PV MARKET 2020 - 2021

- **Malaysian PV Market 2020 continued to grow :** NOVA quota **300MW**, April 2021, fully consumed in **3 mths**
  (MPIA has asked for 3,000MW to be allocated to meet this growing demand, pending a response)
  (**https://www.thestar.com.my/business/business-news/2021/07/10/call-for-malaysia-to-liberalise-solar-power-industry** ***)***

- **PV sector GROWTH despite COVID - 19 : 142 GW** of PV will be added globally **2020** =
  7 X entire capacity installed by the **start** of the **prior decade** (20 GW in 2010) =
  14% increase compared to 2019 (1st October 2020 report, currently 200GW and growing)
  (**https://www.renewableenergyworld.com/solar/142-gw-of-solar-capacity-will-be-added-to-the-global-market-in-2020-says-ihs/#gref** **)**

- **Energy Storage Systems ESS on the horizon :** Neighbouring ASEAN countries already embarking on these ventures ***(US 2 billion Floating Solar + Energy Storage in Batam for Hyper Data Centre in Singapore)***
  https://www.datacenterdynamics.com/en/news/sunseap-signs-mou-to-build-floating-solar-farm-in-batam/

- **China Energy shortage :** Over dependence on China = **75% of components**
  Inflation resulting from sellers' market
  Many globally and in Malaysia are in project limbo ***(MPIA member survey)***

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CURRENT PV MARKET STATUS

U.S. solar industry warns of slowdown due to supply chain disruptions, tariff uncertainty (28th April 2022)

- More than 315 projects are being canceled or delayed, according to the Solar Energy Industries Association. The tariff concerns have added to an array of headaches for U.S. solar developers that include surging costs for components, labor and freight as the global economy recovers from the coronavirus pandemic.
  https://www.reuters.com/world/us/us-solar-industry-warns-slowdown-due-supply-chain-disruptions-tariff-uncertainty-2022-04-28/

Ukraine conflict: as Europe shuns Russian oil and gas, China to demand for solar panels, analysts say (20th March 2022)

- Boycotting Russian supplies will mean near-quadrupling of solar and wind power installations in Europe by 2030 from current levels
- Solar panel prices hover near the recent peak in December, which was the highest since July 2019

https://www.scmp.com/business/article/3171048/ukraine-conflict-europe-shuns-russian-oil-and-gas-china-profit-demand

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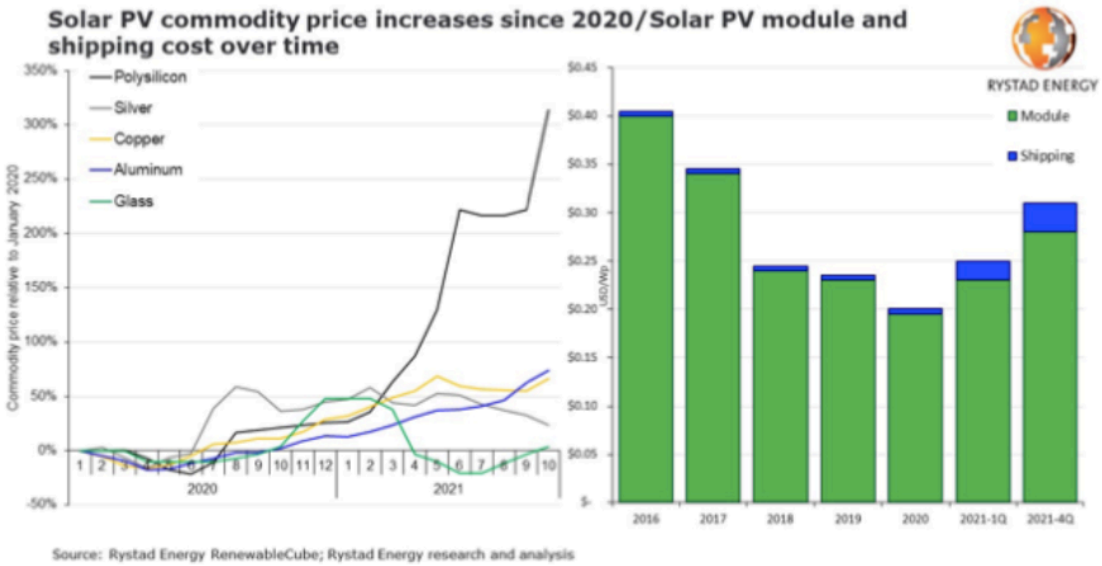
PV MARKET STATUS - end 2021

Rystad Energy: Surging Costs To Cost 56% Of 2022'S Global Utility PV Forecast

Oct 28, 2021



Source: Rystad Energy RenewableCube; Rystad Energy research and analysis

With the pandemic striking the world in 2020, and short supply of PV components due to rising demand module prices have increased significantly since last year. High shipping prices offer no respite either, according to Rystad Energy. (Source: Rystad Energy)

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CURRENT PV MARKET STATUS

‘One thing after another’: More disruption looms over semiconductor market (14th April 2022)

Dive Brief:

- **Supply chain issues in the semiconductor industry could worsen, experts warn, because of disruptions to a major raw materials supplier and Russia’s invasion of Ukraine.**
- **A 3M facility in Belgium responsible for 80% of the world’s supply of coolant, an essential component of semiconductors, halted some operations last month. Major companies including Samsung Electronics, Intel and Taiwan Semiconductor Manufacturing Company rely on the plant for supplies, according to Resilinc.**
- **The war in Ukraine has also disrupted production of neon and argon, chemicals critical to semiconductor production. “There’s going to be a massive impact on the semiconductor industry in the next quarters and years,” said Thomas Foj, director of vertical markets EMEA at Avnet Silica.**

https://www.google.com/search?q=supply+chain+dive&source=lnms&tbm=isch&sa=X&ved=2ahUKEwj-wo2vxvn3AhWFjdgFHf_DDDYQ_AUoAnoECAEQBA&biw=1207&bih=720&dpr=1

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KEY MILESTONE PROGRAMMES

Suria 1000 (2006)

Subsidy for solar PV installations by households.

Feed-in Tariff (FiT) (2011)

All electricity generated from solar PV systems exported to grid at a premium and paid in cash.

Net Energy Metering (NEM) (2016)

Electricity generated from solar PV systems is first consumed by solar PV system owners, excess is exported to grid in exchange for credits to offset electricity bills.

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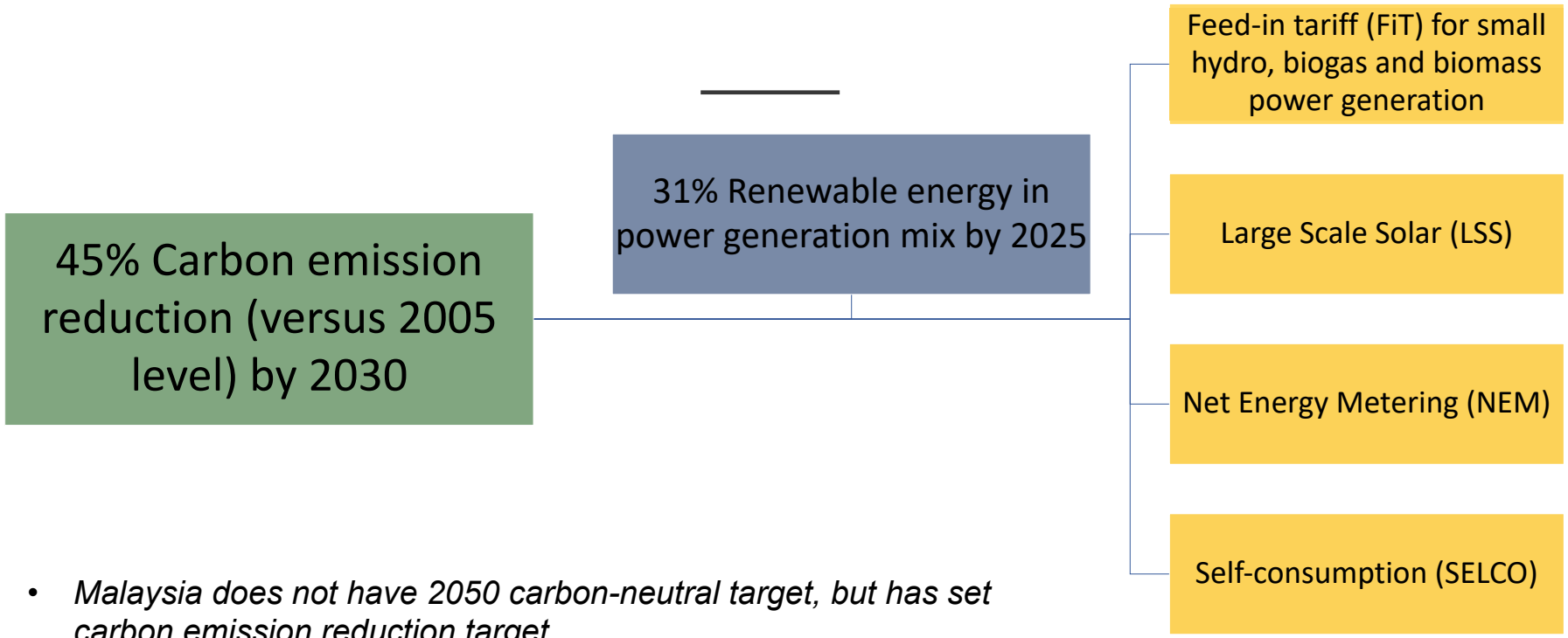
MALAYSIA'S TARGETS AND PROGRAMMES



- *Malaysia does not have 2050 carbon-neutral target, but has set carbon emission reduction target*
- *FiT for solar ended in 2017*
- *Solar programmes are the most extensive and dynamic due to vast solar potential in Malaysia and easy deployment of solar systems*

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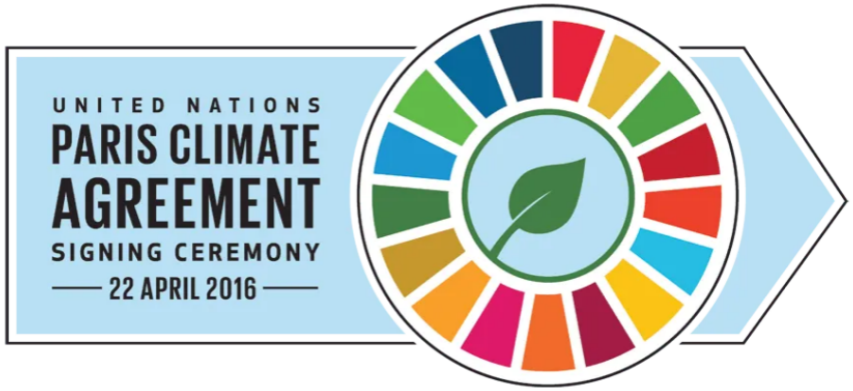

2015

The legally-binding international treaty on climate change **Paris Agreement** was adopted by 196 parties and then came into force in 2016, triggering a wave of carbon neutrality commitments globally.

2017

Sweden became the first country **legislating law** to achieve carbon neutrality (by 2045).

Subsequently, UK, France, Denmark and New Zealand legislated law in 2019 to achieve carbon neutrality by 2050.

2020

Racing for climate change action:

September – China pledged for carbon neutrality by 2060;

October – Japan pledged for carbon neutrality by 2050;

January 2021 – First day in office, Joe Biden brought USA back to Paris Agreement.

Carbon-neutral has become a global campaign !

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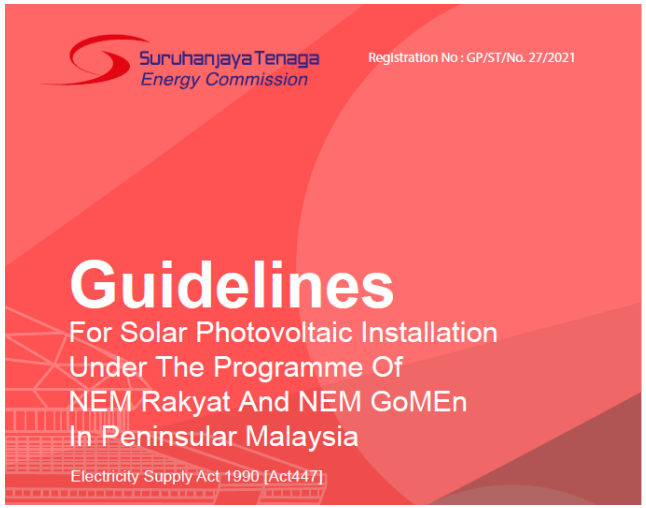

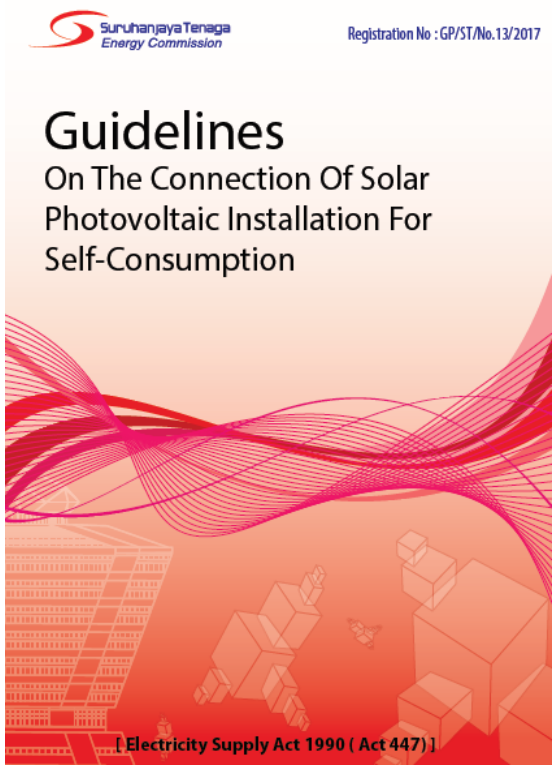

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Ministry of Energy and Natural Resources (KeTSA) – Decide on solar policy and programme.

Energy Commission (ST) – Set technical guidelines; issue licence; award LSS projects.

Sustainable Energy Development Authority (SEDA) – Implement and promote solar programme; advise on solar matters.

Malaysian Green Technology And Climate Change Centre (MGTC) – Manage green financing provided by government.

Malaysian Investment Development Authority (MIDA) – Promote solar investment, process tax incentive applications.

Construction Industry Development Board (CIDB) – Regulate construction works

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5 MAIN ENTITIES

- **SEDA :**
  As implementing agency, responsible for implementation & administration of NOVA ,RAKYAT & GOMEN

- **ST :**
  Issuance of License to RE producers generating more than 72kW

- **TNB :**
  Facilitation of RE project applications, connection availability, connectivity, contract biding, T&C payment to FiAHs, collection agent for the RE Fund.

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5 MAIN ENTITIES

- **MIDA :**
  Government's principal agency to oversee and drive investment into the manufacturing and services sectors in Malaysia.

- **MGTC :**
  MGTC is the government agency under the purview of Ministry of Environment mandated to lead the nation in the areas of Green Growth, Climate Change Mitigation and Climate Resilience and Adaptation

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03

SCHEMES

APPLICATIONS,
CHALLENGES, CHECKLISTS

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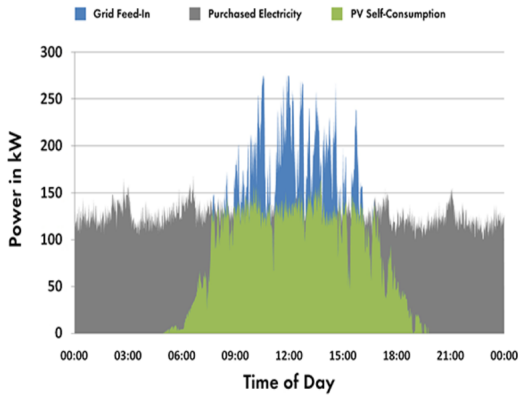
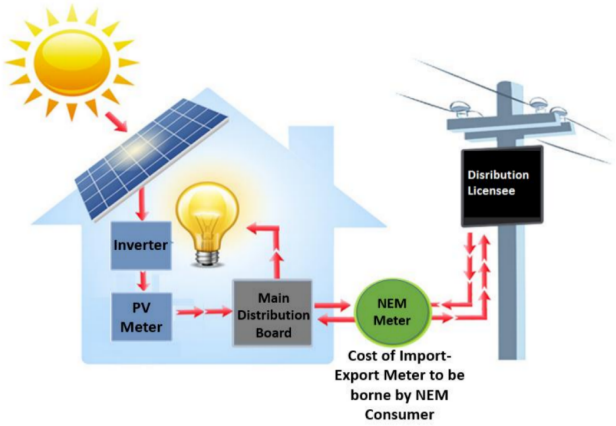
System Electricity	Self Consumption (SELCO)	Net Energy Metering (NEM/NOVA)	Large Scale Solar (LSS)
Self Use	☑	☑	
Export		☑	☑
Notes	1. Consumed Fully 2. Excess NOT allowed to be sold to TNB or SESB 3. Roof tops & Car Porch	1. Consumed First 2. Excess allowed to be sold to TNB or SESB 3. Roof tops & Car Porch	1. Consumed : 0 2. Fully sold to TNB or SESB 3. Any (almost) large area deemed suitable





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LSS PROJECTS COMMERCIALLY OPERATIONAL

Figure 3: LSS Projects Commercially Operational in 2017/2018 and 2019/2020

	2017/2018			2019/2020		
Location	**Package Type**	**No. of Shortlisted Bidders**	**Export Capacity (MWac)**	**Package Type**	**No. of Shortlisted Bidders**	**Export Capacity (MWac)**
Peninsula Malaysia	1MW to 5MW 6MW to 29MW 30MW to 50MW	3 6 7	10 115 309	1MW to 5.99MW 6MW to 9.99MW 10MW to 30MW	6 11 13	26 106 375
Sabah & Labuan	1MW to 5MW 6MW to 29MW	2 1	11 6	1MW to 5.99MW 6MW to 10MW	8 3	28 28
TOTAL		**19**	**451**		**41**	**563**

LSS Projects Commercially Operational in 2017/2018 and 2019/2020
Source: Suruhanjaya Tenaga (Energy Commission), "Announcement of Shortlisted Bidders for the Development of Large Scale Solar Photovoltaic (LSSPV) Plants for Commercial Operation in Peninsular Malaysia, Sabah and Federal Territory of Labuan, 2017 – 2018"

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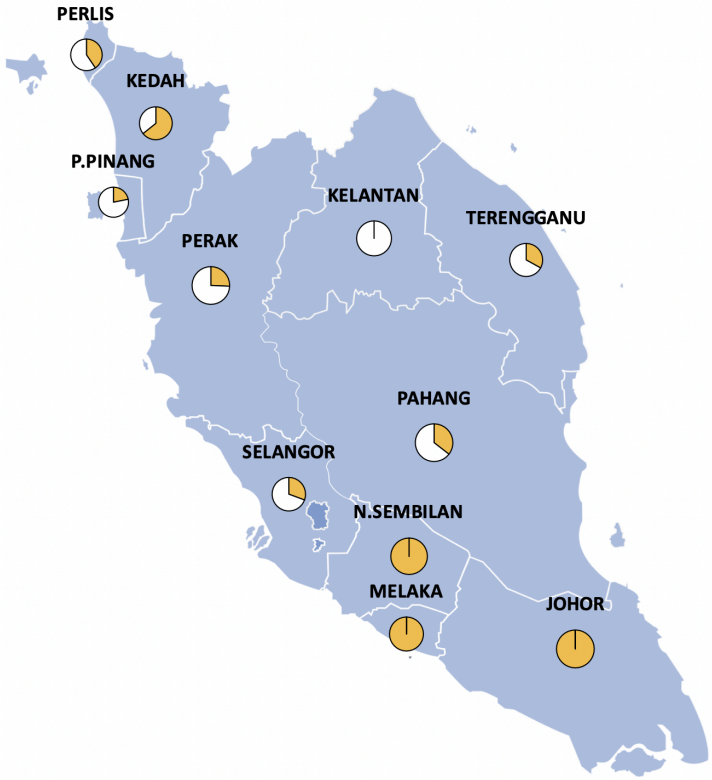
LSS Progress by Region 2022



Region	Capacity Awarded (MW)	Operational Capacity (MW)	In progress (MW)	Percentage
Perlis	83.996	33.996	50	40%
Kedah	491.53	315.87	175.66	64%
P.Pinang	96	21	75	22%
Perak	542.18	138.88	403.3	26%
Kelantan	90	0	90	0%
Terengganu	323.99	106.99	217	33%
Pahang	309.916	109.916	200	35%
Selangor	218.97	66.98	151.99	31%
N. Sembilan	61	61	0	100%
Melaka	56.8	56.8	0	100%
Johor	68.99	68.99	0	100%
Sabah	113.9	50	63.9	44%
	2457.272	1030.422	1426.85	42%

Note: Starting 2022, capacity from LSS@MEnTARI will be included.

https://www.st.gov.my/en/web/industry/details/2/17

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LSS Progress by Region 2022

Region	Capacity Awarded (MW)	Operational Capacity (MW)	In progress (MW)	Percentage
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Johor	68.99	68.99	0	100%
Sabah	113.9	50	63.9	44%
	2457.272	1030.422	1426.85	42%

2020 : 563 MW

https://www.st.gov.my/en/web/industry/details/2/17

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- 3,200,000 Residential houses
- 450,000 Shop houses
- 90,000 Terrace factories
- 21,000 Stand-alone factories
- 1,000 Shopping malls
- 5,000 Government offices / buildings

Less than 1% is with a Solar PV Installation!

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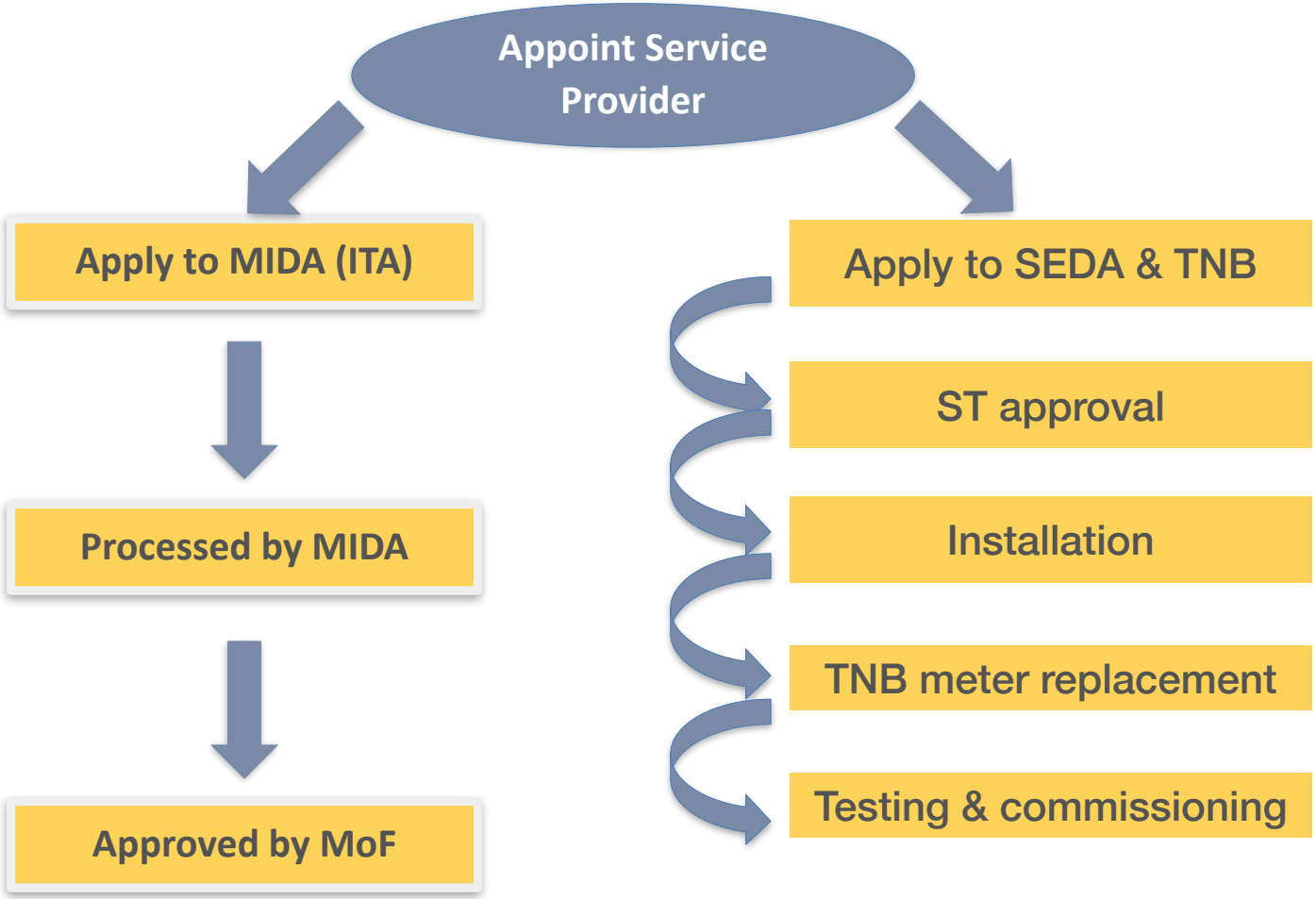
NOVA APPLICATION TO COMMISIONING



www.seda.gov.my/reportal/nem/

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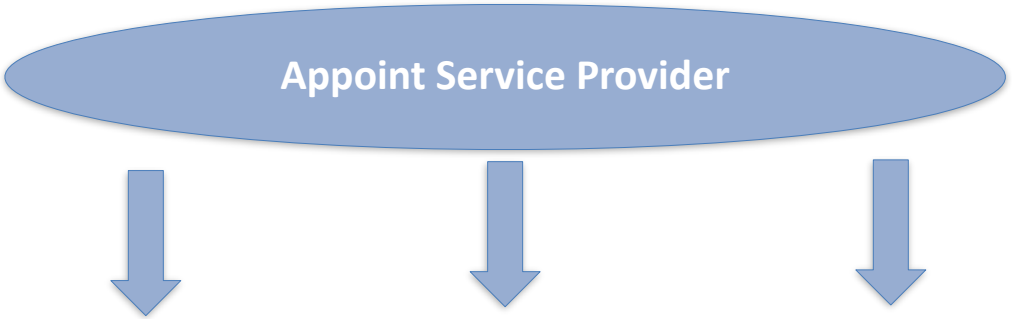
SELCO APPLICATION TO COMMISSIONING



