6/7
		Grid-Co	nnected Sv	/stem: Loss diagram		
Draigat :		Taman Midak				
Simulation var	iont ·					
Simulation var		Siliali lalliny -	9KW			
Main system pa	rameters		System type	Sheds on ground		
Near Shadings PV Field Orientat	rion	L	inear shadings. tilt	5° azimu	th 0°	
PV modules			Model	JAM6-72-320/SI Pno	m 320 Wp	1
PV Array		ļ	Nb. of modules	28 Pnom tot	al <b>8.96 kV</b>	Vp
Inverter User's needs		Dailv househ	iviodei old consumers	Constant over the year Glob	т 8.00 км al 3625 k\	7 ac Nh∕vear
				,		
			Loss diagram ov	ver the whole year		
<b>—</b>	_	1597 kWh/m²		Horizontal global irradiation		
			→-0.07%	Global incident in coll. plane		
			0.00%	Near Shadings: irradiance loss		
			-3.67%	IAM factor on global		
	1538 k	.Wh/m² * 54 m² coll.		Effective irradiation on collectors		
	efficien	cy at STC = 16.53%		PV conversion		
		13.79 MWh		Array nominal energy (at STC effic.)		
			J -0.75%	PV loss due to irradiance level		Ì
			-11.15%	PV loss due to temperature		
			(+0.75%	Module quality loss		
			9-1.10%	Mismatch loss, modules and strings		
	10		9-0.95%	Ohmic wiring loss		
	12			Allay viltual ellergy at MFF		
			→-1.80%	Inverter Loss during operation (efficiency	')	
			→ 0.00% → 0.00%	Inverter Loss over nominal inv. power		
			→ 0.00%	Inverter Loss over nominal inv. voltage		
			→ 0.00%	Inverter Loss due to power threshold		
grid consumption			→-0.04%	Night consumption		
	11	.78 MWh		Available Energy at Inverter Output		
	1					
2.66 MWh 0.97 M	Wh 1	0.82 MWh		Energy injected into grid		
to user to us	ser	to grid				
from grid from s	solar					

PVSYST V6.86						21/04/20	Page 7/7		
		Grid-Conn	ected Syster	m: P50 - P90 ev	aluation				
Project :		Taman Mida	ah (NEM)						
Simulation vari	ant :	small family	- 9kw						
Main system par	rameters		System type	Sheds on ground					
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	on	Daily house	Linear shadings tilt Model Nb. of modules Model shold consumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the yea	azimut Pnor Pnom tota Pnor r Globa	h 0° n 320 Wp al <b>8.96 kV</b> n 8.00 kV al 3625 kV	V <b>p</b> V ac Wh/year		
Evaluation of the	e Produc	tion probabilit	y forecast						
The probability dis on the meteo data	stribution a used for	of the system p the simulation,	roduction forecast and depends on t	t for different years is m the following choices:	ainly depen	dent			
Meteo data source Meteo data Specified Deviatio Year-to-year varia	e n bility	Year dev	Kind viation from aver. Variance	MeteoNorm 7.2 statio Not defined 3 % 0.5 %	n Yea	ar 1995			
The probability dis Specified Deviatio	stribution n P Soi	variance is also V module mode Inverter effici ling and mismat Degrad	depending on so elling/parameters ency uncertainty cch uncertainties ation uncertainty	me system parameters 1.0 % 0.5 % 1.0 % 1.0 %	uncertaintie	S			
Global variability (	(meteo + :	system)	Variance	1.9 % (qi	uadratic sum	1)			
Annual productior	n probabil	ity	Variability P50 P90 P95	0.20 MWh 10.82 MWh 10.56 MWh 10.48 MWh					
Probability distribution									
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05	P90 = 105 P95 = 10485 kV	50 = 10817 kWh E.Grid simul = 10817 558 kWh Wh	kWh				

0.00 **-**10200

E\_Grid system production kWh

PVSYST V6.86					21/04/20	Page 1/7
	Grid-0	Connected Systen	n: Simulation p	arameters		
Project :	Tama	an Midah (NEM)				
Geographical Si	te	Kuala Lumpur/Subang		Country	Malays	ia
Situation		Latitude	3.12° N	Longitude	101.55°	E
Time defined a	as	Legal Time	Time zone UT+8	Altitude	17 m	
Meteo data:		Kuala Lumpur/Subang	MeteoNorm 7.2 sta	tion - Synthetic		
Simulation vari	ant : avera	ige family - 6kw				
		Simulation date	21/04/20 15h58			
Simulation para	meters	System type	Sheds on ground			
<b>Collector Plane</b>	Orientation	Tilt	5°	Azimuth	0°	
Models used		Transposition	Perez	Diffuse	Perez, M	Neteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
User's needs :	Dai	ly household consumers average	Constant over the y 25.1 kWh/Day	ear		
PV Array Charac PV module Original PVsyst Number of PV mo Total number of P Array global powe Array operating ch Total area Inverter Original PVsys Characteristics	teristics database dules V modules r naracteristics (50 t database	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) °C) U mpp Module area Model Manufacturer Operating Voltage	JAM6-72-320/SI JA Solar 10 modules 20 U 6.40 kWp At 336 V 38.8 m <sup>2</sup> SUN2000L-5KTL Huawei Technologie 90-500 V U Max.	In parallel Init Nom. Power operating cond. I mpp Cell area es Init Nom. Power power (=>40°C)	2 strings 320 Wp 5.75 kW 17 A 34.4 m <sup>2</sup> 5.00 kW 5.50 kW	s 'p (50°C) /ac /ac
Inverter pack		Nb. of inverters	2 * MPPT 50 %	Total Power Pnom ratio	5.0 kWa 1.28	ac
PV Array loss fac	ctors					
Thermal Loss fact	or	Uc (const)	20.0 W/m²K	Uv (wind)	0.0 W/n	n²K / m/s
Wiring Ohmic Los Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	ss Losses loss ASHRAE parame	Global array res. etrization IAM =	332 mOhm 1 - bo (1/cos i - 1)	Loss Fraction Loss Fraction Loss Fraction Loss Fraction bo Param.	1.5 % a -0.8 % 1.0 % a 0.10 % 0.05	t STC t MPP



PVSYST V6.86				21	/04/20	Page 3/7
	Frid-Connected S	System	n. Detailed Lls	er's needs		
Drainat :	Tomon Midah (NEN	<i>a</i> \	I. Detailed 03			
Project :		//)				
Simulation variant :	average family - 6k	W				
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear shadings tilt 5° azimuth Model JAM6-72-320/SI Pnom Nb. of modules 20 Pnom total Model SUN2000L-5KTL Pnom Daily household consumers Constant over the year Global				0° 320 Wp <b>6.40 kWp</b> 5.00 kW ac 9174 kWb/year	
Daily household consum	ers Constant over the	vear av	verage = 25.1 kWh/	/dav		
		year, a	verage = 25.1 kwii/	uay		
		Annua	l values			
	Use 5 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		28	18 W/lamp	6 h/da	y 3	3024 Wh/day
TV / PC / Mobile		2	70 W/app	10 h/da	y 1	400 Wh/day
Iron		1	1200 W/app	1 h/da	y 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh/da	y 3	3000 Wh/day
Dish- & Cloth-washers		1		1 Wh/da	y _	500 Wh/day
Instant water heater		2	2000 W tot	2 h/da	y e	3000 Wh/day
Aircond Stand by consumers		3	750 W 101	8 n/ua 24 h/da		24 Wb/day
Total daily energy				24 17 04	<u>y</u> 35	5148 Wh/day
		Hourly	<b>v profile</b>			

PVSYST V6.86									21/04/2	) Pa	ge 4/7
		Grid	-Conne	ected \$	Syster	n: Maiı	n resul	lts			
Project :	Та	man Mi	dah (NE	- M )	5						
	lc										
Simulation varian	t: av	erage fa	amily - 6	kw							
Main system param	eters		Sys	stem type	Shed	s on grou	und				
Near Shadings			Linear	shadings	3						
PV Field Orientation				til	t 5°	70.000/0		azimut	h 0°		
PV modules			Nh o	IVIODE f modules		-72-320/8	bl -	Phon tot	n 3∠0∨ ∍l <b>6∕0</b> I	vp kWn	
Inverter			110.0	Mode	J SUN2	000L-5KT	L	Pnor	n 5.00 l	kW ac	
User's needs		Daily hou	usehold co	onsumers	S Const	ant over t	he year	Globa	al 9174	kWh/yea	ar
Main simulation res	sults	Per	<b>Produce</b> formance	<b>d Energy</b> Ratio PF	<b>8.41</b> 8 82.32	<b>MWh/yea</b> %	i <b>r</b> Sp Solar F	ecific proc	d. 1314 F 9.34 °	kWh/kW %	/p/year
Normalized productions	(per installed	lkWp): No	minal power	6.40 kWp			Pei	formance R	atio PR		
6 Lc : Collection I	III	I I sses) (	- TTTTT		1	.0	I I : Performance F	TTIT	823	- 1 - 1	]
Ls : System Los	s (inverter,)	erter output)	).07 kWh/kWp/da 3.6 kWh/kWb/dav	у _	0	.9					
(day]					0	0.8					
dd 4 -					원 0	.7					
Ekw					Q	0.6					
Elector Elector					0 mance	.5					
pez 2					0 Derfor	0.4					
				-	0	.3					
1-					0	.2					
				-	0	.1					
0 Jan Feb Mar A	pr May Jur	Jul Aug	Sep Oct	Nov Dec	0	1.0 E 1 Jan Feb	Mar Apr	May Jun	Jul Aug S	ep Oct N	lov Dec
			Ba	average lances ar	family - nd main	6kw results					
	ClobHor	DiffHor	T Amb			EArroy	E Licor	E Solar	E Crid	EErCrid	1
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	0°	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh	
January	133.0	82.20	28.10	136.3	131.2	0.726	0.808	0.077	0.635	0.732	1
February	134.6	67.90	27.70	137.4	132.8	0.737	0.703	0.066	0.657	0.636	
March	149.8	88.20	28.00	150.3	144.9	0.804	0.773	0.075	0.713	0.698	
April	140.3	70.50	27.70	138.8	133.9	0.742	0.738	0.073	0.655	0.666	
Мау	140.3	78.60	28.60	136.9	131.7	0.734	0.808	0.078	0.641	0.730	
June	132.0	77.80	27.80	128.3	123.5	0.691	0.738	0.068	0.609	0.670	
July	134.4	87.20	27.80	131.1	125.8	0.710	0.773		0.625	0.702	
Sentember	129.2	79 00	27.00 27.10	128.8	125.2 124 N	0.700	0.008	0.075	0.012	0.734	
October	138.8	82.60	27.40	140.4	135.5	0.754	0.808	0.077	0.662	0.731	
November	117.6	79.20	26.70	119.8	115.4	0.648	0.773	0.067	0.568	0.707	
December	115.0	73.20	26.29	118.1	113.6	0.640	0.738	0.061	0.566	0.677	4
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	9.174	0.857	7.552	8.317	
<u>н</u>	•		I			•	•	•			-
Legends: Glob	Hor F	lorizontal gl	obal irradia	tion		GlobEff	Effect	ive Global, (	corr. for IAN	A and shad	dings
Diff	Hor H	lorizontal d	iffuse irradia	ation		EArray	Effect	ive energy a	at the outpu	ut of the a	rray
[_A	mb T	amb.	nt in cell -	lano		E_User	Energ	y supplied t	o the user		
GIOD		BDDUI INCIDE	ant in coll. pl	alle		E_SUIAF F Grid	Energ	y injected in	suu nto arid		
						EFrGrid	Energ	y from the o	grid		
							<u>9</u>	,	,		



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					21/01/20	
		Grid-Co	nnected Sy	vstem: Loss diagram		
Project :		Taman Midal	h (NEM)			
Simulation var	iant :	average fami	ly - 6kw			
Main system parameters			System type	Sheds on ground		
Near ShadingsPV Field OrientationPV modulesPV ArrayInverterUser's needsDaily house			inear shadings tilt Model Nb. of modules Model nold consumers	5° azimu JAM6-72-320/SI Pro 20 Pnom to SUN2000L-5KTL Pro Constant over the year Glob	uth 0° om 320 Wp tal <b>6.40 kV</b> om 5.00 kV oal 9174 k\	y <b>Vp</b> V ac Wh/year
			Loss diagram o	ver the whole year		
Γ		1597 kWh/m²		Horizontal global irradiation		
			-0.07% -0.07% -0.00% -3.67%	Global incident in coll. plane Global incident below threshold Near Shadings: irradiance loss IAM factor on global		
	1538 k	Wh/m² * 39 m² coll.		Effective irradiation on collectors		
efficiency at STC = 16.53%			•	PV conversion		
		9.85 MWh	-11.15%	Array nominal energy (at STC effic.) PV loss due to irradiance level PV loss due to temperature		
			(+0.75%	Module quality loss		
			→-1.10% →-0.95%	Mismatch loss, modules and strings		
	8.	58 MWh		Array virtual energy at MPP		
			-1.88% -0.00% -0.00% -0.00% -0.01%	Inverter Loss during operation (efficiency Inverter Loss over nominal inv. power Inverter Loss due to max. input current Inverter Loss over nominal inv. voltage Inverter Loss due to power threshold	/)	
grid consumption			40.00% →-0.05%	Night consumption		
	8.4	41 MWh		Available Energy at Inverter Output		
8.32 MWh 0.86 M	Wh	7.55 MWh		Energy injected into grid		
to user to us from grid from s	ser solar	to grid				

PVSYST V6.86						21/04/20	Page 7/7		
		Grid-Connec	ted Syster	n: P50 - P90 e	valuation				
Proiect :		Taman Midah	(NEM)						
Simulation vari	iant :	average family	- 6kw						
Main system pa	rameters		System type	Sheds on ground					
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Lir N Daily househo	near shadings tilt Model b. of modules Model Id consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the ye	azimut Pnor Pnom tota Pnor ear Globa	h 0° m 320 Wp al <b>6.40 kV</b> m 5.00 kW al 9174 kV	<b>/p</b> / ac Vh/year		
Evaluation of the	e Produc	tion probability for	orecast						
The probability dia on the meteo data	stribution a used for	of the system prod	uction forecast d depends on t	for different years is he following choices:	mainly depen	dent			
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	e on ability	Year deviat	Kind ion from aver. Variance	MeteoNorm 7.2 stat Not defined 3 % 0.5 %	tion Yea	ar 1995			
The probability dia Specified Deviation	stribution on P Soi (meteo + :	variance is also de V module modellin Inverter efficiend ling and mismatch Degradatio system)	pending on so g/parameters cy uncertainty uncertainties on uncertainty Variance	me system paramete 1.0 % 0.5 % 1.0 % 1.0 % 1.9 %	rs uncertaintie (quadratic sun	us n)			
Annual productior	n probabil	ity	Variability P50 P90 P95	0.14 MWh 7.55 MWh 7.37 MWh 7.32 MWh					
Probability distribution									
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 0.00 7100 7200 75	P90 = 733 P95 = 7320 kW	i0 = 7552 kWh E_Grid simul = 7552 71 kWh /h 500 7600 7700 7	2 kWh	8000			

E\_Grid system production kWh

PVSYST V6.86					21/04/20	Page 1/7	
Grid-Connected System: Simulation parameters							
Project :	Tama	an Midah (NEM)					
Geographical Site Kuala Lumpur/Subang		Country <b>Malaysia</b>					
Situation		Latitude	3.12° N	Longitude 101.55° E		E	
Time defined as		Legal Time	Time zone UT+8	Altitude	e 17 m		
Alb Meteo data: Kuala Lumpur/Sub		Kuala Lumpur/Subang	MeteoNorm 7.2 station - Synthetic				
Simulation vari	ant : avera	age family - 6kw					
		Simulation date	21/04/20 16h02				
Simulation parameters System type			Sheds on ground				
<b>Collector Plane</b>	Orientation	Tilt	5°	Azimuth	0°		
Models used		Transposition	Perez	Diffuse	e Perez, I	Veteonorm	
Horizon		Free Horizon					
Near Shadings		Linear shadings					
User's needs : Daily household consumers average		Constant over the year 11.1 kWh/Day					
PV Array Charac PV module Original PVsyst Number of PV mo Total number of P Array global powe Array operating ch Total area Inverter Original PVsys Characteristics	teristics database dules V modules r haracteristics (50 t database	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) J°C) U mpp Module area Model Manufacturer Operating Voltage	JAM6-72-320/SI JA Solar 10 modules 20 U 6.40 kWp At 336 V 38.8 m <sup>2</sup> SUN2000L-5KTL Huawei Technologie 90-500 V U Max.	In parallel nit Nom. Power operating cond. I mpp Cell area es Init Nom. Power power (=>40°C)	2 string: 320 Wp 5.75 kW 17 A 34.4 m <sup>2</sup> 5.00 kV 5.50 kV	s /p (50°C) Vac Vac	
Inverter pack		Nb. of inverters	2 * MPP1 50 %	Pnom ratio	r 5.0 kWa 9 1.28	ac	
PV Array loss fact Thermal Loss fact Wiring Ohmic Loss Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	ctors for ss bss Losses loss ASHRAE parame	Uc (const) Global array res. etrization IAM =	20.0 W/m²K 332 mOhm 1 - bo (1/cos i - 1)	Uv (wind) Loss Fraction Loss Fraction Loss Fraction Loss Fraction bo Param.	0.0 W/n 1.5 % a -0.8 % 1.0 % a 0.10 % 0.05	n²K / m/s t STC tt MPP	



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(c	rid-Connected S	System	n. Detailed Lls	er's needs	I					
Droioot :	Tomon Midah (NEN	<i>a</i> \	i. Detailed 00							
Project :		<i>n</i> )								
Simulation variant :	average family - 6k	W			_					
Main system parameters	Syste	em type	Sheds on ground							
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear shadings tilt Model Nb. of modules Model Daily household consumers		5°azimuth0°JAM6-72-320/SIPnom320 Wp20Pnom total <b>6.40 kWp</b> SUN2000L-5KTLPnom5.00 kW acConstant over the yearGlobal4045 kWh/year							
Daily household consume	ers. Constant over the	e vear. av	verage = 11.1 kWh	/dav						
		, <b>j</b> our, u		aug						
Annual values										
	Use 2 days a week	Number	Power	Use	Energy					
Lamps (LED or fluo)		28	18 W/lamp	6 h/day	3024 Wh/day					
TV / PC / Mobile		2	70 W/app	10 h/day	1400 Wh/day					
Iron		1	1200 W/app	1 h/day	1200 Wh/day					
Fridge / Deep-freeze		1		24 Wh/day	3000 Wh/day					
Dish- & Cloth-washers		1		1 Wh/day	500 Wh/day					
Instant water heater		2	2000 W tot	2 h/day	8000 Wh/day					
Aircond		3	750 W tot	10 h/day	21375 Wh/day					
Stand-by consumers				24 h/day	24 Wh/day					
Total daily energy					38523 Wh/day					
Hourly profile Hourly profile										
PVSYST V6.86									21/04/2	D Page 4/7
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		Grid	-Conn	ected \$	Syster	n: Mair	n resu	ts		
Project ·	Т	aman Mi	dah (NF	=M)	2					
Simulation varia	ant: av	/erage ta	amily - 6	KW						
Main system para	ameters		Sys	stem type	e Shed	s on grou	Ind			
Near Shadings			Linear	shadings	5 = -					
PV Field Orientatio	on			til Modo	t 5° I IAME	-72-320/9	1	azimut	h 0° n 320.V	Vn
PV Array			Nh o	f modules	$\sim 20$	-12-320/3	1	Pnom tot	al <b>640</b> I	νp kWn
Inverter			1101 0	Mode	SUN2	000L-5KT	Ľ	Pnor	n 5.00 l	kW ac
User's needs		Daily hou	usehold c	onsumers	s Const	ant over t	he year	Globa	al 4045	kWh/year
Main simulation	results									
System Production	n	_	Produce	d Energy	/ 8.41	MWh/yea	r Sp	ecific proc	d. 1314	kWh/kWp/year
		Per	formance	e Ratio PF	82.32	%	Solar F	raction S	F 23.69	%
Normalized production	ns (nor installo	d kWp). No	minal nowe	r 6.40 kWp			Por	formance P	atio PP	
					1	.0 <b>F</b>				
Lc : Collect	tion Loss (PV-array lo n Loss (inverter,)	verter output)	).7 kWh/kWp/day ).07 kWh/kWp/da		0	.9 E PR	: Performance F	Ratio (Yf / Yr): 0.8	823	
	ed userul energy (inv	ener output)	3.6 KVVI/KVVp/day	′ ]	0	.8				
/dm 4 -					0 光	.7				
Extra Lange					0 0	.6				
3-					0 guce	.5				
				-	o un	.4				
izi 2 -					<u>م</u>	.3				
ē -				-	0	.2				
1-					0	1				
					0		1			
Jan Feb Mar	Apr May Jur	n Jul Aug	Sep Oct	Nov Dec	U	Jan Feb	Mar Apr	May Jun	Jul Aug S	ep Oct Nov Dec
				average	family -	6kw				
			Ba	lances a	nd main	results				
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid
	kWh/m <sup>2</sup>	kWh/m²	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	0.726	0.385	0.094	0.617	0.291
February	134.6	67.90	27.70	137.4	132.8	0.737	0.308	0.081	0.642	0.227
March	149.8	88.20	28.00	150.3	144.9	0.804	0.308	0.079	0.709	0.229
April	140.3	70.50	27.70	138.8	133.9	0.742	0.347	0.082	0.646	0.264
May	140.3	78.60	28.60	136.9	131.7	0.734	0.347	0.078	0.641	0.268
June	132.0	77.80	27.80	128.3	123.5	0.691	0.308	0.070	0.607	0.238
July	134.4	87.20	27.80	131.1	125.8	0.710	0.385	0.095	0.601	0.290
August	132.2	87.20	27.80	130.1	125.2	0.700	0.308	0.065	0.622	0.244
Octobor	129.2	19.00 82.60	27.10 27.40	12ŏ.ŏ 14∩ 4	124.U 125.5	0.091	0.308		0.605	0.235
November	r 117 6	79.20	27.40 26.70	140.4 119 R	135.5 115 /	0.754	0.305	0.098	0.042	0.243
December	r 115.0	73.20	26.29	118.1	113.6	0.640	0.347	0.077	0.551	0.270
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	4.045	0.958	7.451	3.087
		ļ						ļ		I
Legends: G	GlobHor I	Horizontal g	obal irradia	tion		GlobEff	Effect	ive Global, d	corr. for IAN	A and shadings
C	DiffHor I	Horizontal d	iffuse irradi	ation		EArray	Effect	ive energy a	at the outpu	ut of the array
T	[_Amb ]	Гamb.				E_User	Energ	y supplied to	o the user	
(		Jobal incide	ent in coll. p	iane		E_Solar	Energ	y from the s	sun	
						E_Grid	Energ	y injected in	no gria rrid	



PVSYST V6.86						21/04/20	Page 6/7
		Grid-Co	nnected Sv	vstem: Loss diagram			
				Stem: LOSS diagram			
Project :	riant .		$1 (N \in W)$				
Simulation val	nant :	average lann	ly - okw				
Main system pa	arameters		System type	Sheds on ground			
Near Shadings PV Field Orienta PV modules PV Array Inverter User's needs	tion	l Daily houseł	inear shadings. tilt Model Nb. of modules Model nold consumers	5° az JAM6-72-320/SI 20 Pnor SUN2000L-5KTL Constant over the year	zimut Pnor n tota Pnor Globa	h 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kW al 4045 kV	<b>/p</b> / ac Vh/year
			Loss diagram o	ver the whole year			
			C C				
Γ		1597 kWh/m²		Horizontal global irradiation			
			-0.07% -0.07% -0.00% -3.67%	Global incident in coll. plane Global incident below threshold Near Shadings: irradiance loss IAM factor on global			
	1538 k\	Wh/m <sup>2</sup> * 39 m <sup>2</sup> coll.		Effective irradiation on collector	s		
F	efficienc	y at STC = 16.53%		PV conversion			
		9.85 MWh	-11.15%	Array nominal energy (at STC ef PV loss due to irradiance level PV loss due to temperature	ffic.)		
			+0.75%	Module quality loss			
	8.4	58 MWh	→ -1.10% → -0.95%	Mismatch loss, modules and strings Ohmic wiring loss Array virtual energy at MPP			
			1.88% 0.00% 0.00% 0.00% -0.01%	Inverter Loss during operation (effici Inverter Loss over nominal inv. power Inverter Loss due to max. input currer Inverter Loss over nominal inv. volta Inverter Loss due to power threshold	iency) er ent ge d		
grid consumption			→-0.05%	Night consumption	nu		
	8.4	11 MWh		Available Energy at Inverter Out	put		
3.09 MWh 0.96	MWh	7.45 MWh		Energy injected into grid			
to user to u from grid from	iser solar	to grid					

PVSYST V6.86						21/04/20	Page 7/7
		Grid-Connec	ted Svster	m: P50 - P90	evaluation		
Proiect :		Taman Midah	(NEM)				
Simulation vari	iant :	average family	v - 6kw				
Main system pa	rameters		System type	Sheds on ground			
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Lii N Daily househc	near shadings tilt Model b. of modules Model Id consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the s	azimut Pnor Pnom tota Pnor year Globa	h 0° m 320 Wp al <b>6.40 kV</b> m 5.00 kW al 4045 kV	<b>/p</b> / ac Vh/year
Evaluation of the	e Produc	tion probability f	orecast				
The probability dia on the meteo data	stribution a used for	of the system proc the simulation, an	luction forecast d depends on t	for different years in the following choices	s mainly depen s:	dent	
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	e on ability	Year devia	Kind tion from aver. Variance	MeteoNorm 7.2 sta Not defined 3 % 0.5 %	ation Yea	ar 1995	
The probability dia Specified Deviation	stribution on P Soi (meteo + s	variance is also de V module modellir Inverter efficien ling and mismatch Degradation system)	epending on so ng/parameters cy uncertainty uncertainties on uncertainty Variance	me system paramet 1.0 % 0.5 % 1.0 % 1.0 % 1.9 %	ers uncertaintie (quadratic sun	us n)	
Annual productior	n probabil	ity	Variability P50 P90 P95	0.14 MWh 7.45 MWh 7.27 MWh 7.22 MWh			
			Probability	distribution			
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 0.00 7000 7100 7	P90 = 72 P90 = 72 P95 = 7222 kV	i0 = 7451 kWh E_Grid simul = 745 72 kWh Vh 400 7500 7600	51 kWh	7900	

E\_Grid system production kWh

PVSYST V6.86					21/04/20	Page 1/7
	Grid-Co	nnected System	n: Simulation p	arameters	i	
Project :	Taman	Midah (NEM)				
Geographical S	ite Kua	ala Lumpur/Subang		Country	/ Malays	ia
Situation Time defined	as	Latitude Legal Time Albedo	3.12° N Time zone UT+8 0.20	Longitude Altitude	e 101.55° e 17 m	E
Meteo data:	Kua	ala Lumpur/Subang	MeteoNorm 7.2 stat	tion - Synthetic		
Simulation var	ant : average	family - 9kw				
		Simulation date	21/04/20 16h07			
Simulation para	meters	System type	Sheds on ground			
Collector Plane	Orientation	Tilt	5°	Azimuth	n 0°	
Models used		Transposition	Perez	Diffuse	e Perez, I	Veteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
User's needs :	Daily h	ousehold consumers average	Constant over the ye 25.1 kWh/Day	ear		
PV Array Charac PV module Original PVsys Number of PV mo Total number of F Array global powe Array operating cl Total area Inverter Custom param Characteristics	eteristics t database odules V modules er naracteristics (50°C) eters definition	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) U mpp Module area Model Manufacturer Operating Voltage Nb. of inverters	JAM6-72-320/SI JA Solar 14 modules 28 Ur 8.96 kWp At o 470 V 54.3 m <sup>2</sup> SUN2000L-8KTL Huawei Technologie 200-850 V U Max. p 2 * MPPT 50 %	In parallel nit Nom. Power operating cond. I mpp Cell area es nit Nom. Power oower (=>40°C) Total Power Pnom ratic	I 2 string 320 Wp 8.05 kW 17 A 48.2 m <sup>2</sup> r 8.00 kV 8.80 kV r 8.0 kW 5 1.12	s /p (50°C) Vac Vac ac
<b>PV Array loss fa</b> Thermal Loss fac Wiring Ohmic Los Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	ctors tor ss oss Losses loss ASHRAE parametriz	Uc (const) Global array res. ation IAM =	20.0 W/m²K 465 mOhm 1 - bo (1/cos i - 1)	Uv (wind) Loss Fraction Loss Fraction Loss Fraction bo Param	) 0.0 W/n 1.5 % a 1.0 % a 0.10 % . 0.05	n²K / m/s t STC tt MPP



PVSYST V6.86				21	/04/20	Page 3/7
Grid	d-Connected S	System	n. Detailed Lls	er's needs		
	men Mideh (NEN	•				
		1)				
Simulation variant : av	erage family - 9k	N				
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear sl Nb. of n Daily household con	hadings tilt Model nodules Model sumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the y	azimuth Pnom Pnom total Pnom year Global	0° 320 Wp <b>8.96 kV</b> 8.00 kV 9174 kV	V <b>p</b> V ac Vh/year
Daily household consumers,	Constant over the	year, av	/erage = 25.1 kWh/	/day		
		Annua	l values			
	Use 5 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		28	18 W/lamp	6 h/da	iy 3	3024 Wh/day
TV / PC / Mobile		2	70 W/app	10 h/da	iy 1	1400 Wh/day
Iron		1	1200 W/app	1 h/da	iy 1	1200 Wh/day
Fridge / Deep-freeze		1		24 Wh/da	iy 3	3000 Wh/day
Dish- & Cloth-washers		1		1 Wh/da	iy j	500 Wh/day
Instant water heater		2	2000 W tot	2 h/da	iy 8	3000 Wh/day
Aircond Stand by consumers		3	750 W 101	8 n/da		24 Wb/day
Total daily energy				24 11/08	35	5148 Wh/day
	6000 5000 4000 1000 0 3	Hourly	<b>profile</b>			

VSYST V6.86									21/04/2	0 Page 4
		Grid	-Conn	ected \$	Systen	n: Maiı	n resu	lts		
roject ·	Ta	aman Mi	idah (NF	=M)	-					
				_ 1 ¥ 1 )						
imulation variant	t: av	erage fa	amily - 9	kw						
lain system param	eters		Sys	stem type	Shed	s on grou	und			
lear Shadings			Linear	shadings	5					
V Field Orientation				tili	$t 5^{\circ}$	70.000/0		azımut	h 0° 	A /
V modules			Nh o	f modules	1 JAIVIO 28	-12-320/3		Phom tot:	n 320 v al <b>896</b>	νp <b>kWn</b>
verter				Mode	I SUN2	000L-8KT	Ľ	Pnor	n 8.00	kW ac
ser's needs		Daily hou	usehold c	onsumers	Const	ant over t	he year	Globa	al 9174	kWh/year
<b>lain simulation res</b> system Production	sults	Per	<b>Produce</b> formance	<b>d Energy</b> Ratio PR	<b>11.78</b> 82.40	<b>MWh/ye</b> %	<b>ar</b> Sp Solar F	ecific proc Fraction S	d. 1315 F 10.75	kWh/kWp/ye 5 %
Normalized productions (	(per installed	d kWp): No	minal powe	r 8.96 kWp			Ре	rformance Ra	atio PR	
6 Lot Collection L	oss (PV-array lo	sses) (	).7 kWh/kWh/day	, – – – –	1		: Performance	Ratio (Yf / Yr) : 0	824	1 1 1
Ls : System Los	s (inverter,)	ortor output)	0.07 kWh/kWp/day	ay _	0	.9				_
	selui energy (inv	enter output)	3.6 KVVN/KVVP/day	′ ]	0	.8				
/d/ 4-				<b>_</b> -	0 문	.7				
KWH - EK					0 Catio	.6				
- S -					- 0 2 0	.5				
<u> </u>				-	0 gung	.4				
2 -					Pert					
					0	.3				
1-					0	.2				
				-	0	.1				
				Nev Dee	0		Mor Apr			
	inay Jur	i Jui Aug	Sep Oci	NOV DEC		5411 165	iviai Api	Way Juli	Jui Aug (	
				average	family -	9kw				
			Ba	lances ar	nd main i	results				
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid
	KVVN/m <sup>2</sup>	KWN/M <sup>2</sup>	J <sup>°</sup>	κwn/m²	KWN/M <sup>2</sup>	IVIVVh	IVIVI	IVIVVh	IVIVVh	IVIVN
January	133.0	82.20	28.10	136.3	131.2	1.016	0.808	0.089	0.909	0.720
Hebruary	134.0	07.90 80 20	21.10	137.4	132.8 144.0	1.031 1.125	0.703		0.937	0.02/
Anril	149.8 1/0 3	00.20 70.50	20.00 27.7∩	130.3 138.9	144.9 122 0	1.125	0.772	0.08/	1.018	0.000
May	140.3	78.60	28.60	136.0	133.9	1 0 2 7	0.730	0.004	0.730	0.034
June	132.0	77 80	27.80	128.3	123.5	0.967	0.738	0.079	0.870	0.659
Julv	134.4	87.20	27.80	131.1	125.8	0.994	0.773	0.082	0.894	0.692
August	132.2	87.20	27.80	130.1	125.2	0.980	0.808	0.086	0.875	0.722
September	129.2	79.00	27.10	128.8	124.0	0.968	0.703	0.079	0.870	0.624
October	138.8	82.60	27.40	140.4	135.5	1.056	0.808	0.089	0.948	0.720
November	117.6	79.20	26.70	119.8	115.4	0.907	0.773	0.076	0.813	0.698
December	115.0	73.20	26.29	118.1	113.6	0.896	0.738	0.069	0.810	0.669
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	9.174	0.987	10.798	8.187
	•	•				•	•	+		·I
Legends: Glob	Hor H	Horizontal g	lobal irradia	tion		GlobEff	Effect	ive Global, (	corr. for IA	M and shadings
Diff	Hor H	Horizontal d	iffuse irradi	ation		EArray	Effect	ive energy a	at the outp	ut of the array

DiffHor T\_Amb GlobInc Horizontal diffuse irradiation T amb. Global incident in coll. plane Effective Global, corr. for IAM and shadings Effective energy at the output of the array Energy supplied to the user Energy from the sun Energy injected into grid Energy from the grid

E\_User

E\_Solar

E\_Grid

EFrGrid



	1					1	
PVSYST V6.86						21/04/20	Page 6/7
		Grid-Co	nnecte	ed Sv	stem: Loss diagram		
Project :		Taman Midak					
Simulation vari	iant ·						
		average lann	- 5KW				
Main system pa	rameters		System	type	Sheds on ground		
Near Shadings PV Field Orientati	ion	L	inear sha	idings tilt	5° azimu	th 0°	
PV modules			Г	Model	JAM6-72-320/SI Pnc	m 320 Wp	i
PV Array			Nb. of mo	dules	28 Pnom to	tal <b>8.96 kV</b>	Vp
User's needs		Daily househ	י Iold consu	umers	Constant over the year Glob	al 9174 k	Vh/year
			Loss diad	aram ov	ver the whole vear		
		1597 kWh/m <sup>2</sup>			Horizontal global irradiation		
			$\succ$	-0.07%	Global incident in coll. plane		
				-0.07%	Global incident below threshold		
			Ľ,	-3.67%	IAM factor on global		
	1538 k	Wh/m² * 54 m² coll.			Effective irradiation on collectors		
	efficien	cy at STC = 16.53%			PV conversion		
Г		13.79 MWh	l.		Array nominal energy (at STC effic.)		
				).75%	PV loss due to irradiance level		
				11.15%	PV loss due to temperature		
			(+0.75	%	Module quality loss		
			9-1.10%	%	Mismatch loss, modules and strings		
	12	2.01 MWh	9-0.95%	6	Ohmic wiring loss Array virtual energy at MPP		
			l		,		
			→-1.80%	0	Inverter Loss during operation (efficiency	()	
			0.00%		Inverter Loss due to max. input current		
			→ 0.00%		Inverter Loss over nominal inv. voltage		
arid			70.00%		Inverter Loss due to power threshold Inverter Loss due to voltage threshold		
consumption			→-0.04%		Night consumption		
	11	.78 MWh			Available Energy at Inverter Output		
		0.00 1.01			<b>_</b>		
8.19 MWh 0.99 M	/jvvn 1	10.80 MIVVN	J		Energy injected into grid		
to user to us	ser	to grid					
trom grid from s	solar						

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		Grid-Conr	ected Syster	m <sup>.</sup> P50 - P90 eva	aluation		
Project ·		Taman Mid	ah (NFM)				
Simulation varia	ant :	average far	nilv - 9kw				
Main system para	ameters		System type	Sheds on around			
Near Shadings PV Field Orientatio PV modules PV Array Inverter User's needs	n	Daily hous	Linear shadings tilt Model Nb. of modules Model ehold consumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the year	azimutl Pnor Pnom tota Pnor Globa	n 0° n 320 Wp al <b>8.96 kV</b> n 8.00 kW al 9174 k\	<b>Vp</b> √ ac Vh/year
Evaluation of the	Produc	tion probabili	ty forecast				
The probability dist on the meteo data	tribution of used for	of the system p the simulation	production forecast , and depends on t	t for different years is ma the following choices:	ainly depend	Jent	
Meteo data source Meteo data Specified Deviation Year-to-year variab	n pility	Year de	Kind eviation from aver. Variance	MeteoNorm 7.2 station Not defined 3 % 0.5 %	n Yea	ır 1995	
The probability dist Specified Deviation	tribution v n P' Soil	variance is also V module mod Inverter effic ing and misma Degrae	o depending on so elling/parameters ciency uncertainty atch uncertainties dation uncertainty	me system parameters ( 1.0 % 0.5 % 1.0 % 1.0 % 1.9 %	uncertaintie	5	
Annual production	probabili	ty	Variability P50 P90 P95	0.20 MWh 10.80 MWh 10.54 MWh 10.47 MWh		)	
			Probability	distribution			
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05	P50 P90 = 1053 P95 = 10466 kW	0 = 10798 kWh E Grid simul = 10798 kW 19 kWh	Vh	•••••••••••••••••••••••••••••••••••••••	

0.00 **6** 

E\_Grid system production kWh

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PVSYST V6.86					21/04/20	Page 1/7
	Grid-Con	nected System	n: Simulation p	arameters		
Project :	Taman M	idah (NEM)				
Geographical S	ite Kuala	a Lumpur/Subang		Country	Malays	ia
Situation Time defined	as	Latitude Legal Time Albedo	3.12° N Time zone UT+8 0.20	Longitude Altitude	101.55° 17 m	E
	Kuala		Meteonorm 7.2 sta	tion - Synthetic		
Simulation var	iant : average fa	amily - 9kw				
		Simulation date	21/04/20 16h08			
Simulation para	imeters	System type	Sheds on ground			
Collector Plane	Orientation	Tilt	5°	Azimuth	0°	
Models used		Transposition	Perez	Diffuse	Perez, N	Veteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
User's needs :	Daily ho	usehold consumers average	Constant over the ye 11.1 kWh/Day	ear		
PV Array Charac PV module Original PVsys Number of PV mod Total number of F Array global powe Array operating c Total area Inverter Custom param Characteristics	eteristics Si- t database odules V modules er naracteristics (50°C) eters definition	mono Model Manufacturer In series Nb. modules Nominal (STC) U mpp Module area Model Manufacturer Operating Voltage Nb. of inverters	JAM6-72-320/SI JA Solar 14 modules 28 Ur 8.96 kWp At 0 470 V 54.3 m <sup>2</sup> SUN2000L-8KTL Huawei Technologie 200-850 V U Max. p 2 * MPPT 50 %	In parallel nit Nom. Power operating cond. I mpp Cell area es nit Nom. Power power (=>40°C) Total Power Pnom ratio	2 strings 320 Wp 8.05 kW 17 A 48.2 m <sup>2</sup> 8.00 kW 8.80 kW 8.80 kW 1.12	s /p (50°C) Vac Vac ac
<b>PV Array loss fa</b> Thermal Loss fac	<b>ctors</b> tor	Uc (const)	20.0 W/m²K	Uv (wind)	0.0 W/n	n²K / m/s
Wiring Ohmic Lo Module Quality L Module Mismatch Strings Mismatch Incidence effect,	ss oss Losses Ioss ASHRAE parametrizat	Global array res.	465 mOhm 1 - bo (1/cos i - 1)	Loss Fraction Loss Fraction Loss Fraction Loss Fraction bo Param.	1.5 % a -0.8 % 1.0 % a 0.10 % 0.05	t STC tt MPP



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(	Grid-Connected S	System	n: Detailed Lls	er's needs	I
Drainat	Tomon Midah (NEN				
Project :		vi)			
Simulation variant :	average family - 9k	W			
Main system parameters	Syste	em type	Sheds on ground		
Near Shadings	Linear s	hadings			
PV Field Orientation		tilt	5°	azimuth (	)°
PV modules PV Array	Nb of r	modules	JAN16-72-320/51 28	Phom . Pnom total	320 wp 8 <b>.96 kWp</b>
Inverter		Model	SUN2000L-8KTL	Pnom 8	8.00 kW ac
User's needs	Daily household cor	nsumers	Constant over the y	year Global 4	4045 kWh/year
Daily household consum	ers, Constant over the	e year, a	verage = 11.1 kWh/	/day	
		Annua	l values		
	Use 2 days a week	Number	Power	Use	Energy
Lamps (LED or fluo)		28	18 W/lamp	6 h/day	3024 Wh/day
TV / PC / Mobile		2	70 W/app	10 h/day	1400 Wh/day
Iron		1	1200 W/app	1 h/day	1200 Wh/day
Fridge / Deep-freeze		1		24 Wh/day	3000 Wh/day
Dish- & Cloth-washers			2000 W/ tot	1 Wh/day	500 Wh/day
Aircond			2000 W tot	2 n/day 10 b/day	21375 Wb/day
Stand-by consumers		5	750 W tot	24 h/day	21375 Wh/day
Total daily energy			. <b> </b>		38523 Wh/day
					-
	- 5000	Hourly	/ profile		
	° 4000 −			· · · ·	
	ë ₩ - > 3000 —				
	2000 -				
	ັ <sub>ວ</sub> 2000 -				
		6 9	12 15 18	21 24	

