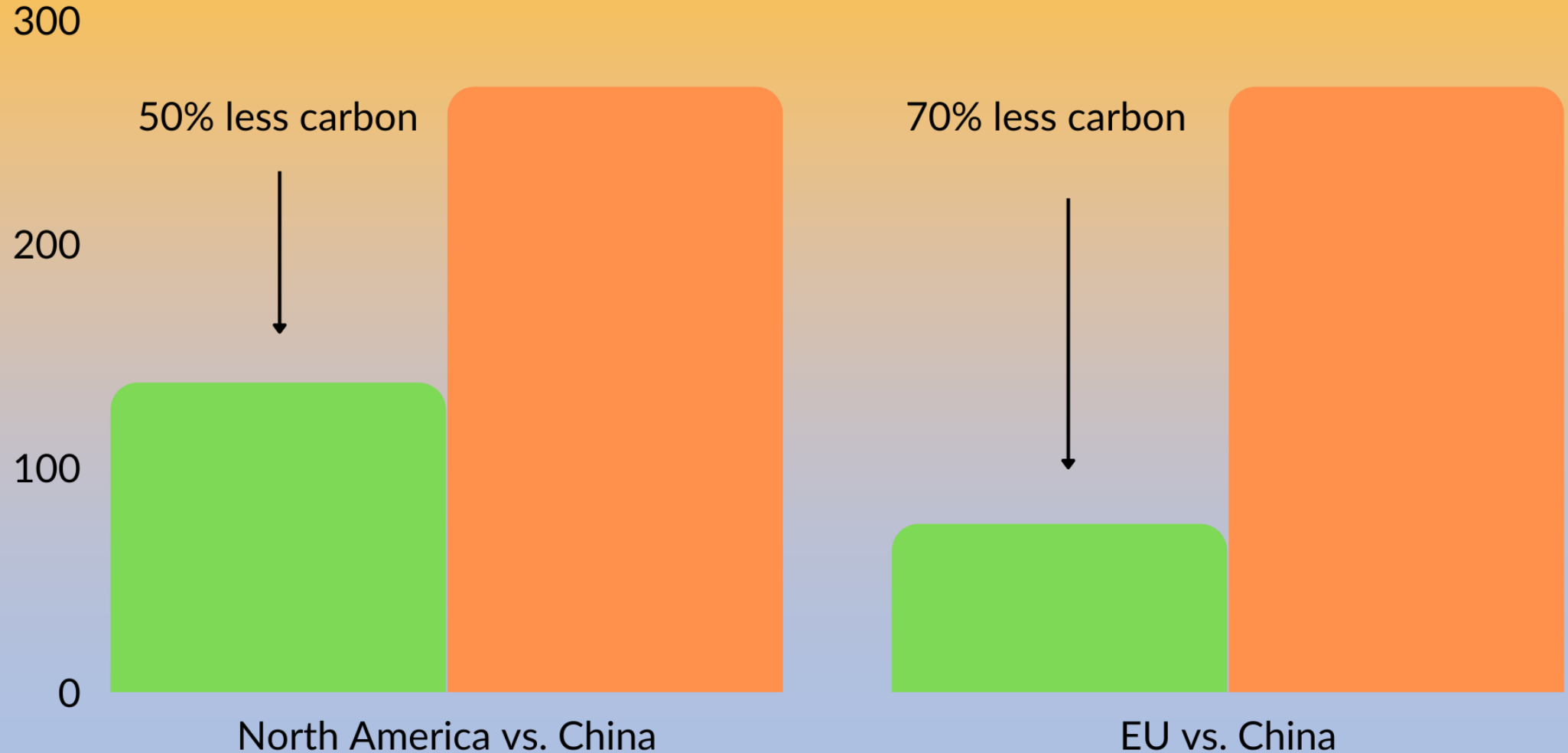


# Overview: EPEAT for Solar



# PV Manufacturing Carbon Intensity - IEA

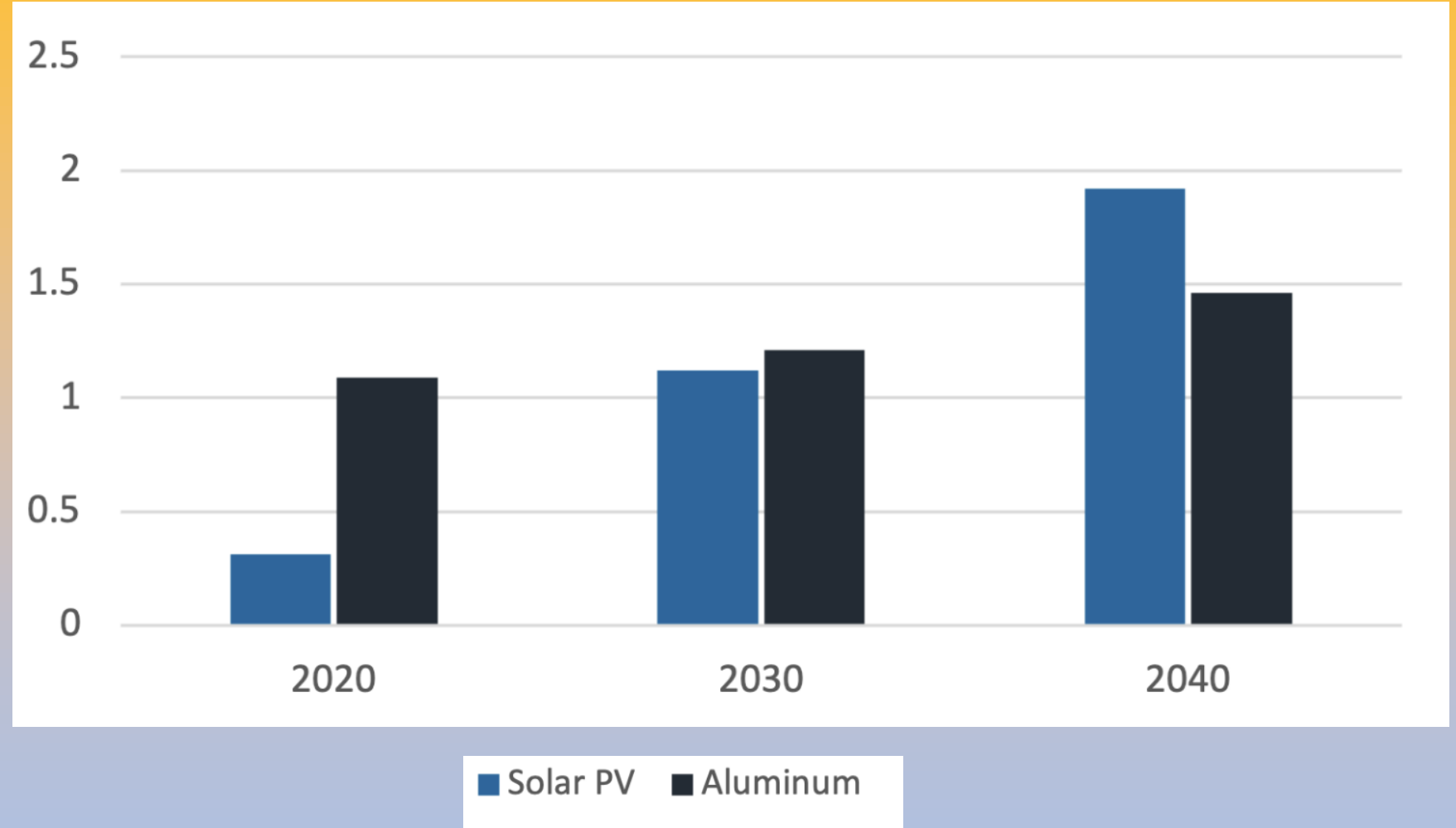
Solar manufacturing carbon footprint by country



# Solar manufacturing emissions under a "business as usual" scenario

Solar manufacturing emissions total 14-18 billion tons CO2 over this period absent changes in supply chain.

Projected global emissions from solar manufacturing could exceed that of aluminum production, a major emitter.



