Use intellectual property to develop and promote carbon neutrality technologies

2022 | 11 | 29

SUNMAN
Lightweight Solar Pioneer

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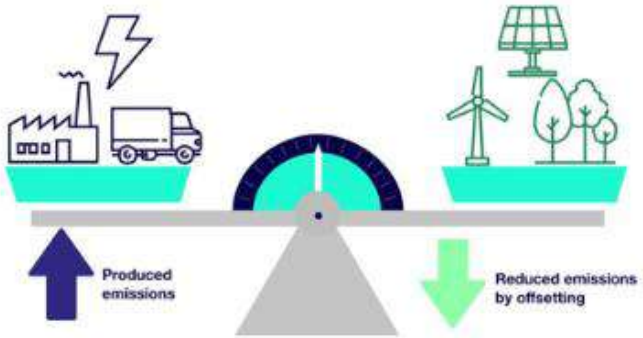
Sunman and carbon neutrality

- **Carbon neutrality** refers to the total amount of carbon dioxide or greenhouse gas emissions produced directly or indirectly by a country, enterprise, product, activity or individual within a certain period of time, and the use of low-carbon energy to replace fossil fuels, reforestation, energy conservation and emission reduction to offset the carbon dioxide or greenhouse gas emissions produced by itself and achieve relatively "zero" carbon dioxide emissions.



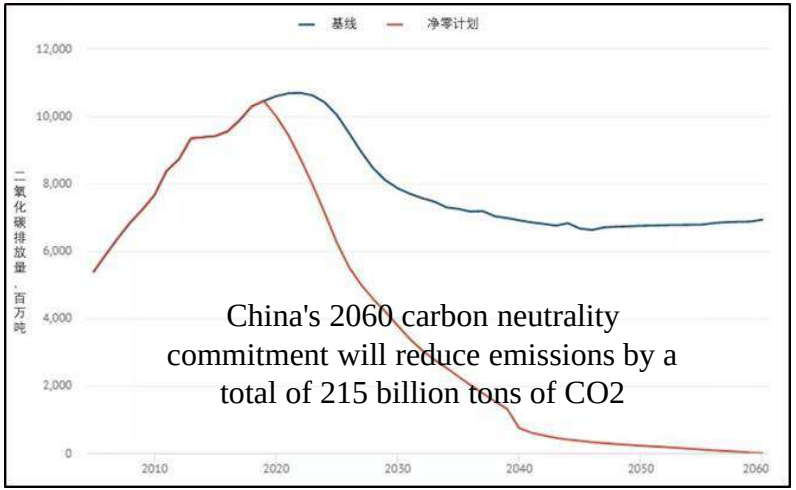
The main pathways to carbon neutrality include:

Reducing carbon emissions; using low or zero carbon emission technologies, such as using renewable energy sources (e.g., wind and solar), so that the amount of carbon released and absorbed back into the earth is in balance and does not increase.

Sunman and carbon neutrality

China to achieve carbon neutrality by 2060

- On September 22, 2020, President Xi Jinping delivered an important speech in which he stated that "China will increase its independent national contribution, adopt stronger policies and measures, strive to peak CO2 emissions by 2030, and strive to achieve carbon neutrality by 2060.



China's 2060 carbon neutrality commitment will reduce emissions by a total of 215 billion tons of CO2

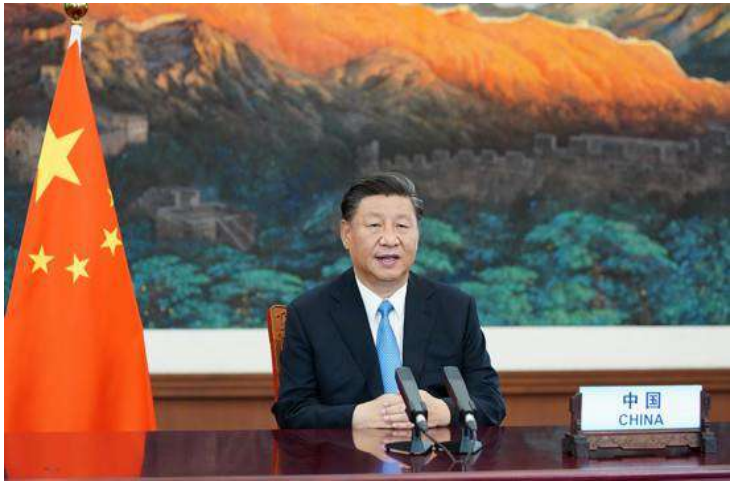
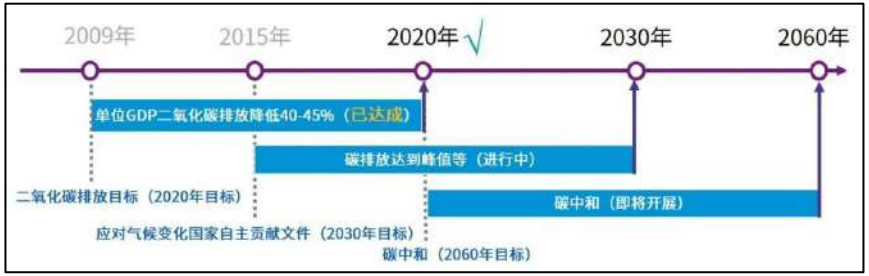


Diagram of China's commitments to address climate change



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Sunman and carbon neutrality

- China's carbon neutrality needs to be achieved through various ways, such as energy structure transformation, paradigm upgrade, energy efficiency improvement, and carbon capture and storage technology, among which the most critical is energy structure transformation and reduction of CO_2 emissions per kWh.