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'		Grid	-Conn	ected \$	Svster	n: Maiı	n resul	ts		
Draigat :	-	Tomon Mi	idah (NE	= = = = = = =						
Project :			idan (NE	- IVI <i>)</i>						
Simulation vari	ant: a	average fa	amily - 9	kw						
Main system par	rameters		Sys	stem type	Shed	s on grou	und			
Near Shadings			Linear	shadings	5			. ,		
PV Field Orientati	on			tili Mode	t 5° I IAME	-72-320/9	1	azimut	n 0° n 320.V	Vn
PV Arrav			Nb. o	f modules	s 28	-12-520/6	1	Pnom tota	al <b>8.96</b>	kWp
Inverter				Mode	I SUN2	000L-8KT	Ľ	Pnor	n 8.00	kW ac
User's needs		Daily ho	usehold c	onsumers	Const	ant over t	he year	Globa	al 4045	kWh/year
Main simulation	results									
System Production	on		Produce	d Energy	11.78	MWh/ye	ar Spe	ecific proc	d. 1315	kWh/kWp/year
		Pei	rformance	e Ratio PF	8 82.40	%	Solar F	raction S	F 25.85	%
Normalized productio	ons (per instal	lled kWp): No	ominal powe	r 8.96 kWp			Per	formance Ra	atio PR	
6 Lc : Colleg	tion Loss (PV-array	v losses)	0.7 kWh/kWp/day	,	1	.0	: Performance R	atio (Yf / Yr) : 0.	824	
Ls : Syste	m Loss (inverter,	.) (inverter output)	0.07 kWh/kWp/da	ay	0	.9				
[/day]	, , , , , , , , , , , , , , , , , , ,		,	′ _	0	.8				
dmy/c 4-				<b>_</b>	8 전	).7				
- Kw					0 0	1.6				
Energy					0 mance	.5				
p z zed				-	Perforr	.4				
					0	.3				
1-					0	.2				
				-	0	.1				
0 Jan Feb Mar	r Apr May	Jun Jul Aug	Sep Oct	Nov Dec	0	.0 <b>E</b> Jan Feb	Mar Apr	May Jun	Jul Aug S	ep Oct Nov Dec
				average	fomily	Okuv				
			Ba	average dances ar	nd main	results				
	GlobHo	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid
	KVVN/M	~ кwn/m²		кvvп/m²	кууп/m²					
January	133.0	82.20	28.10	136.3 127 4	131.2 122 9	1.016	0.385	0.103	0.894 0.027	0.282
March	134.0	88.20	27.70	157.4	132.0	1.125	0.308	0.087	1.021	0.222
April	140.3	70.50	27.70	138.8	133.9	1.039	0.347	0.090	0.931	0.257
May	140.3	78.60	28.60	136.9	131.7	1.027	0.347	0.088	0.920	0.259
June	132.0	77.80	27.80	128.3	123.5	0.967	0.308	0.077	0.872	0.231
July	134.4	87.20	27.80	131.1	125.8	0.994	0.385	0.103	0.872	0.282
August	132.2	87.20	27.80	130.1	125.2	0.980	0.308	0.071	0.891	0.238
Septemb	er 129.2	79.00	27.10	128.8	124.0	0.968	0.308	0.081	0.868	0.227
October	138.8	82.60	27.40	140.4	135.5	1.056	0.385	0.106	0.931	0.280
Novembe	er 117.6	79.20	26.70	119.8	115.4	0.907	0.308	0.072	0.817	0.236
Decembe	er 115.0	73.20	26.29	118.1	113.6	0.896	0.347	0.085	0.794	0.262
Year	1597.2	2 953.59	27.58	1596.2	1537.5	12.005	4.045	1.046	10.738	2.999
Legends:	GlobHor	Horizontal g	Iobal irradia	tion		GlobEff	Effecti	ve Global, o	corr. for IAI	VI and shadings
	UITTHOR	Horizontal d	irtuse irradi	ation		EArray	Effecti	ve energy a	at the outpu	ut of the array
	i_Amb Globlec	i amp. Global incide	ant in coll in	lane		E_USEr E_Solar	Energy	y supplied to	u ine user	
I	JUDUIL		μι τη con. ρ			L_SUIdI	Linergy	y nom the s	oun	

E\_Grid

EFrGrid

Energy injected into grid

Energy from the grid

Γ



	-						
PVSYST V6.86	5					21/04/20	Page 6/7
		Grid-Co	nnected Sv	/stem: Loss diagra	am		
Project :		Taman Midal					
Simulation va	riant ·	average fami	i (i∎⊑ivi) Iv - 9kw				
Main and an a							
Main system pa	arameters		System type	Sneds on ground			
PV Field Orienta	ation	l	tilt	5°	azimut	h O°	
PV modules			Model	JAM6-72-320/SI	Pnor	n 320 Wp	
PV Array			Nb. of modules	28 SUN20001-8KTI	Pnom tota Pnor	al <b>8.96 kV</b> n 8.00 kV	<b>vp</b> V ac
User's needs		Daily house	old consumers	Constant over the year	Globa	al 4045 k\	Nh/year
			Loss diagram o	ver the whole year			
			Ū				
Γ		1597 kWh/m <sup>2</sup>		Horizontal global irradiation	n		
			<b>→</b> -0.07%	Global incident in coll. plan	ie		
			-0.07%	Global incident below threshol	ld		
			-3 67%	Near Shadings: Irradiance loss	5		
	4500 1	\\//- / 2 <b>* 5</b> 4 2 11					
L	1538 K	VVn/m <sup>2</sup> <sup>^</sup> 54 m <sup>2</sup> coll.		Effective irradiation on col	liectors		
Г	efficien	$\frac{12}{12}$ 70 MM/b	, ,	PV conversion			
		13.79 1010011	<b>→</b> -0.75%	PV loss due to irradiance level			
			-11.15%	PV loss due to temperature			
			4+0.75%	Modulo quality loss			
			1 10%	Mismatch loss modulos and s	trings		
			-0.95%	Ohmic wiring loss	annys		
	12	2.01 MWh		Array virtual energy at MPF	P		
			-1 80%	Inverter Loss during operation	(efficiency)		
			→ 0.00%	Inverter Loss over nominal inv	/. power		
			→ 0.00%	Inverter Loss due to max. input	ut current		
			40.00%	Inverter Loss over nominal inv	reshold		
grid			→ 0.00%	Inverter Loss due to voltage th	hreshold		
consumption	11	78 MW/b	→-0.04%	Night consumption	r Output		
				Available Energy at inverte			
2 00 1/1/1- 4 0		0 74 MM/h		Enormy injected into and			
3.00 MVVh 1.05	ivjvvn 1	0.74 IVIVVN	]	Energy injected into grid			
to user to u	user	to grid					
from grid from	solar						

PVSYST V6.86						21/04/20	Page 7/7
		Grid-Con	nected Syster	m: P50 - P90 e	valuation		
Project :		Taman Mi	dah (NEM)		raidation		
Simulation vari	iant :	average fa	mily - 9kw				
Main system na	ramotors	avolugolu	Suctor turo	Shods on ground			
Near Shadings	ameters		Linear shadings	Sheds on ground			
PV Field Orientat	ion		tilt	5°	azimut	h 0°	
PV modules			Model Nb. of modules	JAM6-72-320/SI 28	Pnor Pnom tot	m 320 Wp al <b>896 k</b> V	, Vn
Inverter			Model	SUN2000L-8KTL	Pnor	m 8.00 kV	V ac
User's needs		Daily hou	sehold consumers	Constant over the ye	ear Globa	al 4045 k	Nh/year
Evaluation of th	e Produc	tion probabi	lity forecast				
The probability di	stribution	of the system	production forecast	for different years is	mainly depen	dent	
on the meteo data	a used for	the simulatio	n, and depends on t	the following choices:			
Meteo data sourc	e		Kind	Not defined	Yea	ar 1995	
Specified Deviation	on Link	Year	deviation from aver.	3 %			
Year-to-year varia	ability		Variance	0.5 %			
The probability di	stribution	variance is al	so depending on so	me system paramete	rs uncertaintie	S	
Specified Deviation	on P	V module mo Inverter eff	delling/parameters	1.0 % 0.5 %			
	Soi	ling and mism	natch uncertainties	1.0 %			
Global variability	(meteo +	Degra svstem)	adation uncertainty Variance	1.0 % 1.9 % (	'quadratic sun	n)	
	(				quadratic can	·)	
Annual production	n probabil	ity	Variability P50	0.20 MWh 10.74 MWh			
			P90	10.48 MWh			
			P95	10.41 MWh			
			Probability	distribution			
		0.50	<u> </u>	, , , ,			
		0.45	F	P50 = 10738 kWh	738 kWh	T	
		0.35					
		0.30	/	$\langle \rangle$			
	bability	0.25		$\backslash$			
	Pro	0.20	P90 =	: 10481 kWh			
		0.15				1	
		0.10	P95 = 104		$\backslash$	T	
		0.00					
		10000 10	0200 10400 106	00 10800 11000	11200	11400	

E\_Grid system production kWh

PVSYST V6.86					21/04/20	Page 1/7
	Grid-	Connected Syste	m: Simulation p	parameters	i	
Project :	Tam	an Midah (NEM)				
Geographical Si	te	Kuala Lumpur/Subanç	I	Country	/ Malays	ia
Situation Time defined	as	Latitude Legal Time Albede	e 3.12° N e Time zone UT+8 o 0.20	Longitude Altitude	e 101.55° e 17 m	E
Meteo data:		Kuala Lumpur/Subang	MeteoNorm 7.2 sta	ation - Synthetic		
Simulation vari	ant : big f	amily - 6kw				
		Simulation date	e 21/04/20 15h29			
Simulation para	meters	System type	Sheds on ground			
Collector Plane	Orientation	Til	t 5°	Azimuth	n 0°	
Models used		Transpositior	Perez	Diffuse	e Perez, I	Veteonorm
Horizon		Free Horizor	1			
Near Shadings		Linear shadings	3			
User's needs :	Da	aily household consumers average	Constant over the y 2.6 kWh/Day	/ear		
PV Array Charac PV module Original PVsyst Number of PV mo Total number of P Array global powe Array operating ch Total area Inverter Original PVsys Characteristics	teristics database dules V modules r naracteristics (5 t database	Si-mono Mode Manufacture In series Nb. modules Nominal (STC) 0°C) U mpp Module area Mode Manufacture Operating Voltage	<ul> <li>JAM6-72-320/SI</li> <li>JA Solar</li> <li>10 modules</li> <li>20 L</li> <li>6.40 kWp At</li> <li>336 V</li> <li>38.8 m<sup>2</sup></li> <li>SUN2000L-5KTL</li> <li>Huawei Technologi</li> <li>90-500 V L</li> <li>Max.</li> <li>2 * MPPT 50 %</li> </ul>	In parallel Jnit Nom. Power operating cond. I mpp Cell area es Jnit Nom. Power power (=>40°C) Total Power	I 2 strings 320 Wp 5.75 kW 17 A 34.4 m <sup>2</sup> r 5.00 kW 5.50 kW	s /p (50°C) Vac Vac Vac
inventer public		No. of inverter	5 2 10111 00 /0	Pnom ratio	0.0 km	
<b>PV Array loss fac</b> Thermal Loss fact Wiring Ohmic Los	ctors cor	Uc (const Global array res	) 20.0 W/m²K . 332 mOhm	Uv (wind) Loss Fraction	) 0.0 W/n n 1.5 % a	n²K / m/s t STC
Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	oss Losses loss ASHRAE param	etrization IAM =	= 1 - bo (1/cos i - 1)	Loss Fraction Loss Fraction Loss Fraction bo Param	-0.8 % n 1.0 % a n 0.10 % . 0.05	It MPP



PVSYST V6.86				21/	/04/20	Page 3/7
	rid-Connected	Svetan	n. Detailed Lle	or's noods		
Droiset :		av	I. Detailed 03	er s neeus		
Project :		//)				
Simulation variant :	big family - 6kw					
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings				
PV Field Orientation		tilt Model	5°	azimuth	0° 220 Wp	
PV modules PV Arrav	Nb. of r	nodules	20	Pnom total	320 wp <b>6.40 kW</b>	ďp
Inverter		Model	SUN2000L-5KTL	Pnom	5.00 kW	ac
User's needs	Daily household cor	sumers	Constant over the y	/ear Global	11.91 M	Wh/year
Daily household consume	ers, Constant over the	<b>year, a</b> Annua	verage = 32.6 kWh/ I values	/day		
	Use 5 days a week	Number	Power	Use	E	Energy
Lamps (LED or fluo)	,	30	18 W/lamp	5 h/dav	/ 2	700 Wh/dav
TV / PC / Mobile		3	70 W/app	14 h/day	2	940 Wh/day
Iron		1	1200 W/app	1 h/day	/ 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh/day	/ 3	000 Wh/day
Dish- & Cloth-washers		1		2 Wh/day	/	750 Wh/day
Instant water heater		2	2000 W tot	2 h/day	/ 8	000 Wh/day
Aircond		6	750 W tot	6 h/day	/ 27	000 Wh/day
Stand-by consumers				24 h/day	/	24 Wh/day
rotal dally energy					40	or4 wh/day
	Fraction of dally energy (1)	Hourly Hourly 6 9	<b>/ profile</b>			

PVSYST V6.86									21/04/2	D Page 4/7
		Grid	-Conn	ected \$	Syster	n: Maiı	n resul	ts		
Proiect :	Та	iman Mi	dah (NE	EM)						
Simulation variant	: bio	a family	- 6kw	,						
Main system param	eters	<u></u>	Svs	stem type	Shed	s on aroi	und			
Near Shadings			Linear	shading	2	<u>.</u>				
PV Field Orientation			Linear	til	t 5°			azimut	h 0°	
PV modules				Mode	I JAM6	-72-320/S	SI	Pnor	m 320 V	Vp
PV Array			Nb. o	f modules	s 20		I	Pnom tota	al <b>6.40</b> I	кWp
nverter				Mode	I SUN2	000L-5KT	Ľ	Pnor	m 5.00 l	«W ac
Jser's needs		Daily hou	usehold c	onsumers	s Const	ant over t	he year	Globa	al 11.91	MWh/year
Main simulation res	ults		Produco	d Enorm	7 Q / 1	MWb/voa	r Sn	ocific prov	4 131/	k\//b/k\//p/voo
system Floduction		Per	formance	e Ratio PF	82.32	%	Solar F	raction S	F 9.99 °	%
Normalized productions (p	per installed	i kWp): No	minal power	r 6.40 kWp			Per	formance R	atio PR	
6 Lc : Collection Lc	I I oss (PV-array los	sses) (	).7 kWh/kWp/day	,	1	.0 .9 .9	I I : Performance R	atio (Yf / Yr): 0.	823	
5 - Yf : Produced use	s (inverter,) eful energy (inve	erter output)	).07 kWh/kWp/da 3.6 kWh/kWp/day	ny / -	0			_	_	
b/day]				-	0	7				
му 4- Чч					H C					
≥ <b>.</b>					e Kati	.0				
					0 mance	.5				
p zeq					Derfor	.4				
- Yormal				-	0	.3				
1-					0	.2				
				-	0	.1				
0 lan Feb Mar An	n May Jup		Sep Oct	Nov Dec	0		Mar Apr	May Jup		ep. Oct. Nov. Dec.
our reb mai np	in may burn	our Aug	000 000				indi 7tpi	May our	our nug c	
			Ba	big far	mily - 6k nd main	W				
T										
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid
1	кууп/m²	кууп/m²		кууп/m <sup>2</sup>	κννπ/m²					
January	133.U 124 4	82.20	28.10 27.70	136.3 127 /	131.2 122.9	U./26	0.012	0.103	0.608	0.946
March	134.0 149.8	88.20	27.70 28.00	157.4	132.0 144 Q	0.737	1 004	0.090	0.033	0.022
April	140.3	70.50	27.70	138.8	133.9	0.742	0.958	0.099	0.629	0.859
May	140.3	78.60	28.60	136.9	131.7	0.734	1.049	0.108	0.611	0.941
June	132.0	77.80	27.80	128.3	123.5	0.691	0.958	0.095	0.582	0.863
July	134.4	87.20	27.80	131.1	125.8	0.710	1.004	0.100	0.597	0.904
August	132.2	87.20	27.80	130.1	125.2	0.700	1.049	0.103	0.583	0.946
September	129.2	79.00	27.10	128.8	124.0	0.691	0.912	0.093	0.585	0.819
October	138.8	82.60	27.40	140.4	135.5	0.754	1.049	0.110	0.630	0.939
November	117.6	79.20	26.70	119.8	115.4	0.648	1.004	0.097	0.537	0.906
December	115.0	/3.20	26.29	118.1	113.6	0.640	0.958	0.090	0.537	0.868
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	11.905	1.189	7.220	10.716
Leaends Glob	Hor H	lorizontal d	obal irradia	tion		GlobFff	Fffecti	ve Global	corr. for IAM	A and shadings
DiffH	lor H	lorizontal d	iffuse irradi	ation		EArrav	Effecti	ve enerav	at the outpu	it of the arrav
T_ An	nb T	amb.				E_User	Energy	supplied t	o the user	
GlobI	Inc G	Global incide	ent in coll. p	lane		E_Solar	Energy	from the	sun	
						E_Grid	Energy	y injected ir	nto grid	

EFrGrid

Energy from the grid



PVSYST V6.86	6				21/04/20	Page 6/7
		Grid-Co	nnected Sy	/stem: Loss diagram		
Project :		Taman Midał	n (NEM)			
Simulation va	riant :	big family - 6ł	w			
Main system p	arameters		System type	Sheds on ground		
Near Shadings PV Field Orienta PV modules PV Array Inverter User's needs	ation	L Daily househ	inear shadings tilt Model Nb. of modules Model old consumers	5° azimu JAM6-72-320/SI Pno 20 Pnom tot SUN2000L-5KTL Pno Constant over the year Glob	th 0° m 320 Wp al <b>6.40 kV</b> m 5.00 kW al 11.91 M	<b>Vp</b> ∕ ac IWh/year
			Loss diagram o	ver the whole year		
Γ		1597 kWh/m²		Horizontal global irradiation		
	1538 k efficiend	Wh/m² * 39 m² coll. cy at STC = 16.53% 9.85 MWh	-0.07% -0.07% -0.00% -3.67%	Global incident in coll. plane Global incident below threshold Near Shadings: irradiance loss IAM factor on global Effective irradiation on collectors PV conversion Array nominal energy (at STC effic.) PV loss due to irradiance level		
	8.	.58 MWh	-11.15% -1.10% -0.95% -1.88% 0.00% 0.00% 0.00%	PV loss due to temperature Module quality loss Mismatch loss, modules and strings Ohmic wiring loss <b>Array virtual energy at MPP</b> Inverter Loss during operation (efficiency Inverter Loss over nominal inv. power Inverter Loss due to max. input current Inverter Loss over nominal inv. voltage	)	
grid consumption	8.	41 MWh	→ -0.01% → 0.00% → -0.05%	Inverter Loss due to power threshold Inverter Loss due to voltage threshold Night consumption Available Energy at Inverter Output		
10.72 MWh 1.19	9 MWh	7.22 MWh		Energy injected into grid		
to user to from grid from	user n solar	to grid	J			

PVSYST V6.86						21/04/20	Page 7/7
		Grid-Conne	cted Syster	m <sup>.</sup> P50 - P90 e	valuation		
Drainat				11. 1 30 - 1 30 6			
Project :		raman widan					
Simulation varia	ant :	big family - 6k	w				
Main system par	ameters		System type	Sheds on ground			
Near Shadings		L	inear shadings				
PV Field Orientation	on		tilt	5°	azimut	h O°	
PV modules			Model	JAM6-72-320/SI	Pnor Dnom tot	n 320 Wp	
PV Allay Inverter		I		20 SUN20001 -5KTI	Phom lota Phor	al <b>0.40 KV</b> n 5.00 kV	vp V ac
User's needs		Daily househ	old consumers	Constant over the ye	ear Globa	al 11.91 N	1Wh/year
Evaluation of the	e Produc	tion probability	forecast	for liffer to the		1	
I he probability dis	stribution	of the system pro	duction forecast	t for different years is the following choices:	mainly depen	dent	
Motoo data asura		and christiation, al		MotooNorm 7.0 -t-t	ion		
Meteo data source	3		Kind	Not defined	.1011 Vo:	ar 1005	
Specified Deviation	n	Year devia	ation from aver	3 %	166	1 1990	
Year-to-year varial	bility		Variance	0.5 %			
The probability dis Specified Deviation Global variability (	stribution n P Soi meteo +	variance is also d V module modelli Inverter efficier ling and mismatch Degradat system)	epending on so ng/parameters ncy uncertainty n uncertainties ion uncertainty Variance	me system paramete 1.0 % 0.5 % 1.0 % 1.0 % 1.9 %	rs uncertaintie (quadratic sum	s ))	
Annual production	probabil	ity	Variability	0.14 MWh			
			P50 P90 P95	7.22 MWh 7.05 MWh 7.00 MWh			
			Probability	distribution			
		0.50			· · · ·	3	
		0.45		P50 = 7220 kWh			
		0.40		E_Grid simul = 722	20 kWh	1	
		0.35	/			1	
	~	0.30		$\backslash$		-	
	abilit	0.25		$\backslash$		-	
	Prof	0.20				4	
		0.15	P90 = 70	047 KWh	<b>\</b>	4	
		0.10	P95 = 6998 kV	Vh	$\mathbf{i}$	Ē	
		0.05			$\mathbf{i}$	1 1	
				<u> </u>		E	
		6800 6900	7000 7100	7200 7300 740	00 7500	7600	

E\_Grid system production kWh

PVSYST V6.86						21/04/20	Page 1/7
	Gric	d-Connecte	ed System	n: Simulation p	arameters	;	
Project :	Та	man Midah (	NEM)				
Geographical S	ite	Kuala Lum	pur/Subang		Country	/ Malays	ia
Situation Time defined	as		Latitude Legal Time Albedo	3.12° N Time zone UT+8 0.20	Longitude Altitude	e 101.55° e 17 m	E
Meteo data:		Kuala Lum	pur/Subang	MeteoNorm 7.2 sta	tion - Synthetic	;	
Simulation var	iant : big	j family - 6kw					
		Sin	nulation date	21/04/20 15h35			
Simulation para	ameters	;	System type	Sheds on ground			
Collector Plane	Orientation		Tilt	5°	Azimuth	n 0°	
Models used		Т	ransposition	Perez	Diffuse	e Perez, I	Neteonorm
Horizon		ļ	Free Horizon				
Near Shadings		Line	ear shadings				
User's needs :		Daily household	d consumers average	Constant over the year the yea	ear		
PV Array Charao PV module Original PVsys Number of PV mo Total number of P Array global powe Array operating c Total area Inverter Original PVsys Characteristics	eteristics t database odules PV modules er haracteristics t database	Si-mono r No (50°C) I Opera Nt	Model Vanufacturer In series Nb. modules ominal (STC) U mpp Module area Model Vanufacturer ating Voltage	JAM6-72-320/SI JA Solar 10 modules 20 U 6.40 kWp At o 336 V 38.8 m <sup>2</sup> SUN2000L-5KTL Huawei Technologie 90-500 V U Max. p 2 * MPPT 50 %	In paralle nit Nom. Power operating cond. I mpp Cell area es nit Nom. Powe power (=>40°C Total Powe	I 2 strings r 320 Wp 5.75 kW 17 A a 34.4 m <sup>2</sup> r 5.00 kW j 5.50 kW r 5.0 kW	s /p (50°C) /ac /ac
					Pnom ratio	0 1.28	
<b>PV Array loss fa</b> Thermal Loss fac	<b>ctors</b> tor		Uc (const)	20.0 W/m²K	Uv (wind)	) 0.0 W/n	n²K / m/s
Wiring Ohmic Lo Module Quality L Module Mismatch Strings Mismatch Incidence effect,	ss oss o Losses o Ioss ASHRAE para	Glob	oal array res. IAM =	332 mOhm 1 - bo (1/cos i - 1)	Loss Fractior Loss Fractior Loss Fractior Loss Fractior bo Param	n 1.5 % a n -0.8 % n 1.0 % a n 0.10 % . 0.05	t STC t MPP



PVSYST V6.86				21	/04/20	Page 3/7
	Prid-Connected 9	Sveton	n: Detailed Lise	ar's needs		
Destant		av	I. Detailed 030	3 NCCU3		
Project :	Taman Midah (NEN	/1)				
Simulation variant :	big family - 6kw					
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear s Nb. of r Daily household cor	hadings tilt Model modules Model nsumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the ye	azimuth Pnom Pnom total Pnom ear Global	0° 320 Wp <b>6.40 kV</b> 5.00 kW 5734 kV	<b>Vp</b> √ ac Wh/year
Daily household consum	ers, Constant over the	e year, av	verage = 15.7 kWh/d	lay		
		Annua	l values			
	Use 2 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		30	18 W/lamp	5 h/da	y 2	2700 Wh/day
TV / PC / Mobile		3	70 W/app	14 h/da	y 2	2940 Wh/day
Iron		1	1200 W/app	1 h/da	y 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh/day	y 3	3000 Wh/day
Dish- & Cloth-washers		1		2 Wh/da	У	750 Wh/day
Instant water heater		2	2000 W tot	2 h/da	y e	3000 Wh/day
Aircond		6	750 W tot	8 h/da	y 36	000 Wh/day
Total daily energy				24 N/Ua	<u>y </u> 5/	24 Wh/day
	Function of dally energy for the second seco	Hourly	<b>profile</b>			

PVSYST V6.86									21/04/2	) Pag	ge 4/7
		Grid	-Conn	ected \$	Syster	n: Maiı	n resul	ts			
Project ·	Та	man Mi	dah (NI	=M)	,						
Simulation variant	it ⊦t bi	a family	- 6kw	,							
		granny									
Main system param	eters		Sy	stem type	Shed	s on grou	und				
Near Shadings			Linea	r shadings	5			:	L 00		
PV Field Orientation PV modules				tii Mode	t 5° I JAM6-	-72-320/S	SI	azimut Pnor	n 0° n 320V	/n	
PV Array			Nb. c	of modules	s 20	12 020/0		Pnom tota	al <b>6.40</b> I	‹Wp	
Inverter				Mode	I SUN2	000L-5KT	Ľ	Pnor	n 5.00 l	w ac	
User's needs		Daily hou	usehold c	onsumers	s Const	ant over t	he year	Globa	al 5734	kWh/yea	ır
Main simulation res System Production	ults	Per	<b>Produce</b> formance	ed Energy e Ratio PF	<b>8.41</b>	<b>MWh/yea</b> %	i <b>r</b> Sp Solar F	ecific proc	d. 1314 F 17.91	kWh/kW %	p/year
Normalized productions (	per installed	l kWp): No	minal powe	er 6.40 kWp			Per	formance R	atio PR		
6		<del></del>			1	.0 <b>E</b>	Porfermenter				
Lc : Collection L Ls : System Los	oss (PV-array los s (inverter,)	sses) (	).7 kWh/kWp/day ).07 kWh/kWp/day 3.6 kWb/kWp/day	y ay	0	.9 - PR	. Penomance r	(11/11): 0.	023	_	
				," -	0	.8					
4- 					8 8 0	.7					
A 3					o se Rati	.0					
Ener					0 formane	.4					
2 - malizec					Per 0	.3					
					0	.2					
					0	.1					
Jan Feb Mar A	pr May Jun	Jul Aug	Sep Oct	Nov Dec	0	.0 Jan Feb	Mar Apr	May Jun	Jul Aug S	ep Oct N	ov Dec
				hia far	nily 6k	\					
			Ba	alances ar	niny - ok nd main i	vv results					
	i			1 1				1			1
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid	
lanuary	133 0	82 20	28 10	136.2	121.2	0.726	0.546	0 100			ł
February	134.6	67.90	27.70	137.4	132.8	0.720	0.437	0.094	0.629	0.343	
March	149.8	88.20	28.00	150.3	144.9	0.804	0.437	0.086	0.703	0.351	
April	140.3	70.50	27.70	138.8	133.9	0.742	0.492	0.087	0.641	0.404	
Мау	140.3	78.60	28.60	136.9	131.7	0.734	0.492	0.081	0.638	0.410	
June	132.0	77.80	27.80	128.3	123.5	0.691	0.437	0.073	0.604	0.364	
July	134.4	87.20	27.80	131.1	125.8	0.710	0.546	0.099	0.598	0.448	
August	132.2	87.20 70.00	27.80	130.1	125.2	0.700	0.437		0.615	U.366	
Octobor	129.2 128.9	19.00 82.60	27.1U 27.10	120.0 140.4	124.U 125 5	0.091	0.437	0.080	0.598	0.357	
November	117.6	79.20	27.40 26.70	119.4	115.4	0.734	0 437	0.107	0.573	0.376	
December	115.0	73.20	26.29	118.1	113.6	0.640	0.492	0.077	0.551	0.415	
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	5.734	1.027	7.382	4,708	1
		,00.07	_,					1.527	7.002		1
Legends: Glob	Hor H	lorizontal gl	obal irradia	ation		GlobEff	Effecti	ive Global, (	corr. for IAN	/I and shad	dings
Diff	lor F	lorizontal d	iffuse irradi	iation		EArray	Effecti	ive energy a	at the outpu	ut of the ar	ray
T_Ar	nb T	amb.				E_User	Energ	y supplied t	o the user		
Glob	Inc G	Blobal incide	nt in coll. p	olane		E_Solar	Energ	y from the s	sun		
						E_Grid	Energ	y injected ir	nto grid		
						EFrGrid	Energ	y from the o	grid		



PVSYST V6.86						21/04/20	Page 6/7
		Grid-Cc	nnecte	d Sv	vstem: Loss diagram		
Project ·		Taman Mida	h (NEM)				
Simulation var	riant ·	hig family - 6	kw				
Main avatam na			Custom		Chada an array d		
Main system pa	arameters		System	type	Sneas on ground		
PV Field Orienta	tion		Linear sha	tilt	5° azimut	h 0°	
PV modules			N	Model	JAM6-72-320/SI Pnoi	m 320 Wp	
PV Array			Nb. of mo	dules	20 Pnom tot	al <b>6.40 kV</b> m 5.00 kW	/p
User's needs		Daily housel	nold consu	imers	Constant over the year Glob	al 5734 k\	Vh/year
			Loss diag	gram o	ver the whole year		
Γ		1597 kWh/m²			Horizontal global irradiation		
			-+   -+	0.07% 0.07%	Global incident in coll. plane Global incident below threshold		
				).00%	Near Shadings: irradiance loss		
				.3.67%	IAM factor on global		
	1538 k\	Wh/m <sup>2</sup> * 39 m <sup>2</sup> coll.			Effective irradiation on collectors		
	efficienc	= 16.53%	, ]		PV conversion		
		9.85 MVVN	<b>→</b> -0.	.75%	PV loss due to irradiance level		
			-1	1.15%	PV loss due to temperature		
			+0.75%	6	Module quality loss		
			→-1.10%	, D	Mismatch loss, modules and strings		
	0		⇒-0.95%		Ohmic wiring loss		
	0.				Array Virtual energy at MFF		
			→-1.88%		Inverter Loss during operation (efficiency)		
			$\rightarrow 0.00\%$		Inverter Loss over nominal inv. power		
			→ 0.00%		Inverter Loss over nominal inv. voltage		
			→-0.01%		Inverter Loss due to power threshold		
grid			70.00%		Inverter Loss due to voltage threshold		
consumption	8.4	11 MWh	/-0.0378		Available Energy at Inverter Output		
	I						
4.71 MWh 1.03	MWh	7.38 MWh	J		Energy injected into grid		
to user to u	ser	to grid					
from grid from	solar						

PVSYST V6.86						21/04/20	Page 7/7
		Crid Conn	acted System		avaluation		
		Gna-Conn	ected Syster	n: P50 - P90	evaluation		
Project :		Taman Mida	ah (NEM)				
Simulation vari	iant :	big family - (	ôkw				
Main system par	rameters		System type	Sheds on groun	d		
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Daily house	Linear shadings tilt Model Nb. of modules Model chold consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the	azimut Pno Pnom tot Pno year Glob	h 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kV al 5734 k\	V <b>p</b> V ac Wh/year
Evaluation of the	e Produc	tion probabilit	y forecast				
The probability dis	stribution a used for	of the system p the simulation,	roduction forecast and depends on t	for different years he following choice	is mainly depen es:	dent	
Meteo data sourc Meteo data Specified Deviatic Year-to-year varia	e on ability	Year de	Kind viation from aver. Variance	Not defined 3 % 0.5 %	tation Yea	ar 1995	
The probability distribution variance is also depending on some system parameters uncertainties         Specified Deviation       PV module modelling/parameters       1.0 %         Inverter efficiency uncertainties       0.5 %         Soiling and mismatch uncertainties       1.0 %         Degradation uncertainty       1.0 %         Global variability (meteo + system)       Variance       1.9 %							
Annual productior	n probabil	ity	Variability P50 P90 P95	0.14 MWh 7.38 MWh 7.20 MWh 7.16 MWh			
			Probability	distribution			
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 0.00 6900 7000	P90 = P95 = 7155 7100 7200 73	P50 = 7382 kWh F_Grid simul = 7205 kWh 5 kWh 300 7400 7500	= 7382 kWh	7800	

E\_Grid system production kWh

PVSYST V6.86				2	21/04/20	Page 1/7
	Grid-Conne	cted System	n: Simulation pa	arameters		
Project :	Taman Mida	h (NEM)				
Geographical S	ite Kuala L	umpur/Subang		Country	Malays	ia
Situation		Latitude	3.12° N	Longitude	101.55°	E
Time defined	as	Legal Time	Time zone UT+8	Altitude	17 m	
Meteo data:	Kuala L	umpur/Subang	0.20 MeteoNorm 7.2 stati	on - Synthetic		
Simulation var	ant : big family - 9	kw				
		Simulation date	21/04/20 15h40			
Simulation para	meters	System type	Sheds on ground			
<b>Collector Plane</b>	Orientation	Tilt	5°	Azimuth	0°	
Models used		Transposition	Perez	Diffuse	Perez, I	Neteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
User's needs :	Daily house	hold consumers average	Constant over the ye 32.6 kWh/Day	ar		
PV Array Charac PV module Original PVsys Number of PV mo Total number of F Array global powe Array operating c Total area Inverter Custom param Characteristics Inverter pack	eteristics Si-mo database dules V modules er maracteristics (50°C) eters definition	no Model Manufacturer In series Nb. modules Nominal (STC) U mpp Module area Model Manufacturer perating Voltage	JAM6-72-320/SI JA Solar 14 modules 28 Un 8.96 kWp At op 470 V 54.3 m <sup>2</sup> SUN2000L-8KTL Huawei Technologies 200-850 V Un Max. pr 2 * MPPT 50 %	In parallel it Nom. Power perating cond. I mpp Cell area s it Nom. Power ower (=>40°C) Total Power Pnom ratio	2 string 320 Wp 8.05 kW 17 A 48.2 m <sup>2</sup> 8.00 kW 8.80 kW 8.0 kW 1.12	s /p (50°C) Vac Vac ac
<b>PV Array loss fa</b> Thermal Loss fac Wiring Ohmic Lo Module Quality L Module Mismatch Strings Mismatch Incidence effect,	ctors tor ss ( bss Losses loss ASHRAE parametrization	Uc (const) Global array res. IAM =	20.0 W/m²K 465 mOhm 1 - bo (1/cos i - 1)	Uv (wind) Loss Fraction Loss Fraction Loss Fraction Loss Fraction bo Param.	0.0 W/n 1.5 % a -0.8 % 1.0 % a 0.10 % 0.05	n²K / m/s t STC t MPP



PVSYST V6.86				21/	04/20 Page 3/	/7		
C	Grid-Connected S	System	n. Detailed Lls	er's needs	I			
Brojaat :	Toman Midah (NEN	<i>n</i> )						
		<i>n)</i>						
Simulation variant :	big family - 9kw							
Main system parameters	Syste	em type	Sheds on ground					
Near Shadings	Linear s	hadings						
PV Field Orientation		tilt	5° azimuth 0°					
PV modules PV Array	Nb of r	nodules	JANI6-72-320/51 28	Pnom Pnom Pnom	320 wp 8 <b>.96 kWn</b>			
Inverter	Model		SUN2000L-8KTL	Pnom	3.00 kW ac			
User's needs	Daily household cor	sumers	Constant over the y	year Global	11.91 MWh/year			
Daily household consume	ers, Constant over the	<b>year, a</b> Annua	verage = 32.6 kWh/ I values	/day				
	Use 5 days a week	Number	Power	Use	Energy	٦		
Lamps (LED or fluo)		30	18 W/lamp	5 h/day	2700 Wh/dav	y		
TV / PC / Mobile		3	70 W/app	14 h/day	2940 Wh/da	ý		
Iron		1	1200 W/app	1 h/day	1200 Wh/day	1200 Wh/day		
Fridge / Deep-freeze		1		24 Wh/day	3000 Wh/day	у		
Dish- & Cloth-washers		1		2 Wh/day	750 Wh/day	У		
Instant water heater		2	2000 W tot	2 h/day	8000 Wh/day	У		
Aircond		6	750 W tot	6 h/day	27000 Wh/day	<u>y</u>		
Total daily energy				24 11/uay	45614 Wh/da	<u>у</u>		
	Function of dally ending the formula of the formula	Hourly	<b>y profile</b>					

PVSYST V6.86								21/04/2	) Pag	e 4/7
	Grid	l-Conn	ected	Syster	n: Mair	n resu	lts			
Project ·	Taman M	idah (NI	=M)	2						
Cimulation variant			_111)							
Simulation variant :	big family	- 9KW								
Main system parameters		Sy	stem type	Shed	s on grou	Ind				
Near Shadings		Linea	r shadings	3						
PV Field Orientation			til	t 5°			azimut	h 0°		
PV modules			Mode	I JAM6	-72-320/S		Pnor	m 320 V	Vp	
PV Array		Nb. c	of modules	5 28 J QUND			Pnom tota	al <b>8.96</b> I m 8.00 I	kwp	
User's needs	Daily ho	usehold c	consumers	s Const	ant over t	∟ he vear	Globa	al 11.91	MWh/vea	ar
	Daily no					ilo your				
Main simulation results System Production	Pe	<b>Produce</b>	ed Energy e Ratio PF	<b>/ 11.78</b> R 82.40	<b>MWh/ye</b> %	<b>ar</b> Sp Solar F	ecific proc Fraction S	d. 1315 F 10.83	kWh/kWp %	/year
Normalized productions (per ins	talled kWp): No	ominal powe	er 8.96 kWp			Per	rformance R	atio PR		
6	<del></del>			1	.0 <b>E</b>	<del>, , , , , , , , , , , , , , , , , , , </del>				
Lc : Collection Loss (PV-a Ls : System Loss (inverter	rray losses) ;,)	0.7 kWh/kWp/da 0.07 kWh/kWp/da	y - ay	0	.9 E PR	: Performance F	Ratio (Yf / Yr): 0.	824		-
5 - Yf ; Produced useful energ	y (inverter output)	3.6 kWh/kWp/da	у –	0	.8					
			_ ]	0 ۲	.7					
				원 0	.6					
6.3-				윤 왕 0	.5					
			-	o man	.4					
₽ 				berg						
			-	0						
1-				0	.2					
				0	.1					
Jan Feb Mar Apr May	Jun Jul Aug	Sep Oct	Nov Dec	0	Jan Feb	Mar Apr	May Jun	Jul Aug S	ep Oct Nov	Dec
			big fa	mily Ok						
		D	biy iai	niny - 9K	vv					
		Ba	alances al	nu main i	results					
Glob	Hor DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid	
kWh/	m² kWh/m²	°C	kWh/m <sup>2</sup>	kWh/m²	MWh	MWh	MWh	MWh	MWh	
January 133	.0 82.20	28.10	136.3	131.2	1.016	1.049	0.111	0.886	0.938	
February 134	.6 67.90	27.70	137.4	132.8	1.031	0.912	0.096	0.918	0.816	
March 149	.8 88.20	28.00	150.3	144.9	1.125	1.004	0.107	0.998	0.896	
April 140	.3 70.50	27.70	138.8	133.9	1.039	0.958	0.108	0.912	0.850	
May 140	.3 78.60	28.60	136.9	131.7	1.027	1.049	0.118	0.890	0.931	
June 132	.U //.8U	27.80	128.3	123.5 125 0	0.96/	0.958	0.104	0.844	0.854	
August 134	.4 87.20	27.80	130.1	125.0	0.994	1.004	0.112	0.850	0.937	
September 129	.2 79.00	27.10	128.8	124.0	0.968	0.912	0.102	0.847	0.810	
October 138	.8 82.60	27.40	140.4	135.5	1.056	1.049	0.121	0.915	0.928	
November 117	.6 79.20	26.70	119.8	115.4	0.907	1.004	0.107	0.782	0.896	
December 115	0 73.20	26.20	1101				1			
December 113	.0 73.20	20.29	118.1	113.6	0.896	0.958	0.097	0.782	0.861	

Legends: GlobHor DiffHor

T\_Amb

GlobInc

Horizontal global irradiation Horizontal diffuse irradiation T amb. Global incident in coll. plane Effective Global, corr. for IAM and shadings Effective energy at the output of the array Energy supplied to the user Energy from the sun Energy injected into grid Energy from the grid

