Solar Energy UK Briefing

Solar Supply Chains: Sustainability Issues and Action

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Solar Energy UK

About Us

As an established trade association working for and representing the entire solar and energy storage value chain, Solar Energy UK represents a thriving member-led community of 400+ businesses and associates, including installers, manufacturers, distributors, large-scale developers, investors, and law firms.

Our underlying ethos has remained the same since our foundation in 1978 – to be a powerful voice for our members by catalysing their collective strengths to build a clean energy system for everyone's benefit.

Our mission is to empower the UK solar transformation. Together with our members, we are paving the way for solar to deliver 60GW by 2030 by enabling a bigger and better solar industry.

Glossary

Chain of custody – A documented sequence of physical and legal possession of material as it moves through a supply chain.

Due Diligence – Ongoing, proactive, and reactive process through which companies can use to identify, assess and mitigate risks.

Enterprise Resource Planning (ERP) system – the software and project management tools businesses use to track and manage their operations.

Manufacturing Execution System (MES) – the software and project management tools manufacturers use to track and manage the equipment or components they produce.

Multi Stakeholder Initiative – **(MSI)** are collaborative programmes, which can include assurance and certification schemes, to address specific issues relating to an industry. MSI partners can include industry, government and civil society representatives.

Third-party auditor – External organisations or certification bodies that conduct evaluations of a business and its social or environmental performance.

Traceability – A system to document the flow of materials through a manufacturing process.

Summary

This briefing explores the steps the UK and global solar sector is taking to ensure environmental, social and governance best practices are implemented across the solar supply chain. It contains an overview of the different stages in the supply chain, suggests steps that organisations can take when investing in solar projects to ensure they are responsibly sourced, and explains the work of the sector to develop a multi-stakeholder sustainability assurance scheme, the Solar Stewardship Initiative.

Key components of a solar system

The solar supply chain

The solar supply chain is complex. It is made up of companies who design, manufacture, transport and install solar systems around the world, including solar panels, mounting systems, cables, batteries, and other equipment. The supply chain also includes businesses which mine raw materials, such as the metals and quartz used in a solar panel. Many of the companies involved in the different stages of solar panel manufacturing are based in China. There are also manufacturing companies in South-East Asia, Europe, and the United States, and the sector is expanding.

The solar panel supply chain

The supply chain for solar panels themselves begins with quartz. This is mined and refined into metallurgical grade silicon, and then further refined into polysilicon, which is the material that converts light into power. Polysilicon rods, known as ingots, are then sliced into wafers. These are turned into solar cells, which generate electricity, and they are connected and assembled in a frame to make a solar panel.

Supply chain sustainability issues

The solar sector is working on a variety of sustainability topics:

- Environmental issues: for example, developing measures to reduce the energy and water used in manufacturing processes, and to reuse, repair or recycle solar panels at the end of their commercial life.
- Social issues: for example, ensuring that the rights of those who work in solar manufacturing are respected, and that their working terms and conditions are safe, secure and healthy.
- Governance issues: for example, relating to the management systems companies use to prevent corruption and bribery, and ensure legal compliance, traceability and environmental monitoring.

Greenhouse gases

As with all manufactured products, at present some greenhouse gas (GHG) emissions, such as carbon dioxide, are emitted during the manufacturing of a solar system. This includes GHG associated with producing the panels themselves, as well as the production of cables, mounting systems, and batteries installed alongside them. This is known as embodied carbon. Solar manufacturers are moving to low- or zero-carbon sources of heat and electricity (including solar itself) for their production facilities, in order to minimise embodied carbon. This will further increase the environmental benefits of solar, which is already one of the cleanest sources of energy in the world, and has a lower lifecycle carbon footprint than other generation technologies.

Frequently asked questions

1) What is the UK solar sector's position on responsible sourcing?

Solar Energy UK promotes responsible sourcing and supports the development of a sector with the highest possible level of transparency, environmental sustainability, social responsibility, and good governance.

Solar Energy UK is aware of reports concerning human rights abuses in the solar supply chain, including alleged forced labour in the Xinjiang Uyghur Autonomous Region (XUAR) of China, and takes these reports extremely seriously.

