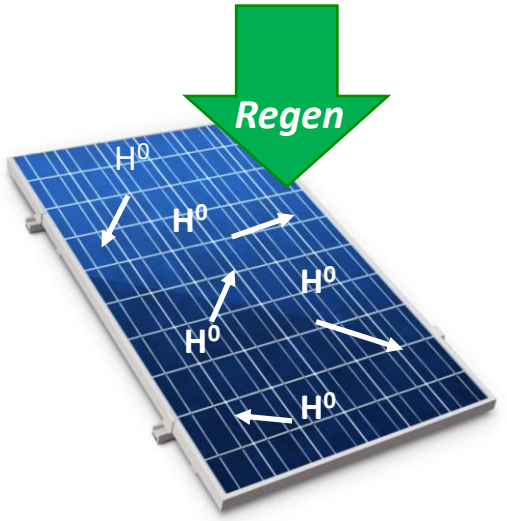
Enabling Sustainable Solar Energy Business through Advanced Regeneration Technology

July 2021

ETAVOLT

Company Background

- Innovative circular advanced panel regeneration technology → World's 1st
- Maximize power output and prolong lifespan of solar panels
- Co-founders with solar PV R&D expertise and industry backgrounds



ETAVOLT Management Team

Dr Stanley Wang

Co-Founder
Chief Executive Officer

- 15 yrs in solar research, manufacturing & tech transfer
- **PI EDB-SCRP** & Programme Director ERI@N, NTU
- **7 years with REC Solar Singapore** with managerial role
- UNSW PhD, Photovoltaic Eng.

Dr Andy So

Co-Founder
Chief Technology Officer

- 15 yrs in solar research & industry, BIPV and automotive production process (BOSCH)
- **7 years with Bosch Singapore** with managerial role
- Certified PM & Agile Master; Customer PoC; Start-up & innovation mgt.
- UNSW PhD, Photovoltaic Eng.

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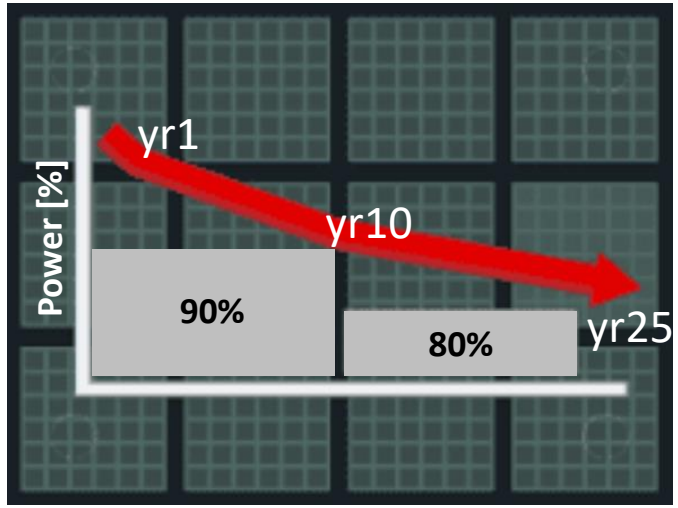
Problem Statement

Current global solar energy economical losses **~ US$ 7.2 Billions** *conservative at 7% degradation