GlobEff

EArray

E\_User

E\_Solar

E\_Grid

EFrGrid


	<del></del>					1	1
PVSYST V6.86						21/04/20	Page 6/7
		Grid-Co	nnec	ted Sv	stem: Loss diagram		
Project ·		Taman Midak			eterni 2000 diagram		
Simulation var	iant ·	big family - 9k	w	")			
Main system na			Svet	om typo	Shade on ground		
Near Shadings	rameter 5	1	inear c		Sheus on ground		
PV Field Orientat	tion	-	incar a	tilt	5° azimu	ith 0°	
PV modules				Model	JAM6-72-320/SI Pno	om 320 W	)
PV Array			Nb. of I	modules	28 Pnom to	tal <b>8.96 k</b>	Np N aa
User's needs		Daily househ	old cor	nsumers	Constant over the year Glob	bal 11.91 l	/Wh/year
			LOSS 0	liagram ov	ver the whole year		
Γ		1597 kWh/m²		1	Horizontal global irradiation		
				→-0.07%	Global incident in coll. plane		
				<b>-</b> 0.07%	Global incident below threshold		
			k	₩0.00%	Near Shadings: irradiance loss		
				→-3.67%	IAM factor on global		
	1538 k	Wh/m <sup>2</sup> * 54 m <sup>2</sup> coll.			Effective irradiation on collectors		
_	efficien	cy at STC = 16.53%	1		PV conversion		
		13.79 MWh		⇒ 0.750/	Array nominal energy (at STC effic.	)	
			K	₹-0.75% ↑			
					PV loss due to temperature		
			(+0	.75%	Module quality loss		
			9-1.	10%	Mismatch loss, modules and strings		
	15	2 01 MW/b	9-0.9	95%	Ohmic wiring loss		
	12				Array virtual energy at wirt		
			€-1.8	30%	Inverter Loss during operation (efficience	y)	
			$\rightarrow 0.00$	1% W	Inverter Loss over nominal inv. power		
			N0.00	)%	Inverter Loss due to max. Input current		
			→ 0.0C	)%	Inverter Loss due to power threshold		
grid			> 0.00	1%	Inverter Loss due to voltage threshold		
consumption	11	1.78 MWh	7-0.0	4%	Available Energy at Inverter Output		
10.62 MWb 1.29	MWb	10.49 MW/b			Energy injected into grid		
10.02 10001 1.25			1				
to user to u	iser solar	to grid					
	20101						

PVSYST V6.86							21/04/20	Page 7/7
		Grid-Conn	acted System	m· P50 - P0		uation		
Design				п. г 50 - г з		ualion		
Project :	. ,							
Simulation vari	iant :	big family - 9	KW					
Main system par	rameters		System type	Sheds on grou	und			
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Daily house	Linear shadings tilt Model Nb. of modules Model hold consumers	5° JAM6-72-320/S 28 SUN2000L-8KT Constant over t	il FL he year	azimuth Pnom Pnom tota Pnom Globa	0° 320 Wp 8 <b>.96 kV</b> 8.00 kV 11.91 N	<b>∕p</b> / ac 1Wh/year
Evaluation of the	e Produc	tion probability	y forecast					
The probability dia on the meteo data	stribution a used for	of the system pr the simulation,	oduction forecast and depends on t	for different yea the following cho	irs is main ices:	ly depend	ent	
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	e on ability	Year dev	Kind viation from aver. Variance	MeteoNorm 7.2 Not defined 3 % 0.5 %	2 station	Yea	<sup>-</sup> 1995	
The probability dia Specified Deviatio	The probability distribution variance is also depending on some system parameters uncertainties Specified Deviation PV module modelling/parameters 1.0 % Inverter efficiency uncertainty 0.5 % Soiling and mismatch uncertainties 1.0 % Degradation uncertainty 1.0 % Global variability (meteo + system)							
Annual productior	n probabil	ity	Variability P50 P90 P95	0.20 MWh 10.49 MWh 10.24 MWh 10.17 MWh				
			Probability	distribution				
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 0.00 9800 10000	P90 = 10 P95 = 10172	0 = 10494 kWh E_Grid simul = 0243 kWh kWh 00 10600	10494 kWh		1200	

E\_Grid system production kWh

PVSYST V6.86				:	21/04/20	Page 1/7
	Grid-Conne	cted System	n: Simulation pa	arameters		
Project :	Taman Mida	h (NEM)				
Geographical S	ite Kuala L	umpur/Subang		Country	Malays	ia
Situation		Latitude	3.12° N	Longitude	e 101.55°	E
Time defined	as	Legal Time	Time zone UT+8	Altitude	e 17 m	
Meteo data:	Kuala L	umpur/Subang	0.20 MeteoNorm 7.2 stati	on - Synthetic		
Simulation var	ant : big family - 9	kw				
		Simulation date	21/04/20 15h42			
Simulation para	meters	System type	Sheds on ground			
<b>Collector Plane</b>	Orientation	Tilt	5°	Azimuth	0°	
Models used		Transposition	Perez	Diffuse	e Perez, I	Neteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
User's needs :	Daily house	hold consumers average	Constant over the year 15.7 kWh/Day	ar		
PV Array Charac PV module Original PVsys Number of PV mo Total number of F Array global powe Array operating c Total area Inverter Custom param Characteristics Inverter pack	eteristics Si-mon t database odules V modules er naracteristics (50°C) eters definition	no Model Manufacturer In series Nb. modules Nominal (STC) U mpp Module area Model Manufacturer perating Voltage	JAM6-72-320/SI JA Solar 14 modules 28 Un 8.96 kWp At op 470 V 54.3 m <sup>2</sup> SUN2000L-8KTL Huawei Technologies 200-850 V Un Max. po 2 * MPPT 50 %	In parallel it Nom. Power perating cond. I mpp Cell area S it Nom. Power ower (=>40°C) Total Power Pnom ratio	2 strings 320 Wp 8.05 kW 17 A 48.2 m <sup>2</sup> 8.00 kW 8.80 kW 8.80 kW 1.12	s /p (50°C) /ac /ac ac
<b>PV Array loss fa</b> Thermal Loss fac Wiring Ohmic Lo Module Quality L Module Mismatch Strings Mismatch Incidence effect,	ctors tor ss ( oss Losses loss ASHRAE parametrization	Uc (const) Global array res. IAM =	20.0 W/m²K 465 mOhm 1 - bo (1/cos i - 1)	Uv (wind) Loss Fraction Loss Fraction Loss Fraction Loss Fraction bo Param.	0.0 W/n 1.5 % a -0.8 % 1.0 % a 0.10 % 0.05	n²K / m/s t STC t MPP



PVSYST V6.86				2	1/04/20	Page 3/7
G	rid-Connected S	System	n. Detailed Llse	or's needs		
C Droinet		<i>a</i> \				
Project :	Taman Midan (NEN	//)				
Simulation variant :	big family - 9kw					
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear s Nb. of r Daily household cor	hadings tilt Model modules Model nsumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the ye	azimuth Pnom Pnom total Pnom ear Global	0° 320 Wp <b>8.96 kV</b> 8.00 kV 5734 k\	V <b>p</b> V ac Wh/year
Daily household consume	ers, Constant over the	e year, av	verage = 15.7 kWh/d	lay		
		Annua	l values			
	Use 2 days a week	Number	Power	Use	ſ	Energy
Lamps (LED or fluo)		30	18 W/lamp	5 h/d	ay 2	2700 Wh/day
TV / PC / Mobile		3	70 W/app	14 h/d	ay 2	2940 Wh/day
Iron		1	1200 W/app	1 h/d	ay 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh/d	ay 3	3000 Wh/day
Dish- & Cloth-washers		1		2 Wh/d	ay	750 Wh/day
Instant water heater		2	2000 W tot	2 h/d	ay 8	3000 Wh/day
Aircond		6	750 W tot	8 h/d	<u>ay 36</u>	5000 Wh/day
Stand-by consumers				24 h/d	ay	24 Wh/day
lotal daily energy		Hourly	/ profile		54	1614 Wh/day
	Topo 6000 1000 2000 0 3000 0 3000 0 3000 0 3000 0 3000 0 3		12 15 18 21	24		

PVSYST V6.86									21/04/2	2 <b>0</b> Pa	ge 4/7
		Grid	-Conn	ected S	Syster	n <sup>.</sup> Mair	n resul	ts			
Destant	-				5,0101	ni man	1100a				
Project :	Ia	aman Mi	dah (NE	=IVI)							
Simulation variant	: bi	g family	- 9kw								
Main system param	eters		Sy	stem type	Shed	s on grou	und				
Near Shadings			Linea	r shadings	5						
PV Field Orientation				til	t 5°			azimut	h 0°		
PV modules				Mode	I JAM6	-72-320/S		Pnor	m 320\	Np	
PV Array			ND. C	t modules	5 28 I SUND		1	Pnom tota	al <b>8.96</b>	kW/ oo	
livenei User's needs		Daily ho	isehold c		Const	ant over t	∟ he vear	Globa	n o.uu al 5734	kWh/vea	ər
		Daily 1100		onsumer	5 001130			01000		KWII/yCC	
Main simulation res	ults						_				
System Production		-	Produce	d Energy	11.78	MWh/ye	ar Sp	ecific prod	d. 1315	kWh/kW	/p/year
		Per	formance	e Ratio PF	82.40	%	Solar F	raction S	F 18.28	3%	
Normalized productions (	per installed	tkWp): No	minal powe	r 8.96 kWp			Per	formance R	atio PR		
6 <b></b>					1	0					
Lc : Collection L	oss (PV-array los	sses) (	D.7 kWh/kWp/day	y -	1		: Performance F	III Ratio (Yf / Yr): 0.	824		
Ls : System Loss	s (inverter,) seful energy (inve	( erter output)	).07 kWh/kWp/da 3.6 kWh/kWp/da	ay y -	0	.9					
[day]		. ,		Í	0	.8					
Yd 4-					0 문	.7					
HAN - HAN AND AND AND AND AND AND AND AND AND A					0 Katio	.6					
6 3 -					0 gu ce	.5					
				-	je o	.4					
2 - 2 -					ද 0	.3					
				-	0	.2					
1-					0	1					
					0		, ,				
Jan Feb Mar Ap	pr May Jun	i Jul Aug	Sep Oct	Nov Dec	U	Jan Feb	Mar Apr	May Jun	Jul Aug	Sep Oct N	lov Dec
			_	big fai	тну - 9к	W					
			Ba	alances ai	nd main	results					
	GlobHor	Diff⊌or	T Amb	Globing	GlobEff	FArroy	E lleor	E Solar	E Grid	FErGrid	ſ
	k\//h/m2	k\//h/m2	י_אוווט ∘ר	k\//h/m2	kW/h/m <sup>2</sup>						
	122.0	02.20	20.10	104.0	101 0	1.01/		0.100	0.000	0.420	1
February	133.0	02.20 67.00	28.10 27.70	130.3	131.Z 122 0	1.010	0.546		0.890	0.439	
March	134.0 140.8	88.20	28.00	157.4	132.0 14/ 9	1 1 1 2 5	0.437	0.094		0.343	
Anril	147.0	70.50	20.00	138.8	133.0	1 039	0 492	0.000	0.928	0.340	
Mav	140.3	78.60	28.60	136.9	131.7	1.027	0.492	0.085	0.924	0.407	
June	132.0	77.80	27.80	128.3	123.5	0.967	0.437	0.073	0.875	0.363	
July	134.4	87.20	27.80	131.1	125.8	0.994	0.546	0.105	0.870	0.441	
August	132.2	87.20	27.80	130.1	125.2	0.980	0.437	0.069	0.893	0.368	
September	129.2	79.00	27.10	128.8	124.0	0.968	0.437	0.081	0.869	0.356	
October	138.8	82.60	27.40	140.4	135.5	1.056	0.546	0.109	0.927	0.437	
November	117.6	79.20	26.70	119.8	115.4	0.907	0.437	0.065	0.824	0.372	
December	115.0	73.20	26.29	118.1	113.6	0.896	0.492	0.079	0.800	0.413	1

Legends: GlobHor Horizontal global irradiation GlobEff Effective Global, corr. for IAM and shadings DiffHor Horizontal diffuse irradiation EArray Effective energy at the output of the array T\_Amb T amb. E\_User Energy supplied to the user GlobInc Global incident in coll. plane E\_Solar Energy from the sun E\_Grid Energy injected into grid EFrGrid Energy from the grid

1537.5

12.005

5.734

1.048

10.736

4.686

1596.2

1597.2

953.59

27.58

Year



PVSYST V6.86	3				21/04/20	Page 6/7
		Grid-Co	onnected Sv	/stem: Loss diagram		
Drainat :		Tomon Mido				
Project :						
Simulation va	irlant :	big family - 9	KW			
Main system p	arameters		System type	Sheds on ground		
Near Shadings	5		Linear shadings			
PV Field Orienta	ation		tilt	5° azim	uth 0°	
PV modules			Nb of modulos	JAN0-72-320/51 Pri	om 320 vvp	) Mn
r v Allay Inverter			No. of modules	SUN2000 -8KTI Pr	om 8.00 kV	<b>vp</b> V ac
User's needs		Dailv house	hold consumers	Constant over the year Glo	bal 5734 k	Wh/vear
			Loss diagram o	ver the whole year		
1		1597 kWh/m <sup>2</sup>		Horizontal global irradiation		
			-0.07%	Global incident in coll plane		
			-0.07%	Global incident below threshold		
			→0.00%	Near Shadings: irradiance loss		
			3-3.67%	IAM factor on global		
	1539 k	$10/10^{-10} \times 54 \text{ m}^2 \text{ coll}$	,	Effective irradiation on collectors		
L						
Г		$\frac{10.537}{10.70}$	<u>0</u>	P v conversion	`	
		13.79 MWh	-0 75%	PV loss due to irradiance level	.)	
			1 4-0.13%			
			-11.15%	PV loss due to temperature		
			+0.75%	Module quality loss		
			<b>→</b> -1.10%	Mismatch loss, modules and strings		
			→-0.95%	Ohmic wiring loss		
	12	2.01 MWh		Array virtual energy at MPP		
			1 80%	Inverter Loss during operation (efficien	cv)	
			V 0.00%	Inverter Loss over nominal inv. power	·y)	
			> 0.00%	Inverter Loss due to max. input current		
			₩0.00%	Inverter Loss over nominal inv. voltage		
			₩0.00%	Inverter Loss due to power threshold		
grid			→0.00%	Inverter Loss due to voltage threshold		
consumption	11	70 M///b	→-0.04%	Night consumption		
	11	./ 0 1010011		Available Energy at inverter Output		
4.69 MWh 1.0	5 MWh 1	0.74 MWh		Energy injected into grid		
			-			
to user to	user n solar	to grid				
nom griu nom	1 30101					

						21/04/20	Daga 7/7
PVSYSI V6.86						21/04/20	Page ///
		Grid-Coni	nected Syster	m: P50 - P90 ev	aluation		
Project :		Taman Mic	lah (NEM)				
- Simulation vari	ant :	big family -	9kw				
Main system par	ameters		System type	Sheds on ground			
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	on	Daily hous	Linear shadings tilt Model Nb. of modules Model sehold consumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the yea	azimut Pnoi Pnom tot Pnoi ar Glob	h 0° n 320 Wp al <b>8.96 kV</b> n 8.00 kV al 5734 k	V <b>p</b> V ac Wh/year
Evaluation of the	e Produc	tion probabil	ity forecast				
The probability dis	stribution	of the system	production forecas	t for different vears is n	nainly depen	dent	
on the meteo data	a used for	the simulation	n, and depends on	the following choices:			
Meteo data source Meteo data Specified Deviatio Year-to-year varia	e n bility	Year d	Kind eviation from aver. Variance	MeteoNorm 7.2 static Not defined 3 % 0.5 %	on Yea	ar 1995	
The probability dis Specified Deviatio	stribution n P Soil	variance is als V module moo Inverter effi ling and mism Degra system)	so depending on so delling/parameters iciency uncertainty atch uncertainties idation uncertainty Variance	me system parameters 1.0 % 0.5 % 1.0 % 1.0 % 1.9 % (q	s uncertaintie juadratic sun	⊹s ∩)	
Annual production	n probabili	ity	Variability P50 P90 P95	0.20 MWh 10.74 MWh 10.48 MWh 10.41 MWh			
			Probability	distribution			
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05	P90 = P95 = 104	P50 = 10736 kWh E_Grid simul = 1073 = 10478 kWh 06 kWh	i6 kWh		

0.00 10000

E\_Grid system production kWh

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Grid	d-Connected System	n: Simulation p	arameters	i	
Та	man Midah (NEM)				
ite	Kuala Lumpur/Subang		Country	/ Malays	ia
as	Latitude Legal Time Albedo	3.12° N Time zone UT+8 0.20	Longitude Altitude	e 101.55° e 17 m	E
	Kuala Lumpur/Subang	MeteoNorm 7.2 sta	tion - Synthetic		
iant : Ov	vn house				
	Simulation date	21/04/20 14h32			
ameters	System type	Sheds on ground			
Orientation	Tilt	5°	Azimuth	n 0°	
	Transposition	Perez	Diffuse	e Perez, I	Neteonorm
	Free Horizon				
	Linear shadings				
	Daily household consumers average	Constant over the year 30.4 kWh/Day	ear		
cteristics t database odules PV modules er haracteristics	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) (50°C) U mpp Module area Model Manufacturer Operating Voltage Nb. of inverters	JAM6-72-320/SI JA Solar 10 modules 20 U 6.40 kWp At 0 336 V 38.8 m <sup>2</sup> SUN2000L-5KTL Huawei Technologie 90-500 V U Max. p 2 * MPPT 50 %	In paralle nit Nom. Power operating cond. I mpp Cell area es nit Nom. Power power (=>40°C Total Power	I 2 string: 320 Wp 5.75 kW 17 A 34.4 m <sup>2</sup> r 5.00 kW 5.50 kW r 5.0 kW	s /p (50°C) Vac Vac
			Pnom ratio	0 1.28	
<b>ctors</b> tor	Uc (const)	20.0 W/m²K	Uv (wind)	) 0.0 W/n	n²K / m/s
ss oss n Losses n loss ASHRAE para	Global array res.	332 mOhm 1 - bo (1/cos i - 1)	Loss Fraction Loss Fraction Loss Fraction Loss Fraction bo Param	1.5 % a -0.8 % 1.0 % a 0.10 % . 0.05	t STC t MPP
	Gric Ta ite as iant : Ow ameters Orientation cteristics at database odules PV modules er haracteristics of st database of database	Grid-Connected System Taman Midah (NEM) ite Kuala Lumpur/Subang Latitude as Legal Time Albedo Kuala Lumpur/Subang iant : Own house Simulation date ameters System type Orientation Tilt Transposition Free Horizon Linear shadings Daily household consumers average Cteristics Si-mono Model th database Manufacturer bdules In series PV modules Nb. modules er Nominal (STC) haracteristics (50°C) U mpp Module area St database Manufacturer Operating Voltage Nb. of inverters tor Uc (const) ss Global array res. os n Losses NASHRAE parametrization IAM =	Grid-Connected System: Simulation provide the second system: Simulation provide the system is the second system i	Grid-Connected System: Simulation parameters     Taman Midah (NEM)     itte Kuala Lumpur/Subang   Country     Latitude Albedo 0.20     Kuala Lumpur/Subang MeteoNorm 7.2 station - Synthetic Albedo 0.20     Kuala Lumpur/Subang MeteoNorm 7.2 station - Synthetic O.20     iant: Own house     Simulation date 21/04/20 14h32     ameters System type Sheds on ground     Orientation Tit 5° Azimuth     Constant over the year 30.4 kWh/Day     Daily household consumers Average 30.4 kWh/Day     Daily household consumers Average 30.4 kWh/Day     Constant over the year 30.4 kWh/Day     Ceteristics     Manufacturer JA Solar     Operating Voltage 38.8 m²     Operating Voltage 90-500 V     Model     SUN2000L-5KTL     Huawei Technologies     Operating Voltage 90-500 V     Operating Voltage 90-500 V     Operating Voltage 90-500 V     Operating Voltage 90-500 V     Operating Voltage 100 modules 100 modules     <	21/04/20     Grid-Connected System: Simulation parameters     Taman Midah (NEM)     itte Kuala Lumpur/Subang   Country Malays     as   Latitude 3.12° N   Longitude 101.55°     as   Latitude 3.12° N   Longitude 101.55°     as   Latitude 2.1/04/20 14h32     ameters   System type   Sheds on ground     Orientation   Tit 5°   Azimuth 0°     Transposition Perez   Diffuse Perez, N     Daily household consumers   Constant over the year     average   30.4 kWh//Day     Certristics     Simono   Model   JAM6-72-320/SI     total box fractor for Model   JAM6-72-320/SI     total colspan="2">Simulation date   2 for Matage     Jameters   Simulation (Sitt) A Solar     Daily household consumers   Constant over the year     Jameters   Simulation for Module   <



				Ι	——————————————————————————————————————	
PVSYST V6.86				21/	04/20	Page 3/8
	Grid-Connected	Systen	n: Detailed Us	er's needs		
Project ·	Taman Midah (NFI	N)				
Simulation variant :		•••				
	Own nouse					
Main system parameter	s Syste	em type	Sheds on ground	l		
Near Shadings	Linear s	shadings	50		•	
PV Field Orientation		tilt Model	5° JAM6-72-320/SI	azimuth Pnom	J° 320 Wn	
PV Array	Nb. of	modules	20	Pnom total	6.40 kW	/p
Inverter		Model	SUN2000L-5KTL	Pnom	5.00 kW	/ ac
User's needs	Daily household cor	nsumers	Constant over the	year Global	11.10 M	IWh/year
Daily household consu	mers, Constant over the	e year, a	verage = 30.4 kWh	/day		
		Annua	al values			
	Use 5 days a week	Number	Power	Use	ŀ	Energy
Lamps (LED or fluo)		30	18 W/lamp	6 h/day	2	970 Wh/day
TV / PC / Mobile		3	70 W/app	4 h/day	/	840 Wh/day
Iron		1	1200 W/app	1 h/day	/ 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh/day	/ 3	000 Wh/day
Dish- & Cloth-washers		1		2 Wh/day	/ 1	000 Wh/day
Instant water heater		1	2000 W tot	1 h/day	/ 2	:000 Wh/day
Aircond		6	750 W tot	7 h/day	<u>'</u> 31	500 Wh/day
Stand-by consumers				24 h/day	1	24 Wh/day
Total daily energy					42	534 Wh/uay
		Hourb	v profile			
	<u>∞</u> 7000					
			<b>.</b>			
	a 4000 -			-		
	<sup>ਰ</sup> 3000 –					
	2000 둔 1000					
		بميلا				
	0 3	6 9	9 12 15 18	21 24		

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		Grid	-Conne	ected \$	Svster	n: Mair	n resul	ts			
Project :	Та	aman Mi	dah (NE	:M)							
Simulation variant	+ · ·										
		WITTIOUS									
Main system param	eters		Sys	stem type	Shed	s on grou	Ind				
Near Shadings			Linear	shadings	5 t 5°			azimut	h O°		
PV modules				Mode	I JAM6 <sup>.</sup>	-72-320/S	51	Pnor	n 320 V	Vp	
PV Array			Nb. of	f modules	3 20			Pnom tota	al <b>6.40</b>	kWp	
Inverter		Daily bo	isebold co	Mode	I SUN2	000L-5KT	L he vear	Pnor	n 5.00	kW ac	oor
		Daily 1100		Jisumera	5 00150		ne year	Globa		/ IVIVVII/ ye	
Main simulation res System Production	sults	Per	<b>Produce</b> formance	d Energy Ratio PF	<b>8.41</b>	MWh/yea %	r Spo Solar F	ecific proc raction SI	d. 1314 F 5.35	kWh/kW %	/p/year
Normalized productions (	(per installed	l kWp): No	minal power	<sup>.</sup> 6.40 kWp			Per	formance Ra	atio PR		
6 Lc : Collection L	Loss (PV-array los	I I sses) (	1 I I 0.7 kWh/kWp/day		1	.0 .9	I I : Performance R	atio (Yf / Yr): 0.4	1 I 823	<del></del>	
5 Yf : Produced us	seful energy (inverter,)	erter output)	3.6 kWh/kWp/day	y -	0	.8					
Kep/dw.					~ 0	.7					
4 4/4/WA					atio PI	.6					
G 3-					0 guce	.5					
E				-	erform	.4					
Lormali:					0	.3					
2				-	0	.2					
				-	0	.1					
0 Jan Feb Mar A	opr May Jur	Jul Aug	Sep Oct	Nov Dec	0	.0 <b>E</b> Jan Feb	Mar Apr	May Jun	Jul Aug S	Sep Oct N	lov Dec
				Owr	house ו						
			Ba	lances ar	nd main	results					
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid	]
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m²	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh	-
January	133.0	82.20	28.10	136.3	131.2	0.726	0.978	0.051	0.660	0.927	
March	134.6	67.90 88.20	27.70	137.4 150.3	132.8 144 9	0.737	0.851	0.047	0.676	0.804	
April	140.3	70.50	27.70	138.8	133.9	0.742	0.893	0.032	0.679	0.845	
May	140.3	78.60	28.60	136.9	131.7	0.734	0.978	0.054	0.665	0.924	
June	132.0	77.80	27.80	128.3	123.5	0.691	0.893	0.046	0.631	0.847	
July	134.4	87.20	27.80	131.1	125.8	0.710	0.936	0.052	0.644	0.884	
August	132.2	87.20	27.80	130.1	125.2	0.700	0.978	0.051	0.635	0.928	
September	129.2	/9.00	27.10	128.8	124.0	0.691	0.851	0.046	0.632	0.805	
November	117 6	02.0U 79.20	27.40 26.70	140.4 110 Q	135.5 115 /	0.754	0.978	0.053	0.007 0.222	0.925 0.925	
December	115.0	73.20	26.29	118.1	113.6	0.640	0.893	0.046	0.582	0.848	
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	11.101	0.594	7.815	10.508	1
	ļ				-		-	ļ	-		4
Legends: Glob	Hor F	lorizontal gl	lobal irradia	tion		GlobEff	Effecti	ve Global, d	corr. for IAI	M and sha	dings
Diff	Hor H	lorizontal d	iffuse irradia	ation		EArray	Effecti	ve energy a	at the outp	ut of the a	rray
T_A	mb T	amb.				E_User	Energy	y supplied to	o the user		
Glob	oinc C	Jobal incide	ent in coll. p	lane		E_Solar	Energy	y from the s	sun		
						E_GNO FFrGrid	Energy	y injected in v from the c	no gria rrid		
								بعسسر	g- 154		



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	1	Grid-Con	nect	ed Sv	stem: Loss diagra	m		
Draigat :		Taman Midah						
Simulation var	iant ·			)				
		own nouse	<b>0</b> /					
Main system pa	rameters		Syste	m type	Sneds on ground			
PV Field Orientat	ion	LII	near sr	tilt	5°	azimut	h O°	
PV modules		N	lb of m	Model	JAM6-72-320/SI	Pnor Pnom tota	n 320 Wp	No.
Inverter		IN	10. OI II	Model	SUN2000L-5KTL	Phom tota Pnor	n 5.00 kV	vp √ac
User's needs		Daily househo	old con	sumers	Constant over the year	Globa	al 11.10 N	1Wh/year
		L	_oss di	agram ov	er the whole year			
Γ		1597 kWh/m <sup>2</sup>			Horizontal global irradiatio	n		
				→-0.07%	Global incident in coll. plan	าย		
				→0.00%	Near Shadings: irradiance los	s		
			N	⇒-3.67%	IAM factor on global			
	1538	kWh/m² * 39 m² coll.			Effective irradiation on co	llectors		
_	efficier	ncy at STC = 16.53%			PV conversion			
		9.85 MWh		H 0 750/	Array nominal energy (at S	STC effic.)		
			1 C	1		-1		
				-11.15%	PV loss due to temperature			
			(+0.	75%	Module quality loss			
			<b>4</b> -1.7	10% 5%	Mismatch loss, modules and s	strings		
	8	8.58 MWh	7-0.3	JJ 70	Array virtual energy at MP	Р		
		1	<b>N</b> -18	8%	Inverter Loss during operation	n (efficiency	4)	
			0.00	%	Inverter Loss over nominal inv	v. power	)	
			→ 0.00'	%	Inverter Loss due to max. input	ut current		
			→-0.01	% 1%	Inverter Loss due to power th	reshold		
grid			→ 0.00 <sup>+</sup>	%	Inverter Loss due to voltage the	hreshold		
consumption	8	3.41 MWh	7-0.00	J 70	Available Energy at Inverte	er Output		
	I							
10.51 MWh 0.59	NWh	7.82 MWh	]		Energy injected into grid			
to user to u	iser	to grid						
from grid from	solar							

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	Grid-Connected Syster	n: P50 - P90 eva	aluation		
Project ·	Taman Midah (NFM)				
Simulation variant :	Own house				
Main system parameters	System type	Sheds on ground			
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear shadings tilt Model Nb. of modules Model Daily household consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the year	azimut Pnor Pnom tota Pnor Globa	h 0° n 320 Wp al <b>6.40 kW</b> n 5.00 kW al 11.10 M	<b>/p</b> / ac IWh/year
Evaluation of the Produc	tion probability forecast				
The probability distribution	of the system production forecast	for different vears is ma	inly depen	dent	
on the meteo data used for	the simulation, and depends on t	he following choices:		2011	
Meteo data source Meteo data Specified Deviation Year-to-year variability	Kind Year deviation from aver. Variance	MeteoNorm 7.2 station Not defined 3 % 0.5 %	Yea	ar 1995	
The probability distribution Specified Deviation P Soi Global variability (meteo +	variance is also depending on so V module modelling/parameters Inverter efficiency uncertainty ling and mismatch uncertainties Degradation uncertainty system) Variance	me system parameters u 1.0 % 0.5 % 1.0 % 1.0 % 1.9 % (qua	uncertaintie adratic sum	s ı)	
Annual production probabil	ity Variability P50 P90 P95	0.15 MWh 7.82 MWh 7.63 MWh 7.58 MWh			
	Probability	distribution			
Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.20 0.15 0.10 P90 = 7628 kWh 0.05 0.00	5 kWh E_Grid simul = 7815 kWh			

0.00 

E\_Grid system production kWh

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	Grid-C	connected Sv	vstem: CO2 Ba	lance		
Project .	Taman Mid	ah (NEM)		lance		
Simulation variant :						
	Own nouse		<u></u>			
Main system parameters		System type	Sheds on ground			
PV Field Orientation		Linear snadings	5°	azimut	h O°	
PV modules		Model	JAM6-72-320/SI	Pnor Pnom tot	n 320 Wp	In
Inverter		Model	20 SUN2000L-5KTL	Phomitola	n 5.00 kW	/p / ac
User's needs	Daily hous	ehold consumers	Constant over the ye	ear Globa	al 11.10 M	Wh/year
Produced Emissions		<b>Total:</b> Source:	<b>11.84 tCO2</b> Detailed calculation	from table bel	ow	
Replaced Emissions	Sy	Total: stem production:	<b>166.5 tCO2</b> 8408.96 kWh/yr	Lifetime	: 30 years	3
	Grid Lifecycle Emissions: Source:			Country	r: Malaysia	а
CO2 Emission Balance		Total:	132.6 tCO2			
System Lifecycle Emissio	ons Details:	M	odules		Supports	
LCE		1713 k	GCO2/kWp 4.40 kgCO2/kg			
Quantity Subtotal [kgCO	2]	6.4	40 kWp 200 kg 10961 880			
		Saved CO2 Er 140 100 60 40 20 -20 0 5 1	nission vs. Time			

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	Grid	d-Connected Systen	n: Simulation p	arameters	;	
Project :	Та	man Midah (NEM)				
Geographical S	ite	Kuala Lumpur/Subang		Country	/ Malays	ia
Situation Time defined	as	Latitude Legal Time Albedo	3.12° N Time zone UT+8 0.20	Longitude Altitude	e 101.55° e 17 m	E
Meteo data:		Kuala Lumpur/Subang	MeteoNorm 7.2 sta	tion - Synthetic	:	
Simulation var	iant : Ov	vn house				
		Simulation date	21/04/20 14h34			
Simulation para	ameters	System type	Sheds on ground			
Collector Plane	Orientation	Tilt	5°	Azimuth	n 0°	
Models used		Transposition	Perez	Diffuse	e Perez, I	Vleteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
User's needs :		Daily household consumers average	Constant over the y 12.8 kWh/Day	ear		
PV Array Charac PV module Original PVsys Number of PV mod Total number of P Array global powe Array operating c Total area Inverter Original PVsys Characteristics	eteristics t database odules PV modules er haracteristics	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) (50°C) U mpp Module area Model Manufacturer Operating Voltage Nb. of inverters	JAM6-72-320/SI JA Solar 10 modules 20 U 6.40 kWp At 0 336 V 38.8 m <sup>2</sup> SUN2000L-5KTL Huawei Technologie 90-500 V U Max. p 2 * MPPT 50 %	In paralle nit Nom. Power operating cond. I mpp Cell area es nit Nom. Power power (=>40°C Total Power	I 2 string: r 320 Wp 5.75 kW 17 A a 34.4 m <sup>2</sup> r 5.00 kW ) 5.50 kW r 5.0 kW	s /p (50°C) Vac Vac Vac
				Pnom ratio	0 1.28	
<b>PV Array loss fa</b> Thermal Loss fac	<b>ctors</b> tor	Uc (const)	20.0 W/m²K	Uv (wind)	) 0.0 W/n	n²K / m/s
Wiring Ohmic Lo Module Quality L Module Mismatch Strings Mismatch Incidence effect,	ss oss i Losses i loss ASHRAE para	Global array res.	332 mOhm 1 - bo (1/cos i - 1)	Loss Fractior Loss Fractior Loss Fractior Loss Fractior bo Param	n 1.5 % a n -0.8 % n 1.0 % a n 0.10 % . 0.05	t STC It MPP



DVOVOT VIG OG				21	/04/20			
PV3131 V0.80				21	/04/20	Page 3/8		
0	Grid-Connected S	Svsten	n: Detailed Use	er's needs				
Project :	Taman Midah (NEN	/)						
Simulation variant ·	Own house	,						
Main avatam naramatara	<u> </u>		Chada an ground					
Main system parameters	Syste	em type	Sheas on ground					
PV Field Orientation	Linear s	nadings tilt	5°	azimuth	0°			
PV modules		Model	JAM6-72-320/SI	Pnom	320 Wp			
PV Array	Nb. of r	nodules		Pnom total	6.40 kW	p		
User's needs	Daily household cor	nsumers	Constant over the y	vear Global	4687 kW	ac h/year		
Daily household consum	ers, Constant over the	e year, av	verage = 12.8 kWh/	day				
		Annua	l values					
	Use 2 days a week	Number	Power	Use	E	nergy		
Lamps (LED or fluo)		30	18 W/lamp	6 h/da	y 29	70 Wh/day		
TV / PC / Mobile		3	70 W/app	14 h/da	y 29	40 Wh/day		
Iron		1	1200 W/app	1 h/da	y 12	200 Wh/day		
Fridge / Deep-freeze		1		24 Wh/da	y 30	00 Wh/day		
Dish- & Cloth-washers		1	2000 14/ 4-4	2 Wh/da	y 10	00 Wh/day		
Instant water neater			2000 W tot	I n/da	y 20	00 Wh/day		
Stand-by consumers		0	750 W 101	24 h/da	y 310 v	24 Wh/day		
Total daily energy				2417.00	<u>446</u>	534 Wh/day		
Stand-by consumers 24 h/day 24 Wh/day   Total daily energy 44634 Wh/day								

Grid-Connected System: Main results	
-	
Project · Taman Midah (NEM)	
Simulation variant : Own nouse	
Main system parameters     System type     Sheds on ground	
Near Shadings Linear shadings	
PV Field Orientation tilt 5° azimuth 0°	A.I
V modules Model JAM6-72-320/SI Phom 320 V	vp kWp
nverter Model SUN20001-5KTI Phom 5.00	kW ac
Jser's needs Daily household consumers Constant over the year Global 4687	kWh/year
lain simulation results	
System ProductionProduced Energy8.41 MWh/yearSpecific prod.1314Performance Ratio PR82.32 %Solar Fraction SF9.32	kWh/kWp/yea %
Normalized productions (per installed kWp): Nominal power 6.40 kWp Performance Ratio PR	
Lc : Collection Loss (PV-array losses) 0.7 kWh/kWp/day Ls : System Loss (inverter,) 0.07 kWh/kWp/day 0.9	-
5 - VI · Produced useful energy (inverter output) 3.6 kWh/kWp/day - 0.8	
OLA LI	Sep Oct Nov Dec
Own nouse Balances and main results	
GlobHor DiffHor T_Amb GlobInc GlobEff EArray E_User E_Solar E_Grid	EFrGrid
kWh/m² kWh/m² °C kWh/m² kWh/m² MWh MWh MWh	MWh
January 133.0 82.20 28.10 136.3 131.2 0.726 0.446 0.042 0.669	0.404
February     134.6     67.90     27.70     137.4     132.8     0.737     0.357     0.035     0.688	0.322
March     149.8     88.20     28.00     150.3     144.9     0.804     0.357     0.035     0.753	0.322
April     140.3     70.50     27.70     138.8     133.9     0.742     0.402     0.038     0.689	0.363
May 140.3 78.60 28.60 136.9 131.7 0.734 0.402 0.038 0.681	0.364
June     132.0     7/.80     27.80     128.3     123.5     0.691     0.357     0.032     0.645       July     134.4     07.20     27.80     121.1     125.0     0.710     0.414     0.250     0.645	0.325
July 134.4 87.20 27.80 131.1 125.8 0.710 0.446 0.043 0.653	0.403
August 132.2 07.20 27.00 130.1 125.2 0.700 0.357 0.030 0.656 September 129.2 79.00 27.10 128.8 124.0 0.601 0.357 0.034 0.644	0.327
October 138.8 82.60 27.40 140.4 135.5 0.754 0.446 0.043 0.697	0.403
November     117.6     79.20     26.70     119.8     115.4     0.648     0.357     0.030     0.605	0.327
December 115.0 73.20 26.29 118.1 113.6 0.640 0.402 0.035 0.592	0.366
Year     1597.2     953.59     27.58     1596.2     1537.5     8.575     4.687     0.437     7.972	4.250
	·1
Legends: GlobHor Horizontal global irradiation GlobEff Effective Global, corr. for IA	M and shadings
Legends: GlobHor Horizontal global irradiation GlobEff Effective Global, corr. for IA   DiffHor Horizontal diffuse irradiation EArray Effective energy at the output   T Amb T amb F blocc	M and shadings ut of the array
Legends:GlobHorHorizontal global irradiationGlobEffEffective Global, corr. for IADiffHorHorizontal diffuse irradiationEArrayEffective energy at the outpT_AmbT amb.E_UserEnergy supplied to the userGlobIncGlobal incident in coll, planeE_SolarEnergy from the sup	M and shadings ut of the array

EFrGrid Energy from the grid



PVSYST V6.86					21/04/20	Page 6/8
		Grid-Co	nnected Sv	/stem: Loss diagram		
Drainat :		Taman Midak				
Simulation var	iant ·					
Simulation val		Own nouse				
Main system pa	rameters		System type	Sheds on ground		
Near Shadings	tion	L	inear shadings.	5° azimi	ιth 0°	
PV modules			Model	JAM6-72-320/SI Pro	m 320 Wr	)
PV Array		ļ	Nb. of modules	20 Pnom to	tal 6.40 kV	Vp
Inverter			Model	SUN2000L-5KTL Pnc	om 5.00 kV	Vac
User's needs		Daily househ	old consumers	Constant over the year Glob	al 4687 k	/Vh/year
			Loss diagram o	ver the whole year		
Г		1597 kWh/m <sup>2</sup>		Horizontal global irradiation		
			-0.07%	Global incident in coll. plane		
			-0.07%	6 Global incident below threshold		
			0.00%	Near Shadings: irradiance loss		
			-3.67%	6 IAM factor on global		
	1538	kWh/m² * 39 m² coll.		Effective irradiation on collectors		
_	efficien	ncy at STC = 16.53%		PV conversion		
		9.85 MWh		Array nominal energy (at STC effic.	)	
			-0.75%	PV loss due to irradiance level		
			-11.15%	6 PV loss due to temperature		
			+0.75%	Module quality loss		
			→-1.10%	Mismatch loss, modules and strings		
			→-0.95%	Ohmic wiring loss		
	8	3.58 MVVN		Array virtual energy at MPP		
			9-1.88%	Inverter Loss during operation (efficiend	cy)	
			₩0.00%	Inverter Loss over nominal inv. power		
			₩0.00%	Inverter Loss due to max. input current		
			$\rightarrow 0.00\%$	Inverter Loss over nominal inv. voltage		
arid			4-0.01%	Inverter Loss due to power threshold		
consumption			-0.05%	Night consumption		
	8	.41 MWh		Available Energy at Inverter Output		
	1					
4.25 MWh 0.44 M	<b>W</b> Wh	7.97 MWh		Energy injected into grid		
to user to us	ser	to grid				
from grid from s	solar					