Clean Energy Buyers Institute "Low-Carbon Solar: Enabling Sustainable Growth and Raising the Industry Standard." September 2021. pg. 7.

# Trends in Global Preference for Sustainable Solar

- Multiple studies have highlighted the significant differences in carbon footprint of PV manufacturing by region.
  - [Domestic and overseas manufacturing scenarios of silicon-based photovoltaics: Life cycle energy and environmental comparative analysis \(abstract\)](#)  
Dajun Yue, Fengqi You and Seth B. Darling; Argonne National Laboratory and Northwestern University
  - [Life Cycle Greenhouse Gas Emissions of Crystalline Silicon Photovoltaic Electricity Generation Systematic Review and Harmonization](#)  
David D. Hsu, Patrick O'Donoghue, Vasilis Fthenakis, Garvin A. Heath, Hyung Chul Kim, Pamala Sawyer, Jun-Ki Choi, and Damon E. Turney
  - [Integrated life-cycle assessment of electricity-supply scenarios confirms global environmental benefit of low-carbon technologies](#)  
Edgar G. Hertwich, Thomas Gibon, Evert A. Bouman, Anders Arvesen, Sangwon Suh, Garvin A. Heath, Joseph D. Bergesen, Andrea Ramirez, Mabel I. Vega, and Lei Shi
  - Reshoring silicon photovoltaics manufacturing contributes to decarbonization and climate change mitigation  
Haoyue Liang<sup>1</sup> & Fengqi You <sup>1,2,3</sup>
- Governments have developed policies creating standards/preferences for sustainable/low carbon solar.
  - Since 2011 France has implemented a PV carbon footprint standard for PV tenders, with incentives for modules with low embodied carbon.
  - Since 2020 South Korea has had a similar program.
  - Since 2022 the US Government has a preference for the use of EPEAT for Solar registered low carbon modules in government purchased PPAs.
  - The US Uyghur Forced Labor Prevention Act prohibits the import of solar and other products made with forced labor.
  - The EU has begun to implement a carbon border adjustment tax (CBAM), a policy the US Congress has also considered.

# Trends in Global Preference for Sustainable Solar

- Private sector preferences
  - “Lightsource bp’s ability to procure products with lower embodied carbon is critical to meeting our targets to reduce Scope 1, 2, and 3 greenhouse gas (GHG) emissions. As a solar company, our Scope 3 emissions comprise over 99% of our total footprint, with the large majority from our supply chain, including the embodied carbon in solar panels and other equipment. ”  
[Nastassja Hagan](#), [Lightsource bp](#)’s Vice President, Sustainability
  - “As we make strides towards a carbon-free grid, the updated EPEAT ecolabel for solar modules gives energy customers an actionable tool to drive decarbonization within their solar supply chain.” [Jen Snook](#), Deputy Director at the [Clean Energy Buyers Institute](#)

# What is EPEAT for Solar?

- A global sustainability leadership standard for PV modules and inverters.
- Multi-attribute, life cycle based.
- ESG criteria (NSF 457) + carbon footprint.
- Criteria are developed in voluntary, consensus process by industry stakeholders (ANSI/NSF/UL).
- Extensive records and documentation required.
- Criteria achievement verified by independent third-party Conformance Assurance Bodies (e.g., TUV Rhineland) approved by EPEAT steward Global Electronics Council (GEC).
- Conformance with criteria must be demonstrated annually, is routinely audited and criteria are reviewed for updates every three years.
- Tiered system; required criteria for EPEAT Bronze, meeting additional optional criteria adds points towards EPEAT Silver and Gold.
- EPEAT ecolabels in effect since 2006, globally applied for more sustainable purchasing, billions of dollars in purchasing to date (office electronics equipment).
- Used by private and public buyers.

# GEC's criteria development process



Aligns with ISO 14024 for Type 1 Ecolabels

# NSF 457 Standard Corporate Responsibility Criteria for Solar

The purpose of this Standard for photovoltaic (PV) modules and PV inverters is to establish product sustainability performance criteria and corporate performance metrics that exemplify sustainability leadership in the market.

