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MakeEasy

光伏电站清扫机器人对光伏电站发电量提升的研究

Research on the Improvement of Power Generation of Photovoltaic Power Plant by PV panel Cleaning Robot

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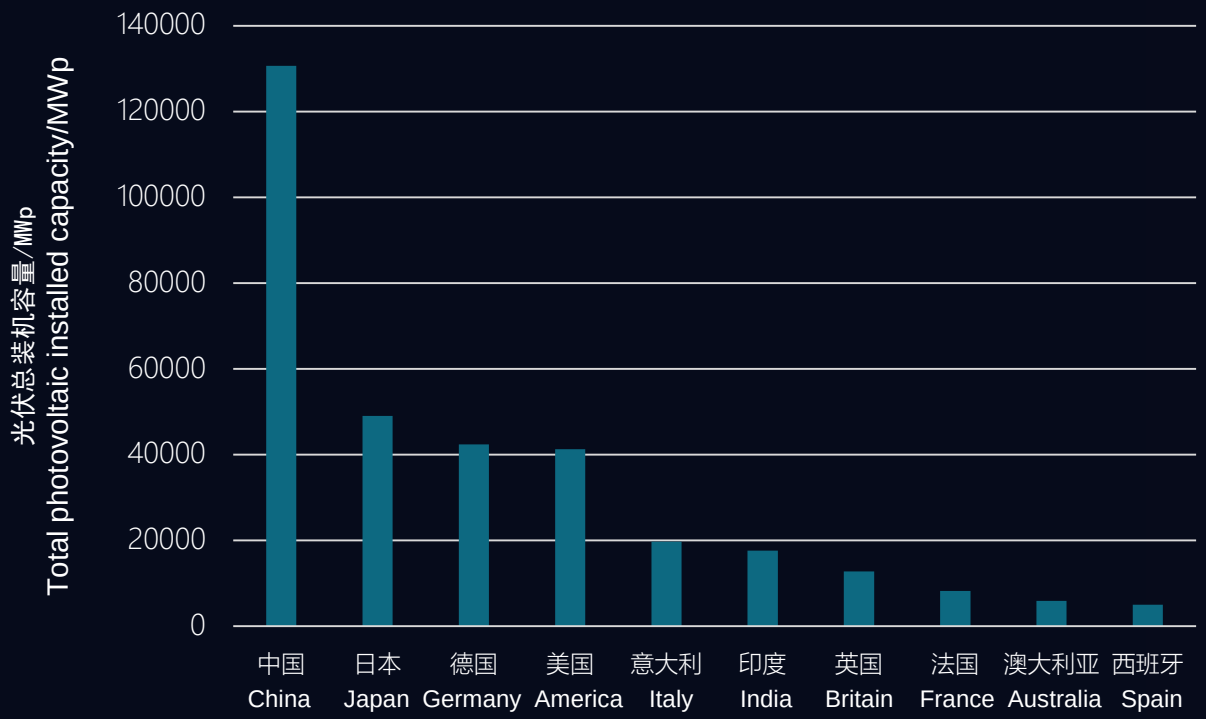
Industry background

行业背景
Industry background

中国的光伏行业规模增长迅速
Photovoltaic industry of China is growing fast.

2017年光伏累计装机容量
Accumulative total photovoltaic installed capacity in 2017



中国的光伏累计装机容量全球第一
Accumulative total photovoltaic installed capacity of China ranks in the first place allover the world.

年份 Year	2020	2030	2050
一次能源需求（亿吨标煤） Primary energy demand (one hundred million tons of standard coal)	42	50	52
可再生能源占比（%） Proportion of renewable energy	15	20	40

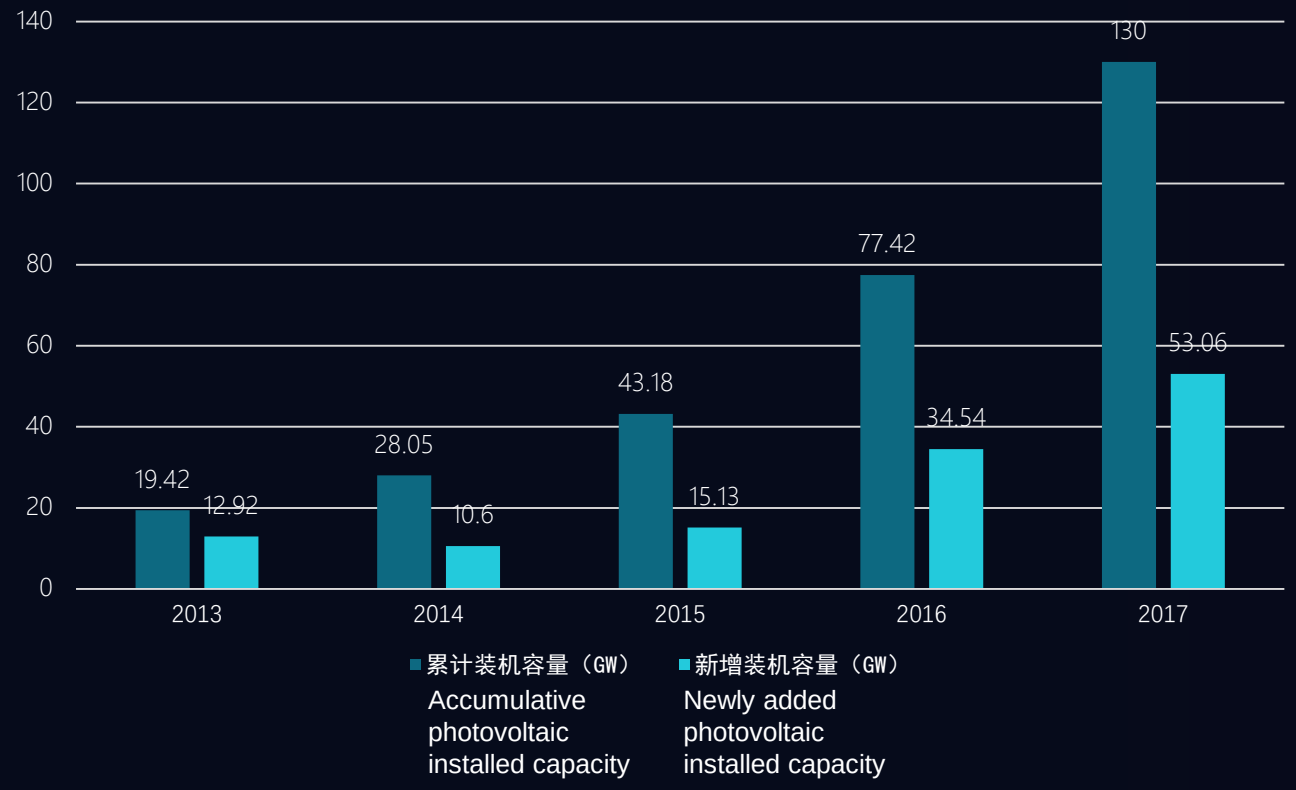
中国2015年可再生能源占一次能源消费总量的10. 1%。
China’s renewable energy accounts for 10.1% of the total consumption of primary energy in 2015.

中国计划到 2030 年非化石能源占一次能源消费比重提高到20%左右。
China plans to raise the proportion of non-fossil energy in primary energy consumption to about 20% in 2030.

行业背景
Industry background

指标收缩，增量拐点来临
Increment turning point comes while the index shrinks

2013~2017年光伏装机容量统计
Statistics of photovoltaic installed capacity during 2013-2017



过去五年，光伏电站装机容量成倍增长，随着5. 31新政的颁布，新增装机容量将大幅度减少，电站增量将迎来拐点，过去重建设、轻运维的风向将彻底改变，光伏的“运维后市场”已到来。

