2021 Asia Pacific Solar Research Conference

PV EoL & Recycling Status and Trend in China

Lyu Fang

Institute of Electrical Engineering, Chinese Academy of Sciences

IEA PVPS Task12，2021-12-16

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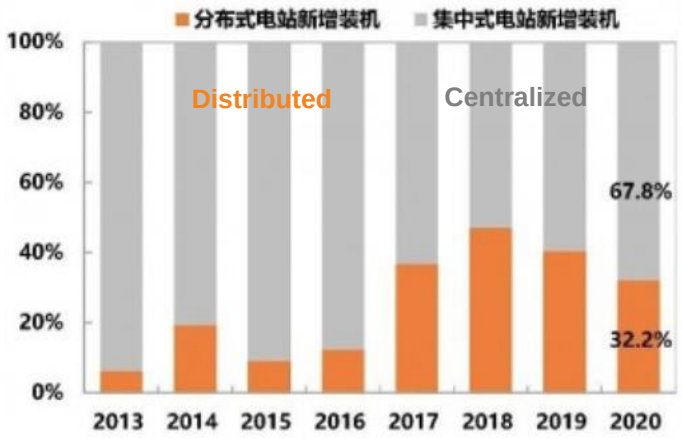
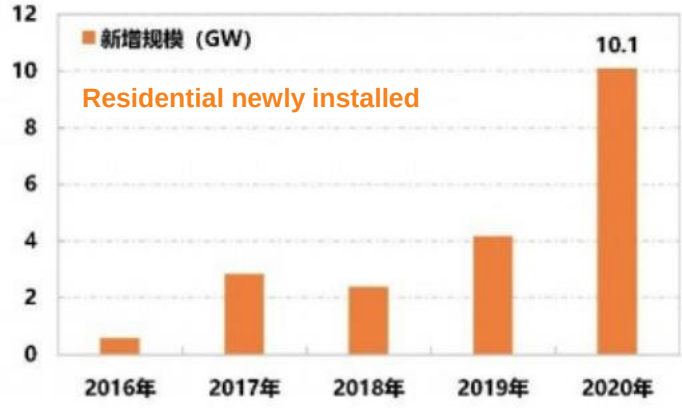
- 2. China EoL & Recycling forecasting
- 3. China PV Recycling R&D
- 4. Conclusion

China PV market 2020

Newly installed PV capacity in China (GW)



Residential newly installed in China (GW)



- New PV capacity in 2020 reached 48.2GW, a year-on-year increase of 60%.
- Cumulative installed capacity reaches 253GW by 2020.
- Distributed new installed capacity reached 15.1GW, residential reached 10.1GW, which exceeding the total of the previous four years.
- PV power generation has increased from 3.1% to 3.5% of total power generation.

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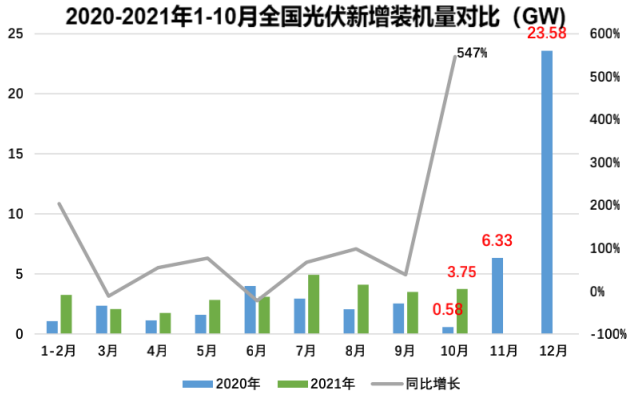
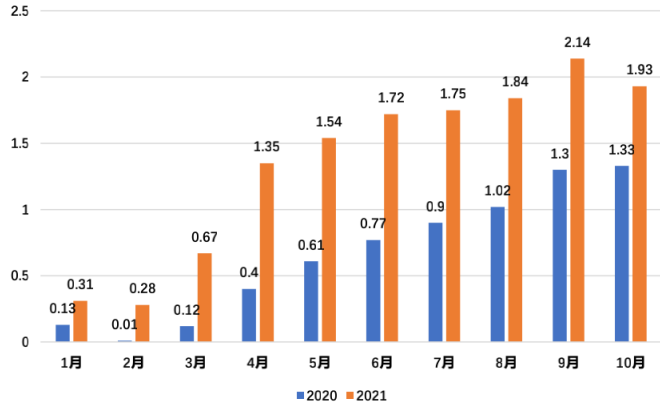
China PV market 2021

