Collaboration Opportunities

Between

PPFS & EGNRET

Presented By

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APEC Policy Partner on Food Security

About APEC PPFS

- APEC Policy Partnership on Food Security (PPFS) was established in 2011 for strengthening public-private cooperation to address food security issues in the region

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About APEC PPFS

- PPFS is established to develop policies and solutions for food security in the Asia Pacific region
- APEC economies have given high priority to the issue of food security and has built a solid foundation for agriculture, aquaculture, fishery, food exchange and cooperation under various multilateral and bilateral frameworks
- PPFS to achieve these food security goals in the region

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About APEC - Facts

- Asia-Pacific accounts for half of the world's cereal production and over 40% of its trade volume, production growth depends on expanding cultivable areas and continue enjoying favourable weather conditions.

- APEC members account for over 80 percent of global aquaculture production and more than 65 percent of the world’s capture fisheries

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About APEC - Facts

- APEC comprises 9 of the 10 top fish producers in the world.
- Aquaculture is now one of the fastest growing food-producing sector which now accounts for almost 50% of global food fish
- PPFS Working Group One (WG1) – Sustainable Development in Agriculture & Fishery Sectors

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Mission of PPFS Working Group One

- Integration and Sharing of Agriculture & Aquaculture technologies, resources and expertise within the APEC Ecosystem

- NTU APEC Centre for Sustainable Development in Agriculture and Fishery Sectors was setup in Singapore to support the initiative of PPFS WG1

NTU APEC Centre for Sustainable Development in Agriculture and Fishery Sectors

Role of the Centre

- Platform for R&D and technology Dissemination in APEC PPFS for both small stake holders, SME and big companies
- Facilitation platform for *Public Private sector* collaboration
- Traction point for identifications of sustainable technologies from various APEC economies

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Identified Areas of Resources

- Infrastructure and Manpower
- Technology and Training
  - Use of Clean and Renewal Energy
- Processing and Trading
- Funding

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Current Projects in Progress

- Currently, we have a total 9 ongoing projects
- Projects are mostly between privates sectors involving 6 countries
  - Singapore, Malaysia, Indonesia, China, Philippines and Australia
  - All projects are technology related and 4 are clean & renewal energy related

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WG1 – NTU APEC Centre for Sustainable Development in Agriculture & Fishery Sectors

Project One : Use of Renewal Energy for Climate Smart Farming

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Use of Renewal Energy for Climate Smart Farming Initiative

- **Use of Renewal Energy – Climate Smart Farming**
  - With the growing scarcity of land, return on economic activities on land is becoming more important
  - Growth of solar energy power generation are growing in huge scale which requires vast amount of land.
  - Ironically and very often, the land below the solar array has no economic benefit which becomes a growing dilemma for many policymakers.

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Use of Renewal Energy for Climate Smart Farming Initiative

- **Use of Renewal Energy – Climate Smart Farming**
  - This scenarios represents a clear opportunity and possible optimal solution where clean energy production and farming can co existing under the same plot of land
  - Crops such as lettuce, mushrooms, chilies and melon are suitable with this type of Sheltered Greenhouse.