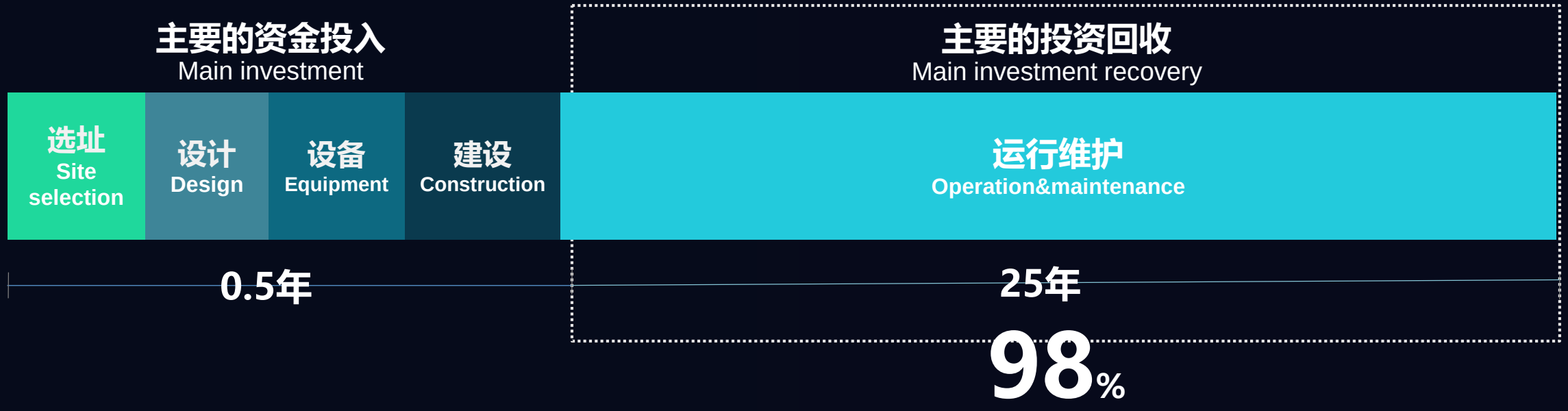
Installed capacity of photovoltaic power plants has been doubled and redoubled in the past five years. With the issue of the 5.31 new policy, newly added photovoltaic installed capacity will decrease by a large margin while the increment of power plants will face a turning point. The trend of paying more attention to construction while less to operation&maintenance will be completely transformed, and the era of post-market of operation&maintenance for photovoltaic has arrived.

按运维费用占光伏电站成本的1%来计算，目前光伏电站的运维，仅存量电站每年就有78亿的市场（按7元/W的电站成本计算），市场空间巨大

Based on the fact that operation and maintenance cost accounts for 1% of the cost of photovoltaic power plant, for the current operation&maintenance of photovoltaic power plant, the stock power plant alone has a market scale of 7.8 billion yuan per year (calculated according to the power plant cost of 7 yuan / W), the market space is huge.

行业背景
Industry background

运维-电站收益的关键
Operation&maintenance--the key to power plant’s profits



由于政策的支持，较为宽松的指标，一直以来光伏行业都在投建电站，对后期运维的重视度不够。

On account of policy support and relatively loose indexes, the photovoltaic industry pays very high attention to the investment and construction of power plants, while pays little attention to their operation&maintenance.

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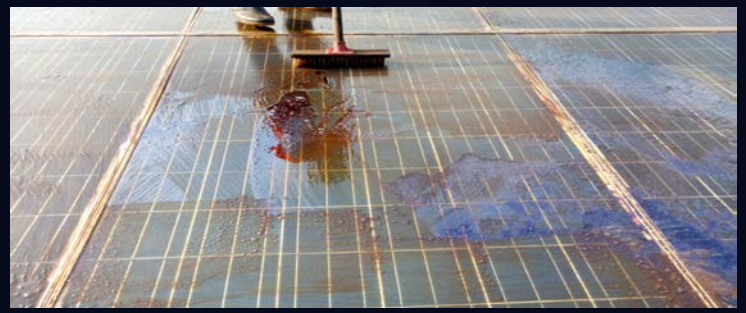
灰尘对组件的影响

Effects of soiling on PV panels

灰尘对组件的影响
Effects of soiling on PV panels

组件的灰尘遮挡成为运维的难题
Soiling on the PV panels becomes a problem for maintenance&operation

上海钢铁厂
Baosteel



江苏造船厂
Shipyards in Jiangsu Province

河南地面电站
Ulity-scale power plants in Henan Province

浙江机械加工厂
Mechanical processing plants in Zhejiang Province

江苏电子厂
Electronics factories in Jiangsu Province

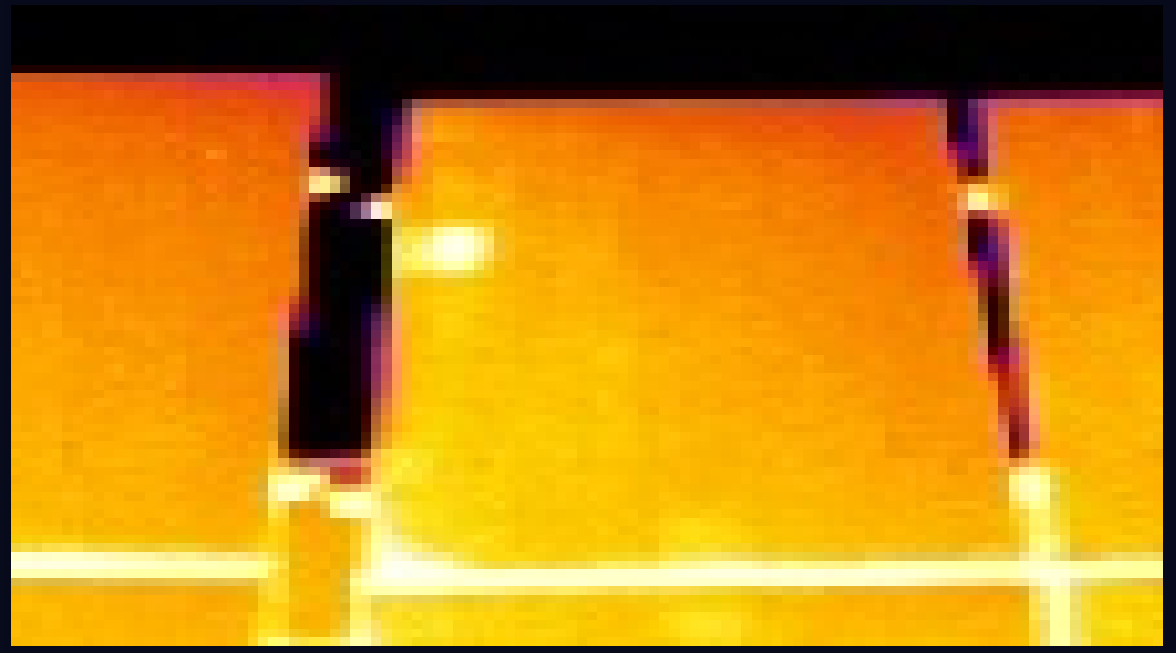
上海化工厂
Chemical plants in Shanghai

对于污染严重的光伏电站，提升发电量最有效的方法就是清洗组件

For photovoltaic power plants that seriously polluted, cleaning PV panels is the most effective way to improve power generation.

灰尘对组件的影响
Effects of soiling on PV panels

灰尘堆积引起热斑
Hot spots caused by soiling accumulation

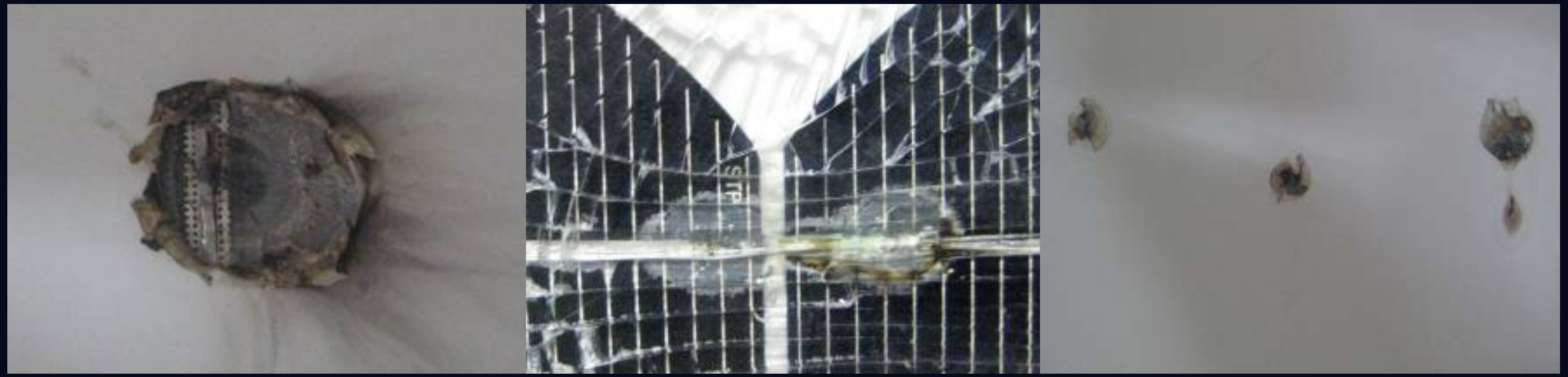


组件积灰如若不进行处理，由于自然环境风、雨、雪的作用，会造成积灰分布不均匀，从而导致热斑的产生，引发安全风险。

Soiling accumulation will be distributed unevenly under the influence of natural environment, such as wind, rain and snow, if it didn’t been handled correctly, leading to hot spots and potential safety hazards.