PVSYST V6.86				21/04/20	Page 7/8
	Grid-Connected Syster	m: P50 - P90 eva	luation		
Project :	Taman Midah (NFM)				
Simulation variant :	Own house				
Main system nerometers	Sustem time	Shada an graund			
Main system parameters	System type	Sneas on ground			
PV Field Orientation	Linear shadings tilt	5°	azimutl	ר 0°	
PV modules	Model	JAM6-72-320/SI	Pnon	n 320 Wp	
PV Array	Nb. of modules		Pnom tota	d 6.40 kV	Vp
Inverter User's needs	Model Daily household consumers	Constant over the year	Phon Globa	n 5.00 KV nl 4687 kV	/ ac Vh/vear
					, and the second s
Evaluation of the Produc	tion probability forecast				
The probability distribution	of the system production forecast	for different years is ma	inly depend	dent	
on the meteo data used for	the simulation, and depends on t	he following choices:			
Meteo data source		MeteoNorm 7.2 station			
Meteo data	Kind	Not defined	Yea	r 1995	
Specified Deviation	Year deviation from aver.	3%			
real-lo-year variability	Validite	0.5 %			
The probability distribution	variance is also depending on so	me system parameters u	Incertaintie	S	
Specified Deviation P	V module modelling/parameters	1.0 %			
Soi	ling and mismatch uncertainties	0.5 %			
	Degradation uncertainty	1.0 %			
Global variability (meteo +	system) Variance	1.9 % (qua	adratic sum	)	
Annual production probabil	itv Variabilitv	0.15 MWh			
	P50	7.97 MWh			
	P90	7.78 MWh			
	P95	7.73 MWh			
	Probability	distribution			
	0.50			3	
	0.45	P50 = 7972 kWh			
	0.40	E_Grid simul = 797	72 kWh		
	0.35				
≥	0.30				
abilit	0.25			1	
2 4	0.20	0 = 7781 kWh		1	
	0.15				
	0.10 P95 = 7	727 kWh	$\mathbf{i}$	1	
	0.05		$\mathbf{i}$	1	
	0.00 <b>7400</b> 7600 7800	8000 820	<u></u>	<b>H</b> 3400	

E\_Grid system production kWh

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F V3131 V0.00					21/04/20				
	Grid-C	connected Sy	vstem: CO2 Ba	lance					
Project :	Taman Mid	ah (NEM)							
Simulation variant :	Own house	)							
Main system parameters		System type	Sheds on ground						
Near Shadings		Linear shadings	٣٩	orimut	ь 0°				
PV Field Orientation PV modules		Model	5 JAM6-72-320/SI	Pnor	n 0° n 320 Wp				
PV Array		Nb. of modules Model	20 SUN2000L-5KTI	Pnom tota Pnor	al <b>6.40 kV</b> n 5.00 kW	<b>/p</b> / ac			
User's needs	Daily hous	ehold consumers	Constant over the ye	ear Globa	al 4687 kV	Vh/year			
Produced Emissions		<b>Total:</b> Source:	<b>11.84 tCO2</b> Detailed calculation	from table bel	ow				
Replaced Emissions	Sy	Total: stem production:	<b>166.5 tCO2</b> 8408.96 kWh/yr	Lifetime	e: 30 years	3			
	660 gCO2/kWh IEA List	Country	/: Malaysi	а					
CO2 Emission Balance		Total:	132.6 tCO2						
System Lifecycle Emissio	System Lifecycle Emissions Details:								
LCE		1713 k	<pre>cgCO2/kWp 4.40 kgCO2/kg</pre>						
Quantity Subtotal [kgCQ	21	6.4 1	40 kWp 200 kg 10961 880						
		Saved CO2 En 140 120 100 80 40 -0 -20 -20 -20 -20 -20 -20 -20	nission vs. Time						

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	Grid-Connected Syster	m: Simulation parameters	3
Project :	Taman Midah (NEM)		
- Geographical S	te Kuala Lumpur/Subang	Countr	y <b>Malaysia</b>
Situation	Latitude	3.12° N Longitud	e 101.55° E
Time defined	as Legal Time	Time zone UT+8 Altitud	e 17 m
Meteo data:	Kuala Lumpur/Subang	MeteoNorm 7.2 station - Synthetic	5
Simulation vari	ant : Own (9KW)		
	Simulation date	21/04/20 14h27	
Simulation para	meters System type	Sheds on ground	
<b>Collector Plane</b>	Orientation Tilt	5° Azimut	h O°
Models used	Transposition	Perez Diffus	e Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
User's needs :	Daily household consumers average	Constant over the year 30.4 kWh/Day	
PV Array Charac PV module Original PVsysi Number of PV mod Total number of P Array global powe Array operating ch Total area Inverter Custom param	teristics Si-mono Model database Manufacturer dules In series V modules Nb. modules or Nominal (STC) haracteristics (50°C) U mpp Module area Model eters definition Manufacturer	JAM6-72-320/SI JA Solar 14 modules In paralle 28 Unit Nom. Powe 8.96 kWp At operating cond 470 V I mp 54.3 m <sup>2</sup> Cell area SUN2000L-8KTL Huawei Technologies	el 2 strings er 320 Wp l. 8.05 kWp (50°C) o 17 A a 48.2 m²
Characteristics	Operating Voltage	200-850 V Unit Nom. Powe Max. power (=>40°C	er 8.00 kWac C) 8.80 kWac
Inverter pack	Nb. of inverters	2 * MPPT 50 % Total Powe Pnom rati	er 8.0 kWac o 1.12
PV Array loss fa	ctors		
Thermal Loss fac	or Uc (const)	20.0 W/m²K Uv (wind	l) 0.0 W/m²K / m/s
Wiring Ohmic Los Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	Global array res. Doss Losses loss ASHRAE parametrization IAM =	465 mOhm Loss Fractio Loss Fractio Loss Fractio Loss Fractio Loss Fractio Loss Fractio Loss Fractio Loss Fractio Loss Fractio Loss Fractio	n 1.5 % at STC n -0.8 % n 1.0 % at MPP n 0.10 % n. 0.05



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		Grid	-Conne	ected \$	Syster	n: Mair	n resul	lts		
Project :	Ta	aman Mi	idah (NE	M)	-					
Project :	4. O			,						
	1. 0	wn (9rv	v)							
Main system param	neters		Syst	tem type	Sheds	s on grou	und			
Near Shadings			Linear	shadings	6					
PV Field Orientation				til	t 5°			azimut	h 0°	
PV modules			NII 4	Mode	I JAM6	-72-320/S	i -	Pnor Pnor	m 320V	Vp
overter			IND. OI	Mode	5 20 1 SUN2		1	Phom lot	al <b>0.90</b>   m 8.00	kwp Wac
Jser's needs		Daily ho	usehold co	nsumers	Const	ant over t	∟ he year	Globa	al 11.10	MWh/year
lain simulation ros	sulte									
System Production	suits		Produced	I Energy	/ 11.78	MWh/ye	<b>ar</b> Sp	ecific prod	d. 1315	kWh/kWp/yea
		Pei	rformance	Ratio PF	R 82.40	%	Solar F	raction S	F 5.49	%
Normalized productions	(per installed	d kWp): No	ominal power	8.96 kWp			Per	rformance R	atio PR	
6		- I - I	<del></del>		1	.° <b>F</b>	1 1	<u> </u>		
Lc : Collection I Ls : System Los	Loss (PV-array los ss (inverter,)	sses)	0.7 kWh/kWp/day 0.07 kWh/kWp/day	1	0	.9 <b>E P</b> R	: Performance F	Ratio (Yf / Yr): 0.	.824	
5 - Yf ; Produced u	iseful energy (inv	erter output)	3.6 kWh/kWp/day	-	0	.8				
Mp/dg				_ ]	~ 0	.7				
4 /4//					음 0	.6				
à a					e O	5				
Energy					manc					
p					0 Perfor	.4				
ormalii					0	.3				
ž 1-					0	.2				
				_	0	.1				
				1	0		1			
Jan Feb Mar A	Apr May Jur	n Jul Aug	Sep Oct I	Nov Dec		Jan Feb	Mar Apr	May Jun	Jul Aug S	ep Oct Nov Dec
				Owr	ר (9KW)					
			Bal	ances ai	nd main i	results				
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	E_Grid	EFrGrid
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m²	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	1.016	0.978	0.052	0.945	0.926
February	134.6	67.90	27.70	137.4	132.8	1.031	0.851	0.047	0.966	0.804
March	149.8	88.20	28.00	150.3	144.9	1.125	0.936	0.052	1.053	0.884
April	140.3	70.50	27.70	138.8	133.9	1.039	0.893	0.050	0.971	0.844
May	140.3	78.60	28.60	136.9	131.7	1.027	0.978	0.056	0.952	0.922
June	132.0	77.80	27.80	128.3	123.5	0.967	0.893	0.048	0.901	0.845
July	134.4	87.20	27.80	131.1	125.8	0.994	0.936	0.052	0.923	0.883
August	132.2	87.20	27.80	130.1	125.2	0.980	0.978	0.052	0.909	0.926
September	129.2	79.00	27.10	128.8	124.0	0.968	0.851	0.047	0.902	0.804
October	138.8	82.60	27.40	140.4	135.5	1.056	0.978	0.055	0.981	0.923
November	117.6	79.20	26.70	119.8	115.4	0.907	0.936	0.050	0.839	0.886
December	115.0	73.20	26.29	118.1	113.6	0.896	0.893	0.048	0.831	0.846
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	11.101	0.609	11.175	10.492
L	1	l	I			<b></b>	ł	<b>!</b>		I
Legends: Glob	oHor H	Horizontal q	lobal irradiati	ion		GlobEff	Effecti	ive Global,	corr. for IAI	A and shadings

Legends: GlobHor DiffHor

T\_Amb

GlobInc

Horizontal global irradiation Horizontal diffuse irradiation T amb. Global incident in coll. plane Effective Global, corr. for IAM and shadings Effective energy at the output of the array Energy supplied to the user Energy from the sun Energy injected into grid Energy from the grid

EArray

E\_User

E\_Solar

E\_Grid

EFrGrid



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		Grid-Co	nnect	ed Sv:	stem: Loss diagram		
Project ·		Taman Midak		) )			
Simulation var	iant :	Own (9KW)		)			
Main system na	ramotors	•••••(•••••)	Sveto	m tupo	Shade on ground		
Noar Shadings	rameters	1	incor sh		Sheas on ground		
PV Field Orientat	ion	L		tilt	5° azimu	th 0°	
PV modules				Model	JAM6-72-320/SI Pnc	m 320 Wp	
PV Array Inverter			Nb. of m	Model	28 Pnom to SUN2000L-8KTI Pno	ial <b>8.96 kV</b> m 8.00 kV	<b>Vp</b> V ac
User's needs		Daily househ	old cons	sumers	Constant over the year Glob	al 11.10 N	1Wh/year
			Loss dia	agram ov	er the whole year		
				•	·		
Г		1597 kWh/m <sup>2</sup>			Horizontal global irradiation		
				→-0.07%	Global incident in coll. plane		
				-0.07%	Global incident below threshold		
			N,	-3 67%	A LAM factor on global		
	1538	kWh/m <sup>2</sup> * 54 m <sup>2</sup> coll		7 0.01 /0			
L	efficier	ncy at STC = 16.539	 %		PV conversion		
Г		13.79 MWh			Array nominal energy (at STC effic	.)	
				<b>∍</b> -0.75%	PV loss due to irradiance level		
				}-11.15%	PV loss due to temperature		
			(+0. <sup>-</sup>	75%	Module quality loss		
			9-1.1	10%	Mismatch loss, modules and strings		
	1		9-0.9	15%	Ohmic wiring loss		
	1	2.01 100011			Anay virtual energy at wir i		
			9-1.8	0%	Inverter Loss during operation (efficien	cy)	
			$70.00^{\circ}$	% %	Inverter Loss over nominal inv. power Inverter Loss due to max, input current		
			→ 0.00°	%	Inverter Loss over nominal inv. voltage		
			> 0.00	%	Inverter Loss due to power threshold		
grid consumption			→-0.04	% 4%	Night consumption		
	1	1.78 MWh			Available Energy at Inverter Output	:	
	1						
10.49 MWh 0.61 I	MWh	11.17 MWh			Energy injected into grid		
to user to u	Iser	to grid					
from grid from	solar						

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	Grid-Connected Syster	n: Simulation parameters	
Project :	Taman Midah (NEM)		
Geographical S	te Kuala Lumpur/Subang	Country	Malaysia
Situation Time defined	as Legal Time	3.12° NLongitudeTime zone UT+8Altitude	101.55° E 17 m
Meteo data:	Albedo Kuala Lumpur/Subang	0.20 MeteoNorm 7.2 station - Synthetic	
Simulation vari	ant : Own (9KW)		
	Simulation date	21/04/20 14h29	
Simulation para	meters System type	Sheds on ground	
Collector Plane	Orientation Tilt	5° Azimuth	0°
Models used	Transposition	Perez Diffuse	Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
User's needs :	Daily household consumers average	Constant over the year 12.8 kWh/Day	
PV Array Charac PV module Original PVsys Number of PV mo Total number of P Array global powe Array operating ch Total area Inverter Custom param	teristics Si-mono Model database Manufacturer dules In series V modules Nb. modules rr Nominal (STC) haracteristics (50°C) U mpp Module area Model eters definition Manufacturer	JAM6-72-320/SI JA Solar 14 modules In parallel 28 Unit Nom. Power 8.96 kWp At operating cond. 470 V I mpp 54.3 m <sup>2</sup> Cell area SUN2000L-8KTL Huawei Technologies	2 strings 320 Wp 8.05 kWp (50°C) 17 A 48.2 m <sup>2</sup>
Characteristics	Operating Voltage	200-850 V Unit Nom. Power Max. power (=>40°C)	8.00 kWac 8.80 kWac
Inverter pack	Nb. of inverters	2 * MPPT 50 % Total Power Pnom ratio	8.0 kWac 1.12
PV Array loss fa	ctors		
Thermal Loss fac	or Uc (const)	20.0 W/m <sup>2</sup> K Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Los Module Quality Lo Module Mismatch Strings Mismatch Incidence effect, A	Global array res. bss Losses loss ASHRAE parametrization IAM =	465 mOhm Loss Fraction Loss Fraction Loss Fraction Loss Fraction 1 - bo (1/cos i - 1) bo Param.	1.5 % at STC -0.8 % 1.0 % at MPP 0.10 % 0.05



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(	Grid-Connected S	System	n. Detailed Lls	er's needs				
	Toman Midah (NEN	<i>a</i> \	i. Detailed 00					
Project :	Taman Midan (NEN	//)						
Simulation variant :	Own (9KW)							
Main system parameters	Syste	em type	Sheds on ground					
Near Shadings	Linear s	hadings						
PV Field Orientation		tilt	5°	azimuth C	)°			
PV modules PV Array	Nb of r	IVIODEI modules	JAM6-72-320/SI 28	Pnom 3 Pnom total 8	320 vvp 8 96 kWn			
Inverter	Model SUN2000L-8KTL Pnom				8.00 kW ac			
User's needs	Daily household cor	nsumers	Constant over the y	year Global 4	4687 kWh/year			
Daily household consum	ers, Constant over the	<b>year, a</b> v Annua	verage = 12.8 kWh/ I values	/day				
	Use 2 days a week	Number	Power	Use	Energy			
Lamps (LED or fluo)		30	18 W/lamp	6 h/day	2970 Wh/day			
TV / PC / Mobile		3	70 W/app	14 h/day	2940 Wh/day			
Iron		1	1200 W/app	1 h/day	1200 Wh/day			
Fridge / Deep-freeze		1		24 Wh/day	3000 Wh/day			
Dish- & Cloth-washers		1		2 Wh/day	1000 Wh/day			
Instant water neater			2000 W tot	I n/day	2000 Wh/day			
Stand-by consumers		0	750 W 101	24 h/day	24 Wh/day			
Total daily energy				2417003	44634 Wh/day			
	Laction of daily energy [3]	Hourly 6 9	<b>/ profile</b>	21 24				

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								21/04/20	) Page	9/6
	(	Grid-Conn	ected \$	Svsten	n: Main	ı resu	lts			
Project :	Tomo	n Midah (NI								
		in which in (ini								
Simulation variant	t: Own	(9KW)								
Main system param	eters	Sy	stem type	Sheds	s on grou	nd				
Near Shadings		Linea	r shadings	;						
PV Field Orientation			til	t 5°			azimut	h O°		
V modules			Mode	I JAM6-	·72-320/SI		Pnor	n 320 W	/р	
V Array		Nb. c	of modules	s 28			Pnom tota	al <b>8.96 k</b>	(Wp	
iverter Isor's poods	Dai	ly household a		Const	000L-8K11	- No voar	Phor Cloby	N 8.00K	(VV ac kWb/yoar	
	Dai		Unsumers	Const	ant over tr	ie year	Gioba	4007	kwn/year	
Main simulation res System Production	sults	<b>Produce</b> Performance	ed Energy e Ratio PF	<b>11.78</b> 82.40	<b>MWh/yea</b> %	a <b>r</b> Sp Solar F	ecific proc Fraction S	d. 1315 F 9.58 %	kWh/kWp/ %	year
Normalized productions (	(per installed kWp	o): Nominal powe	er 8.96 kWp			Pe	rformance R	atio PR		
6			· · · ]	1.				1 1	1	
Lc : Collection Lo Ls : System Los	.oss (PV-array losses) s (inverter,)	0.7 kWh/kWp/da 0.07 kWh/kWp/d	y - ay	0.	9 <b>E</b>	Performance	Ratio (Yf / Yr): 0.	824		-
5 - Yf ; Produced us	seful energy (inverter ou	tput) 3.6 kWh/kWp/da	iy –	0.	8					
Ap/de			1	0.	7					
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6 3-				eg 0.	5					
			-	E O	4					
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paz 2				Ъе	E					
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Partie 2 Normality 1 1				ع 0. 0.	3					
22- 1-				ළ 0. 0.	3 2 1					
2 1 Jan Feb Mar Ap	pr May Jun Jul	I I I Aug Sep Oct	Nov Dec	ළ 0. 0. 0.	3 2 1 Jan Feb	Mar Apr	1 1 1 May Jun	Jul Aug Se	ep Oct Nov	Dec
Difference of the second secon	pr May Jun Jul	I I I I Aug Sep Oct	Nov Dec	2 0. 0. 0.	3 2 1 Jan Feb	Mar Apr	1 1 1 May Jun	Jul Aug Se	ep Oct Nov	Dec
2 1 Jan Feb Mar A	LLLL pr May Jun Jul	I I I I Aug Sep Oct	Nov Dec	ي 0. 0. 0.	3 2 1 Jan Feb	Mar Apr	1 1 1 May Jun	Jul Aug Se	ep Oct Nov	Dec
provide a second	pr May Jun Jul	I I I I Aug Sep Oct	Nov Dec	ຍ 1. 1. 1. 2. 1. 2. 1. 2. 1. 2. 1. 2. 1. 2. 1. 2. 1. 2. 1. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	3 2 1 Jan Feb	L Mar Apr	L L L May Jun	L L Jul Aug Se	ep Oct Nov	Dec
Dan Feb Mar A	pr May Jun Ju	I Aug Sep Oct	Nov Dec Owr alances ar	ິ 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0	Jan Feb	l Mar Apr	1 1 1 May Jun	Jul Aug Se	ep Oct Nov	Dec
Jan Feb Mar A	pr May Jun Ju	Aug Sep Oct	Nov Dec	۵. ۵. ۱ (9KW) ۲ main ۲	Jan Feb	Mar Apr	May Jun	Jul Aug Se	ep Oct Nov	Dec
Dan Feb Mar A	pr May Jun Ju GlobHor Dif	Haug Sep Oct	Nov Dec Owr alances ar	۵. ۵. ۱ (9KW) nd main r GlobEff	Jan Feb	Mar Apr	May Jun	Jul Aug Se	ep Oct Nov	Dec
PPEr 2 1 1 Jan Feb Mar Aj	pr May Jun Ju GlobHor Dif kWh/m² kW	Haug Sep Oct Ba fHor T_Amb h/m <sup>2</sup> °C	Nov Dec Owr alances ar Globl nc kWh/m <sup>2</sup>	د . 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.	Jan Feb	Mar Apr E_User MWh	E_Solar MWh	Jul Aug Se E_Grid MWh	ep Oct Nov EFrGrid MWh	Dec
January	GlobHor Dif kWh/m² kW 133.0 82	fHor T_Amb h/m <sup>2</sup> 22.0 28.10	Nov Dec Owr alances ar GlobInc kWh/m <sup>2</sup> 136.3	ی م روب (9KW) nd main r GlobEff <u>kWh/m</u> 2 131.2	Jan Feb	Mar Apr E_User MWh 0.446	E_Solar MWh	Jul Aug Se E_Grid MWh 0.954	EFrGrid MWh 0.403	Dec
January February	GlobHor Dif kWh/m² kW 133.0 82 134.6 67	FHor T_Amb h/m <sup>2</sup> C 2.20 28.10 7.90 27.70	Owr alances ar GlobI nc kWh/m <sup>2</sup> 136.3 137.4	en (9KW) ad main r GlobEff <u>kWh/m<sup>2</sup></u> 131.2 132.8	<sup>3</sup> <sup>2</sup> <sub>Jan</sub> Feb results EArray MWh 1.016 1.031	Mar Apr E_User MWh 0.446 0.357	E_Solar MWh 0.043 0.036	Jul Aug Se E_Grid MWh 0.954 0.978	EFrGrid MWh 0.403 0.322	Dec
January February March	GlobHor Dif kWh/m² kW 133.0 82 134.6 67 149.8 85	Aug     Sep     Oct       Hor     T_Amb     °C       Aug     28.10     27.70       3.20     28.00	Owr alances ar GlobInc kWh/m <sup>2</sup> 136.3 137.4 150.3	e (9KW) d (9KW) d main r GlobEff kWh/m <sup>2</sup> 131.2 132.8 144.9	<sup>3</sup> <sup>2</sup> <sub>3</sub> <sub>2</sub> <sub>3</sub> <sub>3</sub> <sub>4</sub> <sub>5</sub> <sub>6</sub> <sub>7</sub> <sub>7</sub> <sub>6</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub>	Mar Apr E_User MWh 0.446 0.357 0.357	E_Solar MWh 0.043 0.036 0.036	E_Grid MWh 0.954 0.978 1.070	EFrGrid MWh 0.403 0.322 0.322	Dec
January February March April	GlobHor Dif kWh/m² kW 133.0 82 134.6 67 149.8 88 140.3 70	Aug     Sep     Oct       Aug     Sep     Oct       Ba     C     2.20     28.10       7.90     27.70     28.00       0.50     27.70     27.70	Owr alances ar GlobI nc kWh/m <sup>2</sup> 136.3 137.4 150.3 138.8	e (9KW) nd main r GlobEff kWh/m <sup>2</sup> 131.2 132.8 144.9 133.9	<sup>3</sup> <sup>2</sup> <sub>3</sub> <sub>3</sub> <sub>2</sub> <sub>3</sub> <sub>3</sub> <sub>4</sub> <sub>5</sub> <sub>2</sub> <sub>3</sub> <sub>4</sub> <sub>7</sub> <sub>6</sub> <sub>3</sub> <sub>6</sub> <sub>7</sub> <sub>7</sub> <sub>6</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub> <sub>9</sub>	E_User MWh 0.446 0.357 0.357 0.402	E_Solar MWh 0.043 0.036 0.036 0.039	E_Grid MWh 0.954 0.978 1.070 0.981 0.971	EFrGrid MWh 0.403 0.322 0.362 0.362	Dec
January February March April May	GlobHor Dif kWh/m² kW 133.0 82 134.6 67 149.8 88 140.3 70 140.3 76	FHor T_Amb h/m <sup>2</sup> °C 2.20 28.10 7.90 27.70 3.20 28.60 0.50 27.70 3.60 28.60	Owr alances ar Globl nc kWh/m <sup>2</sup> 136.3 137.4 150.3 138.8 136.9	a (9KW) o (9KW) o main r GlobEff kWh/m <sup>2</sup> 131.2 132.8 144.9 133.9 133.7 100 -	<sup>3</sup> <sup>2</sup> <sub>3</sub> <sub>3</sub> <sub>4</sub> <sub>5</sub> <sub>3</sub> <sub>4</sub> <sub>5</sub> <sub>1</sub> <sub>6</sub> <sub>7</sub> <sub>7</sub> <sub>7</sub> <sub>7</sub> <sub>7</sub> <sub>7</sub> <sub>7</sub> <sub>7</sub> <sub>7</sub> <sub>7</sub>	E_User MWh 0.446 0.357 0.357 0.402 0.402	E_Solar MWh 0.043 0.036 0.036 0.039 0.040	E_Grid MWh 0.954 0.978 1.070 0.981 0.968 0.01	EFrGrid MWh 0.403 0.322 0.322 0.362 0.362	Dec
January February March April May June	GlobHor Dif kWh/m² kW 133.0 82 134.6 67 149.8 88 140.3 70 140.3 76 132.0 77	Aug     Sep     Oct       Aug     Sep     Oct       fHor     T_Amb     °C       h/m²     °C       2.20     28.10       7.90     27.70       3.20     28.00       0.50     27.70       3.60     28.60       7.80     27.80	Owr alances ar GlobInc kWh/m <sup>2</sup> 136.3 137.4 150.3 138.8 136.9 128.3	a (9KW) o (9KW) od main r GlobEff <u>kWh/m<sup>2</sup></u> 131.2 132.8 144.9 133.9 131.7 123.5 125.5	<sup>3</sup> <sup>2</sup> <sup>1</sup> <sub>0</sub> <sub>Jan</sub> <sub>Feb</sub> EArray <u>MWh</u> 1.016 1.031 1.125 1.039 1.027 0.967 0.967	E_User MWh 0.446 0.357 0.402 0.402 0.402 0.357	E_Solar MWh 0.043 0.036 0.036 0.036 0.039 0.040 0.033 0.033	E_Grid MWh 0.954 0.978 1.070 0.981 0.968 0.916 0.921	EFrGrid MWh 0.403 0.322 0.322 0.362 0.362 0.324 0.324	Dec
Jan Feb Mar Aj	GlobHor Dif kWh/m² kW 133.0 82 134.6 67 149.8 88 140.3 70 140.3 78 132.0 77 134.4 87	Aug     Sep     Oct       Aug     Sep     Oct       FHor     T_Amb     °C       2.20     28.10       7.90     27.70       3.20     28.00       0.50     27.70       3.60     28.60       7.80     27.80	Owr alances ar GlobInc kWh/m <sup>2</sup> 136.3 137.4 150.3 138.8 136.9 128.3 131.1	a (9KW) o (9KW) od main r GlobEff kWh/m <sup>2</sup> 131.2 132.8 144.9 133.9 131.7 123.5 125.8 1000	<sup>3</sup> <sup>2</sup> <sup>1</sup> <sub>0</sub> <sub>Jan</sub> Feb EArray MWh 1.016 1.031 1.125 1.039 1.027 0.967 0.994 0.994	Mar Apr E_User MWh 0.446 0.357 0.402 0.402 0.402 0.402 0.357 0.402	E_Solar MWh 0.043 0.036 0.036 0.036 0.039 0.040 0.033 0.044 0.035	E_Grid MWh 0.954 0.978 1.070 0.981 0.968 0.916 0.931 0.931	EFrGrid MWh 0.403 0.322 0.322 0.362 0.362 0.324 0.324 0.402	Dec
Jan Feb Mar Aj	GlobHor Dif kWh/m² kW 133.0 82 134.6 67 149.8 88 140.3 70 140.3 78 132.0 77 134.4 87 132.2 87	Aug     Sep     Oct       fHor     T_Amb     °C       2.20     28.10       7.90     27.70       3.20     28.00       0.50     27.70       3.60     28.60       7.80     27.80       7.20     27.80       7.20     27.80	Owr alances ar GlobInc kWh/m <sup>2</sup> 136.3 137.4 150.3 138.8 136.9 128.3 131.1 130.1	a (9KW) o (9KW) od main r GlobEff kWh/m <sup>2</sup> 131.2 132.8 144.9 133.9 131.7 123.5 125.8 125.8 125.2 125.2	<sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>5</sup> <sup>6</sup> <sup>6</sup> <sup>6</sup> <sup>6</sup> <sup>6</sup> <sup>6</sup> <sup>7</sup> <sup>7</sup> <sup>6</sup> <sup>6</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup>	Mar Apr E_User MWh 0.446 0.357 0.402 0.402 0.402 0.402 0.402 0.457 0.446 0.357	E_Solar MWh 0.043 0.036 0.036 0.039 0.040 0.033 0.044 0.031	E_Grid MWh 0.954 0.978 1.070 0.981 0.968 0.916 0.931 0.930 0.930	EFrGrid MWh 0.403 0.322 0.322 0.362 0.362 0.362 0.324 0.402 0.326 0.326	Dec
January February March April May June July August September	GlobHor Dif kWh/m² kW 133.0 82 134.6 67 149.8 88 140.3 70 140.3 76 132.0 77 134.4 87 132.2 87 129.2 79	Aug     Sep     Oct       Aug     Sep     Oct       fHor     T_Amb     °C       2.20     28.10       7.90     27.70       3.20     28.00       0.50     27.70       3.60     28.60       7.80     27.80       7.20     27.80       7.20     27.80       7.20     27.10	Nov Dec Owr alances ar GlobInc kWh/m <sup>2</sup> 136.3 137.4 150.3 138.8 136.9 128.3 131.1 130.1 128.8	Lange Content of the second se	<sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>5</sup> <sup>6</sup> <sup>6</sup> <sup>5</sup> <sup>6</sup> <sup>6</sup> <sup>6</sup> <sup>7</sup> <sup>6</sup> <sup>6</sup> <sup>6</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>6</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup>	Mar Apr E_User MWh 0.446 0.357 0.402 0.357 0.402 0.357 0.446 0.357 0.446 0.357 0.446	E_Solar MWh 0.043 0.036 0.036 0.039 0.040 0.033 0.044 0.031 0.035 0.035	E_Grid MWh 0.954 0.978 1.070 0.981 0.968 0.916 0.931 0.930 0.930 0.935 0.935	EFrGrid MWh 0.403 0.322 0.362 0.362 0.362 0.362 0.362 0.324 0.402 0.326 0.322	Dec
January February March April May June July August September October	GlobHor Dif kWh/m² kW 133.0 82 134.6 67 149.8 88 140.3 70 140.3 76 132.0 77 134.4 87 132.2 87 132.2 87 132.2 87 132.2 87 138.8 82 115 1	Aug     Sep     Oct       Aug     Sep     Oct       fHor     T_Amb     °C       2.20     28.10       7.90     27.70       3.20     28.00       0.50     27.70       3.60     28.60       7.20     27.80       7.20     27.80       7.20     27.80       2.20     27.40	Nov Dec Owr alances ar GlobI nc kWh/m <sup>2</sup> 136.3 137.4 150.3 138.8 136.9 128.3 131.1 130.1 128.8 140.4	Lange Content of the second se	<sup>3</sup> <sup>2</sup> <sub>3</sub> <sub>3</sub> <sub>2</sub> <sub>3</sub> <sub>3</sub> <sub>2</sub> <sub>3</sub> <sub>3</sub> <sub>2</sub> <sub>3</sub> <sub>4</sub> <sub>7</sub> <sub>6</sub> <sub>1</sub> <sub>1</sub> <sub>1</sub> <sub>1</sub> <sub>1</sub> <sub>1</sub> <sub>1</sub> <sub>1</sub> <sub>1</sub> <sub>1</sub>	E_User MWh 0.446 0.357 0.402 0.402 0.402 0.402 0.357 0.402 0.357 0.446 0.357 0.357 0.446	E_Solar MWh 0.043 0.036 0.036 0.036 0.039 0.040 0.033 0.044 0.031 0.035 0.044	L_Grid MWh 0.954 0.978 1.070 0.981 0.968 0.916 0.931 0.930 0.915 0.992 0.992	EFrGrid MWh 0.403 0.322 0.362 0.362 0.362 0.362 0.362 0.324 0.402 0.326 0.322 0.326 0.322 0.326	Dec
January February March April May June July August September October November	GlobHor Dif kWh/m² kW 133.0 82 134.6 67 149.8 88 140.3 70 140.3 76 132.0 77 134.4 87 132.2 87 132.2 87 132.2 87 132.2 87 138.8 82 117.6 79	Aug     Sep     Oct       fHor     T_Amb       h/m²     °C       2.20     28.10       7.90     27.70       3.20     28.00       0.50     27.70       3.60     28.60       7.80     27.80       7.20     27.80       7.20     27.80       7.20     27.40       2.00     27.40	Nov Dec Owr alances ar Globl nc kWh/m <sup>2</sup> 136.3 137.4 150.3 138.8 136.9 128.3 131.1 130.1 128.8 140.4 119.8 140.4	Lange Content of the second se	<sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>2</sup> <sup>2</sup> <sup>3</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>4</sup> <sup>5</sup> <sup>5</sup> <sup>6</sup> <sup>5</sup> <sup>6</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup>	E_User MWh 0.446 0.357 0.402 0.402 0.402 0.402 0.402 0.357 0.446 0.357 0.446 0.357 0.446 0.357 0.446	E_Solar MWh 0.043 0.036 0.036 0.039 0.040 0.033 0.044 0.031 0.035 0.044 0.031	E_Grid MWh 0.954 0.978 1.070 0.981 0.968 0.916 0.931 0.930 0.915 0.992 0.858 0.916	EFrGrid MWh 0.403 0.322 0.362 0.362 0.362 0.324 0.402 0.326 0.326 0.326 0.326 0.326	Dec
Jan Feb Mar Aj	GlobHor     Dif       kWh/m²     kW       133.0     82       134.6     67       149.8     88       140.3     70       132.0     77       134.4     87       132.2     87       129.2     79       138.8     82       117.6     79       115.0     73	Aug     Sep     Oct       Aug     Sep     Oct       fHor     T_Amb       h/m²     °C       2.20     28.10       7.90     27.70       3.20     28.60       7.80     27.80       7.20     27.80       7.20     27.80       9.00     27.10       2.60     27.40       9.20     26.70       3.20     26.29	Nov Dec Owr alances ar GlobInc kWh/m <sup>2</sup> 136.3 137.4 150.3 138.8 136.9 128.3 131.1 130.1 128.8 130.1 128.8 140.4 119.8 118.1	a (9KW) o (9KW) od main r GlobEff kWh/m <sup>2</sup> 131.2 132.8 144.9 133.9 131.7 123.5 125.8 125.2 125.8 125.2 124.0 135.5 115.4 113.6	<sup>3</sup> <sup>2</sup> <sup>1</sup> <sub>0</sub> <sub>Jan</sub> Feb EArray MWh 1.016 1.031 1.125 1.039 1.027 0.967 0.994 0.980 0.968 1.056 0.907 0.896	Mar Apr E_User MWh 0.446 0.357 0.402 0.402 0.357 0.402 0.357 0.446 0.357 0.357 0.446 0.357 0.357	E_Solar MWh 0.043 0.036 0.036 0.036 0.037 0.044 0.031 0.035	Jul Aug Se Jul Aug Se E_Grid MWh 0.954 0.978 1.070 0.981 0.968 0.916 0.931 0.930 0.915 0.992 0.858 0.842	EFrGrid MWh 0.403 0.322 0.362 0.362 0.324 0.324 0.402 0.326 0.322 0.326 0.322 0.326 0.326 0.326 0.326 0.326	Dec

Legends: GlobHor DiffHor

T\_Amb

GlobInc

Horizontal global irradiation Horizontal diffuse irradiation T amb. Global incident in coll. plane Effective Global, corr. for IAM and shadings Effective energy at the output of the array Energy supplied to the user Energy from the sun Energy injected into grid Energy from the grid

GlobEff

EArray

E\_User

E\_Solar

E\_Grid

EFrGrid


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		Grid-Co	nnec	ted Sv	stem: Loss diagram					
Project -		Taman Midal								
Simulation var	iant ·	Own (9KW)		")						
Main avatam na	ramatara		Svot		Shada an ground					
Noar Shadings	rameters	ſ	Syste	en type	Sheas on ground					
PV Field Orientat	tion	ľ		tilt	5° azimu	th 0°				
PV modules			Nh of	Model	JAM6-72-320/SI Pnom 320 Wp					
Inverter				Model	SUN2000L-8KTL Pno	m 8.00 kV	√ ac			
User's needs		Daily house	nold cor	sumers	Constant over the year Glob	al 4687 kV	Vh/year			
			Loss d	liagram ov	ver the whole year					
		1597 kWh/m <sup>2</sup>		1	Horizontal global irradiation					
				→ -0.07%	Global incident in coll. plane					
			L.	0.00%	Near Shadings: irradiance loss					
				→-3.67%	IAM factor on global					
	1538	kWh/m <sup>2</sup> * 54 m <sup>2</sup> coll.			Effective irradiation on collectors					
г	efficier	ncy at STC = 16.539	%		PV conversion					
		13.79 MWh		∍-0.75%	Array nominal energy (at STC effic.) PV loss due to irradiance level	1				
				→-11.15%	PV loss due to temperature					
			(+C	7 ).75%	Module quality loss					
			<b>→</b> -1	.10%	Mismatch loss, modules and strings					
	1	2.01 MWh	9-0.	95%	Ohmic wiring loss Array virtual energy at MPP					
			k.		.,					
			-1.0 	80% 0%	Inverter Loss during operation (efficienc Inverter Loss over nominal inv. power	y)				
			>0.00	)%	Inverter Loss due to max. input current					
			→ 0.00	)% )%	Inverter Loss over nominal inv. voltage					
grid			>0.00	)%	Inverter Loss due to voltage threshold					
consumption	1	1.78 MWh	→-0.0	14%	Night consumption Available Energy at Inverter Output					
	1									
4.24 MWh 0.45	/Wh 1	11.34 MWh			Energy injected into grid					
to user to us	ser	to grid								
from grid from s	solar									

rr						
PVSYST V6.86					21/04/20	Page 1/8
	Gric	d-Connected System	n: Simulati	on parameters	S	
Project :	Та	man Midah (NEM)				
Geographical Site	9	Kuala Lumpur/Subang		Countr	ry <b>Malays</b>	ia
Situation		Latitude	3.12° N	Longitud	le 101.55°	'Е
Time defined as	6	Legal Time	Time zone UT	F+8 Altitud	le 17 m	
Meteo data:		Kuala Lumpur/Subang	MeteoNorm 7	7.2 station - Syntheti	с	
Simulation varia	nt: SE	LCO - working couple (	6kw)			
		Simulation date	21/04/20 17h	48		
Simulation param	neters	System type	Sheds on gro	ound		
Collector Plane C	rientation	Tilt	5°	Azimut	th 0°	
Models used		Transposition	Perez	Diffus	se Perez, l	Meteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
Storage		Kind Charging strategy Discharging strategy	Self-consumpt When excess As soon as po	tion, No grid reinjecti solar power is availa wer is needed	on Ible	
User's needs :		Daily household consumers average	Constant ove 11.2 kWh/Da	r the year y		
PV Array Character PV module Original PVsyst of Number of PV mode Total number of PV Array global power Array operating char Total area	eristics database ules modules tracteristics (	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) (50°C) U mpp Module area	JAM6-72-320 JA Solar 10 modules 20 6.40 kWp 336 V 38.8 m <sup>2</sup>	In paralle Unit Nom. Powe At operating conc I mp Cell are	el 2 string er 320 Wp d. 5.75 kW p 17 A a 34.4 m <sup>2</sup>	s /p (50°C)
Inverter Original PVsyst Characteristics	database	Model Manufacturer Operating Voltage Nb. of inverters	SUN2000L-51 Huawei Techi 90-500 V 2 * MPPT 50	KTL nologies Unit Nom. Powe Max. power (=>40°0 % Total Powe	er 5.00 kV C) 5.50 kV	Vac Vac ac
		No. of inverters	2 1011130	Pnom rati	io 1.28	40
Battery		Model	PVX-2120L			
Battery Pack Char	acteristics	Manufacturer Nb. of units Voltage Discharging min. SOC Temperature	2 in series x 4 24 V 50.0 % Fixed (20°C)	4 in parallel Nominal Capacit Stored energ	ty 784 Ah iy 9.4 kWl	(C10) h
Battery input cha	rger	Model Max. charging power	Generic 5.4 kWdc	Max./ Euro efficienc	y 97.0/95	.0 %
Battery to Grid in	verter	Model Max. discharging power	Generic 1.9 kWac	Max./ Euro efficienc	y 97.0/95	.0 %
PV Array loss fact	ors					
Thermal Loss facto	r	Uc (const)	20.0 W/m²K	Uv (wind	d) 0.0 W/r	n²K / m/s
Wiring Ohmic Loss		Global array res.	332 mOhm	Loss Fractio	on 1.5% a	t STC
L						

PVSYST V6.86					21/04/20	Page 2/8
	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	L L L ization IAM = 1 - bo (1/cos i - 1)				t MPP



PVSYST V6.86				21/0	04/20 Page 4/8				
(	Grid-Connected S	System	n: Detailed Us	er's needs					
Project ·	Taman Midah (NFN	л)							
Simulation variant :	SELCO - working c	, ouple (6	3kw)						
Main system narameters	Svete		Sheds on around						
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs Daily household consum	Linear s Nb. of r Daily household cor ers, Constant over the	Linear shadings tilt 5° azimuth 0° Model JAM6-72-320/SI Pnom 320 Wp Nb. of modules 20 Pnom total <b>6.40 kWp</b> Model SUN2000L-5KTL Pnom 5.00 kW ac ily household consumers Constant over the year Global 4080 kWh/ye onstant over the year, average = 11.2 kWh/day							
		Annua	l values						
	Use 5 days a week	Number	Power	Use	Energy				
Lamps (LED or fluo)		20	18 W/lamp	7 h/day	2340 Wh/day				
TV / PC / Mobile		1	70 W/app	6 h/day	420 Wh/day				
Iron		1	1200 W/app	1 h/day	600 Wh/day				
Fridge / Deep-freeze		1		24 Wh/day	3000 Wh/day				
Dish- & Cloth-washers		1		1 Wh/day	500 Wh/day				
Instant water heater			2000 W tot	1 h/day	2000 Wh/day				
Aircond Stand by consumers		2	750 W tot	5 n/day	6750 Wh/day				
Total daily energy				24 11/uay	24 WII/Udy 15634 W/b/day				
Item Item Item Item Item Item Item Item   Stand-by consumers 24 h/day 24 Wh/day 15634 Wh/day   Total daily energy 15634 Wh/day									

