Design and Evaluation of PV Rooftop system in Thailand

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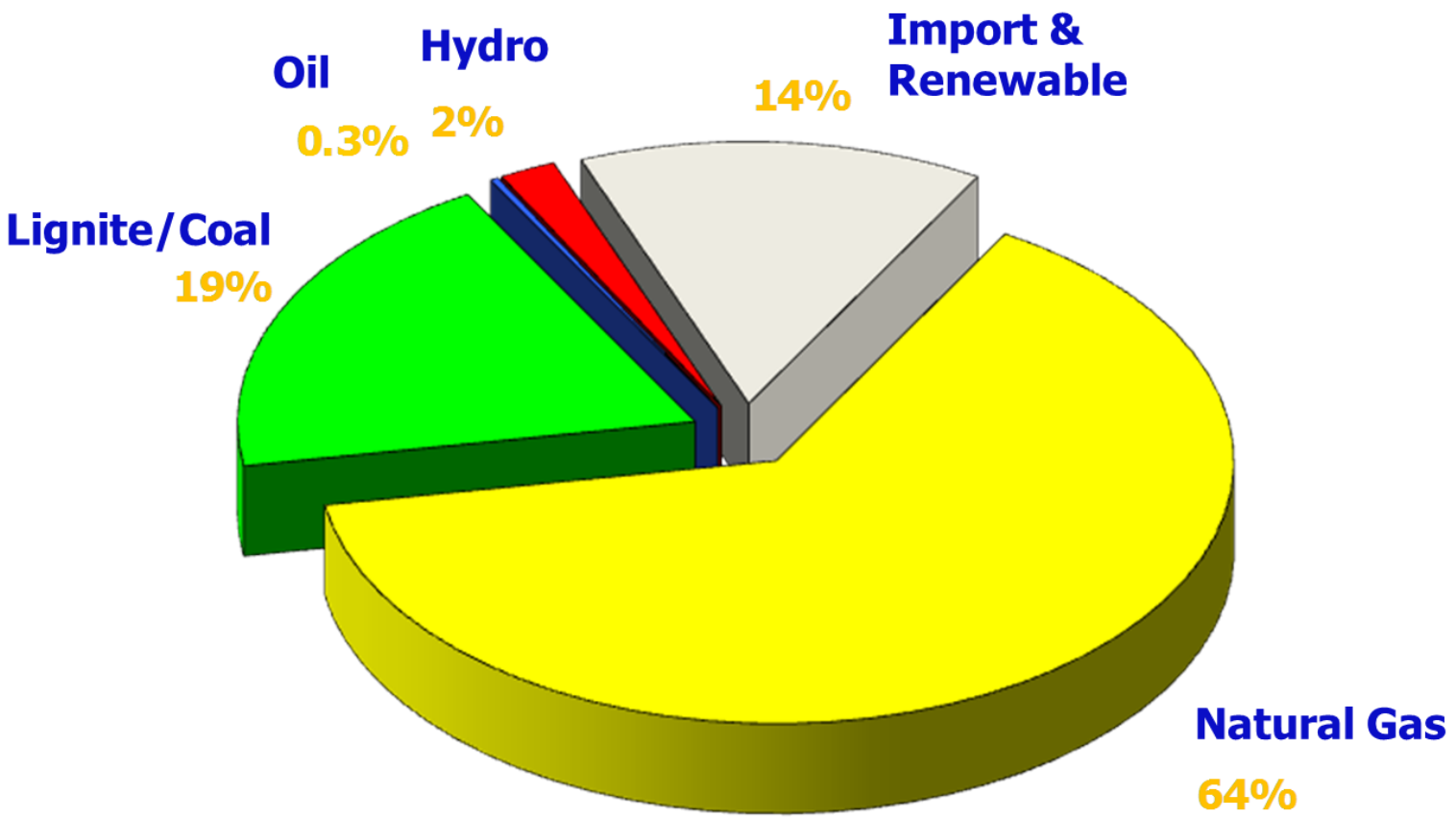
Outline