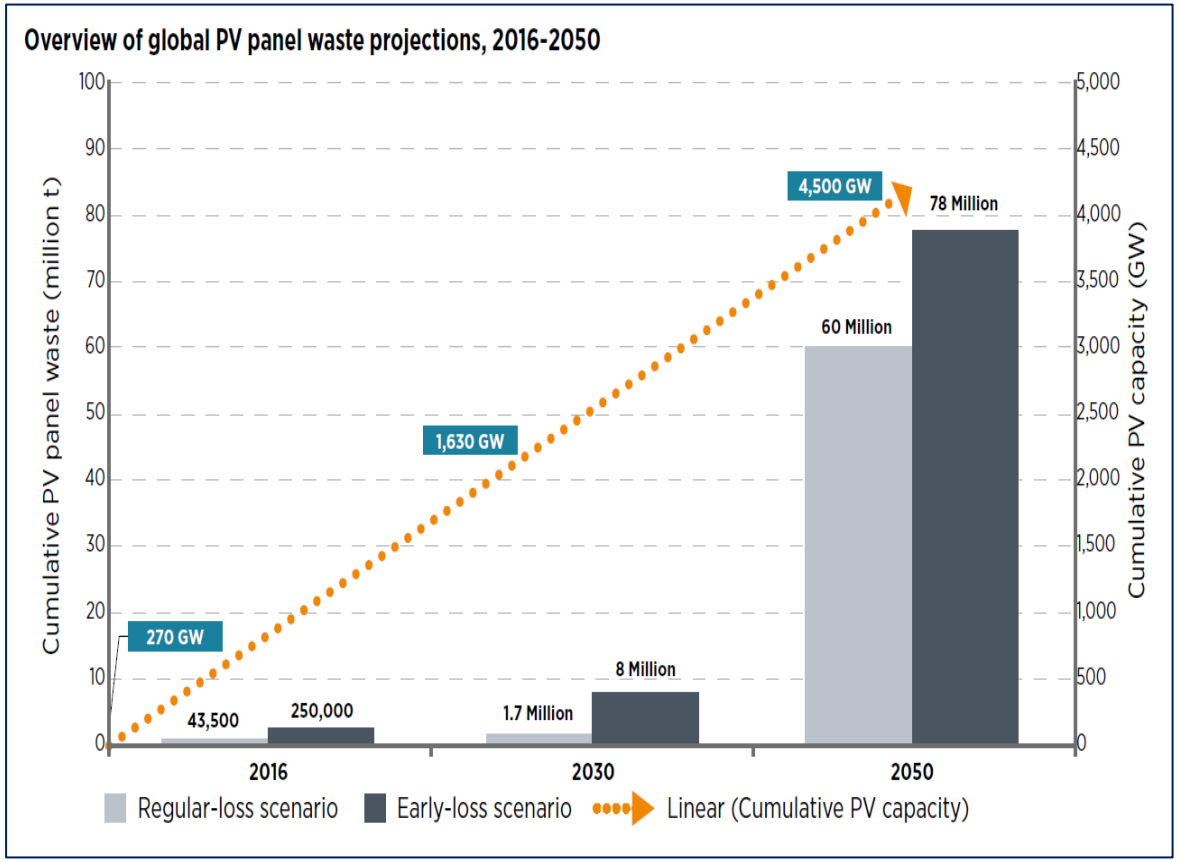
Problem

- P-type silicon solar panels (90% market) suffer from light induced degradation (LID)
- Power reduction up to 25% during panel lifespan
- Degraded panels lead to early decommission and increasing e-waste disposal and landfills



Source: https://www.paradisesolarenergy.com/

Solar capacity growing at unprecedented rate!



Source: IRENA, IEA-PVPS. END-OF-LIFE MANAGEMENT: Solar Photovoltaic Panels, 2016.