Apply to MIDA (ITA)

Processed by MIDA

Approved by MOF

<72 kW	72-425 kW	>425 kW
-	Private Generation License from ST	Private Generation License from ST
-	-	PSS
Installation	Installation	Installation
Testing & Commissioning	Testing & Commissioning	Testing & Commissioning

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CONSIDERATION FOR ROOFTOP

No.	Operation 24/7	Export Possible?	Tax Benefit	Recommend*
1	Yes	Yes	Yes	NEM
2	No	Yes	Yes	NEM
3	No	Yes	No	NEM
4	Yes	Yes	No	NEM
5	Yes	No	Yes	SELCO
6	Yes	No	No	SELCO
7	No	No	Yes	SELCO
8	No	No	No	SELCO

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Company Name :

No.	DOCUMENT CHECKLIST	Done
1	3 Sets of GT/JA Forms	
2	Latest super forms for the incorporation from the companies commission of Malaysia (CCM) for the company and share holdings	
3	latest company annual returns	
4	latest income tax return form - form C (3 years)	
5	Latest audited financial statement (1 year)	
6	Latest TNB bills (3 mths) / copy of TNB application form	
7	A copy of business license	
8	A copy of land title / tenancy agreement (Please provide SSM Super form of the land / building owner	
9	A copy of manufacturing licence (ML) or confirmation letter for company exemption from manufacturing licence (ML) under the industry coordination Act 1975 (if any)	
10	A copy of the Approval letter of the incentive / grants by MIDA or other government agencies (if any)	
11	Group organisation chart with shareholder equity structure (if any)	
12	A copy of invoices and receipts for first capital expenditure (CAPEX) incurred if any	
13	A copy of award letter form SEDA / ST (only for LSS / Biomass / Biogas / mini Hydro projects for business purpose)	
14	Project impact information as Appendix A (only for LSS /Biomass / Biogas / mini Hydro projects for business purposes	

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IMPLEMENTATION CONSTRAINTS

Fluid regulatory requirements

No clear directive on *HOW* to level up

Lack luster industry engagement

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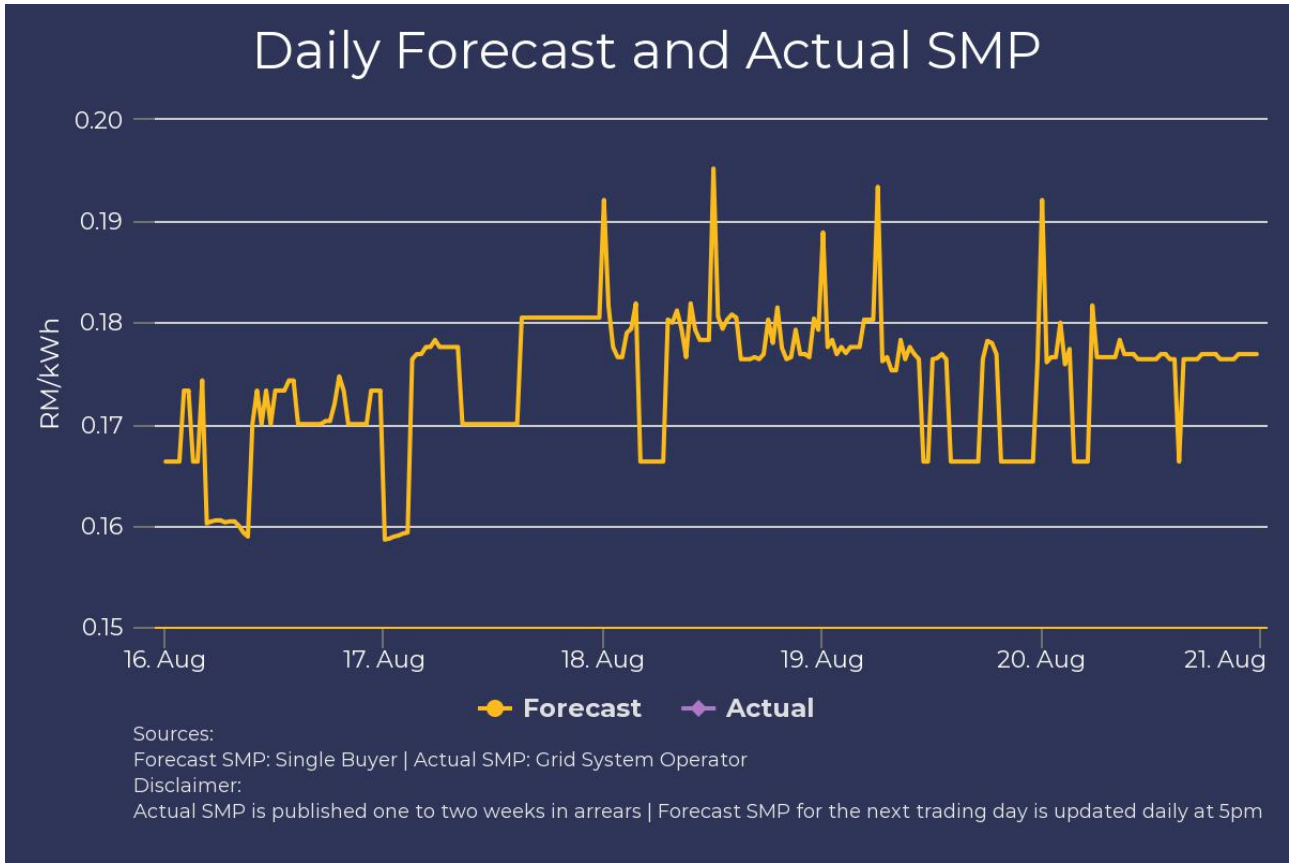
16-08-2021 - 23-08-2021



The highest price of thermal generation being dispatched, it changed every half an hour; for NOVA participants, the offset of current-month electricity export to the grid would be based on the last-month SMP.

https://www.singlebuyer.com.my/resources-marginal.php

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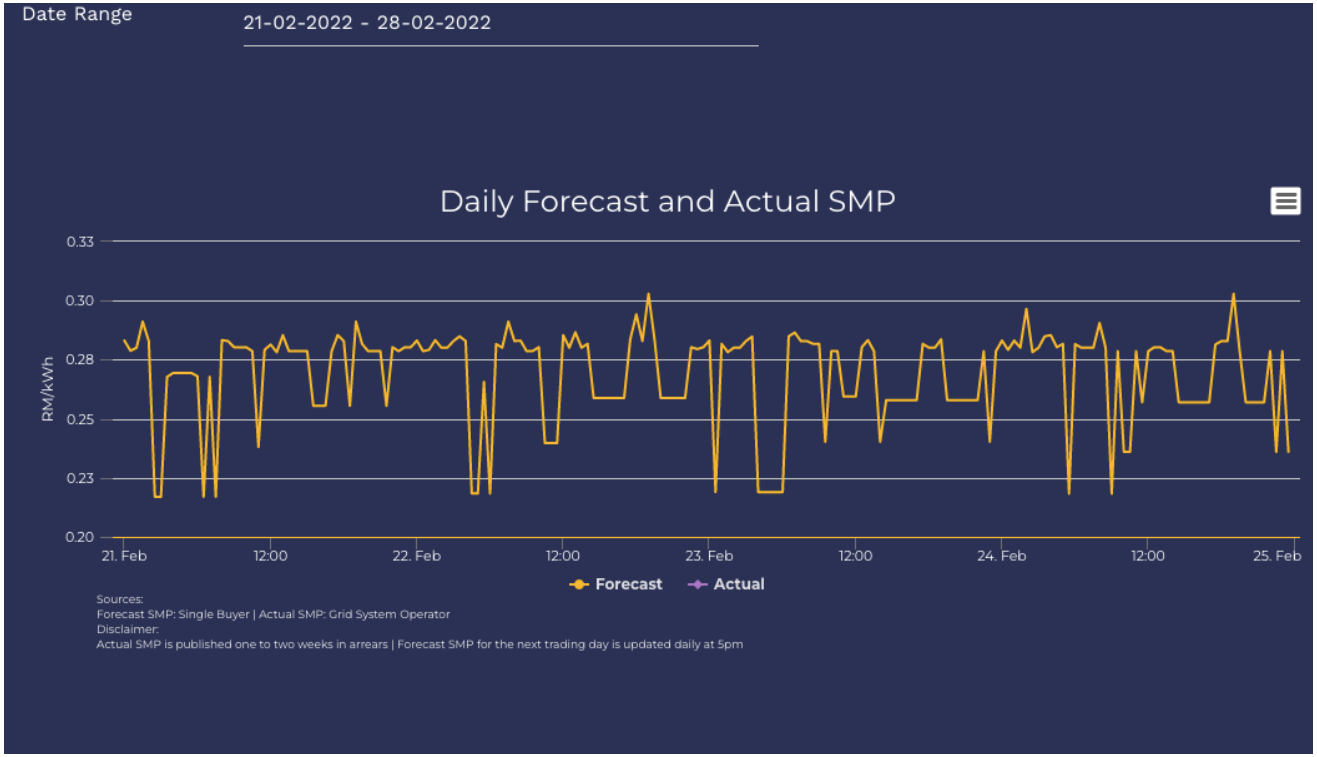
21-02-2022 - 28-02-2022



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https://www.singlebuyer.com.my/resources-marginal.php

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04

MONEY

FUNDING, FINANCING,
MODELS

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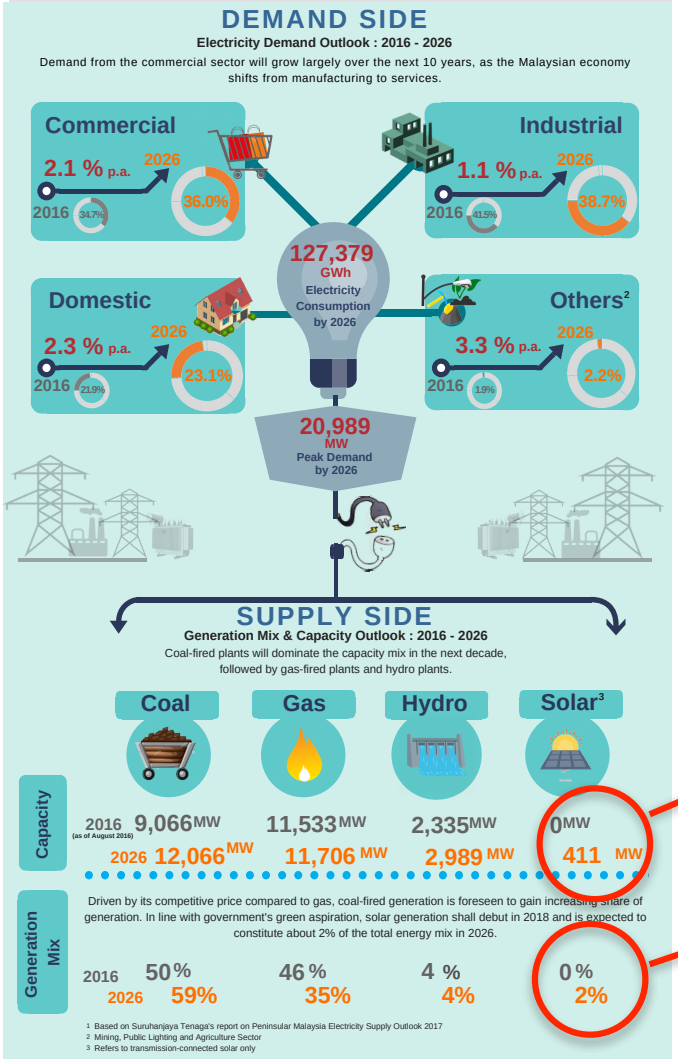
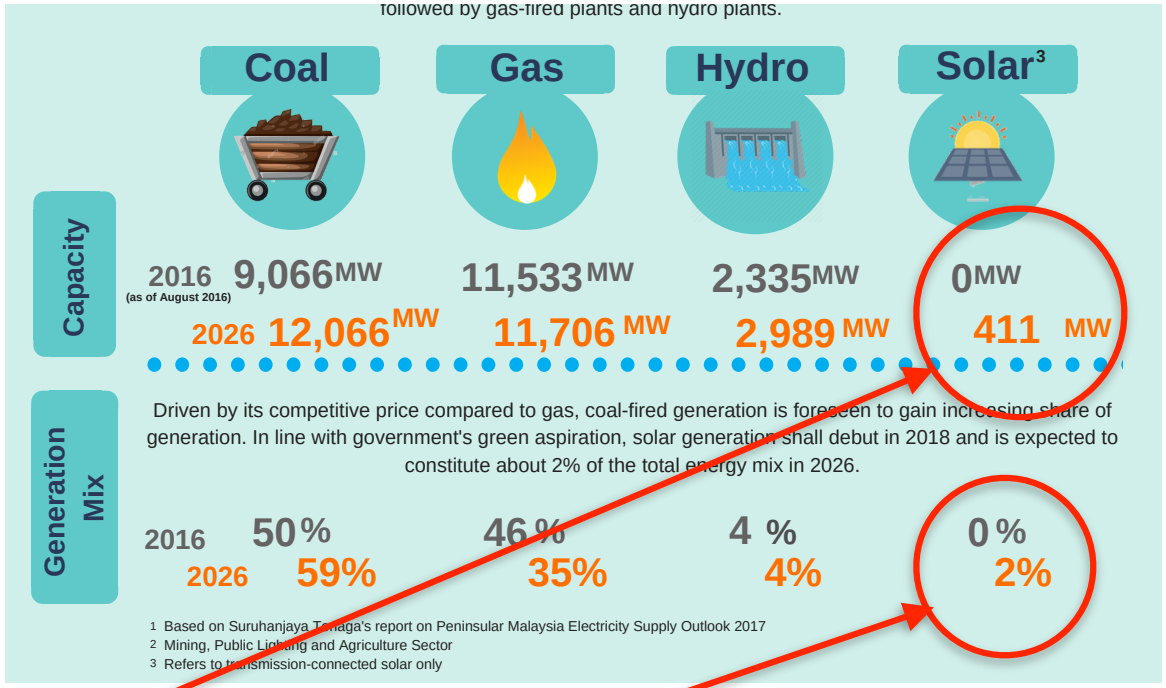
SUPPLY DEMAND OUTLOOK[1]

In Peninsular Malaysia





https://www.singlebuyer.com.my/resources-marginal.php

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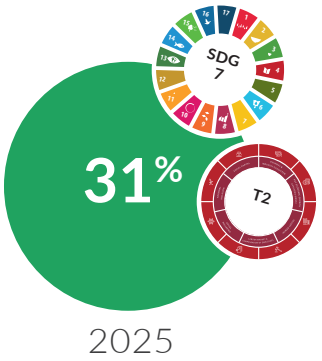
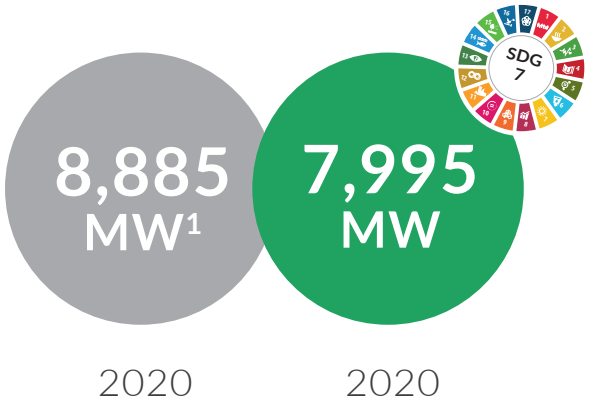
Nevertheless, the energy sector still faces several issues and challenges, such as fragmented policies, impediments in the domestic oil and gas market as well as non-competitive fuel procurement in the electricity subsector.



Renewable Energy of Total Installed Capacity



Renewable Energy Installed Capacity

Chapter 9, 12th Malaysia Plan

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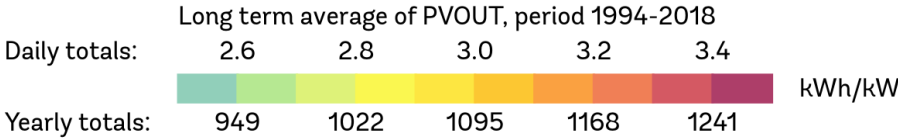
Irradiance Comparison & Installed Capacity
Whats Wrong with This Picture?

Malaysia's 'Lowest' :1200kWh/kW

Germany's Highest 1241kWh/kW:'Highest'

Germany's Irradiation Scale



2,400MW+

49,200MW

International Energy Agency
SEDA Malaysia

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SPECIFIC YIELD

1200 kWh/kW	1350 kWh/kW	1500 kWh/kW
Klang Valley	Melaka	Kelantan
Taiping	Port Dickson	Penang
	Seremban	Kedah
	Johor	North Perak
	Pahang	Sabah
	Ipoh	Alor Setar
		Perlis

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Current Project Business Models

1. **Outright Purchase :**

1.1. Client pays the system by project progress

1.2. Best choice for Value and R.O.I.

2. **Solar Leasing** :

2.1. 0% - XX% of Capital Outlay, Balance on Lease basis

2.2. Fixed Monthly Payment for XX months

5. **Solar Power Purchase Agreement (SPPA) :**

5.1. Client buys back Solar Energy at lower rate

5.2. Discounted Tariff Type

5.3. Fixed Tariff Type

5.4. Commonly 20 – 25 years Contract/Commitment basis

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ON THE HORIZON

P2P

- Peer-to-peer Energy Trading
- Pilot programme started in 2019, pending government's decision

TPA

- Third Party Access
- Already in place for telco network and gas distribution network
- Emerging demand from solar power generation

NEDA

- New Enhanced Dispatch Arrangement
- Halted for solar, waiting for re-opening

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ESTIMATED RETURN ON INVESTMENT (ROI)
Klang Valley, Taiping, Perlis, Kedah & Penang Areas

Category	Capacity (KW)	Years with GITA
Tariff B	250	3-4+
Tariff C1 & C2	700	4-5+
Tariff D	250	4-5+
Tariff E2	1,000	4-5+

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FUNDING AND FINANCING

Business Models	Description	Recommended for
Solar Leasing	Instalment plans by solar service provider/ investor	Companies that are looking for monthly installment options without paying any upfront payment
Power Purchase Agreement	Energy performance contract with registered solar PV investor	Companies that doesn't want to own the PV assets and wants to hit their GBI/ISO KPI
Outright Purchase	Cash Term	Companies with good cash flow and wants faster ROI

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MARKET VALUE & PV SYSTEM (CAPEX & OPEX)

Capacity (kW)	CAPEX (RM)	OPEX (RM)	OPEX (What's included)
< 12	10,000 - 50,000	200 - 2,000 per year	Solar panel: - panel cleaning - visual inspection - performance evaluation Inverter: - inspection of functionality - fan cleaning Cabling: - visual inspection Balance of system: - visual inspection
12 - 72	50,000 - 220,000	2,000 - 4,500 per year	
72 - 425	220,000 - 1,100,000	4,500 - 15,000 per year	
425 – 10,000	1,100,000 - 22,000,000	15,000 - 650,000 per year	
> 10,000	> 22,000,000	> 650,000 per year	

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FINANCIAL ENABLERS

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05

MyRER

Discussion Points

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Figure 6-3: Solar initiatives

SOLAR INITIATIVES	KEY ACTIONS UP TO 2025	KEY ACTIONS POST 2025
1.1 Accelerate Net Energy Metering (NEM)	• Enhancement of existing NEM programme - Accelerate NEM approval procedures - Promote awareness of NEM - Explore potential for government rooftop tendering program • Future NEM programmes - Review net metering tariff - Lift capacity limit restriction - Include Virtual Net Metering	• Liberalization of NEM tariff and new retailers to take role of off-takers • Continued implementation of government rooftop tendering program
1.2 Introduce new business model	• Enable corporate PPAs in line with Third Party Access framework • Pilot and implement P2P energy trading • Enhanced platform for RECs trading from rooftop and large scale solar, supporting corporate PPAs and Green tariff	• Large scale adoption of corporate PPAs in line with market reforms
1.3 Enhance large scale solar auctions	• Continue to promote floating solar PV in LSS auctions • Identify new LSS sites with state level cooperation	• Auction design to align with evolving technological advances and global best practices

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Highlights

1. Building on enablers mentioned in the MyRER which include :
   1.1. TPA
   1.2. Implementing the P2P
   1.3. Lifting limits on future NEM
   1.4. further LSS quota within 2025 period
   1.5. Possibility of Virtual Power Purchase Agreements (VPPAs)

2. Enablers need to be activated and quota be released, as the 2025 target is based on installed capacity.

3. Plan was meant to be released in 2018-2019 (Was a different PV landscape)
   3.1. e.g. TPA should continue with the condition that the systems be accompanied by energy storage systems (ESS)

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Considerations

1. **Roadmap has opened opportunity for**
   - **1.1. improved policies & guidelines**
   - **1.2. New business models**
2. **The industry has the track record via national programs.**
3. **Addressing the fears expressed by the report " duck curve" effect from the solar PV penetration into the grid is further increased.**
   - **3.1. Currently it is capped at 24%.**
   - **3.2. It is our opinion, the duck curve phenomena could be addressed by promoting energy storage.**
   - **3.3. Battery storage will be the next chapter included in the industry.**

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Other Considerations

4. ESG reporting required as a listing rule

4.1. In October 2015, Bursa Malaysia issued amendments to the Main Market Listing Requirements ("Main LR") and ACE Market Listing Requirements ("ACE LR") (collectively referred to as the "LR") relating to sustainability statements in annual reports ("Sustainability Amendments"). Under the Sustainability Amendments, listed issuers are required to disclose a narrative statement of the management of material economic.

5. Hyper Data Centres require 100MW / day to operate

5.1. As a minimum such a data centre would require a minimum of 500-600MW of generation which would include charging of energy storage systems.