The Standard provides a framework and standardized set of performance objectives for manufacturers and the supply chain in the design and manufacture of PV module and PV inverters components. For purchasers, this Standard provides a consensus-based definition of key sustainability attributes and performance metrics, alleviating individual purchasers from the arduous and complex task of defining sustainability performance for PV modules and PV inverters.

This Standard was developed based on the principle that only sustainability leadership products, those in the top-third of the market, are expected to qualify to the Standard at the Bronze level at the date of publication of this Standard. Only a few products are expected to meet the highest performance level (Gold) at the date of publication of this Standard.

This Standard will be continually maintained and periodically reviewed to ensure that the definition of sustainability leadership, as reflected in the performance criteria, progresses with the evolution of technology and services and sustainability/environmental improvements in the product sector.



# EPEAT criteria for PV modules and inverters

## Climate Change Mitigation

- Manufacturing energy efficiency
- F-GHG emissions in manufacturing
- Life cycle assessment and disclosure of cumulative energy demand and global warming potential
- Carbon footprint

## Sustainable Use of Resources

- Recycled content
- Design for recycling
- Product take back & responsible recycling
- Disclosure of recovery & recycling achievement
- Material recovery targets
- Efficient water use in manufacturing

## Reduction of Chemicals of Concern

- Restricted substances in product - RoHS, REACH, halogenated substances
- Substance inventory and disclosure
- Alternatives assessment

## Corporate ESG Performance

- Social performance & audits
- Worker health & safety
- EMS
- Responsible mineral sourcing
- Corporate reporting
- Hot spot identification & leadership compared to industry

# EPEAT Ultra-Low Carbon Solar Criteria

- LCA-based cradle to gate (quartz mining to final module assembly).
- Includes all major materials used in PV modules, including the frame.
- LCAs must follow the requirements laid out in the criteria.
- Two embodied carbon levels; “low carbon”= 630 kgCO<sub>2</sub>e/kWp, “ultra low carbon”= 400 kgCO<sub>2</sub>e/kWp.
- “Low carbon” is required for Bronze, ““ultra low carbon” earns additional points towards Silver and Gold.
- Path A: standard lookup tables for carbon values (component by geography, e.g. polysilicon from Germany, wafer from Vietnam, cell from Germany, module from USA. etc.).
- Path B: site-specific LCA for component per methodology specified in criteria.
- Can use either Path A or Path B for each component (e.g. Path A for poly and wafer, Path B for cell and module).
- Path A values based on national level grid carbon intensities as published by IEA.
- Path B values based on national or sub-national regional grid carbon intensities as published by IEA.
- Path B values may include up to 25% renewable energy, such as PPA, across supply chain provided; RE is properly allocated across the relevant manufacturing operations, the RE use corresponds with the period covered by the calculations, Energy Attribute Credits (e.g. RECS) must meet RE100/ISO 14067 criteria and must be retired (not resold).

# EPEAT Ultra-Low Carbon Solar Criteria

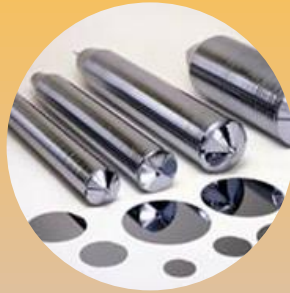
- Component specifics must be validated by the provision of invoices, receipts and purchase orders, must account for loss and breakage during manufacturing.
- Requires disassembly and measurement of module by independent laboratory to confirm component specifics.
- Reports from independent inspections of suppliers within prior 12 months are required, and Conformance Assurance Bodies (CABs) may interview suppliers.
- All calculations require verification by accredited independent third party LCA experts with experience in PV and by EPEAT approved CAB.
- Calculations must be confirmed annually.
- Third party LCA experts may be audited.

# EPEAT for Solar and Embodied Carbon

How do we make ultra-low carbon solar?