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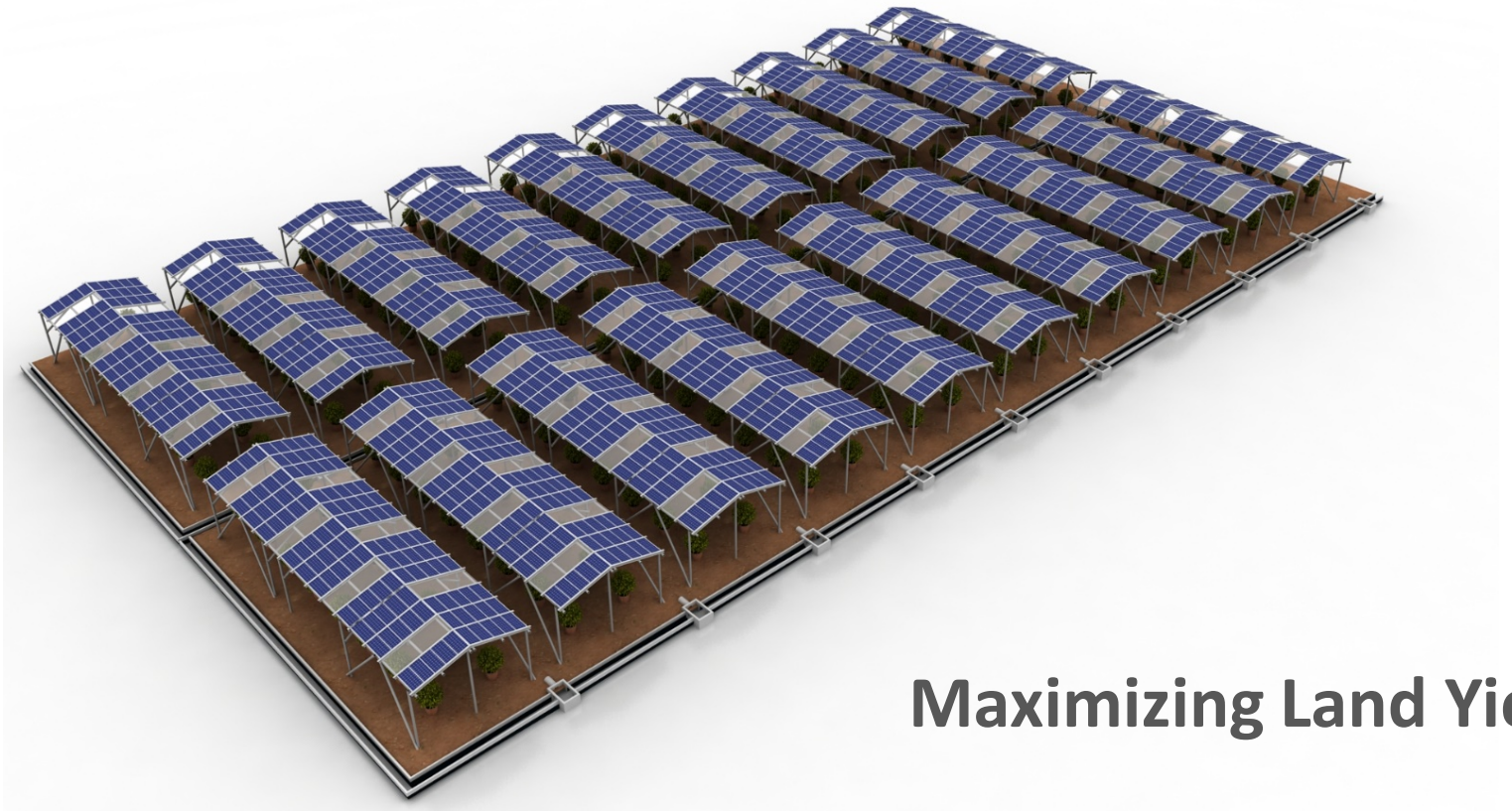
Use of Renewal Energy for Climate Smart Farming Initiative

- **Use of Renewal Energy – Climate Smart Farming**
  - Possible Doubling of yield on the same plot of land
  - Solar array design allows for good light transmission while lowering shading effects given by semi-pitch on which the panels will be set up while aiding adequate ventilation in order to procure optimal climate management.
  - Translucent panel arrangement allows optimal sunlight to go through in order to integrate light diffusion inside.