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06

EOL

END OF LIFE (EOL)
MANAGEMENT, THE FUTURE

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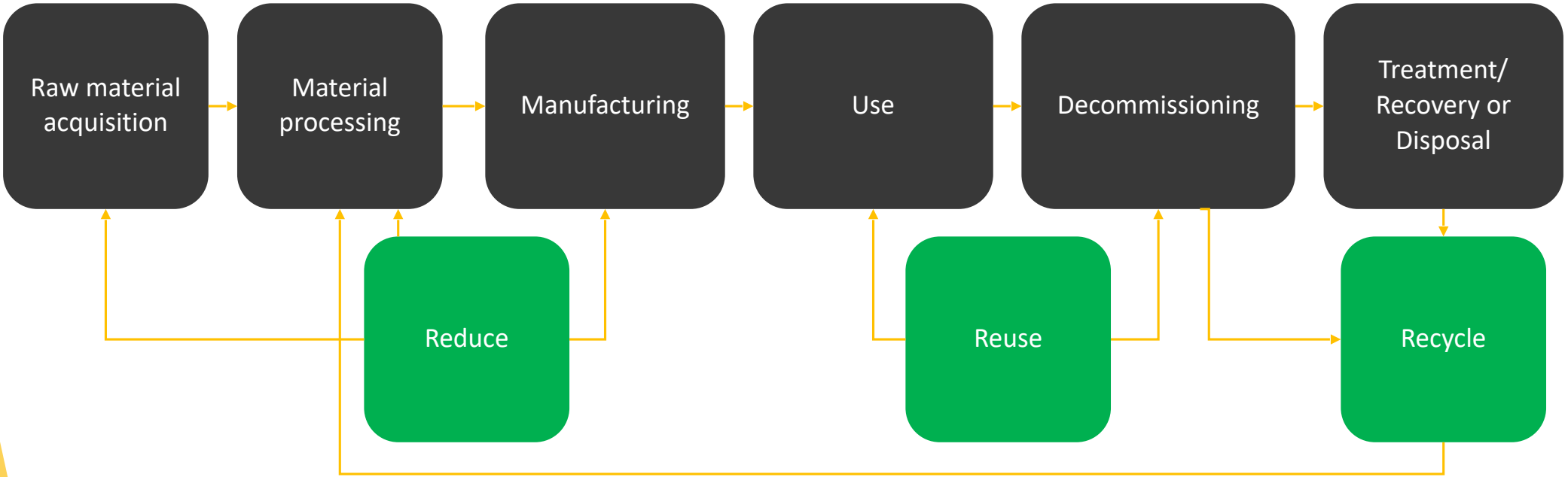
END OF LIFE MANAGEMENT



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06

FOOD FOR THOUGHT

“Be the change you want to see in the world”

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INCENTIVES & ENABLERS

Tax Breaks

1. 0% tax for PV BOS sale within Malaysia = “Buy Malaysia First”
2. Investment tax allowance for new equipment purchased to produce PV BOS
3. Tax rebate for R&D expenditure to commercialise BOS
4. Grants to encourage BOS manufacturing e.g. AC cable manufactures to develop and manufacture PV cables
5. Exemption of 10% Sales Tax (Import Duty can be exempted with Form E) for supply of locally manufactured BOS
6. TAX Holiday of 5 years for manufacturers which set up local BOS manufacturing in Malaysia

Enablers

7. Preferential tariffs with advantage of between 5 – 10 % for projects using locally manufactured BOS Components
8. Allocation of state land at discounted lease to encourage the setup of local manufacturing
9. Fast track approval with directive from federal government to expedite construction of BOS manufacturing facilities to expedite set – up process
10. Rebate for using local content for investors to this reducing the burden e.g. Rm1.00 spent on local BOS = 5% rebate

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IMPACT OF PV INDUSTRY ON RMK12

Chapter 5 RMK12

1. 5-8 building on eRezeki : B40 leveraging on digital platforms (In PV there is IoT, Big Data, Cloud, Drone fleet management etc.)
2. 5-9 further TVET opportunities (PV requires skilled labour with export potential, previous TVET 289,884 graduates could be re-skilled for PV)
3. 5-19 This will help towards the 65% target for participation of skilled Bumiputra in Skilled Occupation Category
4. 5-24 In turn will help narrow the B40 income inequality
5. 5-24 B40 empowerment and increased standard of living
6. 5-25 TVET support of B40 for PV skills training along with synergy with JPK will help increase participation in supply chain
7. 5-25 This will form the seeds for entrepreneurship with internationally marketable skills in a sunrise industry

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THE OPPORTUNITY

FROM 26% US$717.81 million TO 38% US$1,045.96 million

Job creation from NOVA & Utility Scale :
14,581 Direct, 93,630 Indirect

"Previous prices were not competitive but given the current state of the market there is a need to act to overcome the situation & an opportunity to effect positive change in the process"

- *Note PV Modules and inverters are the excluded items in the BOS*
- *BOS Includes contingency, consultancy & project development cost*

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Solar Photovoltaic Systems Workshop of the Malaysian Photovoltaic Industry Association (MPIA) and Malaysian Rubber Council (MRC)

Wed 6 July 2022

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MRC
MALAYSIAN RUBBER COUNCIL

Introduction to Solar Photovoltaic Systems

Dr. Sulaiman Shaari

Master Trainer, Malaysian Photovoltaic Industry Association (MPIA), Petaling Jaya, Selangor
Professor, Faculty of Applied Sciences, Universiti Teknologi MARA (UiTM), Shah Alam, Selangor

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Total number of slides = 47

Sharing session

MALAYSIAN PHOTOVOLTAIC INDUSTRY ASSOCIATION

Session 1

- What photovoltaics (PV) is
- Know key information
- Ensuring performance

Session 2

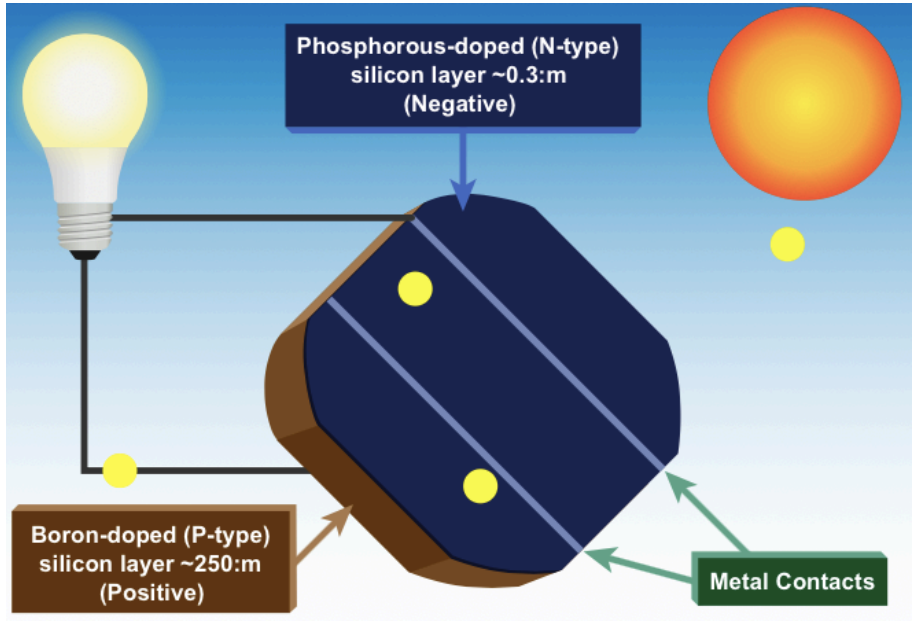
- Question and Answer

Session 1

- **What photovoltaics (PV) is**
- Know key information
- Ensuring performance

What PV is all about

1) What
   - Photovoltaics (PV) is light converted directly into electricity.
2) Technology
   - *Solar* cell, i.e. a PV semiconductor device.
3) How
   - Light energy (photon) impinges on specially-treated PV cell.
   - Photon is absorbed and electric charge pairs are created.
   - External conductor across ends of PV cell provides path for charge to travel.



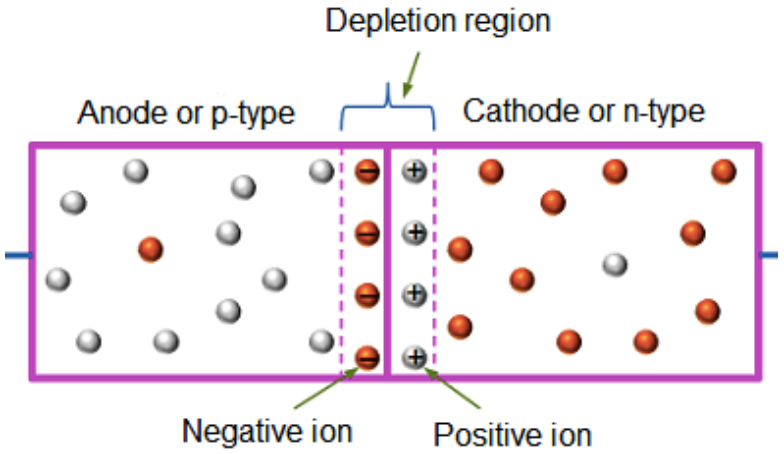
http://www.fsec.ucf.edu/en/consumer/solar_electricity/basics/how_pv_cells_work.htm

What PV is all about

4) Electricity generated by PV is direct current (DC) type.

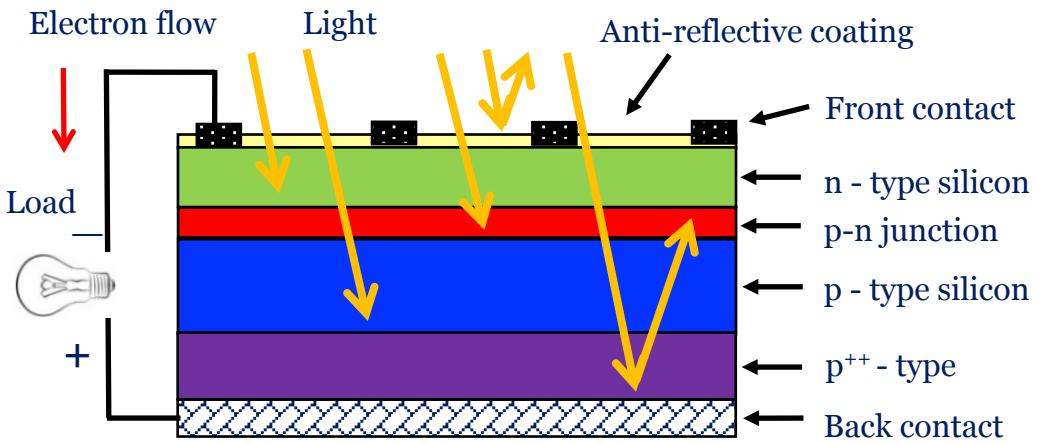
5) Conventional material used for PV cells is silicon due to availability and suitability.

Make-up of a PV cell



https://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/

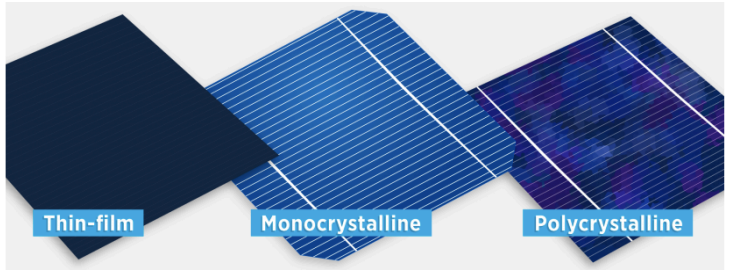
What is happening



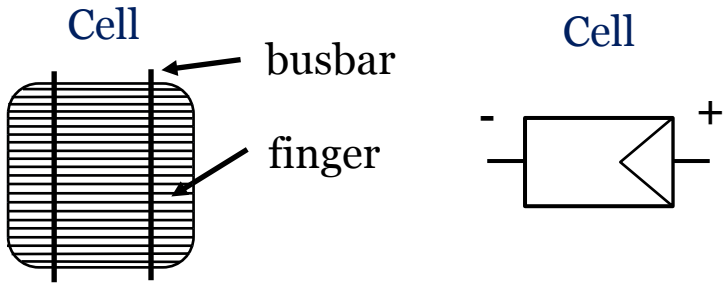
What PV is all about

7) From sand to cell

https://www.cleanenergyreviews.info/blog/solar-panel-components-construction



https://www.energy.gov/eere/solar/solar-photovoltaic-cell-basics



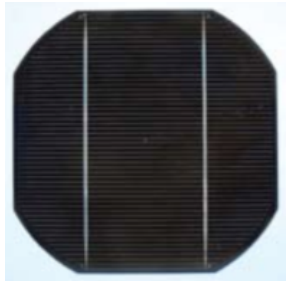
Video showing how to grow a silicon ingot

https://www.youtube.com/watch?v=XbBc4ByimY8

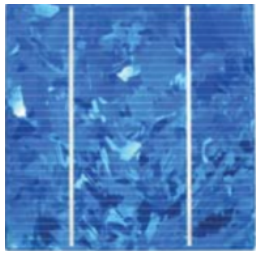
What PV is all about

8) Various types of PV technology

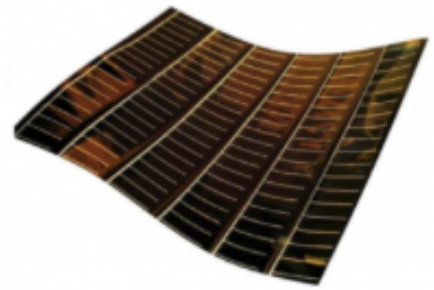
Mono-crysalline



Multi-crysalline



Amorphous

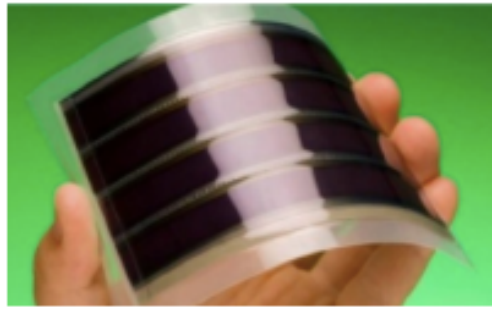


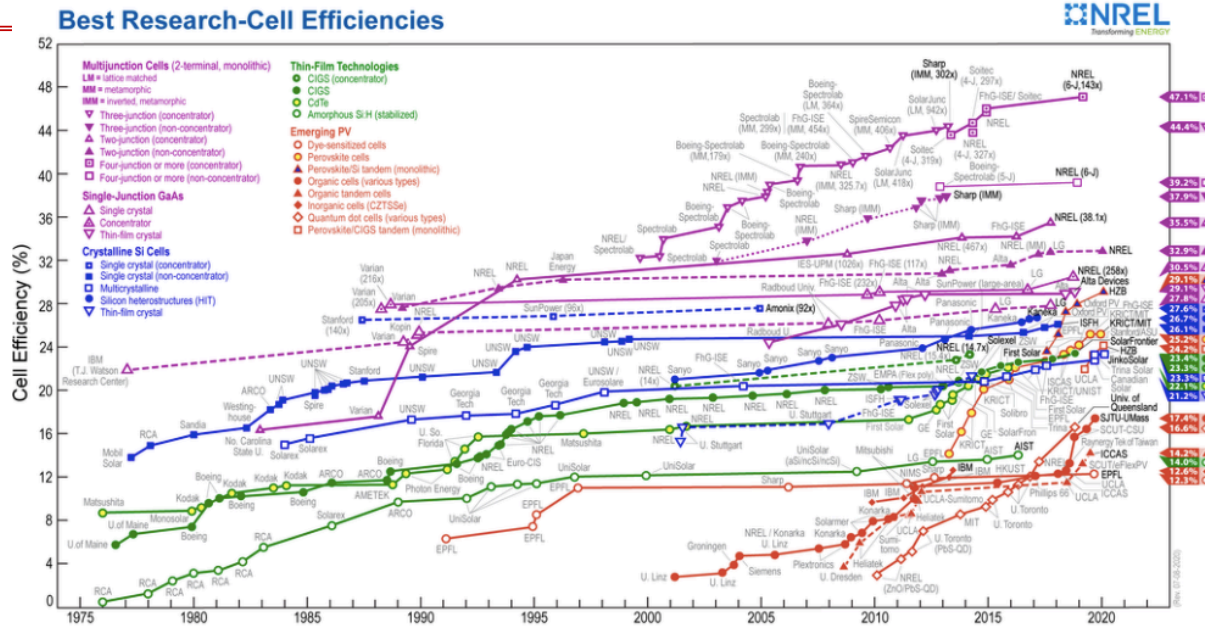
CdTe

Organic

Perovskite

Dye Sensitised Solar Cells (DSSC)

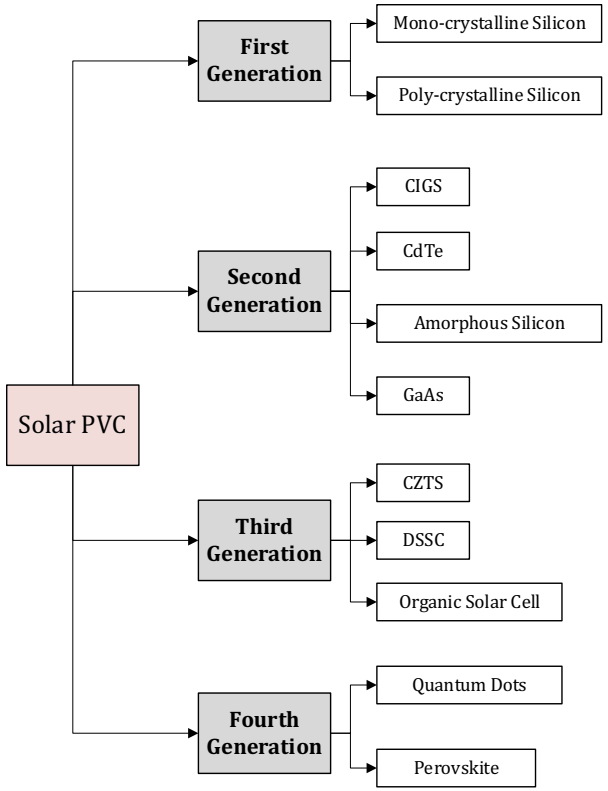




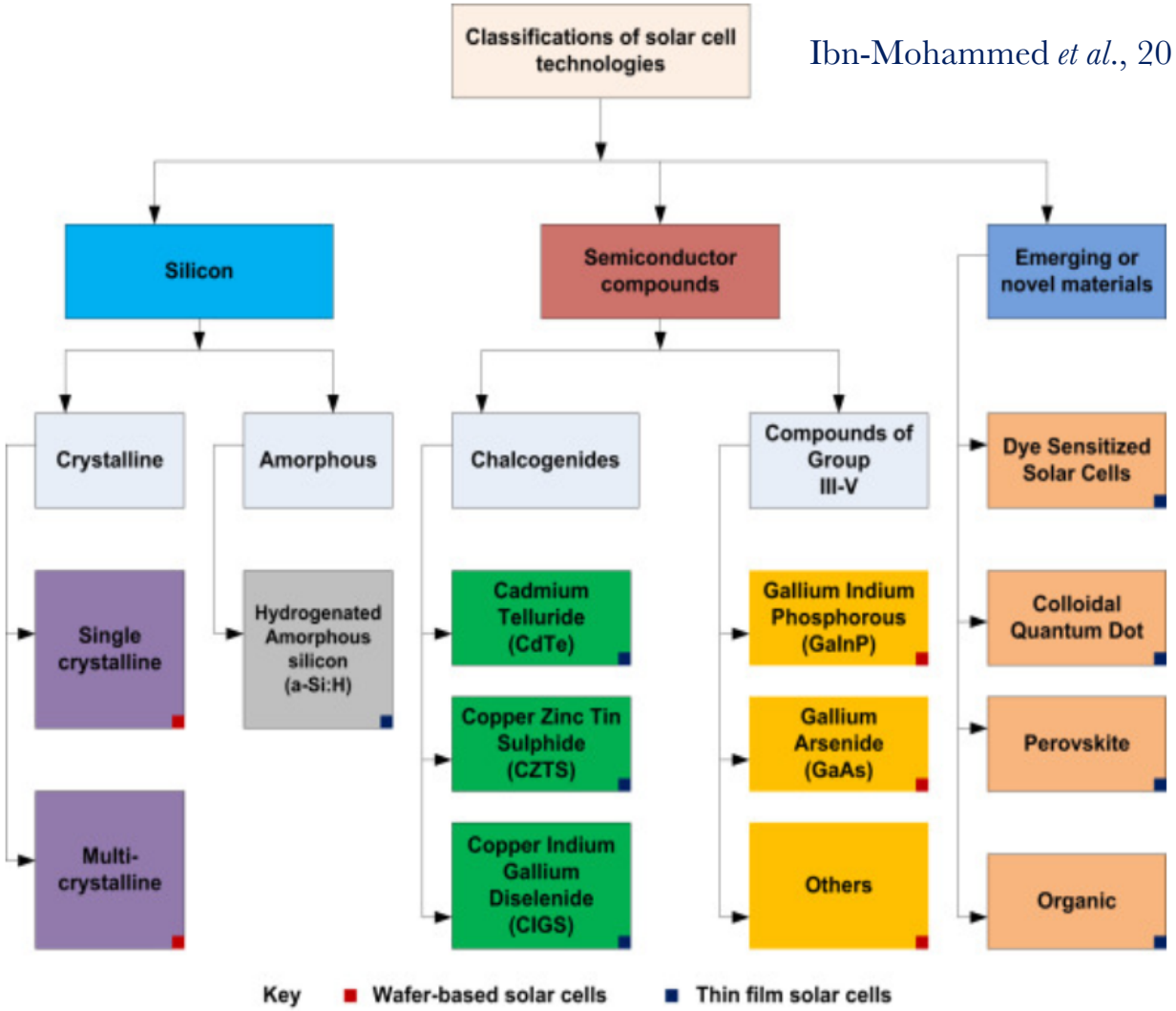
CIGS

What PV is all about

9) Various types of PV technology



Chawla *et al.*, 2020

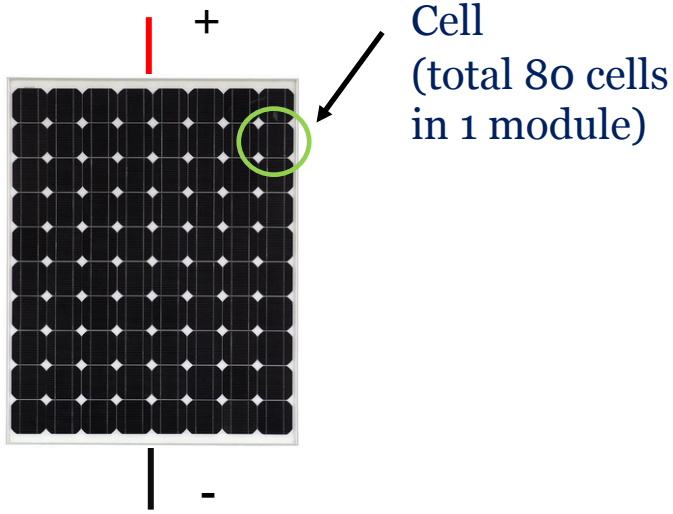


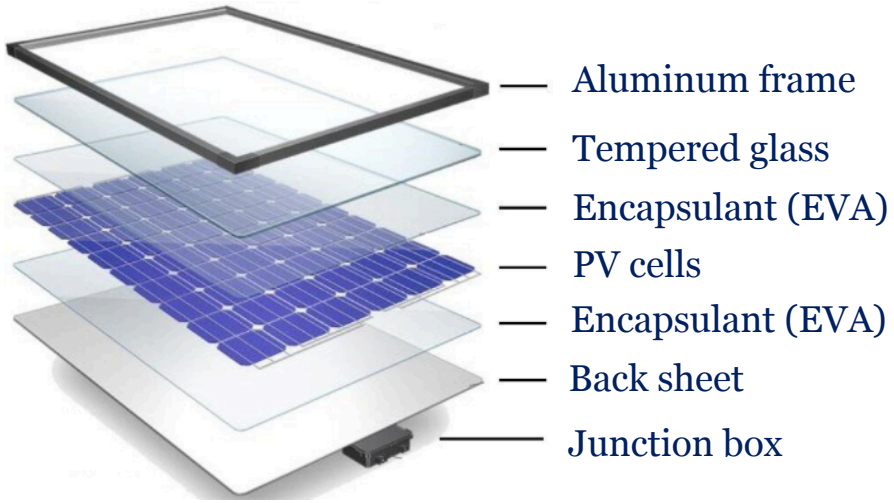
Ibn-Mohammed *et al.*, 2017

What PV is all about

10) From cell, module, string, array, field

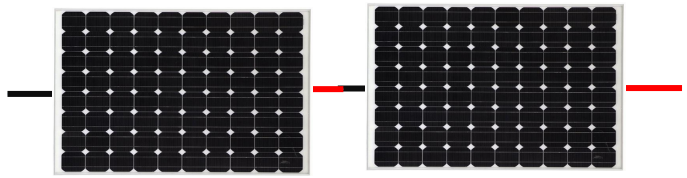
Module



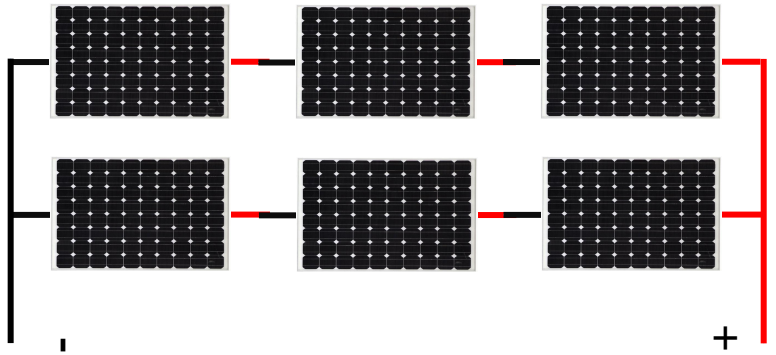


https://www.cleanenergyreviews.info/blog/solar-panel-components/

String (2 modules in series)



Array (2 by 3 i.e. 2 parallel strings by 3 modules in series per string)



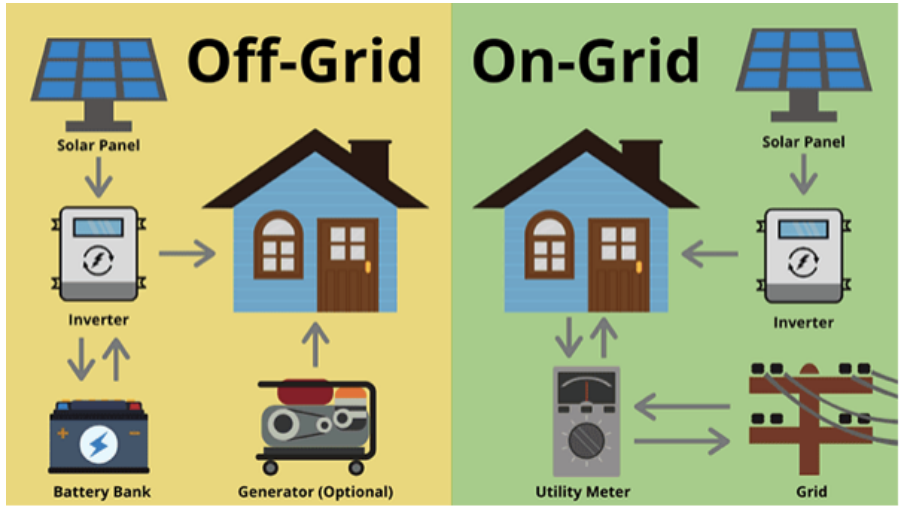
What PV is all about

11) Grid-connected (GC) PV energy system is connected to the utility grid.