PVSYST V6.86				21/04/20	Page 5/8
		Grid-Connected S	ystem: Main results		
Project :		Taman Midah (NEM)			
Simulation varia	nt :	SELCO - working couple (	ôkw)		
Main system para	meters	System type	Sheds on ground		
Near Shadings		Linear shadings			
PV Field Orientation	n	tilt	5° azimu	th 0°	
PV modules		Model	JAM6-72-320/SI Pnc	m 320 Wj	D
PV Array		Nb. of modules	20 Pnom to	tal 6.40 k	Wp
Inverter		Model	SUN2000L-5KTL Pnc	m 5.00 k\	N ac
User's needs		Daily household consumers	Constant over the year Glob	al 4080 k	Wh/year
Main simulation re	esults				
System Production	1	Produced Energy	8.41 MWh/year Specific pro	d. 1314 k	Wh/kWp/year
		Performance Ratio PR	29.80 % Solar Fraction S	SF 74.62 9	%
Battery ageing (Sta	te of We	ear) Cycles SOW	79.3% Static SO	W 80.0%	
		Battery lifetime	4.8 years		







## SELCO - working couple (6kw) Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	0.726	0.360	0.270	0.397	0.090
February	134.6	67.90	27.70	137.4	132.8	0.737	0.313	0.242	0.444	0.071
March	149.8	88.20	28.00	150.3	144.9	0.804	0.344	0.266	0.473	0.078
April	140.3	70.50	27.70	138.8	133.9	0.742	0.328	0.258	0.438	0.070
Мау	140.3	78.60	28.60	136.9	131.7	0.734	0.360	0.269	0.405	0.091
June	132.0	77.80	27.80	128.3	123.5	0.691	0.328	0.237	0.394	0.091
July	134.4	87.20	27.80	131.1	125.8	0.710	0.344	0.262	0.399	0.082
August	132.2	87.20	27.80	130.1	125.2	0.700	0.360	0.261	0.383	0.099
September	129.2	79.00	27.10	128.8	124.0	0.691	0.313	0.235	0.396	0.078
October	138.8	82.60	27.40	140.4	135.5	0.754	0.360	0.264	0.440	0.096
November	117.6	79.20	26.70	119.8	115.4	0.648	0.344	0.241	0.353	0.103
December	115.0	73.20	26.29	118.1	113.6	0.640	0.328	0.241	0.346	0.088
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	4.080	3.045	4.867	1.036
	•	•							•	I
Legends: Glob	Hor	Horizontal glo	obal irradiatio	on		GlobEff	Effectiv	e Global, co	orr. for IAM	and shadings
Diff	lor l	Horizontal dif	fuse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb <sup>-</sup>	Г amb.				E_User	Energy	supplied to	the user	
Glob	olnc (	Global incider	nt in coll. pla	ne		E_Solar	Energy	Energy from the sun		
		EUnused Unused energy (battery full, no grid					grid injection			
						EFrGrid	Energy	from the gr	id	





PVSYST V6.86						21/04/20	Page 8/8
		Grid-Conne	cted Syster	m: P50 - P90 e	evaluation		
Proiect :		Taman Midal	n (NEM)				
Simulation vari	ant :	SELCO - wor	king couple (	ôkw)			
Main system par	rameters		System type	Sheds on ground			
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	on	l Daily houser	inear shadings tilt Model Nb. of modules Model nold consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the y	azimut Pnor Pnom tot Pnor vear Glob	h 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kV al 4080 kV	<b>Vp</b> √ ac Wh/year
Evaluation of the	e Produc	tion probability	forecast				
The probability dis	stribution	of the system or	nonecasi	t for different vears is	mainly denen	dent	
on the meteo data	a used for	the simulation, a	and depends on t	the following choices		dent	
Meteo data source Meteo data Specified Deviatio Year-to-year varia	e n bility	Year devi	Kind ation from aver. Variance	MeteoNorm 7.2 sta Not defined 3 % 0.5 %	tion Yea	ar 1995	
The probability dis Specified Deviatio	stribution n P Soi	variance is also o V module modell Inverter efficie ling and mismato Degrada	depending on so ling/parameters ency uncertainty h uncertainties tion uncertainty	me system paramete 1.0 % 0.5 % 1.0 % 1.0 %	ers uncertaintie	S	
Global variability (	(meteo + :	system)	Variance	1.9 %	(quadratic sun	ו)	
Annual production	n probabil	ity	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh			
			Probability	distribution			
	Viliabability brobability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 50 = 000 kWh 0.00 	X axis: no data fo	or the extremities definition	1	1.0	

ГГ			[]
PVSYST V6.86			21/04/20 Page 1/8
	Grid-Connected System	n: Simulation parameters	6
Project :	Taman Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Counti	y <b>Malaysia</b>
Situation	Latitude	3.12° N Longitud	le 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitud	le 17 m
Meteo data:	Albedo Kuala Lumpur/Subang	0.20 MeteoNorm 7.2 station - Syntheti	с
Simulation variant :	SELCO - working couple (	6kw)	
	Simulation date	21/04/20 17h51	
Simulation parameters	System type	Sheds on ground	
Collector Plane Orienta	tion Tilt	5° Azimut	h 0°
Models used	Transposition	Perez Diffus	e Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind	Self-consumption, No grid reinjecti	on
	Charging strategy Discharging strategy	When excess solar power is availa As soon as power is needed	ble
User's needs :	Daily household consumers average	Constant over the year 6.9 kWh/Day	
PV Array Characteristic PV module Original PVsyst databa Number of PV modules Total number of PV modu Array global power Array operating character Total area	s Si-mono Model se Manufacturer In series les Nb. modules Nominal (STC) istics (50°C) U mpp Module area	JAM6-72-320/SI JA Solar 10 modules In paralle 20 Unit Nom. Powe 6.40 kWp At operating cond 336 V I mp 38.8 m <sup>2</sup> Cell are	el 2 strings er 320 Wp 1. 5.75 kWp (50°C) p 17 A a 34.4 m²
Inverter Original PVsyst databa Characteristics	Model ase Manufacturer Operating Voltage	SUN2000L-5KTL Huawei Technologies 90-500 V Unit Nom. Powe Max. power (=>40°C	er 5.00 kWac C) 5.50 kWac
Inverter pack	Nb. of inverters	2 * MPPT 50 % Total Powe Pnom rati	er 5.0 kWac io 1.28
Battery	Model	PVX-2120L	
Battery Pack Characteris	tics Manufacturer Nb. of units Voltage Discharging min. SOC Temperature	Concorde 2 in series x 4 in parallel 24 V Nominal Capacit 50.0 % Stored energy Fixed (20°C)	ty 784 Ah (C10) Iy 9.4 kWh
Battery input charger	Model	Generic	
Battery to Grid inverter	Max. charging power Model	5.4 kWdc Max./ Euro efficienc Generic	y 97.0/95.0 %
	Max. discharging power	1.9 kWac Max./ Euro efficienc	y 97.0/95.0 %
Thermal Loss factor	Lie (const)	20.0 W/m²k Llv (win	$d = 0.0 W/m^{2}k' / m/c$
	Global array res	332 mOhm Loss Fractic	1, 0.0 w/m-r / m/s
	2.2241 41149 1001		

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	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	L L L ization IAM = 1 - bo (1/cos i - 1)				t MPP



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	rid Connected	Svetor	. Dotailed Llev	or'e poode		
9		System	I. Detalled 056		)	
Project :	Taman Midah (NEN	/1)				
Simulation variant :	SELCO - working c	ouple (6	škw)			
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings				
PV Field Orientation		tilt Model	5° IAM6-72-320/SI	azimut	h 0° m 320.W/m	
PV Array	Nb. of r	nodules	20	Pnom tota	al <b>6.40 kV</b>	Vp
Inverter		Model	SUN2000L-5KTL	Pnor	m 5.00 kV	V ac
User's needs	Daily household con	sumers	Constant over the y	ear Globa	al 2510 k\	Wh/year
Daily household consume	ers, Constant over the	e year, av	verage = 6.9 kWh/d	ay		
		Annua	l values			
	Use 2 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		20	18 W/lamp	5 h	/day 1	1800 Wh/day
TV / PC / Mobile		1	70 W/app	14 h	/day	980 Wh/day
Iron		1	1200 W/app	1 h	/day	600 Wh/day
Fridge / Deep-freeze		1		24 Wh	/day 3	3000 Wh/day
DISN- & CIOTN-Washers		1	2000 W/ tot	1 VVN 1 b	/day	
Aircond		2	2000 W tot	10 h	/day 15	5000 Wh/day
Stand-by consumers			700 W lot	24 h	/day	24 Wh/day
Total daily energy		ļ	•		23	3904 Wh/day
Total daily energy		Hourly	<b>profile</b> 12 15 18 2	21 24	23	3904 Wh/day

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		Grid-Connected S	ystem: Main res	sults		
Project :		Taman Midah (NEM)				
Simulation varia	ant :	SELCO - working couple (	ôkw)			
Main system para	ameters	System type	Sheds on ground			
Near Shadings		Linear shadings				
PV Field Orientatio	on	tilt	5°	azimuth	n 0°	
PV modules		Model	JAM6-72-320/SI	Pnom	n 320 Wp	
PV Array		Nb. of modules	20	Pnom tota	6.40 kV	Vp
Inverter		Model	SUN2000L-5KTL	Pnom	n 5.00 kV	/ ac
User's needs		Daily household consumers	Constant over the year	ar Globa	l 2510 k\	Vh/year
Main simulation	results					
System Production	n	Produced Energy	8.41 MWh/year	Specific prod	. 1314 k\	Nh/kWp/year
		Performance Ratio PR	19.48 % Sola	ar Fraction SF	79.29 %	, D
Battery ageing (Sta	ate of We	ar) Cycles SOW	89.7%	Static SOV	/ 80.0%	
		Battery lifetime	5.0 years			







## SELCO - working couple (6kw) Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	0.726	0.239	0.188	0.481	0.051
February	134.6	67.90	27.70	137.4	132.8	0.737	0.191	0.165	0.529	0.027
March	149.8	88.20	28.00	150.3	144.9	0.804	0.191	0.158	0.600	0.034
April	140.3	70.50	27.70	138.8	133.9	0.742	0.215	0.176	0.530	0.039
Мау	140.3	78.60	28.60	136.9	131.7	0.734	0.215	0.162	0.513	0.053
June	132.0	77.80	27.80	128.3	123.5	0.691	0.191	0.155	0.490	0.037
July	134.4	87.20	27.80	131.1	125.8	0.710	0.239	0.188	0.485	0.051
August	132.2	87.20	27.80	130.1	125.2	0.700	0.191	0.147	0.499	0.045
September	129.2	79.00	27.10	128.8	124.0	0.691	0.191	0.147	0.500	0.045
October	138.8	82.60	27.40	140.4	135.5	0.754	0.239	0.193	0.513	0.046
November	117.6	79.20	26.70	119.8	115.4	0.648	0.191	0.141	0.462	0.050
December	115.0	73.20	26.29	118.1	113.6	0.640	0.215	0.172	0.431	0.043
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	2.510	1.990	6.033	0.520
Lawarda Clah						Clab Eff	<b>Fff h</b>			
Legends: Glob	Hor I	Horizontal gio	bal irradiatio	on		GIODETT	Effectiv	e Global, co	orr. for IAM a	and snadings
DITT	HOr I	Horizontal dif	ruse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb	Famb.				E_User	Energy	supplied to	the user	
Glob	olnc (	Global incider	nt in coll. pla	ne		E_Solar	Energy	Energy from the sun		
						EUnused	Unused	l energy (ba	ttery full, no	grid injection
						EFrGrid	Energy	from the gr	id	





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		Grid-Conne	cted Syste	m: P50 - P90	evaluation		
Proiect :		Taman Midał	n (NEM)				
Simulation var	iant :	SELCO - wor	king couple (	ôkw)			
Main system pa	rameters		System type	Sheds on ground	ł		
Near Shadings PV Field Orientat PV modules PV Array Inverter User's needs	ion	L Daily househ	inear shadings tilt Model Nb. of modules Model old consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the	azimu Pno Pnom tot Pno year Glob	h 0° m 320 Wp al <b>6.40 kV</b> m 5.00 kV al 2510 kV	<b>Vp</b> V ac Vh/year
Evaluation of th	e Produc	tion probability	forecast				
The probability di	istribution	of the system pro-	oduction forecasi	t for different years	is mainly depen	dent	
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	ce on ability	Year devia	Kind ation from aver. Variance	MeteoNorm 7.2 st Not defined 3 % 0.5 %	ation Ye	ar 1995	
The probability di Specified Deviatio	istribution on P Soi (meteo +	variance is also o V module modell Inverter efficie ling and mismatc Degrada system)	depending on so ing/parameters ncy uncertainty h uncertainties tion uncertainty Variance	me system parame 1.0 % 0.5 % 1.0 % 1.0 % 1.9 %	ters uncertaintie	es 1)	
Annual productio	n probabil	ity	Variability	0.00 MWh	(quadratic sur	')	
			P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh			
			Probability	distribution			
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 0.00 0.05 0.00	X axis: no data fo Verse avet 0.2 0.4 E_Grid sy	or the extremities definition	on !	<b>1</b> .0	

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G	Grid-Connected System	n: Simulation parameters	6
Project :	Taman Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Countr	y <b>Malaysia</b>
Situation	Latitude	3.12° N Longitud	le 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitud	le 17 m
Meteo data:	Kuala Lumpur/Subang	MeteoNorm 7.2 station - Syntheti	с
Simulation variant :	SELCO - Small family - 6kv	V	
	Simulation date	21/04/20 17h25	
Simulation parameters	System type	Sheds on ground	
Collector Plane Orientation	on Tilt	5° Azimut	h 0°
Models used	Transposition	Perez Diffus	e Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind Charging strategy	Self-consumption, No grid reinjecti When excess solar power is availa	on Ible
	Discharging strategy	As soon as power is needed	
User's needs :	Daily household consumers average	Constant over the year 19.4 kWh/Day	
PV Array Characteristics PV module Original PVsyst database Number of PV modules Total number of PV modules Array global power Array operating characteristic Total area	Si-mono Model Manufacturer In series S Nb. modules Nominal (STC) ics (50°C) U mpp Module area	JAM6-72-320/SI JA Solar 10 modules In paralle 20 Unit Nom. Powe 6.40 kWp At operating cond 336 V I mp 38.8 m <sup>2</sup> Cell are	el 2 strings er 320 Wp d. 5.75 kWp (50°C) p 17 A a 34 4 m <sup>2</sup>
Inverter Original PVsyst database Characteristics	Model Model Manufacturer Operating Voltage	SUN2000L-5KTL Huawei Technologies 90-500 V Unit Nom. Powe Max. power (=>40°C	er 5.00 kWac C) 5.50 kWac
Inverter pack	Nb. of inverters	2 MPPT 50 % Total Powe Pnom rati	er 5.0 kvvac jo 1.28
Battery	Model	PVX-2120L	
Battery Pack Characteristic	Manufacturer s Nb. of units Voltage Discharging min. SOC Temperature	Concorde 2 in series x 4 in parallel 24 V Nominal Capacit 50.0 % Stored energy Fixed (20°C)	ty 784 Ah (C10) Iy 9.4 kWh
Battery input charger	Model	Generic	
Battery to Grid inverter	Max. charging power Model	5.4 kWdc Max./ Euro efficienc Generic	y 97.0/95.0 %
-	Max. discharging power	3.1 kWac Max./ Euro efficienc	y 97.0/95.0 %
PV Array loss factors		20.0 \/\/m2k	d) 00///m2k / m/a
Wiring Ohmic Loss	UC (CONST) Global array res	332 mOhm Loss Fractio	1, 0.0  w/m-rc / m/s

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	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6		
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	tion -0.8 % tion 1.0 % at MPP tion 0.10 % am. 0.05		



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(	Grid-Connected S	System	n: Detailed Us	er's needs	1					
Brojoct -	Taman Midah (NEN	<i>.</i>								
		vi) 								
Simulation variant :	SELCO - Small fam	ily - 6kw	1							
Main system parameters	Syste	em type	Sheds on ground							
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear s Nb. of r Daily household cor	hadings tilt Model modules Model nsumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the y	azimuth ( Pnom 2 Pnom total ( Pnom 8 year Global 7	h 0° m 320 Wp al <b>6.40 kWp</b> m 5.00 kW ac al 7066 kWh/year					
Daily household consumers, Constant over the year, average = 19.4 kWh/day										
	Use 5 days a week	Number	Power	Use	Enerav					
Lamps (LED or fluo)		26	18 W/lamp	5 h/day	2340 Wh/da	av				
TV / PC / Mobile		20	70 W/app	9 h/day	1260 Wh/da	av				
Iron		1	1200 W/app	1 h/day	1200 Wh/da	ay				
Fridge / Deep-freeze		1		24 Wh/day	3000 Wh/da	ay				
Dish- & Cloth-washers		1		1 Wh/day	500 Wh/da	ay				
Instant water heater		1	2000 W tot	2 h/day	3000 Wh/da	ay				
Aircond		3	750 W tot	7 h/day	15750 Wh/da	ay				
Stand-by consumers				24 h/day	24 Wh/da	ау				
Total daily energy	Harding of the second s	Hourly 6 9	<b>v profile</b>	21 24	27074 Wh/da	зу				

PVSYST V6.86				2	21/04/20	Page 5/8
Project : Simulation vari	iant :	Grid-Connected S Taman Midah (NEM) SELCO - Small family - 6kw	ystem: Main results	5		
Main system parameter		System type	Sheds on ground			
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Linear shadings tilt Model Nb. of modules Model Daily household consumers	5° JAM6-72-320/SI 20 Pn SUN2000L-5KTL Constant over the year	azimuth Pnom om total Pnom Global	0° 320 Wp <b>6.40 kV</b> 5.00 kW 7066 kV	<b>/p</b> / ac Vh/year
Main simulation System Productio Battery ageing (S	results on tate of We	Produced Energy Performance Ratio PR ear) Cycles SOW Battery lifetime	<b>8.41 MWh/year</b> Speci 32.00 % Solar Fra 78.4% Stat 4.6 years	ific prod. ction SF tic SOW	1314 k\ 46.26 % 80.0%	Wh/kWp/year







## SELCO - Small family - 6kw Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	0.726	0.623	0.292	0.373	0.330
February	134.6	67.90	27.70	137.4	132.8	0.737	0.541	0.262	0.420	0.280
March	149.8	88.20	28.00	150.3	144.9	0.804	0.596	0.284	0.449	0.312
April	140.3	70.50	27.70	138.8	133.9	0.742	0.569	0.278	0.415	0.291
Мау	140.3	78.60	28.60	136.9	131.7	0.734	0.623	0.289	0.382	0.333
June	132.0	77.80	27.80	128.3	123.5	0.691	0.569	0.252	0.373	0.316
July	134.4	87.20	27.80	131.1	125.8	0.710	0.596	0.284	0.375	0.311
August	132.2	87.20	27.80	130.1	125.2	0.700	0.623	0.279	0.361	0.343
September	129.2	79.00	27.10	128.8	124.0	0.691	0.541	0.250	0.371	0.291
October	138.8	82.60	27.40	140.4	135.5	0.754	0.623	0.285	0.419	0.338
November	117.6	79.20	26.70	119.8	115.4	0.648	0.596	0.253	0.339	0.342
December	115.0	73.20	26.29	118.1	113.6	0.640	0.569	0.259	0.324	0.310
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	7.066	3.269	4.601	3.798
	•	•								<b>-</b> -
Legends: Glob	Hor	Horizontal glo	obal irradiatio	on		GlobEff	Effectiv	e Global, co	rr. for IAM	and shadings
Diff	lor I	Horizontal dif	fuse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb ¯	Γamb.				E_User	Energy	supplied to	the user	
Glob	lnc (	Global incider	nt in coll. pla	ne		E_Solar	Energy from the sun			
	EUnused Unused energy (battery full, no grid				grid injection					
						EFrGrid	Energy	from the gr	id	





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		Grid-Connec	ted Syster	m: P50 - P90 e	evaluation		
Project ·		Taman Midah	(NFM)				
Simulation var	iant :	SELCO - Small	family - 6kw	1			
Main system pa	rameters		System type	Sheds on ground			
Near Shadings PV Field Orientat PV modules PV Array Inverter User's needs	ion	Lir N Daily househo	hear shadings tilt Model b. of modules Model Id consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the y	azimut Pnoi Pnom tota Pnoi ear Globa	h 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kV al 7066 kV	<b>/p</b> / ac Vh/year
Evaluation of th	e Produc	tion probability f	orecast				
The probability di	stribution	of the system prod	uction forecast	for different years is	mainly depen	dent	
Meteo data source Meteo data Specified Deviation Year-to-year varia	ce on ability	Year deviat	Kind ion from aver. Variance	MeteoNorm 7.2 sta Not defined 3 % 0.5 %	tion Yea	ar 1995	
The probability di Specified Deviatio	stribution on F Soi	variance is also de V module modellin Inverter efficiend iling and mismatch Degradatio	pending on so g/parameters cy uncertainty uncertainties on uncertainty	me system paramete 1.0 % 0.5 % 1.0 % 1.0 %	ers uncertaintie	S	
Global variability	(meteo +	system)	Variance	1.9 %	(quadratic sun	1)	
Annual production	n probabil	lity	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh			
			Probability	distribution			
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 50 = Coo kWh 0.00 	X axis: no data fo	or the extremities definition	   0.8	1.0	

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G	rid-Connected System	n: Simulation parameter	S
Project :	Taman Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Count	ry <b>Malaysia</b>
Situation	Latitude	3.12° N Longitud	de 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitud	de 17 m
Meteo data:	Kuala Lumpur/Subang	MeteoNorm 7.2 station - Synthet	ic
Simulation variant :	SELCO - Small family - 6kv	V	
	Simulation date	21/04/20 17h26	
Simulation parameters	System type	Sheds on ground	
Collector Plane Orientation	n Tilt	5° Azimu	th 0°
Models used	Transposition	Perez Diffus	se Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind Charging strategy Discharging strategy	Self-consumption, No grid reinject When excess solar power is availa As soon as power is needed	ion able
User's needs :	Daily household consumers average	Constant over the year 9.9 kWh/Day	
PV Array Characteristics PV module Original PVsyst database Number of PV modules Total number of PV modules Array global power Array operating characteristic Total area	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) cs (50°C) U mpp Module area	JAM6-72-320/SI JA Solar 10 modules In parall 20 Unit Nom. Powe 6.40 kWp At operating com 336 V I mp 38.8 m <sup>2</sup> Cell are	el 2 strings er 320 Wp d. 5.75 kWp (50°C) op 17 A ea 34.4 m <sup>2</sup>
Inverter Original PVsyst database Characteristics	Model Manufacturer Operating Voltage	SUN2000L-5KTL Huawei Technologies 90-500 V Unit Nom. Pow Max. power (=>40° 2 * MPPT 50 % Total Pow	er 5.00 kWac C) 5.50 kWac er 5.0 kWac
	IND. OF INVERTERS	Pnom rat	io 1.28
Battery	Model	PVX-2120L	
Battery Pack Characteristic	Manufacturer s Nb. of units Voltage Discharging min. SOC Temperature	Concorde 2 in series x 4 in parallel 24 V Nominal Capaci 50.0 % Stored energy Fixed (20°C)	ity 784 Ah (C10) gy 9.4 kWh
Battery input charger	Model	Generic	
Battery to Grid inverter	Max. charging power Model	5.4 kWdc Max./ Euro efficienc Generic	cy 97.0/95.0 %
	Max. discharging power	3.1 kWac Max./ Euro efficience	cy 97.0/95.0 %
BV Array loss fasters			
Thermal Loss factor	Uc (const)	20.0 W/m²K LIv (win	d) 0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	332 mOhm Loss Fraction	on 1.5 % at STC

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	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6		
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	tion -0.8 % tion 1.0 % at MPP tion 0.10 % am. 0.05		



PVSYST V6.86				21	/04/20	Page 4/8			
6	rid-Connected 9	Svetor	n: Detailed Lls	er's needs					
		Jysten	I. Detalled 03	el 3 lleeus					
Project :	Taman Midah (NEN	Л)							
Simulation variant :	SELCO - Small fami	ily - 6kw	1						
Main system parameters	Syste	em type	Sheds on ground						
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear s Nb. of r Daily household cor	hadings tilt Model modules Model nsumers	5°azimuth0°JAM6-72-320/SIPnom320 Wp20Pnom total <b>6.40 kWp</b> SUN2000L-5KTLPnom5.00 kW acConstant over the yearGlobal3625 kWh/year						
Daily household consume	rs, Constant over the	e year, av	verage = 9.9 kWh/d	lay					
Annual values									
	Use 2 days a week	Number	Power	Use		Energy			
Lamps (LED or fluo)		26	18 W/lamp	5 h/da	y 2	2340 Wh/day			
TV / PC / Mobile		2	70 W/app	14 h/da	y 1	1960 Wh/day			
Iron		1	1200 W/app	1 h/da	y 1	200 Wh/day			
Fridge / Deep-freeze		1		24 Wh/da	y 3	3000 Wh/day			
Dish- & Cloth-washers		1		1 Wh/da	y	500 Wh/day			
Instant water heater		1	2000 W tot	2 h/da	y 3	3000 Wh/day			
Aircond		3	750 W tot	10 h/da	y 22	2500 Wh/day			
Stand-by consumers				24 h/da	у	24 Wh/day			
Total daily energy					34	1524 Wh/day			
		Hourly	v profile						
	Second and the second	6 9	12 15 18	21 24					

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		Grid-Connected S	ystem: Main results		
Project :		Taman Midah (NEM)			
Simulation vari	iant :	SELCO - Small family - 6kw	I		
Main system parameter		System type	Sheds on ground		
Near Shadings		Linear shadings			
PV Field Orientati	ion	tilt	5° azimu	th 0°	
PV modules		Model	JAM6-72-320/SI Pnc	m 320 W	р
PV Array		Nb. of modules	20 Pnom to	tal <b>6.40 k</b> '	Wp
Inverter		Model	SUN2000L-5KTL Pnc	m 5.00 k <sup>v</sup>	N ac
User's needs		Daily household consumers	Constant over the year Glob	oal 3625 k	Wh/year
Main simulation	results				
System Production	on	Produced Energy	8.41 MWh/year Specific pro	d. 1314 k	Wh/kWp/year
		Performance Ratio PR	21.25 % Solar Fraction S	SF 59.88 °	%
Battery ageing (S	tate of We	ear) Cycles SOW	88.5% Static SC	W 80.0%	
		Battery lifetime	5.0 years		







## SELCO - Small family - 6kw Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	0.726	0.345	0.207	0.458	0.139
February	134.6	67.90	27.70	137.4	132.8	0.737	0.276	0.184	0.506	0.092
March	149.8	88.20	28.00	150.3	144.9	0.804	0.276	0.175	0.578	0.101
April	140.3	70.50	27.70	138.8	133.9	0.742	0.311	0.188	0.516	0.123
Мау	140.3	78.60	28.60	136.9	131.7	0.734	0.311	0.177	0.494	0.134
June	132.0	77.80	27.80	128.3	123.5	0.691	0.276	0.170	0.471	0.107
July	134.4	87.20	27.80	131.1	125.8	0.710	0.345	0.203	0.465	0.142
August	132.2	87.20	27.80	130.1	125.2	0.700	0.276	0.161	0.479	0.115
September	129.2	79.00	27.10	128.8	124.0	0.691	0.276	0.159	0.482	0.117
October	138.8	82.60	27.40	140.4	135.5	0.754	0.345	0.215	0.486	0.130
November	117.6	79.20	26.70	119.8	115.4	0.648	0.276	0.146	0.456	0.130
December	115.0	73.20	26.29	118.1	113.6	0.640	0.311	0.186	0.414	0.125
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	3.625	2.171	5.806	1.454
Legends: Glob	Hor I	Horizontal glo	bal irradiatio	on		GlobEff	Effectiv	e Global, co	orr. for IAM	and shadings
Diff	Hor I	Horizontal dif	fuse irradiati	on		EArray	Effectiv	e energy at	the output	of the array
T_A	mb <sup>-</sup>	T amb.				E_User	Energy	supplied to	the user	
Glob	Inc	Global incider	nt in coll. pla	ne		E_Solar	Energy	from the su	un	
						EUnused	Unused	l energy (ba	ttery full, no	grid injection
						EFrGrid	Energy	from the gr	id	





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Grid-Connected System: P50 - P90 evaluation									
Project ·		Taman Midah	(NFM)						
Simulation variant :		SELCO - Small family - 6kw							
Main system parameters System type Sheds on ground									
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs		Linear shadings tilt Model Nb. of modules Model Daily household consumers		5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the y	azimut Pnor Pnom tota Pnor year Globa	h 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kV al 3625 kV	<b>Vp</b> √ ac Vh/year		
Evaluation of the	e Produc	tion probability	forecast						
The probability dis	stribution	of the system pro	duction forecast	for different years is	s mainly depen	dent			
on the meteo data Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	a used for e on ability	r the simulation, ai Year devia	nd depends on t Kind ation from aver. Variance	the following choices MeteoNorm 7.2 sta Not defined 3 % 0.5 %	s: ation Yea	ar 1995			
The probability distribution variance is also depending on some system parameters uncertainties Specified Deviation PV module modelling/parameters 1.0 % Inverter efficiency uncertainty 0.5 % Soiling and mismatch uncertainties 1.0 % Degradation uncertainty 1.0 %									
Global variability	(meteo +	system)	Variance	1.9 %	(quadratic sun	1)			
Annual production probability Variability P50 P90 P95		0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh							
			Probability	distribution					
$\begin{array}{c} 0.50 \\ 0.45 \\ 0.40 \\ 0.35 \\ 0.30 \\ 0.25 \\ 0.20 \\ 0.20 \\ 0.15 \\ 0.10 \\ 0.05 \\ 0.00 \\ 0.26 \\ 0.15 \\ 0.10 \\ 0.00 \\ 0.28 \\ 0.08 \\ 0.$									

			1 1					
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Grid-Connected System: Simulation parameters								
Project : Tam	an Midah (NEM)							
Geographical Site	Kuala Lumpur/Subang	Count	ry <b>Malaysia</b>					
Situation	Latitude	3 12° N Longitur	le 101.55° E					
Time defined as	Legal Time	Time zone UT+8 Altitud	de 17 m					
Mater data		0.20 MotooNorm 7.2 station - Syntheti						
Simulation variant : SELC	CO - small family - 9kw	,						
	Simulation date	21/04/20 17h27						
Simulation parameters	System type	Sheds on ground						
<b>Collector Plane Orientation</b>	Tilt	5° Azimut	th 0°					
Models used	Transposition	Perez Diffus	se Perez, Meteonorm					
Horizon	Free Horizon							
Near Shadings	Linear shadings							
Storage	Kind	Self-consumption, No grid reinject	ion					
	Charging strategy Discharging strategy	When excess solar power is availa As soon as power is needed	able					
User's needs : Da	ily household consumers average	Constant over the year 19.4 kWh/Day						
PV Array Characteristics PV module Original PVsyst database Number of PV modules Total number of PV modules Array global power Array operating characteristics (50 Total area	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) 0°C) U mpp Module area	JAM6-72-320/SI JA Solar 14 modules In paralle 28 Unit Nom. Powe 8.96 kWp At operating cond 470 V I mp 54.3 m <sup>2</sup> Cell are	el 2 strings er 320 Wp d. 8.05 kWp (50°C) p 17 A ea 48.2 m <sup>2</sup>					
Inverter Custom parameters definition Characteristics	Model Manufacturer Operating Voltage Nb. of inverters	SUN2000L-8KTL Huawei Technologies 200-850 V Unit Nom. Power Max. power (=>40°C 2 * MPPT 50 % Total Power	er 8.00 kWac C) 8.80 kWac er 8.0 kWac					
inventer pack	ND. OF Inverters	Pnom rat	io 1.12					
Battery	Model	PVX-2120L						
Battery Pack Characteristics	Manufacturer Nb. of units Voltage Discharging min. SOC Temperature	Concorde 3 in series x 4 in parallel 36 V Nominal Capaci 50.0 % Stored energy Fixed (20°C)	ty 784 Ah (C10) gy 14.1 kWh					
Battery input charger	Model	Generic						
Battery to Grid inverter	Max. charging power Model	7.5 kWdc Max./ Euro efficienc Generic	xy 97.0/95.0 %					
	Max. discharging power	3.1 kWac Max./ Euro efficienc	y 97.0/95.0 %					
Thermal Loss factors	Lie (const)	20.0 \//m2k/	d) 0.0 \//m2k / m/a					
	Global array res	465 mOhm Loss Fractic	on 15% at STC					

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Grid-Connected System: Simulation parameters									
Module Quality LossLoss FractModule Mismatch LossesLoss FractStrings Mismatch IossLoss FractIncidence effect, ASHRAE parametrizationIAM = 1 - bo (1/cos i - 1)bo Para					on -0.8 % on 1.0 % at MPP on 0.10 % n. 0.05				


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(	Grid-Connected S	System	n: Detailed Us	er's needs	•			
Project ·	Taman Midah (NFN	л)						
Simulation variant :		ilv - Qkw	,					
	SELCO - Sinaii Taini	ily - Skw						
Main system parameters	Syste	em type	Sheds on ground					
Near Shadings	Linear s	hadings	5°	azimuth (	٥			
PV modules		Model	JAM6-72-320/SI	Pnom 3	, 320 Wp			
PV Array	Nb. of I	modules	28	Pnom total	3.96 kWp			
Inverter	Daily household cor	Model	SUN2000L-8KTL	Pnom 8 (ear Global 7	3.00 kW ac			
Daily household consum	ers, Constant over the	e year, av	verage = 19.4 kWh/	/day				
		Annua	l values					
	Use 5 days a week	Number	Power	Use	Energy			
Lamps (LED or fluo)		26	18 W/lamp	5 h/day	2340 Wh	/day		
TV / PC / Mobile		2	70 W/app	9 h/day	1260 Wh	/day		
Iron		1	1200 W/app	1 h/day	1200 Wh	/day		
Fridge / Deep-freeze				24 Wh/day	3000 Wh	/day		
Disn- & Cloth-Washers			2000 W/ tot	I Wh/day	500 Wh	/day		
Aircond			2000 W tot	2 h/uay 7 h/day	15750 Wh	/uay /day		
Stand-by consumers		5	750 W 101	24 h/day	24 Wh	/day		
Total daily energy					27074 Wh	/day		
Aircond3750 W tot7 h/day15750 Wh/dayStand-by consumers24 h/day24 Wh/dayTotal daily energy27074 Wh/day								

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Grid-Connected System: Main results								
Project :	Taman Midah (NEM)							
Simulation variant :	SELCO - small family - 9kw	1						
Main system paramet	ers System type	Sheds on ground						
Near Shadings	Linear shadings							
PV Field Orientation	tilt	5° azimut	h O°					
PV modules	Model	JAM6-72-320/SI Pnor	m 320 Wp					
PV Array	Nb. of modules	28 Pnom tota	al <b>8.96 kWp</b>					
Inverter	Model	SUN2000L-8KTL Pnor	m 8.00 kW ac					
User's needs	Daily household consumers	Constant over the year Globa	al 7066 kWh/year					
Main simulation resul	ts							
System Production	Produced Energy	11.78 MWh/year Specific proc	d. 1315 kWh/kWp/year					
	Performance Ratio PR	32.41 % Solar Fraction S	F 65.60 %					
Battery ageing (State o	f Wear) Cycles SOW	79.0% Static SOV	V 80.0%					
	Battery lifetime	4.8 years						







## SELCO - small family - 9kw Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	1.016	0.623	0.416	0.512	0.207
February	134.6	67.90	27.70	137.4	132.8	1.031	0.541	0.370	0.583	0.171
March	149.8	88.20	28.00	150.3	144.9	1.125	0.596	0.404	0.619	0.191
April	140.3	70.50	27.70	138.8	133.9	1.039	0.569	0.395	0.575	0.174
Мау	140.3	78.60	28.60	136.9	131.7	1.027	0.623	0.410	0.529	0.213
June	132.0	77.80	27.80	128.3	123.5	0.967	0.569	0.357	0.515	0.211
July	134.4	87.20	27.80	131.1	125.8	0.994	0.596	0.402	0.519	0.194
August	132.2	87.20	27.80	130.1	125.2	0.980	0.623	0.397	0.497	0.226
September	129.2	79.00	27.10	128.8	124.0	0.968	0.541	0.358	0.513	0.183
October	138.8	82.60	27.40	140.4	135.5	1.056	0.623	0.404	0.581	0.219
November	117.6	79.20	26.70	119.8	115.4	0.907	0.596	0.361	0.466	0.234
December	115.0	73.20	26.29	118.1	113.6	0.896	0.569	0.362	0.453	0.207
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	7.066	4.636	6.361	2.431
		•							•	,
Legends: Glob	Hor I	Horizontal glo	obal irradiatio	on		GlobEff	Effectiv	e Global, co	orr. for IAM	and shadings
Diff	lor l	-lorizontal dif	fuse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb <sup>-</sup>	Гamb.				E_User	r Energy supplied to the user			
Glob	olnc (	Global incider	nt in coll. pla	ne		E_Solar	Energy	from the su	un	
						EUnused	Unused	l energy (ba	ttery full, no	grid injection
						EFrGrid	Energy	from the gr	id	





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	Grid-Connected System: P50 - P90 evalua	ition		
Project :	Taman Midah (NEM)			
Simulation varia	nt : SELCO - small family - 9kw			
Main system para	meters System type Sheds on ground			
<b>Near Shadings</b> PV Field Orientatio PV modules PV Array Inverter User's needs	Linear shadings n tilt 5° a Model JAM6-72-320/SI Nb. of modules 28 Pno Model SUN2000L-8KTL Daily household consumers Constant over the year	azimuth Pnom om tota Pnom Globa	n 0° 320 Wp I <b>8.96 kV</b> n 8.00 kW I 7066 kV	<b>/p</b> / ac Vh/year
Evaluation of the	Production probability forecast			
The probability dist	ribution of the system production forecast for different years is mainly of	depend	lent	
on the meteo data Meteo data source Meteo data Specified Deviation Year-to-year variab	used for the simulation, and depends on the following choices: MeteoNorm 7.2 station Kind Not defined Year deviation from aver. 3 % ility Variance 0.5 %	Yea	r 1995	
The probability dist Specified Deviation	ribution variance is also depending on some system parameters uncer PV module modelling/parameters 1.0 % Inverter efficiency uncertainty 0.5 % Soiling and mismatch uncertainties 1.0 % Degradation uncertainty 1.0 % Nariance 1.9 %	tainties	5	
	probability Variability 0.00 MWb	ic Sum	)	
	Piobability 0.00 MWh P50 0.00 MWh P90 0.00 MWh P95 0.00 MWh			
	Probability distribution			
	$ \begin{array}{c} 0.50\\ 0.45\\ 0.40\\ 0.35\\ 0.30\\ 0.25\\ 0.20\\ 0.20\\ 0.20\\ 0.5\\ 0.00\\ 0.25\\ 0.00\\ 0.25\\ 0.00\\ 0.26\\ 0.26\\ 0.26\\ 0.26\\ 0.4\\ 0.26\\ 0.26\\ 0.4\\ 0.6\\ 0.6\\ 0.8\\ E_Grid system production kWh \end{array} $	- - - - - - - - -	1.0	

ГГ			1 1
PVSYST V6.86			21/04/20 Page 1/8
Grid-	Connected Systen	n: Simulation parameter	S
Project : Tam	an Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Count	ry <b>Malaysia</b>
Situation	Latitude	3.12° N Longitu	de 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitue	de 17 m
Meteo data:	Kuala Lumpur/Subang	MeteoNorm 7.2 station - Synthet	ic
Simulation variant : SEL	CO - small family - 9kw	,	
	Simulation date	21/04/20 17h28	
Simulation parameters	System type	Sheds on ground	
<b>Collector Plane Orientation</b>	Tilt	5° Azimu	th 0°
Models used	Transposition	Perez Diffu	se Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind Charging strategy Discharging strategy	Self-consumption, No grid reinject When excess solar power is avail As soon as power is needed	ion able
User's needs : Da	aily household consumers average	Constant over the year 9.9 kWh/Day	
PV Array Characteristics PV module Original PVsyst database Number of PV modules Total number of PV modules Array global power Array operating characteristics (50 Total area	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) D°C) U mpp Module area	JAM6-72-320/SI JA Solar 14 modules In paral 28 Unit Nom. Pow 8.96 kWp At operating con 470 ∨ I mp 54.3 m <sup>2</sup> Cell are	lel 2 strings er 320 Wp d. 8.05 kWp (50°C) pp 17 A ea 48.2 m²
Inverter Custom parameters definition Characteristics	Model Manufacturer Operating Voltage	SUN2000L-8KTL Huawei Technologies 200-850 V Unit Nom. Pow Max. power (=>40°	rer 8.00 kWac C) 8.80 kWac
	ND. OF INVERTERS	Pnom ra	tio 1.12
Battery Battery Pack Characteristics	Model Manufacturer Nb. of units Voltage Discharging min. SOC Temperature	PVX-2120LConcorde3 in series x 4 in parallel36 VStored energy50.0 %Stored energyFixed (20°C)	ity 784 Ah (C10) gy 14.1 kWh
Battery input charger Battery to Grid inverter	Model Max. charging power Model	Generic 7.5 kWdc Max./ Euro efficien Generic	cy 97.0/95.0 %
-	Max. discharging power	3.1 kWac Max./ Euro efficien	cy 97.0/95.0 %
PV Array loss factors			
Thermal Loss factor	Uc (const)	20.0 W/m²K Uv (win	d) 0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	465 mOhm Loss Fraction	on 1.5 % at STC

PVSYST V6.86					21/04/20	Page 2/8
	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	n -0.8 % n 1.0 % a n 0.10 % n. 0.05	t MPP