Use of Renewal Energy for Climate Smart Farming Initiative



Maximizing Land Yield

Use of Renewal Energy for Climate Smart Farming Initiative

Use of Renewal Energy for Climate Smart Farming Initiative

- **Project Objectives**
  - Agriculture & Aquaculture farm that is powered entirely by renewal energy
    - In current discussion with Solar Development & Leasing companies in the region
    - Farmers pay zero dollar for Solar energy infrastructure setup
    - Farmer only pays for usage of energy (Kilowatt)

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Use of Technology

Increasing Efficiency of current PV System

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Woes of Current Solar Farms

- Solar panels (Silicon based) suffers from an inherent degradation problem which has plagued all existing solar cell and panel manufacturers since its inception

- Many if not all solar farms are not able to meet their output projections leading to much unhappiness with their shareholders

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Woes of Current Solar Farms

- As a result, many early days Solar Farms (from 2000s due to adoption of FIT) are no longer viable due to the extreme drop in their panel energy production efficiency

- With the drastic drop in price of PV, many are looking to dump their current system; creating a possible mountain fill of solar panels to be destroyed

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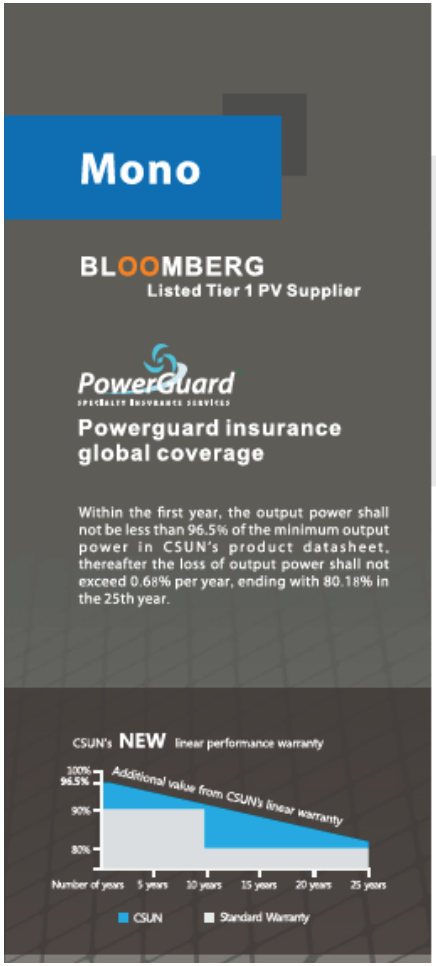
Inherent Problem

Light Induced Degradation (LID)

- Current Solar modules typically degrade around 3-6% within the first year of use and will peak around 20% - 25% degradation in their life time

- It is widely understood that Light Induced Degradation (LID) due to formation of Boron-Oxygen (BO) defects in the silicon solar cell, is the main culprit for this degradation.

Existing Specifications



Module Efficiency : Up to
17.24%

Highest Power Output :
280W

Panel Efficiency
Degradation :
1st Year : 3.5%
Life span : 20%

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Existing Specifications

STP275S - 20/Wew
STP270S - 20/Wew
STP265S - 20/Wew

SUNTECH
BE UNLIMITED

275 Watt
MONOKRISTALLINES SOLARMODUL

Merkmale

Exzellenter Modulwirkungsgrad
Modulwirkungsgrad von bis zu 16,9% wird durch höchst effiziente Zelltechnologie und Fertigungspraktiken erzielt

Hochresistent gegen PID-Effekte
Fortschrittliche Zelltechnologie und hochwertige Materialien führen zu einer hohen Resistenz gegenüber PID-Effekten

Positive Leistungstoleranz
Positive Leistungstoleranz von bis zu 5 W gewährleistet höhere Erträge

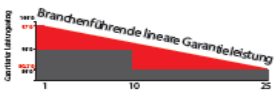
Suntechs Stromklassensortierung
Durch Sortieren und Verpacken der Module nach Stromklassen werden Mismatch-Verluste um bis zu 2% reduziert und die Systemleistung wird maximiert

Erweitertes Testen der mechanischen Belastbarkeit
Modul ist zertifiziert für hohe Wind/Sog- (3.800 Pascal) und Schneelasten (5.400 Pascal)*

Geeignet für härteste Umgebungsbedingungen
Verlässliche Qualität führt zu höherer Widerstandsfähigkeit selbst bei härtesten Umgebungsbedingungen, wie z. B. Wüsten, landwirtschaftlichen Betrieben und Küstengebieten