12) Off-grid (OG) PV energy system is not connected to the utility grid.

13) Type of PV system connection (topology) determines the:
    - Equipment
    - Flow of electricity
    - Scheme

14) Other names:
    - GCPV is also called on-grid or grid-tied
    - OGPV is also called stand-alone or remote power system



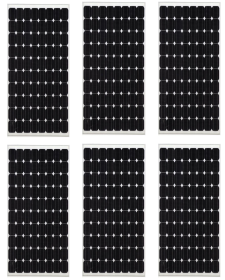
https://www.paradisesolarenergy.com/blog/difference-between-off-grid-and-on-grid-solar-energy

What PV is all about

15) A complete PV system comprises:

- PV array – the PV modules connected in series-parallel
- Balance of System (BOS) – all other components to make the system function as per designed

PV array



Cabling

Fuse

Switch

Controller

Switch

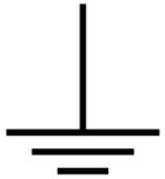
kWh meter

DC load

AC load

Grid

Earthing



AIO inverter

AC inverter

Genset

Charger

Battery

OG inverter

Board

Pump

What PV is all about

16) Topologies:

- GCPV system
  - (without battery)
  - (with battery)
- OGPV system
  - (direct coupled)
  - (with battery)
  - (with battery and generator)

Session 1

- What photovoltaics (PV) is
- **Know key information**
- Ensuring performance

Knowing key information

1) Malaysian Standards (MS)

Up to 2019

INDUSTRY STANDARDS COMMITTEES (ISC)

- Standards Malaysia
- SIRIM Berhad
- Malaysian Timber Industry Board (MTIB)
- Malaysian Institute of Chemistry (IKM)
- Malaysian Plastic Manufacturers Association (MPMA)
- Malaysian Association of Standards Users (Standards Users)
- Malaysian Rubber Board

ISC A	Agriculture
ISC B	Chemicals and Materials
ISC C	Consumer Interests
ISC D	Building, Construction and Civil Engineering
	Timber, Timber Structure & Timber products
ISC E	Generation, Transmission and Distribution of Energy
ISC F	Mechanical Engineering
ISC G	Information Technology, Communication and Multimedia
ISC H	Petroleum and Gas
ISC I	Halal Standards
ISC J	Plastics and Plastic Products
ISC K	Packaging and Logistics
ISC L	Road Vehicles
ISC M	Fire Safety and Prevention
ISC N	Rubber and Rubber Products
ISC O	Organisational Management
ISC P	Metallic Materials and Semi-finished Products
ISC Q	Textiles and Apparels
ISC R	Medical Devices and Facilities for Healthcare
ISC S	Electrical and Electronics Equipments and Accessories
ISC T	Tourism, Exhibition & Hospitality Services
ISC U	Food and Food Products
ISC W	Occupational Safety and Health
ISC Y	Quality Management and Quality Assurance
ISC Z	Environmental Management

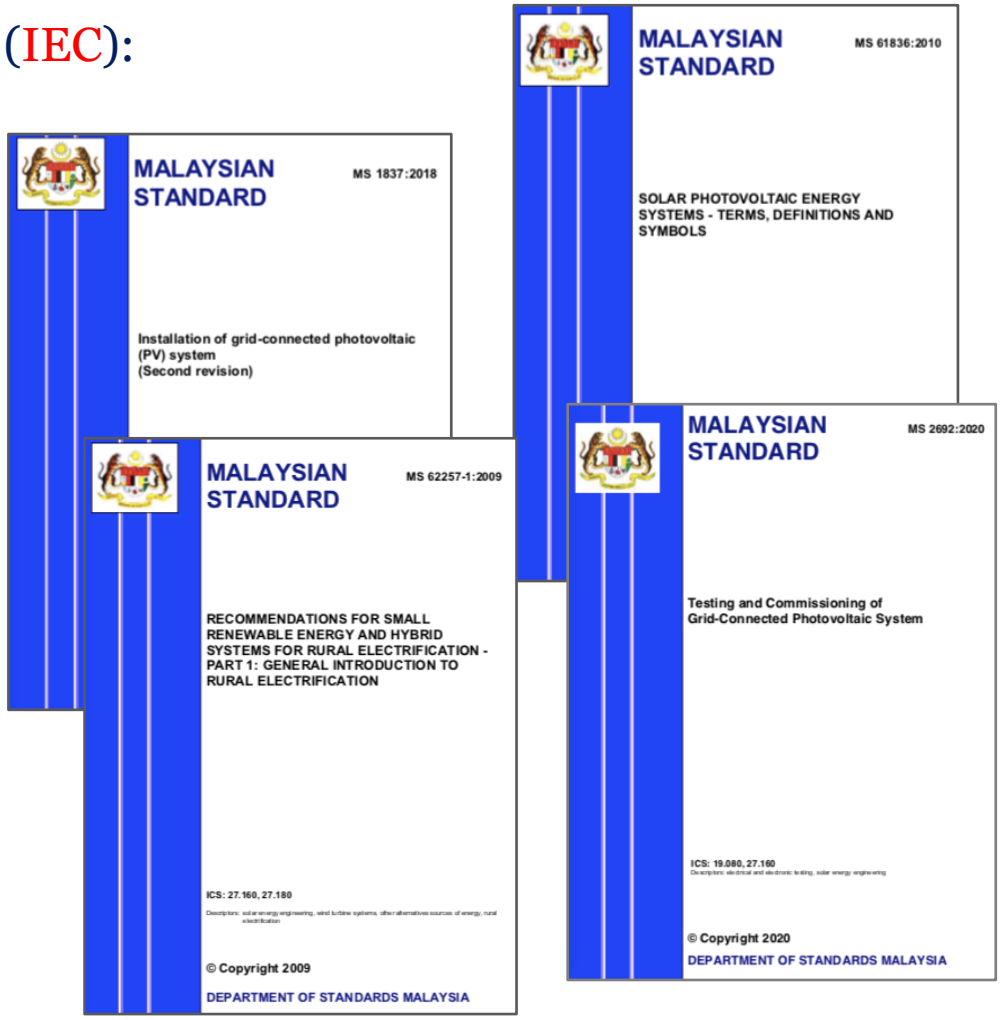
Knowing key information

2) MS based on International Electrotechnical Commission (IEC):

- IEC 61215
- IEC 61730
- IEC TS 62804
- etc

3) Example: IEC 61215 consists of 19 module tests:

- Temperature cycling
- Outdoor exposure test
- UV preconditioning
- Humidity freeze test
- Damp heat test
- Hail test



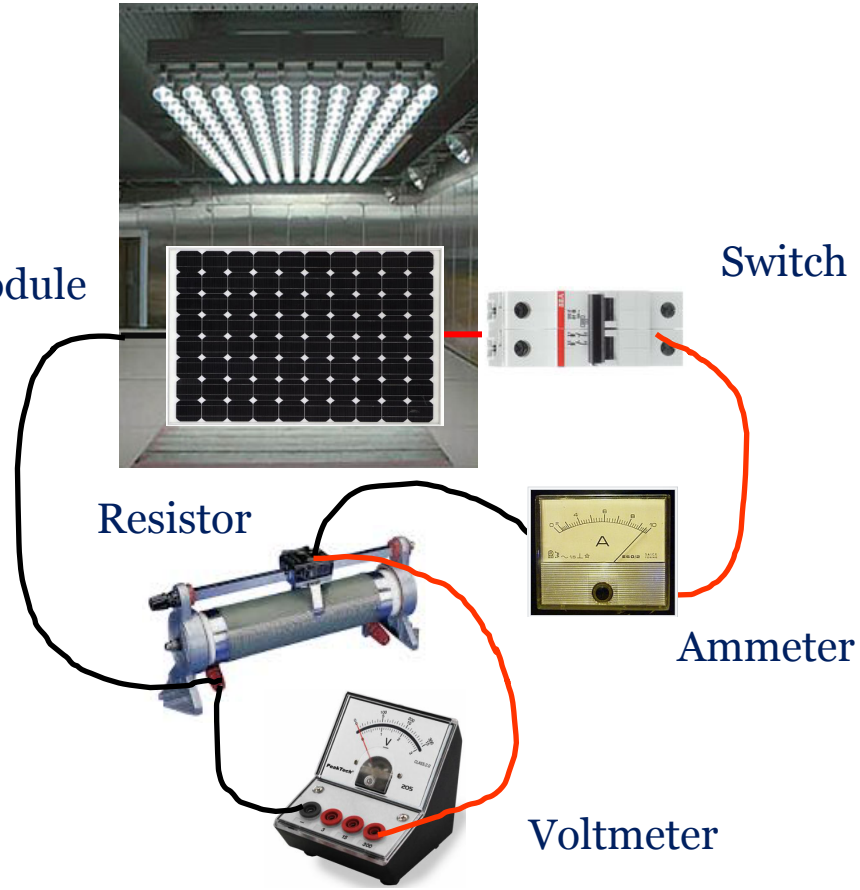
Knowing key information

4) A PV cell or module is rated at a Standard Test Condition (STC) characterised under these:

- Irradiance, G = 1,000 Wm^{-2}
- Temperature of module, T_m = 25 deg C
- Air Mass, AM = 1.5

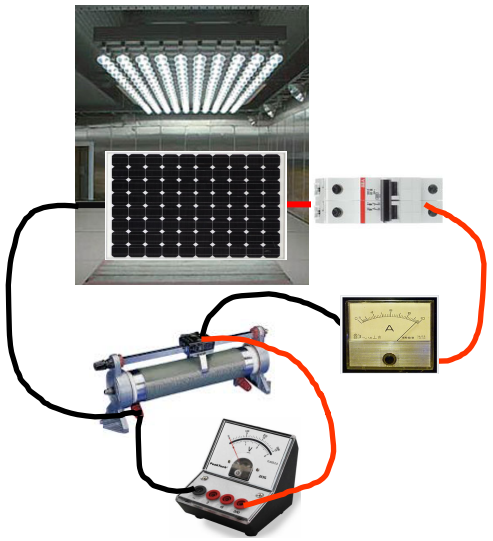
Climate chamber

https://www.espec.co.jp/english/products/measure-semicon/pid/



Knowing key information

5) Results and datasheet



Tolerance f_{mm}

Temperature coefficients

$$\alpha = \frac{\%}{^0C}$$

$$\beta = \frac{\%}{^0C}$$

$$\gamma = \frac{\%}{^0C}$$

Fill factor

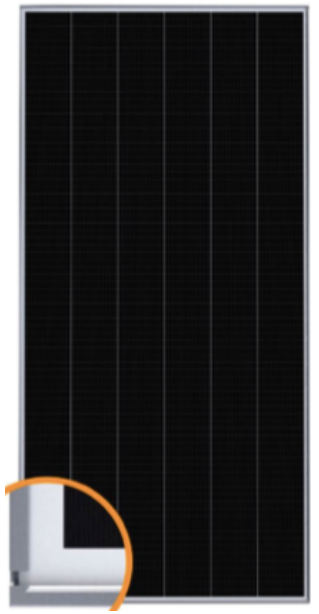
$$FF = \frac{P_{mp}}{I_{sc} \times V_{oc}}$$

Efficiency

$$\eta = \frac{P_{mp}}{G \times A}$$

SUNPOWER®

P3-420-COM-1500

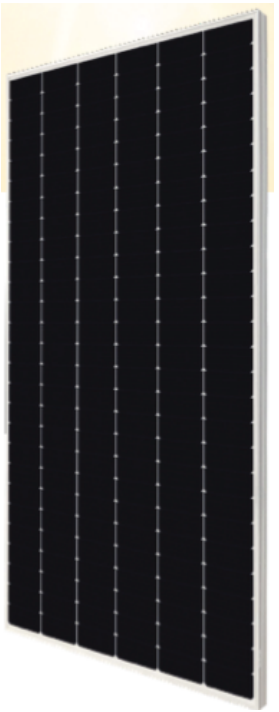


CanadianSolar

High density MONO PERC module

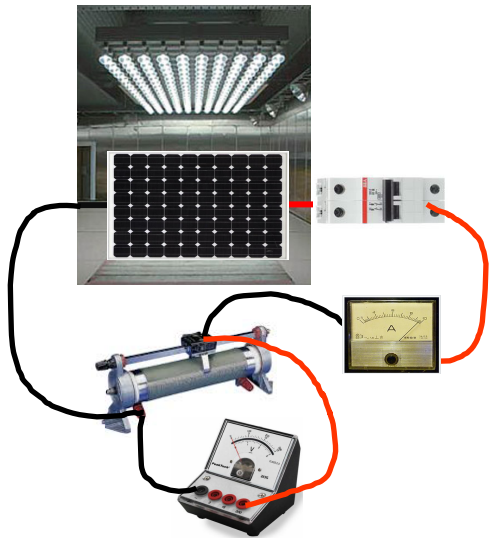
400W~420W

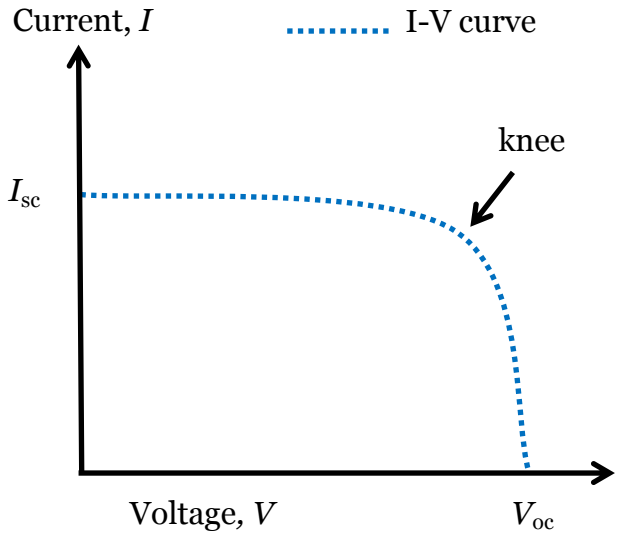
CS1U-400|405|410|415|420MS

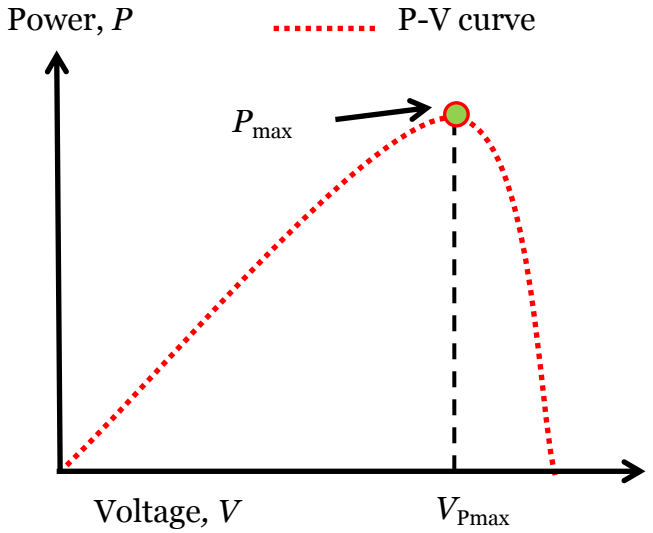


Knowing key information

5) Results and datasheet







I_{sc} short circuit current (A)

V_{oc} open circuit voltage (V)

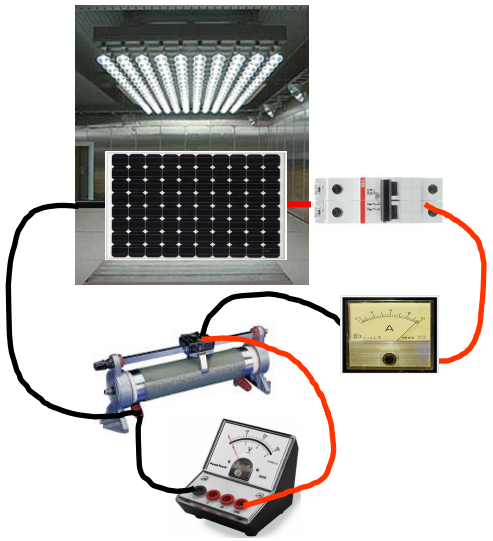
P_{max} maximum power (W)

V_{Pmax} voltage at maximum power (V)

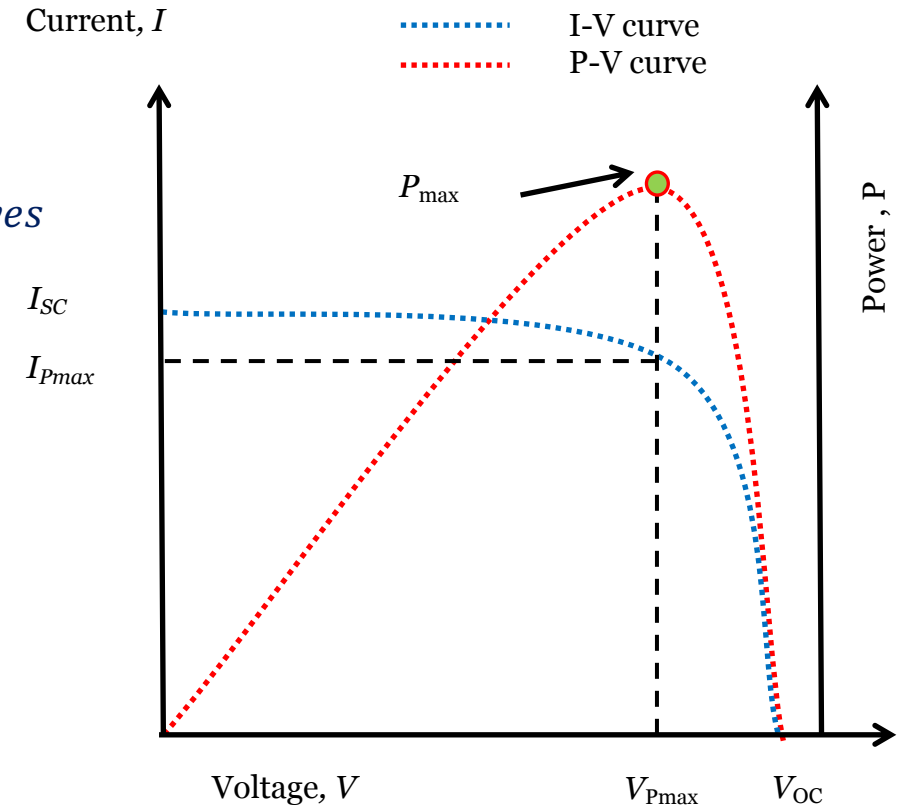
$$Power = Current \times Voltage$$

Knowing key information

5) Results and datasheet



Overlay of curves



I_{Pmax} current at maximum power (A)

Knowing key information

5) Results and datasheet

Model	SPR-P3-420-COM-1500
Nominal Power (Pnom)[4]	420 W
Power Tolerance	+5/–0%
Efficiency	20.4%
Rated Voltage (Vmpp)	45.3 V
Rated Current (Impp)	9.28 A
Open-Circuit Voltage (Voc	54.4 V
Short-Circuit Current (Isc)	9.92 A
Maximum System Voltage	1500 V IEC
Maximum Series Fuse	18 A
Power Temp. Coef.	−0.34% / °C
Voltage Temp. Coef.	−0.28% / °C
Current Temp. Coef.	0.06% / °C
Standard Tests[5]	IEC 61215, IEC 61730

CS1U	420MS
Nominal Max. Power (Pmax)	420 W
Opt. Operating Voltage (Vmp)	44.9 V
Opt. Operating Current (Imp)	9.37 A
Open Circuit Voltage (Voc)	53.8 V
Short Circuit Current (Isc)	9.80 A
Module Efficiency	20.4%
Operating Temperature	-40°C ~ +85°C
Max. System Voltage	1500V (IEC) or
Module Fire Performance	CLASS C (IEC 6
Max. Series Fuse Rating	15 A
Application Classification	Class A
Power Tolerance	0 ~ + 10 W
Temperature Coefficient (Pmax)	-0.37 % / °C
Temperature Coefficient (Voc)	-0.29 % / °C
Temperature Coefficient (Isc)	0.05 % / °C
Nominal Module Operating Temperature	43±3 °C

Fill factor

Efficiency

Temperature coefficients

Tolerance

Knowing key information

5) Results and datasheet

Compare with a different type of module datasheet

DUOMAX twin

Temperature Coefficient of P_{MAX}	- 0.34%/ ℃
Temperature Coefficient of V_{OC}	- 0.25%/ ℃
Temperature Coefficient of I_{SC}	0.04%/°C

BIFACIAL DUAL GLASS 144

Peak Power Watts-P_{MAX} (Wp)*	435
Power Tolerance-P_{MAX} (W)	
Maximum Power Voltage-V_{MPP} (V)	40.8
Maximum Power Current-I_{MPP} (A)	10.67
Open Circuit Voltage-V_{OC} (V)	48.9
Short Circuit Current-I_{SC} (A)	11.24
Module Efficiency η_m (%)	19.7
Maximum Power-P_{MAX} (Wp)	479
Maximum Power Voltage-V_{MPP} (V)	40.8
Maximum Power Current-I_{MPP} (A)	11.74
Open Circuit Voltage-V_{OC} (V)	49.1
Short Circuit Current-I_{SC} (A)	12.36
Pmax gain	10%

Fill factor

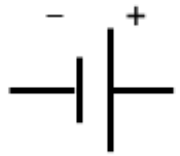
Efficiency

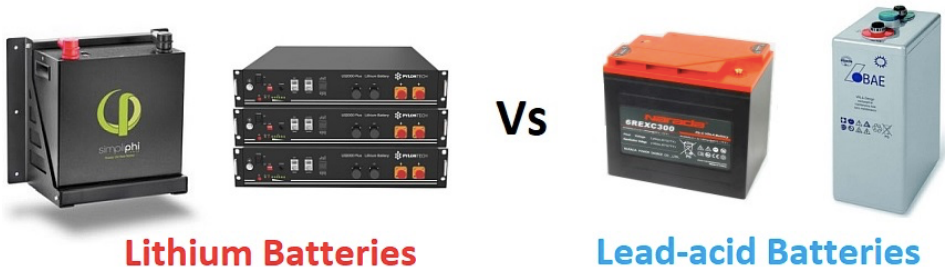
Temperature coefficients

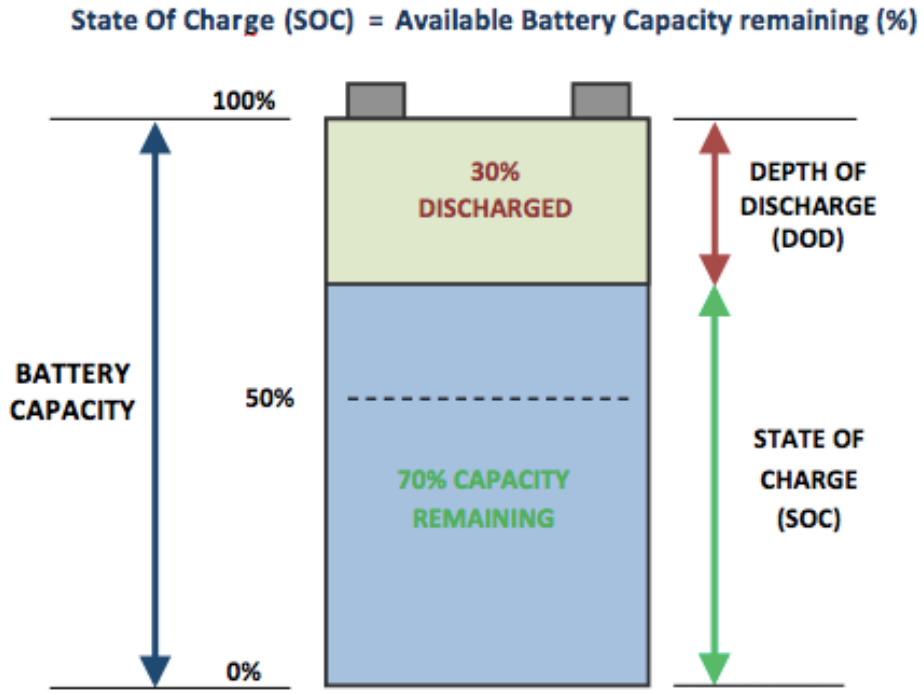
Tolerance

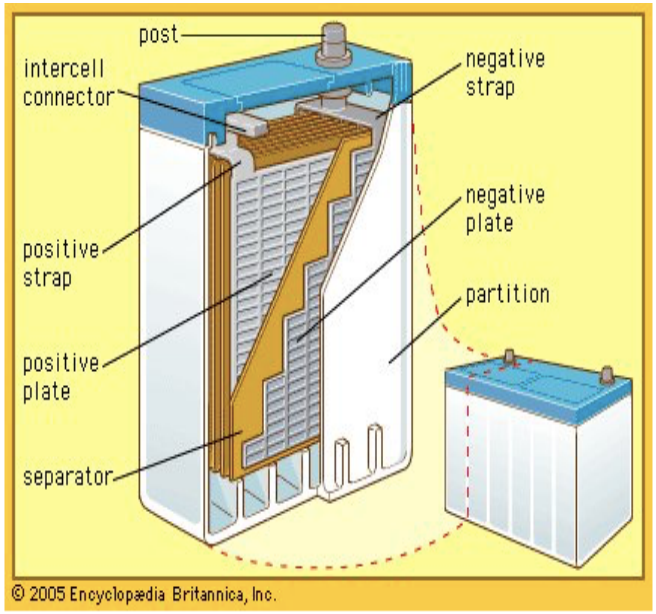
Knowing key information

5) Results and datasheet









Knowing key information

5) Results and datasheet

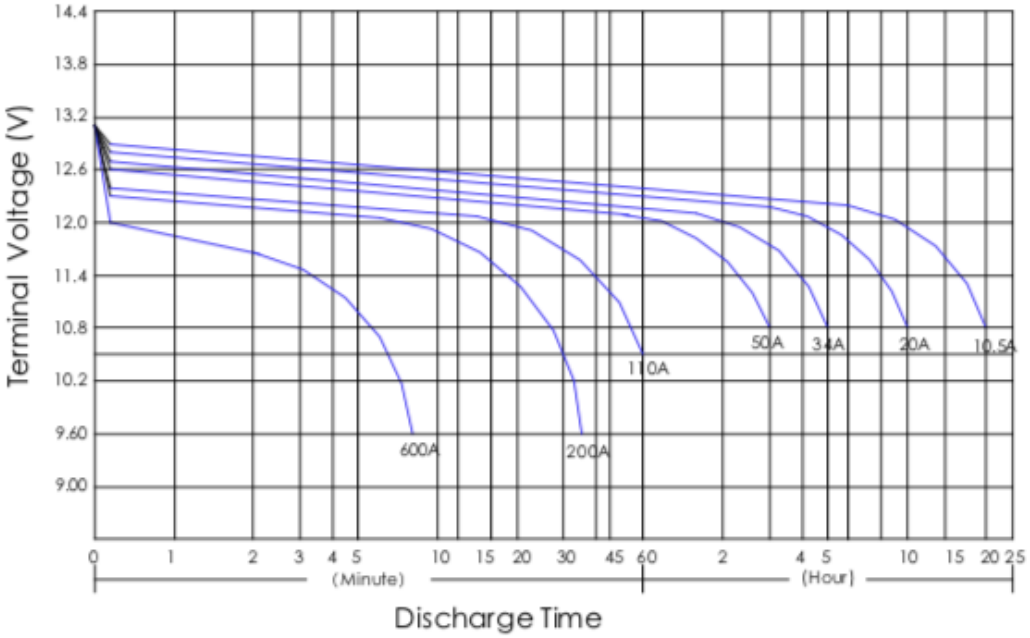
Temp. °F	Temp. °C	Factor
80	26.7	1.00
70	21.1	1.04
60	15.6	1.11
50	10.0	1.19
40	4.4	1.30
30	-1.1	1.40
20	-6.7	1.59