灰尘对组件的影响
Effects of soiling on PV panels

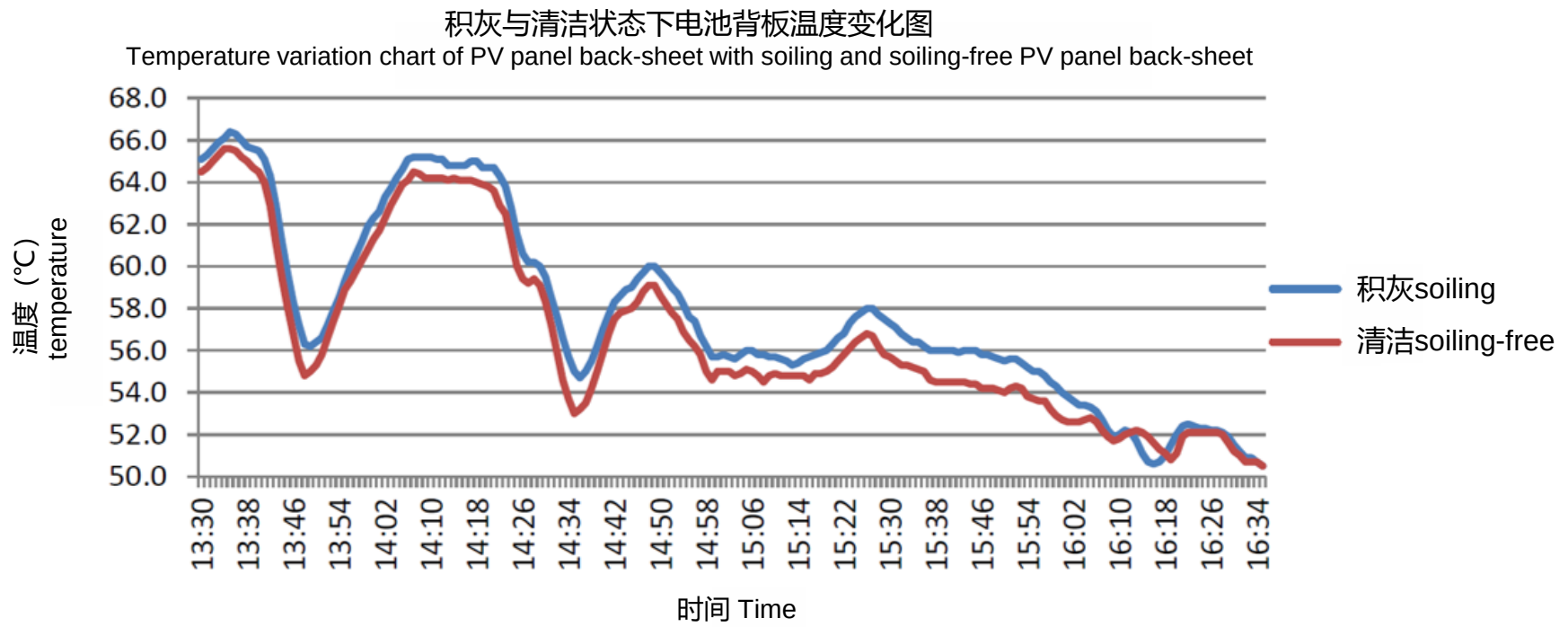
灰尘堆积引起热斑
Hot spots caused by soiling accumulation



热斑长期存在、温度过高会造成EVA脱层、背板烧穿等严重的安全隐患
The long existing and overtemperature of hot spots leads to serious potential safety hazards, such as EVA delaminating, back sheet burn-through

灰尘对组件的影响
Effects of soiling on PV panels

灰尘造成组件温度升高
Soiling accumulation leads to PV panels' temperature rising

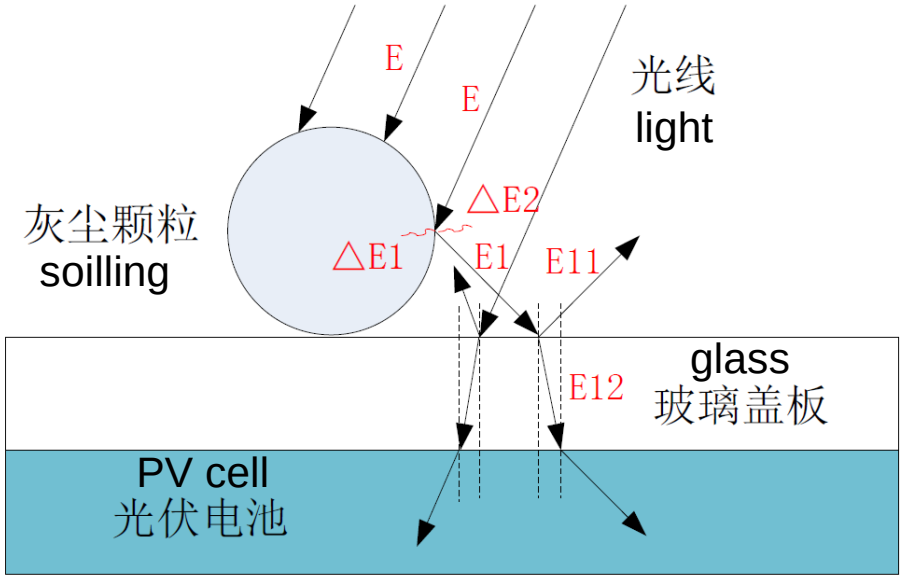


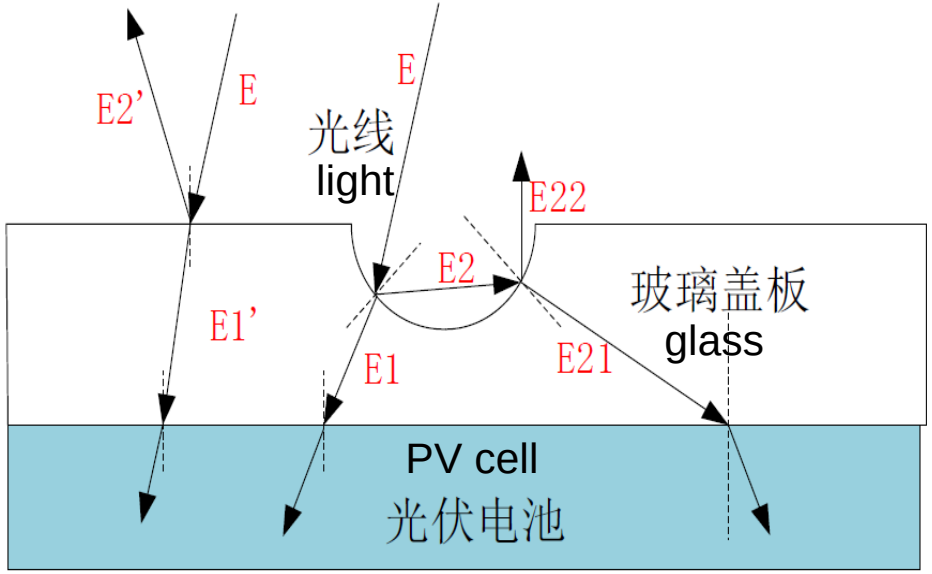
同样的两块电池组件，有灰尘遮挡比无灰尘遮挡的组件温度要高2℃，即使不考虑灰尘遮蔽太阳光造成的功率损失，仅温度升高2℃，有灰尘遮挡的组件比清洁组件功率小0. 6%左右。

For the same two PV panels, temperature of the PV panel with soiling is 2℃ higher than the soiling-free PV panel. Regardless of the power loss resulted from the block out of sunlight by soiling, the rose 2℃ temperature alone results in the fact that the power of soiling-free PV panel is about 0.6% smaller than that with soiling.

灰尘对组件的影响
Effects of soiling on PV panels

灰尘造成组件接受的太阳辐射降低
Soiling causes the PV panel to receive less solar radiation.





组件的积灰会对阳光造成遮蔽，导致组件接收到的太阳辐射能量降低
Soiling accumulation on the PV panel blocks out the sunlight and reduces the solar radiation power received by the PV panel.

带有酸性或碱性的积灰会造成组件玻璃的腐蚀，被腐蚀的玻璃即使没有灰尘遮挡也会造成一部分太阳辐射被反射掉
Acid soiling or alkaline soiling causes the corrosion of the PV panel's glass. The corroded glass will reflect a part of solar radiation even if it is not covered by soiling.

