



**LONGi**

**2022**

Climate Action  
White Paper of LONGi

November 2022

LONGi Green Energy Technology Co., Ltd. (“LONGi” hereinafter) was founded in 2000. The company upholds its commitment to becoming the most valuable solar technology company in the world and the mission of “Utilizing Solar Energy, Building a Green World”. LONGi first put forward the “Solar for Solar” concept at the 24th UN Climate Change Conference (COP24). In 2020, LONGi is the only Chinese company that has joined the four climate initiatives: RE100, EP100, EV100 and SBTi. During the 27th UN Climate Change Conference (COP27), LONGi released its 2022 Climate Action White Paper , which is the second Climate Action report published since 2021.



LONGi has started to disclose corporate climate data through CDP global environmental disclosure platform since 2020, and submitted CDP climate change questionnaire and water security questionnaire in 2022, as further proofs of Company’s commitment to environmental data transparency.



The Carbon Trust provides technical support for this report.

For more information, please contact: [csr@longi.com](mailto:csr@longi.com), or call us at (+86) 4008 601012.

# CONTENTS

---

**CEO's Message** 03

**Highlights** 04

**Our Commitments** 05

---

**01 Accelerating Operational Emissions Reduction** 07

2021 Scope 1 and 2 Emissions

Progress on Operational Emissions Reduction

Decarbonization Roadmap

Zero Carbon Plant

**02 Promoting Value Chain Emissions Reduction** 15

2021 Scope 3 Emissions

Progress on Value Chain Emissions Reduction

Emissions Reduction Strategy and Action Plan in Value Chain

**03 Contributing to Net Zero Future** 20

Create Green & Low-Carbon Products

PV Product-Enabled Emissions Reduction

Innovative Green Solutions

**04 Appendix** 27

Environmental Data

GHG Accounting Boundary and Methodology

Third-Party Verification

# CEO's Message

Hello to all!

Climate change is a common challenge for all human beings, and is closely relevant to the sustainable development. Nowadays, global climate change has shifted from a future challenge to an imminent crisis. Over the past summer, extreme weather has occurred across the globe—deadly heat waves and wildfires have swept Western Europe and North Africa, and continuous high temperature has hit unprecedented record in many regions in China. The latest report published by World Meteorological Organization (WMO) shows that the concentration of main greenhouse gas (carbon dioxide, methane and nitrous oxide) in the atmosphere reached a record high in 2021, and global climate change has brought increasingly severe impact on the natural ecosystem and human economy and society. According to the IPCC report, with the aim to limit global warming to 1.5°C, the greenhouse gas (GHG) emissions need to peak by 2025, and be reduced by half in 2030. In order to mitigate the impact of extreme weather caused by global warming, all parties need to take ambitious and robust actions to facilitate the green and low-carbon transition.

Facing up to the climate change crisis, it's a key step to replace traditional energy with renewable energy in the green and low-carbon transition. It's predicted that, in order to provide effective support for global energy transition and lay the foundation for global net zero emission, the annual addition to global installed PV capacity shall reach 1,500 to 2,000 GW by 2030, which is 10 times the level of 2021. Green and low-carbon transition will give birth to a giant green market, unleashing new momentum for green development.

As the world's leading green energy technology company, LONGi believes that technological innovations of green energy can help human beings achieve carbon neutrality at lower costs. In pursuit of perfection, we keep exploring each technological path. Since 2021, LONGi has broken the world record of PV cell conversion efficiency 12 times in a row, while continuously extending its reach in innovative solutions such as “green electricity + green hydrogen”. We're always committed to being the advocate, practitioner and leader of sustainable development in the global clean energy sector, making a positive contribution to green and low-carbon development and the building of a zero-carbon future in the world.

At LONGi, we are both ambitious and determinedly pragmatic when it comes to the practice of corporate climate action. We have first put forward the “Solar for Solar” concept at the 24th UN Climate Change Conference (COP24) . In 2020, LONGi has become the only Chinese company that has joined the four climate initiatives of RE100, EP100, EV100 and SBTi, soon later launched the construction of the first “Zero Carbon Plant” as well as the supply chain green partner empowerment program.

In the past year, LONGi has steadily advanced its climate action. We set up an accounting system of GHG emissions covering the Company's full value chain (scopes 1, 2 and 3), and accelerate the establishment of sustainable development and ESG management system; with actively increasing the proportion of green electricity and continuously improving energy efficiency, we reduce the carbon emission intensity of our products. All these efforts will lay a foundation for the gradual decoupling of productivity increase and carbon emission.

At present, facing multiple global challenges such as regional conflict, COVID-19 pandemic and supply chain instability, some countries have flip-flopped on their climate policies, while China constantly attaches great importance to addressing climate change and sticks to the path of green development. LONGi believes that tackling climate change and achieving net zero emission should be a global consensus, and is willing to work with partners from different walks for a joint action to accelerate clean energy transition and low-carbon green development. As a green energy technology company, we're ready to contribute to technological innovation and building a zero-carbon future for China and the world.

**Li Zhenguo**

**Founder & President, LONGi**

# Highlights

## Key Achievements in 2021

<p><b>3,096 GWh</b></p>	<p><b>40.19%</b></p>	<p><b>90.76%</b></p>
<p>LONGi consumed 3,096 GWh renewable energy, an increase of 21% compared to 2020</p>	<p>In 2021, LONGi's green electricity ratio reached 40.19%</p>	<p>LONGi's green electricity ratio in Yunnan was up to 90.76%</p>
<p><b>-20.8%</b></p>	<p><b>160 thousand tons</b></p>	<p><b>1,680 thousand tons</b></p>
<p>LONGi has achieved 20.8% reduction in operational emissions per unit of revenue compared to 2020</p>	<p>169,716 tCO<sub>2</sub>e emissions have been cut off through energy saving measures taken by LONGi in 2021</p>	<p>LONGi's consumption of green electricity avoided 1,680 thousand tons tCO<sub>2</sub>e GHG emissions</p>
<p><b>720,000 GWh</b></p>	<p><b>340 million tons</b></p>	<p><b>No. 1</b></p>
<p>All PV silicon wafers produced by LONGi since its public listing are expected to generate over 720,000 GWh green electricity</p>	<p>As of 2021, all PV silicon wafers produced by LONGi since its public listing has avoided emissions over 340 million tCO<sub>2</sub>e</p>	<p>LONGi ranked No. 1 in the PV industry, for the second year in a row, in CATI (Corporate Climate Action Transparency Index) published by IPE<sup>1</sup></p>

<sup>1</sup> Institute of Public and Environmental Affairs (IPE) is committed to collecting, sorting out and analyzing environmental information disclosed by governments and enterprises, promoting the transparency of environmental information and the improvement of environmental governance mechanism, with joint efforts of different parties including enterprises, governments, non-profit organizations, and research institutes.

# Our Commitments

## Our Vision

We firmly believe that technological innovation of green energy can help human beings achieve carbon neutrality at ever decreasing costs. We're committed to being the advocate, practitioner and leader of sustainable development in the global clean energy sector.

## Our Goals

LONGi has successively joined RE100, EP100 and EV100 initiatives in 2020, and committed to the Science Based Targets initiative (SBTi), making it the only Chinese company that has joined all the four climate initiatives.

### Science Based Targets (SBTi)

LONGi has set 2030 science-based target of emissions reduction aligned with the Paris Agreement to limit global warming to 1.5°C.

LONGi is committed to reduce absolute Scope 1 and 2 GHG emissions by **60%** in 2030 from a 2020 base year.



LONGi aims to achieve **20%** reduction of GHG emission intensity per ton of silicon materials, per watt of solar cell and per ton of glass purchased in 2030 from a 2020 base year.



**RE 100** LONGi promises to achieve 100% use of renewable energy in its production and operations across the world by 2028 at the latest.

**EP 100** The deployment of the energy management system will be completed before 2025, and energy efficiency will be improved by 35% compared to the 2015 baseline.

**EV 100** EV charging facilities will be installed in 100% of production and operation sites by 2030, and employees will be encouraged to use electric vehicles as their private car.



