

# ENERGYBIN INSIGHTS

Solutions for PV Repair, Resale and Recycling

Ep. 13 – Expert Intel: Opportunities in Solar  
Panel Reuse & Recycling

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*Presented by: Rob Van Demmeltraadt, EnergyBin.com  
With Bardia Vahidi, IBEC, Inc. –and-  
Brian Musil, The Solar Recycling Company*

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***"We are committed to accelerating a robust and sustainable secondary market."***

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**We bring together PV professionals who provide solutions for repair, resale, and recycling.**

- **Trade**
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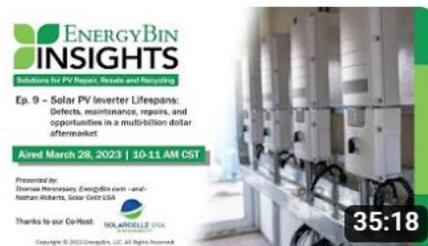
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# *Our Guest Speakers:*



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# Understanding Appendix G Photovoltaic (PV) Modules

By: Dr. Bardia Vahidi



Worldwide R2 and ISO Consulting Firm

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## R2v3 Is Broken Down Into:

**CORE  
Requirements**

**AND**

**PROCESS  
Requirements**

**CORE** Requirements apply to all R2 Certified facilities to ensure the secure and sustainable management of used electronic and IT equipment from the moment it enters the control of an R2 facility and continuing throughout the reuse-recycling chain.

The **Process Requirements** in Appendices A-G are additional requirements that apply only to facilities that perform these specific processes.

If any of the processes are performed by a facility, they must be audited and included in the facility's scope of certification.

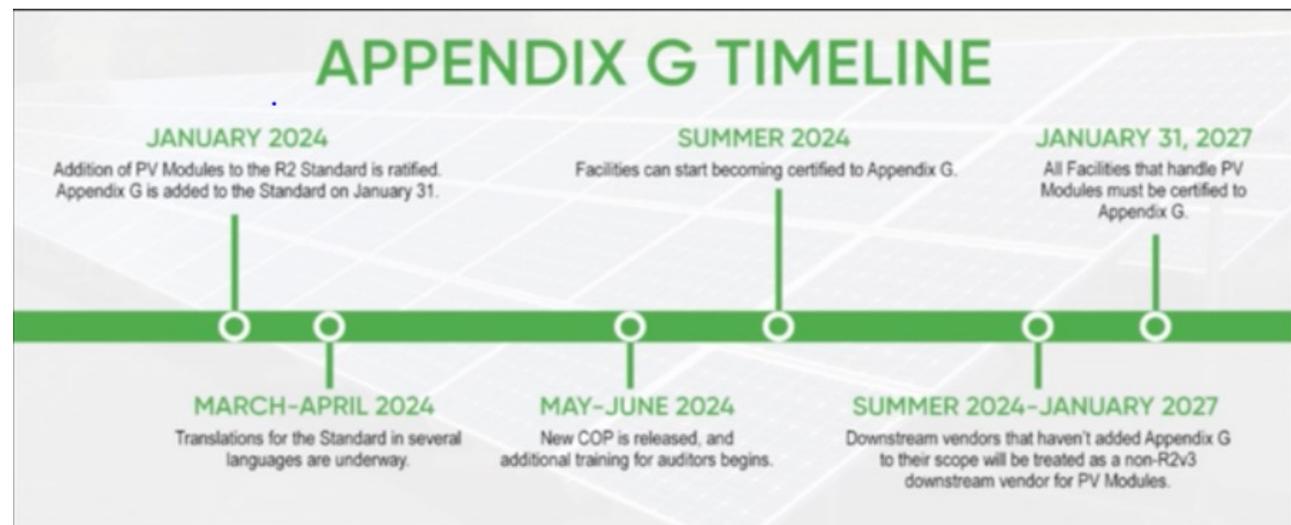
Any Process Requirements that have been certified at a facility will be listed on the facility's R2 Certificate.

# Appendix G

## General Principle

"To ensure that any R2 Facility that handles or processes photovoltaic (PV) modules, also known as solar panels, does so in a safe and environmentally sound manner, in accordance with all applicable R2 requirements."

**If a facility receives, handles, processes, stores, transports, or brokers any quantity of PV modules the facility must certify to Appendix G.**



# Photovoltaic Modules

Also referred to as a solar panel or PV modules

R2 Definition- "A standalone device designed to convert solar radiation into electrical energy."