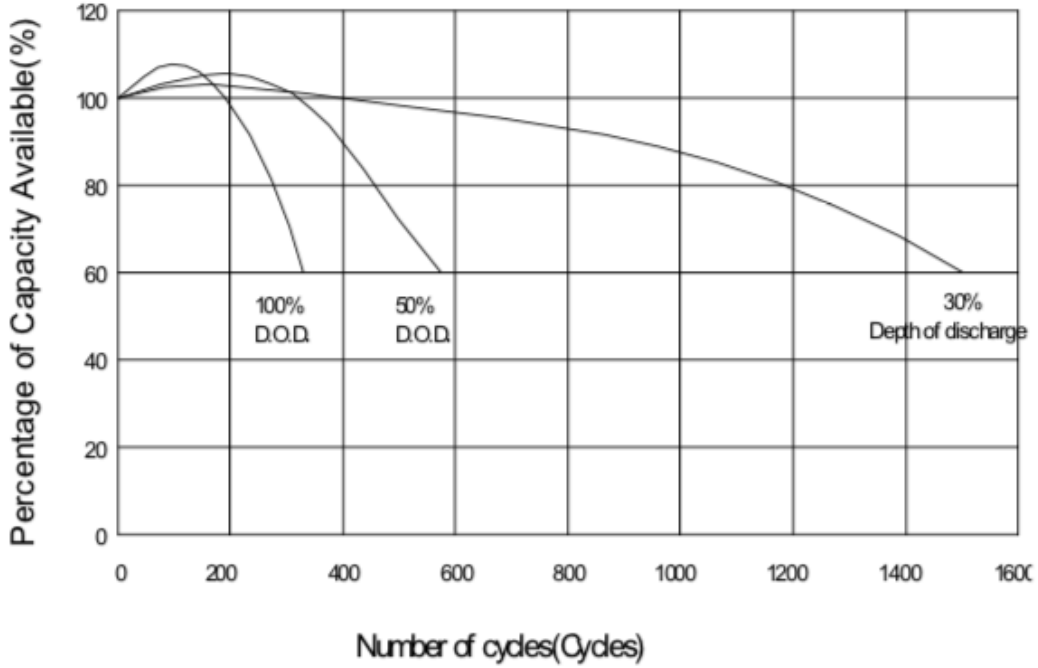
No	Parameter / Rating	Value	Unit
1	Model	SBS200	-
2	Construction	VRLA	-
3	Nominal battery voltage	12	V
4	Capacity	200	Ah
5	Discharge rate	10	hours (h)
6	Reference temperature	20	°C
7	Cycle use voltage	14.5 – 15.1	V
8	Stand-by voltage	13.4 – 13.7	V
9	Self-discharge rate	2.5	% per month
10	Maximum DOD	80	%
11	Coulombic efficiency	90	%
12	Cycle life	1,000	cycles
13	Operating ambient temperature	-10 to 50	°C
14	Dimensions (L x W x H)	521 x 241 x 220	mm
15	Mass	65	kg
16	Terminals	2	-

https://www.leadingedgepower.com/support/

Knowing key information

5) Results and datasheet





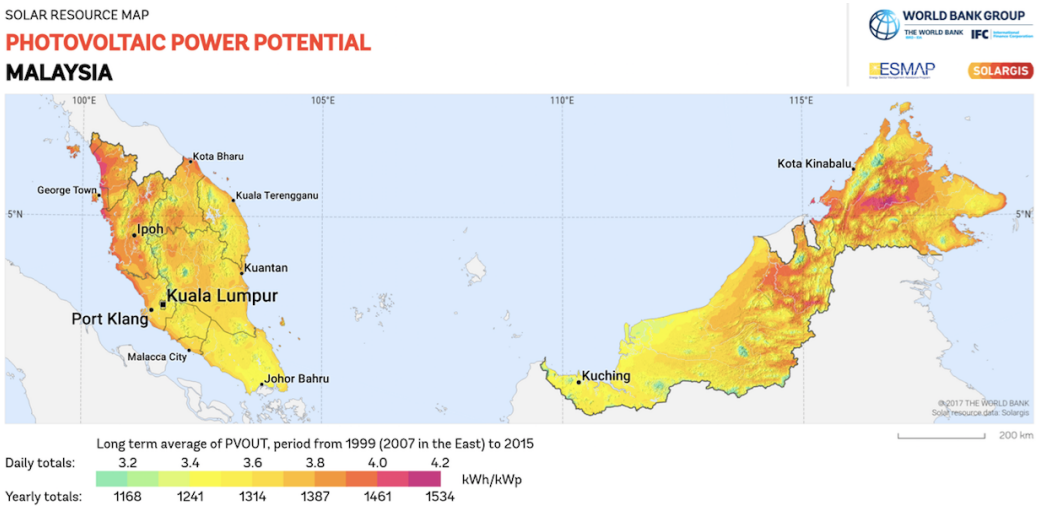
Session 1

- What photovoltaics (PV) is
- Know key information
- **Ensuring performance**

Ensuring performance

1) Clear goal and quantified gold

Does system meet intended purpose and deliver promises?



Ensuring performance

2) What, why, who, how, when:

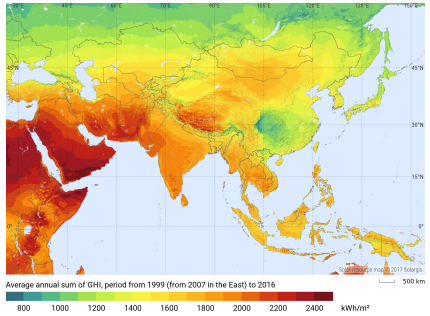
What
- Adequate and accurate info
- Quality product

Who
- Talented people
- Competent skill

When
- Always
- Dynamic

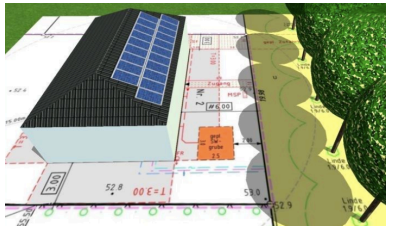
Why
- Right decision
- Appropriate approach
- Accurate design

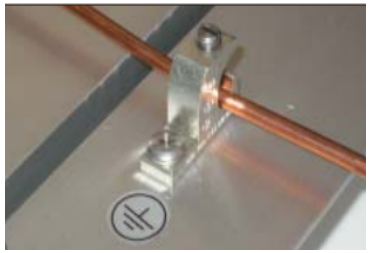
How
- Conducive environment
- Efficient eco-system



https://solargis.com/maps-and-gis-data/

Talented human resource





Ensuring performance

3) Design steps for GCPV systems:

A. Establish: Utilisable area; Energy-Power constraint; Budget

B. Sizing of PV array to inverter (DC-AC ratio)

C. Total number of modules

D. Modules in series string

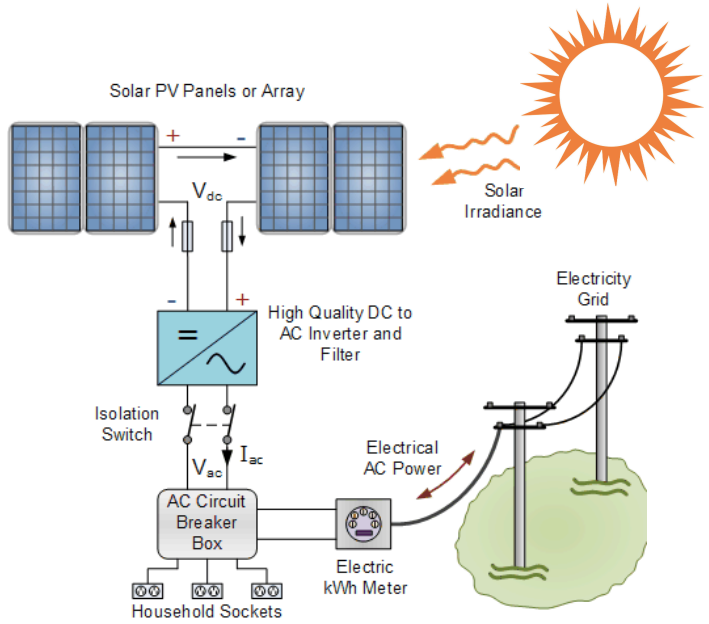
E. Number of parallel strings

F. Sizing of BOS components

G. Estimating losses

H. Prediction of system performance

I. Costing and Return on Investment (ROI)



Ensuring performance

4) Design steps for OGPV systems:

A. Establish: Energy-Power requirement; Constraints; Budget;

B. Link load and resource: worst design month

C. Establish system voltage

D. Determine currents in system

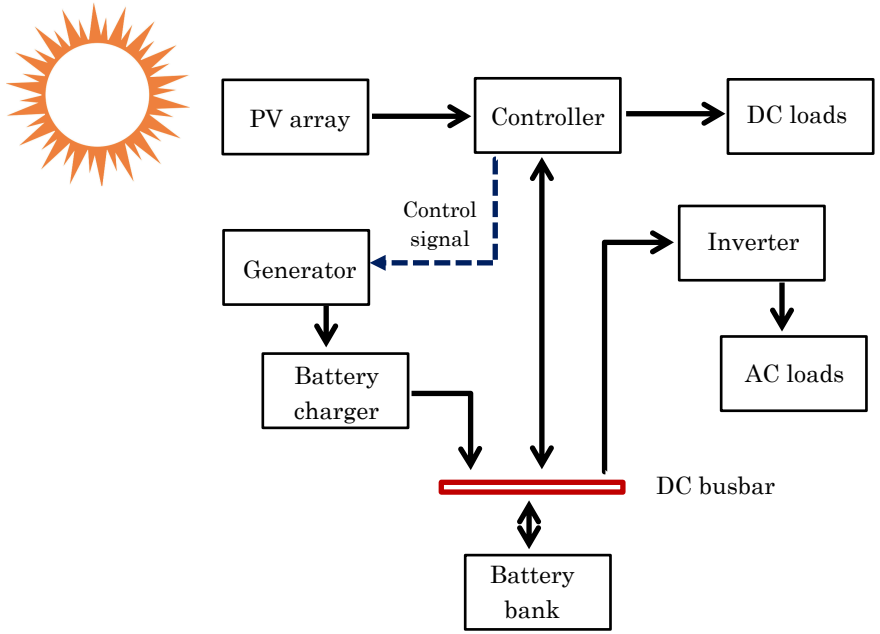
E. Establish storage battery required

F. Configure PV module and controller

G. Configure inverter and load

H. Configure genset and system topology

I. Costing and Return on Investment (ROI)



Ensuring performance

5) Engine

Does system meet intended purpose and deliver promises?

Component matching | Product quality | Ambient & design | Product quality | Work quality

$$N_p \times N_s \times P_{array\_stc} \times f_{mm} \times PSH_{period} \times f_{temp} \times f_{dirt} \times f_{age} \times \eta_{inv} \times \eta_{conn} = E_{out}$$

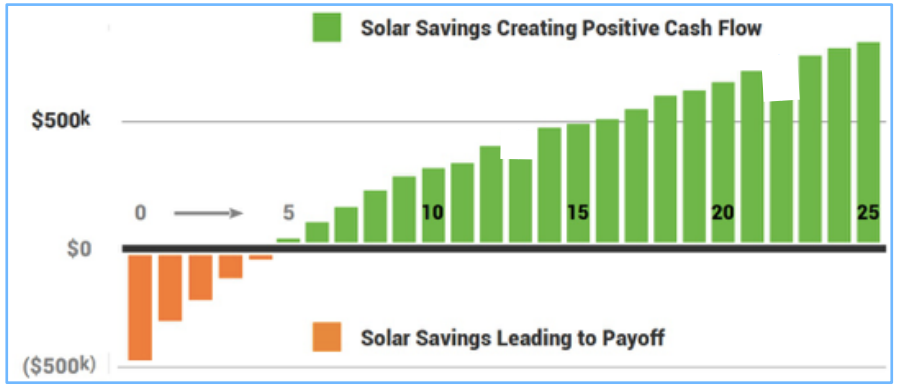
Choice of modules | Ambient environment | Ambient environment | Product quality

Ensuring performance

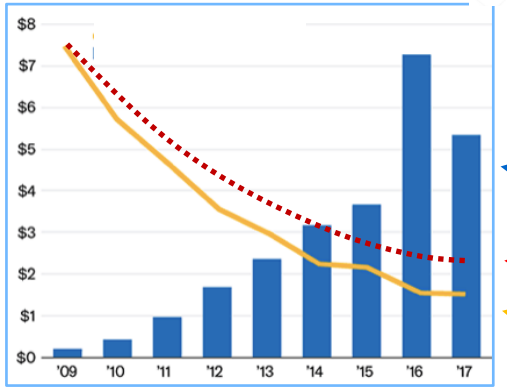
6) Simulated performances

Does system meet intended purpose and deliver promises?

A



C

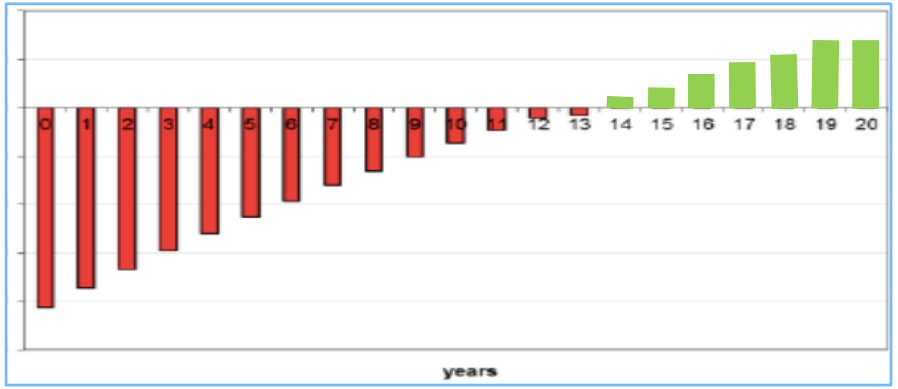


Cumulative generation

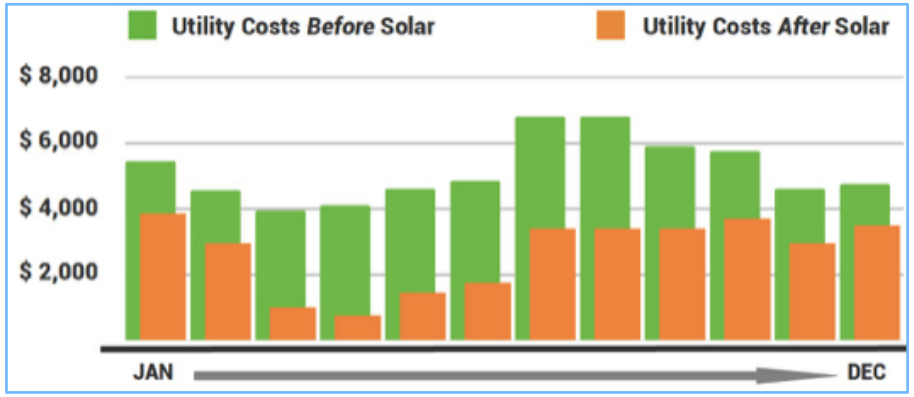
Projected degradation

Actual degradation

B



D



Ensuring performance

7) Comparative system prices

Does system meet intended purpose and deliver promises?

US$ per watt

Typical PV system prices in 2013 in selected countries (USD)

USD/W	Australia	China	France	Germany	Italy	Japan	United Kingdom	United States
Residential	1.8	1.5	4.1	2.4	2.8	4.2	2.8	4.9
Commercial	1.7	1.4	2.7	1.8	1.9	3.6	2.4	4.5
Utility-scale	2.0	1.4	2.2	1.4	1.5	2.9	1.9	3.3

Source: IEA – Technology Roadmap: Solar Photovoltaic Energy report[7]:15

https://en.wikipedia.org/wiki/Photovoltaic_system

Ensuring performance

MPiA
MALAYSIAN PHOTOVOLTAIC INDUSTRY ASSOCIATION

8) Cost of energy generation

Cost of generated kilowatt-hour by a PV-System (US¢/kWh) [hide]

depending on solar radiation and installation cost during 20 years of operation

Installation cost in $ per watt	Insolation annually generated kilowatt-hours per installed kW-capacity (kWh/(kWp·y))								
	2400	2200	2000	1800	1600	1400	1200	1000	800
$0.20	0.8	0.9	1.0	1.1	1.3	1.4	1.7	2.0	2.5
$0.60	2.5	2.7	3.0	3.3	3.8	4.3	5.0	6.0	7.5
$1.00	4.2	4.5	5.0	5.6	6.3	7.1	8.3	10.0	12.5
$1.40	5.8	6.4	7.0	7.8	8.8	10.0	11.7	14.0	17.5
$1.80	7.5	8.2	9.0	10.0	11.3	12.9	15.0	18.0	22.5
$2.20	9.2	10.0	11.0	12.2	13.8	15.7	18.3	22.0	27.5
$2.60	10.8	11.8	13.0	14.4	16.3	18.6	21.7	26.0	32.5
$3.00	12.5	13.6	15.0	16.7	18.8	21.4	25.0	30.0	37.5
$3.40	14.2	15.5	17.0	18.9	21.3	24.3	28.3	34.0	42.5
$3.80	15.8	17.3	19.0	21.1	23.8	27.1	31.7	38.0	47.5
$4.20	17.5	19.1	21.0	23.3	26.3	30.0	35.0	42.0	52.5
$4.60	19.2	20.9	23.0	25.6	28.8	32.9	38.3	46.0	57.5
$5.00	20.8	22.7	25.0	27.8	31.3	35.7	41.7	50.0	62.5

USA Japan Germany Small rooftop system cost and avg. insolation applied to data table, in 2013

Does system meet intended purpose and deliver promises?

Notes:

1) Cost per watt for rooftop system in 2013: Japan $4.64,[136] United States $4.92,[136] and Germany $2.05[137]
2) Generated kilowatt-hour per installed watt-peak, based on average insolation for Japan (1500 kWh/m²/year), United States (5.0 to 5.5 kWh/m²/day),[147] and Germany (1000 to 1200 kWh/m²/year).
3) A 2013 study by the Fraunhofer ISE concludes LCOE cost for a small PV system to be $0.16 (€0.12) rather than $0.22 per kilowatt-hour as shown in table (Germany).

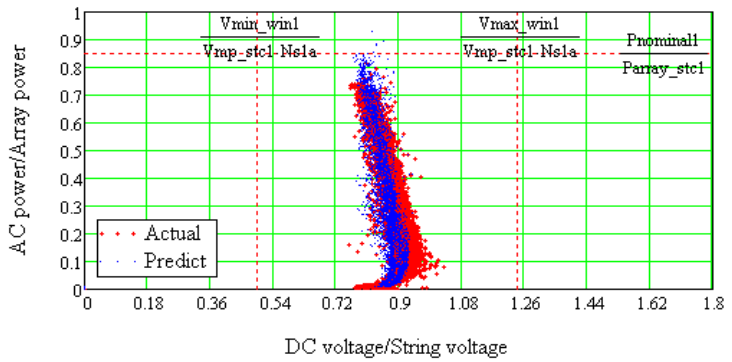
https://en.wikipedia.org/wiki/Photovoltaic_system

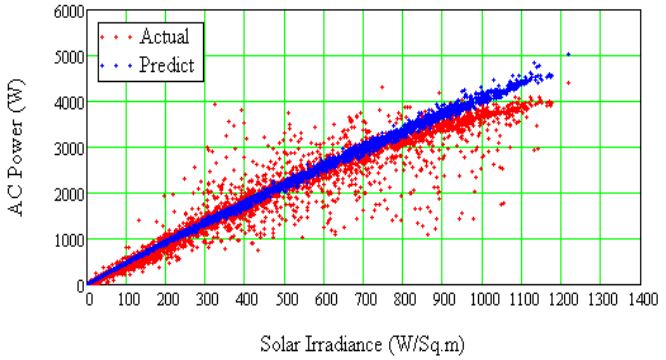
Ensuring performance

9) Literacy in PV:

a) Knowledgeable; competent

b) Job ready and problem solver

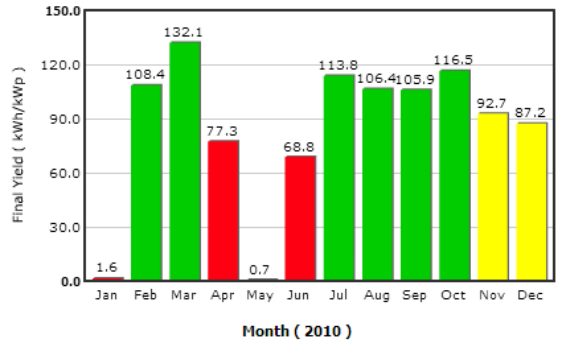


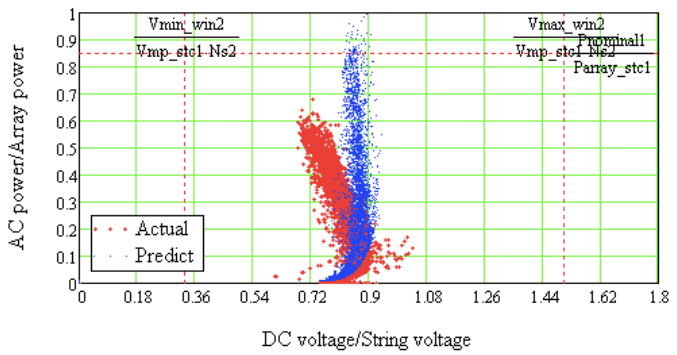


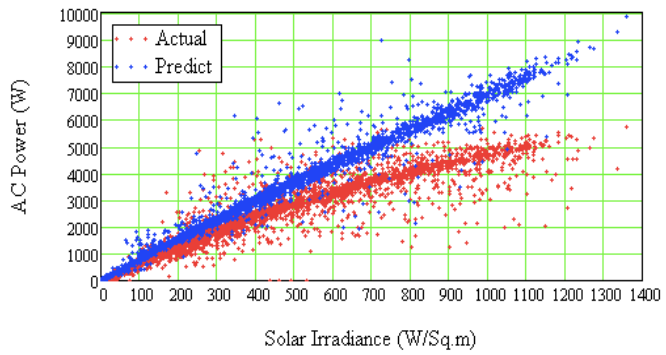
System 1

Blue – expected
Red – measured

Date from Green Energy Research Centre, Universiti Teknologi MARA (UiTM)







System 2

Ensuring performance

10) Energy output

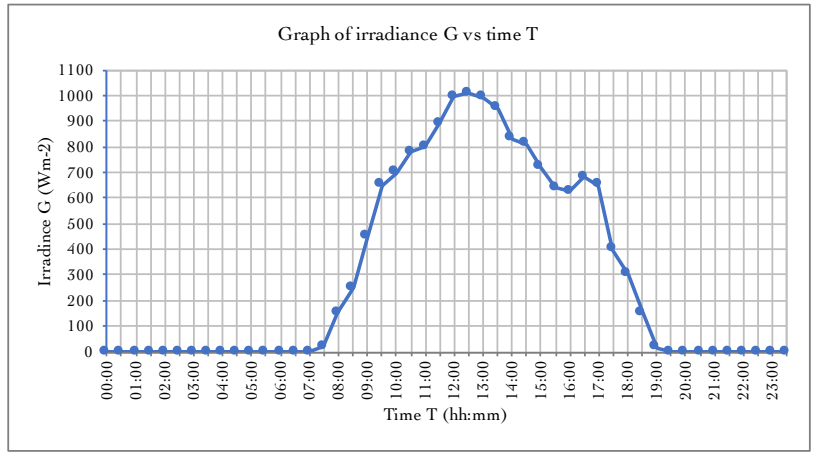
- Amount of energy generated by the system.

$$E_{out} = P_{array\ STC} \times PSH \times f_{mm\,p} \times f_{tem\,p} \times f_{clean} \times f_{age} \times f_{unshade} \times \eta_{cable} \times \eta_{inv}$$

Where

E_{out} is energy output (kWh)

PSH is peak sun hour (h)



11) Final yield

- Amount of energy output by the system per unit capacity.

$$Y_f = \frac{E_{out}}{P_{array\_stc}}$$

Where

Y_f is final yield (kWh kW^{-1})

Ensuring performance

12) Energy performance index

- Dimensionless quantity that gives the overall quality of the system.

$$EPI = \frac{E_{out\ measured}}{E_{out\ expected}} \times 100\%$$

Where

EPI	is energy performance index (dimensionless)
$E_{out\ measured}$	is energy from meter readings (kWh)
$E_{out\ expected}$	is E_{out} (kWh)

13) Capacity factor

- Dimensionless quantity that gives the overall quality of the system.

$$CF = \frac{E_{measured}}{P_{out} \times 24\ hours \times No.of\ days} \times 100\%$$

Where

CF	is performance ratio (dimensionless)
P_{out}	is output power from system (W)

$$CF = 17\%\ (\text{ST})$$

Ensuring performance

14) Performance ratio

- Dimensionless quantity that gives the overall quality of the system.