灰尘对组件的影响
Effects of soiling on PV panels

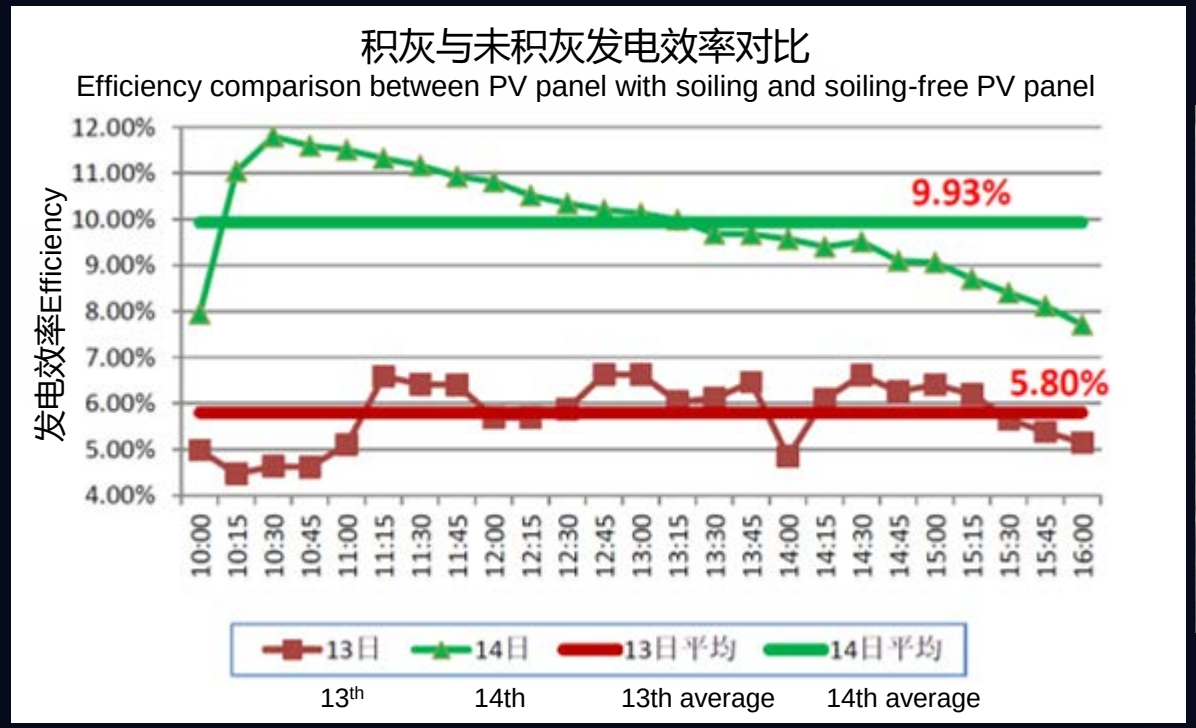
灰尘影响到底损失多少发电量?
How much power is lost due to soiling?

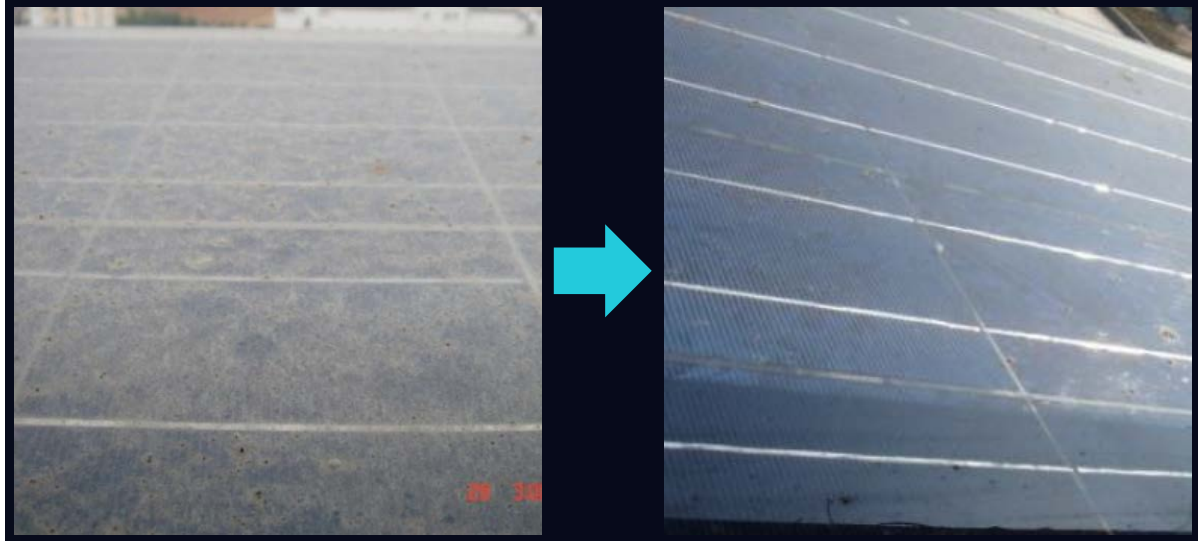
“因为无法彻底解决电池板清洗问题，电池板实际发电效率只有60-70%左右，我们每年的损失在200万以上。”调研中，陕西榆林一家20MW太阳能光伏电站负责人介绍。

"The cleaning problem of PV panels can’t be solved completely, as a result, the actual efficiency of PV panels is only 60%-70% or so, and our annual loss is more than 2 million yuan." The principal of a 20MW solar photovoltaic power plant in Yulin, Shanxi Province, introduced in our investigation.

灰尘对组件的影响
Effects of soiling on PV panels

灰尘影响到底损失多少发电量?
How much power is lost due to soiling?





重庆大学研究人员的对清洗前后组件的效率进行了测试，发现由于灰尘的遮挡，清洗以后的组件比清洗之前的组件转换效率提高了71. 2%

Researchers of Chongqing University tested the efficiency of PV panel before and after cleaning, and found that the efficiency of PV panel after cleaning was 71.2% higher than that of the PV panel before cleaning.

灰尘对组件的影响
Effects of soiling on PV panels

灰尘影响到底损失多少发电量?
How much power is lost due to soiling?

检查对象 Tested objects	状态 State	背板温度(℃) Back sheet temperature	辐射(W/m²) Radiation(W/m²)	STC功率(W) STC efficiency（W）	电量损失 Power loss
某组件 PV panels	清洗前 Before cleaning	47. 98	740	109. 92	42. 5%
某组件 PV panels	清洗后 After cleaning	44. 60	899	190. 60	

数据来源：湖北地区某分布式光伏电站
Data sources: a distributed photovolataic power plant in Hubei Province

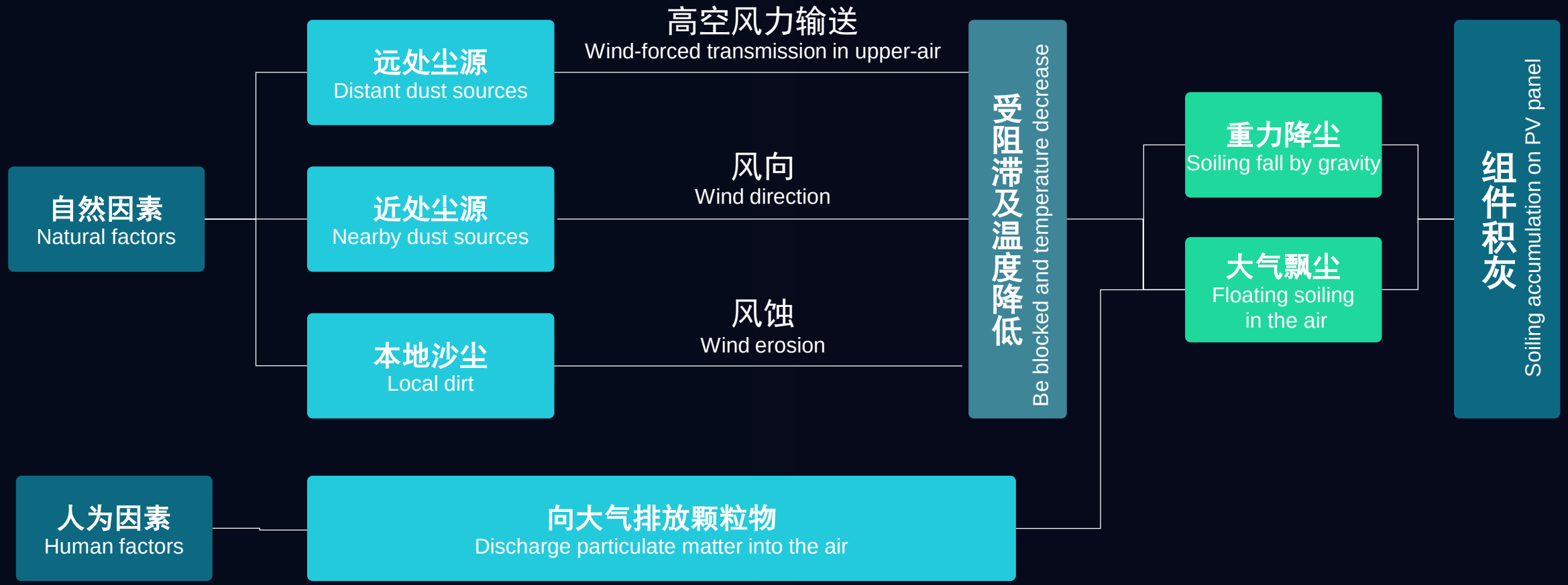
3

组件的清洗方法

Cleaning method of the PV panel

组件的清洗方法
Cleaning method of the PV panel

灰尘的来源
Soiling sources



自然和人为的扬尘都会在重力作用下落在组件表面

Natural dust and artificial soiling falls on the surface of PV panels by gravity

组件的清洗方法
Cleaning method of the PV panel

灰尘的分类
Soiling type

自然粉尘
Natural dust

即风沙、灰尘等自然界粉尘，附着力较弱
Natural dust, such as sand, dirt and etc., has relatively weak adhesion

金属粉尘
Metal soiling

金属颗粒物粉尘，常见于钢厂，长期积累难于清理，并可形成锈蚀在组件玻璃表面
Metal particulate soiling is common in steel mills and difficult to clean up due to long-term accumulation. Rust and corrosion may be generated by it on the surface of PV panel's glass.