- Introduction
- Standard
- Implementation
- Results
- Conclusions

Introduction

Share of Power Generation by Fuel Type February 2016



Remark : on EGAT system

Introduction

PV system installation capacity >1,058 MW



- North 164 MW
- Northeast 379 MW
- Middle 515 MW
- Southern 0.2 MW

June 2015: Ministry of Energy

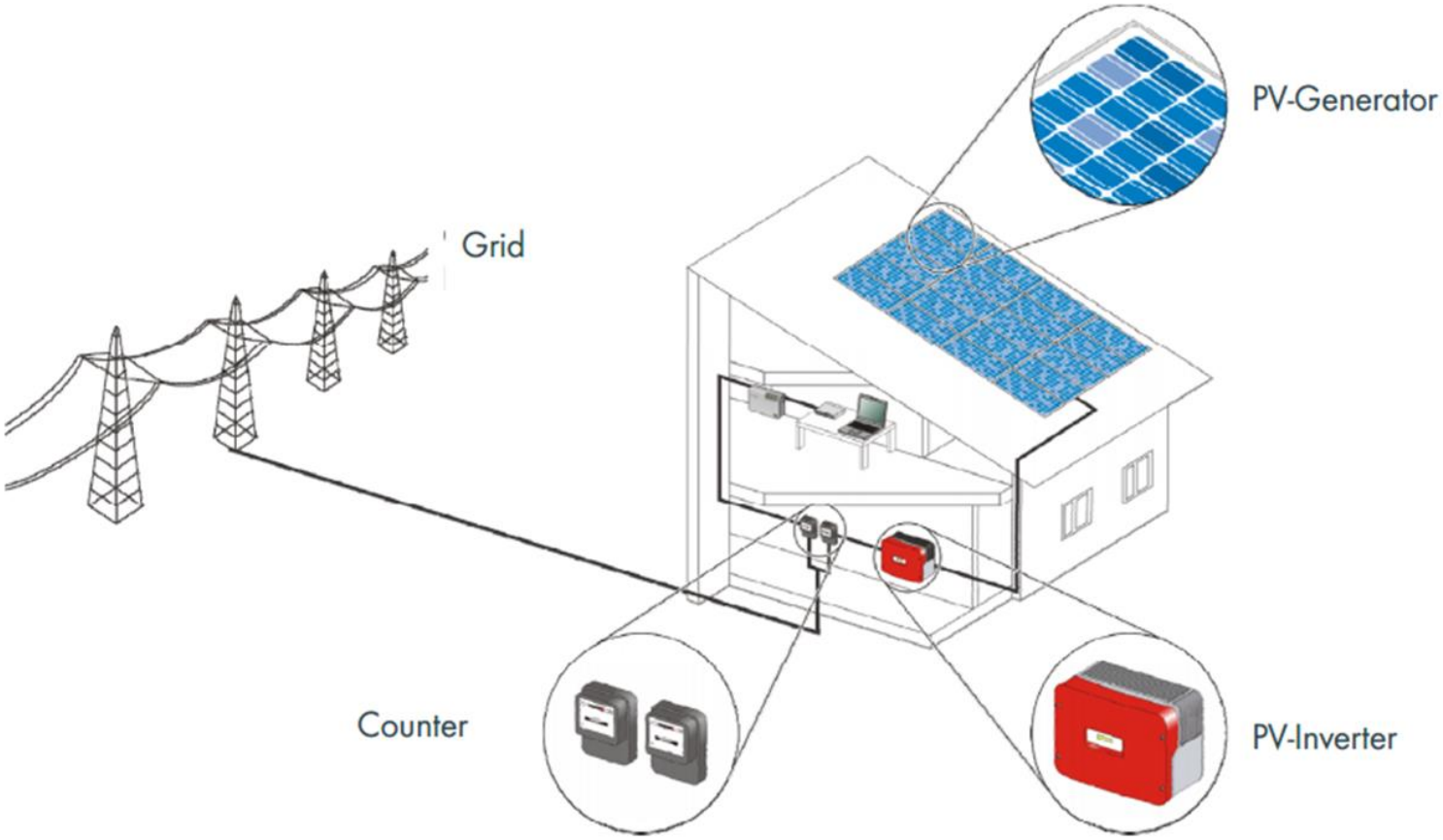
Introduction

Thai Government launched a Feed-in Program PV rooftop system 200 MW_p

Type of Building	Capacity	Total Capacity
Households	< 10 kW_p	100 MW_p
Small Business	10 < 250 kW_p	
Medium and Bigger	250 < 1,000 kW_p	100 MW_p