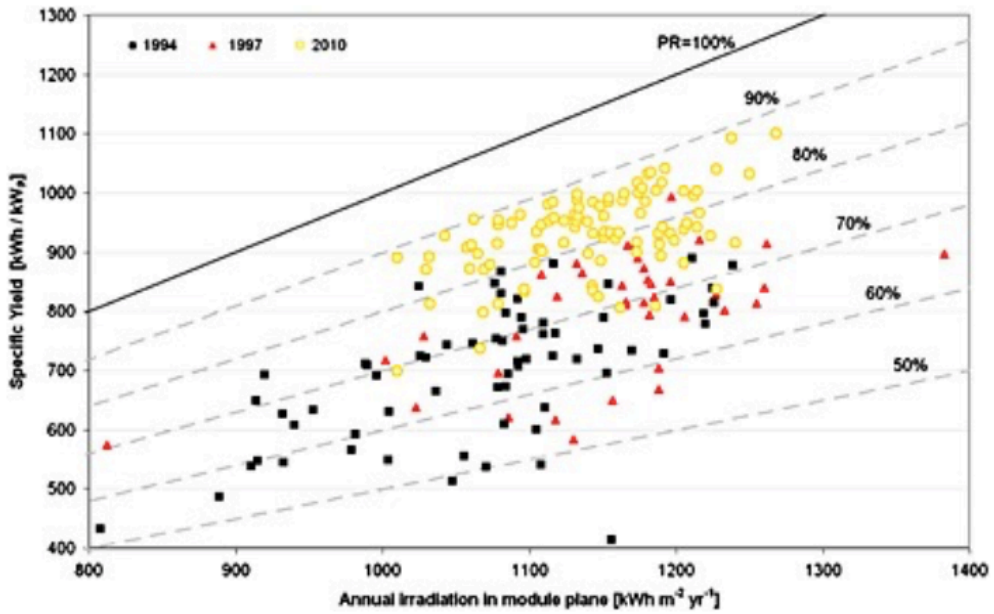
$$PR = \frac{Y_f}{PSH}$$

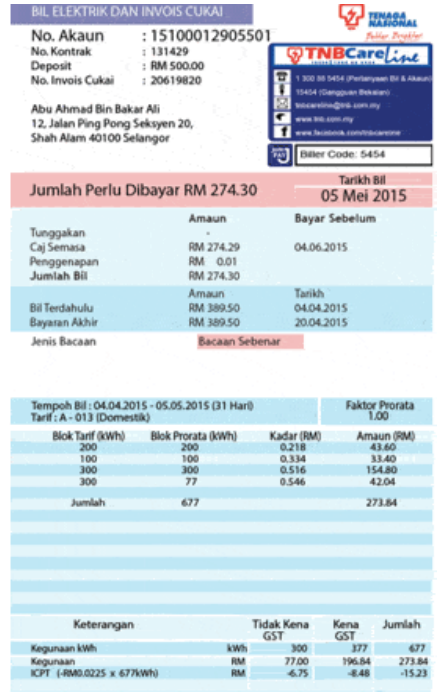
$$PR = 75\% \text{ (SEDA)}$$

Where

PR is performance ratio (dimensionless)

Performance ratio revisited: is PR >90% realistic? Nils H. Reich, Bjoern Mueller, Alfons Armbruster, Wilfried G. J. H. M. van Sark, Klaus Kiefer and Christian Reise




BIL ELEKTRIK DAN INVOIS CUKAI

No. Akaun : 151000129055O1
No. Kontrak : 131429
Deposit : RM 500.00
No. Invois Cukai : 20619820

Abu Ahmad Bin Bakar Ali
12, Jalan Ping Pong Seksyen 20,
Shah Alam 40100 Selangor

Biller Code: 5454

Jumlah Perlu Dibayar RM 274.30

Tarikh Bil 05 Mei 2015

	Amaun	Bayar Sebelum
Tunggakan	-	
Caj Semasa	RM 274.29	04.06.2015
Penggenapan	RM 0.01	
Jumlah Bil	RM 274.30	

	Amaun	Tarikh
Bil Terdahulu	RM 389.50	04.04.2015
Bayaran Akhir	RM 389.50	20.04.2015

Jenis Bacaan: Bacaan Sebenar

Tempoh Bil : 04.04.2015 - 05.05.2015 (31 Hari)
Tarif : A - 013 (Domestik)
Faktor Prorata 1.00

Blok Tarif (kWh)	Blok Prorata (kWh)	Kadar (RM)	Amaun (RM)
200	200	0.218	43.60
100	100	0.334	33.40
300	300	0.516	154.80
300	77	0.546	42.04
Jumlah	677		273.84

Keterangan		Tidak Kena GST	Kena GST	Jumlah
Kegunaan kWh	kWh	300	377	677
Kegunaan	RM	77.00	196.84	273.84
ICPT (-RM0.0225 x 677kWh)	RM	-6.75	-8.48	-15.23

Ensuring performance

15) Industry players

https://mpia.org.my

http://www.seda.gov.my/directory/re-industry-directory/

Ensuring performance

16) Authority and compliance

SEDA

Implementing agency, responsible for implementation & administration of NOVA, RAKYAT & GOMEN

EC

Issuance of License to RE producers generating more than 72 kW

TNB

Facilitation of RE project applications, connection availability, connectivity, contract biding, T&C payment to FiAHs, collection agent for the RE Fund.

MIDA

Principal agency to oversee and drive investment into the manufacturing and services sectors in Malaysia.

MGTC

Agency under Ministry mandated to lead the nation in the areas of Green Growth, Climate Change Mitigation and Climate Resilience and Adaptation

Ensuring performance

17) Real installations

Company A
Selangor

Company B
Perak

Company C
EC Building, Putrajaya

https://www.st.gov.my/en/details/aboutus/9

Ensuring performance

17) Real installations

Company D
Penang

SHRDC Shah Alam

Sulaiman Shaari,
Selangor

Company E
Selangor

Ensuring performance

17) Real installations

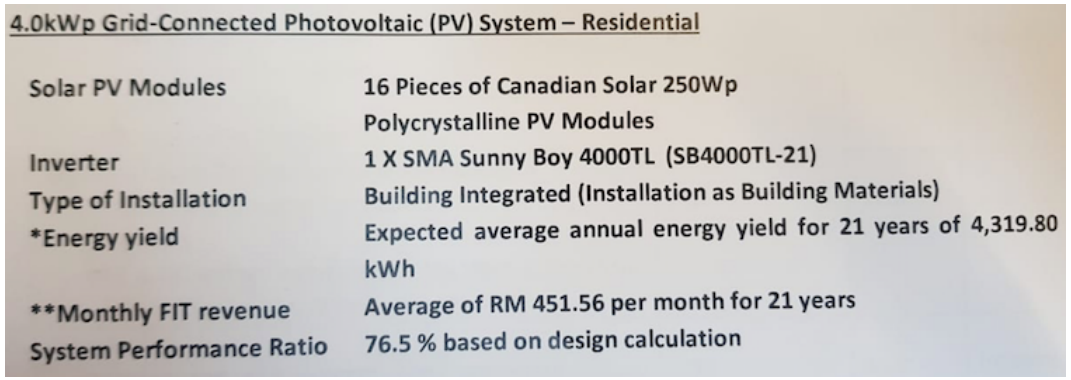
Company F
Sarawak

JKR, Sabah

Company G
Tioman, Johor

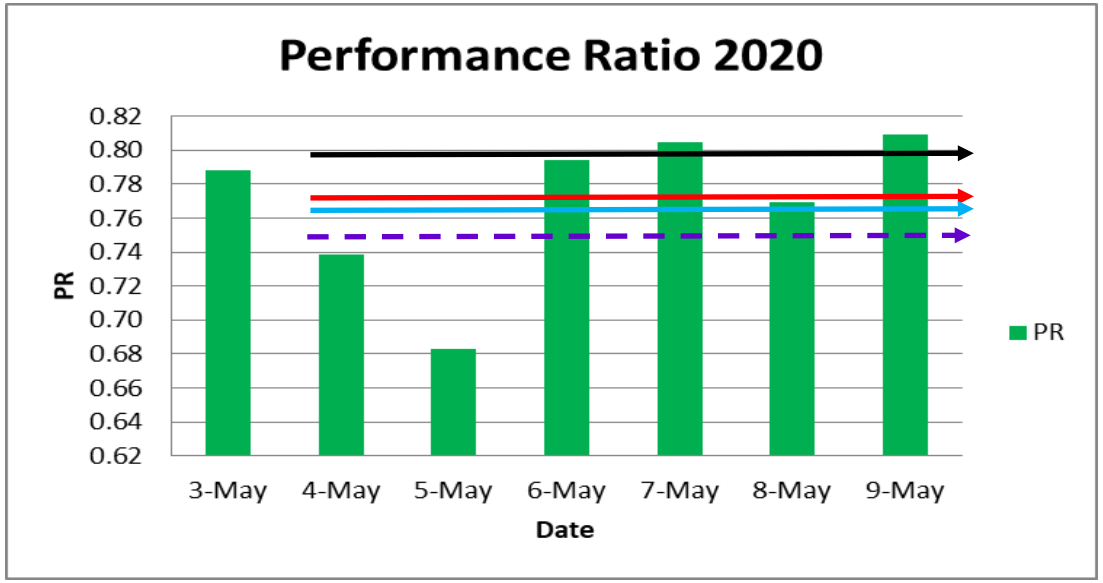
Ensuring performance

17) Real installations



2020 May	PSH (h)	Tmax (°C)	G max (Wm^{-2})	E dc (kWh)	E ac (kWh)	FY ($kWh\ kW^{-1}$)	PR
3	2.65	58	621	8.4	8.3	2.09	0.79
4	5.06	54	545	15.2	15.0	3.74	0.74
5	5.22	56	651	14.5	14.2	3.57	0.68
6	3.80	56	564	12.2	12.1	3.02	0.79
7	3.46	57	586	11.3	11.1	2.78	0.80
8	3.64	56	604	11.3	11.2	2.80	0.77
9	3.24	55	505	10.6	10.5	2.62	0.81

Ave PR = 0.769



0.80 Bank

0.769 Real

0.765 Design

0.75 SEDA

How is yours?

Does my presentation meet intended purpose and deliver promises?

MPiA
MALAYSIAN PHOTOVOLTAIC INDUSTRY ASSOCIATION

Session 1

- What photovoltaics (PV) is
- Know key information
- Ensuring performance

MALAYSIAN PHOTOVOLTAIC INDUSTRY ASSOCIATION

Thank you

Malaysian Photovoltaic Industry Association (MPIA)

SW-03-08, Cova Square,
Jalan Teknologi, Kota Damansara, PJU 5,
47810 Petaling Jaya,Selangor, Malaysia

Website: www.mpia.org.my
Facebook: facebook.com/mpiamalaysia
Email Address: secretary@mpia.org.my
Tel : +603 6151 7227

Session 2

- Question and Answer

Critical Connectivity Solutions for Solar Systems

John Hng
Head of Renewable Energy
JJ-LAPP ASEAN

The sharing will cover the below topics :

1) The common threats & issues in a solar systems

2) The common mistakes made in the solar connectivity system

3) What are the important points to take note while performing crimping and assembling in a solar system

4) The Standard of Procedures (SOPs)

5) Practical session involves every participant to perform the crimping & assembling process (JJ-Lapp will provide the samples & tooling needed)

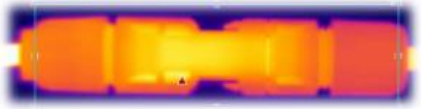
JJ-LAPP

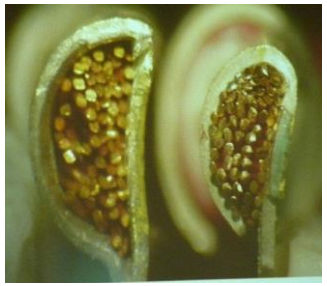
Always Remember

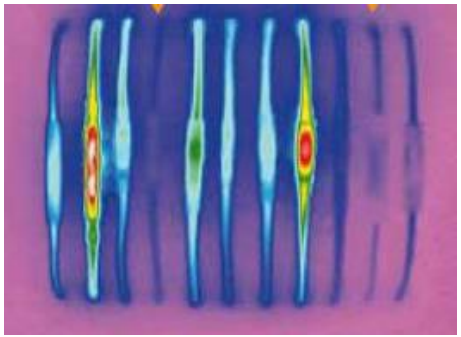
Safety First ✓

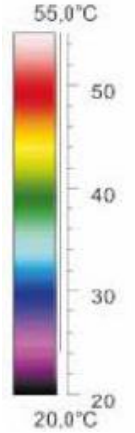
Disaster caused by POOR CONNECTION / Low Quality Components

Low quality connectors









…….and its consequences

- Risk of Fire
- Insulation Fault
- Service Hours
- Increased Electrical Resistance

Danger of Electric Shock

Danger For Life

Power Loss

Maintenance Expenses

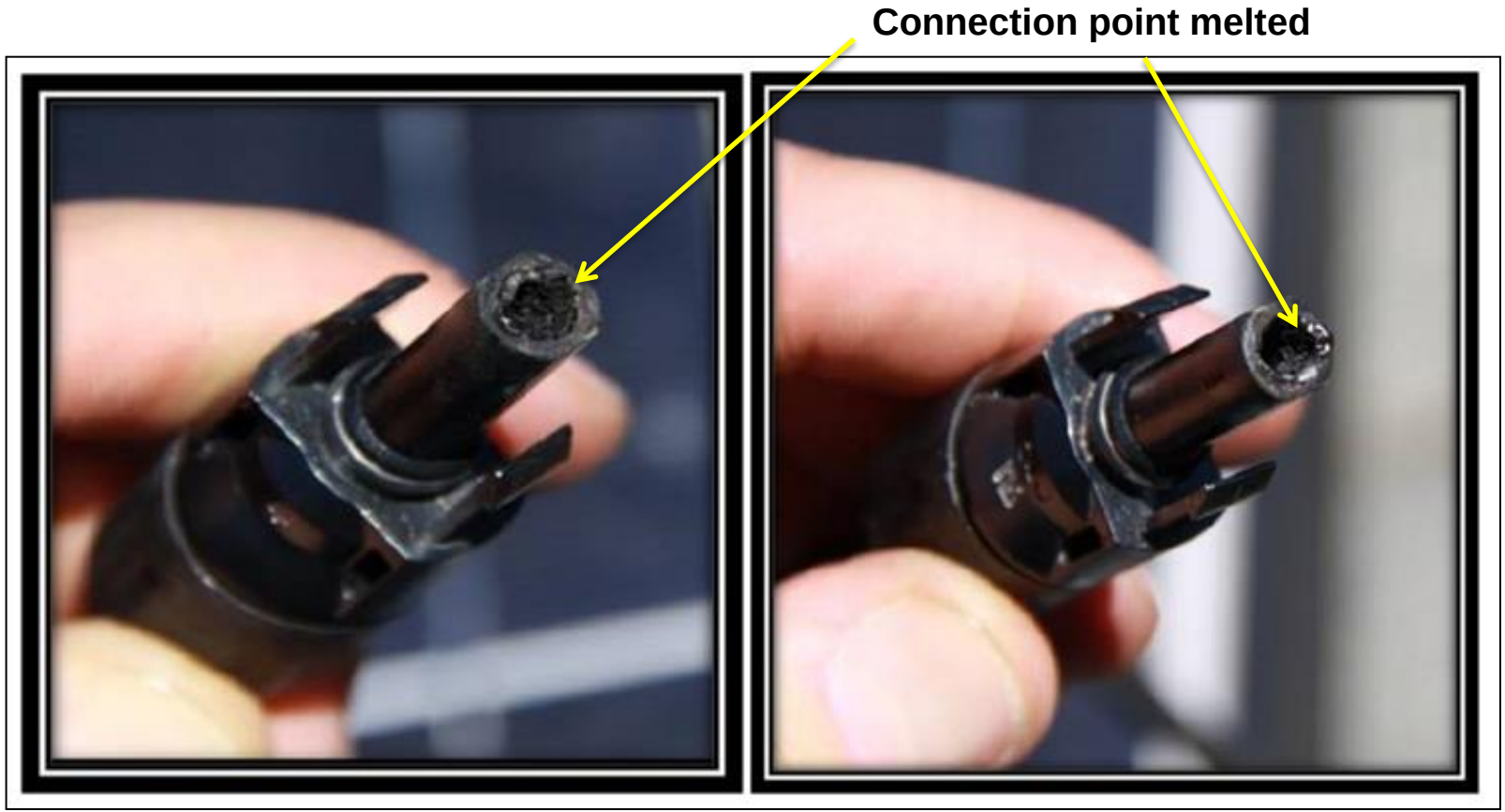
Reduction of PV plants efficiency

Less Income and ROI

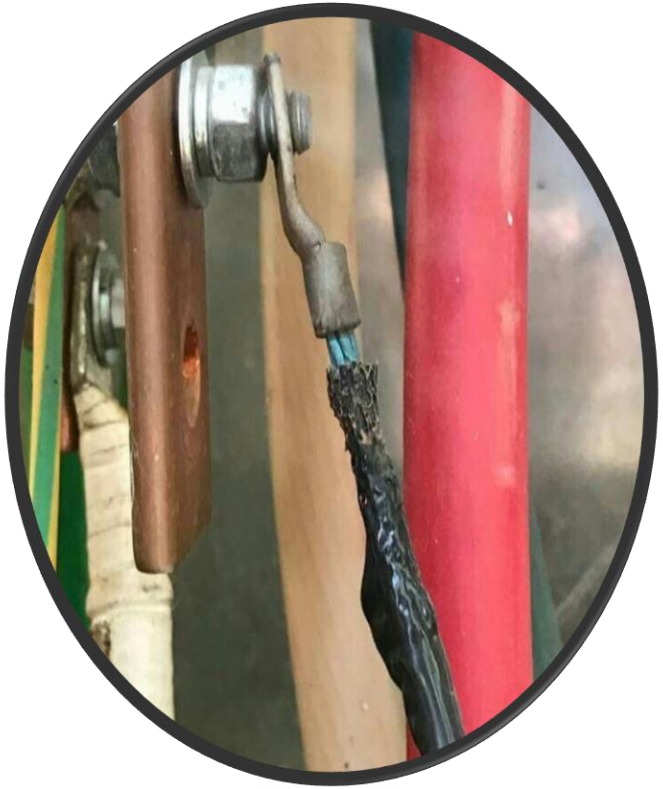
Common Issues & Threats in Solar Systems Connection

Connectivity Threat - Crimping Issue @ sites

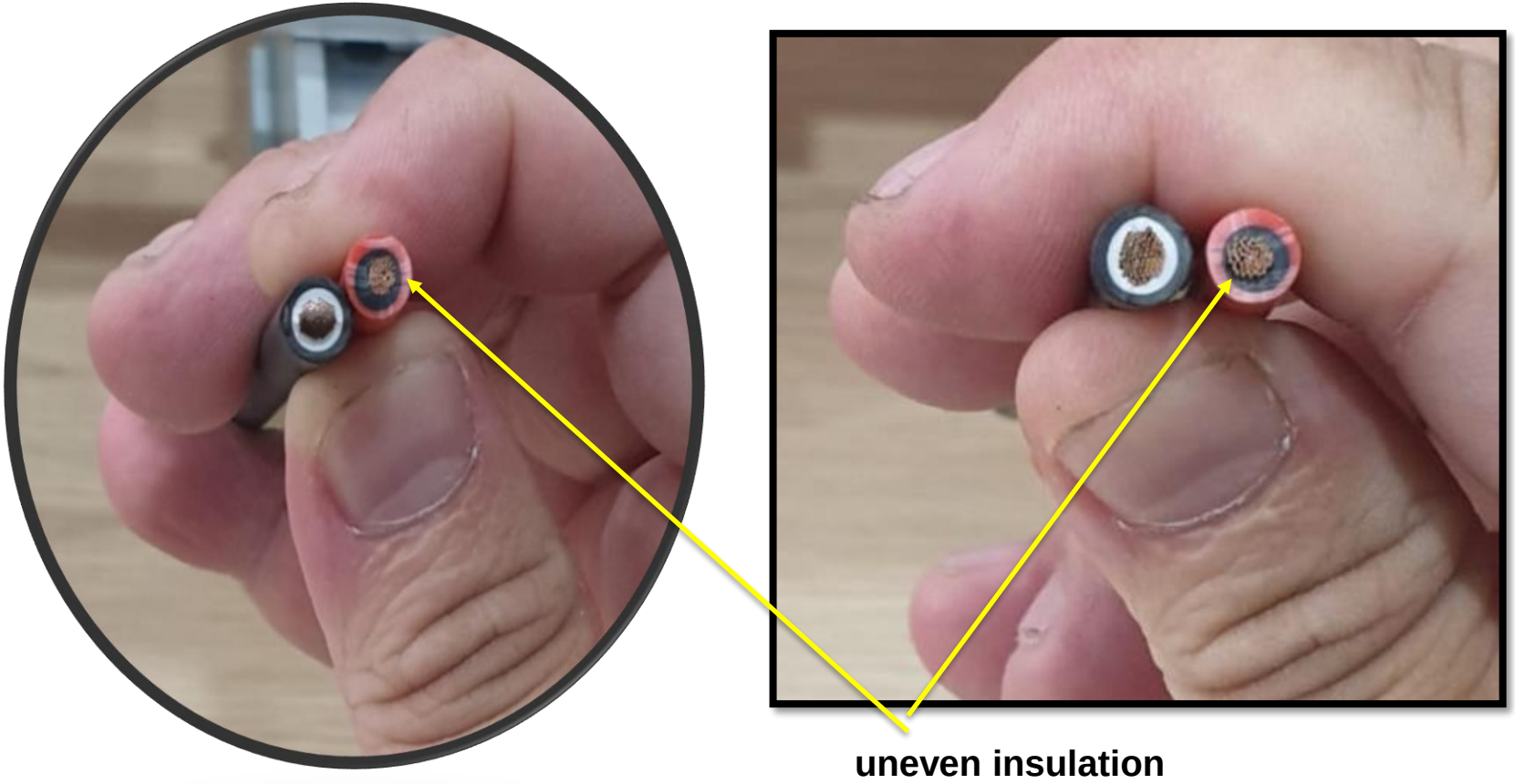
Common Issues | Poor Quality & Workmanship