矿物粉尘
Mineral soiling

无机矿物粉尘长期堆积与雨水混合可产生板结和钙化，其中的酸性或碱性物质会对组件边框和组件玻璃形成腐蚀
Long-term accumulated inorganic mineral soiling can harden and calcify the PV panel by mixing with rainwater, and its acidic or alkaline substances can corrode the PV panel's frame and glass.

油性粉尘
Oily soiling

一般见于化工厂，机械加工厂，长期积累与自然粉尘混合，难以清理
Commonly found in chemical plants, mechanical processing plants, oily soiling is usually long-term accumulated and mixed with natural soiling, while difficult to clean.

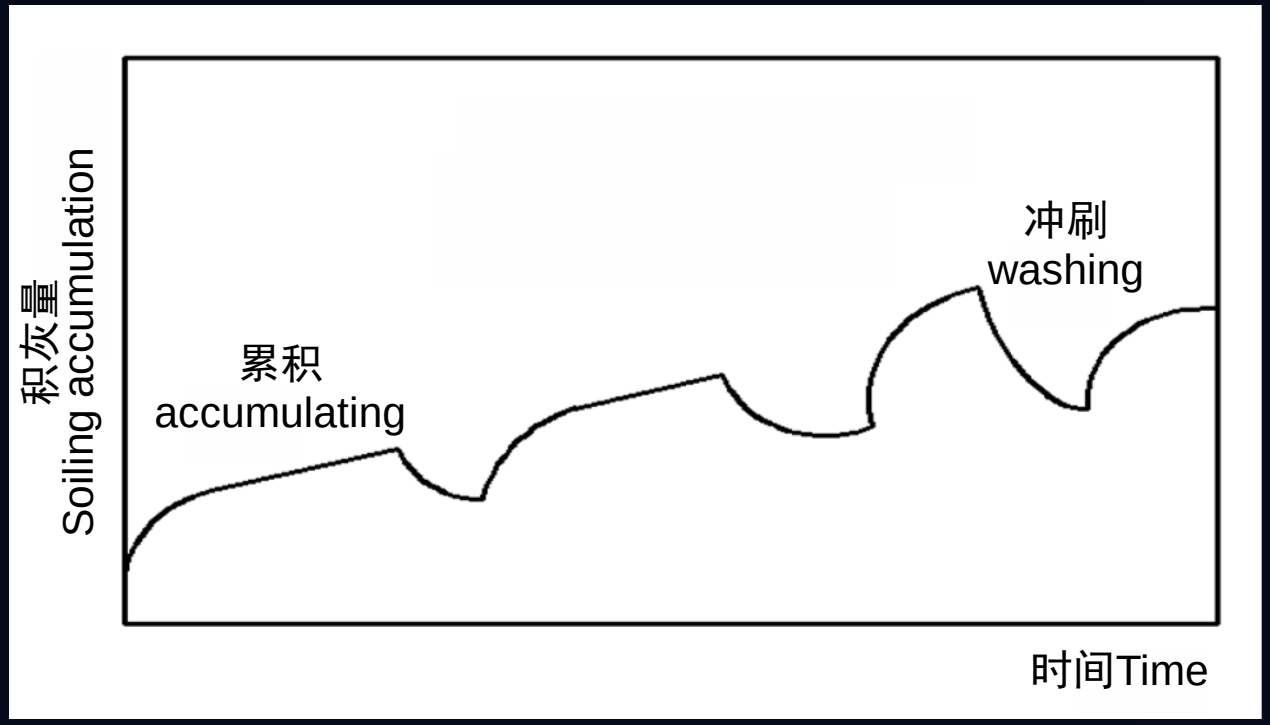
有机物粉尘
Organics soiling

常见于木材厂、纺织厂，附着力低，但长期不清理，与雨水和自然粉尘混合会使清理的难度增加。
Commonly found in timber mills and textile mills, though with weak adhesion, organics soiling will be more difficulty to clean if it's not cleaned for a long time and mixed with rainwater and natural soiling.

不同种类的粉尘特性不同，因此需要采用不同的清洗方式，才能确保最佳的清洗效果。对于顽固污渍需要使用合适的中性清洗液才能够清除干净。
Different cleaning methods should be adopted to different soiling types of different features to achieve best cleaning. Proper neutral cleaning solution is required to remove stubborn stains.

组件的清洗方法
Cleaning method of the PV panel

灰尘积累与降水的关系
Relationship between dust accumulation and rainwater

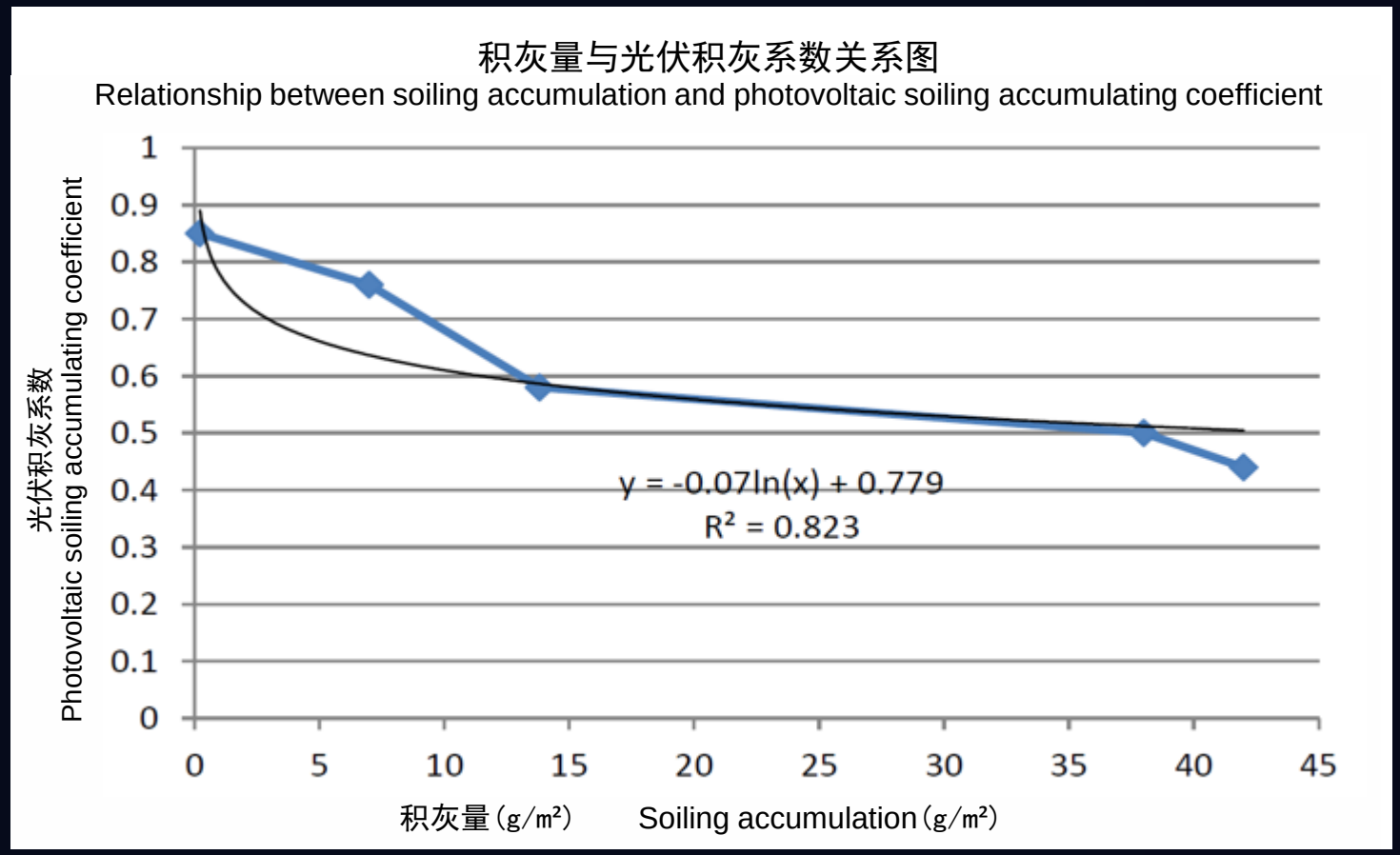


自然降水会对组件的积灰有冲刷的作用，减少组件的积灰，但鉴于组件边框得阻挡，无法完全冲刷干净，随着降水结束，灰尘又迅速积累

Natural rainfall can wash the soiling away on the PV panels and reduce soiling accumulation. However, blocked by PV panels' frames, soiling can't be completely cleaned and will be accumulated fast again after the rainfall.