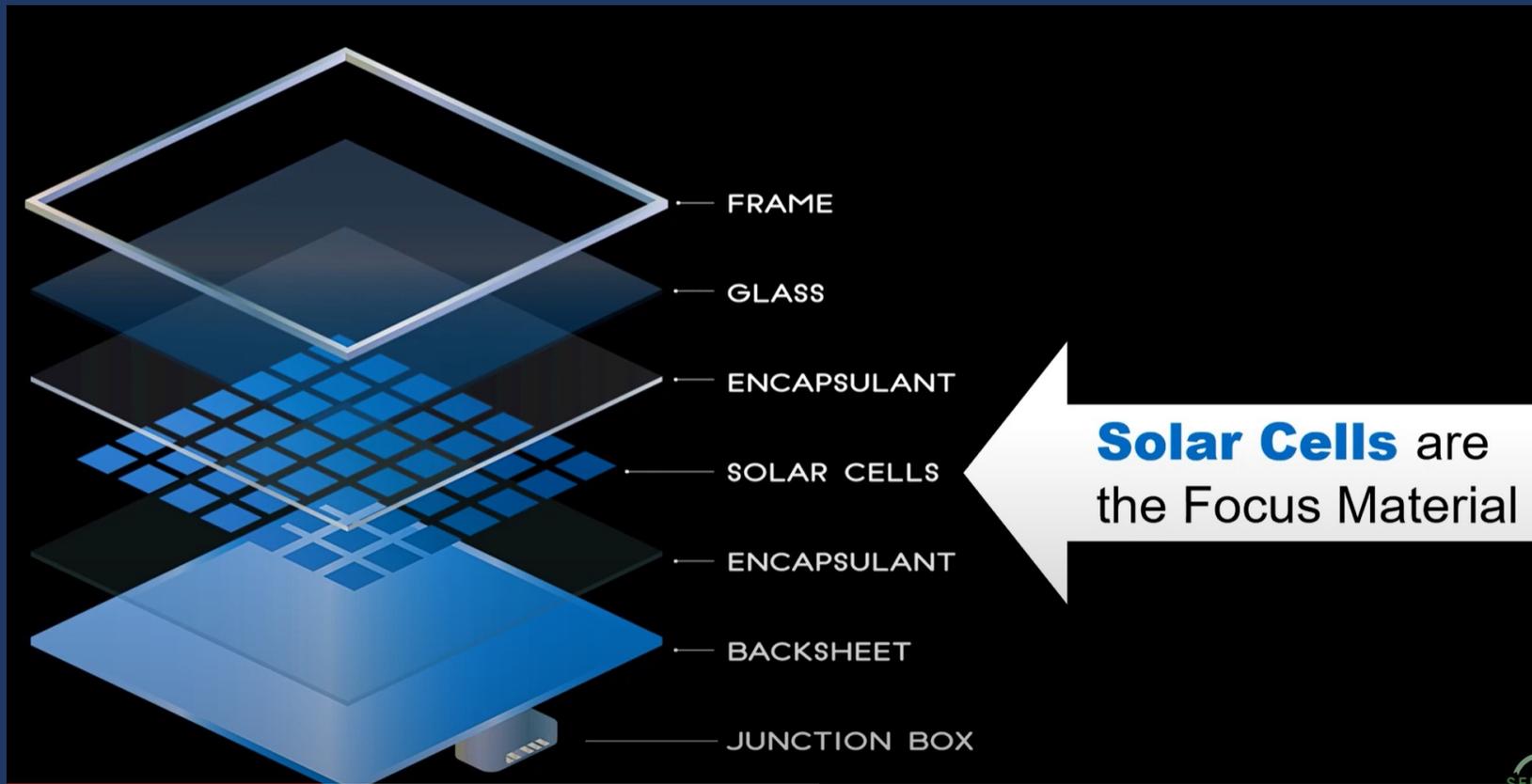
Includes any integrated components attached to the panel

Does not cover modules that are covered into other devices such as calculators or solar power lighting



# Focus Material: Solar Cells

Solar cells are the components of a PV module that convert light into electricity. The R2 Standard has defined solar cells as a Focus Material because they often contain Lead, Cadmium, or Selenium in potentially hazardous amounts and may contain other hazardous materials.



# Main Sections of Appendix G

## Requirements 1-2

- Managed in accordance with all applicable R2 requirements for electronic equipment
- Managed as R2 Control Stream

## Requirements 3-6

- Management of hazards

## Requirements 7-10

- Evaluation and processing



## Requirements 1-2

***PV modules are managed in accordance with all applicable R2 requirements for electronic equipment and as R2 Control Stream***

All R2 Core Requirements Apply to PV modules

- R2 references to electronic equipment also apply to PV modules
- PV modules evaluated for reuse according to Core 2 Hierarchy of Responsible Management Strategies
- Records to track throughput
- PV modules added to Legal Compliance Plan
- Specific Process Requirements as applicable

# PV Modules R2 Controlled Stream Management

Manage PV modules as R2 controlled stream onsite and throughout the downstream recycling chain

## PV modules remain an R2 Controlled Stream until:

1. PV module is a Functional Product as defined in Table 5 of the REC
2. Processed Until Tracking Stops
  1. When received at a facility to recover metals OR
  2. Processed for use in a new product OR
  3. Glass is co-mingled with solar cells OR
  4. Received by an R2-Certified downstream facility

# Requirements 3-6

## Management of Hazards

- Identification of hazards and risks
- Included in FM Management Plan
- Documented process to protect from electrical hazards
- Controls for storage and processing environments

# Requirements 7-10

## Evaluation and Processing

- The organization must conform with Core 2 Hierarchy of Reuse First
- Define criteria to determine reuse capability
- Include steps to re-evaluate if processing changes category of material stream