# 01

## Accelerating Operational Emissions Reduction

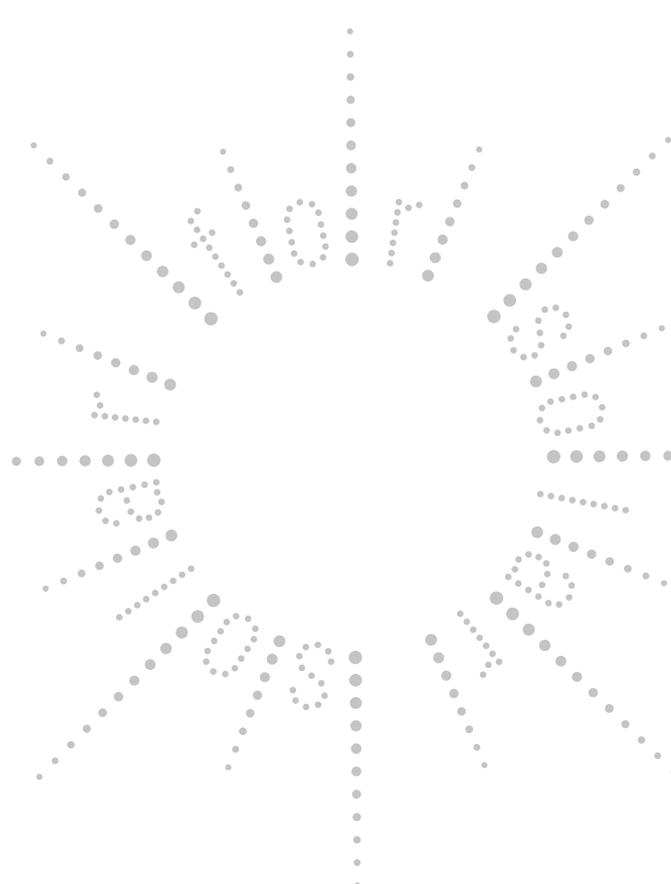
---

2021 Scope 1 and 2 Emissions

Progress on Operational Emissions Reduction

Decarbonization Roadmap

Zero Carbon Plant

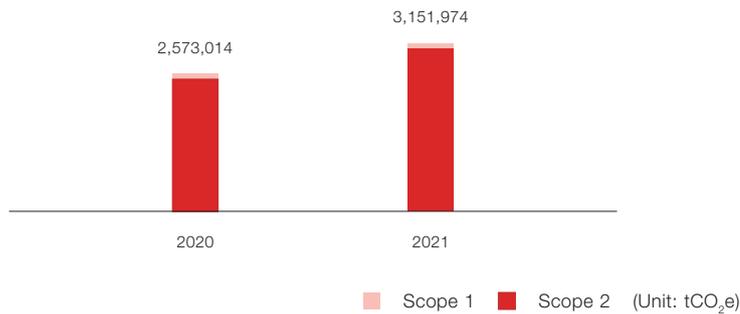


# 2021 Scope 1 and 2 Emissions

## Overview

LONGi has established an internal carbon footprint system covering the Company's full value chain (Scope 1, 2, and 3), including dividing GHG emission accounting units based on scientific methods, preparing accounting practice guidelines and organizing capacity building trainings. LONGi has completed the measurement and calculation of its own operational emissions for two consecutive years, and the results have been verified by third-party institutions.

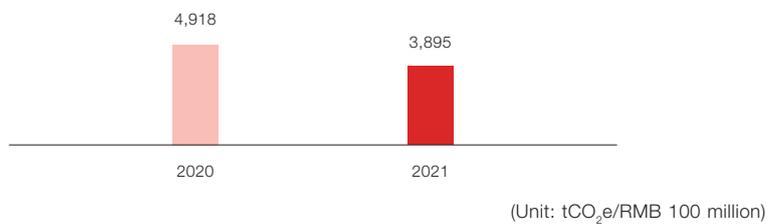
2021 and 2020 Operational Emissions Overview



LONGi's operational emissions in 2021 are 3,151,974 tCO<sub>2</sub>e, **22.5% higher** than 2020. Among which:

- Scope 1 emission is 94,750 tCO<sub>2</sub>e, accounting for 3.0% of the total operational emissions, **2.3% higher** than 2020;
- Scope 2 emission<sup>1</sup> is 3,057,224 tCO<sub>2</sub>e, accounting for 97.0% of the total operational emissions, **23.3% higher** than 2020.

Scope 1&2 Emissions Per Unit of Revenue



↓ 20.8%

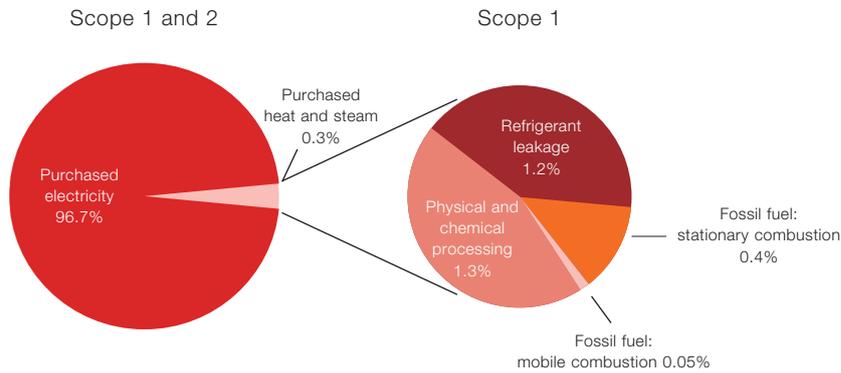
For emission intensity, LONGi has achieved **20.8%** decrease in operational emissions per unit of revenue, compared to 2020, indicating that LONGi has managed to meet the rapidly increasing global demand for PV capacity while further lowering its carbon emission intensity.

<sup>1</sup> Data specification: The "market-based" approach was applied when calculating scope 2 emission.

## Analysis

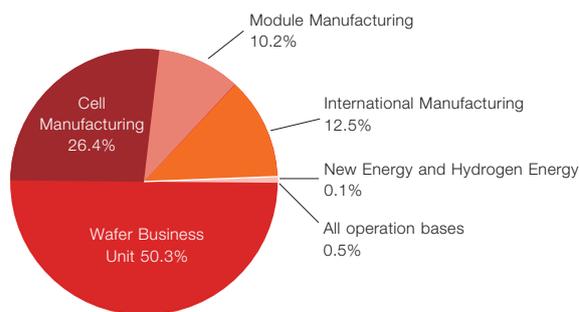
In 2021, the Scope 2 emissions of LONGi were over 3 million tons. As the main source of operational emissions, Scope 2 accounted for **97%** of the total emissions, while scope 1 only accounted for **3%**. The emissions generated by electricity consumption took up **more than 96%** of total operational emissions, followed by the emissions from physical and chemical processing at nearly **1.3%**.

Operational Emissions: By Source



Emissions from manufacture has contributed to over **99.5%** of operational emissions, while emissions from operation only took up **0.5%**. Among the operational emissions, more than half of the emissions came from silicon wafer production, followed by cell production which contributes to around a quarter of total emissions.

Operational Emissions: By Business Unit



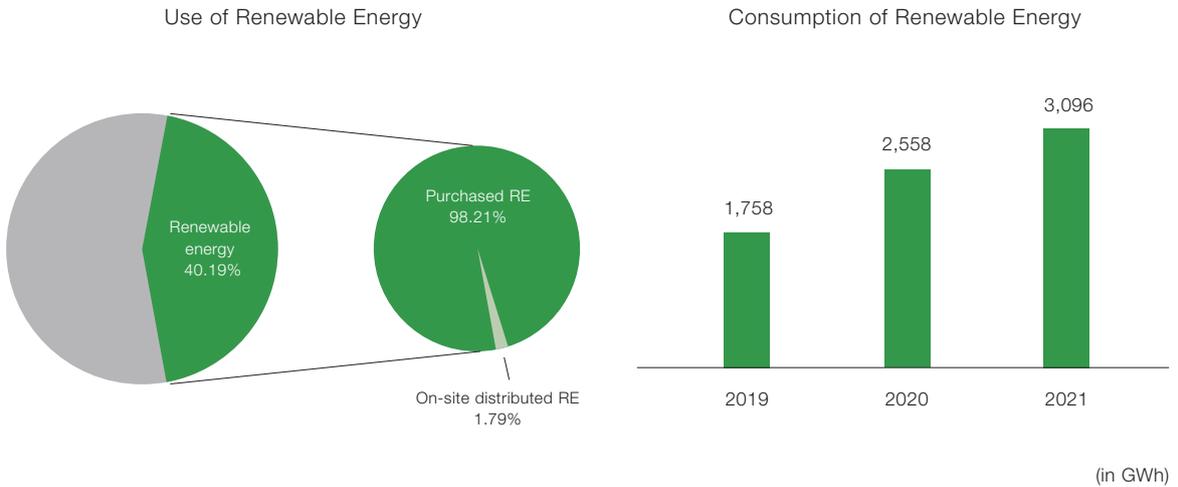
Among LONGi's global manufacturing bases<sup>1</sup>, the top 10 bases with the largest emission volume contribute to **80.2%** of the total emissions. LONGi will place more emphasis on these bases for the next step of emissions reduction.

<sup>1</sup> Boundary specification: 2020 footprint boundary did not include Vietnam base. Meanwhile 2021 emission data covered data from all production and operation bases, including the Vietnam bases whose emissions accounted for 7.4% of LONGi overall operational emissions in 2021.

# Progress on Operational Emissions Reduction

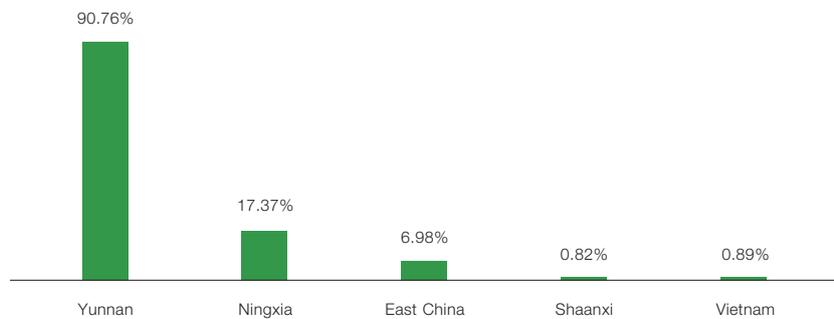
## Renewable Energy Consumption

As a member of RE100 Initiative, LONGi promises 100% renewable energy consumption by 2028, and traces and reports the use of renewable energy on an annual basis according to *RE100 Technical Criteria*. In 2021, LONGi's total electricity consumption is 7,702.4 million kWh, among of which 3,095.9 million kWh is renewable energy, accounting for **40.19%** in total electricity consumption. It is estimated that the consumption of renewable energy can avoid about **1,686,110 tCO<sub>2</sub>e** of emissions.