组件的清洗方法
Cleaning method of the PV panel

灰尘积累与组件功率损失的关系
Relationship between soiling accumulation and PV panels' power loss



光伏积灰系数为在同等光照强度下，积灰光伏板发电效率与清洁光伏板发电效率的比值
The photovoltaic soiling accumulating coefficient is the ratio of power efficiency of photovoltaic panel with soiling accumulation to that of soiling-clean PV panel in the same illumination intensity.

通过人工扬灰模拟自然积灰来研究不同灰尘量与发电量损失的关系。
Study the relationship between soiling accumulation and PV panels' power loss through simulating soiling accumulating by spreading dust manually.

通过左图可以看出，灰尘积累对组件发电量造成的影响是非线性的，在灰尘积累初期，对发电量影响非常大。
It's observed from the left figure that the influence of dust accumulation on the power loss of the PV penals is non-linear, and it greatly influence the power generation in its initial stage.

因此必须重视积灰初期灰尘对光伏发电的影响，因此光伏组件的清洗采用高频次清洗或减少灰尘积累速度的清洗方法最佳。
Therefore, high attention must be paid to the influence of soiling on the photovoltaic power generation in the initial stage of soiling accumulation. In consequence, the best cleaning methods for PV panels are high-frequency cleaning or slowing down the soiling accumulation speed.

组件的清洗方法
Cleaning method of the PV panel

手持式电动清洗设备
Hand-held electric cleaning device

手持式电动清洗设备采用优质刷盘，由锂电池供电，电机驱动刷盘转动，能够进行高效的清扫作业；同时配备水泵和水管，可从盘刷中间喷水辅助清洗。使用该手持电动清洗设备可根据需要同时进行干洗和水洗。

Powered by lithium battery, the hand-held electric cleaning device adopts a high-quality disc brush, whose rotation is drove by a motor, and can achieve efficient cleaning. At the same time, it is equipped with a water pump and a water pipe, which assist in cleaning through spraying water from the middle of the disc brush.The hand-held electric cleaning device can carry out dry cleaning and water cleaning simultaneously on demand.

大型清洗车
Large cleaning vehicle

大型清洗车是以卡车为平台，配备机械臂和辊刷，在汽车行进的过程中配合辊刷的转动达到大面积快速清洗组件的效果。

The large cleaning vehicle is based on a truck as its platform, and equipped with a mechanical arm and rolling brushes. It can clean the PV panels fast in large area with the rotation of the rolling brushes during its moving.

组件的清洗方法
Cleaning method of the PV panel

喷淋系统
Spraying system

类似于绿化的喷淋系统，在电站建设时预先安装水管和喷头，使用时每天定时启动喷淋组件表面，达到冲刷灰尘的目的。

Similar to spraying system of greening, water pipes and nozzles are installed during the power plants' construction in advance. Spraying water on PV panels' surfaces at a fixed time ever day to wash soiling away.

镀膜自清洁技术
Self-cleaning coating technology

使用特殊的纳米材料在光伏组件的表面生成涂层，利用水与纳米二氧化钛薄膜超强亲和力，形成均匀的水膜，该水膜将玻璃表面附着的灰尘、污垢等与玻璃表面隔离，随着水流的冲刷，将表面灰尘和污垢带走，以实现组件面板的清洗

Produce a coating on the surfaces of PV panels with special nano materials, then produce an even water film by making use of the superstrong affinity of water and nano titanium dioxide film. This water film can insulate the dust, dirt that attached to the glass surfaces from them, while those dust and dirt could be washed away by water.

组件的清洗方法
Cleaning method of the PV panel

智能清洗机器人解决方案
Intelligent cleaning robot solution

智能清洗机器人安装于组串支架上，安装完成后无需人工介入，每天可定时进行清扫，并自动归位和充电。高频次的清扫让各种类型粉尘都难以附着在组件上，使组件基本保持无尘状态。

The intelligent cleaning robot is installed on the set stand and doesn't need human interference after installation. It can clean the PV panels at a fixed time every day, while automatically return to set and charge. The intelligent cleaning robot solution can mainly keep the PV panels free from soiling through high-frequency cleaning, which makes it difficult for various types of soiling to adhere to the surfaces of PV panels.

4

机器人清洗解决方案及对发电量的提升

Improvement of power generation by cleaning robot solution

机器人清洗解决方案及对发电量的提升

Improvement of power generation by cleaning robot solution

不同清洗方式对比

Comparison among different cleaning methods

清洗方式 cleaning methods	水源 Water source	组件损伤风险 PV panel's damage risk	成本 Cost	效率 Efficiency	清扫频次 Cleaning frequency	清扫效果 Cleaning effect	地形 Landform	适用电站类型 Applicable power plant types
手持式电动清洗设备 Hand-held electric cleaning device	×	低 Low	低 Low	低 Low	低 Low	好 Excellent	无限制 Unlimited	所有类型电站 All power plant types
大型清洗车 Large cleaning vehicle	×	高 High	低 Low	高 High	低 Low	好 Excellent	地面电站 Flat power plant	平整的地面电站 Flat ulity-scale power plants
喷淋系统 Spraying system	√	–	高 High	高 High	高 High	良 Good	无限制 Unlimited	所有类型电站 All power plant types
镀膜自清洁技术 Self-cleaning coating technology	×	低 Low	中 Middle	高 High	低 Low	差 Poor	无限制 Unlimited	所有类型电站 All power plant types
智能清洗机器人 Intelligent cleaning robot	×	低 Low	中 Middle	高 High	高 High	好 Excellent	无限制 Unlimited	所有类型电站，但对组件排布有要求 All power plant types while has a requirement for PV panels layout

智能清洗机器人由于一年365次的高频次清扫，极大减少了积灰对发电量的影响，并且避免了对顽固污渍大量使用清洗液造成清洗成本高企，清洗效果与天气、气候等外界条件无关，因此目前智能清洗机器人是中国光伏电站的首选清洗方式

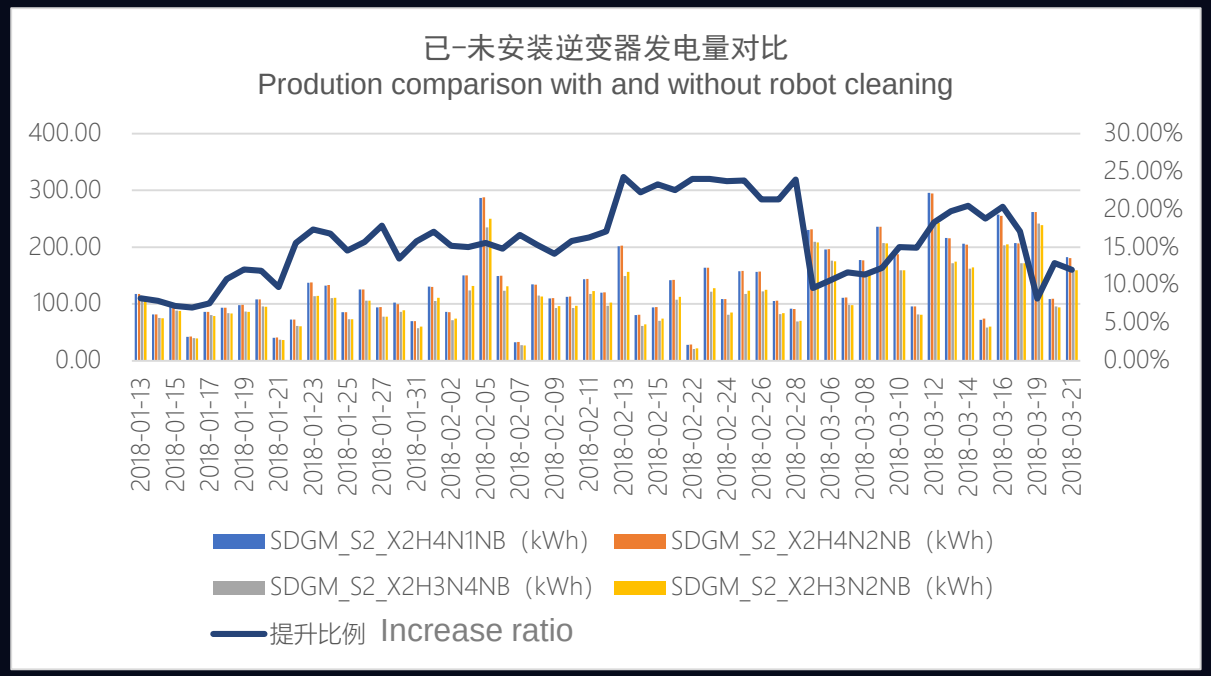
Intelligent cleaning robot can carry out high-frequency cleaning for 365 times in a year, reducing the influence of soiling accumulation on power generation by a large margin and lowering the cost by reducing the use of cleaning solution for stubborn stains. Moreover, the cleaning effects are free from the limits of external conditions, such as weather and climate. As a consequence, intelligent cleaning robot is first choice for the cleaning of PV penals in China at present.