Energy structure transformation is a key grip to reach emission reduction targets

Sunman and carbon neutrality

- BIPV is a technology that integrates solar power (photovoltaic) products into buildings, which can not only achieve perfect integration with buildings, but the electricity generated can also be provided to buildings for use, which is one of the effective ways to solve the carbon emission of buildings.
- China's existing building area of 60 billion square meters, can be installed BIPV products nearly 10 billion square meters, about 1500GW. Every year, about 2 billion square meters of new buildings are added, which can be installed with about 18GW of new area.
- In the context of the goal of carbon neutrality and the vigorous development of green buildings, the development prospect of BIPV market is broad.

Image from Sunman eArc® module installation.

Sunman and carbon neutrality

Module weight= 20 kg

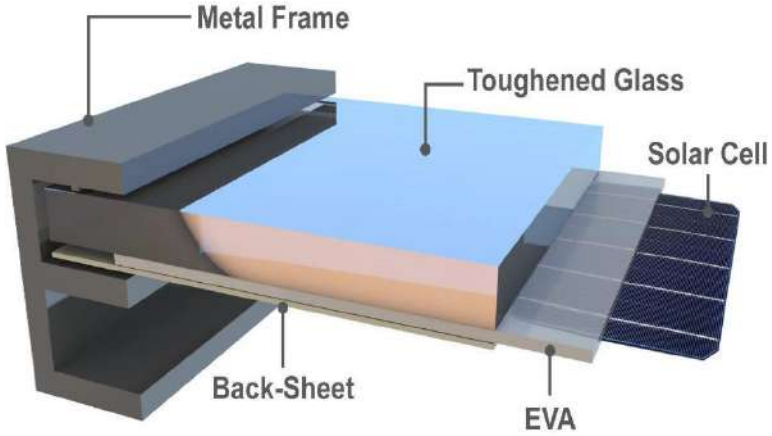
Cell weight= 0.72 kg

Only 3.6% generate electricity

Module thickness= 40 mm

Cell thickness= 0.5 mm

Only 1.3% generate electricity



Due to the bulky and hardened of PV modules, BIPV cannot be applied due to load problems or curved shaped installation environments.

Traditional PV modules have not changed for more than 40 years

This has led to a slow development process of BIPV!

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Sunman and carbon neutrality

Sunman was founded by Dr. Shi Zhengrong and a group of industry veterans, aiming at the expansion of photovoltaic technology applications and the achievement of carbon neutrality goals through the research and development of photovoltaic encapsulant materials and application installation technologies.

The founder, Dr. Shi Zhengrong, is the founder of Suntech, a professor at the University of New South Wales and academician of the Australian Academy of Engineering. As a solar scientist, Dr. Shi holds more than 80 patents for inventions in photovoltaic technology, he has published more than 100 articles and papers in relevant scientific journals and conferences.

Sunman Qualification：

National high-tech enterprise；

Provincial special-precision and special-new enterprises;

Investing more than 5% of sales revenue in R&D projects each year;

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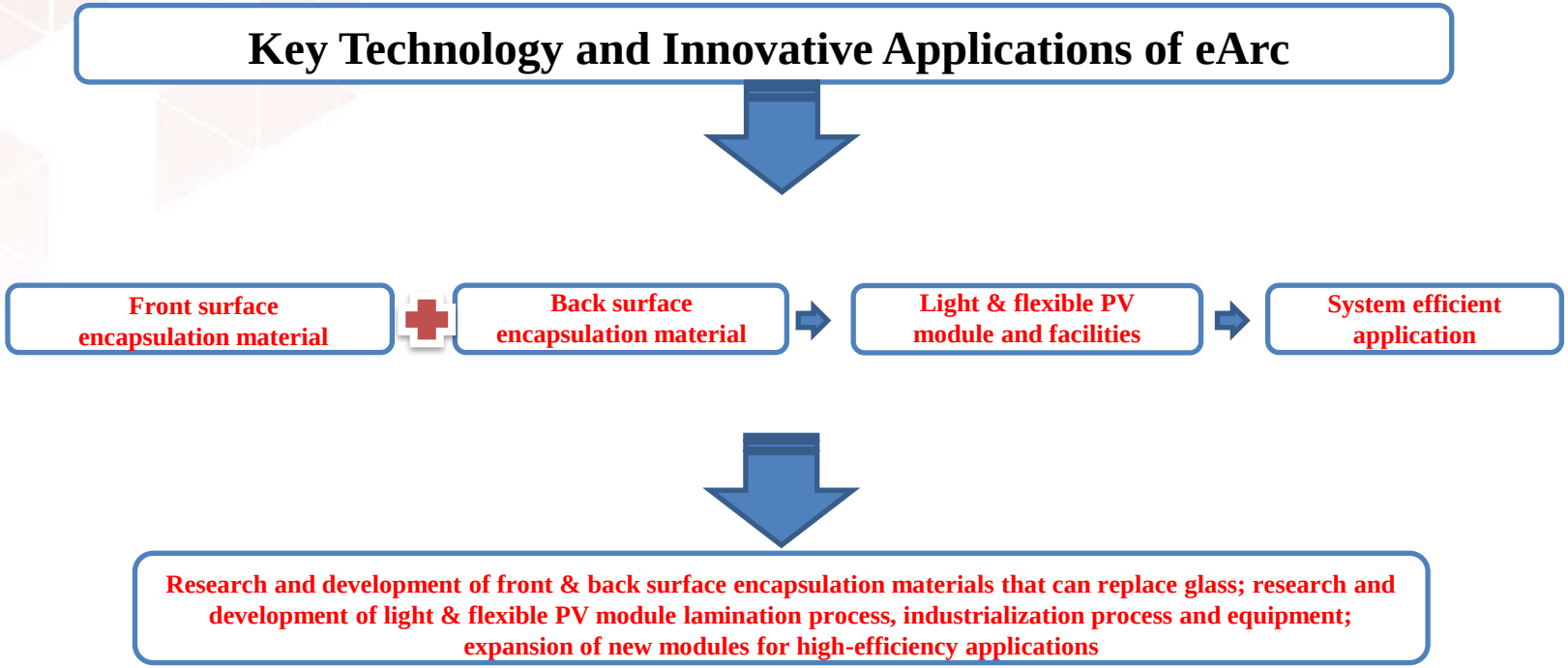
The advent of eArc® technology