Among different sources of consumed green electricity, purchased renewable electricity is 3,040.4 million kWh, approximately 98.21% of the total; on-site distributed renewable energy facilities have generated 55.5 million kWh, accounting for nearly 1.79%. Compared with 2020, LONGi has increased 538.0 million kWh of green electricity consumption, witnessing over 21% growth.

2021 Renewable Energy Consumption: By Region



Among all LONGi's production bases around the world, Yunnan base has the highest proportion of green electricity consumption, reaching **90.76%**.

## Energy Saving and Consumption Reduction

LONGi joined the EP100 Initiative in 2020, and commits to 100% installation of Energy Management System (EMS) in its production and operation sites by 2025 and a 35% higher energy efficiency than the 2015 level. In 2021, LONGi has continuously improved its comprehensive energy utilization efficiency and digital intelligence level through energy saving management, energy saving technological transformation and energy saving awareness improvement. The energy consumption intensity increased by 53.85% compared with 2015.

### Energy Saving Management

LONGi has developed an overall implementation plan for the Group's energy management system, launched the Energy Management Information System, and established an incentive mechanism to promote the implementation of energy saving and emissions reduction projects.

Achievements of LONGi Energy Management System in 2021:



#### Formulating Work Plans

- Clarified the Group's goals for energy management
- Established the Group's Energy Management Leading Group with the chairman as the group leader
- Specified the working mechanism of energy management system and division of work of all departments



#### Optimizing Management System

- Designated 93 energy management personnel at all levels
- Recruited 50 energy management experts
- Formulated and issued 9 system documents



#### Conducting Certification Training

- Formulated the construction plan for the Group's energy management system
- Conducted ISO50001 Energy Management System certification in 3 bases
- Organized training sessions for internal auditors of energy management system



#### Promoting Construction of Energy Management System

- Formulated an overall implementation plan for the Group's Energy Management System (EMS)
- Completed construction of Energy Management System in 6 bases
- Initiated pilot construction of Energy Management System in 2 bases

## Energy Saving Technological Transformation

LONGi has increased investment in environmental protection, planned and implemented energy-saving transformation projects, and continuously reduced the intensity of energy and water use. In 2021, all units of the Group planned and implemented a total of 267 improvement projects (saving water /electricity and other resources), including continuous optimization of process and production systems, replacement of high-efficiency water pumps, optimization of circulating water systems and pump power, optimization of air conditioning systems and compressed air systems, implementation of frequency conversion transformation, frequency conversion of water pumps, air compressors and cooling towers, as well as waste heat recovery and automatic lighting control, optimization of the number of lamps, strengthening lighting management and other measures. These measures helped save 259 million kWh of electricity and reduce emissions by around **169,716 tCO<sub>2</sub>e**. In 2021, the overall electricity consumption of the whole Group decreased by 5.38% year-on-year.

**267**

The number of projects planned and implemented improvements

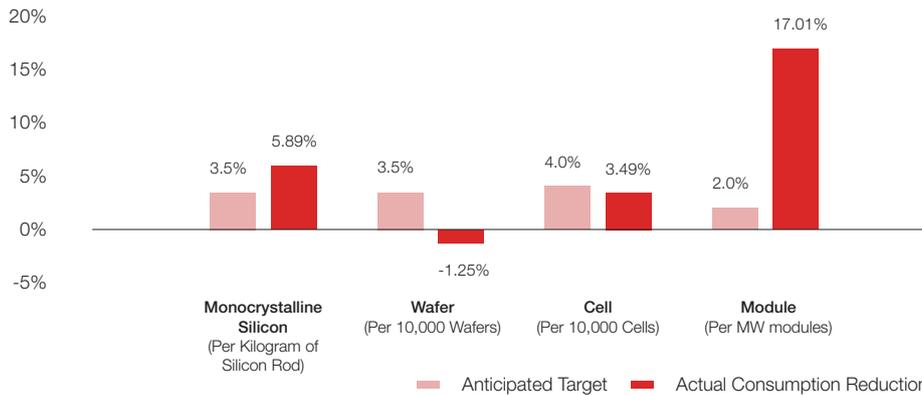
**259** million kWh

of electricity saved

**5.38%**

decrease in electricity consumption group-wide

2021 LONGi's Actual vs Target Energy Consumption Reduction of Each Production Unit



Note: The data are sourced from statistical analysis of LONGi's Energy Management Department

## Energy Saving Awareness Promotion

LONGi regularly propagates energy saving in all production units to promote the concept of green development and raise the awareness of energy saving and environmental protection. During the 31st National Energy Conservation Publicity Week in 2021, a series of publicity activities with the theme of "Energy Saving, Carbon Reduction and Green Development" were held at the Group headquarter to encourage employees to take practical actions and move towards a zero-carbon future together.

# Decarbonization Roadmap

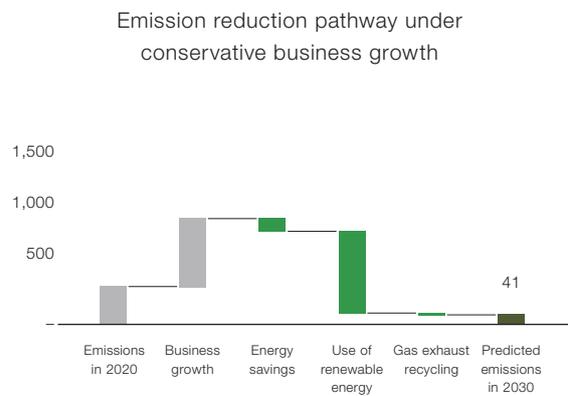
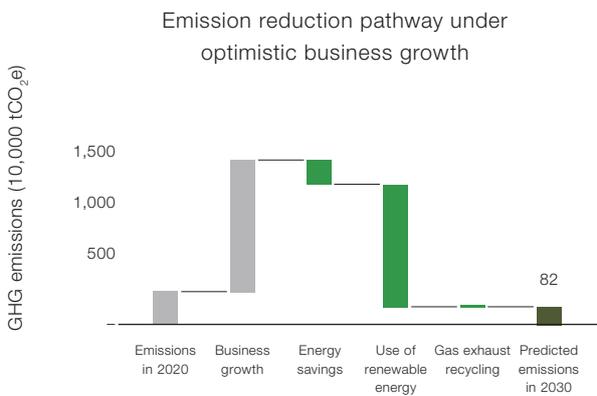
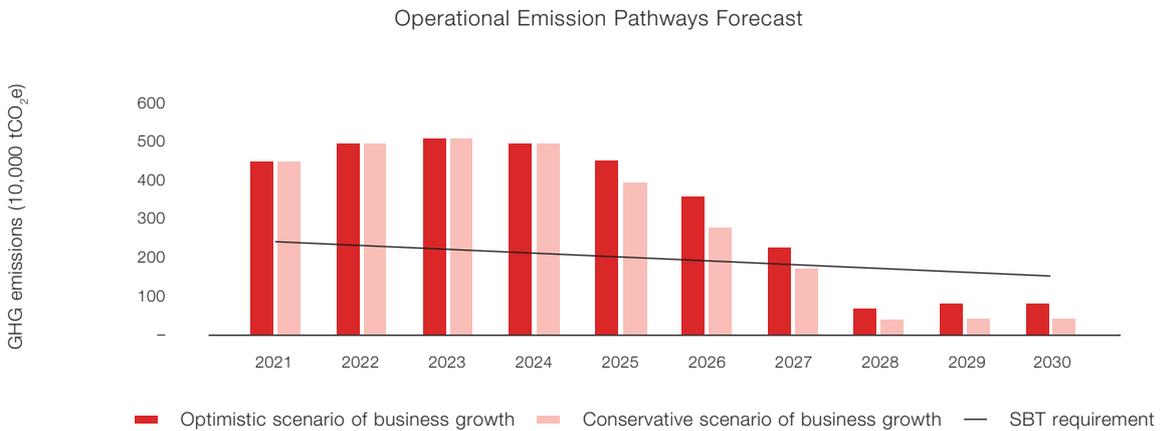
## Science Based Targets (SBTi)

LONGi has joined the Science Based Targets initiative (SBTi), and set up its 2030 science-based targets for operational emissions (Scope 1 and 2) reduction in line with 1.5°C pathway.

From a 2020 base year, LONGi will reduce absolute Scope 1 and 2 GHG emissions by **60%** in 2030. Currently, LONGi has submitted the target documents to SBTi for validation.

## Emissions Reduction Pathways

It is estimated that if the RE100 is achieved as scheduled by 2028, LONGi's total operational GHG emissions in 2030, under the optimistic and conservative business growth scenarios, will decrease by **68%** and **84%** respectively compared with 2020 (the remaining total emissions will be 823 thousand tons and 412 thousand tons respectively).