For this reason, Solar Energy UK members have signed the UK solar sector's renewed commitment to responsible sourcing, published in 2024, and Solar Energy UK is a founding member of the Solar Stewardship Initiative (SSI). The SSI is a comprehensive multi-stakeholder supply chain sustainability assurance scheme. It was developed as part of the sector's work on responsible sourcing to help mitigate and prevent human rights risks in its supply chains.

2) How are UK solar companies supporting responsible sourcing?

Solar Energy UK members have taken extensive action to strengthen responsible sourcing and develop appropriate safeguards. This includes detailed upstream supplier mapping to enable transparency and risk mitigation, comprehensive human rights due diligence, and using procurement and contract management to drive best practice throughout the sector.

UK solar companies work with supply chain partners across the world, and by collectively pushing for the highest standards, the buying power of the sector as a whole is stimulating supply chain diversification, based on robust human rights due diligence implemented in line with key international standards. These standards notably include the UN Guiding Principles on Business and Human Rights (UNGPs), and the SSI ESG Standard.

The establishment of transparency agreements also means that solar installers, and those contracting with solar installers, can know where their products are coming from, enabling them to avoid procuring from regions that present specific sustainability risks which cannot be mitigated, and to deliver the most effective human rights due diligence possible.

Procurement practices adopted by Solar Energy UK members

Managing the risk of exposure to forced labour in procurement requires a comprehensive, risk-based approach that integrates due diligence, transparency, and accountability throughout the supply chain. Procurement practices adopted by Solar Energy UK members include:

- Performing comprehensive pre-qualification due diligence and supplier evaluations, based on detailed questionnaires, public and private reporting, commercial and market intelligence data, and supplier audits. This is used to assess supplier performance and the potential exposure of particular products and value chains to forced labour and other sustainability issues.

- Establishing robust contractual requirements to respect human rights and ESG considerations, disclose where any violations have been identified, and take action to remedy them. This often includes developing a binding supplier Code of Conduct, including the requirement to pass on its obligations to sub-suppliers, and making agreement to these terms a prerequisite to qualify as an approved supplier.

- Carrying out post-production traceability audits, based on the solar industry's development of comprehensive raw material tracing protocols, which enable the purchase of products whose mineral origins can be verified by third-party auditors. This in turn enables buyers to avoid procuring from specific countries or regions which present a risk of exposure to forced labour.

- Publishing sustainability and human rights reports, Modern Slavery Statements, and other disclosures setting out steps to assess, mitigate, prevent and remedy human rights abuses and modern slavery in supply chains.

- Ensuring all the practices above, and broader work to address supply chain risks, are implemented in accordance with specific supply chain policies, are updated regularly, are supported with staff training and awareness, are integrated with broader risk management, are included on company risk registers and matrices, and are subject to appropriate oversight by senior management and board-level governance structures.

3) What action has Solar Energy UK taken on responsible sourcing?

Solar Energy UK was a co-founder in 2021 of the Solar Stewardship Initiative (SSI). The SSI is a multi-stakeholder supply chain sustainability assurance scheme. It has developed solar-specific sustainability and traceability standards that can be used by manufacturers and buyers around the world, including those in the UK. Solar Energy UK's input into the SSI has been driven by its ongoing and extensive engagement, as the trade association representing the UK solar sector, with government, regulators, academia, civil society, investors and sector on procurement and sourcing issues. The purpose of this engagement is to understand and learn from those who research, are part of, regulate, and interact with renewable energy and commodity supply chains. This means that the UK solar sector can learn from others working on supply chain sustainability initiatives around the world.

Drawing on this engagement, Solar Energy UK has also established a Responsible Sourcing Steering Group, whose members drive engagement on how the UK sector can support domestic and international efforts to achieve a more sustainable supply chain. Solar Energy UK provides regular updates to Government, NGOs and other stakeholders regarding this work nationally and internationally.

4) What is the Solar Stewardship Initiative (SSI)?

The SSI is the first-ever supply chain assurance scheme dedicated to the solar PV sector. It was co-founded by Solar Energy UK and the European solar sector association, SolarPower Europe, in 2021, and formally launched in 2023, following an extensive development and engagement phase that included expert input and public consultation.

The SSI is comprised of over 45 members, including manufacturers representing more than 60% of globally shipped solar PV modules (as of March 2025). Its mission is to enhance responsible sourcing, production, and material stewardship throughout the solar value chain, in alignment with ESG principles, thereby supporting a just and inclusive energy transition.