Newly installed PV capacity in China 2020 VS 2021 (GW)

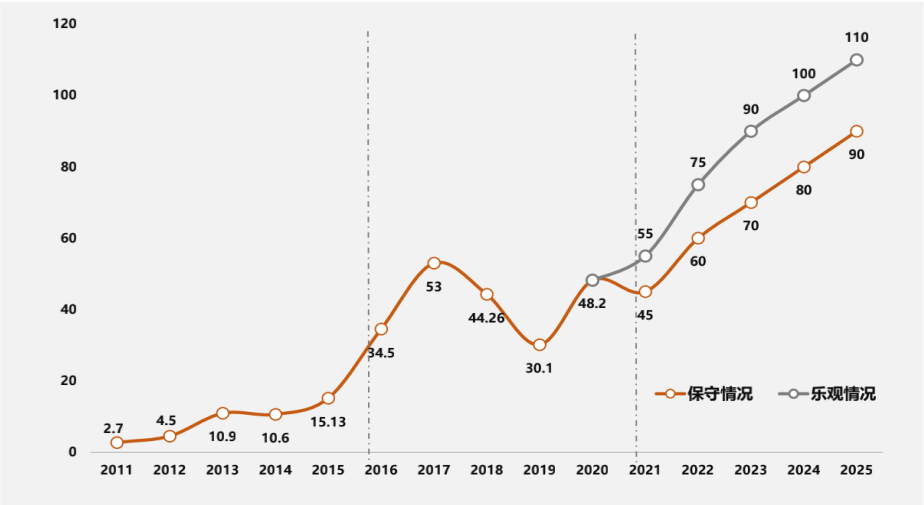


Residential newly installed in China 2020 VS 2021 (GW)



- New PV capacity in 2021 Jan-Oct reached 29.31GW, a year-on-year increase of 34%.
- Centralized account for 35.1% (Jan-Oct).
- Distributed new installed capacity reached 19.03GW, acount 64.9% in total (Jan-Oct).. Among residential reached 13.6GW, acount 51.5% in total.
- PV power generation has increased to 4% of total power generation.

China PV market trend (2021-2025)



- CPIA estimated that 2021 the new installed capacity will be about 55-65GW at the beginning of the year.
- The modified reduced to 45-55GW.

- Rising prices in the industrial chain have slowed down the installation of centralized PV systems.
- CPIA estimated that 2022 the new installed capacity will reach 75GW owning to 2021 reserved installed capacity.
- IEA estimated that annual increase installed capacity will be 220GW from 2030-2060

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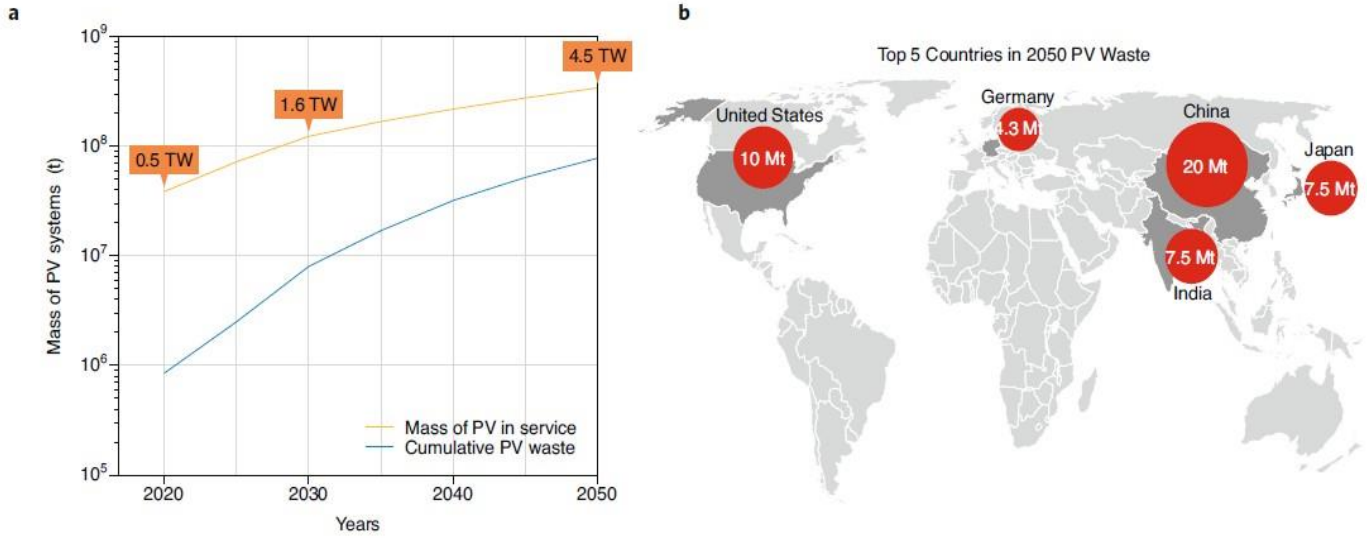
PV EoI forecasting 2050