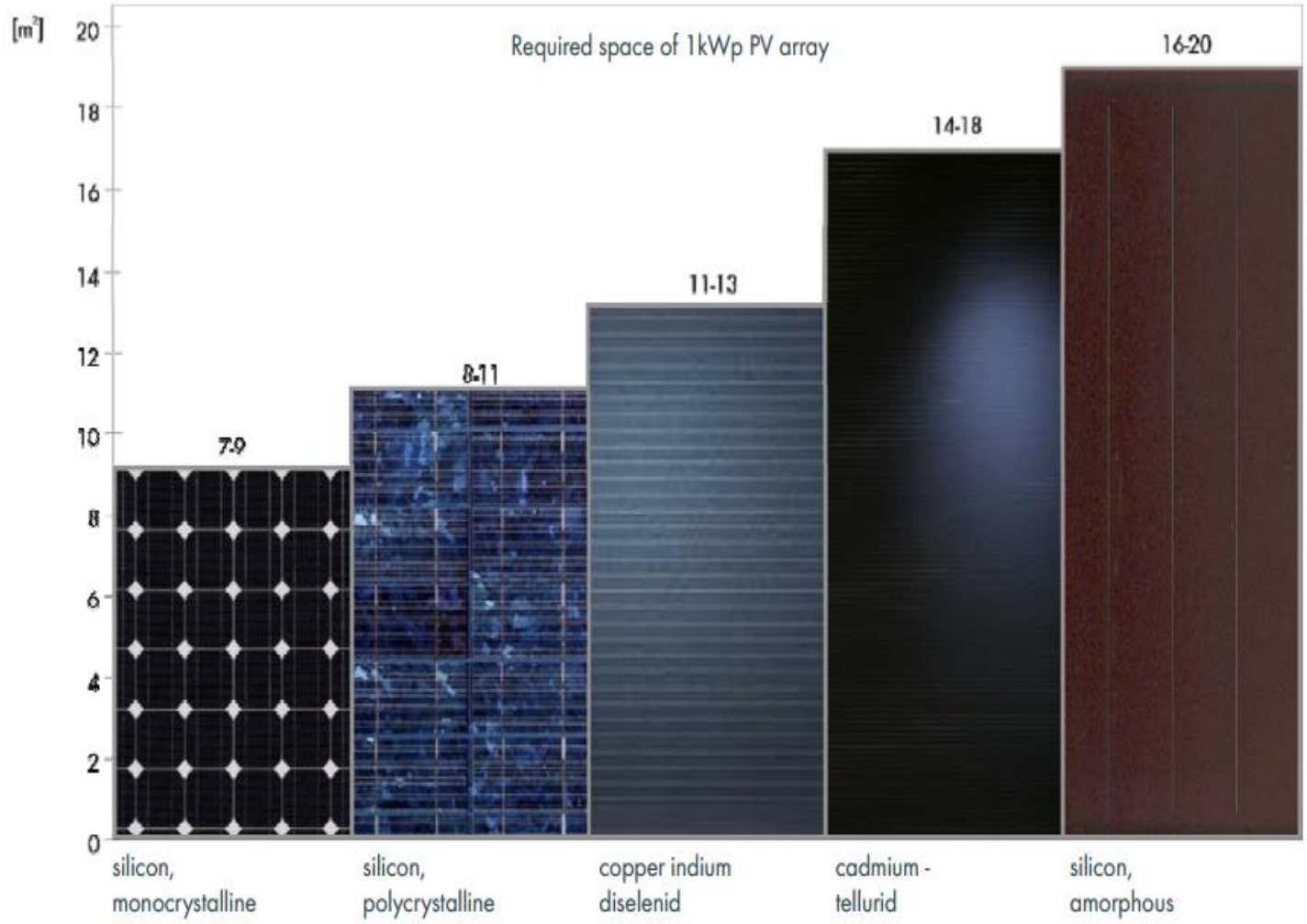
Introduction

Grid Connected System

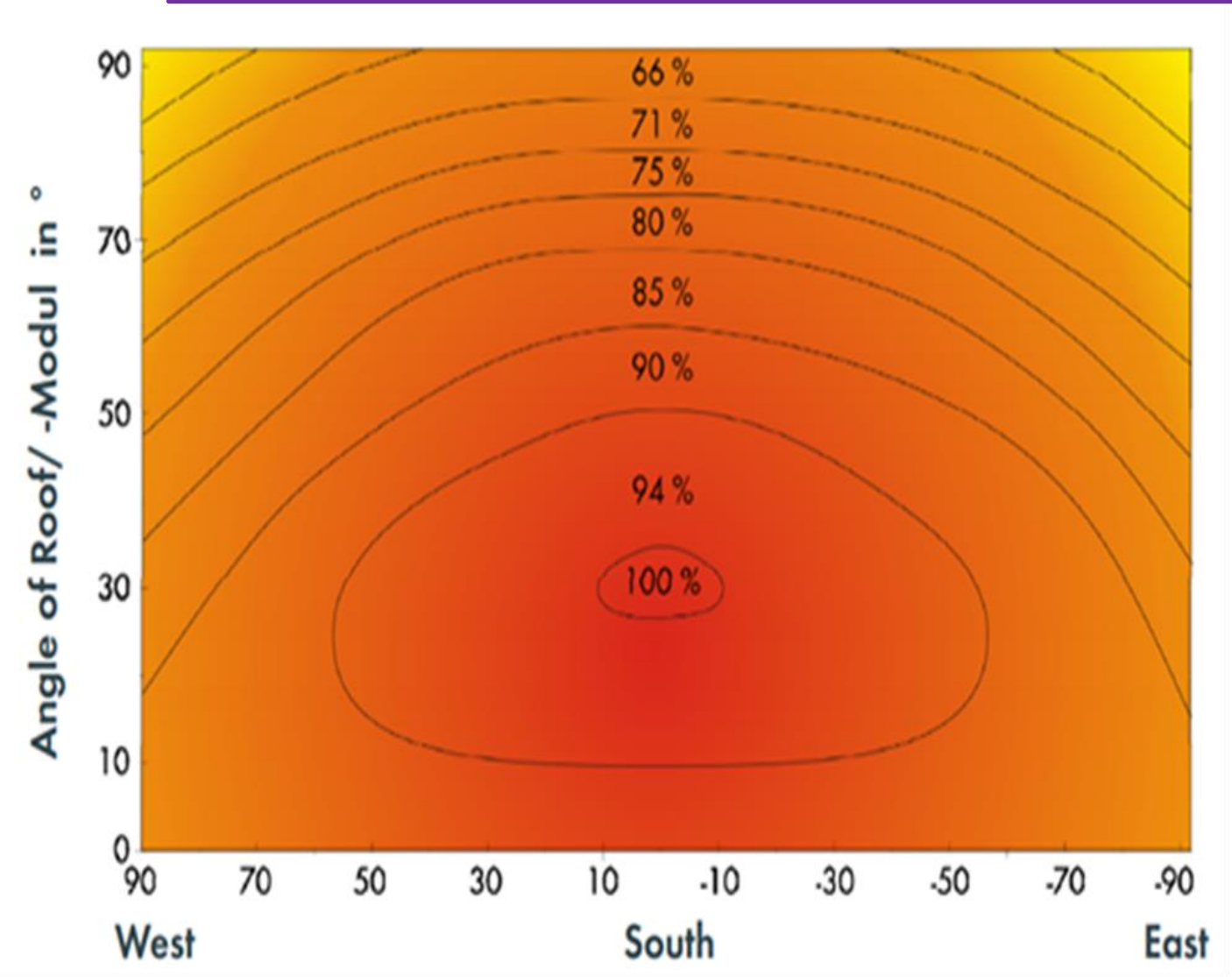


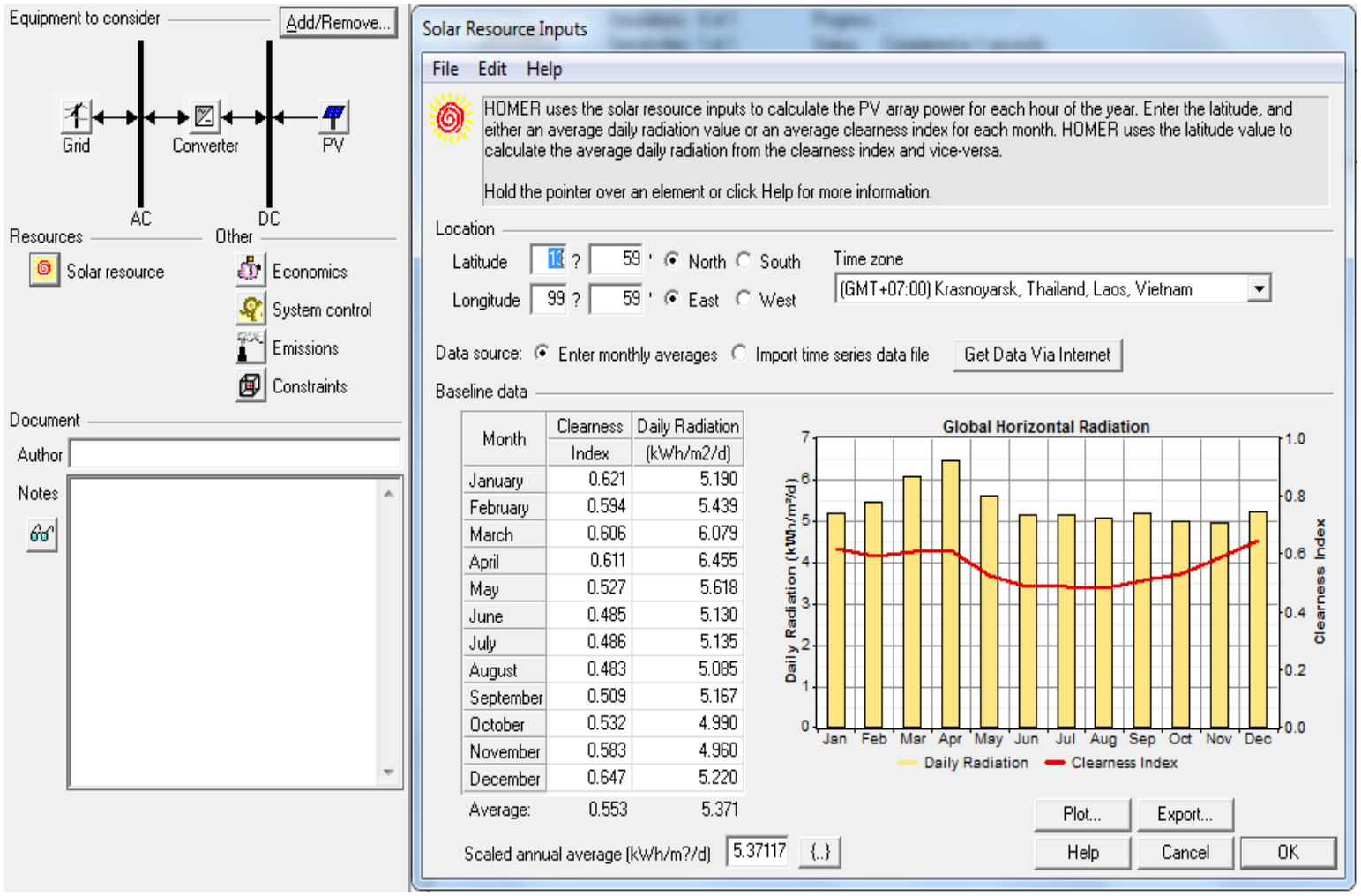
