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LONGi Solar

pv magazine webinars

From solar module production to recycling

30 November 2022

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Welcome!

Do you have any questions? ❓

Send them in via the Q&A tab. 👉 We aim to answer as many as we can today!

You can also let us know of any tech problems there.

We are recording this webinar today. 📹

We‘ll let you know by email where to find it and the slide deck, so you can re-watch it at your convenience. 👀 💡

Customer-driven Value Creation

ROADMAP FOR SUSTAINABLE ENERGY TRANSFORMATION

The World Leading Solar Technology Company

Propelling the transformation

About LONGi

Founded in 2000, LONGi is committed to being the world's leading solar technology company, focusing on customer-driven value creation for full scenario energy transformation.

Under its mission of 'making the best of solar energy to build a green world', LONGi has dedicated itself to technology innovation and established five business sectors, covering mono silicon wafers cells and modules, commercial & industrial distributed solar solutions, green energy solutions and hydrogen equipment. The company has honed its capabilities to provide green energy and has more recently, also embraced green hydrogen products and solutions to support global zero carbon development.

2000
Foundation

60000+
Global Employees

30+
Global Network

15+
Manufacturing Bases

Y2021 Operating Income
$12.694B

Y2021 Net Profit
$1.425B

Y2021 R&D Investment
$689M

1H Y2022 Operating Income
$7.512B

1H Y2022 Net Profit
$966M

1H Y2022 R&D Investment
$547M

SOURCE: 2021 Annual Report & 2022 Interim Report
NOTE: The current exchange rate conversion method is not unified, this table is based on the exchange rate at the end of the reporting period.

Milestones of LONGi

Each milestone has become a key force to promote the development of the industry

2000

STAGE 1
The era of semiconductor technology accumulation

2000
LONGi was established

2005
Formation of annual production capacity of 30 tons silicon ingot

2005

STAGE 2
The era of technological revolution in the monocrystalline silicon wafers

2012
A-share market listing

2014
World's No.1 in production of monocrystalline silicon wafer
- RCz Ingot pulling
- Diamond Wire Slicing Technology
- M1/M2 Silicon standard

2014

STAGE 3
The era of promoting monocrystalline back to the mainstream

2015
Entered solar cell and module market
World's No.1 in shipment of monocrystalline module

2018
The world's most valuable PV manufacturer
- PERC Trend
- LIR Technology
- Bifacial Technology

2019

STAGE 4
The era of utilizing solar technology to change the earth

2019
Certified the low carbon footprint by CERTISOLIS
Set another standard for ultra high efficiency module
- M6 Silicon Wafer Standard

2020
Set a brand new industry standard
- M10 Silicon Wafer Standard

Selected as Sole Photovoltaic Sponsor for China Pavilion at Dubai Expo 2020
Officially joined the Climate Group's RE100 , EV100, EP100 initiative to achieve carbon neutrality

2021

2021
LONGi established the Hydrogen BU

LONGi broke three more world records for solar cell efficiency
- N-type TOPCon Solar Cell Efficiency
- P-type TOPCon Solar Cell Efficiency
- HJT Solar Cell Efficiency

THE FUTURE OF LONGi

With “Solar for Solar”, LONGi officially joined the Global Initiative RE100, EV100, EP100, and will keep building towards achieving 100% clean energy consumption.

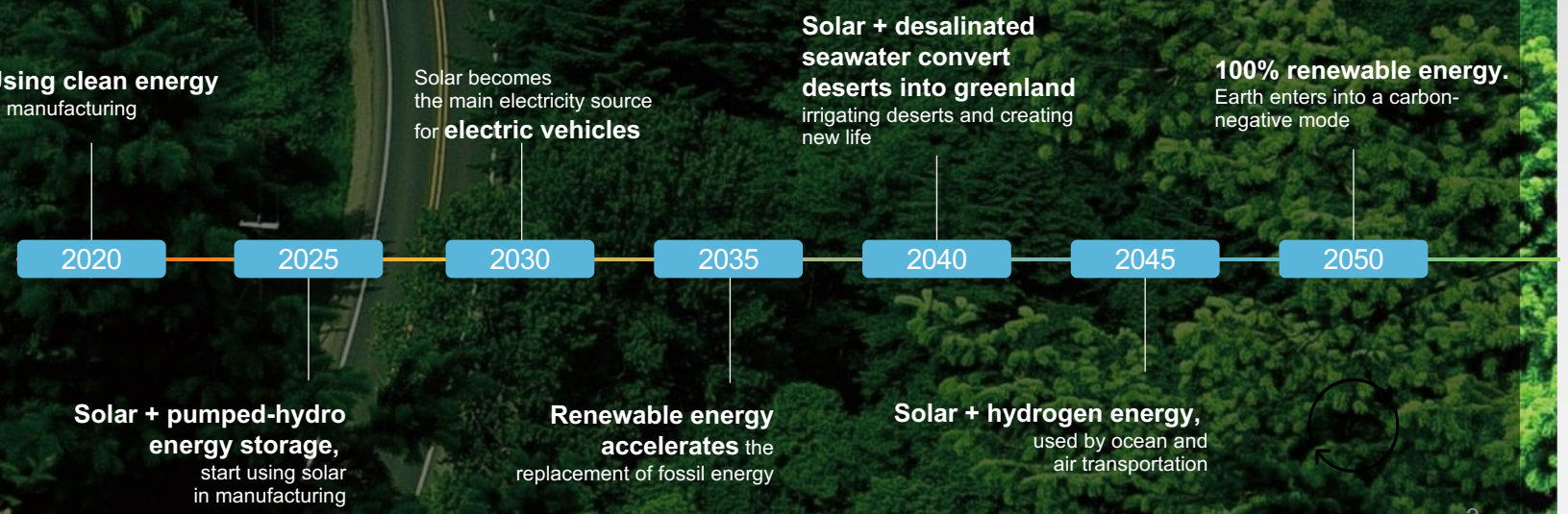
LONGi always had sustainable management as a core criteria for business decision-making, including continuous investments in innovation and research, advocating an open corporate culture and promoting scientific institutional research.

At the same time, LONGi has been leading continuous changes in electric power and energy, promoting the sustainable development of the planet and mankind. It is LONGi’s vision and roadmap that Earth will be completely green and self-sustainable within the first half of this century.

RE100 LONGi has committed to use 100% renewable power across its entire global operations by 2028.

EV100 In the coming 10 years, LONGi will install adequate power charging facilities for vehicles to encourage the employees changing family vehicles into electric vehicles.

EP100 LONGi has committed to completing its energy management system (EnMS) by 2025, as well as a 35% energy efficiency improvement by 2025 compared with 2015 levels.



The World Leading Mono Silicon Wafer Manufacturer

LONGi took the industry lead in standardizing wafer size and achieving **100%** diamond wire cutting of mono silicon wafer.

70GW+
Wafer Shipment
(2021)

105GW
Wafer Capacity
(2021)

39.62GW
Wafer Shipment
(1H 2022)

Leading Capacity and Shipment

In 2021, LONGi became the **1st** solar technology company to ship more than **30GW** of modules in one year.

38.52GW
Module Shipment
(2021)

60GW
Module Capacity
(2021)

18.02GW
Module Shipment
(1H 2022)

LONGi

Propelling the transformation

Customer-driven Value Creation

Technology Roadmap
Sustainable Production

The World Leading Solar Technology Company

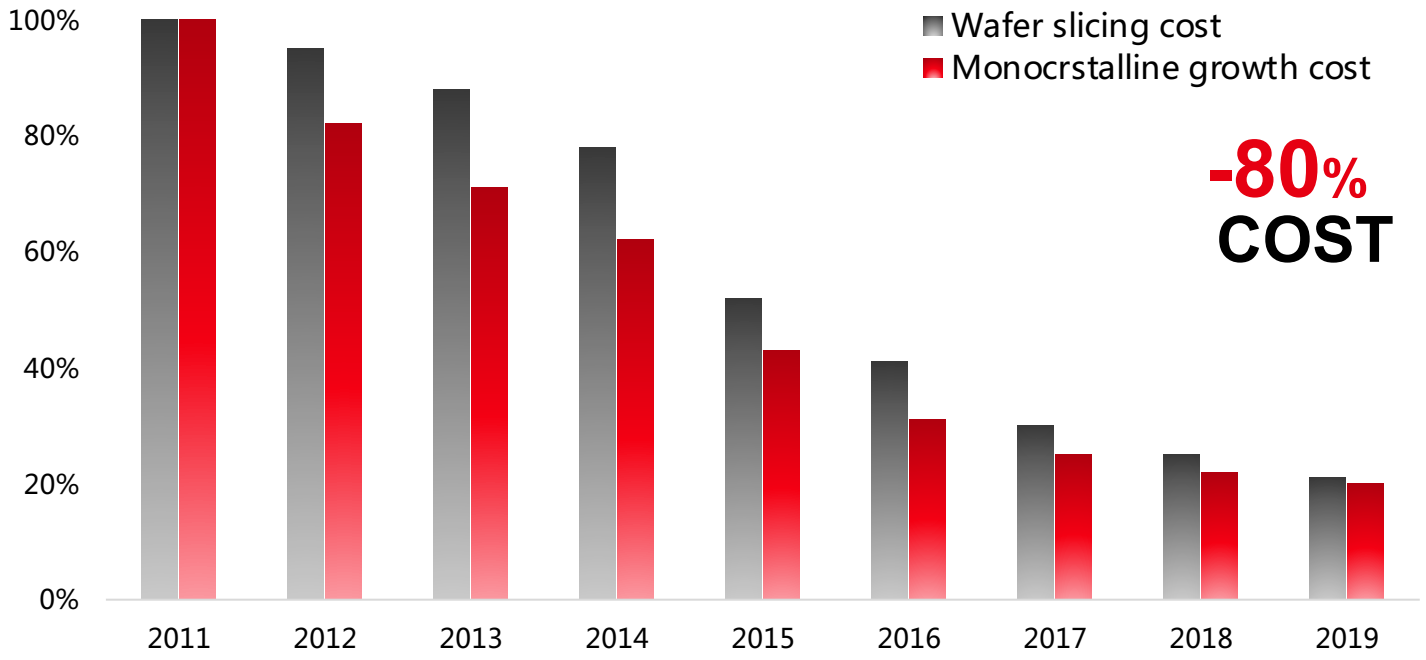
Hi-MO 5
100MW
Utility Scale Solar Power Plant
Huanglong County, Yan'an, Shaanxi Pronvice, China

Photovoltaic technology Route

¿Where have we come from?

Is all about Reducing cost and increasing efficiency

- By the technology innovation on the process of crystal growth and slicing (RCz, diamonds slicing), the cost of monocrystalline wafer is reduced greatly.
- Meanwhile, the content of oxygen, carbon and metal impurities is significantly reduced, leading the increase of minority carrier lifetime, providing high quality wafer for high efficiency cell.