Global PV EoI 80Mt by 2050



Data resource: IEA PVPS TASK12

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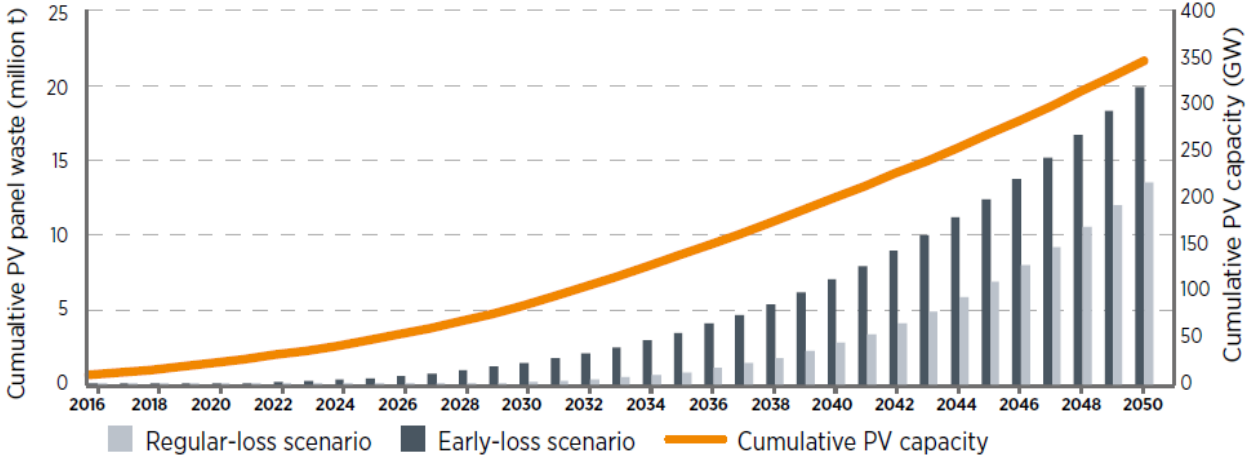
China PV Eol forecasting 2050

China PV Eol 1.5Mt by 2030
7Mt by 2040
20Mt by 2050

Data resource: IEA PVPS TASK12



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China PV Recycling R&D

Crystalline silicon photovoltaic module recycling technology and equipment R&D (MOST 2019-2022)

Project manager : Lyu Fang

Project participation institutions : 16 institutions, including 13 companies, 3 universities.

- Established a **demonstration line** for environmentally-friendly processing of c-Si module based on **Mechanical methods**, with **capacity ≥10MW/year**, mass recovery rate ≥93%, energy consumption ≤25kWh/kW module, silver recovery rate ≥93%, silicon recovery rate ≥96 %, copper recovery rate ≥97%.
- Established a **demonstration line** of high-value environmental protection processing technology for c-Si module based on **Chemical method**, with **capacity ≥12MW/year**, mass recovery rate>92%, energy consumption ≤27kWh/kW module , silver recovery rate≥95%, silicon recovery rate≥ 95%, copper recovery rate ≥ 98%.
- Environmental friendly treatment of the fluorine-containing materials and silicon heterojunction solar cells, establish a **test platform** and form a roadmap for Eco PV modules.
- Propose adding the **life cycle assessment system, standard and policy mechanism recommendations** of PV recycling

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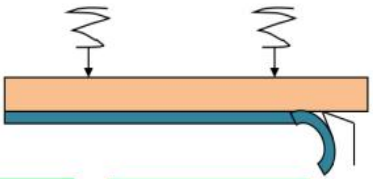
Mechanical Methods

Recovery of crystalline silicon modules through mechanical method - *Special equipments and the effect*:

- The core equipments - *hot knife equipment* for recovering glass, *grinding and separating equipment* for generating the solar cell powder, brazing strips powder, and plastic powder.