Considering that over 95% emissions are generated by electricity consumption, LONGi's efforts to cut down emissions in scope 1 and 2 will focus on energy saving and consumption reduction, as well as renewable electricity consumption.

According to RE100 target, we expect to achieve 100% renewable electricity consumption in 2028. By 2030, green electricity consumption is expected to contribute to **83%** of emissions reduction. Meanwhile, LONGi continues to push forward energy saving and consumption reduction, by further bringing down the unit power consumption of product manufacturing. By 2030, energy saving and consumption reduction measures are expected to contribute to **16%** of emissions reduction.

Moreover, LONGi will complete the renovation of Baoshan base and put it into operation, which will allow large proportion of natural gas exhaust recycled, leading to a substantial decrease in Scope 1 emissions.

## Zero Carbon Plant

### Zero Carbon Plant of LONGi Baoshan

In October 2021, during the 15th Meeting of the Conference of the Parties to the UN Convention on Biological Diversity (COP15), LONGi announced to build the first "Zero Carbon Plant" in the production base of LONGi Silicon (Baoshan) in 2023, now the project develops smoothly in all aspects.

- 100% green electricity: To fulfill the RE100 commitment, we actively leverage with a high-ratio or even 100% use of renewable electricity to bring down a large amount of indirect GHG emissions, laying a solid foundation for the Zero Carbon Plant.
- Energy saving and technical improvement: Through gas exhaust recycling in the sedimentation shop, exhaust recycling from melting furnace, technical improvement of high-temperature furnaces, and introduction of grinder into crucible shop, we have improved energy and raw material use efficiency, and reduced direct GHG emissions during production processes.
- Factory greening: we have completed internal and external greening of the factory zone, by using green plants to absorb CO<sub>2</sub> and noxious gas, building a "Zero Carbon Square" in the factory with the aim to enhance the staff's awareness of green and low-carbon environment and encourage their participation.

Currently, LONGi Baoshan is focusing on the progress of the crucial gas recycling and technical improvement project. This project is expected to help Baoshan base reduce carbon emissions from 32,000 t to 3,200 t per year, over 90% drop. In the meantime, LONGi will introduce third-party institutions for PAS 2060 carbon neutrality standard coaching to get ready for the verification of Baoshan site as a "Zero Carbon Plant".



# 02

## Promoting Value Chain Emissions Reduction

---

2021 Scope 3 Emissions  
Progress on Value Chain Emissions Reduction  
Emissions Reduction Strategy and Action Plan  
in Value Chain

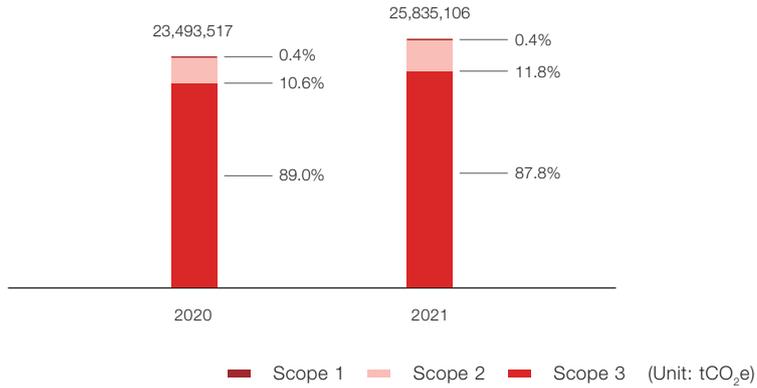


# 2021 Scope 3 Emissions

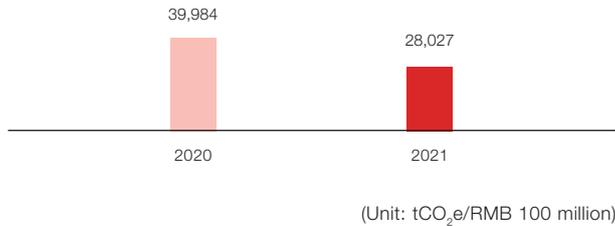
## Overview

In 2021, the Scope 3 emissions of LONGi is 22,683,132 tCO<sub>2</sub>e, representing **87.8%** of total emissions (Scope 1, 2 and 3). Therefore, Scope 3 emissions reduction will remain a long-term focus for LONGi. Compared with 2020, 2021 Scope 3 emissions has increased by **8.4%**, mainly due to the rapid expansion of LONGi's business and the constant growth of output. Emission intensity, on the other hand, has significantly declined – Scope 3 GHG emissions per unit of revenue have dropped by 29.9%.

2020 and 2021 Full Value Chain Emissions Overview



Scope 3 Emissions Per Unit of Revenue

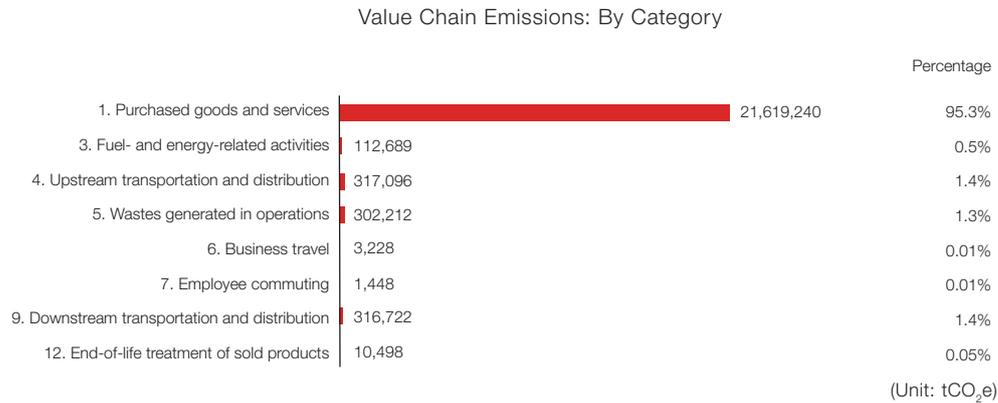


**29.9%**

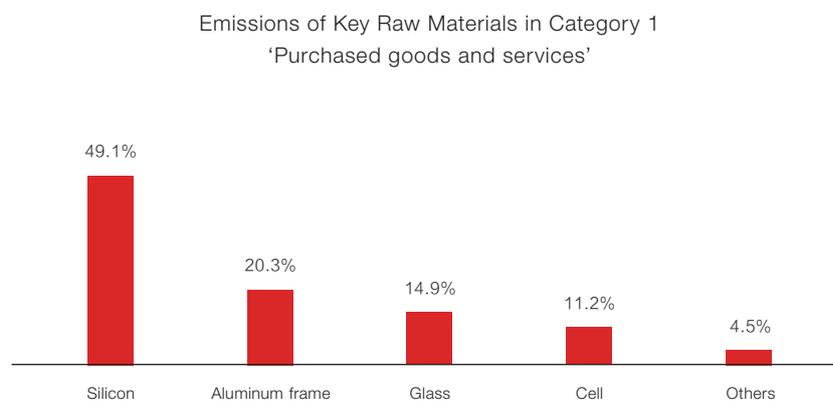
In 2021, Scope 3 emission intensity has dropped by **29.9%** compared to the 2020 level.

## Value Chain Emission Analysis

Purchased goods and services (category 1) is the largest source of LONGi’s value chain emissions, accounting for about 95%. The emissions mainly come from the upstream emissions of purchased raw materials such as silicon and glass. Next major emission sources are upstream transportation and distribution (category 4), downstream transportation and distribution (category 9), and waste generated in operations (category 5). These four categories contribute to more than 99% of Scope 3 emissions.



Based on Scope 3 calculations, silicon, aluminum frames, glass and PV cell are the most important raw materials, with total emissions of 20,639,562 tCO<sub>2</sub>e in 2021, contributing to 91% of LONGi’s Scope 3 emissions. In the next step, LONGi will prioritise these key raw materials, carry out targeted supplier engagement, and continue to promote Scope 3 emissions reduction.



We are fully aware that the current Scope 3 emissions data only covers key categories and key raw materials. To improve the completeness and accuracy of Scope 3 emissions, we will continue to optimize our Scope 3 methodology to include more supplier data and to build a more comprehensive and accurate model of the value chain carbon footprint.

# Progress on Value Chain Emissions Reduction

## Promoting Green Supply Chain Management

In 2021, LONGi continued to improve green supply chain system, and after launching the LONGi Green Supply Chain Carbon Reduction Initiative with 150 suppliers, LONGi supported 27 suppliers to carry out self-assessments for their environmental performance. The “Supply Chain Green Partner Empowerment Program” has also been launched afterwards to support and empower suppliers and partners to promote energy saving and emissions reduction. The program will involve more than 200 suppliers to participate in empowerment learning, 50+ suppliers to measure organizational carbon footprints, and 10+ supplier to set scientific emission reduction targets, to jointly promote the green and low-carbon transition of the photovoltaic (PV) supply chain and reduce the carbon footprints of the PV value chain.