-80%
COST

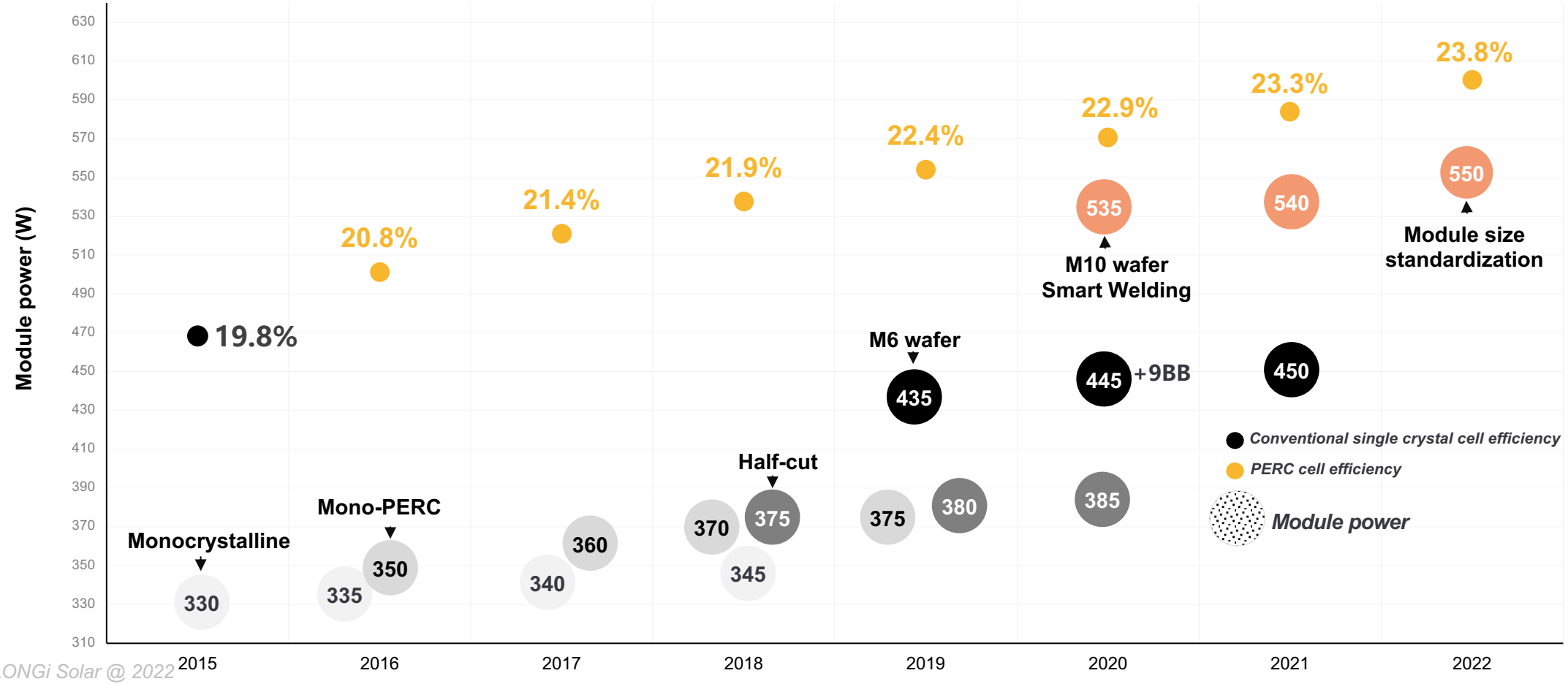
O content -34%
2011~2020

Minority Carrier lifetime +18%
2014~2020

* Monocrystalline technology represents more than 92% of PV modules manufactured with crystalline Polysilicon

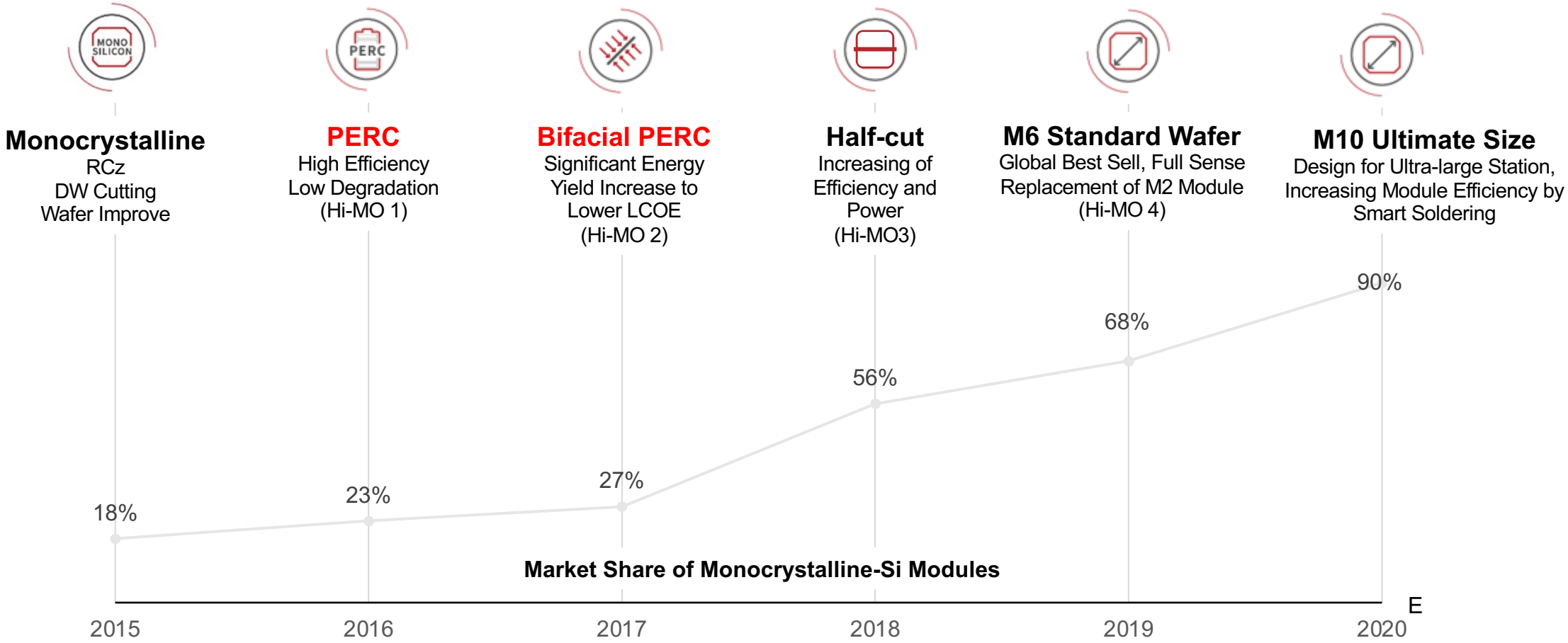
Efficiency as the major driver

- In recent years, the efficiency of PERC cells has grown rapidly, which is now close to 24%. Coupled with the increased efficiency and cost reduction caused by the increase in module size, PERC modules have strong product competitiveness.
- At the same time, other cell technologies and equipment are also making continuous progress. As PERC cell efficiency approaches bottleneck, other high-efficiency cells are promising but need to overcome several challenges.



Efficiency yes, but also size and output power?

LONGi's technological innovation will quickly be transformed into large-scale advanced capacity and be promoted and applied on the client side, promoting the continuous reduction of the cost of photovoltaic power.

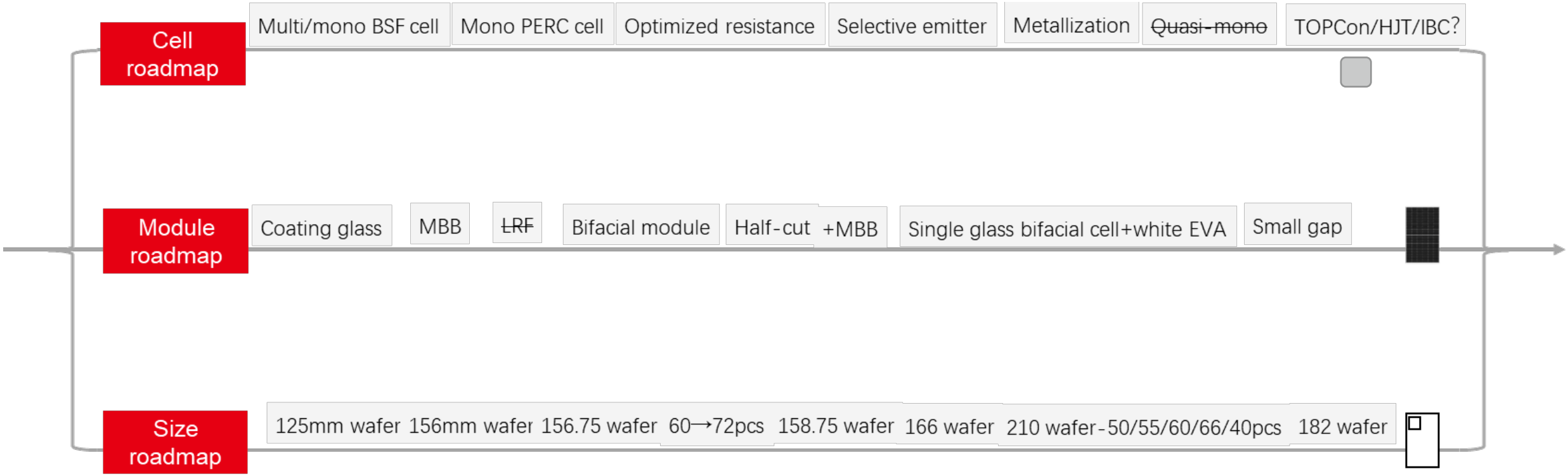


¿So where do we stand?

What are we “looking at”?

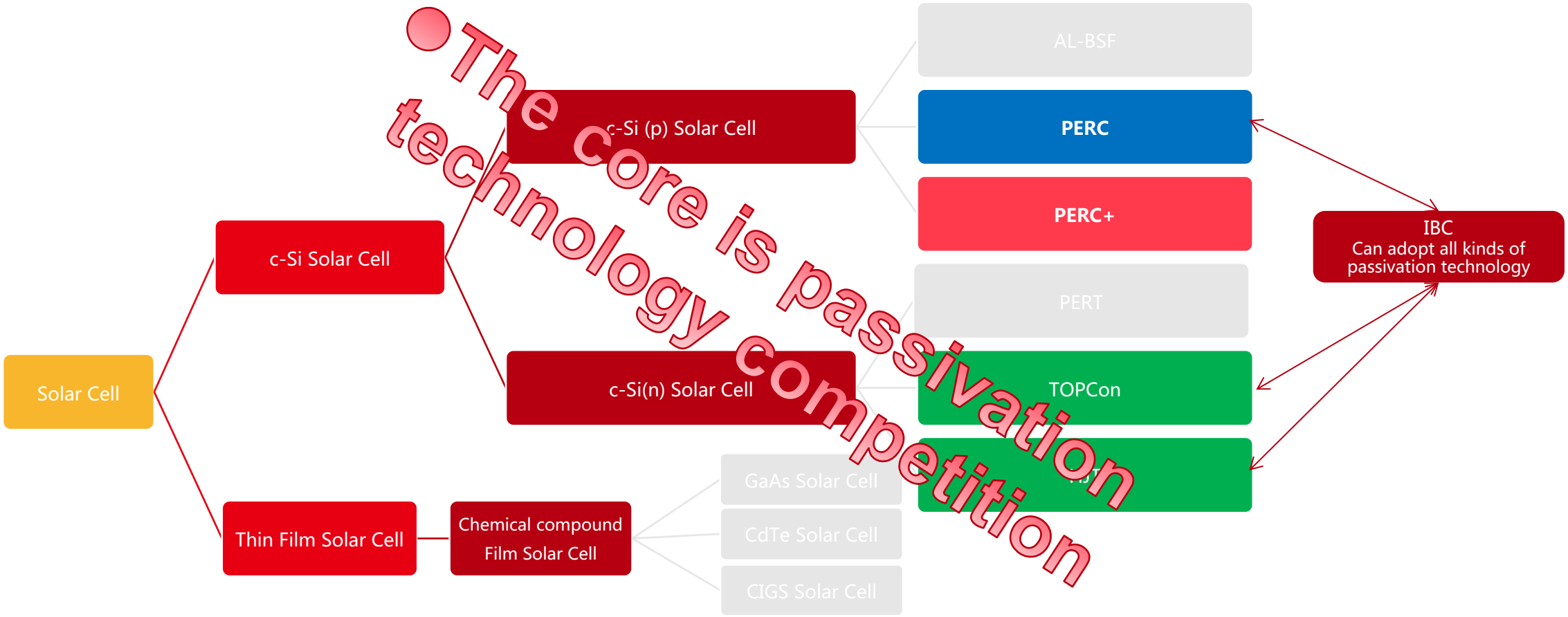
What are the main Discussions?

- The technology reducing the LCOE gradually wins, such as mono-Si, PERC replacing BSF cell, half-cut+MBB became the mainstream module technology, bifacial module dominated the utility power plants.
- The size development is based on the reduced manufacturing cost of large wafer/cell, after 158.75mm industry began to think more about terminal requirement with considering each factors.