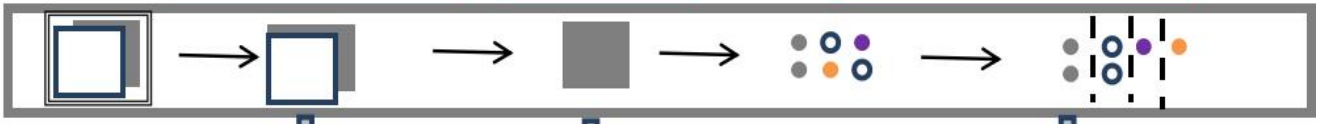


crystalline silicon modules

Junction box and Frame remove equipment

Hot knife equipment

Grinding and separating equipment



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aluminum frames

recoveried glass

solar cell lamination films

solar cell powder

brazing strips powder

plascic powder

Thermochemical Method

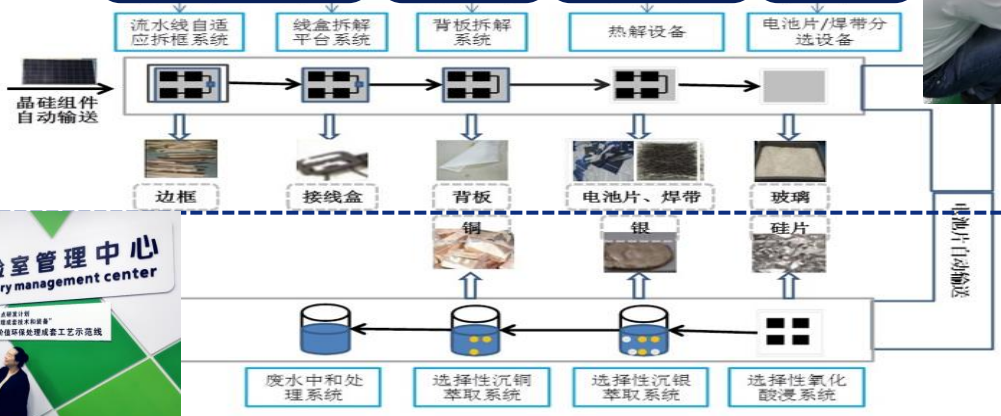
Module recycling: 6min/pcs

Remove: Frame, Junction box

Remove: Backsheet

Remove: Encapsulation materials

Sorting: Cells and ribbons



Thermo Chemical

Waste Treatment

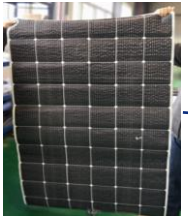
Copper separation extraction

Silver separation extraction

selective etching and resolving

Green recycle for F-backsheet wastes

Solar cell laminated with F-backsheet



Remove

F-backsheet waste

R-PET granules & parts with F composition

Retained properties

Aged properties

Physical Approach

Chemical Approac

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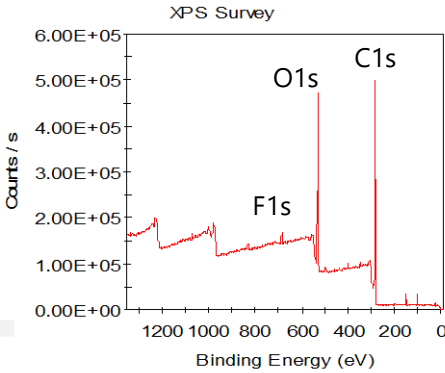
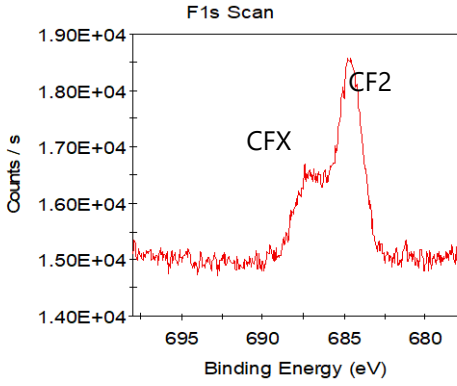
- Reformulation with stabilizers and modifier
- Compounding process technology
- Aged-PET depolymerizaiton and esterization with catalyst
- Reformulation with 3rd monomers & stabilizers
- Polymerizing Flurorine-ester composition.