Introduction

Surface requirements of different module types



Introduction





Homer Simulation

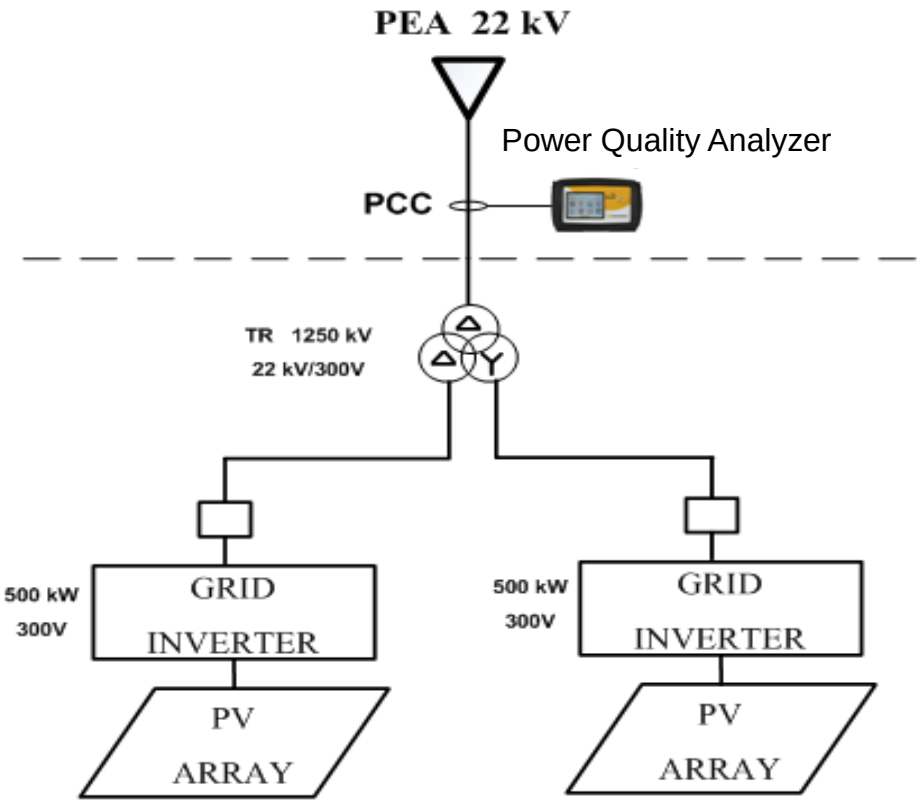
Introduction