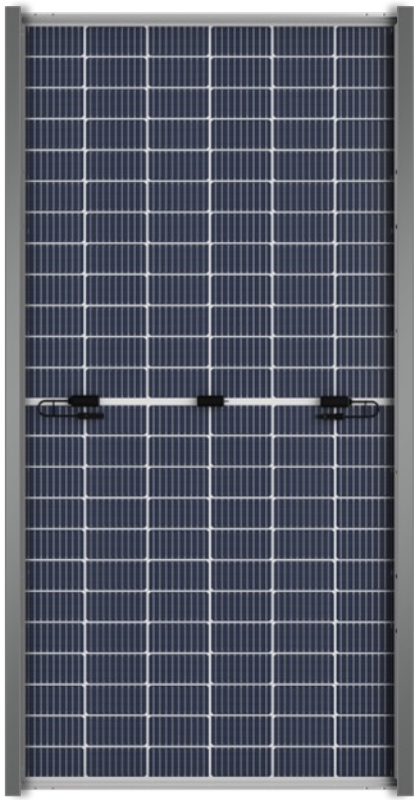


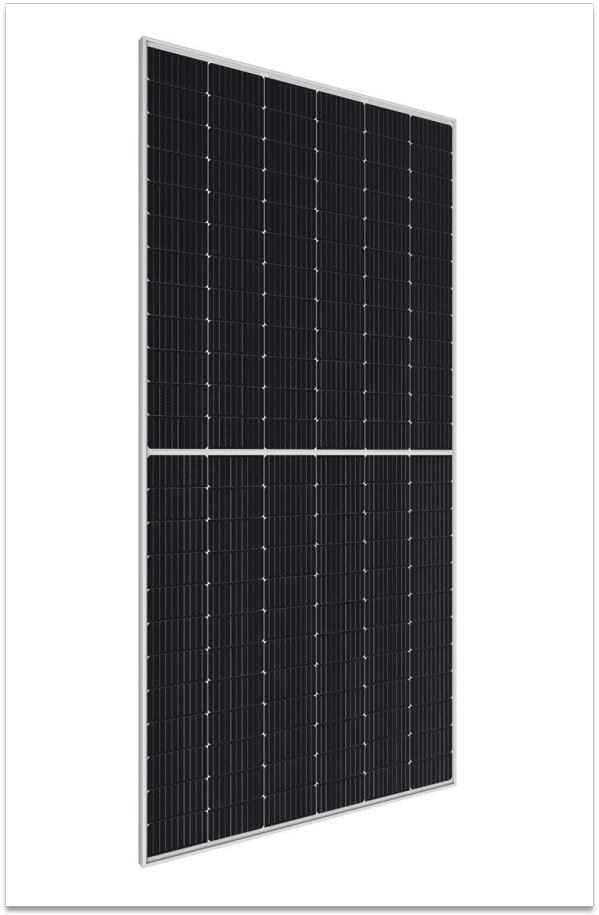
Cell? You Mean Technology then?

- Mainstream Passivation Technology: **p-PERC**
- **Potential Next Generation** Passivation Technology: **p-TOPCon, n-TOPCon, n-HJT**



And the Module Design??





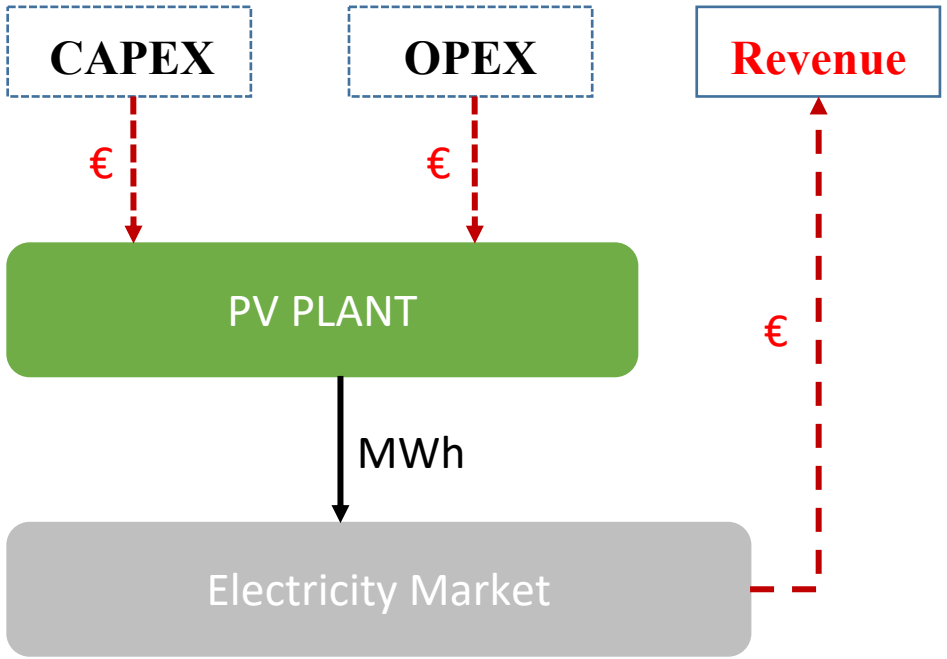
- M10 or M12??
- 66; 72; 78 Cells??
- Bifacial or Monofacial??
- Frame or frameless??
- PERC or TopCon
- P or N
- Half cut or more cuts? Busbars??
- System compatibility
- How I want to fix and install this modules ??
- Where will I Install this modules?

¿So, what to expect?

What are the main Drivers?

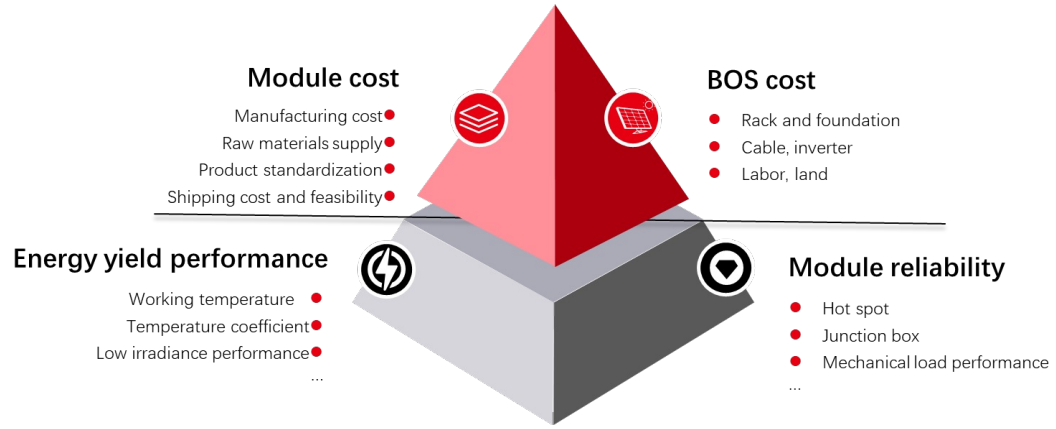
Main Drivers - Efficiency and COSTS

In the Eyes of Investor, the Plant is Investment

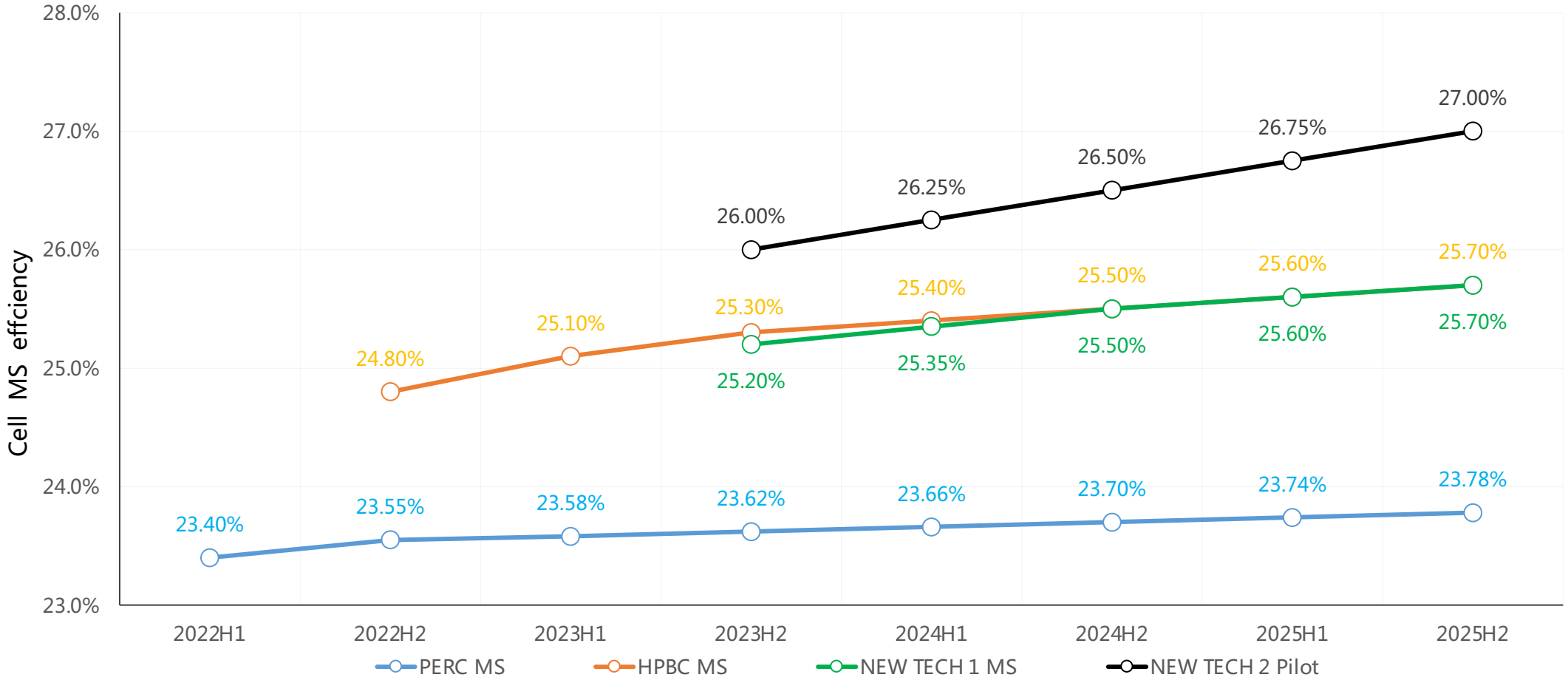


So, LCOE is the anchor for 'best practice'