**Responsible Sourcing**

- Screen new suppliers using environmental criteria, which include indicators of energy consumption and emissions of suppliers and their products;
- Monitor the environmental performance of suppliers through supply chain management platform, such as the Blue Map of Public and Environmental Affairs (IPE);
- Give preference to local suppliers under the equal conditions.



**Cooperative Innovation in Supply Chains**

- Establish communication mechanism with suppliers to promote new materials and processes featuring low carbon and eco-friendly attributes;
- Encourage suppliers to build their plants nearby, and jointly complete value engineering projects that involve energy saving and efficiency improvement;
- Promote the application scope of clean energy and zero-carbon technology at the upstream gradually.



**Strengthening Supplier Management**

- Encourage suppliers to disclose information on emissions, set emissions reduction targets and carry out energy saving and emission reduction actions;
- Strengthen cooperation of supply chain on climate actions, and empower carbon management for suppliers;
- Increase the supplier base included in the green supply chain management system gradually;
- Sign strategic cooperation agreement with key suppliers to jointly promote commitments and practices addressing climate action;
- Join the international sustainable supply chain initiatives and promote the reduction social and environmental impacts of supply chains.

## Supporting Electrification of Employee Commute

After joining EV100 Initiative in 2020, LONGi has promised to install charging facilities in all its production and operation sites. LONGi actively fulfills the EV100 commitment by installing charging piles and PV car parking sheds in production and operation bases, as well as solar storage and charging intelligent equipment, introducing famous EV brands to LONGi, providing EV-friendly support for staff, so as to enhance their awareness of green and low-carbon development, and reduce carbon emissions during their commute.

As of the end of 2021, LONGi has installed more than 50 EV charging facilities, including 41 AC charging piles (7kW) and 9 DC charging piles (40kW), built a PV car parking shed in headquarters, and applied unified charging pile installation norms and standards through centralized procurement, which all prepared for the full coverage of EV charging piles.

# Emissions Reduction Strategy and Action Plan in Value Chain

Scope 3 emissions represent the most significant contributor to LONGi's full value chain footprints, where emissions from procurement of raw materials dominate. In order to reduce emissions from upstream and downstream of the value chain, LONGi focuses its emissions reduction effort on every aspect including purchased goods, transport, operation, and waste disposal.

## Procurement of Raw Materials

### Establish a green supplier management system

- Identify key suppliers and cooperate to jointly develop zero-carbon solutions for the upstream value chain;
- Develop green procurement standards, encourage suppliers to disclose information on emissions, set reduction targets, embark on climate actions, and monitor climate performance of suppliers.

### Promote technological innovation and R&D on low-carbon materials and design

- Improve product design to enhance the recyclability of materials;
- Promote alternative materials and technologies featuring lower carbon attribute;
- Prolong the service life of products and reduce the need to replace.

## Upstream Transportation

### Reduce logistics emissions from upstream activities

- Give preference to local suppliers under the equal conditions, to reduce emissions from logistics;
- Encourage suppliers to build plants nearby, and improve the geographical concentration of operation of the value chain;
- Promote the increase of EV in supplier's fleet, replacing internal combustion engines vehicles with renewable energy vehicles.

## Wastes in Operations

### Dispose and recycle wastes in operations properly

- properly store, dispose and recycle wastes, including silicon mud, waste diamond wire, graphite, waste paper, cardboard, and waste plastics; increase the recycle rate of waste materials and reduce the landfill rate;
- Improve the utilization rate of material input and reduce the waste generated from the manufacturing process.

## End-of-life Treatment

### Upgrade product design and choice of materials

- Improve product design to enhance the recyclability and reutilization of PV modules and packaging, to increase the materials that can be circulated in the entire value chain for a longer time, and advocate to reduce packaging across the whole industry chain;
- Improve the durability of PV modules and reduce the need to maintain, repair or replace.

### Explore recycle solutions for scrap PV modules

- Cooperate with the upstream and downstream of the industry chain to develop recycling technologies and policies of PV products, and build a standard recycling and disposal ecology for scrap PV modules;
- Invest and apply technical solutions to the recycle, disassembly and reutilization of scrap PV modules featuring lower carbon and eco-friendly attributes;
- Enhance after-sales policies for PV modules and strengthen the recycle those at the end of lifetime.

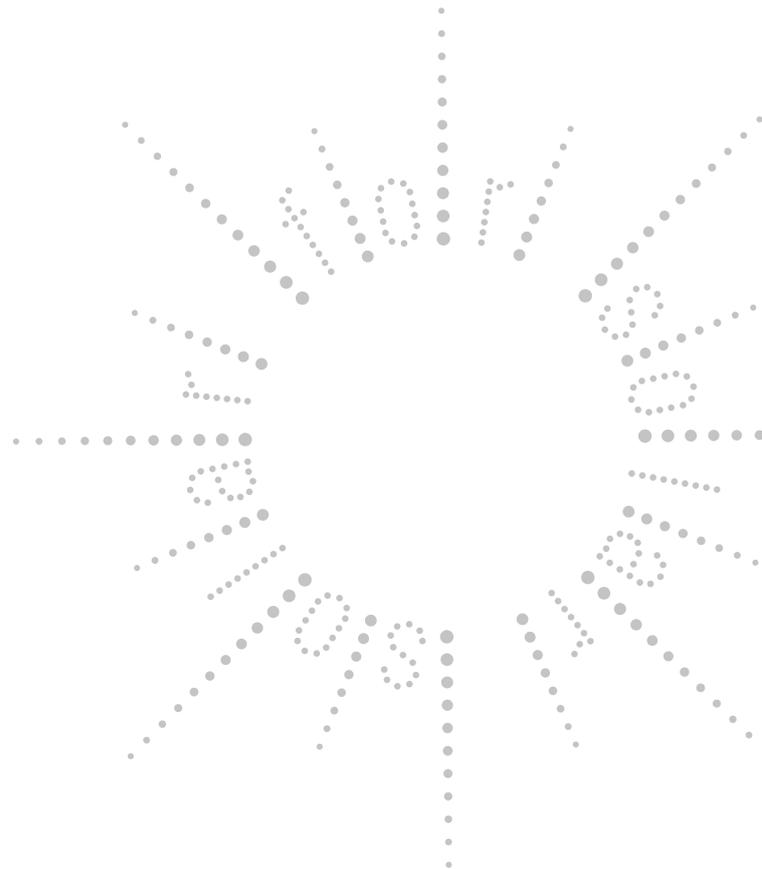


# 03

## Contributing to Net Zero Future

---

- Create Green & Low-Carbon Products
- PV Product-Enabled Emissions Reduction
- Innovative Green Solutions



## Create Green & Low-Carbon Products

Adhering to the 3R (Reduce, Reuse, Recycle) manufacturing concept, LONGi has integrated sustainability into different steps, including supply, material, product design, and manufacturing, with control on carbon emission throughout the entire product life cycle, and implanted the green concept in “LONGi product life cycle standard”, in order to make sure module products are robust and reliable with eco-friendly and low-carbon benefits.

In the production of high-efficiency PV modules, LONGi has successfully built a green sustainable chain covering material selection, manufacturing, end-use and waste recycling. In 2021, LONGi has passed the green manufacturing certification by the Ministry of Industry and Information Technology of China, and has also been awarded three national honors of “Green Factory”, “Green Design Product” and “Green Supply Chain Management Company”.

Up until now, all products of LONGi Hi-MO series have been certified with the “Product Carbon Footprint Declaration” issued by BUREAU VERITAS. As all steps of LONGi Hi-MO 5 PV module production, including material, production line process, module manufacturing, and transportation energy consumption have met the carbon footprint control criteria of France, these PV module products based on 182mm silicon wafers are also awarded the “Carbon Footprint Certificate” issued by Certisolis, a leading certification body in France.



**Green Material**

- Promote waste-free design, recyclable and easy-maintenance design;
- Conduct research and promote the use of green materials.



**Green Packaging**

- Require suppliers to innovate their own packaging scheme in line with LONGi’s standards and advocate to reduce packaging, using greener logistics and recycling across the whole industry chain.



**Green Manufacturing**

- Join the EP100 Initiative and carry out technical rectification for energy saving, and ensure that selected equipments are able to minimize energy consumption during the production process;
- Join the RE100 Initiative, increase the use of green power in all production steps and reduce carbon emissions from manufacturing.



**Low Carbon Recycling**

- Incorporate the considerations of recycling into the product design in advance. Solar cells, glass, backplates, aluminum frames, EVA, and many elements of PV product have recycling value, and over 90% of products are expected to be comprehensively recycled and reused;
- Join the “PV Recycle Industry Development Center” launched by China Green Supply Chain Alliance and explored recycling technology and policy of PV products with related enterprises and institutes;
- Dispose the scrapped PV modules and equipment strictly in line with local regulations and recycled a total of 38.45MW PV modules in 2021.



With its outstanding performance, LONGi Hi-MO 5 modules have obtained the world’s first IEC/TS 62994 certificate issued by TÜV Rheinland. This certification comprises two parts, EHRA (Environment Health Risk Assessment)<sup>1</sup> and LCA (Life Cycle Assessment)<sup>2</sup>, a systematic evaluation of the full process of PV product manufacturing, end-use, recycling, waste disposal and health-safety-environment risk assessment, etc. IEC/TS 62994 certificate is deemed as the approval of LONGi Hi-MO 5 PV modules in terms of health, safety and green & low-carbon development, helping clients achieve energy transition in a healthier and greener way.