The SSI has received endorsements from sector stakeholders including international financial institutions such as the World Bank's International Finance Corporation, the European Investment Bank (EIB), and the European Bank for Reconstruction and Development (EBRD).

In January 2025, the SSI released its first ESG site certificates, with additional certifications anticipated throughout the year. As of January 2025, the SSI's ESG site assessment pipeline included a combined annual module production capacity of 100 GW, surpassing the projected annual demand for solar PV of the European Union and the United Kingdom combined.

In November 2024, the SSI approved its comprehensive multi-stakeholder governance structure and issued a call for expressions of interest from relevant non-sector stakeholders, including civil society, institutional stakeholders, and independent experts, to apply for positions on its Board of Directors.

The SSI framework is founded on the SSI Principles, supported by two key standards: the ESG Standard and the Supply Chain Traceability Standard. Additionally, there are core documents that detail the scheme's functionality.

The SSI Principles set forth the obligations that each company must uphold upon joining the SSI. Members are required to respect human rights within their operations, conduct enhanced due diligence when sourcing raw materials from high-risk and conflict-affected regions, and implement the SSI Standards throughout their operations while promoting their adoption along their supply chains.

In December 2023 the SSI published a solar-specific Environmental, Social and Governance (ESG) Standard, against which solar manufacturing sites will be third-party audited on topics across three key areas:

- Governance and Business Ethics
- Environment
- Human and Labour Rights.

The SSI has also published a solar Supply Chain Traceability Standard, launched in December 2024, which provides a benchmark for how manufacturers can demonstrate the raw material origins and development journey of their products.

These two Standards represent a significant milestone for the solar sector. Certification against the ESG Standard and the Supply Chain Traceability Standard are mandatory for SSI manufacturing members. The two SSI standards are applied simultaneously to create fully certified Chains of Custody (CoC) for responsibly produced products.

Solar Energy UK encourages all companies to join the SSI, although recognises that this may not always be feasible, such as for smaller organisations. This is why Solar Energy UK has supported the development of practical guidance which organisations of any size can use to inform their procurement processes and operations.

The SSI aims to establish and communicate verifiable information on the ESG practices and transparency of businesses along the length of the solar supply chain. It aims to facilitate the effective implementation of international standards and ensure compliance within the solar industry.

The SSI Standards do not act as a replacement for EU, national and other legislation on sustainable supply chains, nor does SSI membership negate the obligations of a business to comply with law and perform its own environmental and human rights due diligence.

5) How does the SSI assurance programme work?

The SSI assurance scheme is based on on-site, independent third-party assessments. These are more robust and credible than voluntary disclosures and self-assessments, because they assess compliance to standard requirements in an impartial manner. Third-party assessments play a crucial role in enhancing consumer trust by providing independent validation.

The SSI assurance process is based on the review of policies, procedures and practices at specific manufacturing sites by qualified and impartial assessors to determine if they are implemented and effective. The assessors carry out interviews with stakeholders and workers, cross-checking the information they receive to ensure robust assessment conclusions, and to obtain an accurate picture of the site's practices. Any gaps identified must be addressed by a fixed deadline, and regular surveillance assessments take place to verify that the site continues to be in compliance with the requirements in the relevant standard.

If an assessment body cannot freely access a site or a region, then this site cannot be certified under the SSI. This is explained further in the SSI FAQs.

Performance and management standards

There is a wide range of product and company-level standards, initiatives and management systems used in manufacturing and other business sectors around the world. Their purpose is to assess specific aspects of a company's environmental, social and governance performance, and many have been incorporated into the SSI. Examples include ISO 14001, which is an international environmental management systems standard, SA 8000, which is an international social standard, and ISO 45001, which is an international occupational health and safety standard. The SSI draws on the work of such standards to provide an auditable, solar-specific assessment of manufacturers which can be used as part of supply chain due diligence processes.

6) Is it possible to know where a solar panel comes from?

Yes. Solar panel manufacturers can provide information on the origins of their products. This is based on documenting the flow of materials through the manufacturing process, which is known in the sector as 'traceability'.

Traceability has evolved rapidly, and installing traceable solar panels means buyers can, for example, avoid procuring from regions with heightened social and environmental risks. Those buying or installing solar PV panels can request that their supplier provide them with details of the product origins. Questions 7 and 8 discuss traceability in more depth.

7) How does traceability work under the Solar Stewardship Initiative?