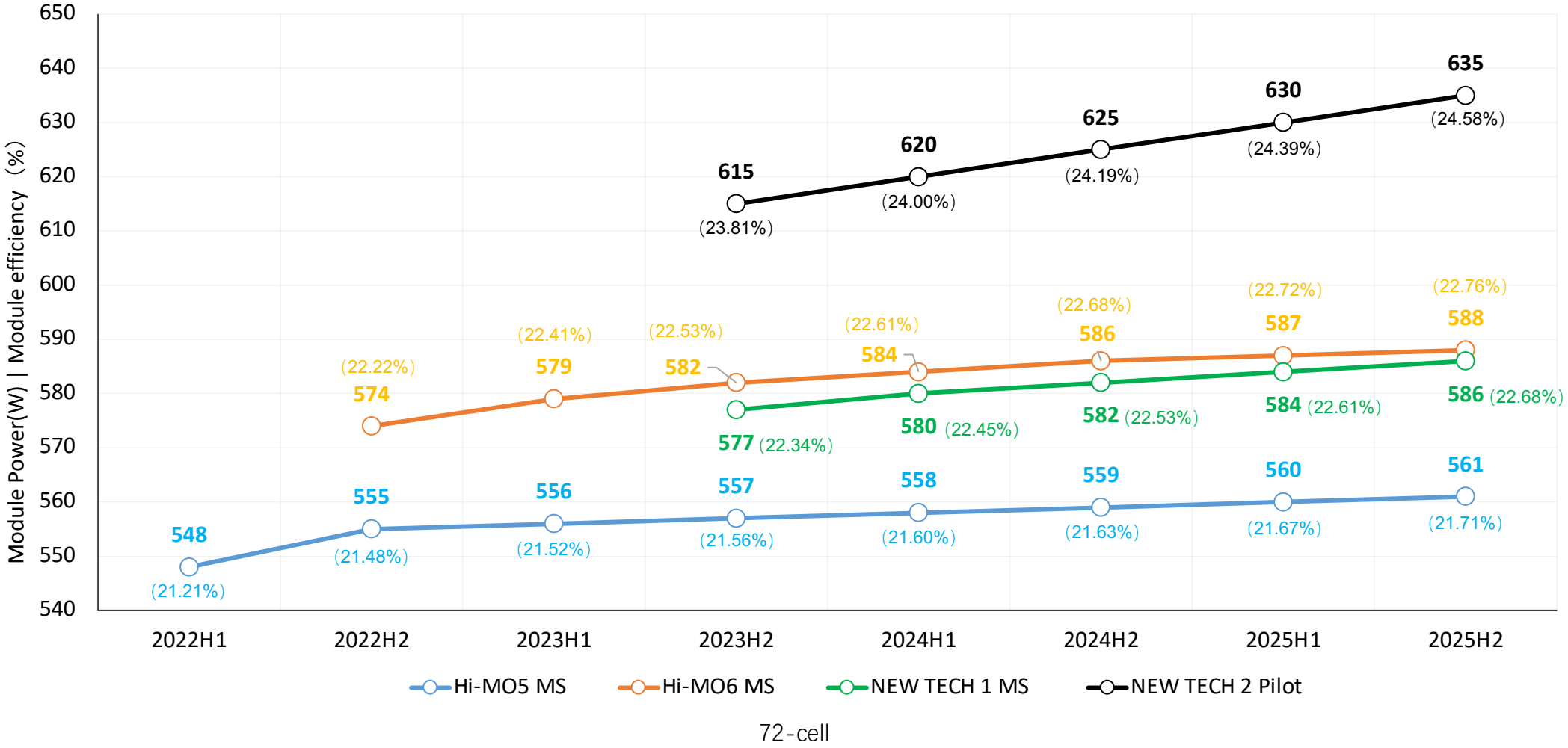
$$\text{LCOE} = \frac{\text{Capital Cost + Operating Cost of asset}}{\text{Generated Energy (kWh)}}$$



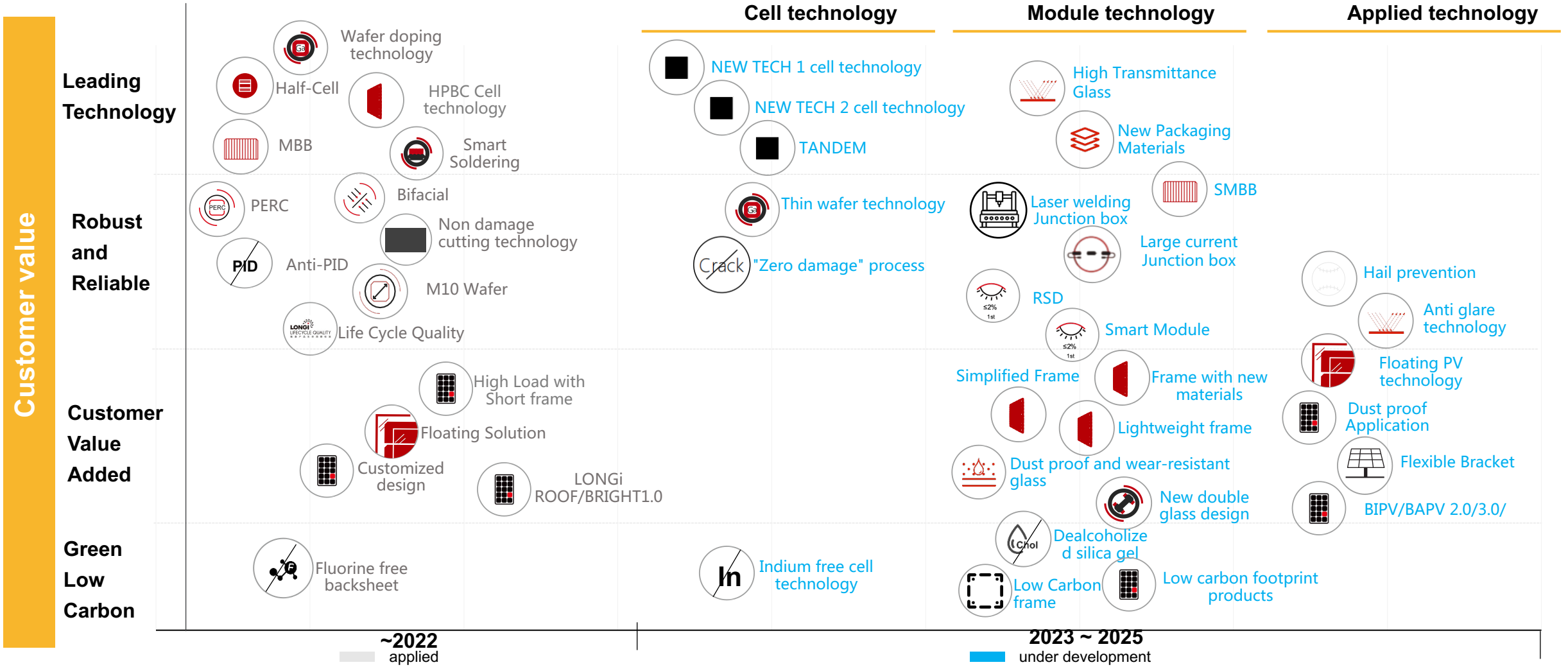
2022-2025 Cell Roadmap



2022-2025 Power Roadmap



2022-2025 technology and application planning



The Third-party Evaluation of Product Quality & Performance

Efficiency Records and Awards

26.81%
LONGi HJT silicon solar cell Efficiency
(November, 2022)

26.50%
LONGi HJT Solar Cell Efficiency
(June, 2022)

26.12%
LONGi P-type HJT Solar Cell Efficency
(September, 2022)

25.40%
LONGi Indium-free HJT
Solar Cell Efficiency
(March, 2022)

25.21%
LONGi N-type TOPCon
Solar Cell Efficiency
(June, 2021)

25.19%
LONGi P-type TOPCon
Solar Cell Efficiency
(July, 2021)

24.06%
LONGi P-type PERC
Solar Cell Front Efficiency
(January, 2019)

Ranked first in TÜV Rheinland
Power generation simulation: 2017, 2018, 2021, 2022
Outdoor empirical: 2019, 2020, 2021

All Quality Matters
TÜVRheinland

TOP PERFORMER
in PV Module Reliability Scorecard
2017-2022

TOP PERFORMER 2022 PVEL PV MODULE RELIABILITY SCORECARD

HIGH ACHIEVER
in PV Module Index
2019, 2020, 2021

2019 PV Module Index HIGH ACHIEVER LONGi Solar RETC

PV MODULE INDEX REPORT 2022 HIGH ACHIEVER RETC

Highest Power Generation
PV Magazine Test
Since June 2018

VERY GOOD pv magazine test MODULE

Leading Technology Advancing Innovation

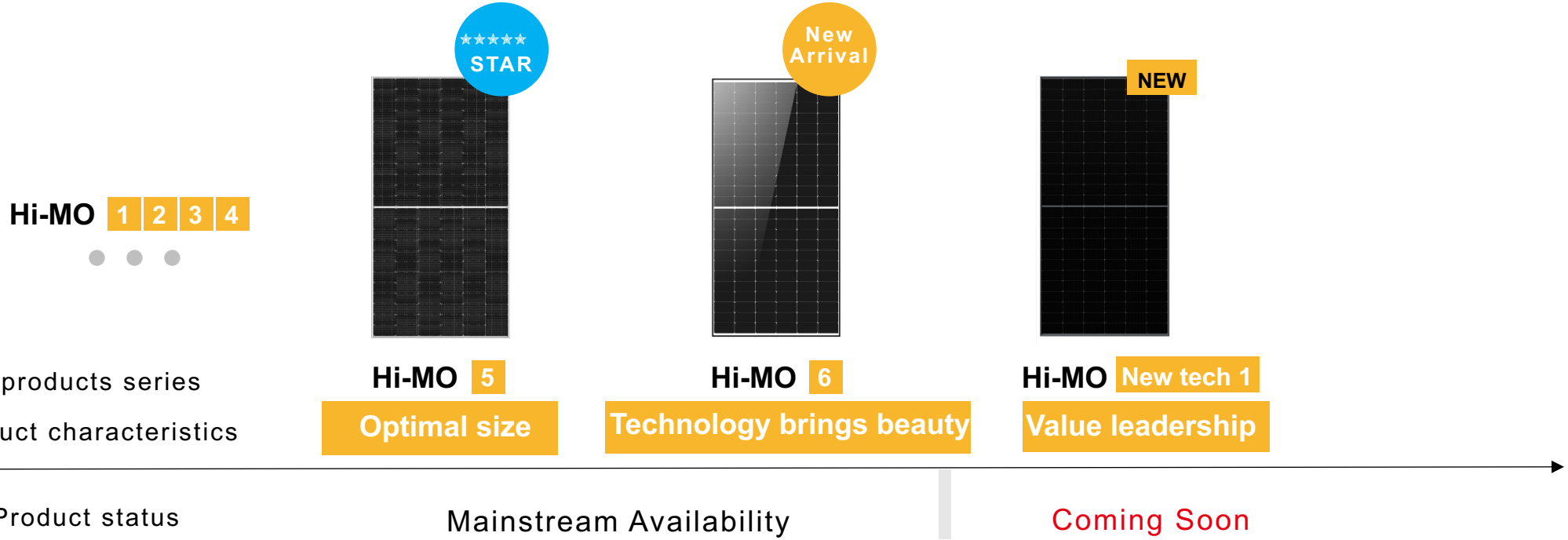
Utilizing Solar Energy Powering into Green World

Persisting in Innovation and Value Creation

Product Portfolio

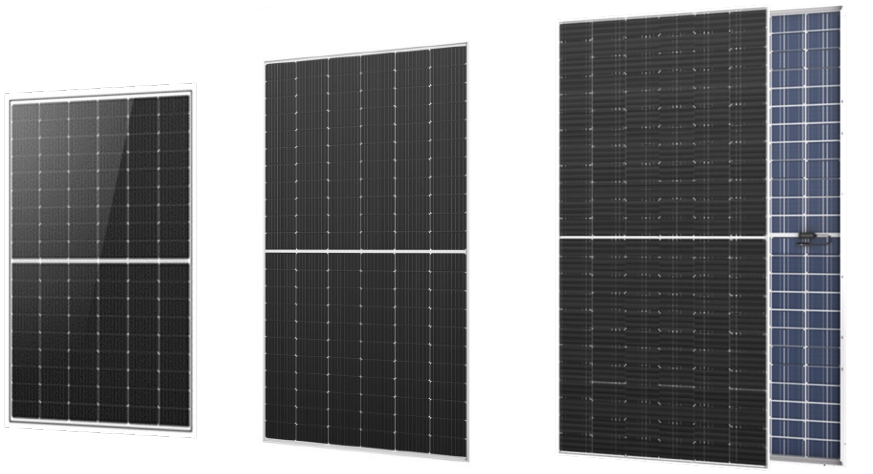
Hi-MO 1 - 6 NEW

From standard monocrystalline to monocrystalline PERC to P-PERC bifacial technology and M6 (166mm) & M10 (182mm) size wafer with gallium-doped technology, every LONGi's new product spearheads the transformation of the photovoltaics industry and becomes a new benchmark for the entire industry.



Hi-MO 5 series

High cost performance products with optimal value size



Hi-MO 5m (54c)	Hi-MO 5m (66c)	Hi-MO 5 (72c)
1722×1134mm	2073×1134mm	2278×1134mm

- **Product positioning:**

Basic products, cost-effective, global scale delivery

- **Value Proposition：**

High cost performance product with optimal value size

- **Time to market：** 2020

- **Supply capacity：** Global 60GW

- **Core advantages**

Realize optimal value creation in the whole life cycle

Taking into account both optimal LCOE and life cycle reliability

High power and more economical

The module efficiency is 21.3%, the increase of power generation is more than 5%, the LCOE saving is more than 3%, and the cost performance is high

High reliability, high performance and robustness

Intelligent welding technology realizes the perfect combination of high reliability and high power

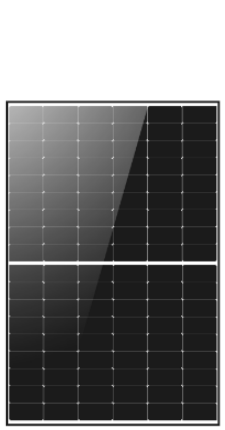
Powerful product delivery capability

Comprehensive product solutions to achieve efficient and large-scale delivery worldwide

Hi-MO 6 series

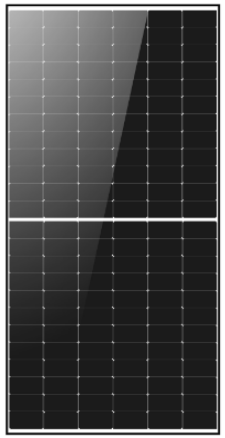
Technology brings beauty, a model of life

The first value choice of customer.