机器人清洗解决方案及对发电量的提升

Improvement of power generation by cleaning robot solution

机器人应用案例-发电量提升分析

Intelligent robot application case-- power generation improvement analysis



高密3MW分布式项目

Gaomi 3MW distributed project

19. 07%

山东省高密市恒涛集团北区厂房

Plants in north district of Hengtao Group, Gaomi, Shandong Province

该项目位于工厂之上，工厂主要生产锅炉，离交通干道很近，附近有火电厂

This project is set in those plants with main business scope of producing boilers and locate near to traffic artery and heat-engine plants.

污染为主要工业粉尘和道路扬灰

Main pollutants are industrial soiling and road dust.

机器人清洗解决方案及对发电量的提升
Improvement of power generation by cleaning robot solution

机器人应用案例-发电量提升分析
Intelligent robot application case-- power generation improvement analysis

对比方法Comparing methods

预留对比组Reserved comparative group

SDGM_S2_X2H3N4NB、SDGM_S2_X2H3N2NB逆变器自然落灰不清扫

For inverters with models of SDGM_S2_X2H3N4NB and SDGM_S2_X2H3N2NB, do not clean them and just let the soiling fall on them naturally.

预留清扫组Reserved cleaning group

SDGM_S2_X2H4N1NB、SDGM_S2_X2H4N2NB使用机器人清扫

For inverters with models of SDGM_S2_X2H4N1NB and SDGM_S2_X2H4N2NB, clean them with intelligent robot.

两台逆变器装机容量相同，记录对比组和清扫组逆变器发电量数据

Those two inverters have same installed capacity. Record the power generation data of comparative group inverters and cleaning group inverters.

Microsoft Excel

记录1月13日至3月21日的逆变器发电量数据，计算得出该电站提升19.07%的发电量

Record inverters' power generaion data from January 13th to March 21st, and power generation of this power plant was increased by 19.07% by calculating with those data.

山东省高密市恒涛集团北区厂房

Plants in north district of Hengtao Group, Gaomi, Shandong Province

该项目位于工厂之上，工厂主要生产锅炉，离交通干道很近，附近有火电厂

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污染为主要工业粉尘和道路扬灰

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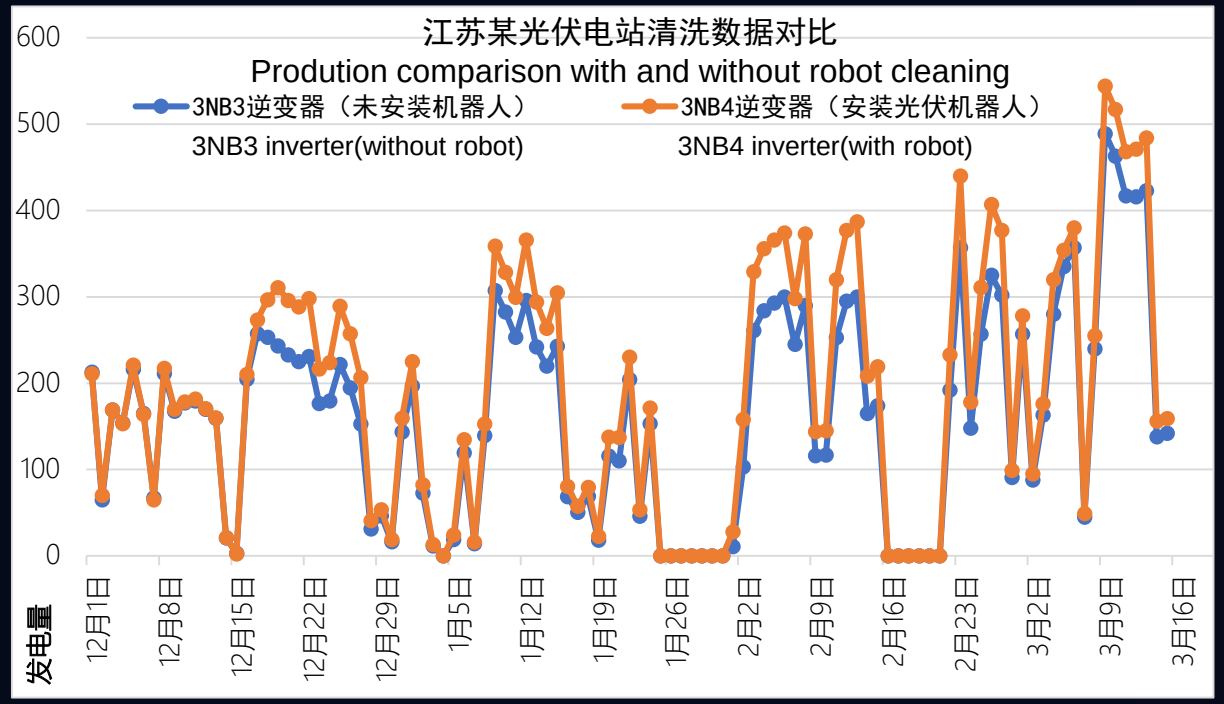


江阴2MW分布式项目

Jiangyin 2MW distributed project

19.16%

江苏省江阴市苏港路

Sugang Road, Jiangyin, Jiangsu Province

该项目位于物流园之上，离港口很近

This project is set in a logistics park that locates close to the port.

污染为主要道路扬灰

Main pollutant is road dust.

机器人清洗解决方案及对发电量的提升

Improvement of power generation by cleaning robot solution

机器人应用案例-发电量提升分析

Intelligent robot application case-- power generation improvement analysis

对比方法Comparing methods

该光伏电站安装的10台机器人覆盖了3NB4逆变器所有组件，有机器人清扫的组件基本处于“无尘”状态，3NB3逆变器组件自然积灰。

The 10 robots installed in this photovoltaic power plant cover all the PV panels of 3NB4 inverter and those PV penals are mainly free from soiling. While 3NB3 inverter PV panels isn’t cleaned and soiling naturally falls on them.

3NB3和3NB4两台逆变器下组件的装机容量相同，因此直接对比发电量，计算提升的比例。

PV panels of 3NB3 inverter and 3NB4 inverter have same installed capacity, so directly compare their power generation and calculate the improvement ratio.

容量相同，记录对比组和清扫组逆变器发电量数据

PV panels of 3NB3 inverter and 3NB4 inverter have same installed capacity.Record the power generation data of comparative group inverters and cleaning group inverters.

记录12月1日至3月15日的逆变器发电量数据，计算得出该电站提升19.16%的发电量

Record inverters’ power generation data from December 1st to March 15th, and power generation of this power plant was increased by 19.16% by calculating with those data.

江苏省江阴市苏港路

Sugang Road, Jiangyin, Jiangsu Province

该项目位于物流园之上，离港口很近

This project is set in a logistics park that locates close to the port.

污染为主要道路扬灰

Main pollutant is road dust.

关于安轩
About ANX

东旭蓝天 TUNGHSU AZURE

投资入股
Invest to become a shareholder

安轩科技 MakeEasy

核心技术团队
Core technology team

上海交通大学 Shanghai Jiao Tong University | 南京大学 Nanjing University

股票代码（000040）
Stock code:000040

创新型高新技术企业
Innovative high-tech enterprise

机器人研发
Robot R&D

智慧能源产品
Intelligent energy products

智慧运维服务
Intelligent O&M service

改变了光伏电站的传统运维方式，实现了光伏电站无人值班、少人值守。
Traditional maintenance&operation mode was transformed, and no-one on shift and few-people on duty was achieved in photovoltaic power plants.
产品应用于超过1GW光伏电站，产品远销至海内外，如印度、伊朗、法国和意大利等国家。
This product could apply to photovoltaic power plants over 1GW and has been sold to many foreign countries and regions, such as India, Iran, France and Italy.