Traceability works by tracking the core materials in a product across the different sites involved in making it, at each stage of the process. The SSI Supply Chain Traceability Standard is the first step to show precisely where the materials used at each link in the solar supply chain come from, and how they are traced. The SSI Supply Chain Traceability Standard and the SSI ESG Standard apply to the full silicon value chain from quartzite mining through metallurgical grade silicon and polysilicon to ingots and wafers to cells and modules. Supply Chain Traceability certification is mandatory for SSI manufacturing members, and complements certification against the SSI ESG Standard, by enabling buyers to implement due diligence by assessing the ability of their supply chain partners to provide transparency on their supply chains and raw material origins.

These assessments are undertaken by third party auditors who are both independent and SSI approved. The auditor will review information with regards to the origin of the silicon material used for making a solar panel. They will review and assess the digital and physical documentation that shows where the polysilicon was made (including raw material extraction), and how it was further processed and transported between different supply chain tiers. The auditor will review contracts, purchase orders, invoices, inbound and outbound delivery notes, and other shipping and warehouse records as needed, checking them against what is recorded in the systems used to manage resource and production processes, such as a company's Manufacturing Execution System (MES) or Enterprise Resource Planning (ERP) system. The SSI provides a list of examples of documents which are reviewed during the SSI certification assessments against the Supply Chain Traceability Standard in Annex II. The SSI Supply Chain Traceability Standard defines requirements for entities implementing traceability management systems and currently it covers silicon and other photovoltaic semiconductor materials. The output of an SSI Supply Chain Traceability audit will include a certification report, of which a summary will be publicly available on the SSI website.

8) How does the SSI support greater traceability of solar panels?

The SSI Supply Chain Traceability Standard formalises the system production sites must have in place to demonstrate raw material origins and comply with SSI membership obligations. The first audits against the Traceability Standard will take place over 2025, with the first certifications expected in 2025. The results of the audits will be summarised and published on the SSI website.

9) Is there similar work taking place on sustainability issues in the battery sector?

Yes. Significant work is taking place on sustainability within the battery sector. The industry is evolving rapidly, supplying not only the energy storage sector (including home and grid-scale stationary batteries) but in particular the transport sector, particularly for electric vehicles. This may present sustainability challenges to which the solar and energy storage industry is exposed, but where it represents only a very small proportion of global demand and is far less able to exert direct influence. This is the case, for example, with batteries, where static energy storage represents a very small proportion of demand compared with electric vehicles.

The most effective way to address concerns in these industries is to aggregate solar demand for responsible supply chain management with demand from the electrification of transport and other industries, and support engagement via these sectors with the upstream suppliers who provide the overall raw material feedstock for the clean energy economy.

This is why Solar Energy UK has begun engaging with responsible mining codes, emerging policy and regulation relating to batteries (EU Battery Regulation) and organisations such as the Global Battery Alliance, to initiate action on relevant topics, including the risk of forced labour in supply chains. Solar Energy UK intends to expand this work in future.

10) Is there any guidance available for solar installers to ensure responsible sourcing?

Yes. As part of its work on responsible sourcing, Solar Energy UK supported the development of guidance on how to address Modern Slavery and labour exploitation in solar supply chains, produced by sustainability experts Action Sustainability. The guidance includes practical steps solar installers can take to carry out due diligence and manage procurement risk, including:

- Example questions that can be used in supplier prequalification.
- Template contract clauses.
- How to make and deliver the business case for communicating and acting on modern slavery issues

The guidance was funded by partners including the British Government's Department for Environment, Food & Rural Affairs (DEFRA), Department for Energy Security and Net Zero (DESNZ), and Environment Agency.