Hi-MO 6 (54c)

1722×1134mm



Hi-MO 6 (72c)

2278×1134mm

- **Product positioning:**

  High end DG application products (Monofacial)

- **Value Proposition:** Science and technology make life beautiful, high appearance, high efficiency, high power and high reliability
- **Time to market :** 2022
- **Supply capacity :** Global 30GW
- **Core advantages**

Technical innovation, high level of appearance, new definition of customer value

Perfect combination of advanced technology, green power and environmental aesthetics to innovate customer value

High efficiency, high power, more power generation, lower LCOE

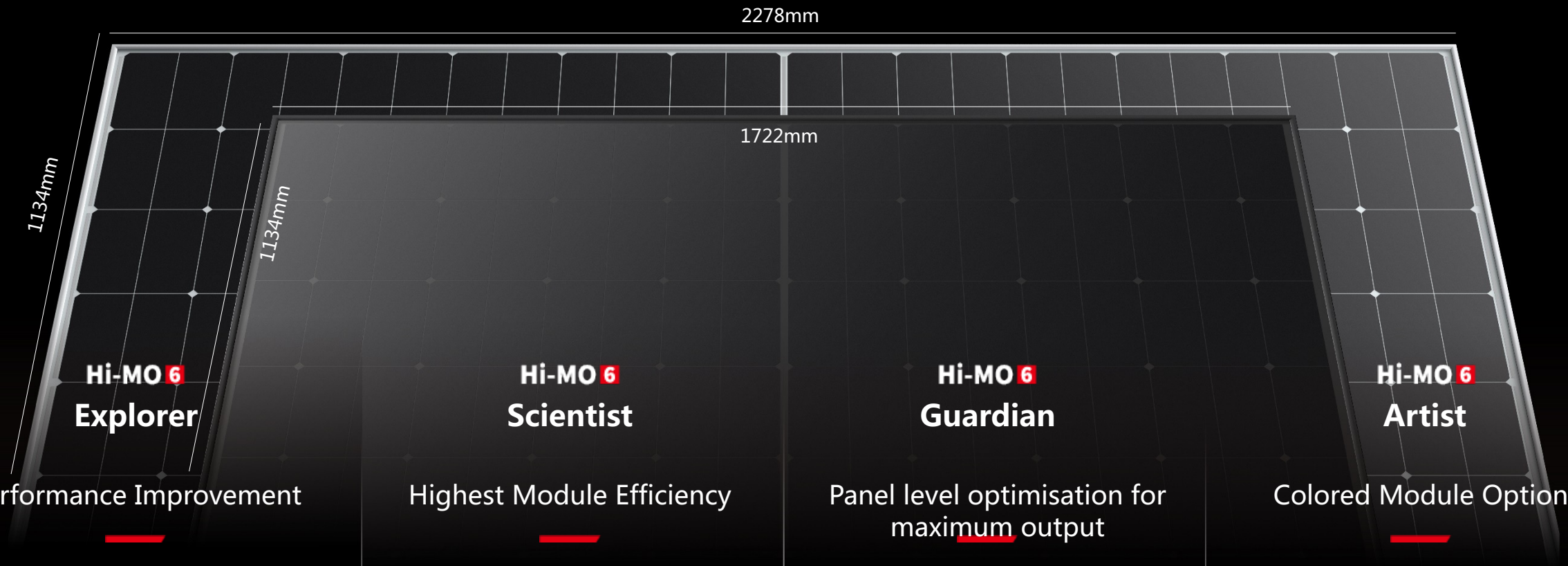
The cell efficiency 25.2%; The module efficiency 22.3%, and the power generation exceeds 3%

Stable and reliable, high performance guarantee in full life cycle

R&D and application of advanced cell and module technology , continuous and reliable high-performance throughout the product life cycle - zero PID, better performance of low irradiation response, lower LID, and lower linear degradation

Hi-MO 6 Product Family

Four product series，based on the 182mm standard



Hi-MO 6 Explorer

Performance Improvement

HPBC

Hi-MO 6 Scientist

Highest Module Efficiency

HPBC PRO

Hi-MO 6 Guardian

Panel level optimisation for maximum output

HPBC

+

optimizer

Hi-MO 6 Artist

Colored Module Options

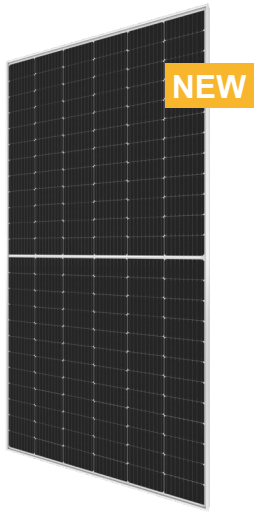
HPBC

+

Colored design

Hi-MO New tech 1 series

Efficient and stable, Value leadership
Achieving lower LCOE



Hi-MO New tech 1 (72c)

2278×1134mm

- **Product positioning :**

High bifacial rate, value advantage product of bifacial scene

- **Value Proposition :**

Efficient and stable, Value leadership, achieving lower LCOE

- **Time to market :** 2023

- **Supply capacity :** Global 30GW

- **Core advantages**

High efficiency and high power

Industry leading high efficiency cell technology application, with conversion efficiency of 25%; The front efficiency of the module is up to 22.5%

Ultra high bifacial rate, lower LCOE

80% bifacial rate; Temperature coefficient - 0.26%; Better low irradiation response performance; LCOE is 5% lower than mainstream products

Stable and reliable, high performance guarantee in full life cycle.

R&D and application of advanced cell and module technology to achieve zero PID, zero LID, lower linear degradation and Temp Efficiency, degradation in the first year 0.8% and line degradation 0.38%

Extensive application scene, better value creation

Widely used in utility power plant and industrial and commercial application scenarios, with excellent performance, especially suitable for high reflection and high radiation scenarios

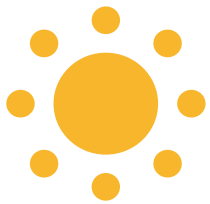
Net Zero Roadmap And WEEE Compliance

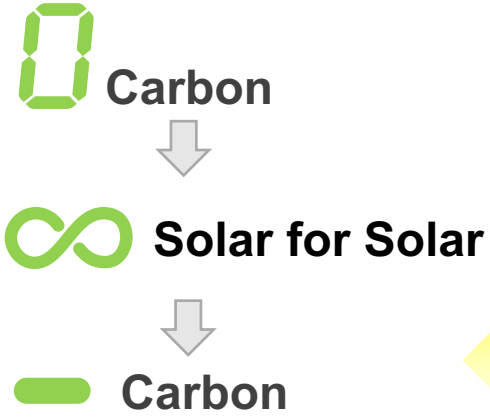
Utilizing Solar Energy Powering into Green World
Persisting in Innovation and Value Creation

LONGi Roadmap in Carbon Reduction

2015 Paris Agreement signed by 178 countries
Global temperature rise < 2℃ target **< 1.5℃**

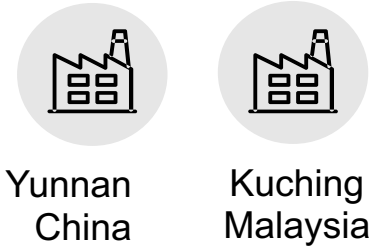
Reach the peak in **2030**
Achieve carbon neutrality by **2060**





2015

Clean energy production
Green electricity use



2018

LONGi proposed the idea of "Solar for Solar"

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

2020

RE 100
LONGi commits to 100% renewable power across its entire global operations by 2028

EV 100
LONGi commits to making electric transport the new normal by 2030

EP 100
LONGi commits to a ten-year effort to achieve a 35% increase in energy productivity by 2025

2021

Hydrogen Business Unit is founded **Green Hydrogen**

Yunnan Baoshan **Frist** **"Zero-Carbon Plant"**

2022

LONGi 2021 sustainable development

High-efficiency and Low-carbon product

CITI
Evaluating brands' environmental management of their supply chains in China (2014-2022)

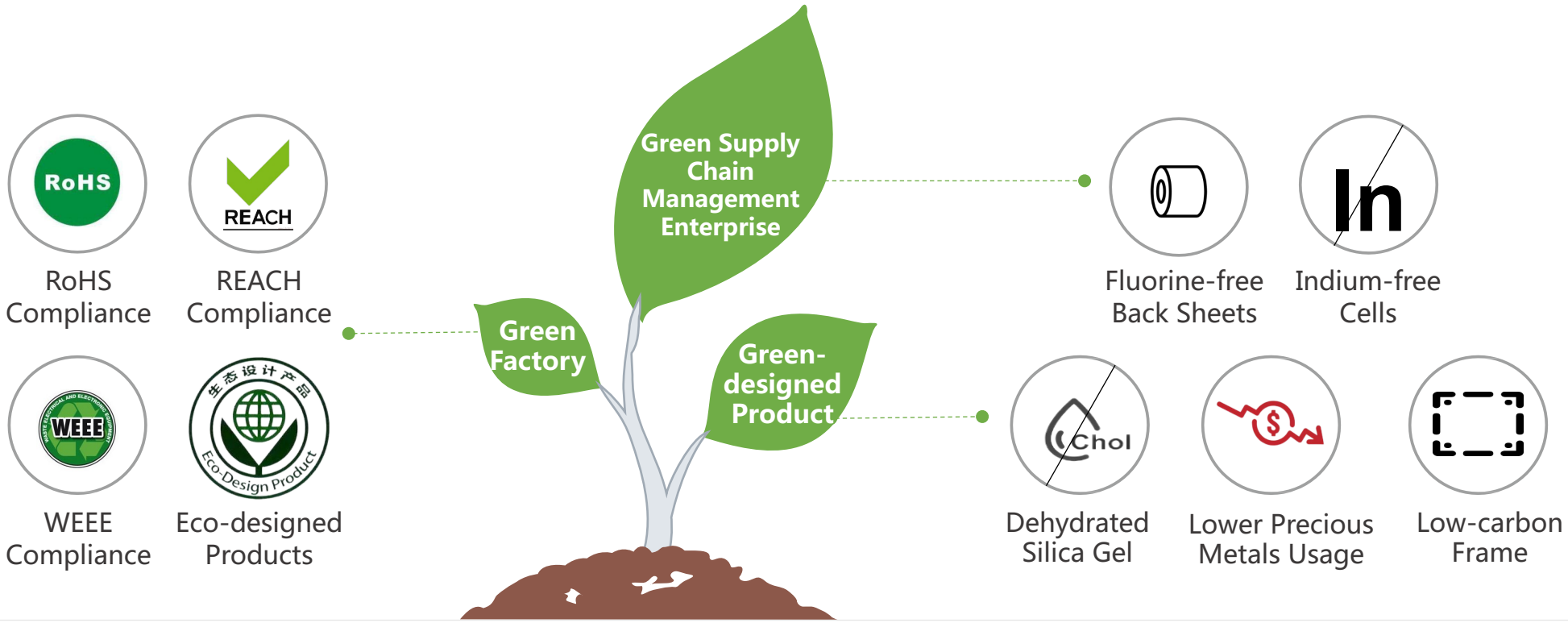
CATI
Evaluating corporate climate action performance
Accelerate global commitment to carbon neutrality