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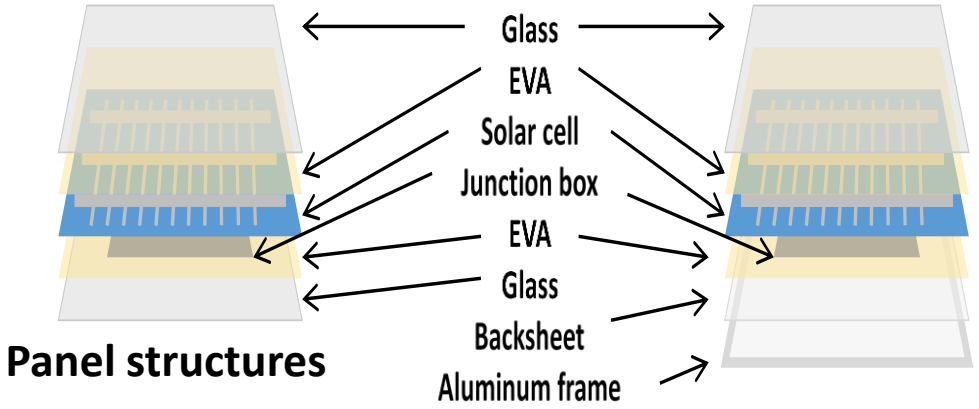
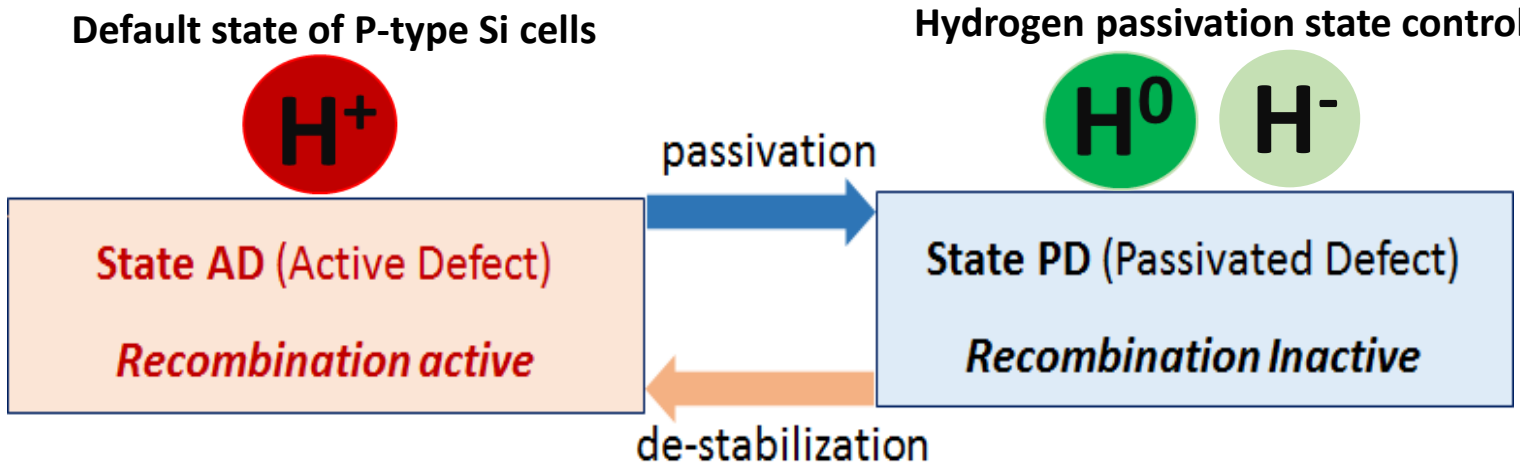
Current Technology Barriers & Status

- Current state of hydrogenation technology is only possible at solar cell level, with factory furnace based type
- Prolonged (>10 mins) panel lamination manufacturing step require >150ºC (reversible effect)
- EVA melting point (167 ºC) makes high temperature based process technologies not applicable



Panel structures



State-of-art Hydrogenation Tech

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Etavolt's Innovation & Novelty

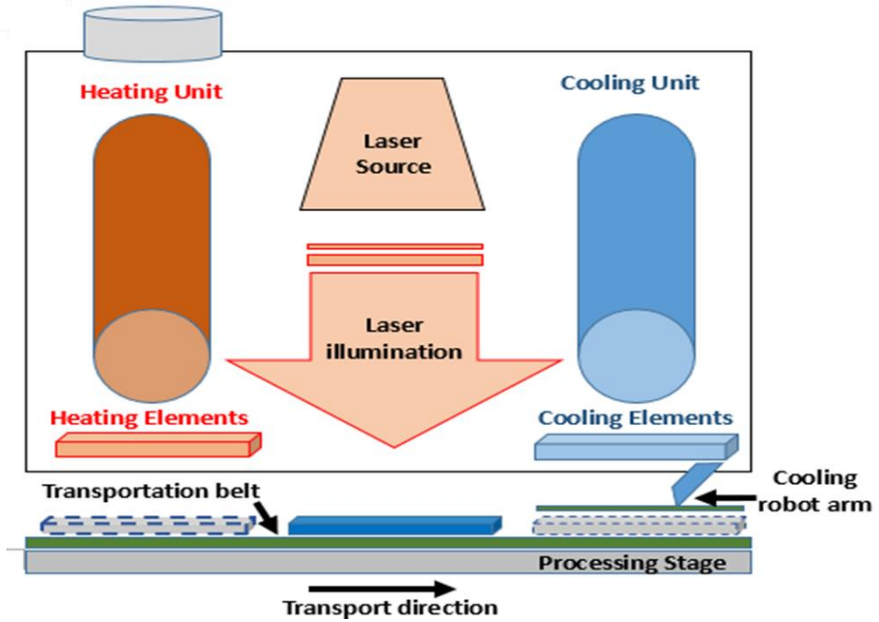
Novel advanced panel regeneration technology