Zertifizierungen und Standards:
IEC 61215, IEC 61730, Konformität mit CE

Branchenführende Garantie gemessen an der Nennleistung



- 97% im ersten Jahr, danach – ab dem 2. Jahr bis zum 25. Jahr – ein maximaler Verlust von 0,7% pro Jahr, gemessen an der Nennleistung des Moduls. Dies führt zu einer Leistung von 80,2% im 25. Jahr nach dem definierten STARTDATUM FÜR DIE GARANTIE.****
- 10 Jahre Produktgarantie
- 25 Jahre lineare Garantie auf die Leistung

Zuverlässige IP68-Anschlussdose
Die IP68-Anschlussdose von Suntech ist extrem wasserdicht, ermöglicht eine Installation in beliebiger Ausrichtung und verringert die Belastung der Kabel. Hochwertige Steckverbinder mit geringem Übergangswiderstand gewährleisten maximale Modulleistung für optimale Energieproduktion.

*Weitere Informationen entnehmen Sie bitte dem Montagehandbuch für Suntech Standardmodule. **PV Cycle nur für den EU-Markt.
***Weitere Informationen entnehmen Sie bitte dem Montagehandbuch für die küstennahe Installation von Suntech Produkten.
****Weitere Informationen entnehmen Sie bitte der Suntech Produktgarantie.

www.suntech-power.com IEC-STP-Wew-NO1.03-Rev 2015

Module Efficiency :
Up to 16.9%

Highest Power Output
: 275W

Panel Efficiency
Degradation :
1st Year : 3%
Life Span : 20%

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Development of Advanced Hydrogenation Technology

- Technology Originated from UNSW Australia
- Commercial Mass Hydrogenation Facility was setup in Singapore – Joint Collaborative Effort between Australia and Singapore