Common Issues | Poor Quality & Workmanship

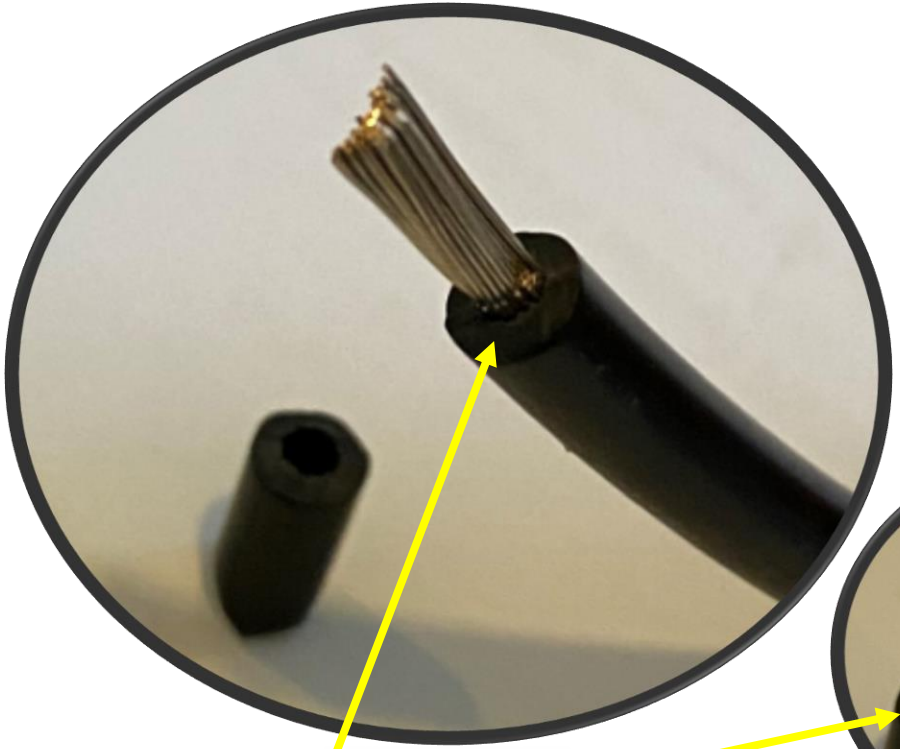


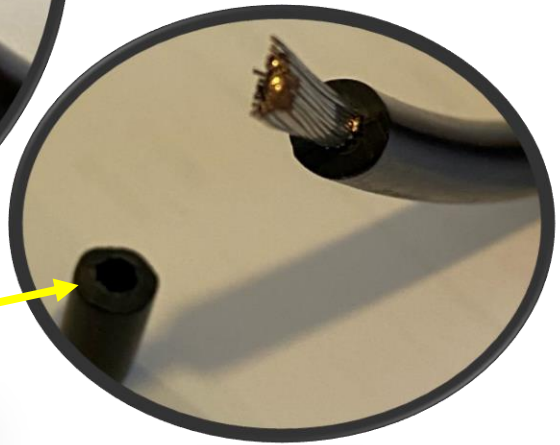
Common Issues | Poor Quality Solar Cables



uneven insulation

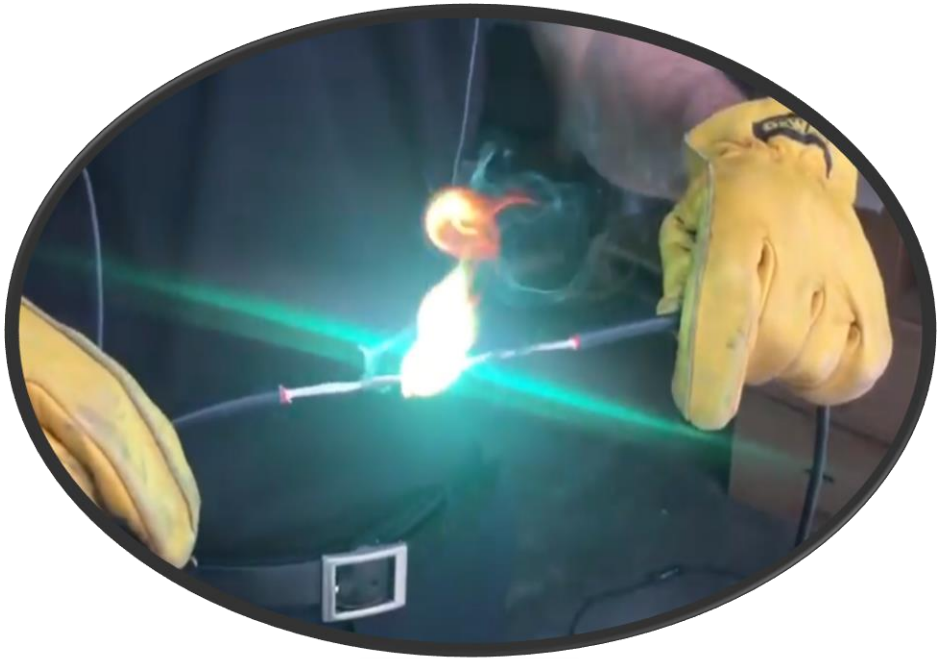
Double Insulated

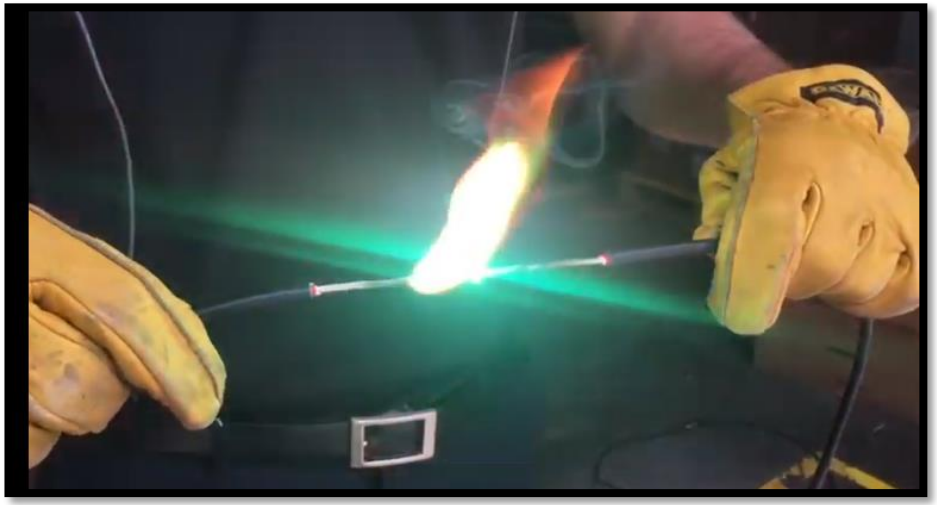




Single Insulated

Arc Fault (Direct Current Application) Fire – how it looks like

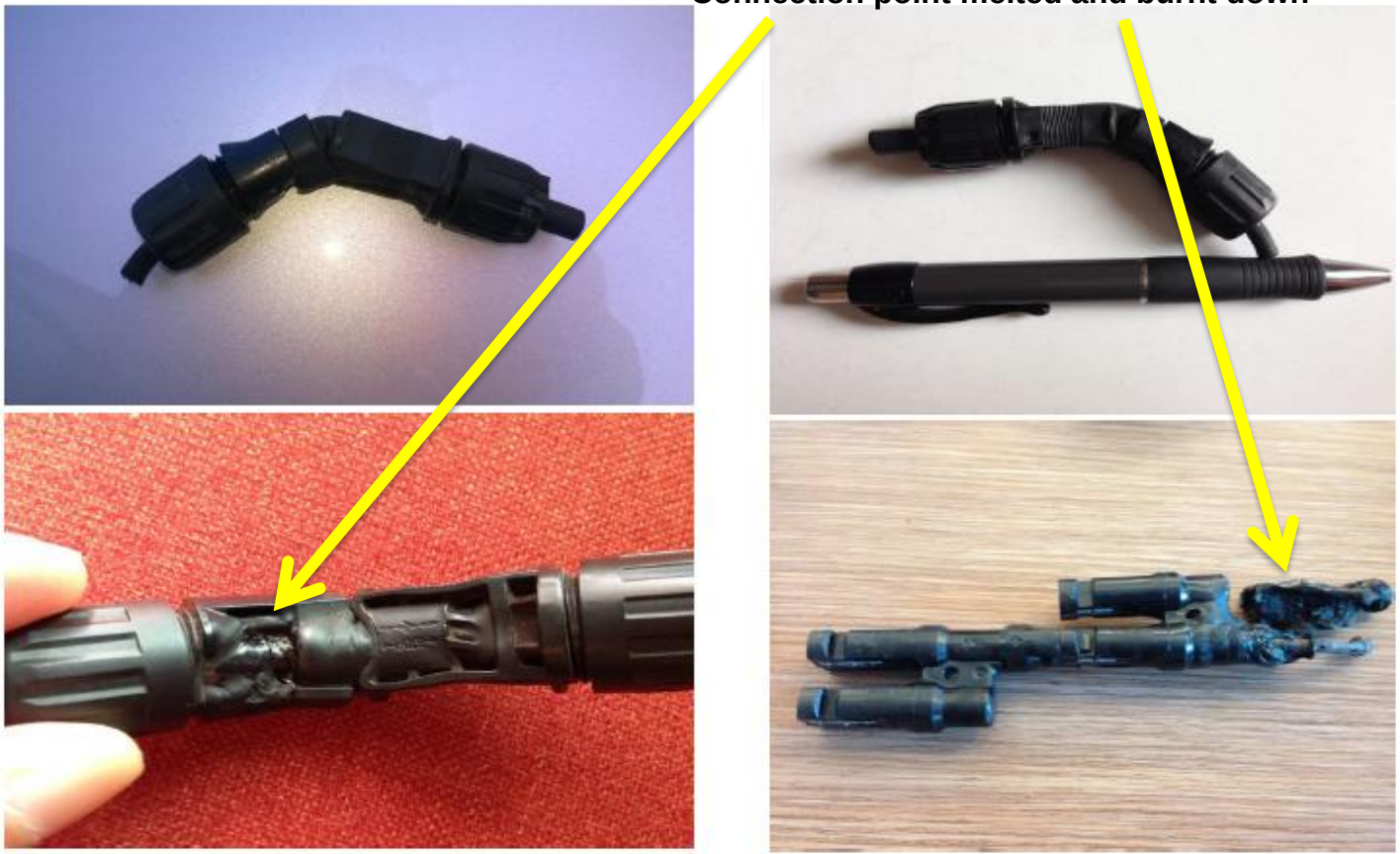




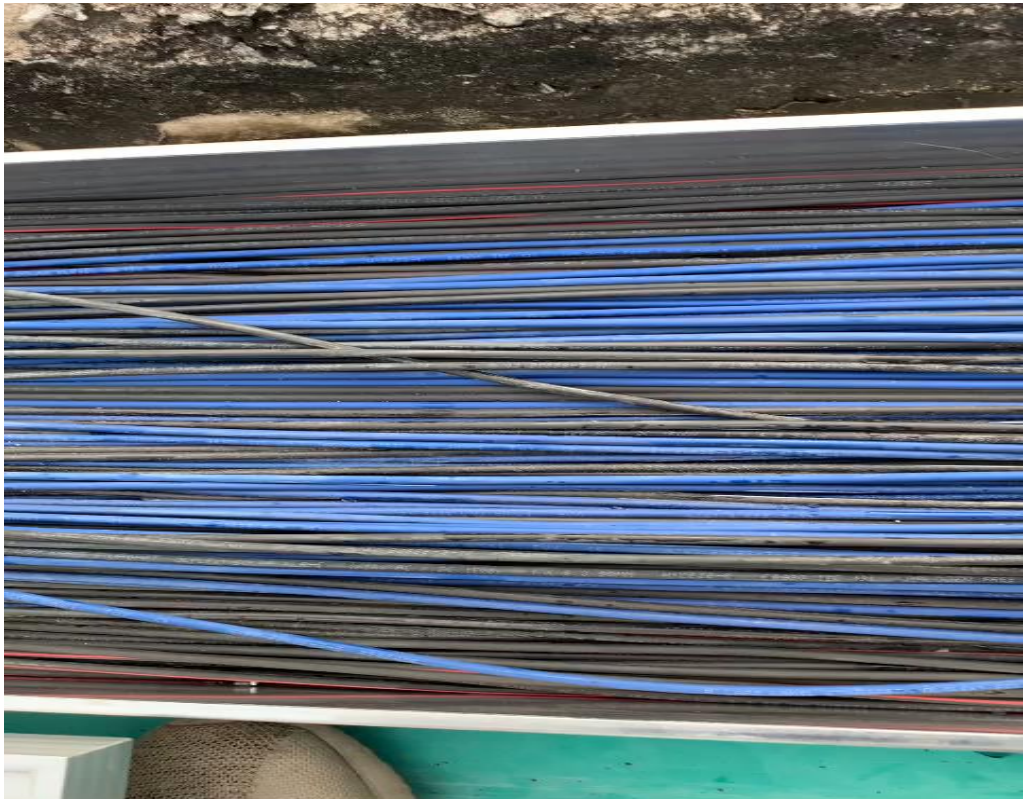
Common Issues | Poor Quality & Workmanship

Threat | Poor Connection | Poor Quality

Connection point melted and burnt down



Threat | Poor Ventilation | solar cables melting

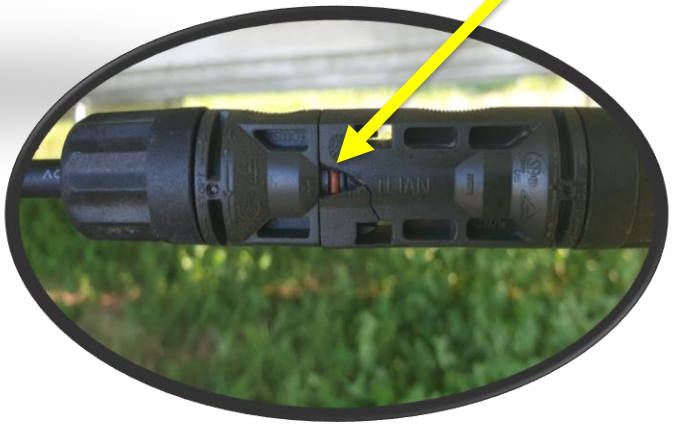


VIDEO

Threat | Poor Quality | solar cables outer jacket cracking

* VIDEO *

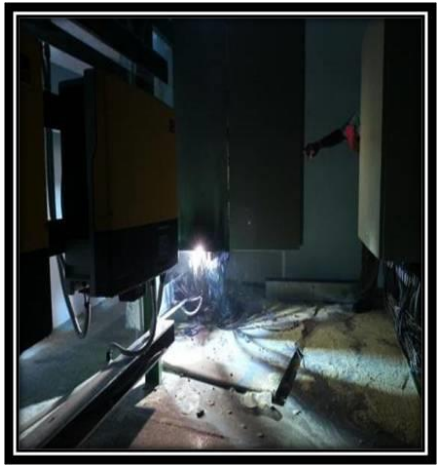
Threat | Poor Connection | Poor Quality

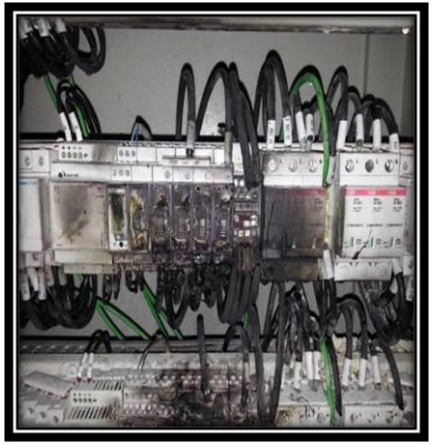


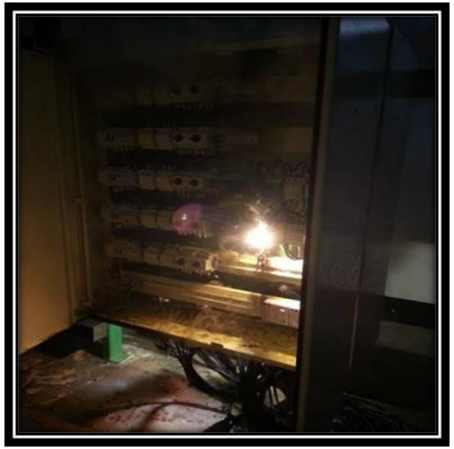
Connection point melted & burned

Threat | REALLY Poor Connection

Threat | Poor Connection causes Fire







Poor connectivity causes TOTAL LOST

Threat | DC Arc Faults – Solar Fires

Beware of what is WATER RESISTANCE vs WATER PROOF

AD8 testing, this is done in **drinkable water**. Details of the test as under (only for academic interest).

AD8 test follows EN 50525-2-21 (submersion standardization for H07RN8-F submersible-pump rubber cable).
==>EN 50525-2-21, Annex D (Electrical water resistance):

D.1: Voltage pre-testing of 20m sample in drinkable water of 20 °C
- 1 hour of submersion of complete cable
- Afterwards AC voltage test per Section 6 of EN 50395

The long-term immersion test to conduct is :-1.5 kV DC-3.000 hours submersed in water-Water temperature of 85 ° C-NaClsalt concentration of 3 % (low quality products will offer only 1 % = 10 g/ltr.)-Breakdown shall not occur during submersion-After submersion, no damage shall be visible on the sample's outer surface-Min. insulation resistance after 3.000 h (low quality products will offer only 240 h, **so quality test is 1150 % longer**, under even saltier conditions) of submersion shall be 50 GOhms

Flooded Site video

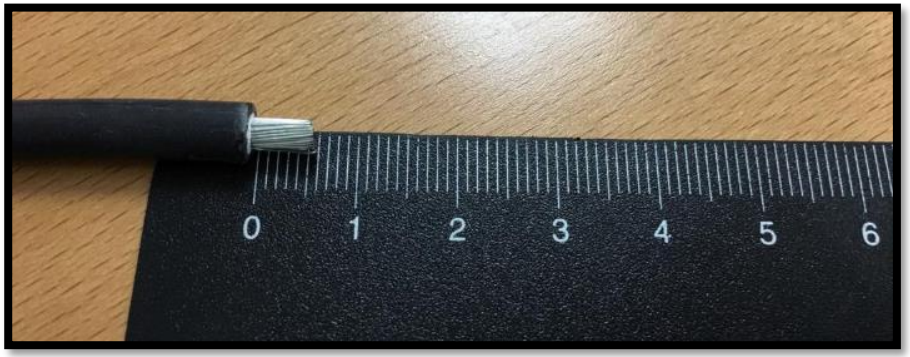
Beware of what is WATER RESISTANCE vs WATER PROOF

The misconception that you can lay PV1-F cable in empty piping underground, you have to clear out here. Laying the solar cable in conduits does not improve here: Minimal damage to the empty pipe causes water to penetrate the pipework, condensation causes the water in the pipes to run off and can no longer run off. As a result, the solar cables are permanently in the water. It is almost impossible to keep water out of underground conduits. Completely right there are no general working instructions. It has meanwhile (2018) found that conduits even increase the problem of water resistance, ie PV1-F cables are ideally laid in the sand bed.

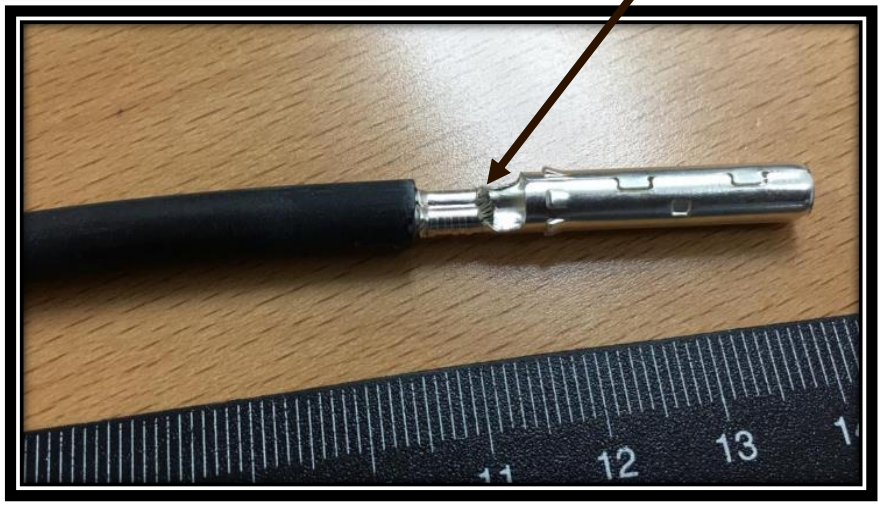
Some datasheets refer to the current (January 2018) UL 44 5.4 "Long-term insulation resistance in water" as well as to the (December 2015) valid UL 2556 6.4 "insulation resistance". Solartechnik Bayern points out that these tests are not specific to solar cables. The UL 44 refers to thermoset insulated cables, the UL 2556 to normal cables. Solar cables, however, are to be regarded as separate due to the temperature specification (fire retardant) as well as the system voltages (up to 1,500VDC) and therefore can not be subordinated to these (US) test specifications and specified accordingly. Certainly, these UL test specifications are an aid to the manufacturers to qualify their own products, however, the test procedure in the respective regulations is to apply to the respective cable. For solar cables there are no such stored test specifications by date. Solar technology Bavaria would also be no UL (USA) test specification for the water resistance of solar cables known.

Good practices to minimize the *THREATS*

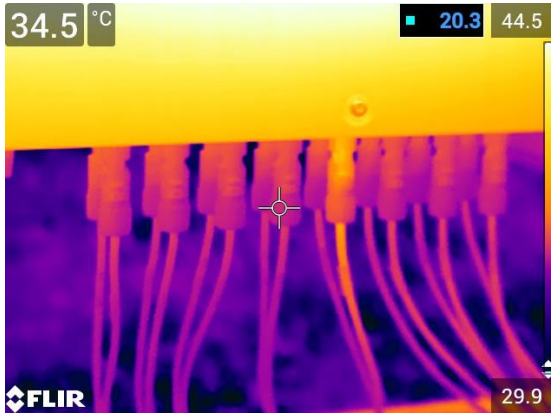
Correct SOPs

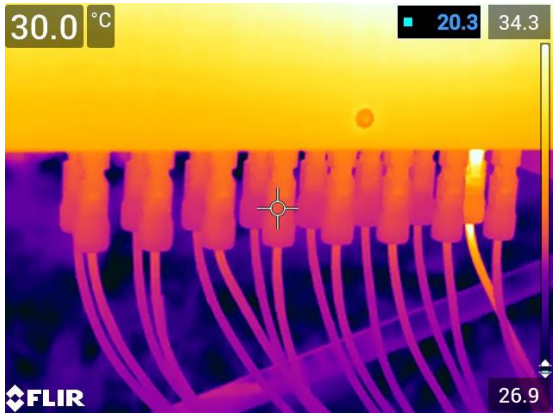


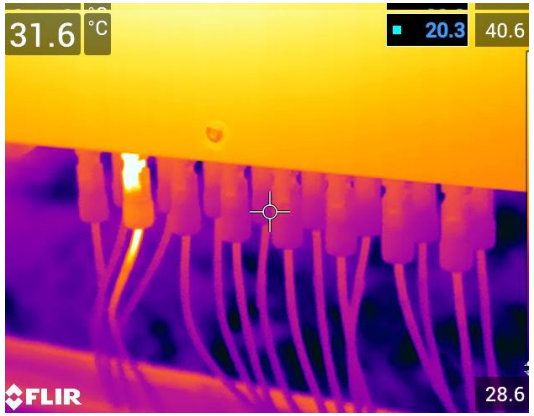
The conductor length is just nicely crimped

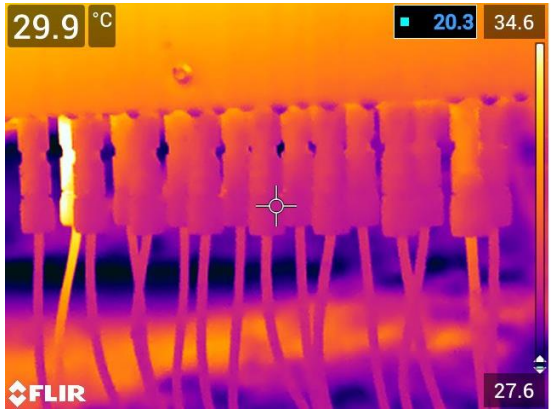


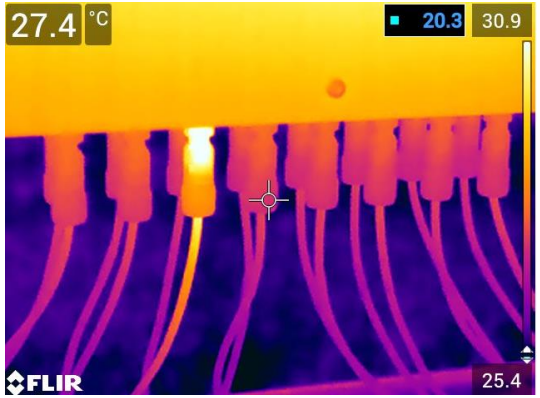
Connectivity Examination | Thermal Imager











Good connection – tidy wiring / cable management

Part. No.	Color insulation	Color outer sheath	Conductor cross section [mm²]	Outer diameter approx. [mm]
1023651	white	black	1 x 2,5	5.0
1023652	white	black	1 x 4	5.4
1023653	white	black	1 x 6	6.0
1023654	white	black	1 x 10	7.2
1023655	white	black	1 x 16	8.7
1023656	white	black	1 x 25	10.6
1023657	white	black	1 x 35	12.2
1023658	white	black	1 x 50	14.4
1023659	white	black	1 x 70	16.4
1023660	white	black	1 x 95	18.4
1023661	white	black	1 x 120	20.2
1023662	white	black	1 x 150	22.4
1023663	white	black	1 x 185	25.2
1023664	white	black	1 x 240	28.6
1023665	white	black	1 x 300	32.0

Each line is marked properly with industrial grade cable marking

- Waterproof
- UV-resistant
- Space requirement
- Halogen-free
- Good chemical resistance
- Wind Energy
- Solar Energy

Nicely designed & constructed – Malaysia

Well Constructed & Maintained | Ground Mounted - Vietnam

Floating Solar | Safety | High ROI - Thailand

Well Designed and High ROI – Laos

Great Success projects – Floating Solar Projects – ASEAN region

Good performance for factories rooftop installation - Malaysia

SUMMARY
The importance of quality components in a PV System

Components as most prone to failure

- In a PV system, the components which have been and continue to be the most prone to failure are the cables, connectors and the junction box on the rear of the PV module.