Standard of Power Quality

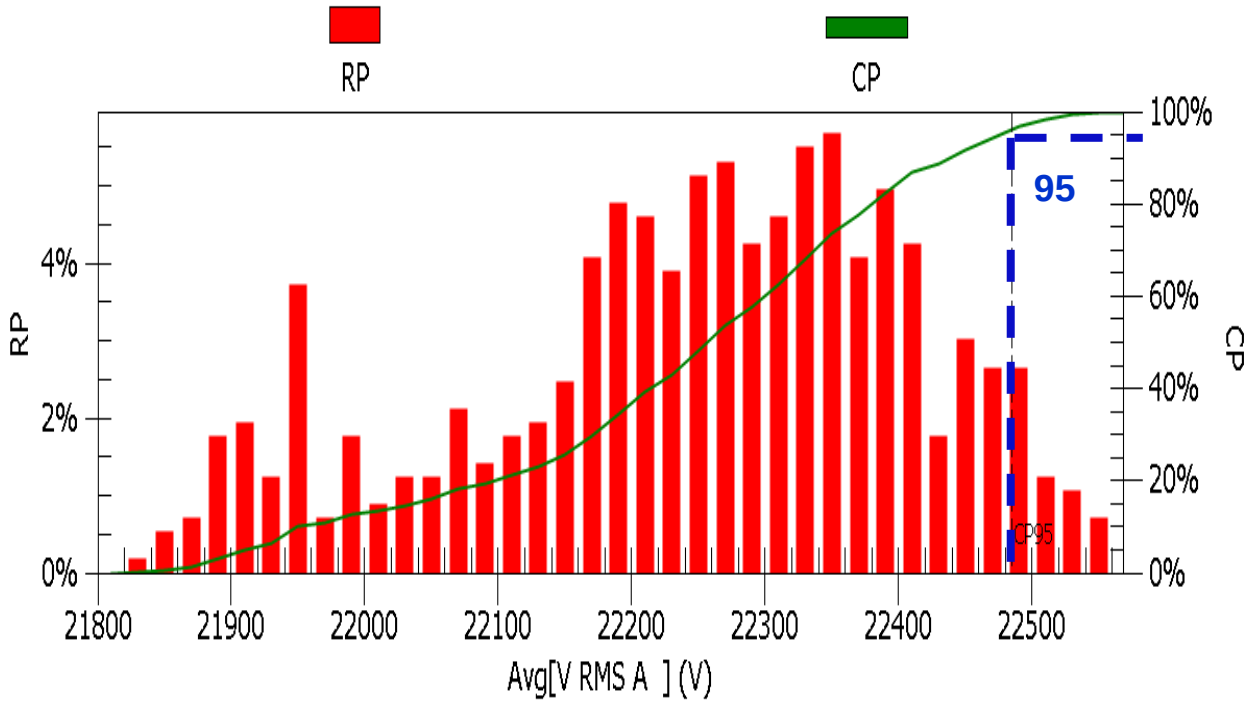
- Voltage RMS
- Power Frequency
- Harmonics
- Voltage Unbalance
- Voltage Fluctuation