PVSYST V6.86				2	1/04/20	Page 4/8		
			. Datailad Lla					
G	na-Connected a	System	1. Detailed US	ers needs				
Project : 1	Гатап Midah (NEM	1)						
Simulation variant : S	SELCO - small fami	ly - 9kw						
Main system parameters	Syste	em type	Sheds on ground					
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear s Nb. of r Daily household cor	hadings tilt Model nodules Model sumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the y	azimuth Pnom Pnom total Pnom year Global	0° 320 Wp <b>8.96 kV</b> 8.00 kV 3625 k\	<b>Vp</b> V ac Wh/year		
Daily household consumer	rs, Constant over the	e year, av	verage = 9.9 kWh/d	lay				
		Annua	l values					
	Use 2 days a week	Number	Power	Use		Energy		
Lamps (LED or fluo)		26	18 W/lamp	5 h/da	ay 2	2340 Wh/day		
TV / PC / Mobile		2	70 W/app	14 h/da	ay 1	960 Wh/day		
Iron		1	1200 W/app	1 h/da	ay 1	200 Wh/day		
Fridge / Deep-freeze		1		24 Wh/da	ау З	3000 Wh/day		
Dish- & Cloth-washers		1		1 Wh/da	зу	500 Wh/day		
Instant water heater		1	2000 W tot	2 h/da	ау З	3000 Wh/day		
Aircond		3	750 W tot	10 h/da	зу 22	2500 Wh/day		
Stand-by consumers				24 h/da	<u>ay</u>	24 Wh/day		
l otal daily energy					32	1524 Wh/day		
Stand-by consumers     24 h/day     24 Wh/day       Total daily energy     34524 Wh/day								

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Grid-Connected System: Main results								
Project :	Taman Midah (NEM)							
Simulation variant :	SELCO - small family - 9kw							
Main system paramete	ers System type	Sheds on ground						
Near Shadings	Linear shadings							
PV Field Orientation	tilt	5° azimutl	ר 0°					
PV modules	Model	JAM6-72-320/SI Pnon	n 320 Wp					
PV Array	Nb. of modules	28 Pnom tota	al 8.96 kWp					
Inverter	Model	SUN2000L-8KTL Pnon	n 8.00 kW ac					
User's needs	Daily household consumers	Constant over the year Globa	l 3625 kWh/year					
Main simulation result	ts							
System Production	Produced Energy	11.78 MWh/year Specific prod	. 1315 kWh/kWp/year					
	Performance Ratio PR	19.78 % Solar Fraction SI	78.05 %					
Battery ageing (State of	Wear) Cycles SOW	89.2% Static SOV	V 80.0%					
	Battery lifetime	5.0 years						







## SELCO - small family - 9kw Balances and main results

	GlobHor	DiffHor	T Amb	GlobIng	GlobEff	EArray	E User	E Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	1.016	0.345	0.265	0.665	0.080
February	134.6	67.90	27.70	137.4	132.8	1.031	0.276	0.234	0.734	0.043
March	149.8	88.20	28.00	150.3	144.9	1.125	0.276	0.225	0.833	0.051
April	140.3	70.50	27.70	138.8	133.9	1.039	0.311	0.252	0.736	0.059
Мау	140.3	78.60	28.60	136.9	131.7	1.027	0.311	0.231	0.710	0.080
June	132.0	77.80	27.80	128.3	123.5	0.967	0.276	0.220	0.679	0.056
July	134.4	87.20	27.80	131.1	125.8	0.994	0.345	0.266	0.672	0.079
August	132.2	87.20	27.80	130.1	125.2	0.980	0.276	0.209	0.688	0.067
September	129.2	79.00	27.10	128.8	124.0	0.968	0.276	0.208	0.693	0.068
October	138.8	82.60	27.40	140.4	135.5	1.056	0.345	0.275	0.708	0.070
November	117.6	79.20	26.70	119.8	115.4	0.907	0.276	0.199	0.643	0.077
December	115.0	73.20	26.29	118.1	113.6	0.896	0.311	0.246	0.597	0.065
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	3.625	2.829	8.360	0.796
Legends: Glob	Hor I	Horizontal glo	obal irradiatio	on		GlobEff	Effectiv	e Global, co	rr. for IAM	and shadings
Diff	Hor I	Horizontal dif	fuse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb	T amb.				E_User	Energy	supplied to	the user	
Glob	olnc (	Global incider	nt in coll. pla	ne		E_Solar	Energy	from the su	IN	
						EUnused	Unused	l energy (ba	ttery full, no	grid injection
						EFrGrid	Energy	from the gr	id	





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	Grid-Connected System: P50 - P90 evaluatio	n	
Proiect :	Taman Midah (NEM)	•	
Simulation varia	nt : SELCO - small family - 9kw		
Main system para	meters System type Sheds on ground		
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear shadings n tilt 5° azim Model JAM6-72-320/SI Pn Nb. of modules 28 Pnom to Model SUN2000L-8KTL Pn Daily household consumers Constant over the year Glo	uth 0° om 320 Wp otal <b>8.96 kV</b> om 8.00 kV bal 3625 k <sup>1</sup>	V <b>p</b> V ac Wh/year
Evaluation of the	Production probability forecast		
The probability dist	ribution of the system production forecast for different years is mainly dependent of the simulation, and dependence the following chaines:	endent	
Meteo data source Meteo data Specified Deviation Year-to-year variab	MeteoNorm 7.2 station Kind Not defined Y Year deviation from aver. 3 % Ility Variance 0.5 %	ear 1995	
The probability dist Specified Deviation	ribution variance is also depending on some system parameters uncertain PV module modelling/parameters 1.0 % Inverter efficiency uncertainty 0.5 % Soiling and mismatch uncertainties 1.0 % Degradation uncertainty 1.0 %	ies	
Global variability (m	neteo + system) Variance 1.9 % (quadratic su	ım)	
Annual production p	probability Variability 0.00 MWh P50 0.00 MWh P90 0.00 MWh P95 0.00 MWh		
	Probability distribution		
	$ \begin{array}{c} 0.50\\ 0.45\\ 0.40\\ 0.35\\ 0.20\\ 0.25\\ 0.20\\ 0.15\\ 0.00\\ 0.95\\ 0.00\\ 0.95\\ 0.00\\ 0.95\\ 0.00\\ 0.2\\ 0.4\\ 0.4\\ 0.4\\ 0.4\\ 0.6\\ 0.6\\ 0.8\\ E_Grid system production kWh \end{array} $	1.0	

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PVSYST V6.86			21/04/20 Page 1/8
	Grid-Connected System	n: Simulation parameters	3
Project :	Taman Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Countr	y <b>Malaysia</b>
Situation	Latitude	3.12° N Longitud	e 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitud	e 17 m
Meteo data:	Kuala Lumpur/Subang	MeteoNorm 7.2 station - Synthetic	C
Simulation variant :	SELCO - average family - (	ôkw	
	Simulation date	21/04/20 16h13	
Simulation parameter	s System type	Sheds on ground	
Collector Plane Orien	tation Tilt	5° Azimut	h O°
Models used	Transposition	Perez Diffus	e Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind	Self-consumption, No grid reinjection	on
	Charging strategy Discharging strategy	When excess solar power is availa As soon as power is needed	ble
User's needs :	Daily household consumers average	Constant over the year 25.1 kWh/Day	
PV Array Characterist PV module Original PVsyst data Number of PV modules Total number of PV mod Array global power Array operating character Total area	ics Si-mono Model base Manufacturer In series dules Nb. modules Nominal (STC) eristics (50°C) U mpp Module area	JAM6-72-320/SI JA Solar 10 modules In paralle 20 Unit Nom. Powe 6.40 kWp At operating cond 336 V I mpj 38.8 m <sup>2</sup> Cell are	el 2 strings er 320 Wp I. 5.75 kWp (50°C) p 17 A a 34.4 m²
Inverter Original PVsyst data Characteristics	Model base Manufacturer Operating Voltage	SUN2000L-5KTL Huawei Technologies 90-500 V Unit Nom. Power Max. power (=>40°C	er 5.00 kWac C) 5.50 kWac
Invener pack	ND. OF INVERTERS	2 MPPT 50 % Total Powe Pnom rati	o 1.28
Battery	Model	PVX-2120L	
Battery Pack Character	ristics Nb. of units Voltage Discharging min. SOC Temperature	Concorde 2 in series x 4 in parallel 24 V Nominal Capacit 50.0 % Stored energ Fixed (20°C)	y 784 Ah (C10) y 9.4 kWh
Battery input charger	Model	Generic	
Battery to Grid inverte	Max. charging power <b>Pr</b> Model	5.4 kWdc Max./ Euro efficienc	y 97.0/95.0 %
	Max. discharging power	5.2 kWac Max./ Euro efficienc	y 97.0/95.0 %
DV/ Arrow loop factors			
Thermal Loss factor	Le (const)	20.0 W/m²K	1) 00W/m2K/m/s
Wiring Ohmic Loss	Global arrav res.	332 mOhm Loss Fractio	n 1.5 % at STC
	,		

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	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	n -0.8 % n 1.0 % a n 0.10 % n. 0.05	t MPP



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(	Grid-Connected S	System	n: Detailed Us	er's needs			
Project :	Taman Midah (NEM	A)					
Simulation variant : SELCO - average family - 6kw							
Main system parameters	Syste	em type	Sheds on ground				
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs Daily household consum	Linear s Nb. of r Daily household cor ers, Constant over the	hadings tilt Model modules Model nsumers <b>year, av</b>	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the y <b>/erage = 25.1 kWh/</b>	azimuth Pnom Pnom total Pnom year Global	0° 320 Wp <b>6.40 kV</b> 5.00 kV 9174 k\	<b>Vp</b> V ac Wh/year	
		Annua	l values				
	Use 5 days a week	Number	Power	Use		Energy	
Lamps (LED or fluo)		28	18 W/lamp	6 h/c	lay 3	3024 Wh/day	
TV / PC / Mobile		2	70 W/app	10 h/c	lay 1	400 Wh/day	
Iron		1	1200 W/app	1 h/c	lay 1	200 Wh/day	
Fridge / Deep-freeze		1		24 Wh/c	lay 3	3000 Wh/day	
Dish- & Cloth-washers		1		1 Wh/c	lay	500 Wh/day	
Instant water heater		2	2000 W tot	2 h/c	lay 8	3000 Wh/day	
Aircond		3	750 W tot	8 h/c	lay 18	3000 Wh/day	
Stand-by consumers				24 h/c	lay	24 Wh/day	
Stand-by consumers     3     750 W lot     8 in/day     18000 Win/day       Total daily energy     35148 Wh/day							

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Grid-Connected System: Main results									
Project : Taman Midah (NEM)									
Simulation variant : SELCO - average family - 6kw									
Main system pa	rameters	System type	Sheds on ground						
Near Shadings		Linear shadings							
PV Field Orientat	ion	tilt	5° azimu	th 0°					
PV modules		Model	JAM6-72-320/SI Pnc	m 320 W	р				
PV Array		Nb. of modules	20 Pnom to	tal 6.40 k	Wp				
Inverter		Model	SUN2000L-5KTL Pnc	m 5.00 k <sup>v</sup>	N ac				
User's needs		Daily household consumers	Constant over the year Glob	oal 9174 k	Wh/year				
Main simulation	results								
System Production	on	Produced Energy	8.41 MWh/year Specific pro	d. 1314 k	Wh/kWp/year				
		Performance Ratio PR	33.81 % Solar Fraction S	SF 37.65 °	%				
Battery ageing (S	tate of We	ear) Cycles SOW	79.1% Static SC	W 80.0%					
		Battery lifetime	4.8 years						







# SELCO - average family - 6kw Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	0.726	0.808	0.307	0.356	0.502
February	134.6	67.90	27.70	137.4	132.8	0.737	0.703	0.274	0.405	0.429
March	149.8	88.20	28.00	150.3	144.9	0.804	0.773	0.299	0.432	0.475
April	140.3	70.50	27.70	138.8	133.9	0.742	0.738	0.295	0.394	0.443
Мау	140.3	78.60	28.60	136.9	131.7	0.734	0.808	0.307	0.362	0.501
June	132.0	77.80	27.80	128.3	123.5	0.691	0.738	0.268	0.355	0.470
July	134.4	87.20	27.80	131.1	125.8	0.710	0.773	0.297	0.361	0.477
August	132.2	87.20	27.80	130.1	125.2	0.700	0.808	0.295	0.343	0.514
September	129.2	79.00	27.10	128.8	124.0	0.691	0.703	0.267	0.355	0.436
October	138.8	82.60	27.40	140.4	135.5	0.754	0.808	0.307	0.393	0.501
November	117.6	79.20	26.70	119.8	115.4	0.648	0.773	0.270	0.320	0.504
December	115.0	73.20	26.29	118.1	113.6	0.640	0.738	0.269	0.310	0.469
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	9.174	3.454	4.384	5.720
Legends: Glob	Hor I	Horizontal glo	bal irradiatio	)n	•	GlobEff	Effectiv	e Global co	orr for IAM	and shadings
Diff	lor I	Horizontal dif	fuse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb .	Г amb.				E_User	Energy	supplied to	the user	
Glob	Inc	Global incider	nt in coll. pla	ne		E_Solar	Energy	Energy from the sun		
						EUnused	Unused	Unused energy (battery full, no grid injection)		
						EFrGrid	Energy	from the gr	- id	





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		Grid-Conne	cted Syster	m: P50 - P90 (	evaluation				
Proiect :		Taman Midah	(NEM)						
Simulation var	iant :	SELCO - aver	age family - 6	Skw					
Main system pa	rameters	i	System type	Sheds on ground					
Near Shadings PV Field Orientat PV modules PV Array Inverter User's needs	ion	L Daily househ	inear shadings tilt Model Nb. of modules Model old consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the y	azimu Pno Pnom tot Pno year Glob	h 0° m 320 Wp al <b>6.40 kV</b> m 5.00 kV al 9174 kV	<b>Vp</b> V ac Vh/year		
Evaluation of th	e Produc	ction probability	forecast						
The probability di on the meteo dat	istribution a used for	of the system pro	duction forecast	t for different years is the following choices	s mainly depen s:	dent			
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	ce on ability	Year devia	Kind ation from aver. Variance	MeteoNorm 7.2 sta Not defined 3 % 0.5 %	ation Ye	ar 1995			
The probability di Specified Deviatio	The probability distribution variance is also depending on some system parameters uncertainties Specified Deviation PV module modelling/parameters 1.0 % Inverter efficiency uncertainty 0.5 % Soiling and mismatch uncertainties 1.0 %								
Global variability	(meteo +	system)	Variance	1.9 %	(quadratic sur	n)			
Annual productio	n probabil	lity	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh					
			Probability	distribution					
0.50 0.45 0.40 0.35 0.20 0.25 0.20 0.15 0.10 0.50 = 000 kWh 0.00 = page. Use out where with 0.4 = 0.6 = 0.8 = 1.0 E_Grid system production kWh									

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	Grid-Connected System	n: Simulation parameters	3
Project :	Taman Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Country	y <b>Malaysia</b>
Situation	Latitude	3.12° N Longitude	e 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitude	e 17 m
Meteo data:	Kuala Lumpur/Subang	MeteoNorm 7.2 station - Synthetic	
Simulation variant :	SELCO - average family - (	δkw	
	Simulation date	21/04/20 16h14	
Simulation parameters	System type	Sheds on ground	
Collector Plane Orienta	tion Tilt	5° Azimut	n O°
Models used	Transposition	Perez Diffus	e Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind Charging strategy Discharging strategy	Self-consumption, No grid reinjection When excess solar power is available As soon as power is needed	on ble
User's needs :	Daily household consumers average	Constant over the year 11.1 kWh/Day	
PV Array Characteristics PV module Original PVsyst databa Number of PV modules Total number of PV modu Array global power Array operating character Total area	s Si-mono Model se Manufacturer In series les Nb. modules Nominal (STC) stics (50°C) U mpp Module area	JAM6-72-320/SI JA Solar 10 modules In paralle 20 Unit Nom. Powe 6.40 kWp At operating cond 336 V I mpp 38.8 m <sup>2</sup> Cell area	el 2 strings r 320 Wp . 5.75 kWp (50°C) o 17 A a 34.4 m²
Inverter Original PVsyst databa Characteristics Inverter pack	Model ase Manufacturer Operating Voltage Nb. of inverters	SUN2000L-5KTL Huawei Technologies 90-500 V Unit Nom. Powe Max. power (=>40°C 2 * MPPT 50 % Total Powe	er 5.00 kWac 5) 5.50 kWac er 5.0 kWac
		Pnom ratio	o 1.28
Battery Battery Pack Characteris	Model Manufacturer tics Nb. of units Voltage	PVX-2120L         Concorde         2 in series x 4 in parallel         24 V         Nominal Capacity         50 0 %	y 784 Ah (C10)
	Temperature	Fixed (20°C)	y J.4 NVVII
Battery input charger Battery to Grid inverter	Model Max. charging power Model	Generic 5.4 kWdc Max./ Euro efficiency Generic	y 97.0/95.0 %
	Max. discharging power	5.2 kWac Max./ Euro efficiency	y 97.0/95.0 %
PV Array loss fasters			
Thermal Loss factor	LLC (const)	20.0 W/m²K	) 0 0 W/m²K / m/e
Wiring Ohmic Loss	Global arrav res.	332 mOhm Loss Fraction	n 1.5 % at STC
<b>~</b>	,		

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	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	n -0.8 % n 1.0 % a n 0.10 % n. 0.05	t MPP



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Grid-Connecte	ed System	n: Detailed Us	er's needs				
Project : Taman Midah (I	NEM)						
Simulation variant : SELCO - average family - 6kw							
Main system parameters	Svstem type	Sheds on around					
Near Shadings Line	ear shadings	U					
PV Field Orientation	tilt	5°	azimuth (	)°			
PV modules PV Array Nb	Model of modules	JAM6-72-320/SI 20	Pnom Com Com Com Com Com Com Com Com Com C	320 vvp 6 <b>40 kWn</b>			
Inverter	Model	SUN2000L-5KTL	Pnom 5	5.00 kW ac			
User's needs Daily household	consumers	Constant over the y	/ear Global 4	1045 kWh/year			
Daily household consumers, Constant over	r the year, av	verage = 11.1 kWh/	/day				
	<b>A</b> in in i o						
	Annua			,			
Use 2 days a w	eek Number	Power	Use	Energy			
Lamps (LED or fluo)	28	18 W/lamp	6 h/day	3024 Wh/day			
TV / PC / Mobile	2	70 W/app	10 h/day	1400 Wh/day			
Iron	1	1200 W/app	1 h/day	1200 Wh/day			
Fridge / Deep-freeze			24 Wh/day	3000 Wh/day			
Disn- & Ciolin-Washers		2000 W/ tot	i wn/day	S00 Wh/day			
Aircond	2	750 W tot	10 h/day	21375 Wh/day			
Stand-by consumers		750 W lot	24 h/day	24 Wh/day			
Total daily energy		ł	ļj	38523 Wh/day			
· 5000	Hourly	/ profile	<b>-</b>				
중 4000 —	1						
5 5 2000							
			-				
5 2000 <b>-</b>							
	3 6 9	12 15 18	21 24				

PVSYST V6.86			21/04/20	Page 5/8					
Grid-Connected System: Main results									
Simulation variant : SELCO - average family - 6kw									
Main system parameter	s System type	Sheds on ground							
Near Shadings	Linear shadings								
PV Field Orientation	tilt	5° azimut	h 0°						
PV modules	Model	JAM6-72-320/SI Pnor	m 320 Wp	1					
PV Array	Nb. of modules	20 Pnom tota	al <b>6.40 kV</b>	Vp					
Inverter	Model	SUN2000L-5KTL Pnor	m 5.00 kV	V ac					
User's needs	Daily household consumers	Constant over the year Globa	al 4045 k\	Wh/year					
Main simulation results									
System Production	Produced Energy	8.41 MWh/year Specific proc	d. 1314 k\	Nh/kWp/year					
	Performance Ratio PR	21.51 % Solar Fraction S	F 54.33 %	, D					
Battery ageing (State of V	Vear) Cycles SOW	87.8% Static SO	N 80.0%						
	Battery lifetime	5.0 years							

### Normalized productions (per installed kWp): Nominal power 6.40 kWp



Performance Ratio PR



## SELCO - average family - 6kw Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	0.726	0.385	0.209	0.451	0.176
February	134.6	67.90	27.70	137.4	132.8	0.737	0.308	0.186	0.500	0.123
March	149.8	88.20	28.00	150.3	144.9	0.804	0.308	0.177	0.571	0.131
April	140.3	70.50	27.70	138.8	133.9	0.742	0.347	0.189	0.510	0.157
Мау	140.3	78.60	28.60	136.9	131.7	0.734	0.347	0.179	0.488	0.168
June	132.0	77.80	27.80	128.3	123.5	0.691	0.308	0.172	0.464	0.137
July	134.4	87.20	27.80	131.1	125.8	0.710	0.385	0.205	0.458	0.180
August	132.2	87.20	27.80	130.1	125.2	0.700	0.308	0.163	0.471	0.145
September	129.2	79.00	27.10	128.8	124.0	0.691	0.308	0.162	0.475	0.146
October	138.8	82.60	27.40	140.4	135.5	0.754	0.385	0.221	0.475	0.164
November	117.6	79.20	26.70	119.8	115.4	0.648	0.308	0.147	0.449	0.161
December	115.0	73.20	26.29	118.1	113.6	0.640	0.347	0.187	0.406	0.159
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	4.045	2.197	5.719	1.847
		•								I
Legends: Glob	Hor	Horizontal glo	obal irradiatio	on		GlobEff	Effectiv	e Global, co	orr. for IAM	and shadings
Diff	lor l	Horizontal dif	fuse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb <sup>-</sup>	Г amb.				E_User	Energy	supplied to	the user	
Glob	olnc (	Global incider	nt in coll. pla	ne		E_Solar	Energy	Energy from the sun		
				EUnused	Unused energy (battery full, no grid injection)					
EFrGrid Energy from the grid										





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		Grid-Conne	cted Syster	m: P50 - P90	evaluation				
Project :		Taman Midah	n (NEM)						
Simulation var	iant :	SELCO - aver	age family - 6	Skw					
Main system pa	rameters		System type	Sheds on ground	1				
Near Shadings PV Field Orientat PV modules PV Array Inverter User's needs	ion	L Daily househ	inear shadings tilt Model Nb. of modules Model old consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the	azimut Pnor Pnom tot Pnor year Glob	h 0° m 320 Wp al <b>6.40 kV</b> m 5.00 kV al 4045 k\	V <b>p</b> V ac Vh/year		
Evaluation of th	e Produc	tion probability	forecast						
The probability di on the meteo data	istribution a used for	of the system pro	duction forecast	t for different years i the following choice	is mainly depen s:	dent			
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	ce on ability	Year devia	Kind ation from aver. Variance	MeteoNorm 7.2 st Not defined 3 % 0.5 %	ation Yea	ar 1995			
The probability di Specified Deviatio	The probability distribution variance is also depending on some system parameters uncertainties Specified Deviation PV module modelling/parameters 1.0 % Inverter efficiency uncertainty 0.5 % Soiling and mismatch uncertainties 1.0 %								
Global variability	(meteo +	system)	Variance	1.9 %	(quadratic sun	n)			
Annual production	n probabil	ity	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh					
			Probability	distribution					
Probability distribution									

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Grid-	Connected Systen	n: Simulation parameters	6
Project : Tam	an Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Countr	y <b>Malaysia</b>
Situation	Latitude	3.12° N Lonaitud	e 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitud	e 17 m
Meteo data:	Albedo Kuala Lumpur/Subang	0.20 MeteoNorm 7.2 station - Synthetic	c
Simulation variant : SEL	CO - average family - 9	)kw	
	Simulation date	21/04/20 16h17	
Simulation parameters	System type	Sheds on ground	
<b>Collector Plane Orientation</b>	Tilt	5° Azimut	h 0°
Models used	Transposition	Perez Diffus	e Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind	Self-consumption, No grid reinjecti	on
	Charging strategy Discharging strategy	When excess solar power is availa As soon as power is needed	ble
User's needs : Da	ily household consumers average	Constant over the year 25.1 kWh/Day	
PV Array Characteristics PV module Original PVsyst database Number of PV modules Total number of PV modules Array global power Array operating characteristics (50 Total area	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) 0°C) U mpp Module area	JAM6-72-320/SI JA Solar 14 modules In paralle 28 Unit Nom. Powe 8.96 kWp At operating cond 470 V I mp 54.3 m <sup>2</sup> Cell are	el 2 strings er 320 Wp l. 8.05 kWp (50°C) p 17 A a 48.2 m²
Inverter Custom parameters definition Characteristics	Model Manufacturer Operating Voltage	SUN2000L-8KTL Huawei Technologies 200-850 V Unit Nom. Power Max. power (=>40°C	er 8.00 kWac C) 8.80 kWac
	ND. OF INVERTERS	Pnom rati	o 1.12
Battery	Model	PVX-2120L	
Battery Pack Characteristics	Manufacturer Nb. of units Voltage Discharging min. SOC Temperature	Concorde 3 in series x 4 in parallel 36 V Nominal Capacit 50.0 % Stored energ Fixed (20°C)	y 784 Ah (C10) y 14.1 kWh
Battery input charger	Model	Generic	
Battery to Grid inverter	Max. charging power Model	7.5 kWdc Max./ Euro efficienc Generic	y 97.0/95.0 %
-	Max. discharging power	5.2 kWac Max./ Euro efficienc	y 97.0/95.0 %
PV Array loss factors			
Thermal Loss factor	Lic (const)	20.0 W/m²K	1) 00 W/m2K / m/s
Wiring Ohmic Loss	Global arrav res.	465 mOhm Loss Fractio	n 1.5 % at STC
• •			

PVSYST V6.86					21/04/20	Page 2/8
	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	n -0.8 % n 1.0 % a n 0.10 % n. 0.05	t MPP



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		<b></b>		I					
(	Fild-Connected	System	n: Detailed Use	er's needs					
Project :	Taman Midah (NEM	Л)							
Simulation variant :	SELCO - average fa	amily - 9	)kw						
Main system parameters	Syste	em type	Sheds on ground						
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs Daily household consum	Linear s Nb. of r Daily household cor ers, Constant over the	hadings tilt Model modules Model nsumers	5°azimuth0°JAM6-72-320/SIPnom320 Wp28Pnom total <b>8.96 kWp</b> SUN2000L-8KTLPnom8.00 kW acConstant over the yearGlobal9174 kWh/yearverage = 25.1 kWh/day						
Annual values									
	Use 5 days a week	Number	Power	Use	Ener	rgy			
Lamps (LED or fluo)		28	18 W/lamp	6 h/day	3024	Wh/day			
TV / PC / Mobile		2	70 W/app	10 h/day	y 1400 Wh/da				
Iron		1	1200 W/app	1 h/day	1200	) Wh/day			
Fridge / Deep-freeze		1		24 Wh/day	3000	) Wh/day			
Dish- & Cloth-washers		1		1 Wh/day	500	Wh/day			
Instant water heater		2	2000 W tot	2 h/day	8000	Wh/day			
Aircond		3	750 W tot	8 h/day	18000	) Wh/day			
Stand-by consumers				24 h/day	24	Wh/day			
Hourly profile Hourly profile									

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Grid-Connected System: Main results								
Project : Taman Midah (NEM)								
Simulation variant : SELCO - average family - 9kw								
Main system parameters		System type	Sheds on ground					
Near Shadings		Linear shadings						
PV Field Orientation	ו	tilt	5° azi	nuth	0°			
PV modules		Model	JAM6-72-320/SI P	nom	320 Wp			
PV Array		Nb. of modules	28 Pnom	total	8.96 kV	Vp		
Inverter		Model	SUN2000L-8KTL P	nom	8.00 kV	/ ac		
User's needs		Daily household consumers	Constant over the year G	obal	9174 kV	Vh/year		
Main simulation re	esults							
System Production		Produced Energy	11.78 MWh/year Specific	orod.	1315 k\	Nh/kWp/year		
		Performance Ratio PR	34.34 % Solar Fractio	n SF	53.54 %	, D		
Battery ageing (Stat	te of We	ar) Cycles SOW	79.0% Static S	SOW	80.0%			
		Battery lifetime	4.8 years					







## SELCO - average family - 9kw Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	1.016	0.808	0.438	0.489	0.371
February	134.6	67.90	27.70	137.4	132.8	1.031	0.703	0.389	0.561	0.314
March	149.8	88.20	28.00	150.3	144.9	1.125	0.773	0.426	0.593	0.347
April	140.3	70.50	27.70	138.8	133.9	1.039	0.738	0.421	0.544	0.317
Мау	140.3	78.60	28.60	136.9	131.7	1.027	0.808	0.436	0.501	0.373
June	132.0	77.80	27.80	128.3	123.5	0.967	0.738	0.380	0.490	0.359
July	134.4	87.20	27.80	131.1	125.8	0.994	0.773	0.425	0.496	0.349
August	132.2	87.20	27.80	130.1	125.2	0.980	0.808	0.420	0.472	0.388
September	129.2	79.00	27.10	128.8	124.0	0.968	0.703	0.379	0.490	0.324
October	138.8	82.60	27.40	140.4	135.5	1.056	0.808	0.431	0.549	0.377
November	117.6	79.20	26.70	119.8	115.4	0.907	0.773	0.384	0.440	0.389
December	115.0	73.20	26.29	118.1	113.6	0.896	0.738	0.382	0.429	0.356
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	9.174	4.912	6.054	4.262
DiffHor Horizontal diffuse irradiation				FArray	Effectiv	Effective energy at the output of the array				
T Amb T amb				E llser	Energy	Energy supplied to the user				
Glob	Global incident in coll plane			E_Solar	Energy	Energy from the sun				
0.01				EUnused	Unuser	Unused energy (battery full no grid injection)				
				EFEGrid Energy from the grid			gria injection			
	Errond Energy from the grid									




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		Grid-Connec	ted Syster	m: P50 - P90	evaluation			
Project ·		Taman Midah	(NFM)					
Simulation vari	iant :	SELCO - avera	age family - 9	)kw				
Main system par	rameters		System type	Sheds on ground	d			
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Lii N Daily househc	near shadings tilt Model Ib. of modules Model Id consumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the	azimu Pno Pnom tol Pno year Glob	th 0° m 320 Wp al <b>8.96 kV</b> m 8.00 kV al 9174 kV	V <b>p</b> V ac Wh/year	
Evaluation of the	e Produc	tion probability f	orecast					
The probability dis	stribution	of the system proc	luction forecast	for different years	is mainly deper	ndent		
on the meteo data	a used for	the simulation, an	d depends on t	he following choice	es:			
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	e n bility	Year devia	Kind tion from aver. Variance	MeteoNorm 7.2 st Not defined 3 % 0.5 %	tation Ye	ar 1995		
The probability distribution variance is also depending on some system parameters uncertainties Specified Deviation PV module modelling/parameters 1.0 % Inverter efficiency uncertainty 0.5 % Soiling and mismatch uncertainties 1.0 %								
Global variability	(meteo +	system)	Variance	1.9 %	(quadratic sur	n)		
Annual productior	n probabil	ity	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh				
			Probability	distribution				
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 50 = C00 kWh 0.00 	X axis: no data fo	or the extremities definition	on !	1.0		

			1 1
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Grid-	Connected Systen	n: Simulation parameter	S
Project : Tam	an Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Count	ry <b>Malaysia</b>
Situation	Latitude	3 12° N Longitur	le 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitud	de 17 m
Motoo data:	Albedo	0.20 MotooNorm 7.2 station - Syntheti	
Simulation variant : SEL	CO - average family - 9	)kw	
	Simulation date	21/04/20 16h19	
Simulation parameters	System type	Sheds on ground	
<b>Collector Plane Orientation</b>	Tilt	5° Azimut	th 0°
Models used	Transposition	Perez Diffus	se Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind	Self-consumption, No grid reinject	ion
	Charging strategy Discharging strategy	When excess solar power is availa As soon as power is needed	able
User's needs : Da	ily household consumers average	Constant over the year 11.1 kWh/Day	
PV Array Characteristics PV module Original PVsyst database Number of PV modules Total number of PV modules Array global power Array operating characteristics (50 Total area	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) 0°C) U mpp Module area	JAM6-72-320/SI JA Solar 14 modules In paralle 28 Unit Nom. Powe 8.96 kWp At operating cond 470 V I mp 54.3 m <sup>2</sup> Cell are	el 2 strings er 320 Wp d. 8.05 kWp (50°C) p 17 A ea 48.2 m <sup>2</sup>
Inverter Custom parameters definition Characteristics	Model Manufacturer Operating Voltage	SUN2000L-8KTL Huawei Technologies 200-850 V Unit Nom. Power Max. power (=>40°C	er 8.00 kWac C) 8.80 kWac
invener pack	IND. OF Inverters	2 MPPT 50 % Total Pow Pnom rat	io 1.12
Battery	Model	PVX-2120L	
Battery Pack Characteristics	Manufacturer Nb. of units Voltage Discharging min. SOC Temperature	Concorde 3 in series x 4 in parallel 36 V Nominal Capaci 50.0 % Stored energy Fixed (20°C)	ty 784 Ah (C10) gy 14.1 kWh
Battery input charger	Model	Generic	
Battery to Grid inverter	Max. charging power Model	7.5 kWdc Max./ Euro efficienc Generic	y 97.0/95.0 %
	Max. discharging power	5.2 kWac Max./ Euro efficienc	y 97.0/95.0 %
DV Arrow loop fasters			
Thermal Loss factors	Lie (const)	20.0 \//m2k	d) 0.0 \//m2k / m/a
	Global array res	465 mOhm Loss Fractic	on 15% at STC

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	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6		
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	tion -0.8 % tion 1.0 % at MPP tion 0.10 % am. 0.05		



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(	Grid-Connected S	System	n: Detailed Use	er's needs		
Brojoct ·	Taman Midah (NEN	<i>n</i> )				
		//)				
Simulation variant :	SELCO - average fa	amily - 9	)kw			
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Linear s Nb. of r Daily household cor	hadings tilt Model modules Model nsumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the ye	azimuth Pnom Pnom total Pnom ear Global	h 0° n 320 Wp al <b>8.96 kWp</b> n 8.00 kW ac al 4045 kWh/year	
Daily household consum	ers, Constant over the	e year, av	verage = 11.1 kWh/o	day		
		Annua	l values			
	Use 2 days a week	Number	Power	Use	Energy	
Lamps (LED or fluo)		28	18 W/lamp	6 h/day	/ 3024 Wh/day	
TV / PC / Mobile		2	70 W/app	10 h/day	/ 1400 Wh/day	
Iron		1	1200 W/app	1 h/day	/ 1200 Wh/day	
Fridge / Deep-freeze		1		24 Wh/day	/ 3000 Wh/day	
Dish- & Cloth-washers		1		1 Wh/day	/ 500 Wh/day	
Instant water heater		2	2000 W tot	2 h/day	/ 8000 Wh/day	
Aircond		3	750 W tot	10 h/day	/ 21375 Wh/day	
Stand-by consumers				24 h/day	/ 24 Wh/day	
Total daily energy	5000 4000 1000 0 3000 0 3 3 3	Hourly	<b>/ profile</b>	24	38523 Wh/day	

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	Grid-Connected S	ystem: Main results		
Project :	Taman Midah (NEM)			
Simulation variant :	SELCO - average family - 9	)kw		
Main system parameters	System type	Sheds on ground		
Near Shadings	Linear shadings			
PV Field Orientation	tilt	5° azimut	th 0°	
PV modules	Model	JAM6-72-320/SI Pnoi	m 320 Wp	
PV Array	Nb. of modules	28 Pnom tot	al <b>8.96 kV</b>	/р
Inverter	Model	SUN2000L-8KTL Pnoi	m 8.00 kW	/ ac
User's needs	Daily household consumers	Constant over the year Globa	al 4045 kV	Vh/year
Main simulation results				
System Production	Produced Energy	11.78 MWh/year Specific proc	d. 1315 k\	Vh/kWp/year
	Performance Ratio PR	20.55 % Solar Fraction S	F 72.65 %	)
Battery ageing (State of W	ear) Cycles SOW	88.4% Static SO	N 80.0%	
	Battery lifetime	5.0 years		







## SELCO - average family - 9kw Balances and main results

	GlobHor	DiffHor	T Amb	GlobInc	GlobEff	EArray	E User	E Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	1.016	0.385	0.278	0.646	0.107
February	134.6	67.90	27.70	137.4	132.8	1.031	0.308	0.245	0.717	0.063
March	149.8	88.20	28.00	150.3	144.9	1.125	0.308	0.235	0.816	0.074
April	140.3	70.50	27.70	138.8	133.9	1.039	0.347	0.258	0.724	0.088
Мау	140.3	78.60	28.60	136.9	131.7	1.027	0.347	0.238	0.698	0.109
June	132.0	77.80	27.80	128.3	123.5	0.967	0.308	0.230	0.663	0.078
July	134.4	87.20	27.80	131.1	125.8	0.994	0.385	0.276	0.657	0.109
August	132.2	87.20	27.80	130.1	125.2	0.980	0.308	0.217	0.671	0.091
September	129.2	79.00	27.10	128.8	124.0	0.968	0.308	0.217	0.678	0.091
October	138.8	82.60	27.40	140.4	135.5	1.056	0.385	0.288	0.691	0.098
November	117.6	79.20	26.70	119.8	115.4	0.907	0.308	0.202	0.636	0.106
December	115.0	73.20	26.29	118.1	113.6	0.896	0.347	0.254	0.581	0.092
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	4.045	2.938	8.178	1.106
	•	•							•	
Legends: Glob	Hor I	Horizontal glo	obal irradiatio	on		GlobEff	Effectiv	e Global, co	orr. for IAM	and shadings
Diff	lor I	Horizontal dif	fuse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb <sup>-</sup>	Г amb.				E_User	Energy	supplied to	the user	
Glob	Inc (	Global incider	nt in coll. pla	ne		E_Solar	Energy	Energy from the sun		
				EUnused	Unused	Unused energy (battery full, no grid injection)				
EFrGrid Energy from the							from the gr	id		





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		Grid-Connec	ted Syster	m: P50 - P90 (	evaluation				
Project ·		Taman Midah	(NEM)						
Simulation var	iant :	SELCO - avera	ige family - 9	)kw					
Main system pa	rameters	i	System type	Sheds on ground					
Near Shadings PV Field Orientat PV modules PV Array Inverter User's needs	ion	Lir N Daily househo	near shadings tilt Model b. of modules Model Id consumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the y	azimut Pno Pnom tot Pno year Glob	th 0° m 320 Wp al <b>8.96 kV</b> m 8.00 kV al 4045 k\	<b>/p</b> / ac Vh/year		
Evaluation of th	e Produc	tion probability f	orecast						
The probability di	istribution	of the system prod	luction forecast	t for different years is	s mainly depen	dent			
on the meteo dat Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	a used for ce on ability	r the simulation, an Year deviat	d depends on f Kind tion from aver. Variance	the following choices MeteoNorm 7.2 sta Not defined 3 % 0.5 %	s: ation Yea	ar 1995			
The probability distribution variance is also depending on some system parameters uncertainties Specified Deviation PV module modelling/parameters 1.0 % Inverter efficiency uncertainty 0.5 % Soiling and mismatch uncertainties 1.0 % Degradation uncertainty 1.0 %									
Global variability	(meteo +	system)	Variance	1.9 %	(quadratic sun	n)			
Annual productio	n probabil	lity	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh					
			Probability	distribution					
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 	X axis: no data fo	or the extremities definition	n ! 	<b>1</b> .0			

					1	
PVSYST V6.86					21/04/20	Page 1/8
	Grid	-Connected Systen	n: Simulati	on parameter	S	
Proiect :	Tan	nan Midah (NEM)				
Geographical Site		Kuala Lumpur/Subang		Count	∾ Malavs	ia
Situation		l atitude	3 12° N	Lonaituc	le 101.55°	F
Time defined as		Legal Time	Time zone UT	Γ+8 Altituc	le 17 m	_
Meteo data:		Albedo Kuala Lumpur/Subang	0.20 MeteoNorm 7	7.2 station - Syntheti	C	
				2 station by the		
Simulation variar	nt: SEL	.CO - big family - 6kw				
		Simulation date	21/04/20 15h	44		
Simulation parame	eters	System type	Sheds on gro	ound		
Collector Plane Or	rientation	Tilt	5°	Azimu	h 0°	
Models used		Transposition	Perez	Diffus	e Perez, I	Veteonorm
Horizon		Free Horizon				
Near Shadings		Linear shadings				
Storage		Kind	Self-consumpt	tion, No grid reinjecti	on	
		Charging strategy Discharging strategy	When excess As soon as po	solar power is availa wer is needed	ıble	
User's needs :	D	aily household consumers average	Constant over 32.6 kWh/Da	r the year y		
PV Array Character PV module Original PVsyst da Number of PV modu Total number of PV Array global power	<b>ristics</b> atabase iles modules	Si-mono Model Manufacturer In series Nb. modules Nominal (STC)	<b>JAM6-72-320</b> JA Solar 10 modules 20 <b>6.40 kWp</b>	<b>)/SI</b> In parall Unit Nom. Powe At operating cond	el 2 string: er 320 Wp 1. 5.75 kW	s /p (50°C)
Array operating char	acteristics (5	50°C) U mpp Module area	336 V <b>38-8 m²</b>	l mp Cell are	p 17A a 344m²	
Inverter Original PVsyst d Characteristics	latabase	Model Manufacturer Operating Voltage	<b>SUN2000L-5I</b> Huawei Techi 90-500 V	KTL nologies Unit Nom. Powe Max. power (=>40°0	er 5.00 kV C) 5.50 kV	Vac Vac
Inverter pack		Nb. of inverters	2 * MPPT 50	% Total Powe Pnom rat	er 5.0 kWa io 1.28	ac
Battery		Model	PVX-2120L			
Battery Pack Chara	cteristics	Manufacturer Nb. of units Voltage Discharging min. SOC	Concorde 2 in series x 4 24 V 50.0 %	4 in parallel Nominal Capaci Stored energ	ty 784 Ah jy 9.4 kWł	(C10) า
		I emperature	Fixed (20°C)			
Battery input charged Battery to Grid inv	ger rerter	Model Max. charging power Model	Generic 5.4 kWdc Generic	Max./ Euro efficienc	y 97.0/95	.0 %
-		Max. discharging power	5.6 kWac	Max./ Euro efficienc	y 97.0/95	.0 %
PV Array loss facto	ors	11 7 3		/ .		-216 / - /
I nermal Loss factor		Uc (const)	$20.0 \text{ W/m}^2\text{K}$	Uv (wind	u.u.w/n 1.5 º/ כ	n~K / M/S
		Giobai altay les.	332 munin	LUSS FIACIO	n 1.0 % a	1010
L						