CITI: No.1 in 2020 and 2021
CATI: No.1 in 2021

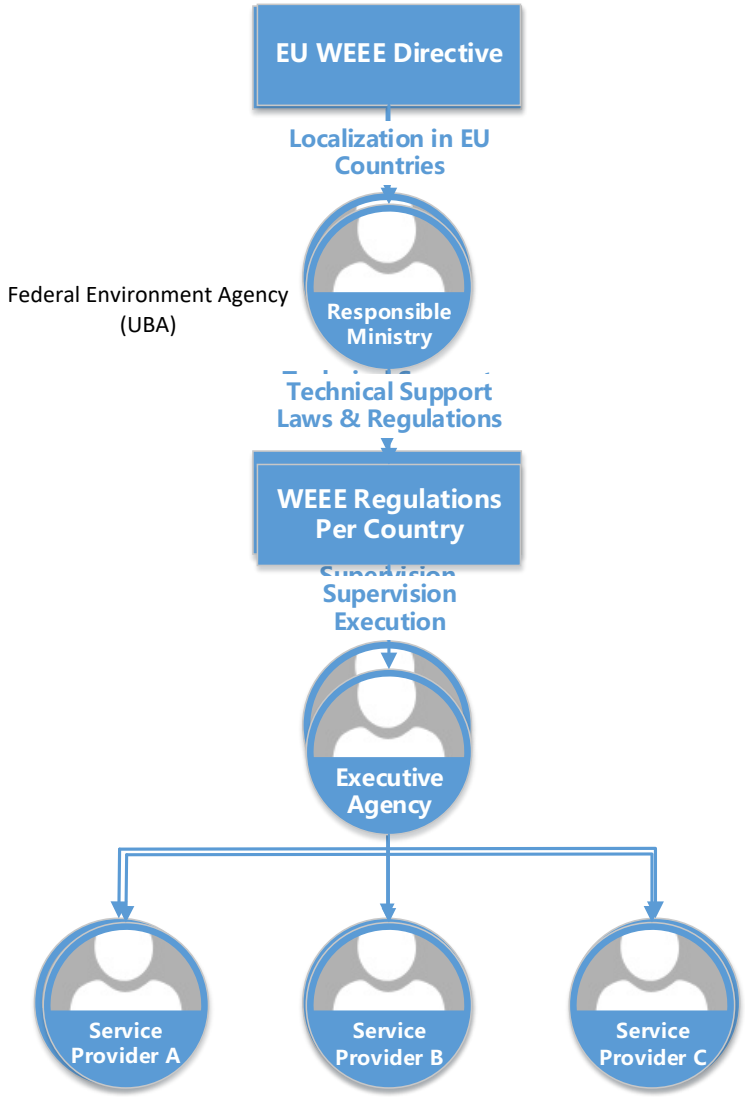
Low-Carbon Operation

Create industry-leading value for our customers in a sustainable manner

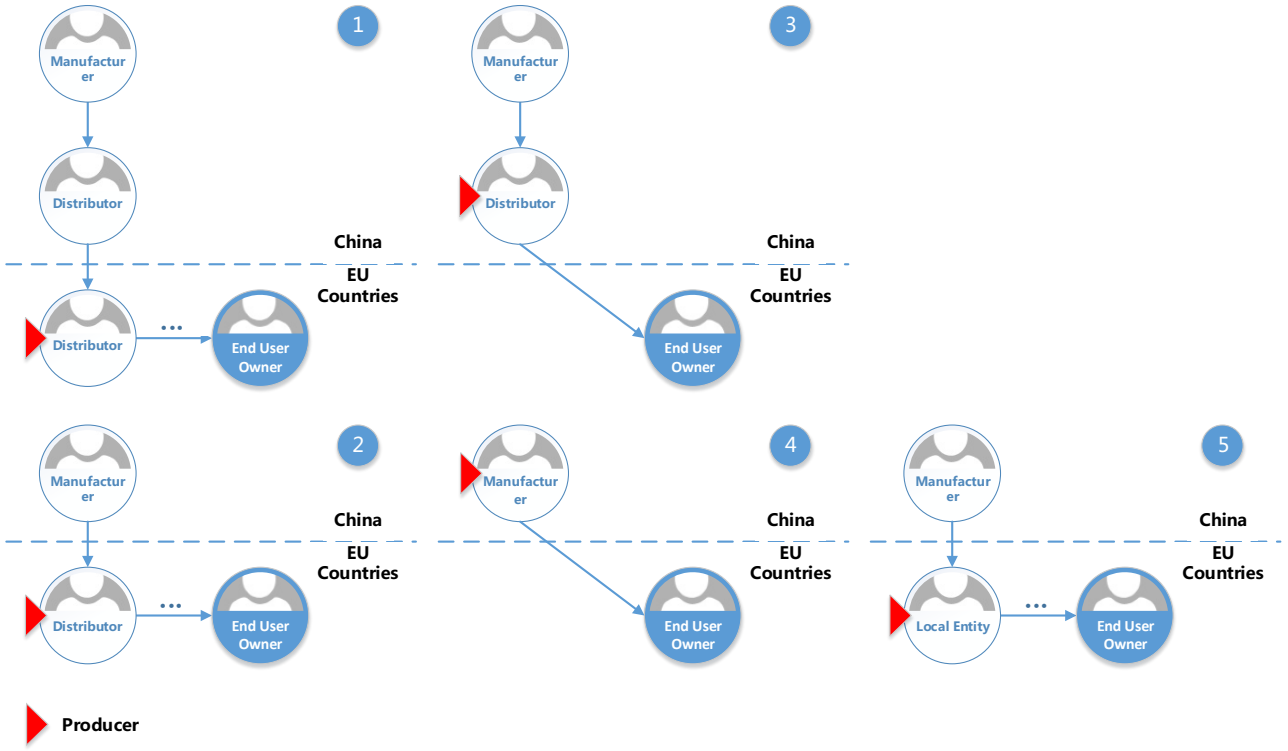
LONGi deeply practices the green and low-carbon concept and implements green manufacturing to achieve "win-win" economic and ecological benefits. LONGi has become a PV enterprise that has won three national honors of "Green Factory", "Green-designed Product" and "Green Supply Chain Management Enterprise" at the same time.



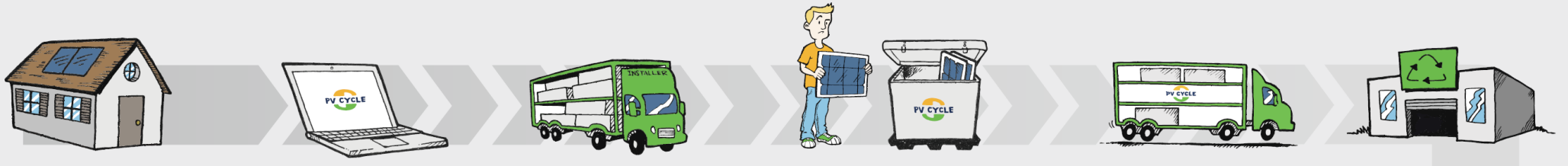
WEEE Directive and Extend Producer Responsibility



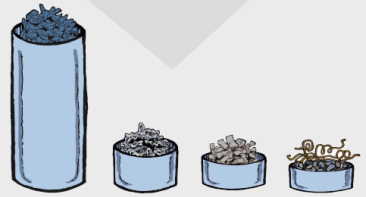
- **WEEE Directive：** Waste Electrical and Electronic Equipment (WEEE) Directive.
- The main purpose of the WEEE Directive is to manage electronic and electrical equipment waste (electronic waste) reasonably, and to reduce the volume of electronic waste and protect the natural environment by collecting, reusing, recycling and restoring scrap products.
- The WEEE Directive sets minimum legislative standards for EU member states, and member states can choose to implement more strict policies and measures, that is, localization.
- Since February 14, 2014, every EU country must supervise the collection, transportation and processing (recycling/waste management) of photovoltaic modules. Therefore, all PV module producers who want to trade modules in EU countries must register for WEEE in the related country.



The Basic Recycling Flow of Waste PV Modules under EU Directive



B2C : Discarded household modules shall be disassembled by the user himself, and the modules shall be transported to the recycling point designated by the country for placement.

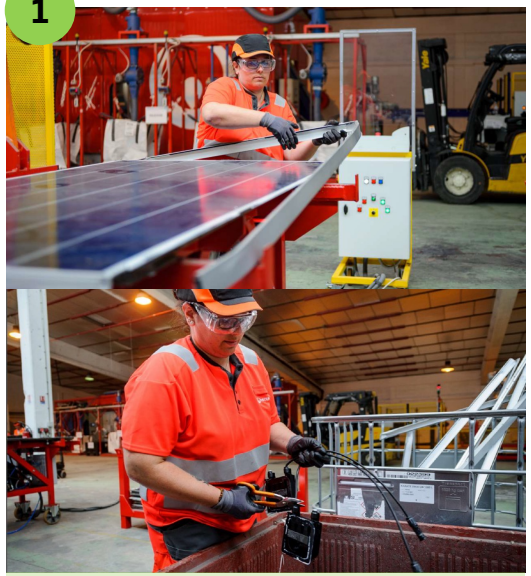


B2B : Discarded modules from utility and C&I projects shall be disassembled and placed reasonably by the user himself at the project sites.

Source: PV Cycle

Grave Process of PV Module Recycling — Rousset in France

1



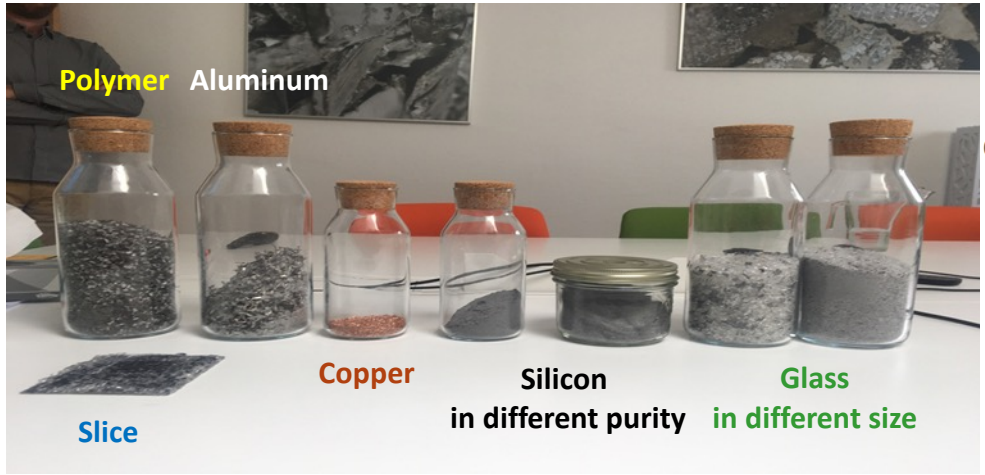
Aluminum frame, junction box, and cables are removed and recycled.

2

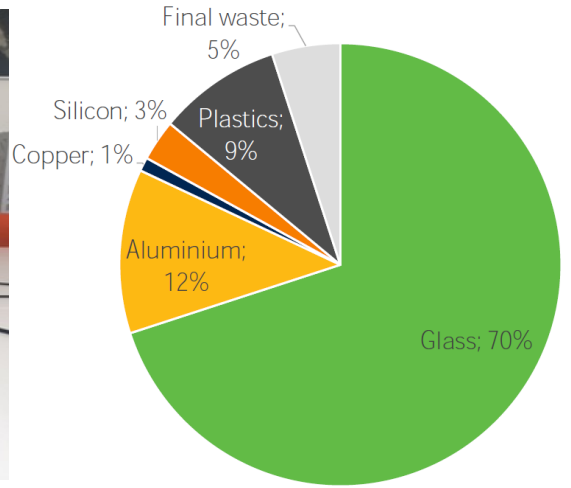
The laminate is cut into slice with fixed size.

3

The slices are thoroughly shredded and separated into different components.