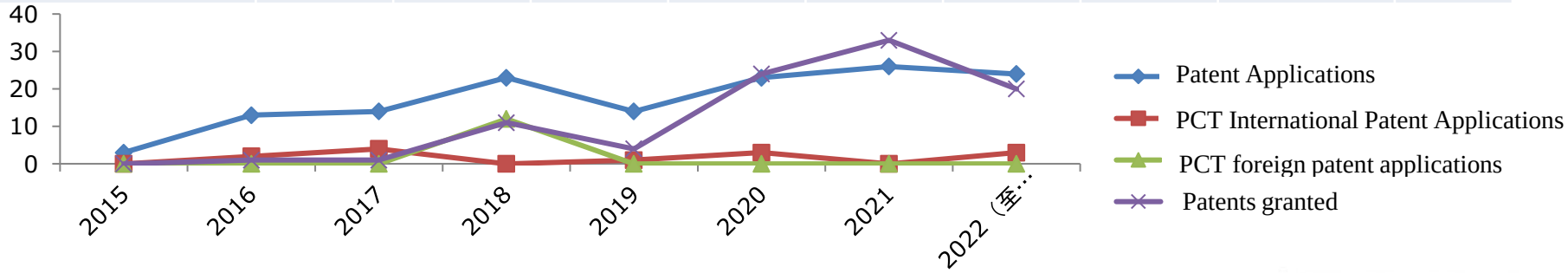
The advent of eArc® technology

- Officially named "eArc" brand, and obtained Chinese trademark registration in Class 4, 6, 7, 9, 35. Achieved a new type of photovoltaic module without glass, light weight and thin sheet.
- eArc ® module weight **≤ 3.3kg/m²** = 30% of the weight of traditional PV modules.
- eArc ® module thickness **≤ 2 mm**, shape and size can be modulated to achieve customized design and production, easy transportation, and significantly reduce transportation costs. eArc ® technology was born to expand the imagination of photovoltaic technology applications infinitely! It can be easily combined with various innovative solutions, making it very suitable for scenarios such as the lightweight roof market, BIPV, mobile energy, robotics and outdoor activities.

eArc® Panel

Patent planning of eArc® technology

	2015	2016	2017	2018	2019	2020	2021	2022 (until now)	Total
Patent Applications	3	13	14	23	14	23	26	24	**140**
PCT International Patent Applications	0	2	4	0	1	3	0	3	**13**
PCT foreign patent applications	0	0	0	12	0	0	0	0	**12**
Patents granted	0	1	1	11	4	24	33	20	**94**



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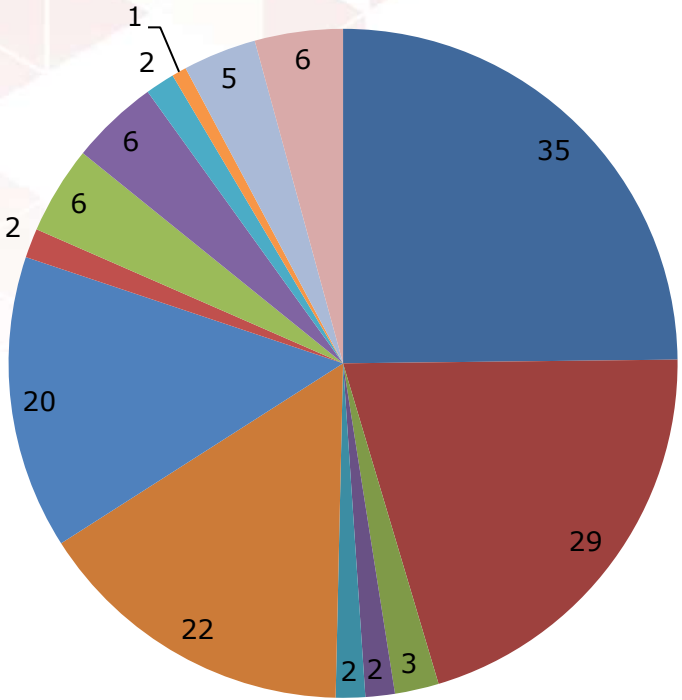
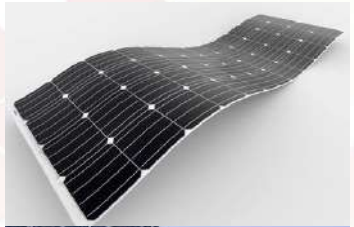
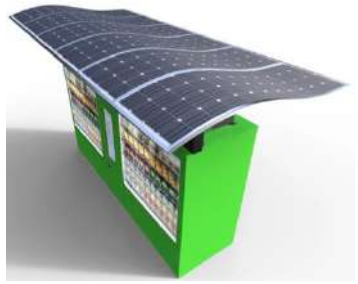
Patent planning of eArc® technology