# Processing Pathways for Reuse

- PV modules can be tested, refurbished and/or repaired internally in accordance with Appendix C- Test and Repair  
OR
- They can be transferred to a qualified downstream vendor for testing, repair, and/or refurbishing



## Processing for Reuse Internally

- Test, repair, refurbish in accordance with Appendix C-Test and Repair
- Add PV modules to R2 Reuse Plan
  - ✓ Detail functions to be tested, test methods, and pass/fail criteria
  - ✓ Product safety plans and procedures

## Processing for Reuse by Downstream Vendor

- Qualified in accordance with Appendix A-Downstream Recycling Chain for testing, repair, and refurbishing
- Operating in conformance to Appendix G requirements



# Processing for Materials Recovery

- Process internally according to Appendix E-Materials Recovery  
OR
- Send to Downstream vendor:
  - ✓ Qualified in accordance with Appendix A-Downstream Recycling Chain
  - ✓ Operates in conformance with Appendix G requirements

# Brokering PV Modules

- Must operate in conformance to Appendix F-Brokering
- Must qualify downstream vendors in accordance with Appendix A
  - ✓ Ensure Down Stream Vendors meet the requirements of Appendix G including test, repair, and refurbishing

# Thank You!

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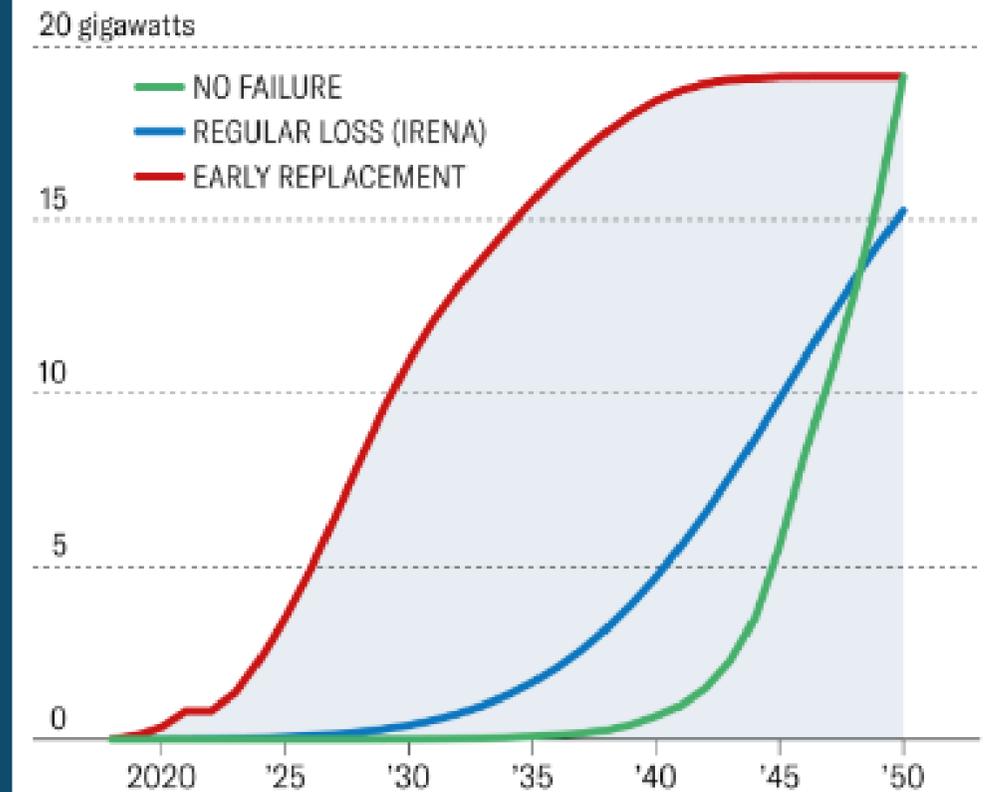
## Number of End-of-Life Solar Modules

CURRENT	9,000,000
IN 5 YEARS	26,000,000
BY 2050	2,250,000,000,000

## The Solar Trash Wave

According to our research, cumulative waste projections will rise far sooner and more sharply than most analysts expect, as the below graph shows. The green "no failure" line tracks the disposal of panels assuming that no faults occur over the 30-year life cycle; the blue line shows the official International Renewable Energy Agency (IRENA) forecast, which allows for some replacements earlier in the life cycle; and the red line represents waste projections predicted by our model.

### Cumulative capacity



Source: International Renewable Energy Agency, Electricity Data Browser, Global Solar Atlas



# NATURAL DISASTERS



**HAIL STORM WREAKS  
HAVOC ON SOLAR PANELS**



duke\_energy • Following

duke\_energy Our crews are working to assess the damage to our Florida service footprint after #Milton made landfall, along with emergency response agencies, residents and others who are taking stock of what is needed in the days ahead.

Milton was a force, bringing a record 11.5 inches of rainfall to Tampa, the most in 100+ years. More than 126 tornado warnings were issued by the

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# REUSE IS A VALUABLE SOLUTION TOO



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