PVSYST V6.86					21/04/20	Page 2/8	
	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6		
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	tion -0.8 % tion 1.0 % at MPP tion 0.10 % am. 0.05		



PVSYST V6.86					21/04/20	Page 4/8
(	Grid-Connected	System	n. Detailed Lls	er's needs		
		a)	i. Detailed 03			
Project :	Taman Midah (NEN	/1)				
Simulation variant :	SELCO - big family	- 6kw				
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings	<b>C</b> 0		- 00	
PV Field Orientation		tiit Model	5° JAM6-72-320/SI	azimuti Pnon	n 0° n 320.Wn	1
PV Array	Nb. of r	nodules	20	Pnom tota	al 6.40 kV	Vp
Inverter		Model	SUN2000L-5KTL	Pnon	n 5.00 kV	/ ac
User's needs	Daily household cor	sumers	Constant over the y	/ear Globa	al 11.91 N	1Wh/year
Daily household consum	ers, Constant over the	e year, a	verage = 32.6 kWh/	/day		
		Annua	l values			
	Use 5 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		30	18 W/lamp	5 h/	/day 2	2700 Wh/day
TV / PC / Mobile		3	70 W/app	14 h/	/day 2	2940 Wh/day
Iron		1	1200 W/app	1 h/	/day 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh	/day 3	3000 Wh/day
Dish- & Cloth-washers		1		2 Wh	/day	750 Wh/day
Instant water heater		2	2000 W tot	2 h/	/day 8	3000 Wh/day
Aircond		6	750 W tot	6 h/	/day 27	2000 Wh/day
Stand-by consumers				24 h/	/day	24 Wh/day
Total daily energy					43	of 14 wh/day
	Fraction of daily needs 3000 0 0000 0 0000 0 0000 0 0000 0 0000 0	Hourly	7 <b>profile</b> 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			

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	Grid-Connected S	ystem: Main results	
Project :	Taman Midah (NEM)		
Simulation variant :	SELCO - big family - 6kw		
Main system paramete	System type	Sheds on ground	
Near Shadings	Linear shadings		
PV Field Orientation	tilt	5° azimut	h O°
PV modules	Model	JAM6-72-320/SI Pnor	n 320 Wp
PV Array	Nb. of modules	20 Pnom tota	al <b>6.40 kWp</b>
Inverter	Model	SUN2000L-5KTL Pnor	n 5.00 kW ac
User's needs	Daily household consumers	Constant over the year Globa	al 11.91 MWh/year
Main simulation result	S		
System Production	Produced Energy	8.41 MWh/year Specific proc	I. 1314 kWh/kWp/year
	Performance Ratio PR	36.09 % Solar Fraction SI	= 30.97 %
Battery ageing (State of	Wear) Cycles SOW	80.8% Static SOV	V 80.0%
	Battery lifetime	5.0 years	







## SELCO - big family - 6kw Balances and main results

GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
kWh/m <sup>2</sup>	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
133.0	82.20	28.10	136.3	131.2	0.726	1.049	0.326	0.332	0.723
134.6	67.90	27.70	137.4	132.8	0.737	0.912	0.290	0.386	0.622
149.8	88.20	28.00	150.3	144.9	0.804	1.004	0.317	0.411	0.686
140.3	70.50	27.70	138.8	133.9	0.742	0.958	0.315	0.371	0.643
140.3	78.60	28.60	136.9	131.7	0.734	1.049	0.329	0.336	0.720
132.0	77.80	27.80	128.3	123.5	0.691	0.958	0.288	0.332	0.670
134.4	87.20	27.80	131.1	125.8	0.710	1.004	0.315	0.340	0.689
132.2	87.20	27.80	130.1	125.2	0.700	1.049	0.316	0.316	0.733
129.2	79.00	27.10	128.8	124.0	0.691	0.912	0.285	0.334	0.627
138.8	82.60	27.40	140.4	135.5	0.754	1.049	0.331	0.365	0.718
117.6	79.20	26.70	119.8	115.4	0.648	1.004	0.290	0.297	0.714
115.0	73.20	26.29	118.1	113.6	0.640	0.958	0.284	0.295	0.674
1597.2	953.59	27.58	1596.2	1537.5	8.575	11.905	3.687	4.115	8.219
-lor -	Iorizontal de	bal irradiatio	n .		GlobEff	Effectiv	e Clobal co	rr for IAM	and shadings
or F	Horizontal dif	fuse irradiati	on		FArray	Effectiv	e energy at	the output i	of the array
nh 1	F amh		on		E LISOr	Energy	supplied to	the user	or the array
	Slobal incider	nt in coll pla	ne		E_OSCI	Energy	Energy supplied to the user		
		n in coil. più	ne -		Ellnused	Linergy from the sun			
						Enorgy	from the ar	id	gria injection
	GlobHor <u>kWh/m²</u> 133.0 134.6 149.8 140.3 140.3 132.0 134.4 132.2 129.2 138.8 117.6 115.0 1597.2 Hor For nc C	GlobHor DiffHor   kWh/m² kWh/m²   133.0 82.20   134.6 67.90   149.8 88.20   140.3 70.50   140.3 78.60   132.0 77.80   132.2 87.20   129.2 79.00   138.8 82.60   117.6 79.20   15.0 73.20   1597.2 953.59   Horizontal difficit Global incider	GlobHor DiffHor T_Amb   kWh/m² °C   133.0 82.20 28.10   134.6 67.90 27.70   149.8 88.20 28.00   140.3 70.50 27.70   140.3 78.60 28.60   132.0 77.80 27.80   132.1 87.20 27.80   132.2 87.20 27.80   129.2 79.00 27.10   138.8 82.60 27.40   117.6 79.20 26.70   115.0 73.20 26.29   1597.2 953.59 27.58   Horizontal global irradiation or Horizontal diffuse irradiation or Horizontal dire or Horizontal diffuse irradiatire or Horizontal diffuse irrad	GlobHor DiffHor T_Amb GlobInc   kWh/m2 °C kWh/m2   133.0 82.20 28.10 136.3   134.6 67.90 27.70 137.4   149.8 88.20 28.00 150.3   140.3 70.50 27.70 138.8   140.3 78.60 28.60 136.9   132.0 77.80 27.80 128.3   134.4 87.20 27.80 131.1   132.2 87.20 27.80 130.1   129.2 79.00 27.10 128.8   138.8 82.60 27.40 140.4   117.6 79.20 26.70 119.8   115.0 73.20 26.29 118.1   1597.2 953.59 27.58 1596.2   Arr Horizontal diffuse irradiation 1596.2 1596.2   Nor Horizontal diffuse irradiation 1596.2 1596.2	GlobHor DiffHor T_Amb GlobInc GlobEff   kWh/m2 kWh/m2 °C kWh/m2 kWh/m2   133.0 82.20 28.10 136.3 131.2   134.6 67.90 27.70 137.4 132.8   149.8 88.20 28.00 150.3 144.9   140.3 70.50 27.70 138.8 133.9   140.3 78.60 28.60 136.9 131.7   132.0 77.80 27.80 128.3 123.5   134.4 87.20 27.80 130.1 125.8   132.2 87.20 27.80 130.1 125.2   129.2 79.00 27.10 128.8 124.0   138.8 82.60 27.40 140.4 135.5   117.6 79.20 26.70 119.8 115.4   1507 2953.59 27.58 1596.2 1537.5   for Horizontal diffuse irradiation 1596.2 1537.5 <td< td=""><td>GlobHor DiffHor T_Amb GlobInc GlobEff EArray   kWh/m2 kWh/m2 °C kWh/m2 kWh/m2 MWh   133.0 82.20 28.10 136.3 131.2 0.726   134.6 67.90 27.70 137.4 132.8 0.737   149.8 88.20 28.00 150.3 144.9 0.804   140.3 70.50 27.70 138.8 133.9 0.742   140.3 78.60 28.60 136.9 131.7 0.734   132.0 77.80 27.80 128.3 123.5 0.691   134.4 87.20 27.80 131.1 125.2 0.700   132.2 87.20 27.80 130.1 125.2 0.700   129.2 79.00 27.10 128.8 124.0 0.648   117.6 79.20 26.70 119.8 115.4 0.640   1597.2 953.59 27.58 1596.2 1537.5 8.575</td><td>GlobHor DiffHor T_Amb GlobInc GlobEft EArray E_User   kWh/m2 kWh/m2 °C kWh/m2 kWh/m2 MWh MWh   133.0 82.20 28.10 136.3 131.2 0.726 1.049   134.6 67.90 27.70 137.4 132.8 0.737 0.912   149.8 88.20 28.00 150.3 144.9 0.804 1.004   140.3 70.50 27.70 138.8 133.9 0.742 0.958   140.3 78.60 28.60 136.9 131.7 0.734 1.049   132.0 77.80 27.80 128.3 123.5 0.691 0.958   134.4 87.20 27.80 130.1 125.2 0.700 1.049   129.2 79.00 27.10 128.8 124.0 0.691 0.912   138.8 82.60 27.40 140.4 135.5 0.754 1.049   117.6 79.20</td><td>GlobHor DiffHor T_Amb GlobInc GlobEff EArray E_User E_Solar   kWh/m2 kWh/m2 °C kWh/m2 MWh MWh MWh   133.0 82.20 28.10 136.3 131.2 0.726 1.049 0.326   134.6 67.90 27.70 137.4 132.8 0.737 0.912 0.290   149.8 88.20 28.00 150.3 144.9 0.804 1.004 0.317   140.3 70.50 27.70 138.8 133.9 0.742 0.958 0.315   140.3 78.60 28.60 136.9 131.7 0.734 1.049 0.329   132.0 77.80 27.80 128.3 123.5 0.691 0.958 0.288   134.4 87.20 27.80 130.1 125.2 0.700 1.049 0.316   129.2 79.00 27.10 128.8 124.0 0.691 0.912 0.285   138.8</td></td<> <td>GlobHor DiffHor T_Amb GlobInc GlobEff EArray E_User E_Solar EUnused   kWh/m2 kWh/m2 °C kWh/m2 MWh MUh MUh MUh MUh MIssitintin</td>	GlobHor DiffHor T_Amb GlobInc GlobEff EArray   kWh/m2 kWh/m2 °C kWh/m2 kWh/m2 MWh   133.0 82.20 28.10 136.3 131.2 0.726   134.6 67.90 27.70 137.4 132.8 0.737   149.8 88.20 28.00 150.3 144.9 0.804   140.3 70.50 27.70 138.8 133.9 0.742   140.3 78.60 28.60 136.9 131.7 0.734   132.0 77.80 27.80 128.3 123.5 0.691   134.4 87.20 27.80 131.1 125.2 0.700   132.2 87.20 27.80 130.1 125.2 0.700   129.2 79.00 27.10 128.8 124.0 0.648   117.6 79.20 26.70 119.8 115.4 0.640   1597.2 953.59 27.58 1596.2 1537.5 8.575	GlobHor DiffHor T_Amb GlobInc GlobEft EArray E_User   kWh/m2 kWh/m2 °C kWh/m2 kWh/m2 MWh MWh   133.0 82.20 28.10 136.3 131.2 0.726 1.049   134.6 67.90 27.70 137.4 132.8 0.737 0.912   149.8 88.20 28.00 150.3 144.9 0.804 1.004   140.3 70.50 27.70 138.8 133.9 0.742 0.958   140.3 78.60 28.60 136.9 131.7 0.734 1.049   132.0 77.80 27.80 128.3 123.5 0.691 0.958   134.4 87.20 27.80 130.1 125.2 0.700 1.049   129.2 79.00 27.10 128.8 124.0 0.691 0.912   138.8 82.60 27.40 140.4 135.5 0.754 1.049   117.6 79.20	GlobHor DiffHor T_Amb GlobInc GlobEff EArray E_User E_Solar   kWh/m2 kWh/m2 °C kWh/m2 MWh MWh MWh   133.0 82.20 28.10 136.3 131.2 0.726 1.049 0.326   134.6 67.90 27.70 137.4 132.8 0.737 0.912 0.290   149.8 88.20 28.00 150.3 144.9 0.804 1.004 0.317   140.3 70.50 27.70 138.8 133.9 0.742 0.958 0.315   140.3 78.60 28.60 136.9 131.7 0.734 1.049 0.329   132.0 77.80 27.80 128.3 123.5 0.691 0.958 0.288   134.4 87.20 27.80 130.1 125.2 0.700 1.049 0.316   129.2 79.00 27.10 128.8 124.0 0.691 0.912 0.285   138.8	GlobHor DiffHor T_Amb GlobInc GlobEff EArray E_User E_Solar EUnused   kWh/m2 kWh/m2 °C kWh/m2 MWh MUh MUh MUh MUh MIssitintin





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		Grid-Conne	ected Syster	m: P50 - P90 ev	aluation		
Project :		Taman Mida	h (NEM)				
Simulation var	iant :	SELCO - big	family - 6kw				
Main system pa	rameter	S	System type	Sheds on ground			
Near Shadings PV Field Orientat PV modules PV Array Inverter User's needs	tion	Daily house	Linear shadings tilt Model Nb. of modules Model hold consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the yea	azimut Pnor Pnom tota Pnor ar Globa	h 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kW al 11.91 M	<b>∕p</b> / ac 1Wh/year
Evaluation of th	ie Produ	uction probability	/ forecast				
The probability di on the meteo data	istributio a used fo	n of the system pr or the simulation,	oduction forecast and depends on t	t for different years is m the following choices:	nainly depend	dent	
Meteo data sourc Meteo data Specified Deviatic Year-to-year varia	ce on ability	Year dev	Kind viation from aver. Variance	MeteoNorm 7.2 static Not defined 3 % 0.5 %	on Yea	ar 1995	
The probability di Specified Deviatio	istributio on S (meteo -	n variance is also PV module mode Inverter efficie oiling and mismat Degrada + system)	depending on so lling/parameters ency uncertainty ch uncertainties ation uncertainty Variance	me system parameters 1.0 % 0.5 % 1.0 % 1.0 % 1.9 % (q	s uncertaintie uadratic sum	s ı)	
Annual production	n probat	bility	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh			
			Probability	distribution			
	Dechodelite	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 P50 = 0 00 kWh 0.00 	X axis: no data fo	or the extremities definition !	 	Title 1.0	

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PVSYST V6.86			21/04/20 Page 1/8
	Grid-Connected System	n: Simulation parameters	3
Project :	Taman Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Countr	y <b>Malaysia</b>
Situation	Latitude	3.12° N Longitud	e 101.55° E
Time defined as	Legal Time Albedo	Time zone UT+8 Altitud	e 17 m
Meteo data:	Kuala Lumpur/Subang	MeteoNorm 7.2 station - Synthetic	2
Simulation variant :	SELCO - big family - 6kw		
	Simulation date	21/04/20 15h45	
Simulation parameter	s System type	Sheds on ground	
Collector Plane Orien	tation Tilt	5° Azimut	h O°
Models used	Transposition	Perez Diffus	e Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind Charging strategy Discharging strategy	Self-consumption, No grid reinjection When excess solar power is availand As soon as power is needed	on ble
User's needs :	Daily household consumers average	Constant over the year 15.7 kWh/Day	
PV Array Characterist PV module Original PVsyst datat Number of PV modules Total number of PV mod Array global power Array operating character Total area	ics Si-mono Model base Manufacturer In series dules Nb. modules Nominal (STC) eristics (50°C) U mpp Module area	JAM6-72-320/SI JA Solar 10 modules In paralle 20 Unit Nom. Powe 6.40 kWp At operating cond 336 V I mpp 38.8 m <sup>2</sup> Cell area	el 2 strings r 320 Wp l. 5.75 kWp (50°C) p 17 A a 34.4 m²
Inverter Original PVsyst data Characteristics	Model base Manufacturer Operating Voltage Nb. of inverters	SUN2000L-5KTL Huawei Technologies 90-500 V Unit Nom. Powe Max. power (=>40°C 2 * MPPT 50 % Total Powe	er 5.00 kWac 3) 5.50 kWac 9r 5.0 kWac
		Pnom rati	o 1.28
Battery	Model	PVX-2120L	
Battery Pack Character	ristics Nb. of units Voltage Discharging min. SOC	2 in series x 4 in parallel 24 V Nominal Capacit 50.0 % Stored energ Fixed (20°C)	y 784 Ah (C10) y 9.4 kWh
Battery input charger	Model Max. charging power	Generic 5.4 kWdc Max./ Euro efficienc	y 97.0/95.0 %
	Max. discharging power	5.6 kWac Max./ Euro efficienc	y 97.0/95.0 %
<b>PV Array loss factors</b> Thermal Loss factor	Uc (const)	20.0 W/m²K Uv (wind	l) 0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	332 mOhm Loss Fractio	n 1.5 % at STC
	•		

PVSYST V6.86					21/04/20	Page 2/8
	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	n -0.8 % n 1.0 % a n 0.10 % n. 0.05	t MPP



PVSYST V6.86					21/04/20	Page 4/8				
	Grid-Connected S	Svsten	n: Detailed Us	er's needs						
Project ·	Taman Midah (NEN	 /\								
Cimulation variant		() ()								
Simulation variant :	SELCO - big family	- 6KW								
Main system parameters	Syste	em type	Sheds on ground							
Near Shadings	Linear s	hadings			• •					
PV Field Orientation		tilt Model	5° IAM6-72-320/SI	azimuti	1 0° n 320.Wn					
PV Array	Nb. of r	modules	20	Pnom tota	al 6.40 kV	Vp				
Inverter		Model	SUN2000L-5KTL	Pnon	n 5.00 kV	/ ac				
User's needs	Daily household cor	nsumers	Constant over the y	/ear Globa	al 5734 k\	Wh/year				
Daily household consum	Daily household consumers, Constant over the year, average = 15.7 kWh/day Annual values									
	Use 2 days a week	Number	Power	Use		Energy				
Lamps (LED or fluo)		30	18 W/lamp	5 h/	/day 2	2700 Wh/day				
TV / PC / Mobile		3	70 W/app	14 h/	/day 2	2940 Wh/day				
Iron		1	1200 W/app	1 h/	/day 1	200 Wh/day				
Fridge / Deep-freeze		1		24 Wh	/day 3	3000 Wh/day				
Dish- & Cloth-washers		1		2 Wh	/day	750 Wh/day				
Instant water heater		2	2000 W tot	2 h/	/day 8	3000 Wh/day				
Aircona Stand by consumers		0	750 W 101	8 n/ 24 h	/day 30	24 Wb/day				
Total daily energy				24 11/	<sup>r</sup> uay 5/	$\frac{24}{Wh/day}$				
	Fraction of data 4000 00000 0000 0000 0000 0000 0000 0000 0000 0000	Hourly 6 9	<b>r profile</b> 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1							

PVSYST V6.86					21/04/20	Page 5/8
		Grid-Connected S	ystem: Main res	sults		
Project :		Taman Midah (NEM)				
Simulation variant : SELCO - big family - 6kw						
Main system par	ameters	System type	Sheds on ground			
Near Shadings		Linear shadings				
PV Field Orientation	on	tilt	5°	azimuth	0° ו	
PV modules		Model	JAM6-72-320/SI	Pnom	n 320 Wp	
PV Array		Nb. of modules	20	Pnom tota	d 6.40 kV	Vp
Inverter		Model	SUN2000L-5KTL	Pnom	n 5.00 kV	/ ac
User's needs		Daily household consumers	Constant over the year	ar Globa	l 5734 k\	Wh/year
Main simulation	results					
System Productio	n	Produced Energy	8.41 MWh/year	Specific prod	. 1314 k\	Nh/kWp/year
		Performance Ratio PR	21.32 % Sola	ar Fraction SF	<b>37.98</b> %	, D
Battery ageing (St	ate of We	ear) Cycles SOW	87.3%	Static SOV	V 80.0%	
		Battery lifetime	5.0 years			







## SELCO - big family - 6kw Balances and main results

	GlobHor	DiffHor	T Amb	GlobInc	GlobEff	EArray	E User	E Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	0.726	0.546	0.211	0.450	0.335
February	134.6	67.90	27.70	137.4	132.8	0.737	0.437	0.187	0.498	0.250
March	149.8	88.20	28.00	150.3	144.9	0.804	0.437	0.177	0.570	0.260
April	140.3	70.50	27.70	138.8	133.9	0.742	0.492	0.191	0.507	0.301
Мау	140.3	78.60	28.60	136.9	131.7	0.734	0.492	0.176	0.492	0.316
June	132.0	77.80	27.80	128.3	123.5	0.691	0.437	0.167	0.468	0.270
July	134.4	87.20	27.80	131.1	125.8	0.710	0.546	0.205	0.458	0.342
August	132.2	87.20	27.80	130.1	125.2	0.700	0.437	0.157	0.477	0.280
September	129.2	79.00	27.10	128.8	124.0	0.691	0.437	0.162	0.477	0.275
October	138.8	82.60	27.40	140.4	135.5	0.754	0.546	0.221	0.474	0.325
November	117.6	79.20	26.70	119.8	115.4	0.648	0.437	0.143	0.452	0.294
December	115.0	73.20	26.29	118.1	113.6	0.640	0.492	0.182	0.412	0.310
Year	1597.2	953.59	27.58	1596.2	1537.5	8.575	5.734	2.178	5.738	3.556
Legends: Glob	Hor H	Horizontal glo	obal irradiatio	on		GlobEff	Effectiv	e Global, co	orr. for IAM	and shadings
Diff	Hor H	Horizontal dif	fuse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb 1	Famb.				E_User	Energy	supplied to	the user	
Glob	olnc (	Global incider	nt in coll. pla	ne		E_Solar	Energy	from the su	un	
					EUnused	Unused	Unused energy (battery full, no grid injection)			
						EFrGrid	Energy	from the gr	id	





PVSYST V6.86						21/04/20	Page 8/8	
		Grid-Conr	nected Syster	m: P50 - P90 eva	aluation			
Project :		Taman Mid	ah (NEM)					
Simulation vari	iant :	SELCO - bi	g family - 6kw					
Main system par	rameters		System type	Sheds on ground				
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Daily hous	Linear shadings tilt Model Nb. of modules Model sehold consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the year	azimutl Pnon Pnom tota Pnon Globa	n 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kV al 5734 kV	<b>/p</b> / ac Vh/year	
Evaluation of the	e Produc	tion probabil	ty forecast					
The probability dis on the meteo data	stribution a used for	of the system	production forecast	t for different years is ma the following choices:	ainly depend	dent		
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	e on ability	Year de	Kind eviation from aver. Variance	MeteoNorm 7.2 station Not defined 3 % 0.5 %	n Yea	ır 1995		
The probability dis Specified Deviatio	stribution on P Soil	variance is als V module moc Inverter effi ling and misma Degra system)	o depending on so lelling/parameters ciency uncertainty atch uncertainties dation uncertainty Variance	me system parameters 1.0 % 0.5 % 1.0 % 1.0 % 1.9 % (gu	uncertaintie	S		
Annual production	n probabili	ity	Variability P50	0.00 MWh 0.00 MWh		<i>''</i>		
			P90 P95	0.00 MWh 0.00 MWh				
The probability distribution of the system production forecast for different years is mainly dependent on the meteo data used for the simulation, and depends on the following choices: Meteo data source MeteoNom 7.2 station Meteo data Source Near 1995 Specified Deviation Year deviation from aver. 3 % Year-to-year variability Variance is also depending on some system parameters uncertainties Specified Deviation PV module modelling/parameters 1.0 % Inverter efficiency uncertainty 0.5 % Soliling and mismatch uncertainties 1.0 % Degradation uncertainty 1.0 % Global variability (meteo + system) Variance 1.9 % (quadratic sum) Annual production probability Probability distribution Probability distribution Probability distribution Probability distribution Probability distribution								
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 50 = Q00 kWh 0.00 	X axis: no data fo 0.2 0.4 E_Grid sy	or the extremities definition !	8	1.0		

ГГ			
PVSYST V6.86			21/04/20 Page 1/8
Grid-	Connected Systen	n: Simulation parameter	S
Project : Tam	an Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Count	ry <b>Malaysia</b>
Situation	Latitude	3.12° N Longitud	de 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitud	de 17 m
Meteo data:	Albedo Kuala Lumpur/Subang	0.20 MeteoNorm 7.2 station - Synthet	ic
Simulation variant : SEL	CO - big family - 9kw		
	Simulation date	21/04/20 15h47	
Simulation parameters	System type	Sheds on ground	
<b>Collector Plane Orientation</b>	Tilt	5° Azimu	th 0°
Models used	Transposition	Perez Diffu	se Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind	Self-consumption, No grid reinject	ion
	Charging strategy Discharging strategy	As soon as power is needed	able
User's needs : Da	aily household consumers average	Constant over the year 32.6 kWh/Day	
PV Array Characteristics PV module Original PVsyst database Number of PV modules Total number of PV modules Array global power Array operating characteristics (50 Total area	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) D°C) U mpp Module area	JAM6-72-320/SI JA Solar 14 modules In parall 28 Unit Nom. Pow 8.96 kWp At operating con 470 V I mp 54.3 m <sup>2</sup> Cell are	lel 2 strings er 320 Wp d. 8.05 kWp (50°C) pp 17 A 2a 48 2 m <sup>2</sup>
Inverter Custom parameters definition Characteristics	Model Manufacturer Operating Voltage Nb. of inverters	SUN2000L-8KTL Huawei Technologies 200-850 V Unit Nom. Pow Max. power (=>40° 2 * MPPT 50 % Total Pow	er 8.00 kWac C) 8.80 kWac er 8.0 kWac
		Pnom rat	tio 1.12
Battery Battery Pack Characteristics	Model Manufacturer Nb. of units Voltage Discharging min. SOC Temperature	PVX-2120LConcorde3 in series x 4 in parallel36 VStored energy50.0 %Stored energyFixed (20°C)	ity 784 Ah (C10) gy 14.1 kWh
Battery input charger	Model	Generic	
Battery to Grid inverter	Max. charging power Model	7.5 kWdc Max./ Euro efficience Generic	cy 97.0/95.0 %
	Max. discharging power	5.6 kWac Max./ Euro efficiend	cy 97.0/95.0 %
PV Arrow loss fasters			
Thermal Loss factor	Lic (const)	20.0 W/m²K Llv (win	d) 00W/m²K/m/s
Wiring Ohmic Loss	Global arrav res.	465 mOhm Loss Fractio	on 1.5 % at STC

PVSYST V6.86					21/04/20	Page 2/8
	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	n -0.8 % n 1.0 % a n 0.10 % n. 0.05	t MPP



PVSYST V6.86					21/04/20	Page 4/8
(	Grid-Connected	System	n. Detailed Lise	er's needs		
		a)	I. Detailed 030			
Project :	Taman Midah (NEN	/1)				
Simulation variant :	SELCO - big family	- 9kw				
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings	50		00	
PV Field Orientation		tilt Model	5° IAM6-72-320/SI	azimutr	ו 0° א 320 Wn	
PV Array	Nb. of r	nodules	28	Pnom tota	<b>8.96 kV</b>	Vp
Inverter		Model	SUN2000L-8KTL	Pnom	n 8.00 kV	/ ac
User's needs	Daily household cor	sumers	Constant over the ye	ear Globa	l 11.91 N	1Wh/year
Daily household consum	ers, Constant over the	<b>year, a</b> v Annua	verage = 32.6 kWh/o	day		
	Use 5 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		30	18 W/lamp	5 h/	/day 2	2700 Wh/day
TV / PC / Mobile		3	70 W/app	14 h/	/day 2	940 Wh/day
Iron		1	1200 W/app	1 h/	/day 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh/	'day 3	8000 Wh/day
Dish- & Cloth-washers		1		2 Wh/	′day	750 Wh/day
Instant water heater		2	2000 W tot	2 h/	/day 8	8000 Wh/day
Aircond		6	750 W tot	6 h/	day 27	24 Wh/day
Total daily operay				24 n/	/day	24 Wh/day
	Figure 1000 Figure 1000 Figur	Hourly	<b>profile</b> 112 15 18 2	24		

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	Grid-Connected S	system: Main results				
Project :	Taman Midah (NEM)					
Simulation variant	: SELCO - big family - 9kw					
Main system parame	eters System type	Sheds on ground				
Near Shadings	Linear shadings					
PV Field Orientation	tilt	5° azimut	n 0°			
PV modules	Model	JAM6-72-320/SI Pnor	n 320 Wp			
PV Array	Nb. of modules	28 Pnom tota	al 8.96 kWp			
Inverter	Model	SUN2000L-8KTL Pnor	n 8.00 kW ac			
User's needs	Daily household consumers	Constant over the year Globa	al 11.91 MWh/year			
Main simulation resu	ults					
System Production	Produced Energy	11.78 MWh/year Specific proc	l. 1315 kWh/kWp/year			
	Performance Ratio PR	36.24 % Solar Fraction SI	= 43.54 %			
Battery ageing (State	of Wear) Cycles SOW	80.0% Static SOV	V 80.0%			
	Battery lifetime	5.0 years				







## SELCO - big family - 9kw Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	1.016	1.049	0.458	0.465	0.591
February	134.6	67.90	27.70	137.4	132.8	1.031	0.912	0.408	0.543	0.505
March	149.8	88.20	28.00	150.3	144.9	1.125	1.004	0.445	0.575	0.559
April	140.3	70.50	27.70	138.8	133.9	1.039	0.958	0.444	0.521	0.514
Мау	140.3	78.60	28.60	136.9	131.7	1.027	1.049	0.461	0.472	0.588
June	132.0	77.80	27.80	128.3	123.5	0.967	0.958	0.404	0.464	0.554
July	134.4	87.20	27.80	131.1	125.8	0.994	1.004	0.442	0.477	0.561
August	132.2	87.20	27.80	130.1	125.2	0.980	1.049	0.443	0.446	0.606
September	129.2	79.00	27.10	128.8	124.0	0.968	0.912	0.402	0.465	0.510
October	138.8	82.60	27.40	140.4	135.5	1.056	1.049	0.466	0.512	0.583
November	117.6	79.20	26.70	119.8	115.4	0.907	1.004	0.409	0.415	0.595
December	115.0	73.20	26.29	118.1	113.6	0.896	0.958	0.401	0.411	0.557
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	11.905	5.184	5.765	6.722
										······
Legends: Glob	Hor	Horizontal glo	obal irradiatio	on		GlobEff	Effectiv	e Global, co	orr. for IAM	and shadings
Diff	lor l	-lorizontal dif	fuse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb ¯	Г amb.				E_User	Energy	supplied to	the user	
Glob	olnc (	Global incider	nt in coll. pla	ne		E_Solar	Energy	from the su	un	
					EUnused	Unused	Unused energy (battery full, no grid injection)			
						EFrGrid	Energy	from the gr	id	





PVSYST V6.86						21/04/20	Page 8/8		
		Grid-Conne	ected Syster	m: P50 - P90 ev	aluation				
Project : Taman Midah (NEM)									
Simulation vari	iant :	SELCO - big	family - 9kw						
Main system pa	rameter	s	System type	Sheds on ground					
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Daily house	Linear shadings tilt Model Nb. of modules Model hold consumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the yea	azimut Pnor Pnom tota Pnor ar Globa	h 0° n 320 Wp al <b>8.96 kV</b> n 8.00 kW al 11.91 M	<b>∕p</b> / ac 1Wh/year		
Evaluation of the Production probability forecast									
The probability distribution of the system production forecast for different years is mainly dependent on the meteo data used for the simulation, and depends on the following choices:									
Meteo data sourc Meteo data Specified Deviatic Year-to-year varia	e on ability	Year dev	Kind iation from aver. Variance	MeteoNorm 7.2 statio Not defined 3 % 0.5 %	n Yea	ar 1995			
The probability dia Specified Deviatio	stributio on S (meteo -	n variance is also PV module mode Inverter efficie oiling and mismate Degrada + system)	depending on so lling/parameters ency uncertainty ch uncertainties ation uncertainty Variance	me system parameters 1.0 % 0.5 % 1.0 % 1.0 % 1.9 % (q	uncertaintie uadratic sum	s ı)			
Annual productior	n probat	bility	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh					
Probability distribution									
	Dockooliite	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 P50 = C00 kWh 0.00 P98-x46.004k	X axis: no data fo X axis: no data fo 0.2 0.4 E_Grid sy	or the extremities definition !	<u> </u> 0.8	1.0			

PVSYST V6.86			21/04/20 Page 1/8					
Grid-Connected System: Simulation parameters								
Project : Tam	an Midah (NEM)							
Geographical Site	Kuala Lumpur/Subang	Count	ry <b>Malaysia</b>					
Situation	. Latitude	3.12° N Longitu	de 101.55° E					
Time defined as	Legal Time	Time zone UT+8 Altitue	de 17 m					
Meteo data:	Albedo Kuala Lumpur/Subang	0.20 MeteoNorm 7.2 station - Synthet	ic					
Simulation variant : SEL	CO - big family - 9kw							
	Simulation date	21/04/20 15h48						
Simulation parameters	System type	Sheds on ground						
<b>Collector Plane Orientation</b>	Tilt	5° Azimu	th 0°					
Models used	Transposition	Perez Diffu	se Perez, Meteonorm					
Horizon	Free Horizon							
Near Shadings	Linear shadings							
Storage	Kind	Self-consumption, No grid reinject	tion					
	Charging strategy Discharging strategy	When excess solar power is availand As soon as power is needed	able					
User's needs : Da	aily household consumers average	Constant over the year 15.7 kWh/Day						
PV Array Characteristics PV module Original PVsyst database Number of PV modules Total number of PV modules Array global power Array operating characteristics (5	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) 0°C) U mpp Module area	JAM6-72-320/SI JA Solar 14 modules In paral 28 Unit Nom. Pow 8.96 kWp At operating con 470 V I mp	lel 2 strings er 320 Wp d. 8.05 kWp (50°C) pp 17 A					
Inverter Custom parameters definition Characteristics	Module area Model Manufacturer Operating Voltage Nb. of inverters	SUN2000L-8KTL Huawei Technologies 200-850 V Unit Nom. Pow Max. power (=>40° 2 * MPPT 50 % Total Pow	rer 8.00 kWac C) 8.80 kWac rer 8.0 kWac					
		Pnom rat	tio 1.12					
Battery Battery Pack Characteristics	Model Manufacturer Nb. of units Voltage Discharging min. SOC Temperature	PVX-2120LConcorde3 in series x 4 in parallel36 VStored energy50.0 %Stored energyFixed (20°C)	ity 784 Ah (C10) gy 14.1 kWh					
Battery input charger	Model							
Battery to Grid inverter	Model	Generic 5.6 kWac Max / Euro efficient	cy 97.0/95.0 %					
	war. userarying power		Jy 91.0/90.0 /0					
PV Array loss factors								
Thermal Loss factor	Un (const)	20.0 W/m²K Llv (win	d) 0.0 W/m²K / m/s					
Wiring Ohmic Loss	Global array res.	465 mOhm Loss Fraction	on 1.5 % at STC					
-								

PVSYST V6.86					21/04/20	Page 2/8			
Grid-Connected System: Simulation parameters									
Module Quality LossLoss FractModule Mismatch LossesLoss FractStrings Mismatch lossLoss FractIncidence effect, ASHRAE parametrizationIAM = 1 - bo (1/cos i - 1)bo Para				Loss Fractio Loss Fractio Loss Fractio bo Param	on -0.8 % on 1.0 % at MPP on 0.10 % m. 0.05				


PVSYST V6.86				2	21/04/20	Page 4/8
(	Grid-Connected S	System	n. Detailed Us	er's needs		
Brojoot :	Tomon Midoh (NEN	л)				
		") 				
Simulation variant :	SELCO - big family	- 9KW				
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings	<b>F</b> <sup>0</sup>	o – imuth	00	
PV modules		Model	5 JAM6-72-320/SI	Pnom	320 Wp	
PV Array	Nb. of r	nodules	28	Pnom total	8.96 kV	Vp
Inverter		Model	SUN2000L-8KTL	Pnom	8.00 kV	/ ac
User's needs	Daily household cor	nsumers	Constant over the y	ear Global	5734 k\	Wh/year
Daily household consum	ers, Constant over the	e year, av	verage = 15.7 kWh/	day		
		Annua	l values			
	Use 2 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		30	18 W/lamp	5 h/c	day 2	2700 Wh/day
TV / PC / Mobile		3	70 W/app	14 h/c	day 2	2940 Wh/day
Iron		1	1200 W/app	1 h/c	day 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh/c	day 3	3000 Wh/day
Dish- & Cloth-washers		1		2 Wh/c	day	750 Wh/day
Instant water heater		2	2000 W tot	2 h/c	day 8	3000 Wh/day
Aircond Stand by consumers		6	750 W tot	8 n/c	aay 30	24 Wh/day
Total daily energy				24 11/0	uay  5/	$\frac{24}{Wh/day}$
	Fundamental states of the stat	Hourly	r profile			

PVSYST V6.86					21/04/20	Page 5/8
		Grid-Connected S	ystem: Main res	sults		
Project :		Taman Midah (NEM)				
Simulation vari	ant :	SELCO - big family - 9kw				
Main system par	rameters	System type	Sheds on ground			
Near Shadings		Linear shadings				
PV Field Orientati	on	tilt	5°	azimuth	0° ו	
PV modules		Model	JAM6-72-320/SI	Pnom	n 320 Wp	
PV Array		Nb. of modules	28	Pnom tota	l 8.96 kV	Vp
Inverter		Model	SUN2000L-8KTL	Pnom	n 8.00 kV	/ ac
User's needs		Daily household consumers	Constant over the year	ar Globa	l 5734 k\	Wh/year
Main simulation	results					
System Productio	n	Produced Energy	11.78 MWh/year	Specific prod	. 1315 k\	Nh/kWp/year
		Performance Ratio PR	21.02 % Sola	ar Fraction SF	52.43 %	, D
Battery ageing (St	tate of We	ear) Cycles SOW	87.8%	Static SOW	/ 80.0%	
		Battery lifetime	5.0 years			





Performance Ratio PR



## SELCO - big family - 9kw Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	1.016	0.546	0.285	0.640	0.261
February	134.6	67.90	27.70	137.4	132.8	1.031	0.437	0.254	0.708	0.183
March	149.8	88.20	28.00	150.3	144.9	1.125	0.437	0.242	0.807	0.194
April	140.3	70.50	27.70	138.8	133.9	1.039	0.492	0.265	0.716	0.227
Мау	140.3	78.60	28.60	136.9	131.7	1.027	0.492	0.243	0.692	0.249
June	132.0	77.80	27.80	128.3	123.5	0.967	0.437	0.234	0.657	0.203
July	134.4	87.20	27.80	131.1	125.8	0.994	0.546	0.283	0.649	0.263
August	132.2	87.20	27.80	130.1	125.2	0.980	0.437	0.218	0.671	0.219
September	129.2	79.00	27.10	128.8	124.0	0.968	0.437	0.223	0.673	0.214
October	138.8	82.60	27.40	140.4	135.5	1.056	0.546	0.302	0.674	0.244
November	117.6	79.20	26.70	119.8	115.4	0.907	0.437	0.202	0.634	0.235
December	115.0	73.20	26.29	118.1	113.6	0.896	0.492	0.255	0.580	0.236
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	5.734	3.007	8.102	2.728
Legends: Glob	Hor I	Horizontal glo	obal irradiatio	on		GlobEff	Effectiv	e Global, co	orr. for IAM	and shadings
Diff	Hor I	-lorizontal dif	fuse irradiat	ion		EArray	Effectiv	e energy at	the output	of the array
T_A	mb <sup>-</sup>	Гamb.				E_User	Energy	supplied to	the user	
Glob	olnc (	Global incider	nt in coll. pla	ne		E_Solar	Energy	from the su	un	
						EUnused	Unused	l energy (ba	ttery full, no	grid injection
						EFrGrid	Energy	from the gr	id	





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		Grid-Con	nected Syster	m: P50 - P90 ev	aluation		
Project :		Taman Mic	lah (NEM)				
Simulation vari	iant :	SELCO - bi	g family - 9kw				
Main system par	rameter	S	System type	Sheds on ground			
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Daily hous	Linear shadings tilt Model Nb. of modules Model sehold consumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the yea	azimut Pnor Pnom tota Pnor r Globa	h 0° n 320 Wp al <b>8.96 kV</b> n 8.00 kW al 5734 kV	<b>/p</b> / ac Vh/year
Evaluation of the	e Produ	iction probabil	ity forecast				
The probability dia on the meteo data	stributior a used fo	n of the system or the simulatior	production forecast	t for different years is m the following choices:	ainly depend	dent	
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	e on ability	Year d	Kind eviation from aver. Variance	MeteoNorm 7.2 station Not defined 3 % 0.5 %	n Yea	ar 1995	
The probability dia Specified Deviation	stributior on So (meteo +	n variance is als PV module moo Inverter effi oiling and mism Degra ⊦ system)	to depending on so delling/parameters ciency uncertainty atch uncertainties dation uncertainty Variance	me system parameters 1.0 % 0.5 % 1.0 % 1.0 % 1.9 % (qu	uncertaintie uadratic sum	s ))	
Annual productior	n probab	bility	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh			
			Probability	distribution			
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 P50 = 000 kWh 0.00 - 298 - 200 0.0	X axis: no data fo	or the extremities definition !	<u> </u> 	1.0	