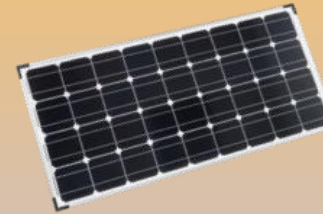
## Polysilicon

Grid decarbonization, manufacturing energy efficiency and efficient technology like FBR are key contributors to lower carbon.



## Cell

Grid decarbonization, manufacturing energy efficiency, materials efficiency.



## Ingots/Wafers

Grid decarbonization, manufacturing energy efficiency, materials efficiency (kerf recycling) and low carbon technologies.



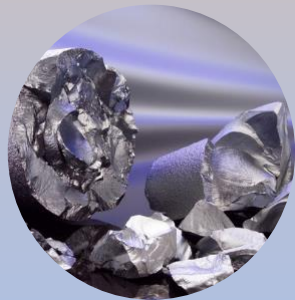
## Module

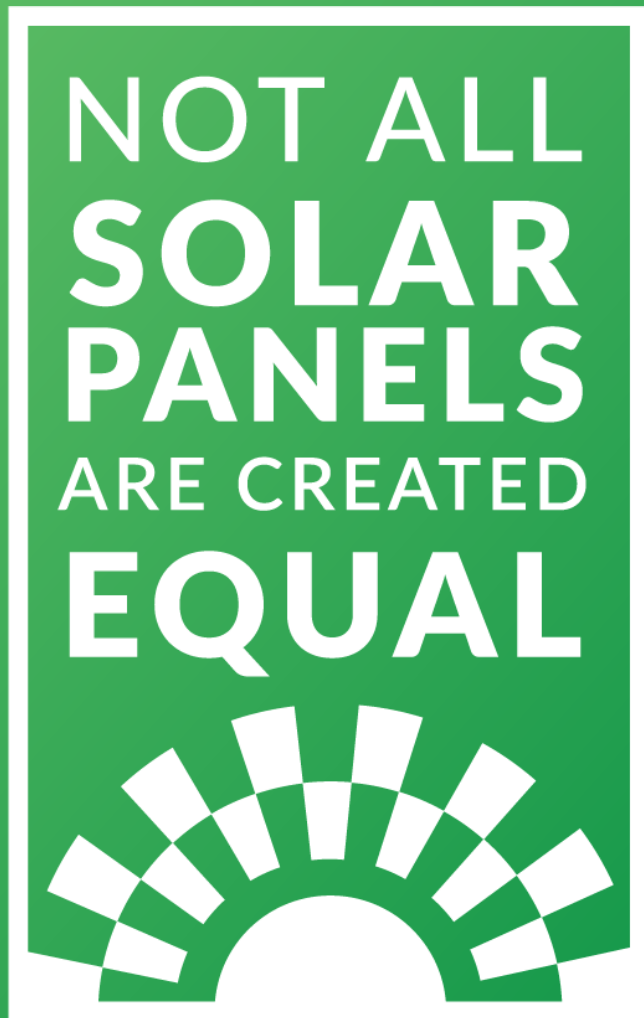
Grid decarbonization, manufacturing energy efficiency, materials efficiency, low carbon frame and cover.

## Frame, cover

High recycle content, low carbon Materials such as polymers, grid decarbonization, energy efficiency.

For thin film technologies: grid decarbonization, materials efficiency and energy efficiency.





## Benefits to PV Buyers

Improved transparency, traceability and Sustainability in your supply chains.

Reduction in Scope 3 emissions.

Easy to implement, rigorous and reliable.

Demand signal for more low carbon, sustainably manufactured PV travels through entire supply chain.

Incentivizes low carbon PV manufacturing expansion.

De-risks mid to longer term PV supply.