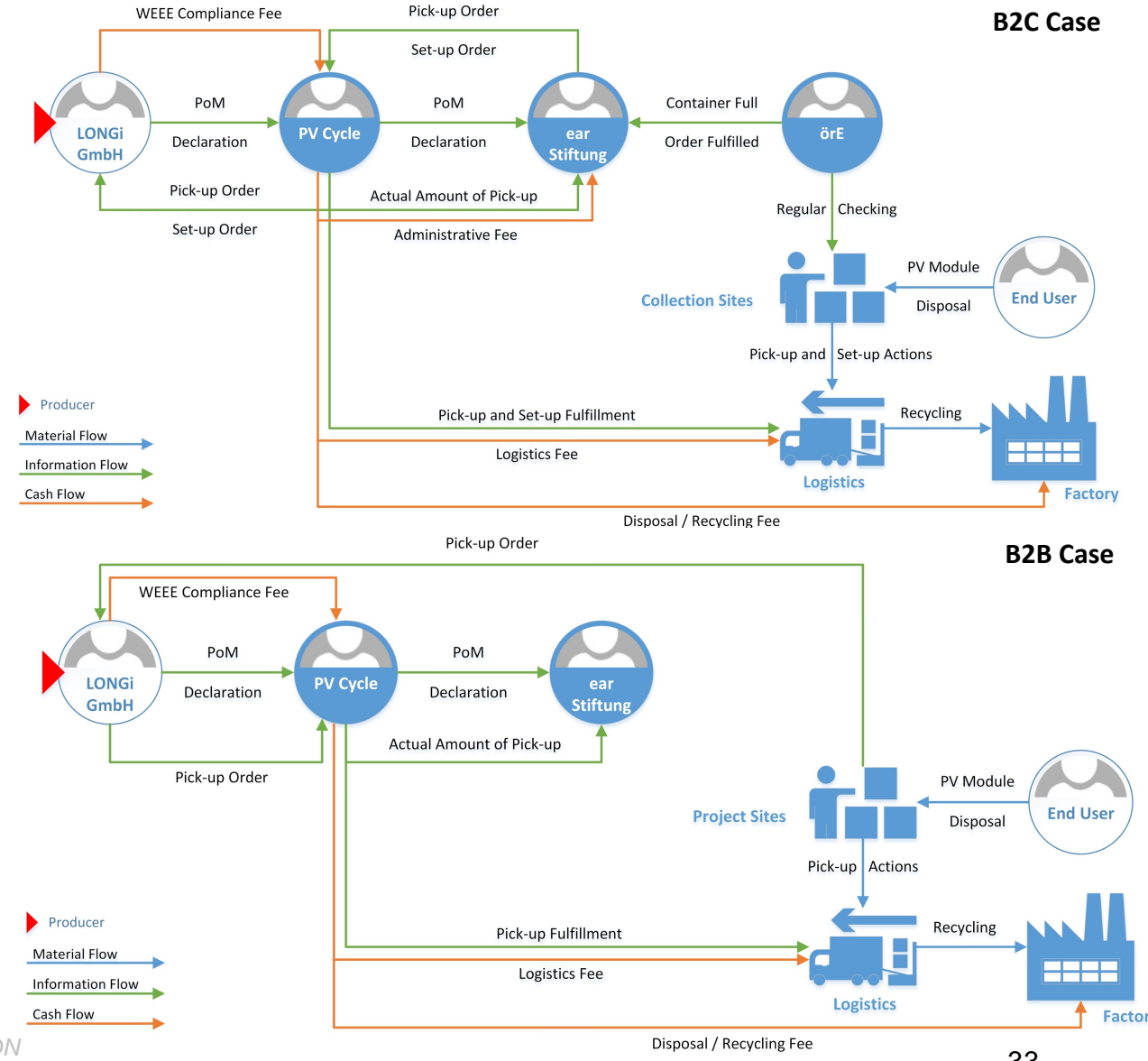


Source: soren



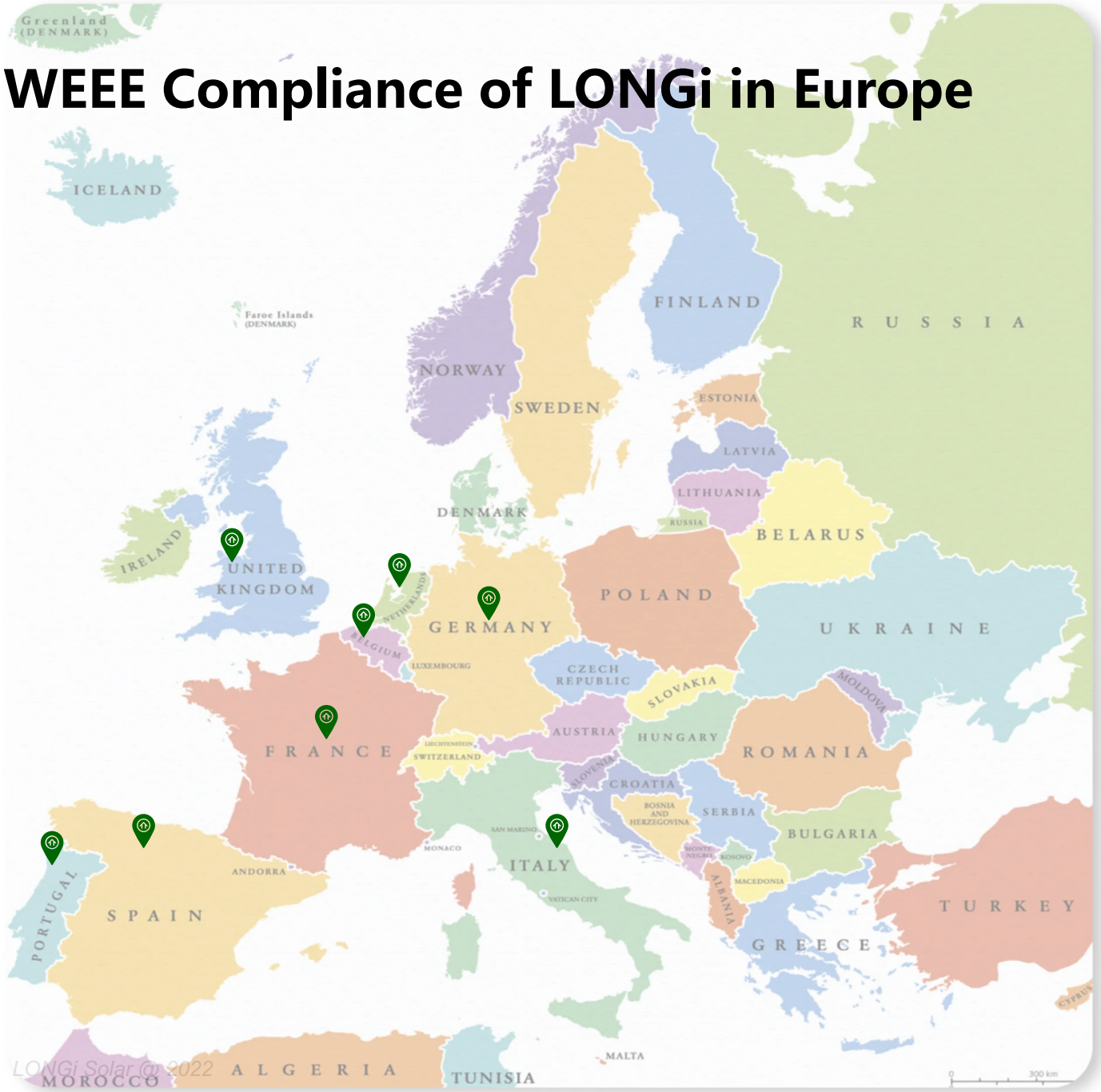
- **95% recovery rate achieved**
- **5% solid fuel for energy**

PV Module Recycling in Germany - Process



- German WEEE regulation: Electrical and Electronic Equipment Act (ElektroG).
- stiftung ear (elektro-altgeräte register) is the platform for registration and waste management in Germany https://www.stiftung-ear.de/en/home.
- Producers registered in- and outside (authorized representative AR is needed) Germany can register in stiftung ear.
- Declaration is monthly.
- örE (öffentlich-rechtliche Entsorgungsträger) are the legal entities that are obliged to dispose of waste under the respective state law including setting up the collection points, mostly independent towns and (rural) districts. 1800+ collection points (Wertstoffhöfe) for PV modules in Germany.

WEEE Compliance of LONGi in Europe

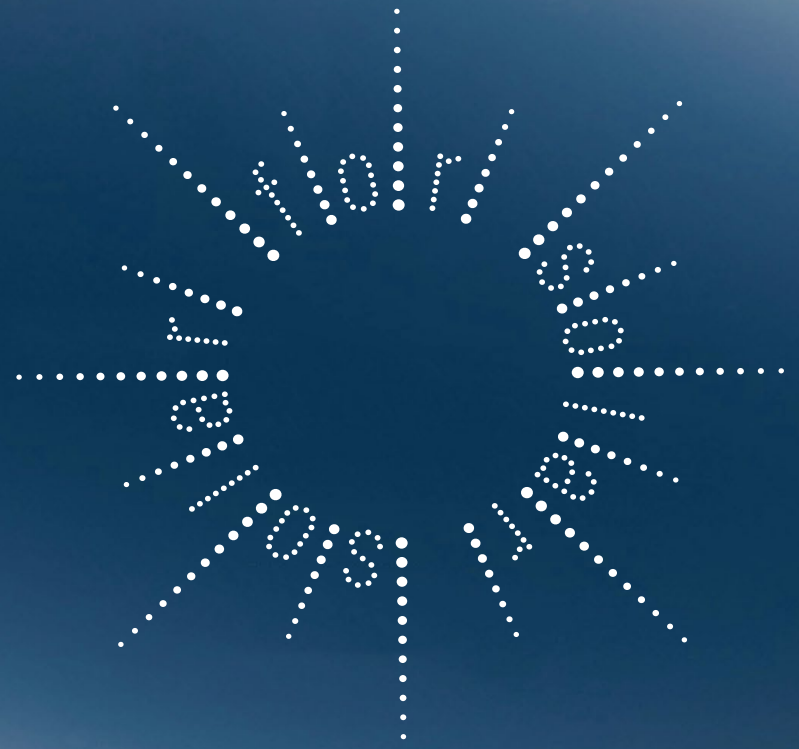


- In Europe, WEEE registration in 8 countries
- Global membership covers other countries
- Training and helping our customers on WEEE compliance
- Fulfillment of waste management, e.g. in Germany only B2C market, we have been managed more than 200 containers since 2019.
- Support local audit from 3rd parties
- And more …

LONGi | SUSTAINABLE DEVELOPMENT GOALS

Propelling the transformation

LONGi Sustainability Actions



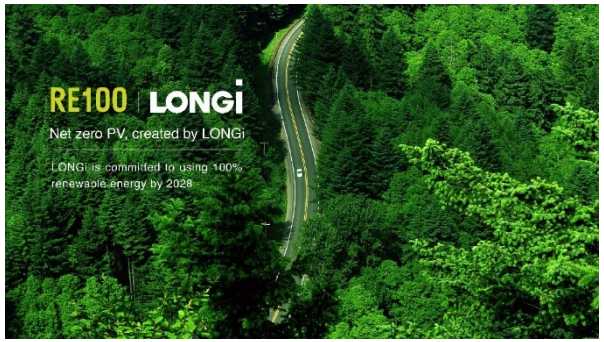
2021 Sustainability Report

Sustainable Development Roadmap

”Solar for Solar"

LONGi initiated carbon reductions with a green supply chain in the solar industry to facilitate low carbon economic development and realizations of climate goals.

LONGi joined the RE100, EV100, EP100 initiatives and SBTi to fulfill its commitments for the entire society.



RE100: Committed to using 100% renewable power across its entire global operations by 2028

In 2021, the proportion of renewable electricity utilization reached 40.2%.

EV100: Install adequate power charging facilities to encourage the employees to change into electric vehicles.

50 charging facilities have been installed in 2021.