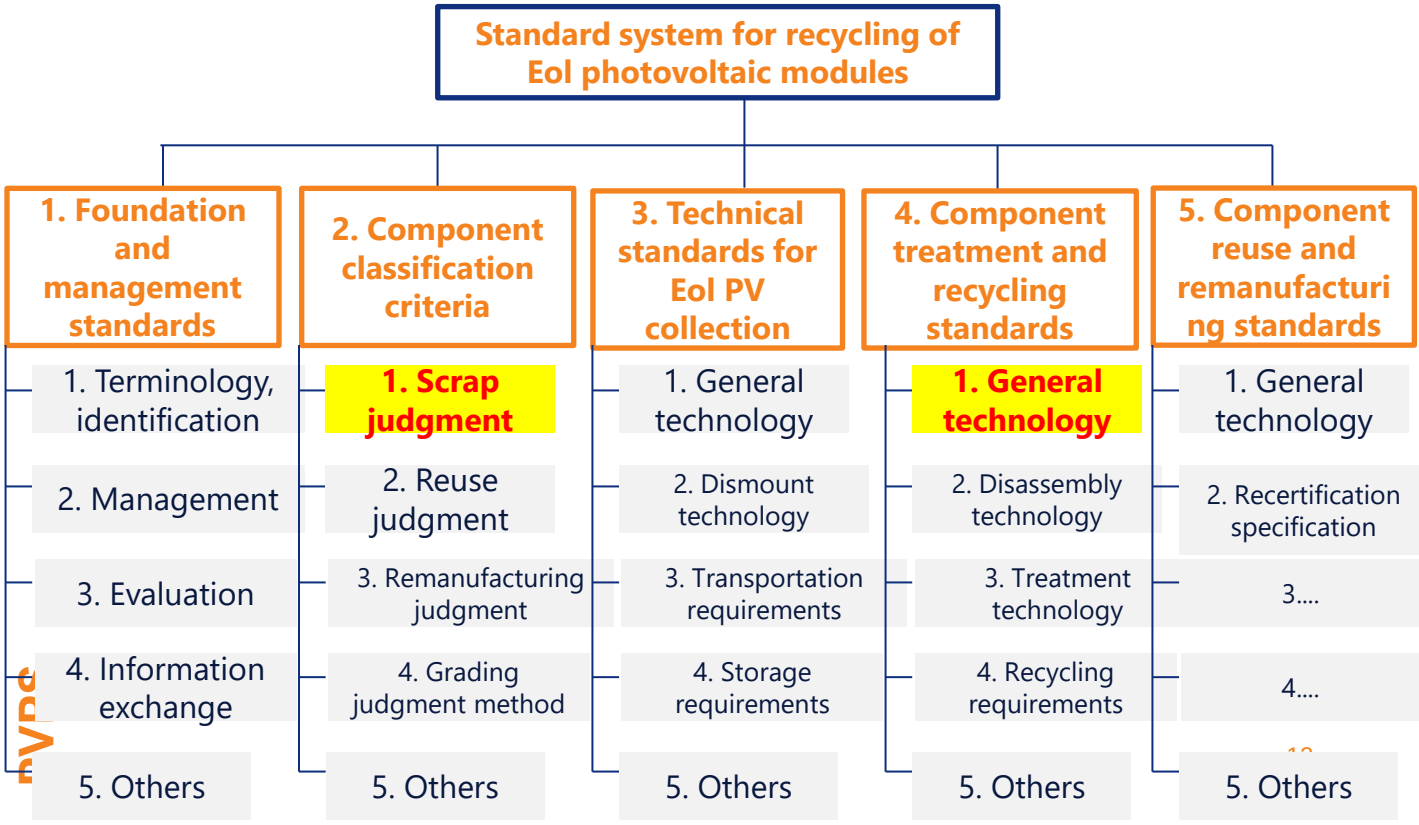
X-ray photoelectron spectroscopy of R-PET resin from F-backsheet