# Benefits to PV Manufacturers

- Leadership in sustainability
- Third party validation of transparency, traceability and sustainability in your supply chain
- Reduction in Scope 3 emissions

# Qcells





# Benefits to PV Manufacturers

- Competitive advantage
- Strengthen customer relationships
- Increasing market demand for lower carbon, sustainably manufactured solar PV

# Qcells

# How to Register Products With EPEAT

1

**BECOME AN EPEAT  
PARTICIPATING  
MANUFACTURER**

2

**ENGAGE WITH A  
CONFORMITY  
ASSURANCE BODY  
(CAB)**

3

**CAB VALIDATES  
MANUFACTURER  
PRODUCT CLAIMS**

4

**PRODUCTS UNDERGO  
CONTINUOUS  
MONITORING**

<https://globalelectronicscouncil.org/epeat-solar-panels-inverters>



# Additional Details on NSF 457 EPEAT Photovoltaic Modules and Inverters Category Criteria

# EPEAT for Solar NSF 457 criteria

## Management of substances

- **List and assessment of substances**
  - Required – List of declarable substances in product and declarable substances used in manufacturing
  - Optional
    - Disclosure of declarable substances
    - database of substances in product
    - alternatives assessment
    - making alternatives assessment publicly available
- **Reduction of substances of concern (SVHC)**
  - Required
    - Disclosure of substances on the EU REACH Substances of Very High Concern (SVHC)
    - Avoidance or reduction of high global warming potential (GWP) gas emissions
    - Conformance with provisions of European Union RoHS Directive (applicable only to PV inverters)
  - Optional
    - Presence of substances on the REACH Substances of Very High Concern (SVHC)
    - Bromine, chlorine, and fluorine content in electric cables
    - Bromine, chlorine, and fluorine content in plastic parts other than electric cables

## Preferable materials use

- **Recycled content**
  - Required – Declaration of recycled content in product
  - Optional – Use of recycled content in product (more = more points)

# EPEAT for Solar NSF 457 criteria

## Life cycle assessment (LCA)

- **PV module LCA**
  - Required – Conducting LCA
  - Optional
    - Public disclosure of LCA results
    - Public disclosure of LCI inventory data
- **Reduction in LCA impacts**
  - Optional
    - Environmental hot spot identification
    - Environmental leadership compared to industry average (PV modules)

## Energy efficiency and water use

- **Energy efficiency and management system**
  - Required
    - Weighted efficiency reporting (PV inverters)
    - Tare loss reporting (PV inverters)
  - Optional
    - Energy management system for manufacturing facilities
    - Certified energy management system
    - Certified energy management performance improvement

# EPEAT for Solar NSF 457 criteria

## Energy efficiency and water use

- **Water use metrics**
  - Required – Water inventory
    - Optional
      - Quality of wastewater discharges
      - Improved water use efficiency

## End of life management and design for recycling

- **End-of-life (EOL) management**
  - Required – Product take-back service and processing requirements (corporate)
  - Optional
    - Publicly available record of annual recycling and recovery achievement (corporate)
    - Material recovery targets (corporate)
- **Design for recycling**
  - Optional
    - Identification of materials for EOL management (only applicable to PV modules)
    - Replacement components availability (applicable only to PV inverters)
- **Eliminate substances of concern in product packaging**
  - Required
    - Elimination of substances of concern in product packaging Required
    - Elimination of chlorine in processing packaging materials
- **Recyclability of packaging**
  - Required – Enhancing recyclability of packaging materials

# EPEAT for Solar NSF 457 criteria



## End of life management and design for recycling

- **Recycled content in packaging**
  - Optional
    - Recycled content paper-based packaging
    - Postconsumer recycled content plastic in packaging

## Corporate responsibility

- **Environmental, health, and safety management systems**
  - Environmental management system (EMS) certification
  - Manufacturer conformance with occupational health and safety performance (corporate)
- **Corporate reporting**
  - Required – Reporting on key performance indicators (corporate)
    - Optional
      - Reporting additional key performance indicators (corporate)
      - Reporting on screening of Tier 1 suppliers
- **Corporate social performance**
  - Required - Commitment to environmental and social responsibility (corporate)
  - Optional- Auditing or certification to social responsibility performance standard (corporate)
- **Conflict mineral sourcing**
  - Required – Public disclosure of use of conflict minerals in products (corporate)
  - Optional
    - Conflict mineral sourced only from validated conflict free smelters (corporate)
    - Participation in in-region conflict-free sourcing program (corporate)