The global leader in applied safety science, UL Solutions, has certified EPD (Environmental Product Declaration) for LONGi high efficiency modules, which is also recognized by EPD Italy through the mutual recognition program. The aforesaid certification covered production steps of crystal pulling, silicon wafer, cell, modules at LONGi, and took 5 months for the data collection and verification steps. Through calculation and analysis by UL Solutions experts, LONGi’s high-efficiency modules, including LR4-72 series, LR5-54 series and LR5-72 series, were found to meet the performance criteria of EPD. In the future, LONGi will continuously commit to international environmental initiatives, accelerate the innovation and upgrade of PV technology in an all-round way, and strive to provide healthier, eco-friendly and quality high efficiency PV products for all users around the world.

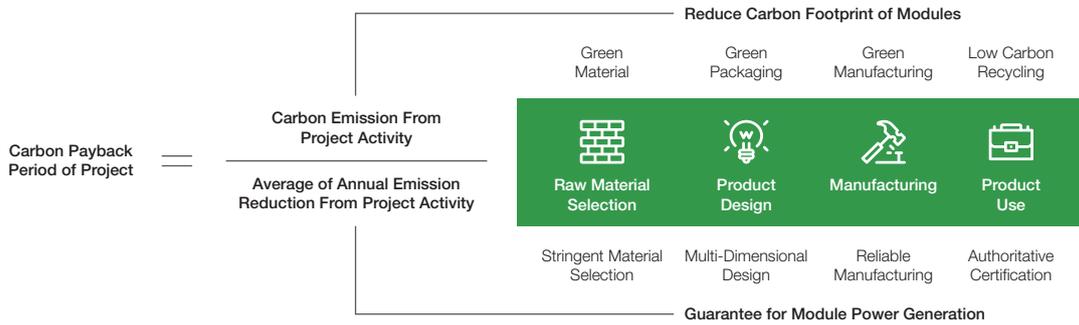
<sup>1</sup> EH&S Risk Assessment refers to environmental and health risk assessment, a systematic inspection approach of potential harm on human health and environment during unconventional operations. This assessment approach comprises the procedures of risk identification, dose-response assessment, exposure analysis and risk characterization. Based on the systematic assessment of health and safety risks, we can confirm if product manufacturing meets the environment-health-safety policy, regulatory requirements, and operation strategy, thus allowing us to keep improving the performance of environment, health and safety.

<sup>2</sup> LCA refers to life cycle assessment of the complete process covering raw material extraction, production, product use, recycle, reuse and waste disposal, based on the life cycle assessment methods and requirements of ISO14040/ISO14044, which is used to clearly calculate and evaluate the product impact on environment through a top-down estimation.

# PV Product-Enabled Emissions Reduction

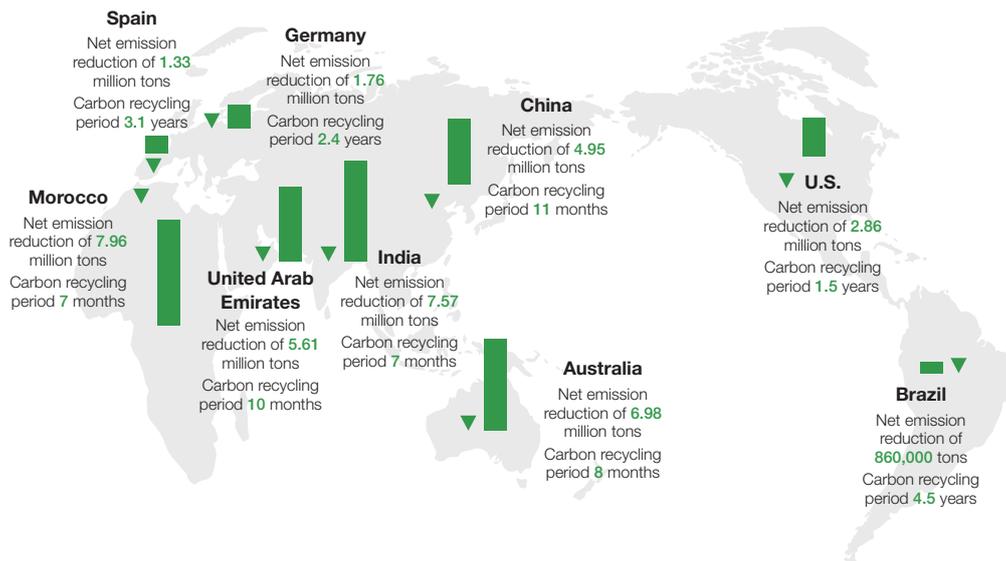
## Enablement Effects of LONGi Modules

As a provider of green and clean energy, PV products can greatly reduce GHG emissions compared with fossil energy power generation. LONGi builds a green and low-carbon chain throughout the whole life cycle of its products, aiming to reduce the product carbon footprints while ensuring the power generation capability, thus improving the net emissions reduction enabled by PV modules in the whole life cycle and shortening the “carbon payback” period<sup>1</sup> of the project.



\*Only the simplified formula of “carbon payback” period is shown here. The actual calculation also takes into account change in annual amount of power generated and enabled emissions reduction.

We assessed the carbon footprint throughout the whole life cycle of our PV system, from manufacturing and transportation to O&M and estimated the enabled emissions reduction and carbon payback period of a 200 MW PV power station in various locations around the world built with LONGi Hi-MO 5 dual-glass modules emissions reduction within its life cycle of 30 years.



\*Capacity: 200 MW Module: Hi-MO 5 dual-glass products Lifetime: 30 years  
<sup>2</sup>Data source: ISO14067 report, LONGi GPCC simulator, IEA grid electricity emission factors<sup>2</sup>

<sup>1</sup> “Carbon payback” period is the duration of time needed for the cumulative emissions reduction and carbon emissions of the project throughout its lifecycle to break even.  
<sup>2</sup> The calculation of annual emissions reduction for 2021-2050 uses the average emission factors of each country’s power grid published by the International Energy Agency (IEA) in 2022, which reflects the 2020 grid level.

Taking a 200MW PV power station built with LONGi Hi-MO 5 dual-glass product modules in China as an example, the carbon emission intensity of the whole life cycle is only 3% of the grid emissions factor, and during the 30 years of operation, the net GHG emissions reduction from the project amounts to 4.95 million tons, equivalent to planting 24.76 million trees, and the carbon payback period is about 11 months.

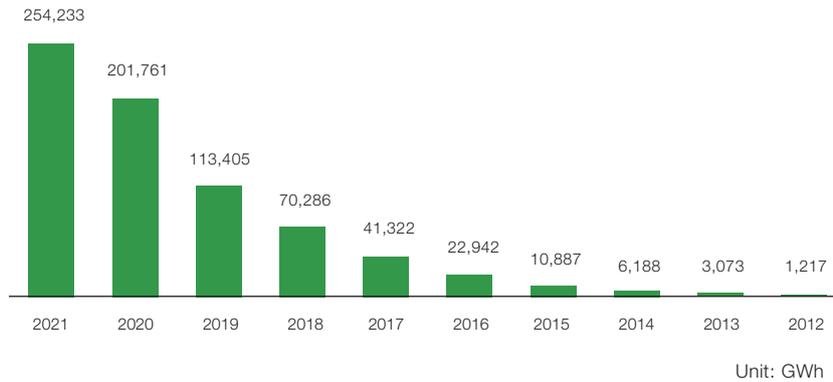
Annual carbon emissions reduction during 30-year operation



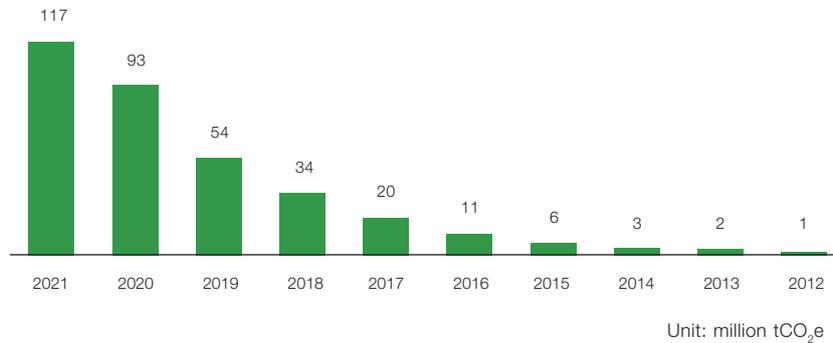
## Enablement Effects of LONGi PV Wafers

LONGi focuses on R&D and manufacturing of high-efficiency PV products, continuously providing green energy to the world. From its public listing in 2012 to 2021, the total capacity of solar wafers delivered by LONGi reached 204.47 GW, which can generate more than **720,000 GWh<sup>1</sup>** of clean power, equal to approximately 90 million tons of coal equivalent. The amount of clean power generated can avoid the emissions of more than **340 million tCO<sub>2</sub>e<sup>2</sup>**, equivalent to planting about **1.71 billion trees<sup>3</sup>**.