First in the World

Regen

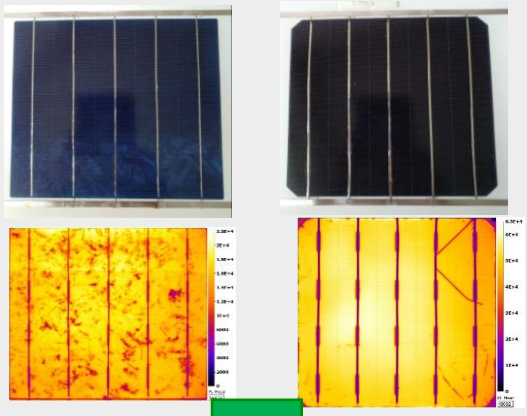
Raw Material → High Purity Silicon → Silicon Solar Cell → Silicon Solar Panel (new) → Solar Panel System (installed)

Prototype system design

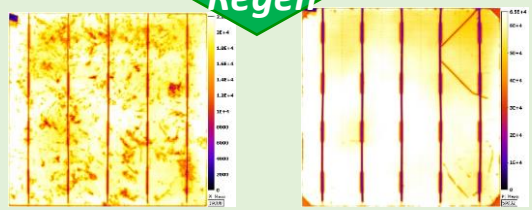


Current Achievements

Degraded P-multi & P-mono 6" module



Regen



>5% Power recovery

- Solved LID, achieved stable state with efficiency improvements
- >10,000 solar cells processed & >1600 panels built - in field
- Regeneration performance validation on field degraded solar cell
- The current prototype needs to be modified & upgraded for module level, part of the POC WP

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Competitive Landscape & Propriety Technology

Cutting edge advanced regeneration technology

High illumination based technology

- State of the art, first in the market
- Applicable for cell and module level
- Higher light intensity for better charge passivation state control
- Provide best regeneration performance for LID
- Portability feasible

Technology Comparisons Parameters	Laser illumination	Furnace process (Belt furnace process)	Current Induced Process
Light Intensity	≥30 Suns	20 Suns	-
Duration (per module)	3-5 s	10 minutes	15-30 minutes [8]
Temperature (Degree Celsius)	50 - 100	850	200
Application at module level (1m x2m)	Yes	No	No
Cooling rate	>20 degrees/s	40-50 degrees/s	N/A

Note: 1 sun is defined as equal to 100 mW/cm^2 of irradiance

Competitive Advantages			
	Etavolt Technology (Laser based) First in the market	**Asia Neotech (LED- Belt furnace)**	**China in house (Current Induced)**
LID degradation recovery rate at module level (%)	**≥5%**	Not suitable on module level	Not suitable on module level
Relative efficiency recovery on cell level (%)	**≥8%**	≥5%	3% to 5%
Throughput	6000 cells/hr 60 modules/hr (Pilot unit POC is lower)	6000 cells/hr N/A with module	2000 cells/hr N/A with module
Market	Applicable on-field	Stationary	Stationary
Footprint/Size of the device (kW)	100cm (Width) x 120 cm (Length) x120 cm (Height)	100cm (Width) x429 cm (Length) x132 cm (Height)	N/A