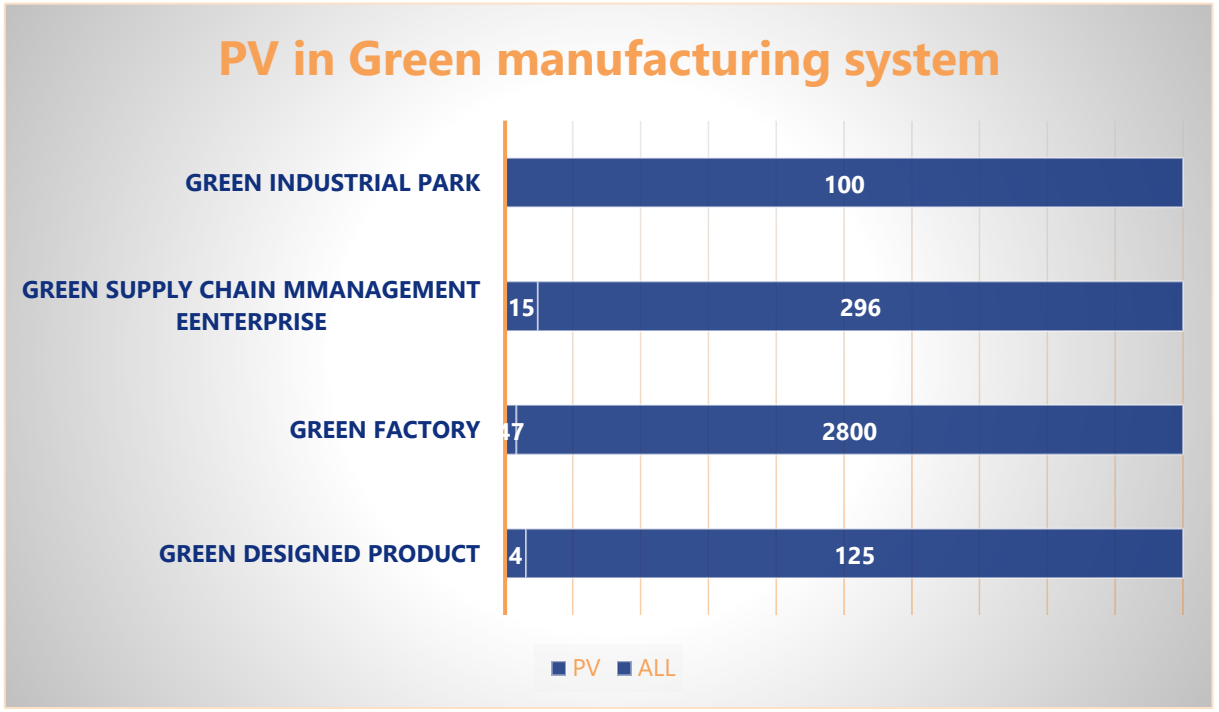


C-Si PV Module Recycling Support System

Four Major Topics: LCA / Standards / Policy / Roadmap



Ministry of Industry and Information Technology
Green Manufacturing System



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Green Manufacturing System by the State Council

- Guidance on accelerating the establishment and improvement of a green, low-carbon and circular economy system (index no. 000014349/2021-00015)
- Key words: Energy conservation and environmental protection, clean production, clean energy, recycling of renewable resources

China PV Recycle Industry Development Coorperation Center (soon)

With State Power Investment Corporation and 30+ companies, universities, institutes. International partnership welcom!

- National Eol PV survey 2030-2050;
- Recycling Roadmap and WhiteBook;
- Recycling Standards Frameworks;
- PV Recycler Accreditation & Certification;
- National Eol PV GIS system & Recycling digitization;
- Annual PV Recycling Exhibiting & Conference
- Eco design & DFR module;
- International cooperation

中国光伏回收产业发展合作中心
CHINA PV RECYCLE CENTER

China PV Recycle Industry Development Coorperation Center (coming soon)

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Conclusion

1. China is the biggest manufacture and market country, and emphasis on EoI and Recycling technical and facility R&D in past ten years, China will be the biggest PV recycling market Country
2. The 10MW/Y Mechanical and 12MW/Y Thermal Chemical Demo recycling line shows China PV recycling industry begin.
3. PV recycling will be the last point to full Green supply chain.
4. PV recycling promote the future Eco-design and DfR module manufacture.
5. China PV Recycle Industry Development Cooperation Center will be the windows for domestic & international cooperation.

Thank you!

Lyu Fang，IEA PVPS TASK12

purple@mail.iee.ac,cn

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中国光伏回收产业发展合作中心
CHINA PV RECYCLE CENTER