Power Quality Analyzer Measurement

Period of Measurement	**7+ 1 Days**



Analysis CP95 of PCC

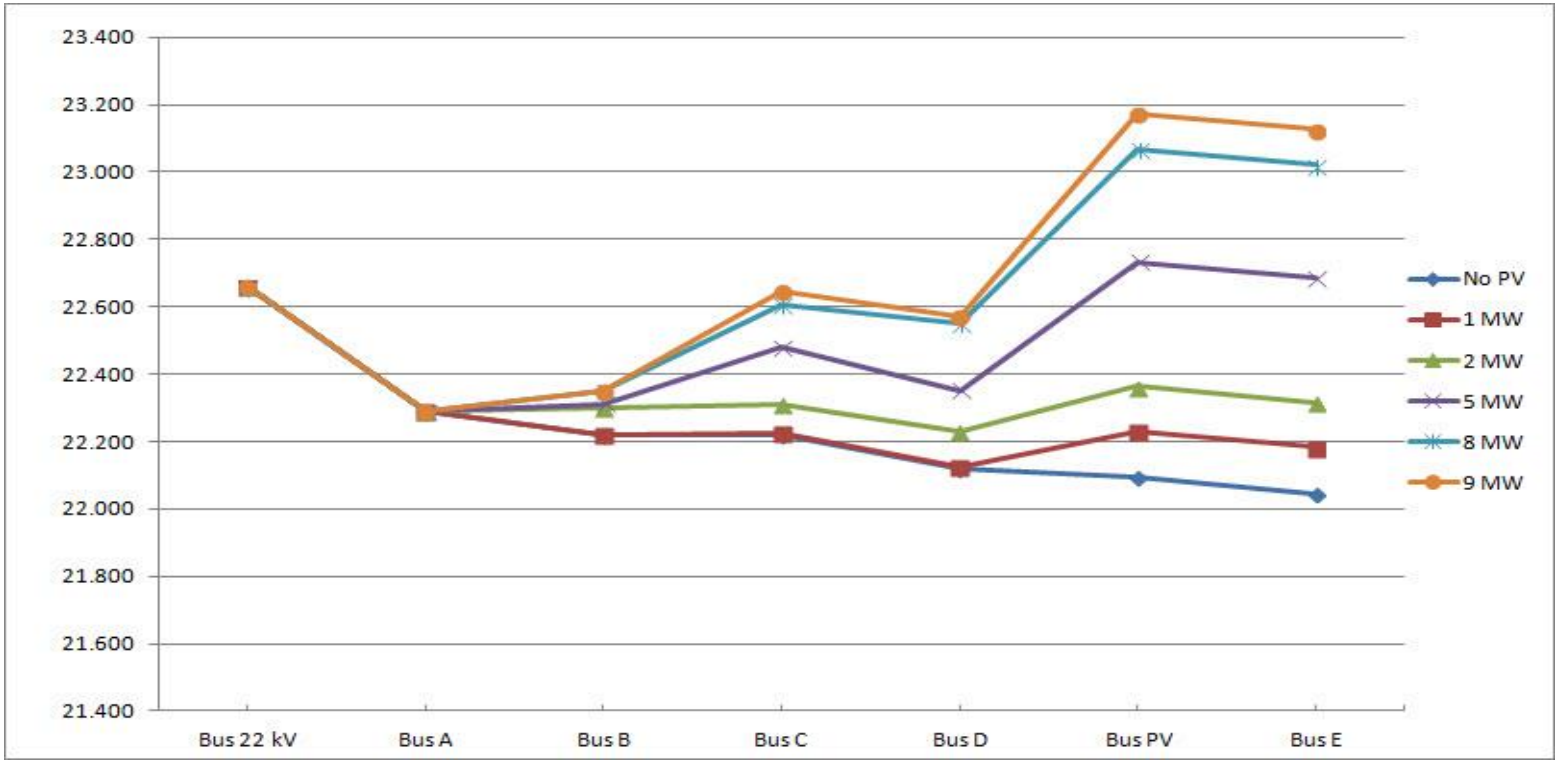


Standard EN 50160

Standard must be considered : PEA

Parameters	Phase	Standard	Measured	
Voltage	A	22±5% (21.9-23.1 kV)	22.613	Pass
	B		-	-
	C		22.793	Pass
Frequency		50±1% (49.5-50.5 Hz)	50.05	Pass
THD_V	A	$THD_V < 4$ %	1.631	Pass
	B		-	-
	C		1.347	Pass
Voltage Fluctuation: Plt	A	Pst < 0.8	0.467	Pass
	B		-	-
	C		0.657	Pass