Annual power generation from PV wafers



Enabled emission reduction from PV wafers



<sup>1</sup> The calculation is based on the assumption that LONGi's PV wafers generate electricity for 1,500 hours per year, while the wafers produced in 2021 were deployed for half the time that year, thus 750 hours.

<sup>2</sup> The amount of enabled emissions reduction of 2012-2021 is calculated based on IEA grid electricity emission factors published in 2022 emissions reduction.

<sup>3</sup> The equivalent tree planting is calculating based on the assumption that a tree can absorb and store 10 kilograms of carbon dioxide per year for 20 years, as it is also the estimated period length of a forest carbon sink project.

# Innovative Green Solutions

## Building-integrated PV System

The combination of PV products and building is gaining traction around the world. LONGi ROOF BIPV<sup>1</sup> system is a PV product with architectural properties, and high performance in efficiency, security, heat dissipation, wind and water resistance, and force resistance, which makes it suitable for a variety of application scenarios, and all components of the entire system have a life as long as 25 years. In October 2022, LONGi ROOF BIPV series won the championship of “All Quality Matters’ BIPV module performance AQM Award 2022” for its excellent material attributes, reliable performance and stable power generating capacity, and LONGi ROOF BIPV is also the only BIPV product suitable for industrial and commercial roofs certified by TÜV Rheinland.

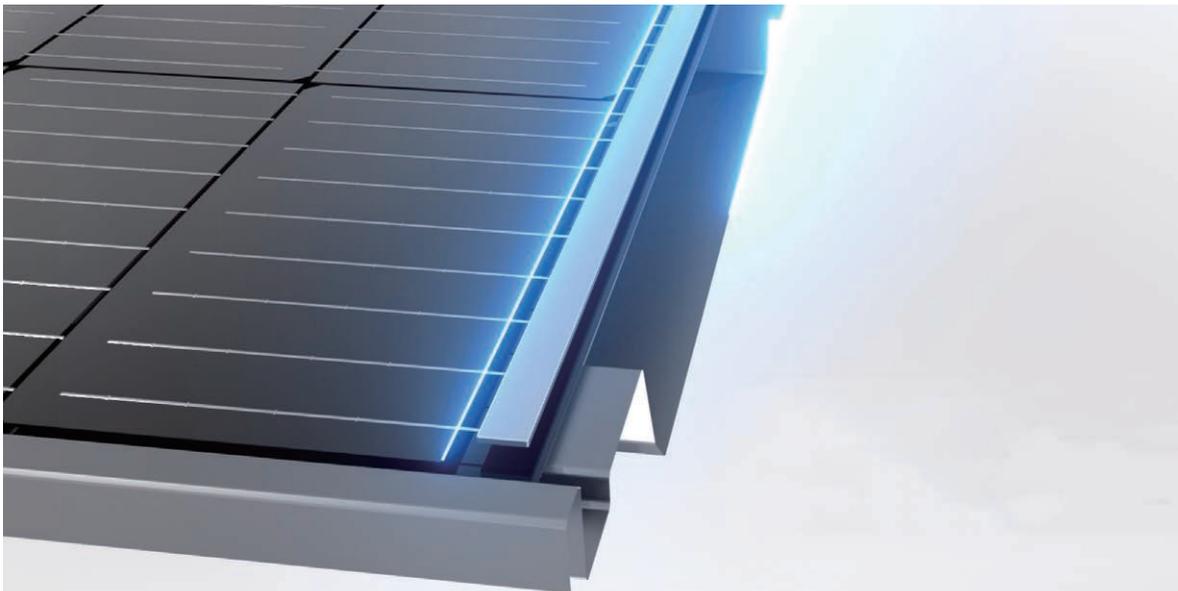
The industrial park BIPV project of Shandong Heavy Industry Group is currently the largest BIPV project in the world, completely built with LONGi BIPV products, whose installed capacity is at least 20% higher than traditional PV product, with more than 3% increase in power generation. The phase I project is expected to generate 143 GWh electricity, with nearly **140,000 tons** of carbon emissions reduction per year. It gives strong momentum to climate actions of Shandong Heavy Industry Group and helps the group transform from sole “energy consumer” to “energy producer” with practical action, serving as an excellent example of building-integrated PV system in the industry.

---

### LONGi Roof Quality Advantage

The whole system has a long life of 25 years, and the net income increases by 26.89% during the whole life cycle.

Integrated construction of metal roof enclosure system,  
Integrated warranty, Access to Green electricity.




---

<sup>1</sup> “BIPV” (Building Integrated PV) is a solar PV power generation system that is designed, constructed and installed the same time as the building and perfectly integrated with the building system, also known as “constructed” and “building material” solar PV buildings. As part of the external structure of the building, it does not only generate power, but also serves as building components and building materials. It can even enhance the outlook of the building and forms a perfect unity with the building.

## Green Electricity+Green Hydrogen Solution

In 2021, LONGi officially entered the hydrogen sector, and launched the “green power+green hydrogen” solution to support the society-wide carbon neutrality goal. With its commitment to the green development as well as high R&D investment and technology-driven product innovation, LONGi Hydrogen has built up its capability of installing large-scale electrolysis equipment, and kept improving products and intermittent green electrolytic hydrogen production solutions. LONGi Hydrogen has been shortlisted for SINOPEC’s first 10,000-ton green hydrogen demonstration project, which is by far the largest green hydrogen project in China and in the world and provides reference to energy transition in supporting the achievement of the carbon peaking and neutrality targets. The global leading alkaline water electrolysis system provided by LONGi has the following attributes:

- Firstly, four 1,000Nm<sup>3</sup>/h electrolysis are equipped for one gas-liquid separation device, and has production capacity up to 4,000Nm<sup>3</sup>/h and purification capacity up to 8,000Nm<sup>3</sup>/h. The system excels in energy consumption level from both empirical data and design quality;
- Secondly, the system combines high current density and high hydrogen yield perfectly, which effectively brings down the cost of investment;
- Thirdly, the system is adapted to the power quality and fast response to load featured in a large-scale renewable-energy-based hydrogen production scenario, where the response time to load can be measured in millisecond;
- Fourthly, the system is highly compatible with IGBT power and copes well with the matching issue between renewable energy and power quality parameters like harmonic power factor.

The project is estimated to be completed and put into operation in 2023. The green hydrogen produced will partly replace hydrogen produced from natural gas and can reduce **485,000 tons** CO<sub>2</sub> emission per year, making it a technologically-leading green hydrogen project worldwide.





# 04

## Appendix

---

Environmental Data

GHG Accounting Boundary and Methodology

Third-Party Verification



# Environmental Data

**Table: LONGi Energy Consumption in 2021**

Energy type	Quantity	Unit
Electricity	7,702,405	MWh
Heat and steam	78,362	GJ
Natural gas	5,296,479	Nm <sup>3</sup>
Diesel	371.7	Ton
Gasoline	178.8	Ton
LNG	4.6	Ton
LPG	78.3	Ton
Ethyne	0.1	Ton

**Table: LONGi Scope 1&2 GHG Emission in 2021**

Emission sources in Scope 1 and 2	Emissions in 2021 (tCO <sub>2</sub> e)	Percentage	Scopes 1/2 percentage
Scope 1	94,750	3.0%	
Emissions from fossil fuel combustion: Stationary combustion	12,173	0.4%	12.8%
Emissions from fossil fuel combustion: Mobile combustion	1,514	0.05%	1.6%
Emissions from physical and chemical processing	42,279	1.3%	44.6%
Fugitive emissions	38,784	1.2%	40.9%
Scope 2	3,057,224	97.0%	
Emissions from purchased electricity	3,048,604	96.7%	99.7%
Emissions from purchased heat and steam	8,620	0.3%	0.3%

**Table: LONGi Scope 3 GHG Emissions in 2020 and 2021**

Emission category	Emission in 2021 (tCO <sub>2</sub> e)	Percentage	Emission in 2020 (tCO <sub>2</sub> e)	Percentage
1. Purchased goods and services	21,619,240	95.31%	20,314,408	97.10%
3. Fuel- and energy- related activities	112,689	0.50%	82,162	0.39%
4. Upstream transportation and distribution	317,096	1.40%	353,090	1.69%
5. Waste generated in operations	302,212	1.33%	2,848	0.01%
6. Business travel	3,228	0.01%	Excluded	/
7. Employee commuting	1,448	0.01%	Excluded	/
9. Downstream transportation and distribution	316,722	1.40%	163,437	0.78%
12. End-of-life treatment of sold products	10,498	0.05%	4,558	0.02%
Total	22,683,132		20,920,503	

# GHG Accounting Boundary and Methodology

**Report period:** January 1, 2021 to December 31, 2021.

**Organizational boundary:** The organizational boundary defines the businesses and operations that constitute the company for the purpose of accounting and reporting greenhouse gas emissions. Companies can choose to report either the emissions from operations over which they have financial or operational control (the control approach) or from operations according to their share of equity in the operation (the equity share approach). LONGi’s carbon footprint uses the operational control approach. As such, it includes all its subsidiaries and holding companies.

**Operational boundary:** Defining the operational boundary involves identifying emissions associated with certain operations and categorizing them as either direct or indirect emissions. The following definitions are used:

**Direct GHG emission**

- Scope 1: Direct GHG emissions from sources owned or controlled by the reporting company.