Categories	Patent applications
Encapsulation Materials	35
Module Structure	29
Module Process	3
Flame Retardant Function	2
Heat Dissipation	2
Mounting	22
Low wire loss installation	20
No junction box installation	2
Foldable installation	6
Waterproof integration	6
Insulation Integration	2
Wind Resistant	1
Water Surface PV	5
Module Applications	6

Patent planning of eArc® technology





Key foundation patents:

Front surface encapsulation material technology.
ZL201610927464.6.
Licensed in China, Europe, USA, Australia, Japan.

Back surface encapsulation material technology.
ZL201921204030 .9.
Has been authorized in China and is entering abroad through PCT.

Laminated process technology
ZL201610927383.6
Has been authorized in China.

Color Lightweight PV Modules
ZL201611215902.2

Photovoltaic sunflower panel:
ZL201820956504.4,
ZL201830556519.7
Photovoltaic wall panel:
ZL201830271487.6,
ZL201820979608.7

Application of double-sided, overlapping cells photovoltaic modules
ZL201710639557.3
ZL201710638477.6

Lightweight photovoltaic backsheet and heat dissipation technology
ZL201910689090.2
ZL201921203338.1

Lightweight and efficient composite backsheet
ZL201810879732.0

Lightweight flame retardant composite backsheet technology
ZL201922076234.5

Thermal insulation panel integration technology
ZL201921703167.9
ZL201921703473.2

Photovoltaic waterproofing membrane technology
2021200260413 and other 6 patent applications

Lightweight photovoltaic roof installation technology
ZL2019221577093

Foldable High Power PV Modules
202110464333X and other 6 patent applications

Key product “eRoof" low wire loss module patent family:
2020106350678 and other 16 new patent applications and 3 international PCT patent applications.

More application technologies: wind-resistant, waterproof, demountable and other series of patent applications

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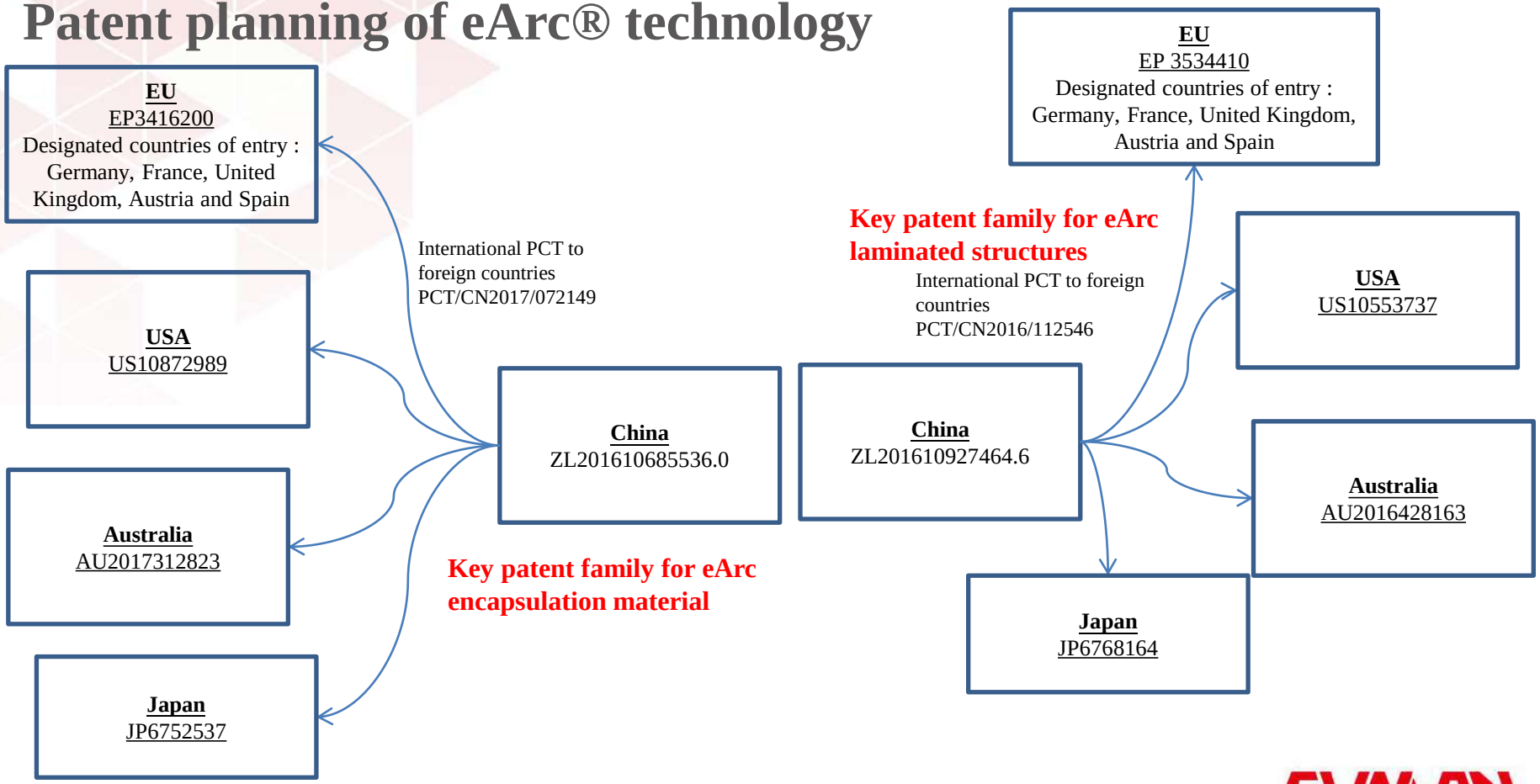
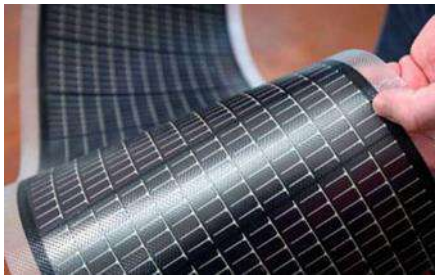
Patent planning of eArc® technology