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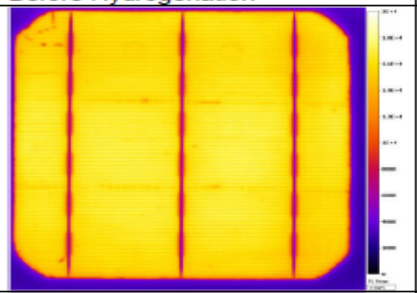
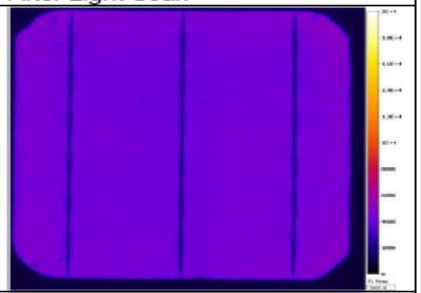
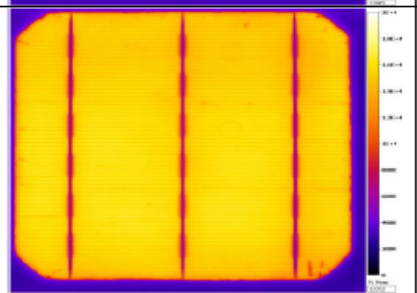
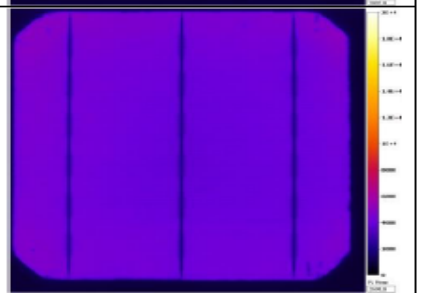
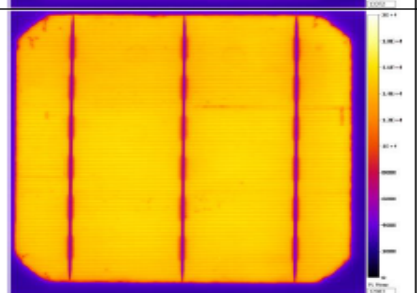
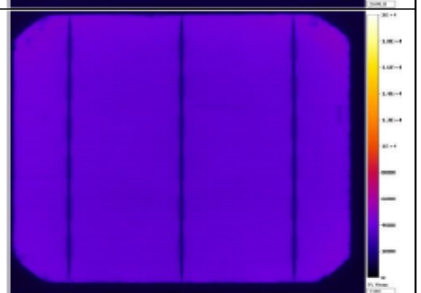
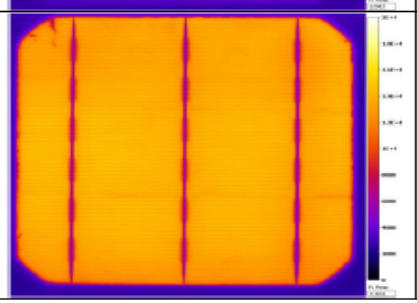
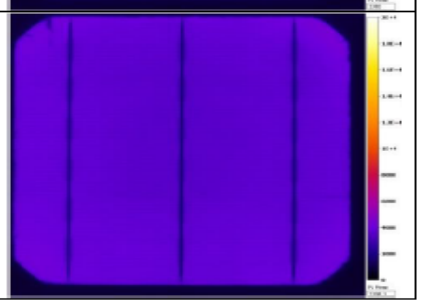
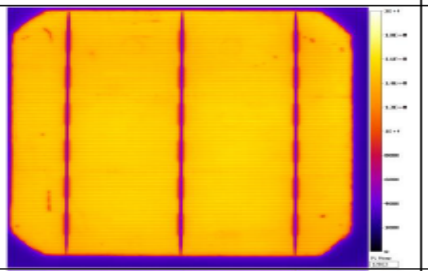
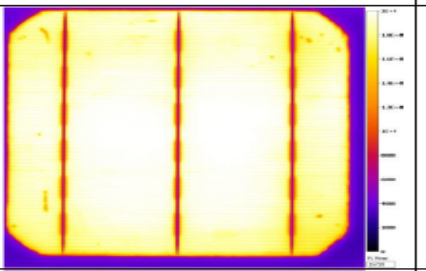
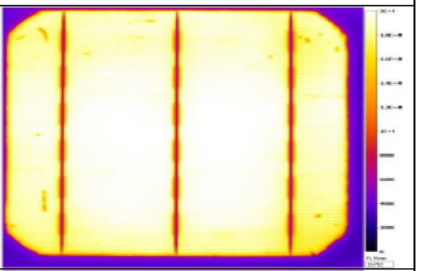
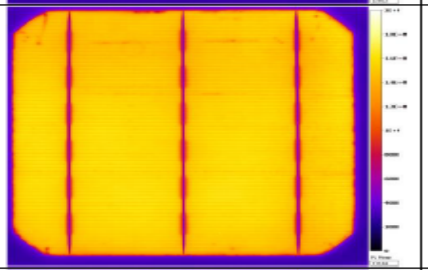
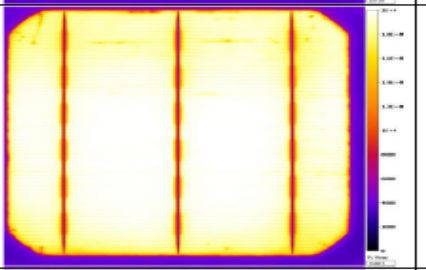
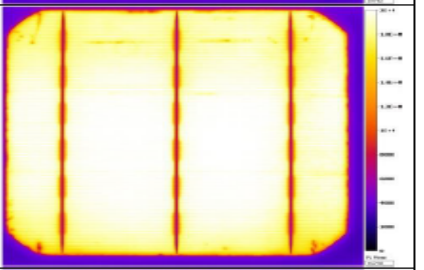
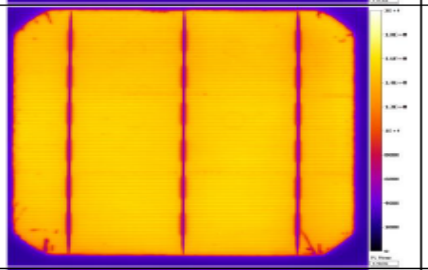