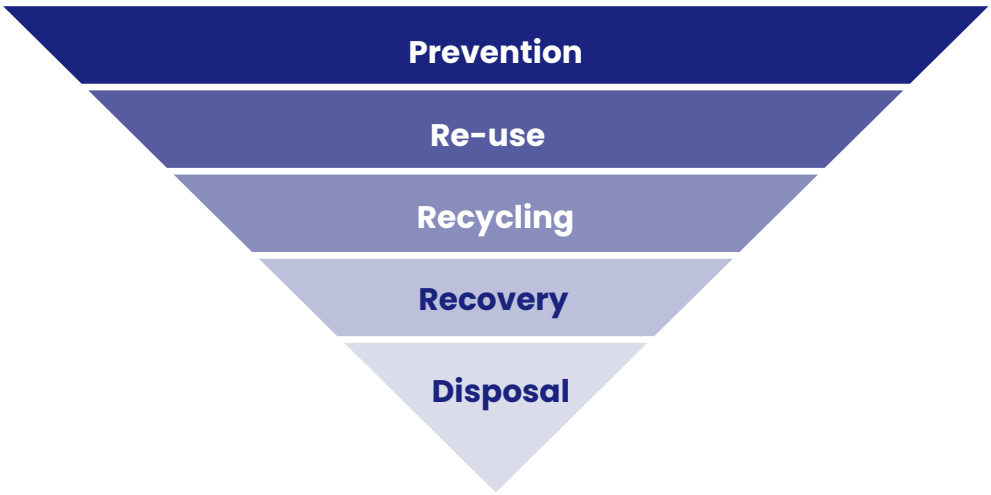
The SSI is also developing guidance for those buying and sourcing PV panels. This will provide advice to large and small companies on how to incorporate due diligence and use the SSI Standards and framework in their procurement practices.

For financial institutions and investors, there are specific frameworks that can be used to assess and manage environmental, social and governance risk, as well as disclose action they are taking to address them. These include:

11) How does the solar industry ensure responsible decommissioning and end-of-life handling?

The typical lifespan of a new silicon-based solar panel will be around 40 years. Earlier panels are expected to last at least 25 years, being extremely durable and designed for exposure to the elements, and therefore solar PV waste volumes are expected to rise by 2035. Because of their long lifespan, solar panels prevent waste from occurring for considerably longer than other electrical products: many of the first solar systems installed in the UK are only halfway through their intended lifespan. There are already organisations and universities in the UK which are innovating and focusing on improving solar decommissioning processes. As such, PV recycling technologies are evolving at pace. As the volume of solar panels ready to be recycled increases, more are expected to begin providing end-of-life services, with a sub-industry developing to provide jobs and growth for the UK economy.

In principle, solar panels can be reused if they comply with the necessary safety standards and customer protections, although at present there are challenges relating to regulatory requirements, and the low cost of new panels. Second life markets may develop for older models which still have high performance, and enable compliance with the waste hierarchy which enshrines "reuse" as the preferred option (prior to"recycling") in legislation.



In the UK, companies who import or manufacture and sell electrical equipment under their own brand, or distributors who make electrical equipment available on the UK market (known simply as "producers"), must comply with the Extended Producer Responsibility (EPR) obligations of the Waste Electrical and Electronic Equipment (WEEE) Regulations 2013. The WEEE regulations aim to reduce the environmental impacts caused by end-of-life electronic and electrical items. The WEEE Regulations includes 14 categories of electronic waste, with solar PV classified under category 14.

The WEEE Regulations includes a requirement for producers to join a Producer Compliance Scheme (PCS).These regulations require that the collection, preparation for reuse and waste treatment and recycling of electronic and electrical equipment are organised and part financed by the so-called Producers or better 'First placers on the territory of the United Kingdom'.

The UK government ran a consultation on updating the WEEE regulations in 2023-2024, and to dispose of solar panels responsibly, consumers and businesses should contact a specialist business that is accredited under the WEEE regulations. Solar Energy is establishing a dedicated group to focus on decommissioning and end-of-life issues.

Solar Recycling

Solar panels are made from materials for which established recycling procedures exist, such as aluminium, copper and glass. This means that it is technically possible for the majority of a solar panel to be recycled. The industry is working on processes to ensure the commercial viability of recycling and increase the rate, and range, of materials recycled over time.

Solar Energy UK will support action intended to make solar panels easier to dismantle, and to recycle recovered materials.

12) What are the next steps in responsible sourcing?

Solar supply chains – as well as policy, regulation and markets – are evolving rapidly. Work underway on solar sustainability management includes the expansion of raw material traceability, the development of low or zero carbon factories and shipping, and action to address the global decline in biodiversity. As with other industries, and in line with international standards such as the UN Guiding Principles, a pragmatic and risk-based approach will be required for effective supply chain management in the solar industry. The sector will grow very rapidly as the world transitions to a clean energy economy, and this needs to be a just transition, that promotes human rights, respects nature, and ensures fair opportunities for all. The UK solar industry supports these objectives.

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