The true savings and better investment

- It is interesting to note that these components comprise only 1%-2% of the overall cost of a PV module system and price savings among component choices are rarely more than 20%. Therefore, it is appropriate to ask if a savings of 0.002 percent gained by using cheaper components is justified when considering the additional safety risks and decreased efficiency such a choice might entail.

Sustainable PV system

- The European experience has shown that for a system to last the warranted lifetime of 25 years, PVC and rubber cables, in addition to connectors which are not moisture proof, will ultimately prove to be the weakest links.

≠

Site Visit & Critical Connectivity Technical Workshop for Our ASEAN Customers

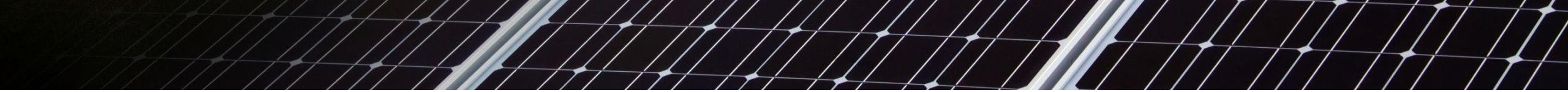

THANK YOU
THANK YOU VERY MUCH
MERCI
OBRIGADO
ASANTE
SPASIBO
MULTUMESC
MATONDO
SUWUN
ZIKOMO
СПАСИБО
EIO
WELALIN
GRAZIE
CHOKRANE
MAAKE
VINAKA
MOCHCHAKKERAM
БАЯРЛАЛАА
どうも

INSURANCE

SUPPORT FOR SOLAR PV PROJECTS

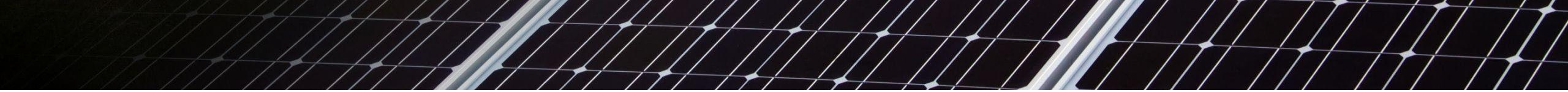
Presented by

anora®



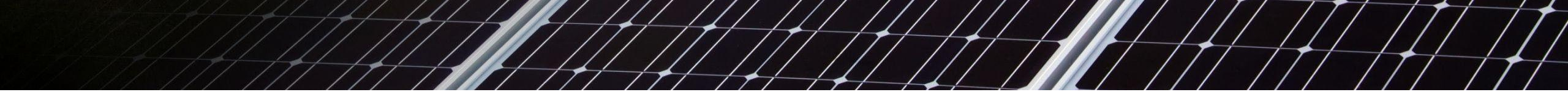
What is Insurance?

- A contract between insurance company and policy holder
- Financial protection or reimbursement against losses



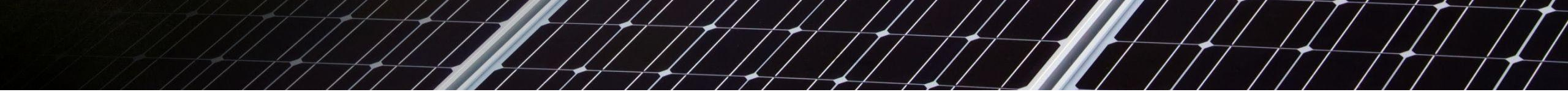
Insurance contribute to industry

- Security & Safety
- Economic & financial stability
- Development



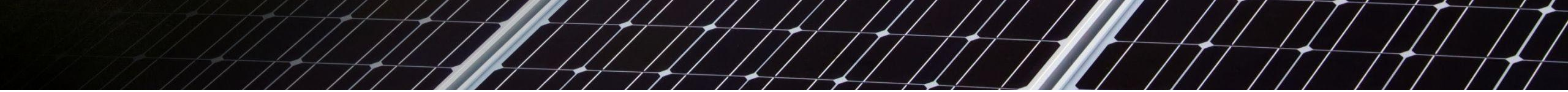
Security & Safety

- First financial responder
- Recovery for claimant
- Insurance claim payment benefits supply chain
- Risks Mitigator



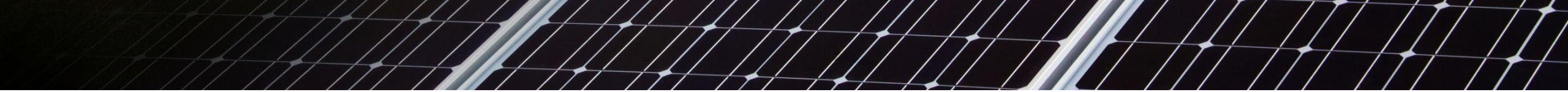
Economic & Financial Stability

- Softening financial impact
- Sustaining supply chain
- Reduce the need for rainy day fund



Development

- Enable infrastructure development
- Innovation cataylst



INSURANCE SUPPORT FOR SOLAR PV PROJECTS

anora® SOLARPRO®

PRE-INSTALLATION

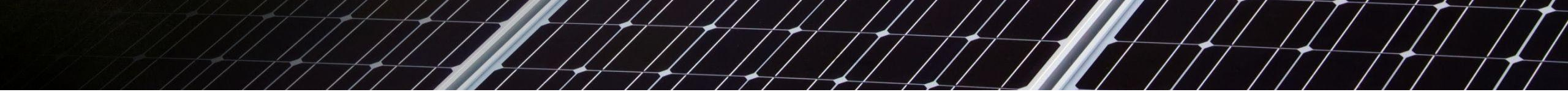
STAKEHOLDER	PROBLEM
EPCC/RPVI	1. Loss/Damage due to System Design 2. Loss/Damage to Materials in Shipment 3. Project Delay

INSTALLATION

STAKEHOLDER	PROBLEM
EPCC	1. Loss/Damage to Materials 2. Loss/Damage to Building Owner's Property 3. Property Damage/Bodily Injury to Public 4. Workmen

OPERATION & MAINTENANCE

STAKEHOLDER	PROBLEM
Owner / RPVI	1. Loss/Damage to Solar PV System 2. Property Damage/Bodily Injury to Public 3. Production Line Stoppage
EPCC	1. Loss/Damage to Building Owner's Property 2. Workmen



INSURANCE PROTECTS THE ECOSYSTEM

INSURANCE

protects interests of

GOVERNMENT

Safeguards the Government's aspiration to meet the new 40% Renewable Energy target.

FINANCIERS

Banks and other financiers' need the comfort of the loanee's assets are well insured.

PV SERVICE PROVIDERS

Protection from all types of risks for every stage: design to installation to commissioning to O&M.

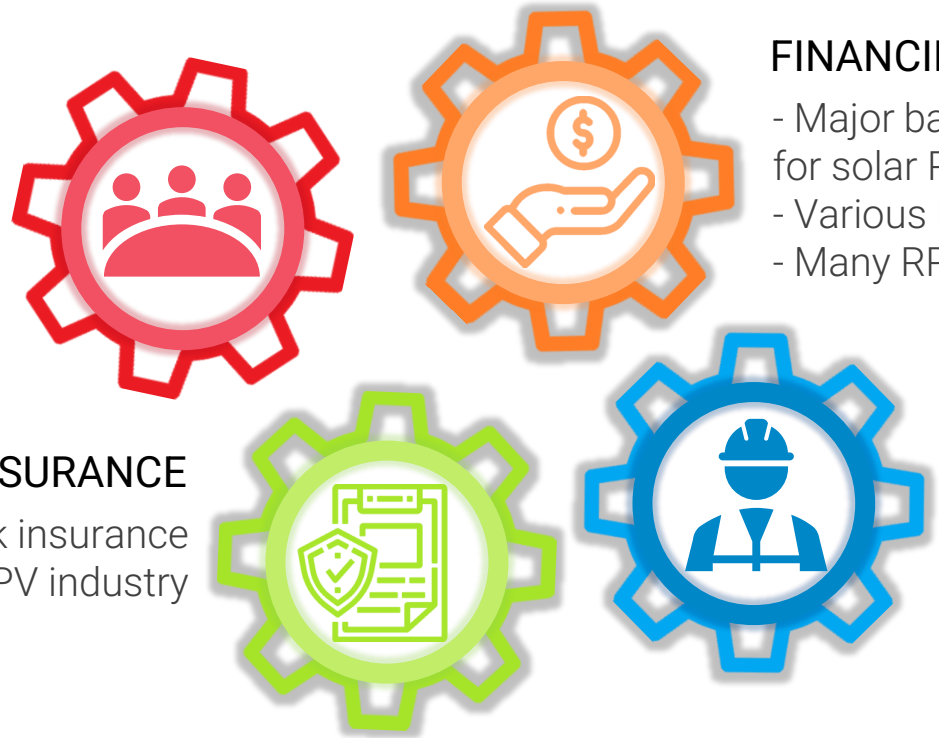
ASSET OWNERS

A solar PV specific insurance should insure more than the average fire and all-risk perils AND compensate the insured during system downtime.

INSURANCE IN SOLAR PV ECOSYSTEM

GOVERNMENT

- New RE target of 40% by 2035
- FiT/NEM schemes to drive adoption
- Green Investment Tax Incentives)



FINANCING

- Major banks & financiers allocating funds for solar PV financing.
- Various lease/rent-to-own programs
- Many RPVIs

INSURANCE

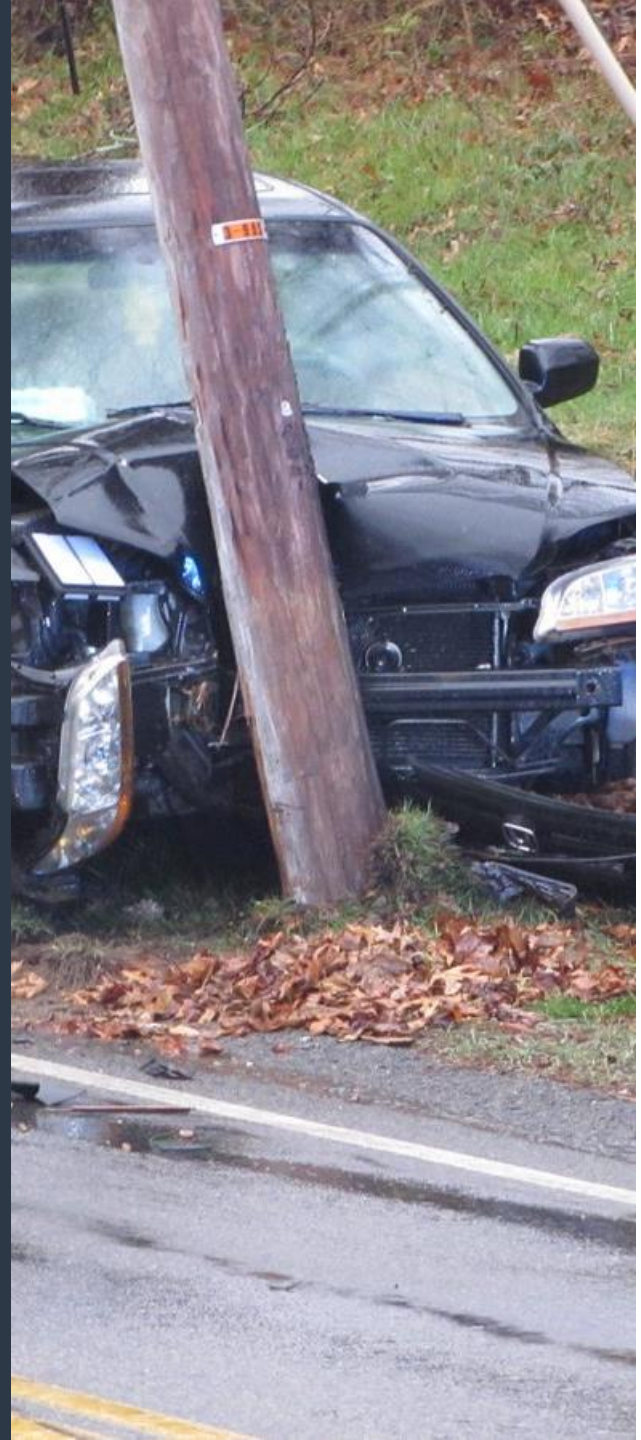
- Traditional fire & all-risk insurance created specifically for PV industry

PV SERVICE PROVIDERS

- Wealth of experienced and reliable EPCCs

SCENARIO 1

A vehicle crashed into interconnecting pole outside solar farm, causing zero energy production and supply disruption for a week.



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PROBLEM

- Solar farm was **shut down** while the pole and cables are repaired
- Income generated by the solar farm is **lost**

SOLUTION

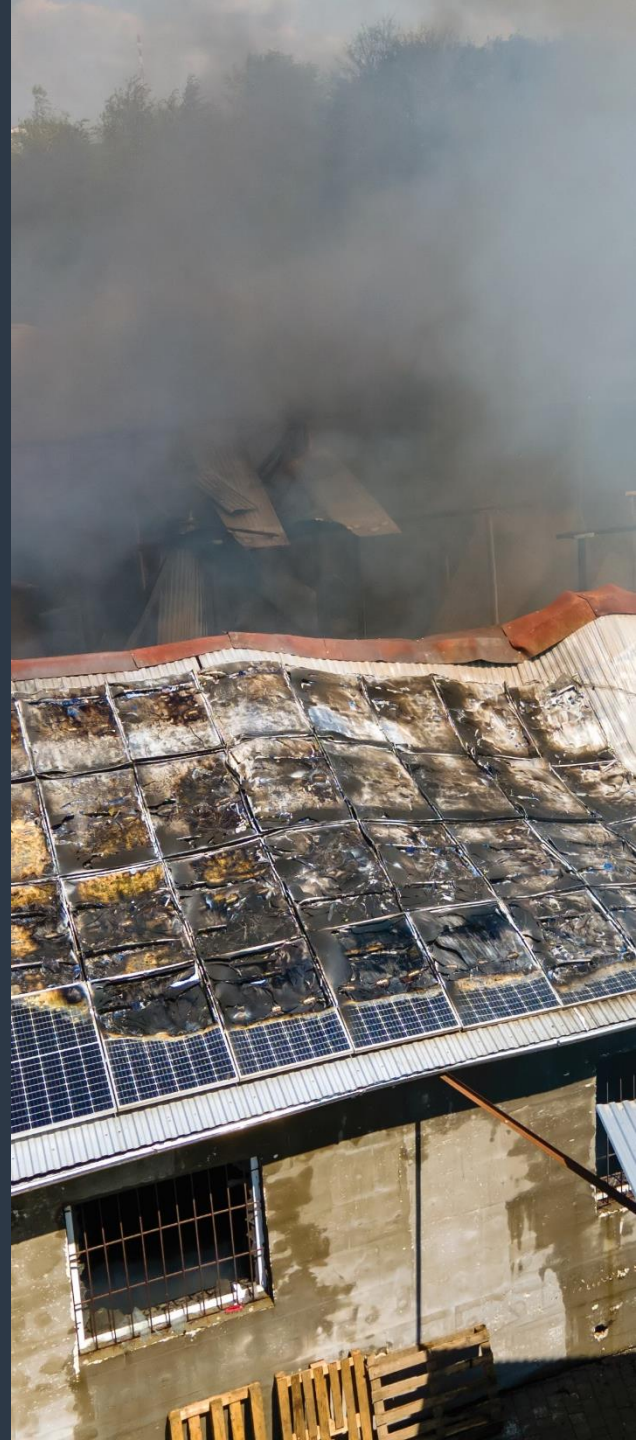
- **Solar PV system** insurance

RESULT

- Client's income is **compensated** and financial risk is mitigated

SCENARIO 2

Damage to the roof structure of the owners' building due to installation or operational & maintenance works.



PROBLEM

- **Structural and content damage** of the owner's property e.g. building, stocks, machinery and etc.

SOLUTION

- **Project** insurance

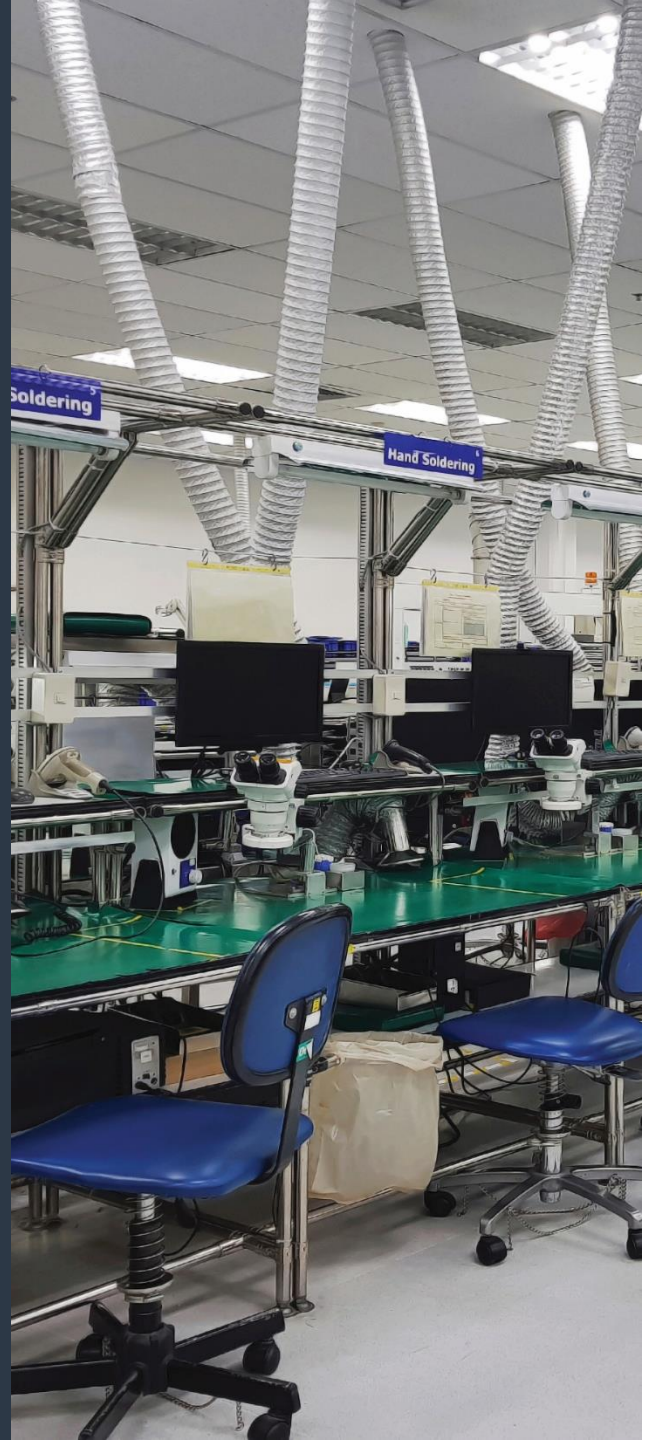
RESULT

- PVSP's financial **risks are mitigated**

SCENARIO 3

The RPVI entered into a Power Purchase Agreement with the offtaker.

The Solar PV system causes damage resulting in interruption to the offtaker's production line.



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PROBLEM

- Manufacturer **unable to produce its products and suffer massive financial losses**

SOLUTION

- **Line stoppage** insurance

RESULT

- Offtaker and RPVI's financial **risks are mitigated**

SCENARIO 4

The PVSP is performing preventive maintenance on the Client's PV modules on the roof during its DLP period.

While descending from the roof, the skylift lost balance and hit the Client's building and damaged its roof and walls.

PROBLEM

- The EAR policy's DLP period **does not cover** damage to Principal's Existing Property.

SOLUTION

- **SolarPro Maintenance** insurance

RESULT

- PVSP's financial **risks are mitigated**

SOLARPRO SUITE OF SOLUTIONS

SolarPro protects everything from Residential, Commercial & Industrial rooftop installations & Large-Scale Solar farms

SUPERIOR

- More comprehensive coverage

- Designed exclusively for the Solar PV industry

EXPERTISE

- Designer of Malaysia's 1st Solar PV insurance

- Experienced in the Solar PV industry

COMPLETE

- Full suite of insurance solutions for all stages of the industry

INCOME/SAVINGS PROTECTION

- Ensure financial protection for Solar PV owners

THANK YOU

anora®

SOLARPRO®

SHAPING A SUSTAINABLE FUTURE

It's Our Responsibility to Go Renewable!

Presented by

Name: Teresa Tan Hooi Ying

Position: Vice President, SME Product Development

CIMB

FORWARD WITH SUSTAINABILITY

CIMB has always emphasized value creation which requires a delicate balancing of the long term interests of its people, planet and profitability.

ENVIRONMENTAL, ECONOMIC & SOCIAL

CLIMATE CHANGE

is affecting all of us.

It is not just an environmental problem.

Risk

Physical damages
Operational risk

Cost

Resource scarcity
Transportation cost

Demand

Prioritize sustainability
Eco-friendly products

Regulation

ESG requirement
Carbon tax

Facts Source: Renewable Energy Magazine
Photos Source: Madison.com, Time, BuzzFeed, FreedomWorks

It's REWARDING to go RENEWABLE

Save your bill. Save the Earth.

FINANCING SUITE

Empowering businesses in the ecosystem of solar energy

Manufacturer → Supplier → EPCC / Service Provider → Purchaser / End User

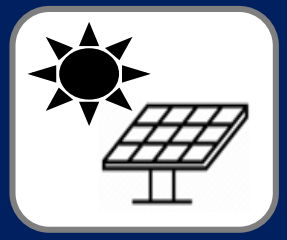
Working Capital

- Financing to support day to day business operation
- Shorter in tenure, i.e. from 5 to 10 years
- Financing limit up to RM1Mil for SMEs; higher limit for Mid Corp
- Require no collateral

Asset Backed Financing

- Financing to purchase property, assess to working capital or facilitate trade activities
- Multiple types of facility: Term Loan, OD, Tradelines
- Longer in tenure & higher financing limit
- May require property or deposits as collateral

Renewable Energy Financing



- Capex financing to purchase & install solar PV
- Term Loan or Industrial Hire Purchase
- Tenure from 5 to 10 years
- Financing limit up to 100% of total system cost
- For commercial / industrial projects only

Credit Card

- Purchase solar PV using CIMB credit cards
- Up to 36 months of 0% installment payment plan
- Available for both commercial, industrial & residential projects
- Subject to merchant's T&C

Note: Financing application subject to Bank's credit assessment & approval.

THE JOURNEY of Going Renewable

Begin your journey

Get Quotation

Seek for consultation, quotation & site inspection by the solar service provider

Acceptance of Proposal

Agree on the proposal & quotation by the solar service provider

Financing Application

Submit loan/financing application with the required documents

Installation Starts

Once approved, the solar service provider will starts the installation

Enjoy saving & start consuming solar energy

General Documents Requirement:

- Audited / management accounts (3 years)
- Bank statement (6 months)
- Business registration / statutory documents
- Identification documents
- Booking form / contract to purchase solar PV
- Any other documents required by the Bank

Solar Panel Vendor under the Bank's Panel

Empaneled under the buysolar online platform

https://www.buysolar.my/

GSPARX Sdn Bhd

Solarvest Holdings Berhad

Verdant Solar Sdn Bhd

Samaiden Sdn Bhd

Yongyang Sdn Bhd

ERS Energy Sdn Bhd

We Power Venture Sdn Bhd

Plus Xnergy Services Sdn Bhd (formerly known as Plus Solar Systems Sdn. Bhd.)

Brilliant Solar Sdn Bhd

Hasilwan (M) Sdn Bhd

VSD Automation Sdn Bhd

Leader Solar Sdn Bhd

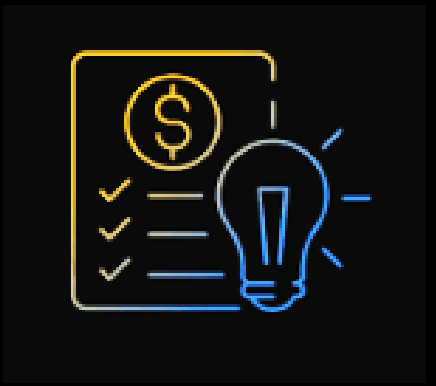
Bank's panel

CIMB Renewable Energy Financing – Low Carbon Transition Facility-i

- Financing limit up to RM1m*
- Attractive financing rate of 5% p.a.
- Financing tenure up to 10 years*
- Wide range of CIMB solar panel vendors for consultation and installation

**subject to eligibility*

Assessment by CIMB



1. 51% owned by Malaysian
2. Within Bank's acceptable risk rating
3. Good repayment/payment credit conduct history (CCRIS)
4. Positive tangible networth company
5. Age of sole-proprietor or key partner is within 21 to 65 year old
6. business sector is NOT Investment Holding, NRCC, NGOs, NPOs, Religious Organizations, Limited Company (Syarikat Berhad), Co-Ops (Koperasi), Clubs
7. Property must be owned by Applicant / Key Person

SUMMARY

- CIMB's sustainability agenda
- Products offering & features
- Application process


THANK YOU
FROM TOMORROW