Introduction of eArc® products



The complementary advantages of two important technical routes in the PV industry: C-Si technology and Thin-film technology.

Introduction of eArc® products

Lightweight

Glass module

22.0-27.0 kg

eArc ®

7.2 kg

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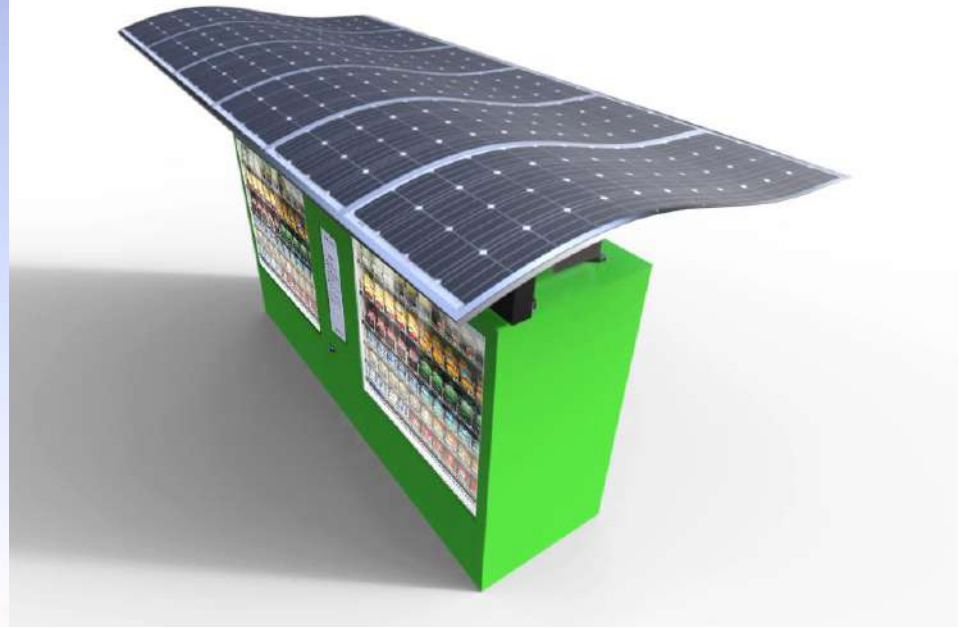
Introduction of eArc® products

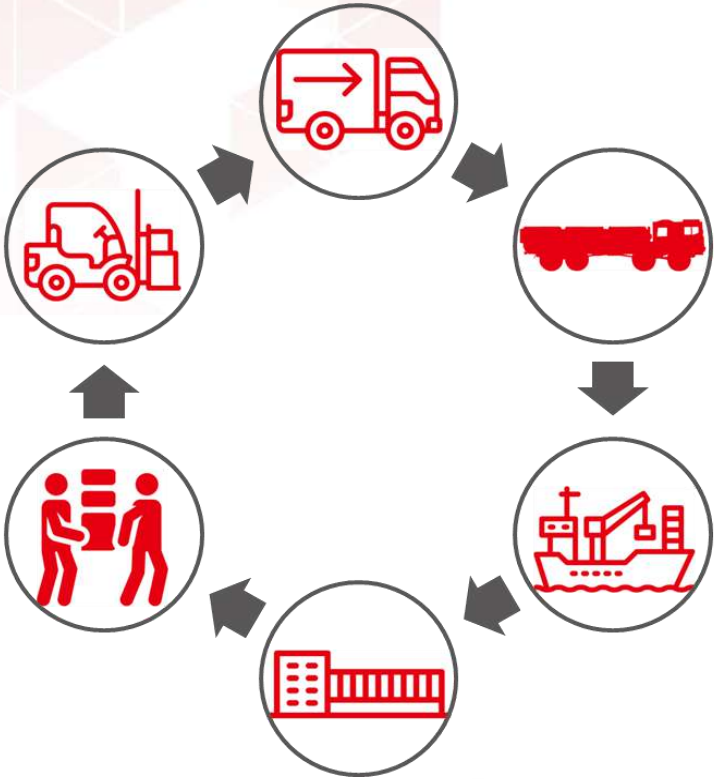
Bendable

Lightweight



Introduction of eArc® products

Easy to transport



Amount per person per carry:

	Amount per person per carry
Glass module	0.5-1 piece
eArc ®	1-2 piece

Modules per container:

	20’ container	40’ container
Glass module	125 piece	600 piece
eArc ®	270 piece	1080 piece

Introduction of eArc® products

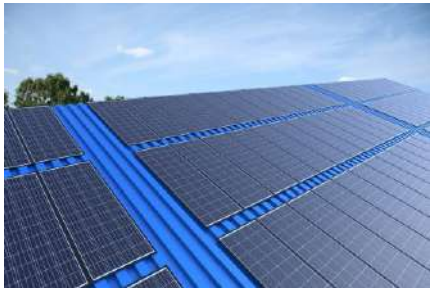
Easy installation

prefabrication

- In-factory prefabrication
- Saves a lot of roof construction
- Simplifies installation process
- Aesthetic installation

Bonding

- No extra installation structure
- Strong adhesion to meet building requirements
- No risk of roof penetration



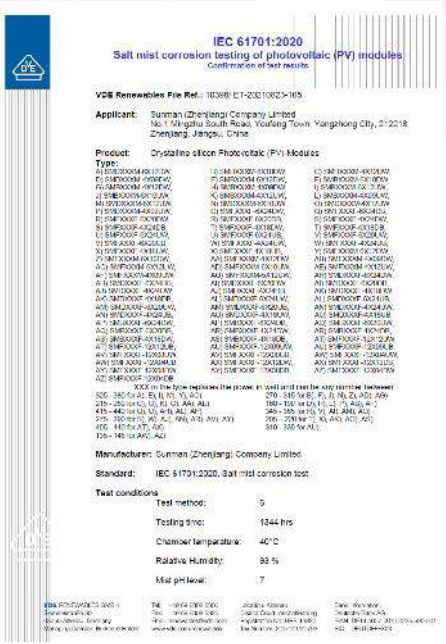
Mechanical installation

- Applicable to existing surface structures
- Simple installation for roofs and facades
- Minimal structural requirements for installation

Introduction of eArc® products

Product certificates:
IEC61215/IEC61730/UL1703/
IEC61701/IEC62804-1

Introduction of eArc® products



IEC 61701:2020
Salt mist corrosion testing of photovoltaic (PV) modules
Confirmation of test results

VDE Renewables File Ref.: 10398/ ET-20210823-165

Applicant: Sunman (Zhenjiang) Company Limited
No.1 Mingzhu South Road, Youfang Town, Yangzhong City, 212218 Zhenjiang, Jiangsu, China

Product: Crystalline silicon Photovoltaic (PV) Modules

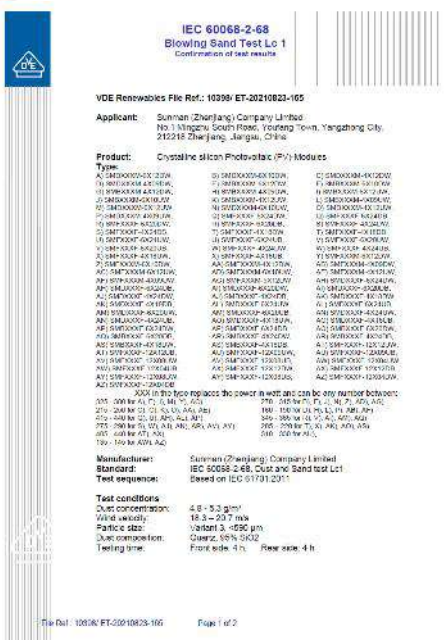
Type:

Manufacturer: Sunman (Zhenjiang) Company Limited

Standard: IEC 61701:2020, Salt mist corrosion test

Test conditions

Test method:	5
Testing time:	1344 hrs
Chamber temperature:	40°C
Relative Humidity:	93 %
Mist pH level:	7



IEC 60068-2-68
Blowing Sand Test Lc 1
Confirmation of test results

VDE Renewables File Ref.: 10398/ ET-20210823-165

Applicant: Sunman (Zhenjiang) Company Limited
No.1 Mingzhu South Road, Youfang Town, Yangzhong City, 212218 Zhenjiang, Jiangsu, China