**Indirect GHG emission**

Indirect GHG emissions from an organization’s activities but are from sources that owned or controlled by another entity. These are classified as:

- Scope 2: Indirect GHG emissions from the consumption of purchased electricity, heat or steam.
- Scope 3: Indirect GHG emissions from other activities. A detailed Corporate Value Chain (Scope 3) Standard, as outlined per the GHG Protocol, exists that sets out the rules for 15 categories of Scope 3 emissions.

Emission categories included in LONGi Scope 1, 2 and 3, and categories excluded are identified based on the following reasons:

**Table: Identification of Emission Categories for Scope 1 and 2**

Operational emission category	Included or not	Reasons for exclusion
Fossil fuel combustion	Included	/
Direct emissions from physical and chemical processing	Included	/
Refrigerant leakage	Included	/
Leakage from firefighting facilities	Not included	Negligible
Wastewater treatment	Not included	Wastewater treatment within operational boundaries do not cause GHG emission
Purchased electricity	Included	/
Purchased heat and steam	Included	/

**Table: Identification of Emission Categories for Scope 3**

Value chain emission categories	Included or not	Reasons for exclusion
Purchased goods and services	Included*	/
Capital goods	Not included	Estimated to be negligible and not included in current calculation
Fuel- and energy-related activities	Included	/
Upstream transportation and distribution	Included	/
Wastes generated in operations	Included	/
Business travel*	Included	/
Employee commuting	Included	/
Upstream leased assets	Not included	Non applicable
Downstream transportation and distribution	Included	/
Processing of sold products	Not included	Data unavailable at the moment, not included in current calculation
Use of sold products	Not included	Non applicable
End-of-life treatment of sold products	Included	/
Downstream leased assets	Not included	Non applicable
Franchises	Not included	Non applicable
Investment	Not included	Non applicable

\*Note: Some non-essential materials are not yet included in current data collection and emission measurement and calculation. LONGi will gradually expand the data collection scope, striving to improve the accuracy and completeness of Scope 3 footprint.

## Emission Factor Sources

Emission factors are calculated ratios relating GHG emissions to a measure of activity at an emissions source. LONGi has adopted the mix mode of primary data and secondary data to measure GHG emissions. Emission factors directly provided by suppliers or calculated with actual data are prioritized, while emission factors from internationally well-accepted data base or published by relevant authorities are chosen in the second place.

Emission sources	Emission factor sources
<b>Scope 1</b>	
Diesel	
Gasoline	
LPG	
Natural gas	<ul style="list-style-type: none"> <li>• China Energy Statistical Yearbook 2020</li> <li>• IPCC 2006 V2_2_Ch2_Table 2.3</li> <li>• IPCC 2006 V2_3_Ch3_Table 3.2.1, Table 3.2.2</li> </ul>
LNG	
Anthracite	
Bitumite	
Ethyne	
Refrigerant leakage	<ul style="list-style-type: none"> <li>• IPCC 2006 V3_8_Ch8_Table 8.2, Table 8.3, Table 8.4</li> <li>• IPCC 2019 Refinement V3_Ch7_Table 7.9</li> </ul>
<b>Scope 2</b>	
Electricity	<ul style="list-style-type: none"> <li>• China regional power grid average CO<sub>2</sub> emission factors in 2011 and 2012 by National Development and Reform Commission (NDRC)</li> </ul>
Heat and steam	<ul style="list-style-type: none"> <li>• Guidelines for GHG Accounting and Reporting for Industrial Companies and Other Sectors (Trial) by National Development and Reform Commission (NDRC)</li> </ul>
<b>Scope 3</b>	
1. Purchased goods and services	<ul style="list-style-type: none"> <li>• Gabi database</li> <li>• Calculation based on supplier data and Gabi database</li> </ul>
3. Fuel- and energy-related activities	<ul style="list-style-type: none"> <li>• China regional power grid average CO<sub>2</sub> emission factors in 2011 and 2012 by National Development and Reform Commission (NDRC)</li> <li>• China Electric Power Yearbook 2019</li> <li>• Provincial Guidelines of GHG Inventory Preparation (Trial)</li> </ul>
4. Upstream transportation and distribution 9. Downstream transportation and distribution	<ul style="list-style-type: none"> <li>• GHG Emission Calculation Tool</li> </ul>
5. Wastes generated in operations	<ul style="list-style-type: none"> <li>• Gabi database</li> </ul>
6. Business travel	<ul style="list-style-type: none"> <li>• Data provided by travel management system service provider</li> </ul>
7. Employee commuting	<ul style="list-style-type: none"> <li>• China regional power grid average CO<sub>2</sub> emission factors in 2011 and 2012 by National Development and Reform Commission (NDRC)</li> <li>• China Electric Power Statistical Yearbook 2019</li> <li>• China Energy Statistical Yearbook 2020</li> <li>• IPCC 2006 V2_2_Ch2_Table 2.3</li> <li>• IPCC 2006 V2_3_Ch3_Table 3.2.1, Table 3.2.2</li> </ul>
12. End-of-life treatment of sold products	<ul style="list-style-type: none"> <li>• Gabi database</li> </ul>

## Third-Party Verification

## CGC Assurance Statement of GHG Emissions

**鉴衡认证**  
CHINA GENERAL CERTIFICATION

### 温室气体排放验证声明

#### Assurance Statement of GHG emissions

---

证书编号 : CGC-CC&SS-CN20220002  
Certificate No. :

企业名称 : 隆基绿能科技股份有限公司  
Company Name : LONGi Green Energy Technology Co., Ltd.

地址 : 中国陕西省西安市  
Address : Xi'an, Shaanxi, PR China

报告周期 : 2021年1月1日 - 2021年12月31日  
Reporting Period : 01/01/2021 - 31/12/2021

温室气体排放量化标准 : ISO 14064-1:2018 Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals  
Applied Standards :

报告边界 : 直接排放 (范围 1) Direct GHG emissions  
能源间接排放 (范围 2) Indirect GHG emissions from imported energy  
其他间接排放 (范围 3) Other indirect GHG emissions  
Reporting Boundary :

温室气体类别 : CO<sub>2</sub> CH<sub>4</sub> N<sub>2</sub>O HFCs PFCs SF<sub>6</sub>  
GHG Included :

温室气体排放量 : 直接排放 (范围 1) : 94,750 tCO<sub>2</sub>e  
能源间接排放 (范围 2) : 3,057,224 tCO<sub>2</sub>e  
其他间接排放 (范围 3) : 22,683,132 tCO<sub>2</sub>e  
GHG Emissions :

经验证, 上述组织层面温室气体核算符合选定的标准, 结果准确、保守、可信。  
This is to assure that above GHG emissions accounting is in line with selected standards, results are accuracy, conservative, and reliable.



北京鉴衡认证中心有限公司  
China General Certification Center  
2022年04月25日  
证书专用章  
101052249097

# IEC TS 62994 Certificate



## Verification

---

**Registration No.:** FI 50548670
Page 1
**Report No.:** CN22YUWU 001

---

<p><b>License Holder:</b>                  LONGi Solar Technology Co., Ltd.                  No.8369 Shangyuan Road, Caotan Ecological Industrial Park, Xi'an Economic And Technological Development Zone, 710018 Xi'an City, Shaanxi, P.R. China</p>	<p><b>Manufacturing Plant:</b>                  LONGi Solar Technology (Chuzhou) Co., Ltd.                  No. 19 Huaian Road,                  Chuzhou City 239000 Anhui, P.R. China</p>
---	--

<p><b>Product:</b></p> <p><b>Type designation:</b>                  With mono c-Si cut cells:                  LR4-72HBD-xxxM (xxx= 425-455, in steps of 5)                  LR4-72HPH-xxxM (xxx= 430-460, in steps of 5)                  LR5-72HBD-xxxM (xxx= 530-550, in steps of 5)                  LR5-72HPH-xxxM (xxx= 535-555, in steps of 5)</p>	<p><b>Photovoltaic Modules</b></p>
---	------------------------------------

The manufacturing plant with PV module's type designation (as above) has been executed and assessed according to

## IEC TS 62994:2019

Details can be found in the report CN22YUWU 001.

This certificate is valid until 23.06.2025

The certificate does not permit the use of TÜV Rheinland mark of conformity. This certificate is valid in connection with report CN22YUWU 001.

---



**Certification body**



Weichun Li

---

24.06.2022

TÜV Rheinland (China) Ltd.  
 No. 01/03B-08, Floor 7 and No. 01/04B-08, Floor 11, AVIC Building, No.10B, Central Road, East 3rd Ring Road, Chaoyang District, Beijing, P.R. China  
 Tel: +86 10 8524 2222 Fax: +86 10 8524 2200 http://www.tuv.com

10020 © 04.08 TÜV, TÜV and TÜV are registered trademarks. Utilization and application requires prior approval.



LONGi Green Energy Technology Co., Ltd.  
Block A, No.8369 Shangyuan Road, Xi'an, Shaanxi, China.  
Tel: +86-29-81566686  
Fax: +86-29-81566685  
E-mail: [csr@longi.com](mailto:csr@longi.com)  
Web: [www.longi.com](http://www.longi.com)