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	Grid-Connected System	n: Simulation parameters	5
Project :	Taman Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Country	y Malaysia
Situation	Latitude	3.12° N Longitude	e 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitude	e 17 m
Meteo data:	Kuala Lumpur/Subang	MeteoNorm 7.2 station - Synthetic	;
Simulation variant :	Own house - SELCO 6kw	inv	
	Simulation date	21/04/20 14h40	
Simulation parameters	System type	Sheds on ground	
Collector Plane Orienta	tion Tilt	5° Azimut	n 0°
Models used	Transposition	Perez Diffus	e Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind Charging strategy Discharging strategy	Self-consumption, No grid reinjection When excess solar power is available As soon as power is needed	on ble
User's needs :	Daily household consumers average	Constant over the year 30.4 kWh/Day	
PV Array Characteristics PV module Original PVsyst databas Number of PV modules Total number of PV modul Array global power Array operating characterin Total area	Si-mono Model se Manufacturer In series les Nb. modules Nominal (STC) stics (50°C) U mpp Module area	JAM6-72-320/SI JA Solar 10 modules In paralle 20 Unit Nom. Powe 6.40 kWp At operating cond 336 V I mpp 38.8 m <sup>2</sup> Cell area	el 2 strings r 320 Wp . 5.75 kWp (50°C) o 17 A a 34.4 m <sup>2</sup>
Inverter Original PVsyst databa Characteristics Inverter pack	Model Nee Manufacturer Operating Voltage Nb. of inverters	SUN2000L-5KTL Huawei Technologies 90-500 V Unit Nom. Powe Max. power (=>40°C 2 * MPPT 50 % Total Powe	r 5.00 kWac ) 5.50 kWac r 5.0 kWac
		Pnom ratio	o 1.28
Battery	Model	PVX-2120L	
Battery Pack Characteris	tics Nb. of units Voltage Discharging min. SOC	2 in series x 4 in parallel 24 V Nominal Capacit 50.0 % Stored energy	y 784 Ah (C10) y 9.4 kWh
Battery input charger	Model	Generic	
Battery to Grid inverter	Max. charging power Model	5.4 kWdc Max./ Euro efficiency Generic	/ 97.0/95.0 %
-	Max. discharging power	6.6 kWac Max./ Euro efficiency	/ 97.0/95.0 %
Thermal Loss factors	Lie (const)	20.0 W/m²k Llv (wind	) 0.0 $W/m^{2}k$ / m/s
Wiring Ohmic Loss	Global arrav res.	332 mOhm Loss Fraction	n 1.5 % at STC
<b>,</b>			

PVSYST V6.86					21/04/20	Page 2/9
	Grid-Connected Sy	/stem	n: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	n -0.8 % n 1.0 % a n 0.10 % n. 0.05	t MPP



PVSYST V6.86					21/04/20	Page 4/9
G	rid-Connected S	System	n. Detailed Use	er's needs		
Braiaat .	Tomon Midoh (NEN	<b>/</b> )				
Project :	i aman Midan (NEN					
Simulation variant : C	Own house - SELC	0 6kw i	inv			
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings				
PV Field Orientation		tilt Modol	5° IAM6-72-320/SI	azımuth	ר 0° מי 220 Wr	
PV Array	Nb. of r	nodules	20	Pnom tota	al <b>6.40 kV</b>	qV
Inverter		Model	SUN2000L-5KTL	Pnom	n 5.00 kV	/ ac
User's needs	Daily household cor	sumers	Constant over the ye	ear Globa	l 11.10 M	1Wh/year
Daily household consumer	rs, Constant over the	e year, av	verage = 30.4 kWh/c	day		
		Annua	l values			
	Use 5 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		30	18 W/lamp	6 h/	/day 2	970 Wh/day
TV / PC / Mobile		3	70 W/app	4 h/	/day	840 Wh/day
Iron		1	1200 W/app	1 h/	/day 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh/	/day 3	8000 Wh/day
Disn- & Cloth-Washers			2000 W/ tot	2 VVN/ 1 b/	/day	000 Wh/day
Aircond		6	2000 W tot	1 11/ 7 h/	/day 31	500 Wh/day
Stand-by consumers		0	730 W tot		/day	24 Wh/day
Total daily energy			ĮĮ.		42	2534 Wh/day
	Faction of daily end 000 1000 000 000 000 000 000 0	Hourly	<b>/ profile</b>	1 24		

	-										
PVSYST V6.86									21/04/2	20 Р	'age 5/9
		Grid	-Conn	ected S	Syster	n: Mai	n resu	lts			
Project :	Та	aman Mi	idah (NE	EM)							
Simulation var	riant : O	wn hous	se - SEL	.CO 6kw	/ inv						
Main system pa	arameters		Sys	stem type	Shed	s on gro	und				
Near Shadings PV Field Orienta PV modules PV Array Inverter User's needs	tion	Daily hou	Linear Nb. o usehold c	shadings til Mode f modules Mode onsumers	s t 5° I JAM6 s 20 I SUN2 s Cons	-72-320/\$ 2000L-5K <sup>-</sup> tant over	SI FL the year	azimu Pno Pnom to Pno Glob	oth 0° om 320 tal <b>6.40</b> om 5.00 oal 11.1	Wp <b>kWp</b> kW ac 0 MWh/ <u>y</u>	year
Main simulatior	n results										
System Producti Battery ageing (S	on State of Wear)	Per	Produce formance Cyc	d Energy Ratio PR cles SOW	8.41 8 30.52 9 81.29	MWh/yea %	ar Sp Solar I	ecific pro Fraction S Static SO	od. 1314 SF 28.0 W 80.0	4 kWh/k\ 9 % %	Np/year
Normalized product	ions (per installe	d kWp): No	minal powe	r 6.40 kWp			Pe	erformance	Ratio PR		
6 Lc : Coll Ls : Sys 5 5 1 4 4 4 1 5 5 5 5 5 5 5 5 5 5 5 5 5	tar Apr May Jur	rter output)	0.7 kWh/kWp/day 2.34 kWh/kWp/da 1.33 kWh/kWp/da 1.33 kWh/kWp/da	vy ay	Performance Ratio PR	1.0 PF	R : Performance	Ratio (Yf / Yr) :	Jul Aug	Sep Oct	Nov Dec
			Ow Ba	n house - Ilances ar	SELCO	6kw inv results					
	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid	]
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh	4
January	133.0	82.20	28.10	136.3	131.2	0.726	0.978	0.276	0.380	0.703	

	Glob	Hor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh	/m²	kWh/m²	°C	kWh/m <sup>2</sup>	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133	.0	82.20	28.10	136.3	131.2	0.726	0.978	0.276	0.380	0.703
February	134	.6	67.90	27.70	137.4	132.8	0.737	0.851	0.248	0.424	0.603
March	149	.8	88.20	28.00	150.3	144.9	0.804	0.936	0.268	0.457	0.667
April	140	0.3	70.50	27.70	138.8	133.9	0.742	0.893	0.264	0.418	0.629
Мау	140	0.3	78.60	28.60	136.9	131.7	0.734	0.978	0.276	0.387	0.702
June	132	.0	77.80	27.80	128.3	123.5	0.691	0.893	0.240	0.376	0.653
July	134	.4	87.20	27.80	131.1	125.8	0.710	0.936	0.271	0.379	0.664
August	132	.2	87.20	27.80	130.1	125.2	0.700	0.978	0.264	0.367	0.714
Septembe	er 129	.2	79.00	27.10	128.8	124.0	0.691	0.851	0.239	0.378	0.612
October	138	8.8	82.60	27.40	140.4	135.5	0.754	0.978	0.276	0.417	0.702
November	r 117	.6	79.20	26.70	119.8	115.4	0.648	0.936	0.245	0.336	0.690
December	- 115	.0	73.20	26.29	118.1	113.6	0.640	0.893	0.248	0.324	0.645
Year	159	7.2	953.59	27.58	1596.2	1537.5	8.575	11.101	3.118	4.642	7.983
Legends:	GlobHor	ł	Horizontal glo	bal irradiatio	n		GlobEff	Effectiv	e Global, coi	r. for IAM a	nd shadings
	DiffHor	ŀ	- Horizontal difi	fuse irradiatio	on		EArray	Effectiv	e energy at	the output o	f the array
	T_Amb	٦	Г amb.				E_User	Energy	supplied to	the user	
	GlobInc	(	Global incider	it in coll. plar	ie		E_Solar	Energy	from the su	n	
							EUnused	Unused	energy (bat	tery full, no	grid injection)
							EFrGrid	Energy	from the gri	d	





PVSYST V6.86						:	21/04/20	Page 8/9
		Grid-Conne	ected Syster	m: P50 - P90	) evalua	ation		
Project :		Taman Mida	h (NEM)					
Simulation var	iant :	Own house -	SELCO 6kw	inv				
Main system pa	rameters		System type	Sheds on grour	nd			
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Daily housel	Linear shadings tilt Model Nb. of modules Model nold consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over th	Pn - e year	azimuth Pnom om total Pnom Global	0° 320 Wp <b>6.40 kW</b> 5.00 kW 11.10 N	<b>/p</b> / ac  Wh/year
Evaluation of th	e Product	tion probability	forecast					
The probability dia on the meteo data	istribution of a used for	of the system protocol the simulation, a	oduction forecast and depends on t	t for different years	s is mainly ces:	depend	ent	
Meteo data sourc Meteo data Specified Deviatic Year-to-year varia	ce on ability	Year dev	' Kind iation from aver. Variance	MeteoNorm 7.2 : Not defined 3 % 0.5 %	station	Year	<sup>-</sup> 1995	
The probability dia Specified Deviatio	istribution v on P <sup>v</sup> Soil (meteo + s	variance is also V module model Inverter efficie ing and mismato Degrada system)	depending on so ling/parameters ency uncertainty ch uncertainties ation uncertainty Variance	me system param 1.0 % 0.5 % 1.0 % 1.0 % 1.9 %	eters unce (quadra	ertainties atic sum)		
Annual production	n probabili	ty	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh				
			Probability	distribution				
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 50 = 000 kWh 0.00 	X axis: no data fo We so www. 0.2 0.4 E_Grid sy	or the extremities defini	ition !		.0	

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	Grid-C	connected Sy	vstem: CO2 Ba	lance		
Project :	Taman Mid	ah (NEM)				
Simulation variant :	Own house	e - SELCO 6kw	inv			
Main system parameters		System type	Sheds on ground			
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Daily hous	Linear shadings tilt Model Nb. of modules Model ehold consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the ye	azimut Pnor Pnom tota Pnor ear Globa	h 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kV al 11.10 N	V <b>p</b> V ac /Wh/year
Produced Emissions		<b>Total:</b> Source:	<b>11.84 tCO2</b> Detailed calculation	from table be	ow	
Replaced Emissions	Sy	Total: stem production:	<b>166.5 tCO2</b> 8408.96 kWh/yr Annus	Lifetime al Degradatior	e: 30 year n: 1.0 %	S
	Grid Life	cycle Emissions: Source:	660 gCO2/kWh IEA List	Country	/: Malaysi	а
CO2 Emission Balance		Total:	132.6 tCO2			
System Lifecycle Emissic	one Details:					
Item		M	odules		Supports	
LCE		1713 k	gCO2/kWp	2	1.40 kgCO2/kg	J
Subtotal [kgCO	2]	1	0961		880	
		Saved CO2 Er 140 120 100 60 40 -20 0 5 1	nission vs. Time			

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	Grid-Connected System	n: Simulation parameters	3
Project :	Taman Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Countr	y <b>Malaysia</b>
Situation	Latitude	3.12° N Longitud	e 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitud	e 17 m
Meteo data:	Kuala Lumpur/Subang	0.20 MeteoNorm 7.2 station - Synthetic	2
Simulation variant :	Own house - SELCO 6kw	inv	
	Simulation date	21/04/20 14h41	
Simulation parameters	System type	Sheds on ground	
Collector Plane Orienta	tion Tilt	5° Azimut	h 0°
Models used	Transposition	Perez Diffus	e Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind	Self-consumption, No grid reinjection	on
	Charging strategy Discharging strategy	When excess solar power is availa As soon as power is needed	ble
User's needs :	Daily household consumers average	Constant over the year 12.8 kWh/Day	
PV Array Characteristic PV module	s Si-mono Model	JAM6-72-320/SI	
Number of PV modules	In series	10 modules In paralle	el 2 strings
Total number of PV modu	les Nb. modules	20 Unit Nom. Powe	r 320 Wp
Array operating character	istics (50°C) U mpp	336 V At operating cond	5.75 kwp (50 C) 5 17 A
Total area	Module area	38.8 m <sup>2</sup> Cell area	a 34.4 m²
Inverter	Model	SUN2000L-5KTL	
Original PVsyst databa Characteristics	ase Manufacturer Operating Voltage	Huawei Technologies 90-500 V Unit Nom. Power	er 5.00 kWac
Inverter pack	Nh. of invortors	iviax. power (=>40°C 2 * MPPT 50 % Total Dowe	h = 5.00  kWac
nivenei pauk	ND. OF INVERTERS	2 WEELSO / Poom rati	o 1.28
Battery	Model	PVX-2120L	
Battery Pack Characteris	tics Nb. of units	2 in series x 4 in parallel	
	Discharging min. SOC Temperature	50.0 % Stored energ Fixed (20°C)	y 9.4 kWh
Battery input charger	Mov. charging power	Generic	
Battery to Grid inverter	Model	Generic	y 97.0/93.0 %
	Max. discharging power	6.6 kWac Max./ Euro efficiency	y 97.0/95.0 %
PV Arrav loss factors			
Thermal Loss factor	Uc (const)	20.0 W/m²K Uv (wind	l) 0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	332 mOhm Loss Fractio	n 1.5 % at STC

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	Grid-Connected Sy	/stem	n: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	n -0.8 % n 1.0 % a n 0.10 % n. 0.05	t MPP



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	Grid-Connected	Svetor	n. Detailed Lls	or's noods		
Droinet :			i. Detailed 03			
Project :		//) 				
Simulation variant	: Own nouse - SELC	O 6KW I	nv			
Main system parame	ters Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings				
PV Field Orientation		tilt Model	5° IAM6-72-320/SI	azimut	h 0° m 320.Wn	, ,
PV Array	Nb. of I	modules	20	Pnom tota	al <b>6.40 kV</b>	Vp
Inverter		Model	SUN2000L-5KTL	Pnor	n 5.00 kV	V ac
User's needs	Daily household cor	nsumers	Constant over the y	year Globa	al 4687 KN	/Vh/year
Daily household con	sumers, Constant over the	e year, av	verage = 12.8 kWh/	/day		
		_				
		Annua	l values			
	Use 2 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		30	18 W/lamp	6 h	/day 2	2970 Wh/day
TV / PC / Mobile		3	70 W/app	14 h	/day 2	2940 Wh/day
Iron		1	1200 W/app	1 h	/day 1	1200 Wh/day
Fridge / Deep-freeze	<del>5</del>	1		24 Wh	/day 3	3000 Wh/day
Dish- & Cloth-washe	ers	1		2 Wh	/day 1	1000 Wh/day
Instant water heate	r	1	2000 W tot	1 h	/day 2	2000 Wh/day
Aircond		6	750 W tot	7 h	/day 31	1500 Wh/day
Stand-by consumers	5			24 h	/day	24 Wh/day
l otal dally energy					44	1634 Wh/day
		Hourly	profile			
	≊ 7000 <mark></mark>					
	6000 - 5000 -					
	5000 - ≥ 4000 -					
	· <sup>reg</sup> 3000 -			-1		
	ົ <u></u> 2000					
	0 3	6 9	12 15 18	21 24		

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									2.00.02		
		Grid	-Conn	ected \$	Syster	n: Mai	n resu	lts			
Project :	Та	man Mi	dah (NE	EM)							
Simulation variant	:: 0	vn hous	se - SEL	_CO 6kw	/ inv						
Main system parame	eters		Sy	stem type	Shed	s on gro	und				
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs		Daily hou	Linear Nb. c usehold c	r shadings til Mode f modules Mode consumers	s t 5° I JAM6 s 20 I SUN2 s Const	-72-320/\$ 2000L-5K <sup></sup> ant over t	SI TL the year	azimu Pnc Pnom to Pnc Glot	om 320 tal <b>6.40</b> om 5.00 oal 4687	Wp <b>kWp</b> kW ac ⁄ kWh/ye	ar
Main simulation res System Production Battery ageing (State	ults of Wear)	Per	<b>Produce</b> formance Cyc	ed Energy e Ratio PF cles SOW	<b>/ 8.41</b> R 16.70 / 87.6%	MWh/yea %	ar Sp Solar F	ecific pro Fraction S Static SO	od. 1314 SF 36.4 W 80.0	4 kWh/k\ 0 % %	Vp/year
Normalized productions (per installed kWp): Nominal power 6.40 kWp Performance Ratio PR											
Lc : Collection Lc Ls : System Loss 5	<pre>6 6 7 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9</pre>								Nov Dec		
			Ba	alances ai	nd main	results					
	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb ℃	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_User MWh	E_Solar MWh	EUnused MWh	EFrGrid MWh	
January	133.0	82.20	28.10	136.3	131.2	0.726	0.446	0.156	0.499	0.290	
March	134.0	88.20	27.70	157.4	132.8 144.9	0.737	0.357	0.138	0.605	0.219	
April	140.3	70.50	27.70	138.8	133.9	0.742	0.402	0.153	0.538	0.249	
Мау	140.3	78.60	28.60	136.9	131.7	0.734	0.402	0.139	0.519	0.262	
June	132.0	77.80	27.80	128.3	123.5	0.691	0.357	0.134	0.495	0.223	
	124.4	07.00		1 141 1	175.8		1 1/4/6	1 161	1 1/106	11/25	
August	134.4 132.2	87.20 87.20	27.80 27.80	131.1	125.0	0.710	0.440	0.124	0.475	0.200	
August September	134.4 132.2 129.2	87.20 87.20 79.00	27.80 27.80 27.10	130.1 128.8	125.2 124.0	0.700	0.357	0.124	0.506	0.233	
August September October	134.4 132.2 129.2 138.8	87.20 87.20 79.00 82.60	27.80 27.80 27.10 27.40	130.1 128.8 140.4	125.0 125.2 124.0 135.5	0.700 0.691 0.754	0.357 0.357 0.446	0.124 0.124 0.170	0.473 0.506 0.509 0.518	0.233 0.233 0.277	
August September October November	134.4 132.2 129.2 138.8 117.6	87.20 87.20 79.00 82.60 79.20	27.80 27.80 27.10 27.40 26.70	130.1 128.8 140.4 119.8	125.0 125.2 124.0 135.5 115.4	0.700 0.691 0.754 0.648	0.357 0.357 0.446 0.357	0.124 0.124 0.170 0.122	0.473 0.506 0.509 0.518 0.466	0.233 0.233 0.277 0.235	
August September October November December	134.4 132.2 129.2 138.8 117.6 115.0	87.20 87.20 79.00 82.60 79.20 73.20	27.80 27.80 27.10 27.40 26.70 26.29	130.1 128.8 140.4 119.8 118.1	125.0 125.2 124.0 135.5 115.4 113.6	0.710 0.700 0.691 0.754 0.648 0.640	0.357 0.357 0.446 0.357 0.402	0.124 0.124 0.170 0.122 0.149	0.493 0.506 0.509 0.518 0.466 0.438	0.233 0.233 0.277 0.235 0.253	

Legends: GlobHor DiffHor

T\_Amb

GlobInc

Horizontal global irradiation Horizontal diffuse irradiation T amb. Global incident in coll. plane GlobEff Effective Global, corr. for IAM and shadings EArray Effective energy at the output of the array E\_User Energy supplied to the user E\_Solar Energy from the sun EUnused Unused energy (battery full, no grid injection) EFrGrid Energy from the grid







PVSYST V6.86				21/04/20	Page 8/9
	Grid-Connected System	n: P50 - P90 eva	luation		
Project :	Taman Midah (NEM)				
Simulation varia	nt : Own house - SELCO 6kw in	าง			
Main system para	meters System type	Sheds on ground			
Near Shadings PV Field Orientatio PV modules PV Array Inverter User's needs	Linear shadings n tilt 5 Model 5 Nb. of modules 2 Model 5 Daily household consumers 6	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the year	azimutl Pnon Pnom tota Pnon Globa	n 0° n 320 Wp n <b>6.40 kW</b> n 5.00 kW n 4687 kV	<b>/p</b> / ac Vh/year
Evaluation of the	Production probability forecast				
The probability dist	ibution of the system production forecast four section is a simulation, and depends on the	for different years is mai	nly depend	dent	
Meteo data source Meteo data Specified Deviation Year-to-year variab	ا Kind Year deviation from aver. 3 النام النام ال	MeteoNorm 7.2 station Not defined 3 % 0.5 %	Yea	r 1995	
The probability dist Specified Deviation Global variability (n	ribution variance is also depending on som PV module modelling/parameters Inverter efficiency uncertainty Soiling and mismatch uncertainties Degradation uncertainty neteo + system) Variance	ne system parameters un 1.0 % 0.5 % 1.0 % 1.0 % 1.9 % (qua	ncertaintie	s )	
Annual production	probability Variability P50 ( P90 ( P95 (	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh			
	Probability c	distribution			
	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 P50 = 000  kWh 0.00 P50 = 000  kWh 0.02 0.25  kWh 0.04 0.05  kWh 0.05 P50 = 000  kWh 0.04 0.25  kWh 0.05 P50 = 000  kWh 0.26  kWh	the extremities definition !	I	1.0	

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	Grid-C	onnected Sy	vstem: CO2 Ba	lance				
Project :	Taman Mid	ah (NEM)						
Simulation variant :	Own house	- SELCO 6kw	inv					
Main system parameters		System type	Sheds on ground					
Near Shadings PV Field Orientation PV modules PV Array Inverter User's needs	Daily hous	Linear shadings tilt Model Nb. of modules Model ehold consumers	5° JAM6-72-320/SI 20 SUN2000L-5KTL Constant over the ye	azimut Pnor Pnom tot Pnor ear Glob	h 0° n 320 Wp al <b>6.40 kV</b> n 5.00 kW al 4687 kV	<b>∕p</b> ∕ ac Vh/year		
Produced Emissions		<b>Total:</b> Source:	<b>11.84 tCO2</b> Detailed calculation	from table be	ow			
Replaced Emissions	eplaced Emissions Total: System production: Grid Lifecycle Emissions: Source:			<ul> <li>166.5 tCO2</li> <li>8408.96 kWh/yr Lifetime: 30 years Annual Degradation: 1.0 %</li> <li>660 gCO2/kWh</li> <li>IEA List Country: Malaysia</li> </ul>				
CO2 Emission Balance		Total:	132.6 tCO2					
System Lifecycle Emissio	ns Details:	Ma 1713 k 6.4 1	odules gCO2/kWp 0 kWp 0961		Supports I.40 kgCO2/kg 200 kg 880			
		Saved CO2 En 140 120 100 40 -20 0 5 1	nission vs. Time					

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(	Grid-Connected System	n: Simulation parameter	S
Proiect :	Taman Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Count	rv <b>Malavsia</b>
Situation	Latitude	3 12° N Longitur	de 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitud	de 17 m
Matao data	Albedo	0.20 MotooNorm 7.2 station Syntheti	
Simulation variant :	Own house - SELCO 9kw	inv	
	Simulation date	21/04/20 15h11	
Simulation parameters	System type	Sheds on ground	
Collector Plane Orientati	on Tilt	5° Azimu	th 0°
Models used	Transposition	Perez Diffus	se Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind	Self-consumption, No grid reinject	ion
	Charging strategy Discharging strategy	When excess solar power is availa As soon as power is needed	able
User's needs :	Daily household consumers average	Constant over the year 30.4 kWh/Day	
PV Array Characteristics PV module Original PVsyst database Number of PV modules Total number of PV module Array global power Array operating characteris Total area	Si-mono Model Manufacturer In series s Nb. modules Nominal (STC) tics (50°C) U mpp Module area	JAM6-72-320/SI JA Solar 14 modules In parall 28 Unit Nom. Powe 8.96 kWp At operating cone 470 V I mp 54.3 m <sup>2</sup> Cell are	el 2 strings er 320 Wp d. 8.05 kWp (50°C) p 17 A ea 48.2 m <sup>2</sup>
Inverter Custom parameters defi Characteristics	Model nition Manufacturer Operating Voltage Nb. of inverters	SUN2000L-8KTL Huawei Technologies 200-850 V Unit Nom. Pow Max. power (=>40°C 2 * MPPT 50 % Total Pow	er 8.00 kWac C) 8.80 kWac er 8.0 kWac
		Pnom rat	io 1.12
Battery	Model	PVX-2120L	
Battery Pack Characteristic	Manufacturer cs Nb. of units Voltage Discharging min. SOC Temperature	Concorde 3 in series x 4 in parallel 36 V Nominal Capaci 50.0 % Stored energy Fixed (20°C)	ty 784 Ah (C10) gy 14.1 kWh
Battery input charger	Model	Generic	
Battery to Grid inverter	Max. charging power Model	7.5 kWdc Max./ Euro efficienc Generic	cy 97.0/95.0 %
	Max. discharging power	6.6 kWac Max./ Euro efficience	cy 97.0/95.0 %
PV Array loss factors			
Thermal Loss factor	Uc (const)	20.0 W/m²K Uv (win	d) 0.0 W/m²K / m/s
vviring Ohmic Loss	Global array res.	465 mOhm Loss Fractio	on 1.5 % at STC

PVSYST V6.86					21/04/20	Page 2/8
	Grid-Connected Sy	rsterr	: Simulation pa	arameters	6	
Module Quality Le Module Mismatch Strings Mismatch Incidence effect,	oss n Losses n loss ASHRAE parametrization I/	AM =	1 - bo (1/cos i - 1)	Loss Fractio Loss Fractio Loss Fractio bo Param	n -0.8 % n 1.0 % a n 0.10 % n. 0.05	t MPP



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G	rid-Connected S	System	n. Detailed Lise	r's needs		
Draigat .	Tomon Midoh (NEN	<b>/</b> )		10110040		
Project :	i aman Midan (NEN	//) 				
Simulation variant : 0	Own house - SELC	:O 9kw i	inv			
Main system parameters	Syste	em type	Sheds on ground			
Near Shadings	Linear s	hadings	50		00	
PV Field Orientation		tilt Model	5° IAM6-72-320/SI	azimuth	ו 0° איז 220 W/m	
PV Array	Nb. of r	nodules	28	Pnom tota	<b>8.96 kV</b>	Vp
Inverter		Model	SUN2000L-8KTL	Pnom	n 8.00 kV	/ ac
User's needs	Daily household cor	sumers	Constant over the yea	ar Globa	I 11.10 N	1Wh/year
Daily household consume	rs, Constant over the	e year, av	verage = 30.4 kWh/da	ay		
		Annua	l values			
	Use 5 days a week	Number	Power	Use		Energy
Lamps (LED or fluo)		30	18 W/lamp	6 h/	/day 2	2970 Wh/day
TV / PC / Mobile		3	70 W/app	4 h/	/day	840 Wh/day
Iron		1	1200 W/app	1 h/	/day 1	200 Wh/day
Fridge / Deep-freeze		1		24 Wh/	'day 3	8000 Wh/day
Disn- & Cloth-Washers			2000 W/ tot	2 WN/	day (day	1000 Wh/day
Aircond		6	2000 W tot	1 11/ 7 h/	/day 31	500 Wh/day
Stand-by consumers		0	730 W lot		day 5	24 Wh/day
Total daily energy			ĮĮ		42	2534 Wh/day
		Hourly	<b>v profile</b>	24		

PVSYST V6.86				2	21/04/20	Page 5/8			
		Grid-Connected S	ystem: Main results	;					
Project :		Taman Midah (NEM)							
Simulation varia	Simulation variant : Own house - SELCO 9kw inv								
Main system para	ameters	System type	Sheds on ground						
Near Shadings		Linear shadings							
PV Field Orientatio	on	tilt	5°	azimuth	0°				
PV modules		Model	JAM6-72-320/SI	Pnom	320 Wp				
PV Array		Nb. of modules	28 Pn	om total	8.96 kV	/p			
Inverter		Model	SUN2000L-8KTL	Pnom	8.00 kV	/ ac			
User's needs		Daily household consumers	Constant over the year	Global	11.10 N	1Wh/year			
Main simulation r	results								
System Production	า	Produced Energy	11.78 MWh/year Speci	ific prod.	1315 k\	Wh/kWp/year			
		Performance Ratio PR	31.64 % Solar Frac	ction SF	40.76 %	)			
Battery ageing (Sta	ate of We	ear) Cycles SOW	80.1% Stat	ic SOW	80.0%				
		Battery lifetime	5.0 years						





Performance Ratio PR



## Own house - SELCO 9kw inv Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_User	E_Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	1.016	0.978	0.400	0.522	0.578
February	134.6	67.90	27.70	137.4	132.8	1.031	0.851	0.358	0.589	0.492
March	149.8	88.20	28.00	150.3	144.9	1.125	0.936	0.388	0.630	0.548
April	140.3	70.50	27.70	138.8	133.9	1.039	0.893	0.384	0.580	0.509
Мау	140.3	78.60	28.60	136.9	131.7	1.027	0.978	0.400	0.532	0.578
June	132.0	77.80	27.80	128.3	123.5	0.967	0.893	0.350	0.517	0.543
July	134.4	87.20	27.80	131.1	125.8	0.994	0.936	0.392	0.524	0.544
August	132.2	87.20	27.80	130.1	125.2	0.980	0.978	0.385	0.504	0.594
September	129.2	79.00	27.10	128.8	124.0	0.968	0.851	0.347	0.520	0.504
October	138.8	82.60	27.40	140.4	135.5	1.056	0.978	0.402	0.575	0.576
November	117.6	79.20	26.70	119.8	115.4	0.907	0.936	0.357	0.462	0.579
December	115.0	73.20	26.29	118.1	113.6	0.896	0.893	0.361	0.445	0.532
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	11.101	4.525	6.400	6.576
Laganda, Clab	llor l	lorizontol ala	hal imadiati			ClabEff	Effectio	. Clabal as	tor IAM	and chodings
Legends: Glob	HOF I	Horizontal gio	odal irradiatio	on Is is		GIODEIT	Effectiv	e Global, co	orr. for TAIM	and snadings
DITT	HOF I	Horizontal dir	ruse irradiat	ion		EArray	Effectiv	e energy at	the output	or the array
I_A	mb	amb.				E_User	Energy	supplied to	the user	
Glob	oinc (	iobal incider	nt in coll. pla	ne		E_Solar	Energy	from the su	un	
						EUnused	Unused	l energy (ba	ttery full, no	grid injection
						EFrGrid	Energy	from the gr	id	





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		Grid-Conne	cted Syster	m: P50 - P90	evaluat	ion		
Project :		Taman Midah	n (NEM)					
Simulation var	iant :	Own house -	SELCO 9kw	inv				
Main system pa	rameters	5	System type	Sheds on groun	d			
Near Shadings PV Field Orientat PV modules PV Array Inverter User's needs	lion	L Daily househ	inear shadings tilt Model Nb. of modules Model old consumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the	az Pnor e year (	zimuth Pnom n total Pnom Global	0° 320 Wp <b>8.96 kW</b> 8.00 kW 11.10 M	<b>/p</b> / ac IWh/year
Evaluation of th	e Produc	ction probability	forecast					
The probability di on the meteo dat	istribution a used for	of the system pro	oduction forecast	t for different years	is mainly de	epende	ent	
Meteo data sourc Meteo data Specified Deviatio Year-to-year varia	ce on ability	Year devia	Kind ation from aver. Variance	MeteoNorm 7.2 s Not defined 3 % 0.5 %	station	Year	1995	
The probability di Specified Deviatio	istribution on F Soi (meteo +	variance is also o V module modell Inverter efficie iling and mismatc Degrada system)	depending on so ing/parameters ncy uncertainty h uncertainties tion uncertainty Variance	me system parame 1.0 % 0.5 % 1.0 % 1.0 % 1.9 %	eters uncerta	ainties sum)		
Annual production	n probabil	lity	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh				
			Probability	distribution				
	Probability	0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 - 0.05 - 0.00 - - - - - - - - - - - - -	X axis: no data fo	or the extremities definit	ion !		.0	

			1 1
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Grid-	Connected Systen	n: Simulation parameter	S
Proiect : Tam	an Midah (NEM)		
Geographical Site	Kuala Lumpur/Subang	Count	ry <b>Malaysia</b>
Situation	Latitude	3.12° N Longitud	de 101.55° E
Time defined as	Legal Time	Time zone UT+8 Altitud	de 17 m
Meteo data:	Albedo Kuala Lumpur/Subang	0.20 MeteoNorm 7.2 station - Syntheti	ic
Simulation variant : Own	house - SELCO 9kw	inv	
	Simulation date	21/04/20 15h12	
Simulation parameters	System type	Sheds on ground	
<b>Collector Plane Orientation</b>	Tilt	5° Azimu	th 0°
Models used	Transposition	Perez Diffus	se Perez, Meteonorm
Horizon	Free Horizon		
Near Shadings	Linear shadings		
Storage	Kind	Self-consumption, No grid reinject	ion
	Charging strategy Discharging strategy	When excess solar power is availa As soon as power is needed	able
User's needs : Da	aily household consumers average	Constant over the year 12.8 kWh/Day	
PV Array Characteristics PV module Original PVsyst database Number of PV modules Total number of PV modules Array global power Array operating characteristics (50 Total area	Si-mono Model Manufacturer In series Nb. modules Nominal (STC) D°C) U mpp Module area	JAM6-72-320/SI JA Solar 14 modules In parall 28 Unit Nom. Powe 8.96 kWp At operating cone 470 V I mp 54.3 m <sup>2</sup> Cell are	el 2 strings er 320 Wp d. 8.05 kWp (50°C) pp 17 A ea 48.2 m <sup>2</sup>
Inverter Custom parameters definition Characteristics	Model Manufacturer Operating Voltage	SUN2000L-8KTL Huawei Technologies 200-850 V Unit Nom. Pow Max. power (=>40°C	er 8.00 kWac C) 8.80 kWac er 8.0 kWac
inventer pack	ND. OF INVERTERS	Pnom rat	io 1.12
Battery	Model	PVX-2120L	
Battery Pack Characteristics	Manufacturer Nb. of units Voltage Discharging min. SOC Temperature	Concorde 3 in series x 4 in parallel 36 V Nominal Capaci 50.0 % Stored energy Fixed (20°C)	ty 784 Ah (C10) gy 14.1 kWh
Battery input charger	Model	Generic	
Battery to Grid inverter	Max. charging power Model	7.5 kWdc Max./ Euro efficienc Generic	cy 97.0/95.0 %
	Max. discharging power	6.6 kWac Max./ Euro efficienc	cy 97.0/95.0 %
Thermal Loss factor	Lie (const)	20 0 \//m2k/	d) $0.0.10/(m^{2}k^{\prime}/m^{2}c)$
	Global array res	465 mOhm Loss Fractic	on 1.5 % at STC

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Grid-Connected System: Simulation parameters											
Module Quality LossLoss FracModule Mismatch LossesLoss FracStrings Mismatch lossLoss FracIncidence effect, ASHRAE parametrizationIAM = 1 - bo (1/cos i - 1)bo Par				Loss Fractio Loss Fractio Loss Fractio bo Param	on -0.8 % on 1.0 % at MPP on 0.10 % m. 0.05						



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G	rid-Connected S	Svetor	. Dotailod Lla	or's poods								
Breiset												
Project : I aman Mildan (NEM)												
Simulation variant : Own house - SELCO 9kw inv												
Main system parameters	System type		Sheds on ground									
Near Shadings	Linear shadings		50									
PV Field Orientation	tiit Model		5° JAM6-72-320/SI	n 0° n 320.Wn	320 Wp							
PV Array	Nb. of modules		28 Pnom total <b>8.96 kWp</b>			Vp						
Inverter	Model		SUN2000L-8KTL Pnom 8.00 kW ac			√ ac						
User's needs	Daily household con	sumers	Constant over the year Global 4687 kWh/year			Nh/year						
Daily household consumers, Constant over the year, average = 12.8 kWh/day												
					1							
	Use 2 days a week	Number	Power	Use		Energy						
Lamps (LED or fluo)		30	18 W/lamp	6 h	/day 2	2970 Wh/day						
TV / PC / Mobile		3	70 W/app	14 h	/day 2	2940 Wh/day						
Iron		1	1200 W/app	1 h	/day	200 Wh/day						
Fridge / Deep-freeze		1		24 VVN 2 W/b	/day 3	3000 Wh/day						
Instant water beater		1	2000 W/ tot	2 VVII 1 b	/uay	2000 Wh/day						
Aircond		6	750 W tot	7 h	/day = 2	1500 Wh/day						
Stand-by consumers		0	730 W 101	 24 h	/day 3	24 Wh/day						
Total daily energy			4		44	1634 Wh/day						
Total daily energy 44634 Wh/day												
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Grid-Connected System: Main results												
Project :		Taman Midah (NEM)										
Simulation variant :		Own house - SELCO 9kw inv										
Main system parameters		System type	Sheds on ground									
Near Shadings		Linear shadings										
PV Field Orientation		tilt	5° azimuth		0° ו							
PV modules		Model	JAM6-72-320/SI Pnom		n 320 Wp	1						
PV Array		Nb. of modules	28 Pnom tota		l 8.96 kV	Vp						
Inverter		Model	SUN2000L-8KTL Pnom		n 8.00 kV	8.00 kW ac						
User's needs		Daily household consumers	Constant over the year Global		l 4687 k\	4687 kWh/year						
Main simulation	results											
System Production		Produced Energy	11.78 MWh/year	Specific prod	. 1315 k\	Nh/kWp/year						
		Performance Ratio PR	16.99 % Sola	ar Fraction SF	51.85 %	, 0						
Battery ageing (State of We		ear) Cycles SOW	87.8%	Static SOV	V 80.0%							
		Battery lifetime	5.0 years									





Performance Ratio PR



## Own house - SELCO 9kw inv Balances and main results

	GlobHor	DiffHor	T Amb	GlobInc	GlobEff	EArray	E User	E Solar	EUnused	EFrGrid
	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	°C	kWh/m <sup>2</sup>	kWh/m <sup>2</sup>	MWh	MWh	MWh	MWh	MWh
January	133.0	82.20	28.10	136.3	131.2	1.016	0.446	0.220	0.701	0.226
February	134.6	67.90	27.70	137.4	132.8	1.031	0.357	0.194	0.765	0.163
March	149.8	88.20	28.00	150.3	144.9	1.125	0.357	0.192	0.851	0.165
April	140.3	70.50	27.70	138.8	133.9	1.039	0.402	0.217	0.757	0.184
Мау	140.3	78.60	28.60	136.9	131.7	1.027	0.402	0.201	0.729	0.201
June	132.0	77.80	27.80	128.3	123.5	0.967	0.357	0.191	0.695	0.166
July	134.4	87.20	27.80	131.1	125.8	0.994	0.446	0.229	0.696	0.217
August	132.2	87.20	27.80	130.1	125.2	0.980	0.357	0.177	0.707	0.180
September	129.2	79.00	27.10	128.8	124.0	0.968	0.357	0.176	0.717	0.181
October	138.8	82.60	27.40	140.4	135.5	1.056	0.446	0.242	0.728	0.205
November	117.6	79.20	26.70	119.8	115.4	0.907	0.357	0.175	0.654	0.182
December	115.0	73.20	26.29	118.1	113.6	0.896	0.402	0.214	0.613	0.187
Year	1597.2	953.59	27.58	1596.2	1537.5	12.005	4.687	2.430	8.614	2.257
Legends: GlobHor Horizontal global irradiation					GlobEff	Effectiv	re Global, co	orr. for IAM	and shadings	
DiffHor Horizontal diffuse irradiation					EArray	Effectiv	Effective energy at the output of the array			
T_Amb T amb.			E_User	Energy	Energy supplied to the user					
GlobInc Global incident in coll. plane			E_Solar	Energy	Energy from the sun					
					EUnused	Unused	Unused energy (battery full, no grid injection)			
						EFrGrid	Energy	from the gr	id	





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		Grid-Connect	ed Syster	m: P50 - P90 e	evaluation						
Project :											
Simulation variant :		Own house - SELCO 9kw inv									
Main system par	rameters	:	System type	Sheds on ground							
Near Shadings PV Field Orientati PV modules PV Array Inverter User's needs	ion	Lin Nb Daily household	ear shadings tilt Model o. of modules Model d consumers	5° JAM6-72-320/SI 28 SUN2000L-8KTL Constant over the y	azimut Pnor Pnom tota Pnor ear Globa	h 0° n 320 Wp al <b>8.96 kV</b> n 8.00 kW al 4687 kV	<b>/p</b> / ac Vh/year				
Evaluation of the Production probability forecast											
The probability di	stribution a used for	of the system produ	uction forecast I depends on t	t for different years is the following choices:	mainly depen	dent					
Meteo data sourc Meteo data Specified Deviatic Year-to-year varia	e on ability	Year deviation	Kind on from aver. Variance	MeteoNorm 7.2 stat Not defined 3 % 0.5 %	tion Yea	ar 1995					
The probability dis Specified Deviation	stribution on P Soi (meteo +	variance is also dep V module modelling Inverter efficienc ling and mismatch u Degradatio system)	pending on so g/parameters y uncertainty uncertainties n uncertainty Variance	me system paramete 1.0 % 0.5 % 1.0 % 1.0 % 1.9 %	ers uncertaintie (quadratic sun	n)					
Annual productior	n probabil	ity	Variability P50 P90 P95	0.00 MWh 0.00 MWh 0.00 MWh 0.00 MWh							
Probability distribution											
0.50 0.45 0.40 0.35 0.20 0.20 0.20 0.15 0.10 0.05 P50 = 000 kWh 0.00 0.20 0.40 0.50 E_Grid system production kWh											