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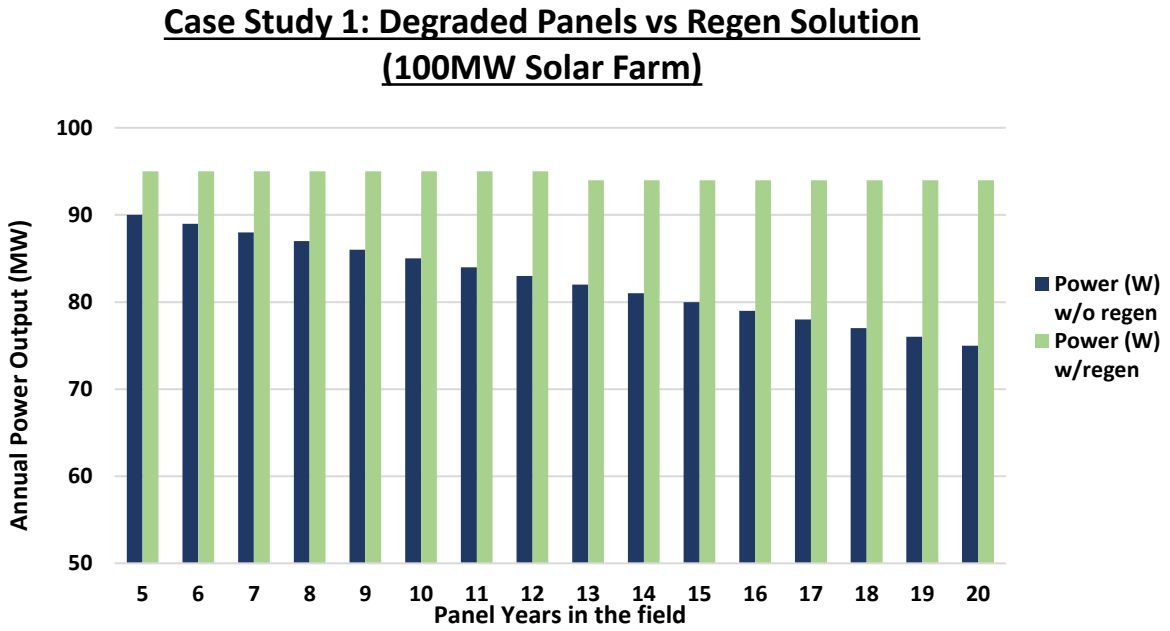
Customer Prefer EtaVolt's Regeneration Solution



Solar Farm System Age	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Degradation rate (%) w/o regen	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Degradation rate (%) w/regen	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6
Extra power gain (MW) Power (w/o regen)- Power (w/regen)	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19