Grid Connected Capacity

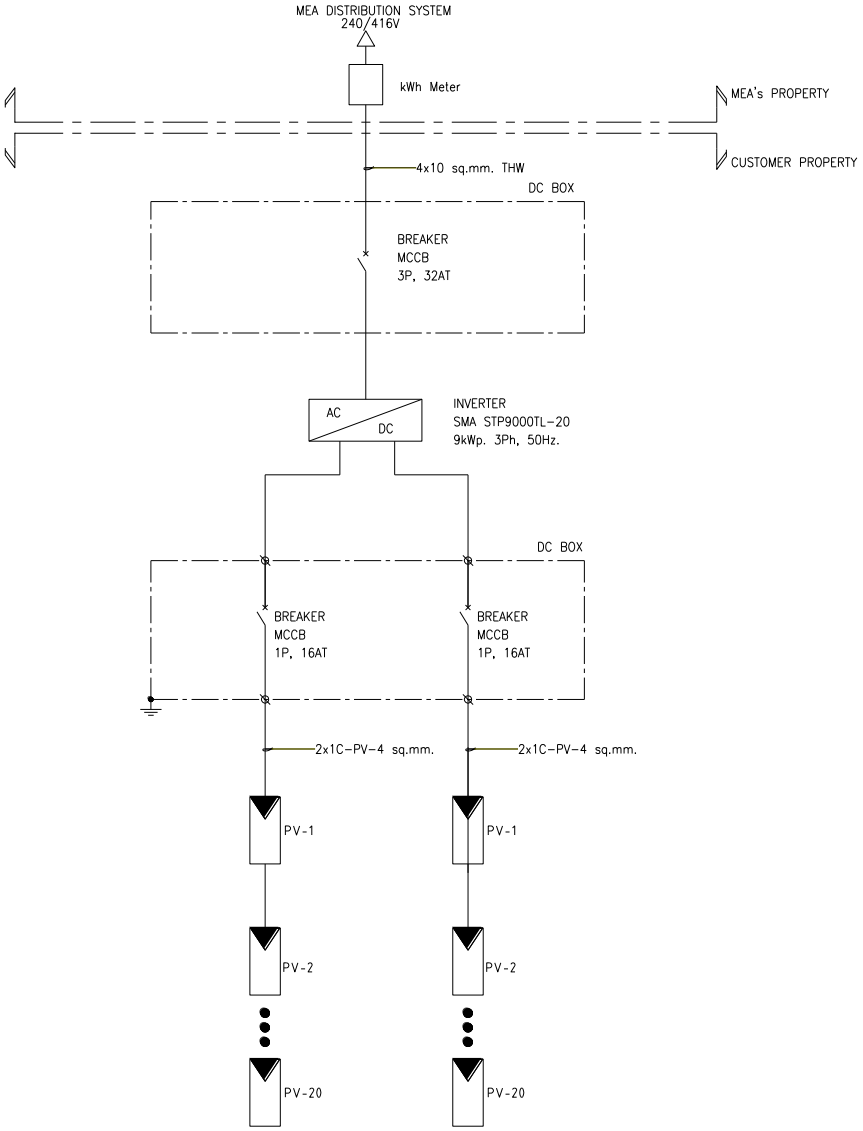


DIgSILENT Simulation

PV Rooftop System

1 Phase or 3 phase inverter??

3 Phase inverter



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Installation

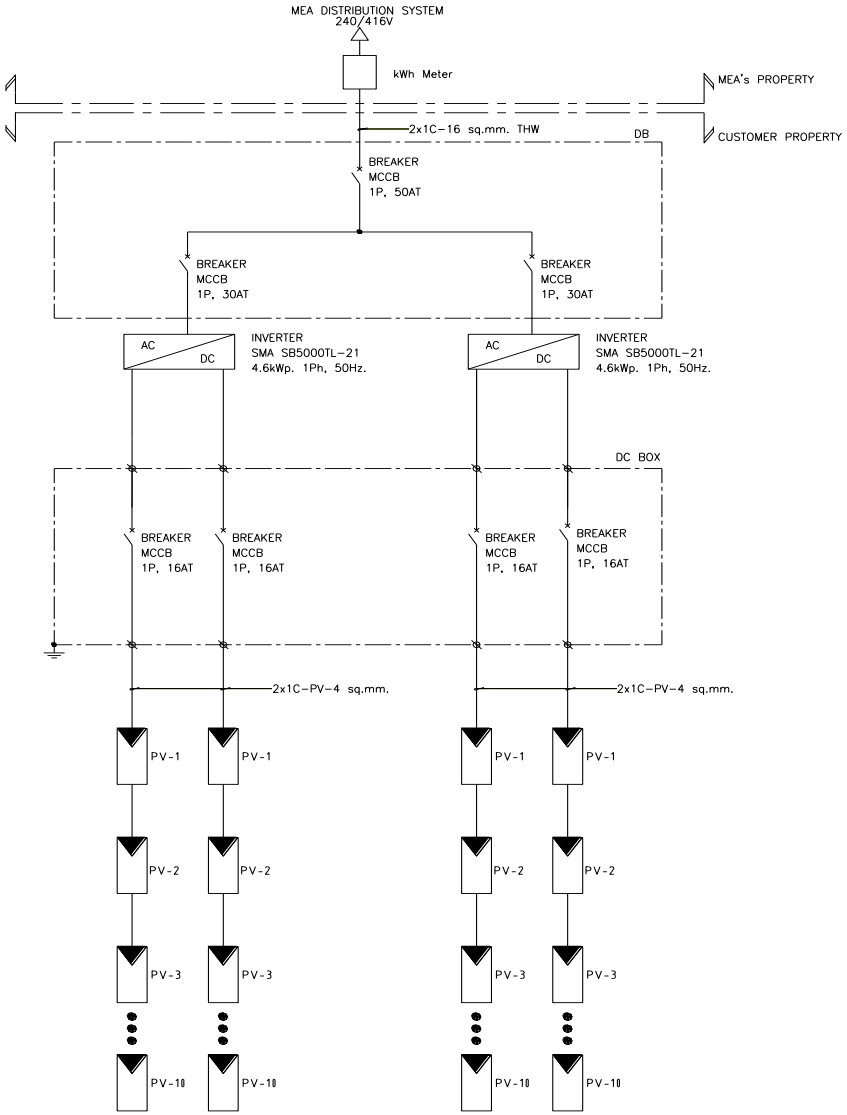








1 Phase inverter



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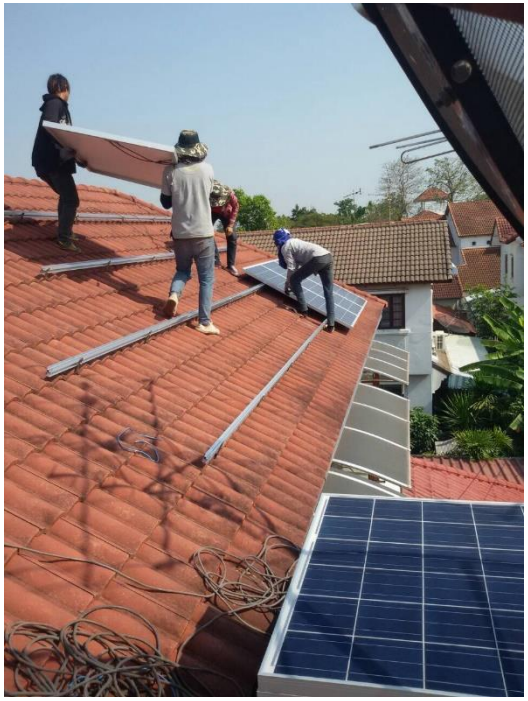
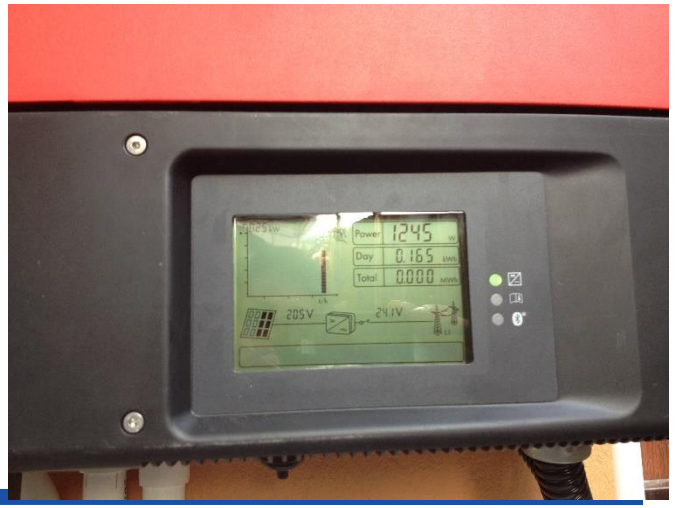
Installation