Product: Crystalline silicon Photovoltaic (PV) Modules

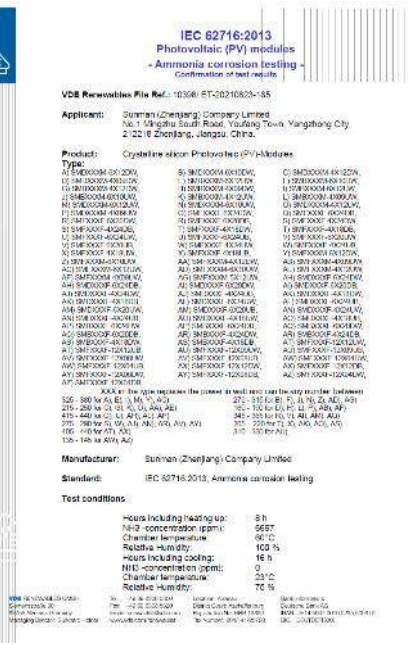
Type:

Manufacturer: Sunman (Zhenjiang) Company Limited
Standard: IEC 60068-2-68, Dust and Sand test Lc1
Test sequence: Based on IEC 61701:2011

Test conditions

Dust concentration:	4.8 - 5.3 g/m³
Wind velocity:	16.3 – 20.7 m/s
Particle size:	Variant 3, <590 µm
Dust composition:	Quartz, 98% SiO2
Testing time:	Front side: 4 h Rear side: 4 h

File Ref.: 10398/ ET-20210823-165 Page 1 of 2



IEC 62716:2013
Photovoltaic (PV) modules
- Ammonia corrosion testing -
Confirmation of test results

VDE Renewables File Ref.: 10398/ ET-20210823-165

Applicant: Sunman (Zhenjiang) Company Limited
No.1 Mingzhu South Road, Youfang Town, Yangzhong City, 212218 Zhenjiang, Jiangsu, China

Product: Crystalline silicon Photovoltaic (PV) Modules

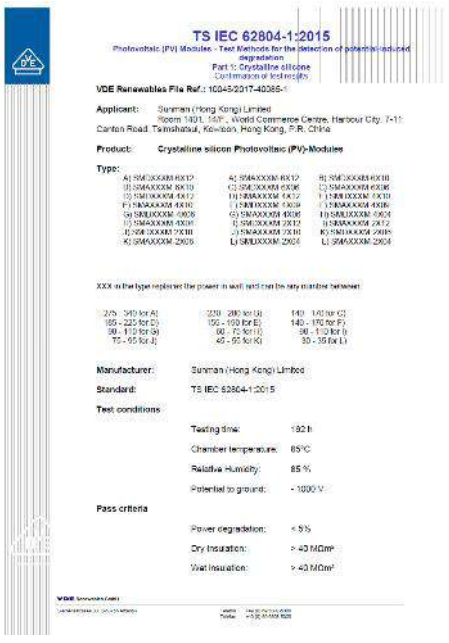
Type:

Manufacturer: Sunman (Zhenjiang) Company Limited

Standard: IEC 62716:2013, Ammonia corrosion testing

Test conditions

Hours including heating up:	8 h
NH3 -concentration (ppm):	9697
Chamber temperature:	60°C
Relative Humidity:	100 %
Hours including cooling:	16 h
NH3 -concentration (ppm):	0
Chamber temperature:	23°C
Relative Humidity:	70 %



TS IEC 62804-1:2015
Photovoltaic (PV) Modules - Test Methods for the detection of potential-induced degradation
Part 1: Crystalline silicone
Confirmation of test results

VDE Renewables File Ref.: 10845/2017-40386-1

Applicant: Sunman (Hong Kong) Limited
Room 1401, 14/F., World Commerce Centre, Harbour City, 7-11 Canton Road, Tsimshatsui, Kowloon, Hong Kong, P.R. China

Product: Crystalline silicon Photovoltaic (PV)-Modules

Type:

XXX in the type replaces the power in watt and can be any number between:

Manufacturer: Sunman (Hong Kong) Limited

Standard: TS IEC 62804-1:2015

Test conditions

Testing time:	192 h
Chamber temperature:	85°C
Relative Humidity:	85 %
Potential to ground:	-1000 V

Pass criteria

Power degradation:	< 5 %
Dry Insulation:	> 40 MΩm²
Wet Insulation:	> 40 MΩm²

Passed tests for salt spray, sand and dust, ammonia and PID

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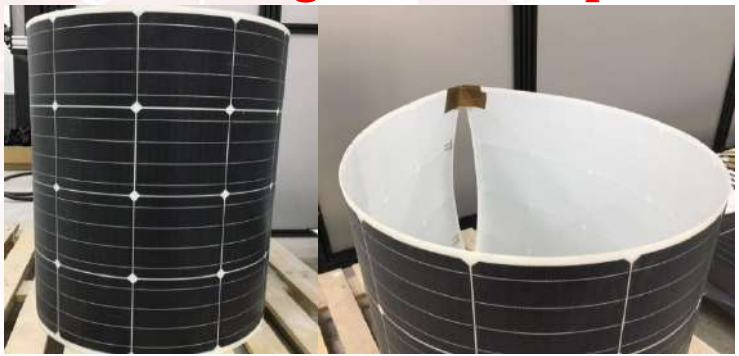
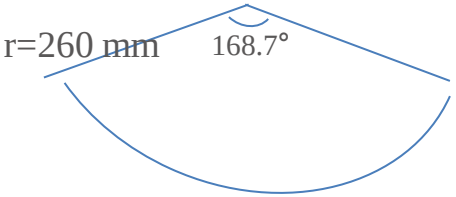
Introduction of eArc® products