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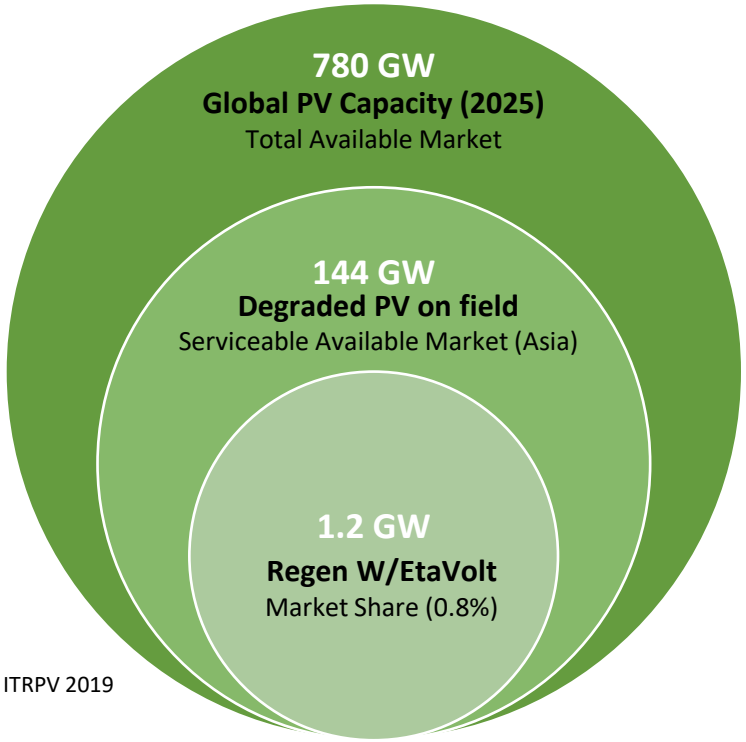
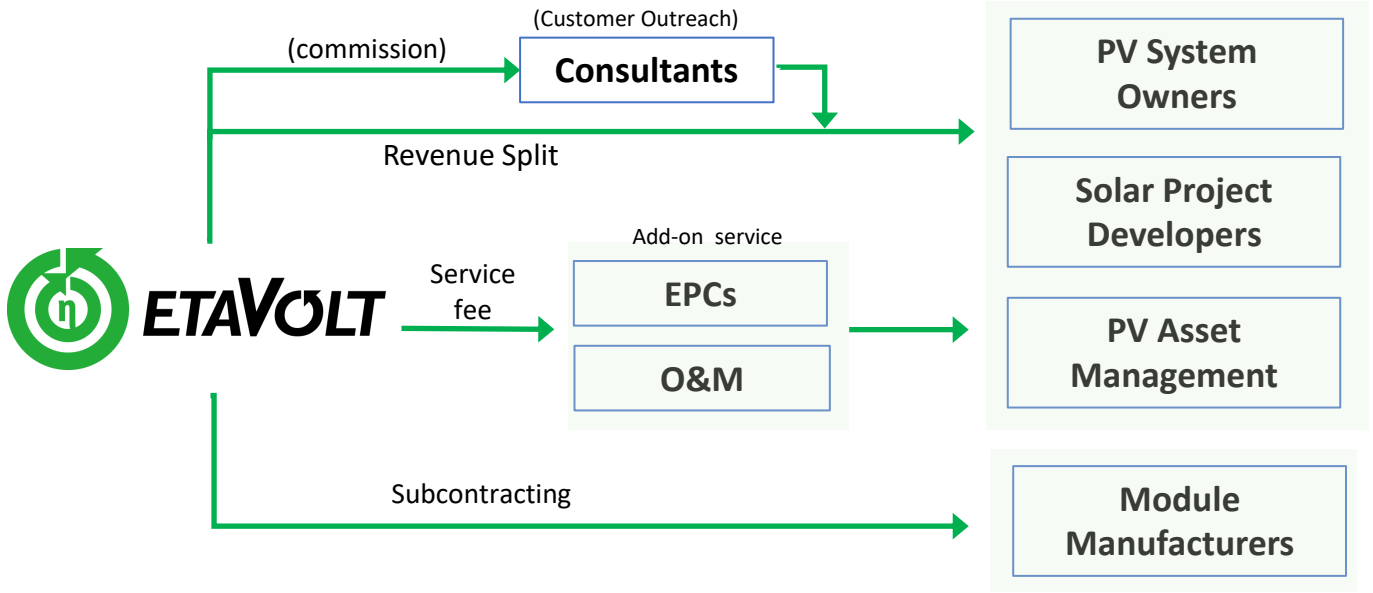
Market Potential & Commercialization

Potential Regen Market Size



Source: ITRPV 2019

Market Strategy & Commercialization



- Potential revenue streams: 1) revenue split, 2) service fee, 3) subcontract
- Initial strategy to partner local pilot customer for small-scale PV panels regeneration demo (various LOI signed)
- Engage oversea solar farm PV customers, e.g. owners or PV asset management through Singapore demo project portfolios (supporting by BD consultant)

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Expected Benefits to Singapore

Relevance and importance of module advanced regeneration technologies

Technology Impacts

New Business

- Enable blue ocean opportunities to open up new marketplace and business model for solar panel performance recovery

Innovations

- World's first solar panel regeneration, make SGP brand visible on global arena
- Locally registered IP and up to 2 future ones improve competitive advantage

Commercialization

- Achieve >5% solar panel performance recovery is major breakthrough
- Disruptive technology to create global impact in renewable industry and reduce environmental impacts

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Solar Panel Advanced Regeneration

SUSTAINABLE DEVELOPMENT GOALS

Social Impacts

Sustainable Cities

- Increase energy efficiency and reduce greenhouse emission
- Support Singapore customers to achieve sustainable solar energy access

Economic Growth

- Hiring local professional team and develop local technical talents
- Develop business and collaboration among local companies and start-ups in SGP

Circular Economy

- Maximize power output and prolong lifespan of degraded panels to reduce solar e-waste or landfill

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