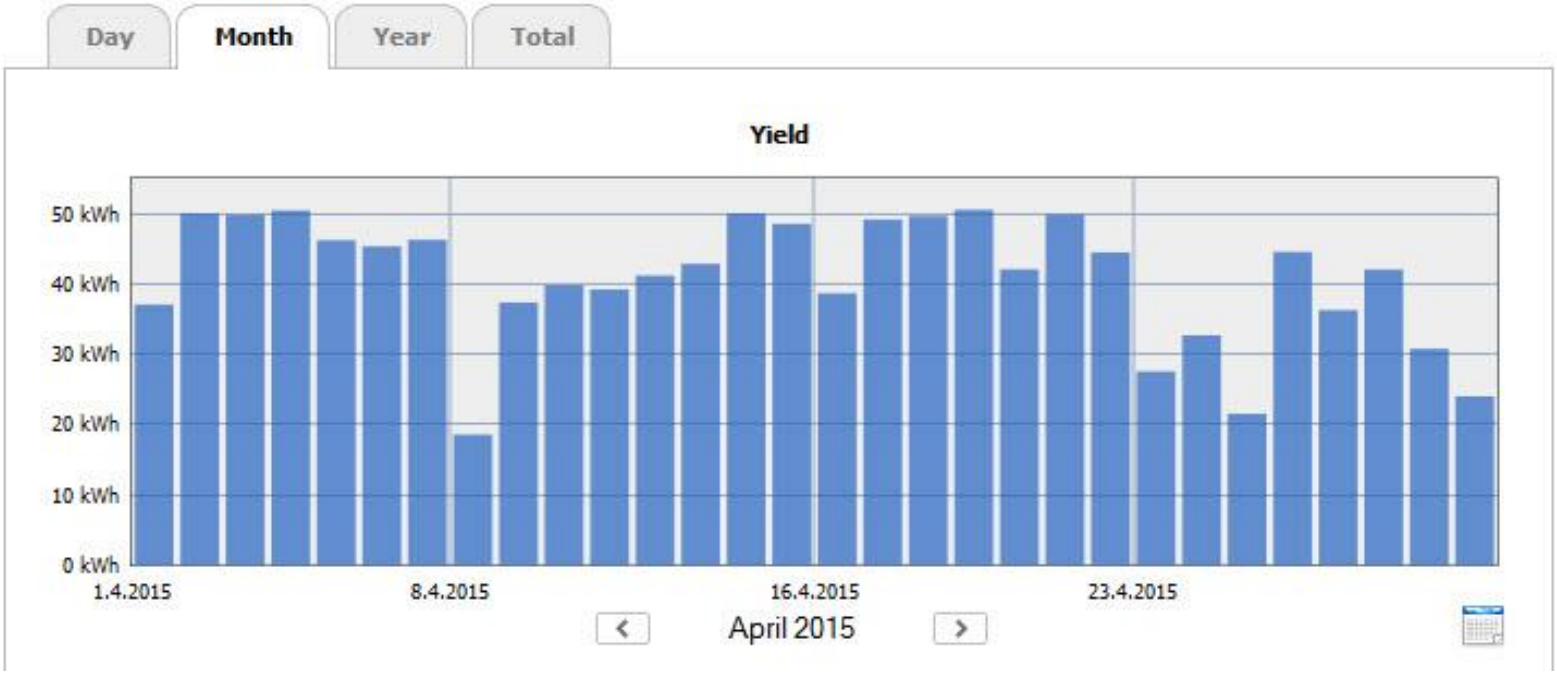




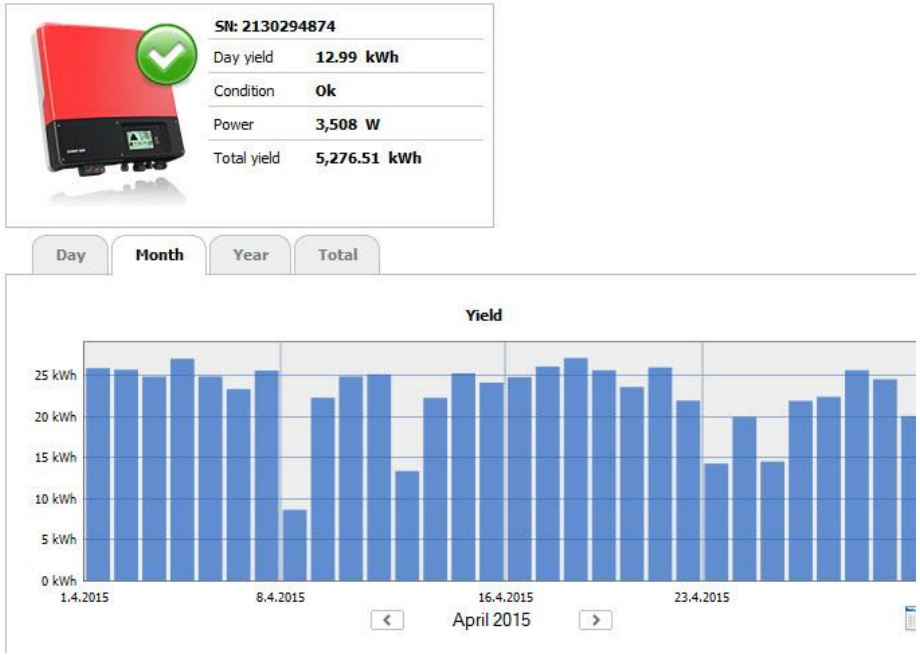
Installation

Energy Yield from 3 Phase Inverter

SN: 304989812	
Day yield	**43.20 kWh**
Condition	**Ok**
Power	**2,693 W**
Total yield	**10.231 MWh**



Energy Yield from 1 Phase Inverter



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Measurement Result of Energy Yield

Day	Energy (kWh/day)		Day	Energy (kWh/day)		Day	Energy (kWh/day)	
	3 Ph	1 Ph		3 Ph	1 Ph		3 Ph	1 Ph
1	37.08	49.29	11	39.21	48.36	21	49.87	48.71
2	50.02	49.26	12	41.18	25.82	22	44.49	41.39
3	49.82	47.86	13	42.85	43.15	23	27.54	27.29
4	50.44	51.32	14	50.05	48.08	24	32.70	37.60
5	46.21	47.06	15	48.54	45.89	25	21.53	28.15
6	45.33	45.82	16	38.65	48.34	26	44.54	40.87
7	46.26	49.97	17	49.15	50.19	27	36.27	42.33
8	18.59	16.82	18	49.64	51.24	28	42.06	48.02
9	37.35	43.15	19	50.54	48.58	29	30.77	46.25
10	39.82	47.75	20	42.06	44.49	30	24.01	38.07
Annual							1,227	1,301

PV Efficiency from selected System

ประสิทธิภาพของแผงเซลล์แสงอาทิตย์ (η : Total Efficiency)

$$\eta = \frac{E_{tot}}{H_i \times A_A}$$

$$= \frac{3{,}858.71}{5.32 \times 7{,}000}$$

$$= 10.36\ \%$$

Economics calculation from selected System

Annuity Method

$$a = NPV \cdot \frac{i \cdot (1+i)^n}{(1+i)^n - 1}$$

a	=	annuity [currency]
NPV	=	net present value [currency]
i	=	fictitious interest
n	=	planning horizon [a]

n = 9.34 Years

FIT = 6.16 THB/UNIT

Conclusions

- Meet the Standards
- Rooftop has a difficulty for installation
- Roof has different Tile angles in one system
- Group all PVs in one inverter: lower yields
- Rooftop gains lower than ground system
- Difficulty for Cleaning

Thank you

Khob-Khun-Krabb

ขอบคุณครับ

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