发展历程
History

2013年
安轩科技成立；
ANXTEC was established
开始从事光伏智能运维机器人的研发和销售
We started the R&D and sales of PV cleaning robots

2014年
自主研发**第一代iSUN**光伏智能运维机器人；
We independently developed the first generation of iSUN PV cleaning robot
设备销售突破**100台**
Our equipment sales exceeded 100 units

2015年
与**上海交通大学**联合开发运维机器人和平台；
We developed a PV cleaning robot and an operation & maintenance platform together with Shanghai Jiao Tong University
第二代iSUN光伏智能运维机器人研发成功，实现电池组件清扫和组件热斑检测；
We successfully developed the second generation of iSUN PV cleaning robot and realized PV panel cleaning and hot spot inspection for modules
取得**全球首张CPVT**光伏智能运维机器人测试认证；
We obtained the world's first CPVT PV cleaning robot test certificate
设备销售量突破**400台**
Our sales exceeded 400 units

2016年
研发**第一代运维平台**，实现电池组件清扫、检测、监控一体化；
We developed the first generation of intelligent power plant O&M platform and realized the integration of PV panel cleaning, inspection and monitoring;
第三代iSUN光伏智能运维机器人研发成功；
We successfully developed the third generation of iSUN PV intelligent cleaning robot
东方卫视对iSUN光伏智能运维机器人进行专题报道；
Dragon TV made special reports on iSUN intelligent cleaning robots;
销售突破1200台，电站应用超过800MW
exceeding 1,200 units. The power station application exceeds 800MW.

2017年
东旭蓝天（000040）入股，安轩进入快速发展阶段；
TUNGHSU AZURE (000040) bought our shares and thus ANX entered the stage of rapid development
安轩率先推出**“分布式光伏电站无值守运维方案”**；
ANX took the lead in launching the "unattended O&M program of distributed PV power stations"
第四代iSUN光伏智能运维机器人研发成功；
We successfully developed the fourth generation of iSUN PV intelligent cleaning robot
依托东旭蓝天近3GW的光伏电站，打造先进的“光伏电站无人化智能运维平台”
Relying on TUNGHSU AZURE's nearly 3 GW PV power station, we have been making efforts to create the world's most advanced “unmanned PV power station O&M platform”.

2018年
第五代iSUN光伏智能运维机器人研发成功；
We successfully developed the fifth generation of iSUN PV intelligent cleaning robot
平单轴组件光伏智能运维机器人研发成功；
We successfully developed the PV intelligent cleaning robot for horizontal single-axis PV system
双玻组件光伏智能运维机器人
We successfully developed the PV intelligent cleaning robot for double-glass PV panel

公司资质
Company Qualifications

高新技术企业
证书

企业名称：上海安轩自动化科技有限公司　　证书编号：GR201631000875

发证时间：2016 年 11 月 24 日　　有 效 期：三年

批准机关：

CIEC 无锡新能源商会
China Renewable Energy Council (Wuxi)

会员证书

上海安轩自动化科技有限公司

普通会员单位

证书编号：H-01-101

有效期：2015年5月——2018年5月

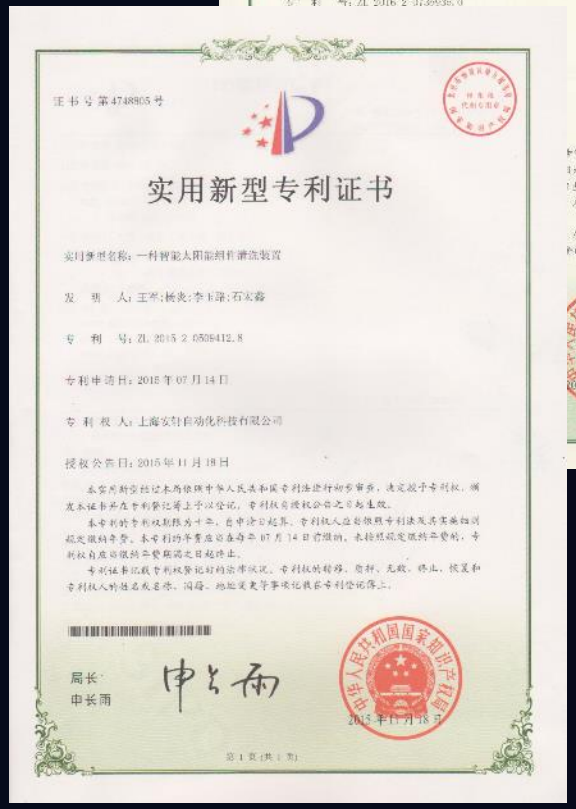
证书号第 5828039 号

实用新型专利证书

实用新型名称：单自太阳能组件清洗装置

发　明　人：杨爽；王军；单志强；石文鑫；王首吉；黄立文

专　利　号：ZL 2016 2 0748938.0



证书号第4748905号

实用新型专利证书

实用新型名称：一种智能太阳能组件清洗装置

发　明　人：王军；杨爽；李卡路；石文鑫

专　利　号：ZL 2015 2 0509412.8

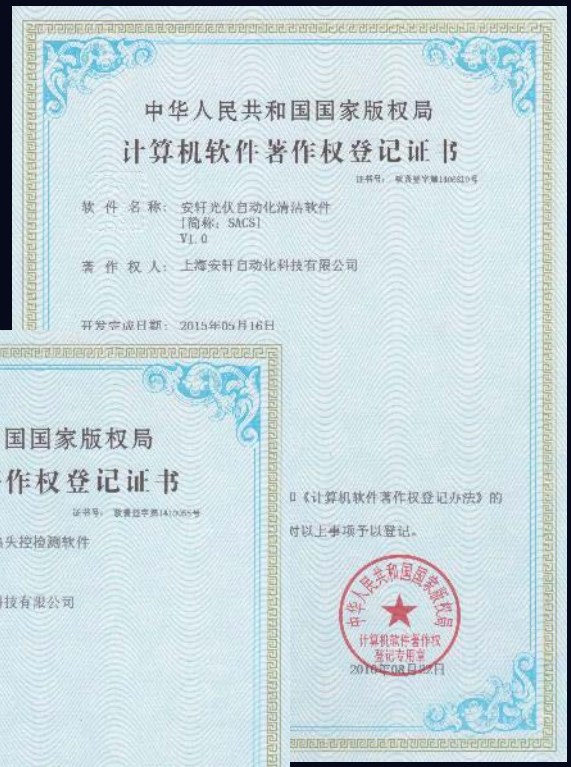
专利申请日：2015 年 07 月 14 日

专 利 权 人：上海安轩自动化科技有限公司

授权公告日：2015 年 11 月 18 日

局长
申长雨

2015 年 11 月 18 日



中华人民共和国国家版权局
计算机软件著作权登记证书

软 件 名 称：安轩光伏自动化清洁软件
[简称：SACS]
V1.0

著 作 权 人：上海安轩自动化科技有限公司

开发完成日期：2015年05月16日

《计算机软件著作权登记办法》的
对以上事项予以登记。

2016年08月23日

中华人民共和国国家版权局
计算机软件著作权登记证书

软 件 名 称：安轩光伏二极管热斑控检测软件
[简称：SDTRTS]
V1.0

著 作 权 人：上海安轩自动化科技有限公司

开发完成日期：2015年05月19日

首次发表日期：2015年05月26日

权利取得方式：原始取得

权 利 范 围：全部权利

登　记　号：2016SR231438

根据《计算机软件保护条例》和《计算机软件著作权登记办法》的规定，经中国版权保护中心审核，对以上事项予以登记。

No. 01258851

2016年08月23日

合作伙伴
Partners

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科技有限公司

东旭蓝天新能源
股份有限公司

中建材浚鑫科技
有限公司

晶科电力科技
股份有限公司

浙江正泰新能源
开发有限公司

中节能太阳能
科技有限公司

隆基绿能科技
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中广核太阳能
开发有限公司

北控清洁能源
集团有限公司

国发节能环保发展
集团有限公司

新疆中讯新能源
有限公司

上海伏光太阳能
科技有限公司

特变电工新疆新能源
股份有限公司

浙江芯能光伏科技
股份有限公司

无锡隆玛科技股份
有限公司

甘肃上航电力
运维有限公司

上海晶澳太阳能
科技有限公司

国高技术服务
有限公司

天合光能股份
有限公司

江苏红日新能源
有限公司

安轩科技
MakeEasy

THANK YOU

上海安轩自动化科技有限公司

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