Bending & shake experiment





Bending diameter: 900 mm

No micro cracks

No power attenuation

EL Before test

EL After test

12 h continuous shake bending test, no new micro cracks, power attenuation <3%

Introduction of eArc® products

Anti-glare test

Glass module

eArc ®

eArc can significantly reduce light pollution

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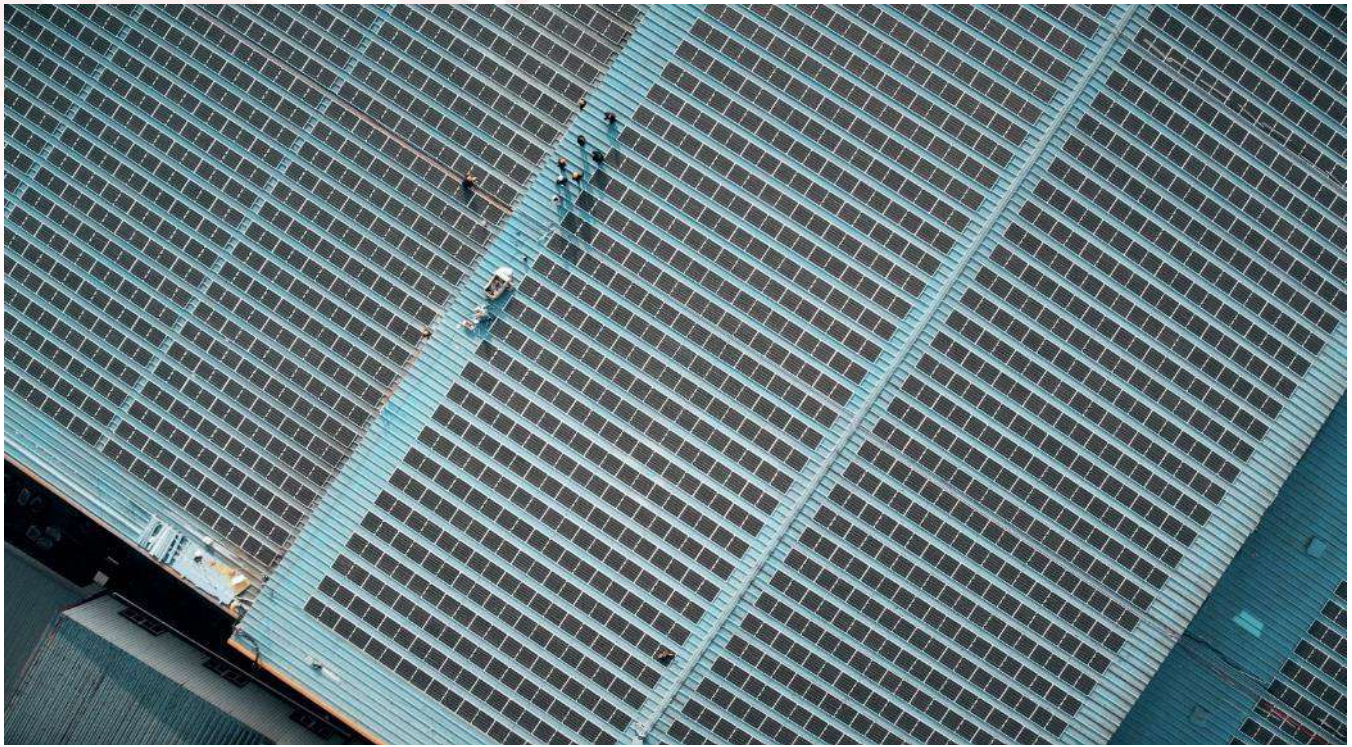
Applications and projects of eArc®



Profiled steel roof, China

Applications and projects of eArc®

Profiled steel roof, Germany

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Applications and projects of eArc®

Profiled steel roof, Australia National Maritime Museum

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Applications and projects of eArc®

Waterproof membrane roof , Netherlands

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Applications and projects of eArc®

Curved steel carport, China

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Applications and projects of eArc®







Shaped roof, China

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Applications and projects of eArc®

Glass roof, China

Applications and projects of eArc®

Solar wall, Norway

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Applications and projects of eArc®

Retractable Solar Carport, Switzerland

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Applications and projects of eArc®

Solar Train, Australia

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Applications and projects of eArc®

Winter Olympics snow wax car, China

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Applications and projects of eArc®

Other applications

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Patent technology achievements and prospects of eArc®

Benefits of eArc patented technologies:

	2019	2020	2021
Total installed capacity （MW）	10.17	15.71	75.22
Sales revenue (ten thousand ￥)	4592.51	5412.94	11740.47
Profits （ten thousand ￥）	328.54	264.53	581.59

Access to financing for eArc® patented technologies.

- Southern Cross REVC Trustco， **3.5 Million $**
- SBCVC Fund V,L.P.， **3.5 Million $**
- Clean Energy Finance Corporation， **7 Million $**

Patent technology achievements and prospects of eArc®

A new 1GW eArc® module production base is built in 2021, covering 260 acres of land.

In 2025, it is expected that reach 60-70% of the market share of lightweight crystalline silicon photovoltaic field, with sales volume exceeding 5 GW, which can add 1 billion + sales

THANKS!

SUNMAN

Lightweight Solar Pioneer

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