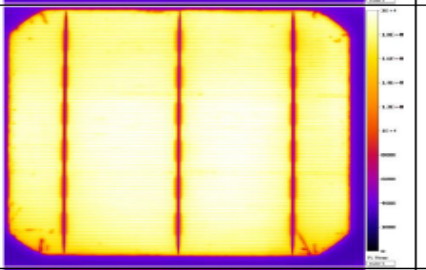
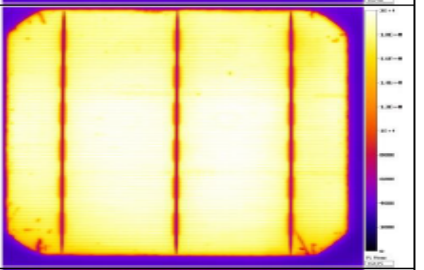
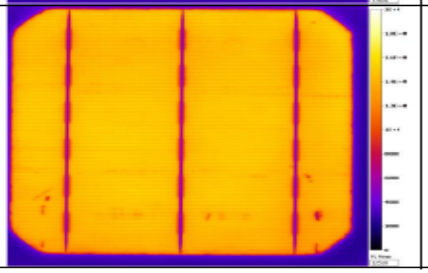
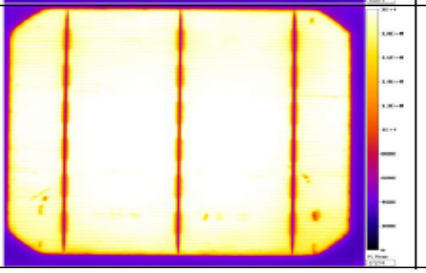
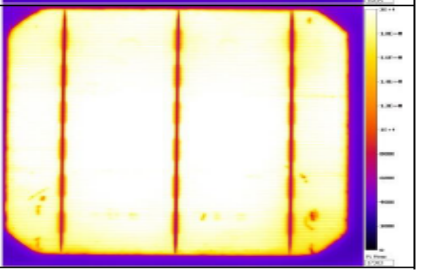
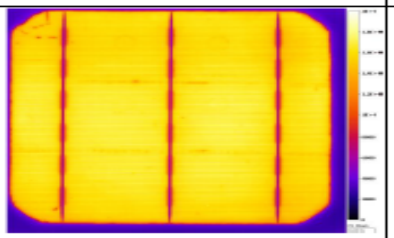
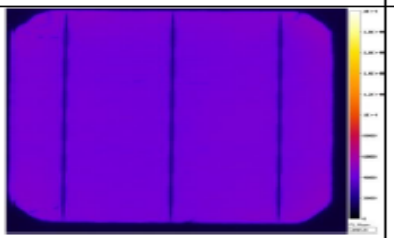
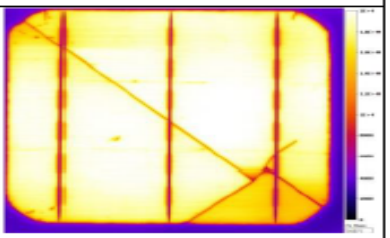
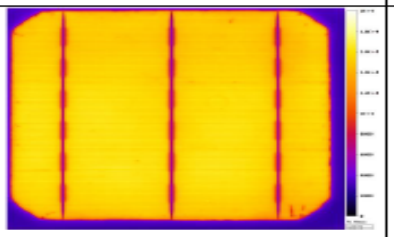
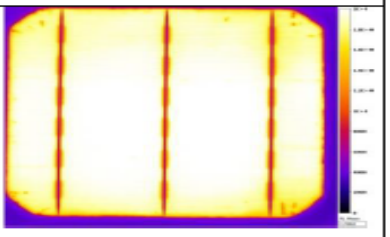
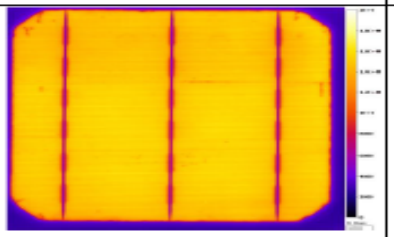
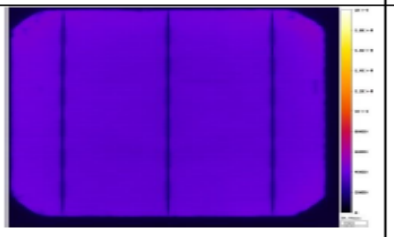
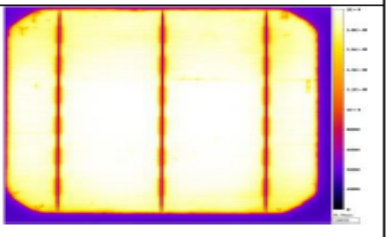
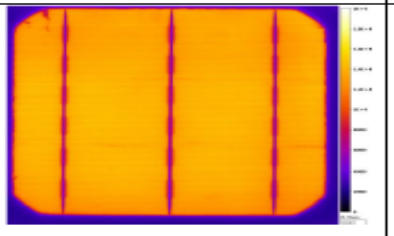
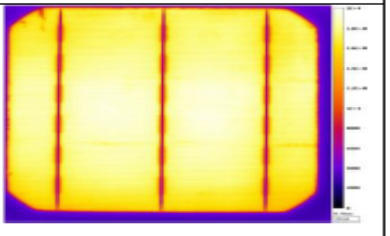
PL images for Group 1 (four non-hydrogenated CEC solar cells)