EP100: Improve energy management system (EnMS) by 35% energy efficiency in 2025 from 2015

In 2021, energy management systems installed in 8 bases; energy efficiency has increased by 54% compared to 2015

SBTi: Formulate LONGi's scientific emission reduction targets in 2030 based on the 1.5-degree scenario

Environment

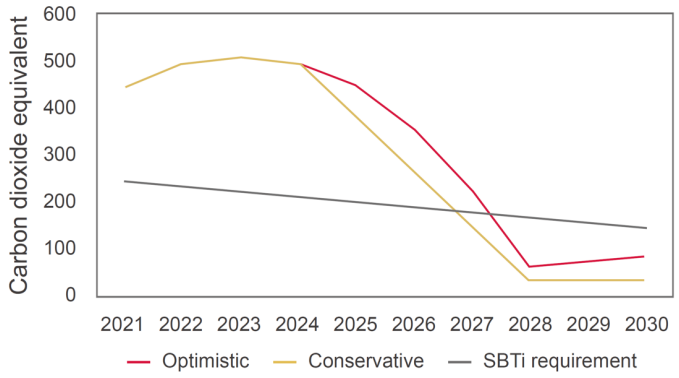
LONGi's GHG Emissions

LONGi conducted GHG calculation to ISO 14064-1:2018 standard, simulated the emission reduction pathway and set carbon reduction targets

Science-based Targets

Reduction of GHG emissions within the operational boundary

Reduction of carbon emission intensity per 3 major materials: silicon, cells and glass



Predicted GHG emissions of LONGi under optimistic and conservative scenarios

Important Accomplishments in 2021

3,096 GWh	40.19%	90.76%
LONGi uses 3,096 GWh renewable power, increased by more than 21% compared to that of 2020	In 2021, LONGi's green electricity proportion reached 40.19%	LONGi's green electricity proportion in Yunnan has reached up to 90.76%

-20.8%	16 million Tons	168 million Tons
The GHG emission per unit of revenue within LONGi operation scopes 1 s reduced by 20.8% compared to that of 2020	Nearly 169,716 tCO2e emissions have been cut thanks to LONGi's energy conservation and consumption reduction measures in 2021	LONGi's use of green electricity eliminated 1686000 tCO2e of GHG

720,000 GWh	340 million Tons	No.1
The total of PV silicon wafers delivered by LONGi since its public listing are expected to generate over 720,000 GWh green electricity.	Up to 2021, all PV silicon wafers produced by LONGi since its public listing contribute to a total emission cut of around 340 million tCO2e.	According to the corporate climate action CITI index published by IPE[1], LONGi has ranked first in the PV industry for the second year in a row.

Social: Labor & Human Rights

Human rights, health and safety, working conditions, data privacy, and community impact.

Contributing to the development of local communities and job creation

We abide by a stringent Code of Conduct, And we ask the same of our suppliers

▲ Code of Conduct "Pyramid" of LONGi

Supplier Management

Through our **Supplier Code of Conduct and Strategic Supplier Management Measures**, we incorporated sustainable development requirements of business ethics, environmental impacts, labour rights and human rights, as well as health & safety. We conducted social responsibility related training for suppliers.

▼ **Requirement for Suppliers to Protect Worker's Rights, Interest, Health and Safety**

Labor interests and human rights	• Zero-child labor and forced labor • Equal employment against discrimination • Support freedom of association
Health and safety	• Prevent and control occurrence of accidents and occupational diseases • Provide education and training on health and safety • Observe local labor protection laws

Responsible Sourcing

Suppliers of production materials are required to have Quality Management System, Environmental Management System and Occupation Health Safety Management System Certifications.

screened using environmental criteria

50% new suppliers

by applying the supply chain management platform of the of Public and Environmental Affairs (IPE)

screened using social criteria

96% new suppliers

30 suppliers' environmental information have been monitored

We promote green suppliers' self-assessment, and monitors environmental information of suppliers through the supply chain management platform

Governance

- Sustainable Profitability
- Business Compliance
- Commercial Ethics
- Cooperation and Exchange

- Business integrity, anti-corruption and anti-money laundering legislation and rules
- Increased transparency in the countries where conduct business by adhering to the rule of law and implementing our standards

Key Successes in 2021

98.97%
Employee satisfaction score

39.66 hours
per-capita training on employees' occupational health and safety

CNY **39.49** million
benefits distributed

CNY **101** million
investment in occupational health and safety

7.59%
percentage of foreign employees

25%
proportion of female employees in executive management

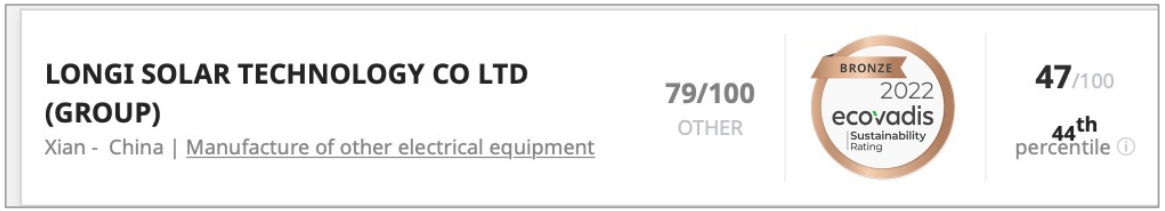
CNY **26** million
donations for COVID-19 epidemic prevention and control

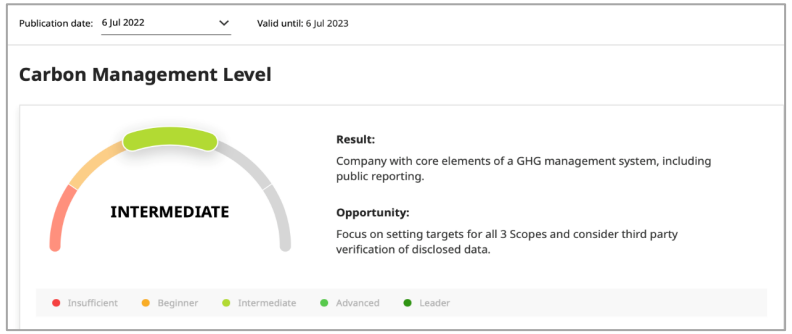
Awarded two honorable titles, i.e. **China's Best Employer 2021** and **China's Most Sustainable Employer 2021 – Forbes**

Awarded **the Humanitarian Badge of Red Cross of China** by the Red Cross Society of China

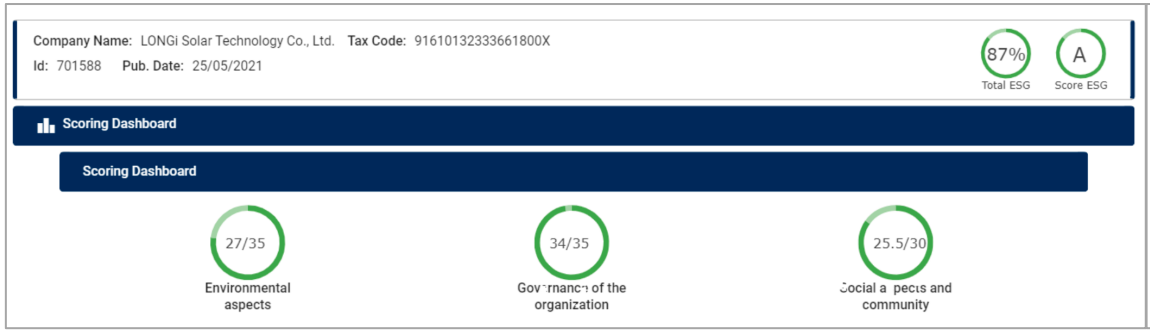
LONGi ESG Scorecards 2022

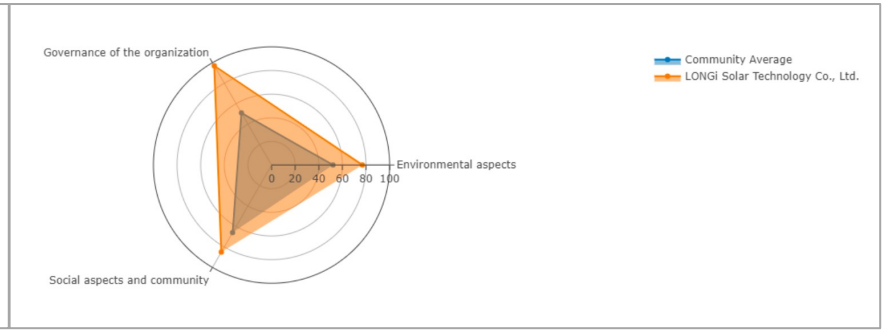
Ecovadis, July-2022

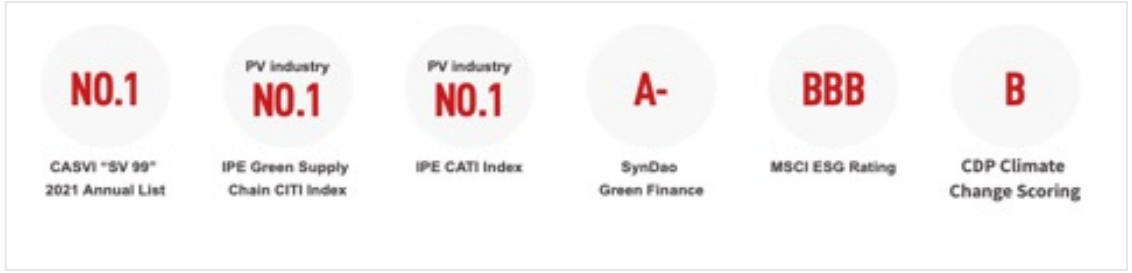




RBI, 2022







2021 CorporateKnights Global 100

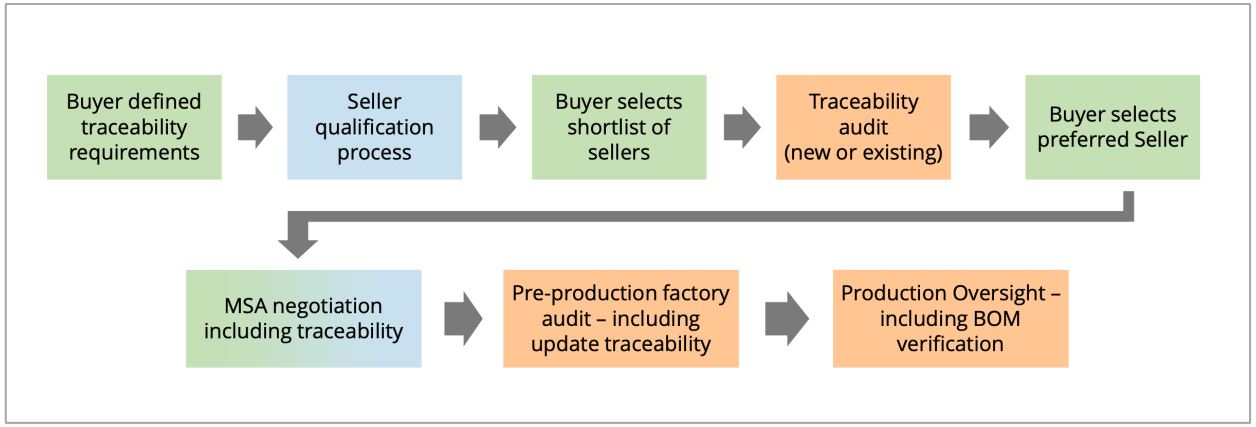
Traceability

LONGi is an elected Board Member of SolarPower Europe and a member of the Solar Stewardship Initiative (SSI) workgroup.

Implementing traceability program properly, and reaching 100% traceability, takes time. Traceability across the full supply can only be accomplished with the collective will and co-operation of the PV industry.

LONGi

Procurement and Verification for Traceability



PI Berlin, 2022

SolarPower Europe SSI aims to enhance end-to-end transparency, sustainability, and ESG performance across the solar supply chain and to define the standards that the European PV industry should hold itself to.

- A viable and credible system
- Commitment from the PV industry
- Path to establish traceability
- Clear set of rules for all in Europe PV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From solar module production to recycling
Q&A

30 November 2022

9:00 am – 10:00 am | GMT, London
10:00 am – 11:00 am | CET, Berlin, Madrid
11:00 am – 12:00 pm | EET, Athens

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pv magazine

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Editor
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Coming up next…

Thursday, 1 December 2022
5:00 pm – 6:00 pm CET, Berlin, Paris, Madrid
11:00 am – 12:00 pm EST, New York City

Understanding utility-scale solar and storage O&M cost drivers

Monday, 5 December 2022
10:00 am – 11:00 am CET, Berlin, Paris, Madrid
5:00 pm – 6:00 pm CST, Beijing

TOPCon heads to the rooftop

Many more to come!

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Thank you for joining today!