Label	Before Hydrogenation	No treatment	After Light Soak
SR23			
SR33			
SR35			
SR37			

PL images for Group 2 (four hydrogenated CEC solar cells)

Label	Before Hydrogenation	After Hydrogenation	After Light Soak
SR 24			
SR 34			
SR 36			
SR 38			

PL Images for Group 1 solar cells				
Label	Before Hydrogenation	No treat-ment	After Light Soak	Hydrogenation after LID
SR 23				
SR 33				
SR 35				
SR 37				

IV Characteristics for Group 1 solar cells						
Label		Before Hydrogenation	No Treatment	After Light Soak	Hydrogenation after LID	Differences %
SR23	Efficiency (%) : Voc (mV): Jsc (mA/cm2): FF (%): N:	20.46 667.27 39.29 78.05 1.18		18.96 640.71 38.31 77.24 1.51	Cell broke	NA
SR33	Efficiency (%) : Voc (mV): Jsc (mA/cm2): FF (%): N:	20.35 665.79 39.23 77.89 1.19		18.87 640.47 38.18 77.15 1.54	20.58 669.87 39.10 78.59 1.07	+ 9.06%
SR35	Efficiency (%) : Voc (mV): Jsc (mA/cm2): FF (%): N:	20.41 665.70 39.27 78.09 1.20		18.84 637.83 38.12 77.48 1.49	20.61 669.73 39.11 78.66 1.09	+ 9.39%
SR37	Efficiency (%) : Voc (mV): Jsc (mA/cm2): FF (%): N:	20.39 663.26 39.15 78.54 1.18		18.90 636.44 38.05 78.07 1.43	20.67 667.93 39.08 79.18 1.08	+ 9.36%

Advanced Hydrogenation Technology

Normal Solar Panels	Treated Panels
1. Panel Efficiency Degradation after 20 years use • Average 20%	1. Panel Efficiency Degradation after 20 years use • Less than 3 % 2. Possible future development re. Recycling Old solar Panels

PPFS & EGNRET

- **Possible Areas of Collaboration with EGNRET**
  - Exchange of Best Practises
  - Use of Technologies
    - Use of Hydrogenation Technology in Solar Farm projects in Malaysia, Philippines & Singapore
    - Use of Solar Energy for Urban Farming in Singapore
    - Recycling of Used Solar Panel* – Taiwan & Singapore
  - Test bedding of Clean and Renewal Energy Technologies in WG1 members' farms

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- **Possible Areas of Collaboration with EGNRET**
  - Cross Fora Co Operation - Support EGNRET's Concept Note & Joint Concept Note and vice versa
  - Others

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The Future of Farming

PPFS & EGNRET

Thank You

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