RECLITE
RECYCLING THROUGH INNOVATION®

Reclite SA (Pty) Ltd

Sustainable and cost-effective end of life management of Solar PV equipment in South Africa

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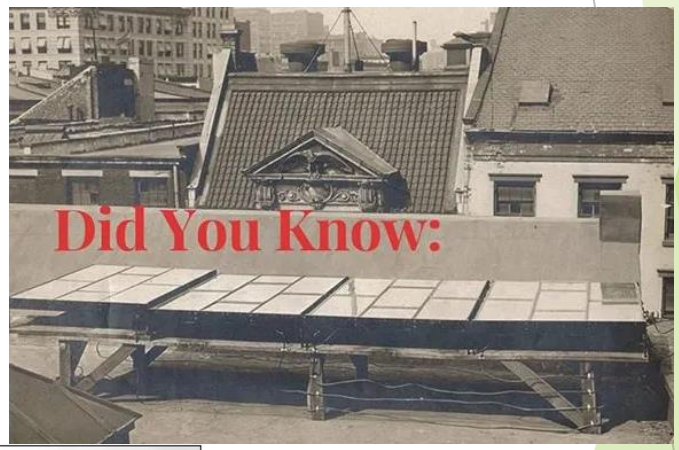
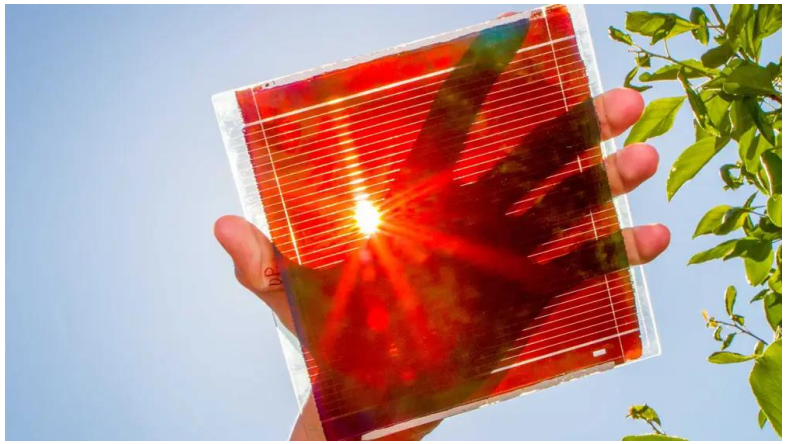
Intro - The high-tech PV tech started here

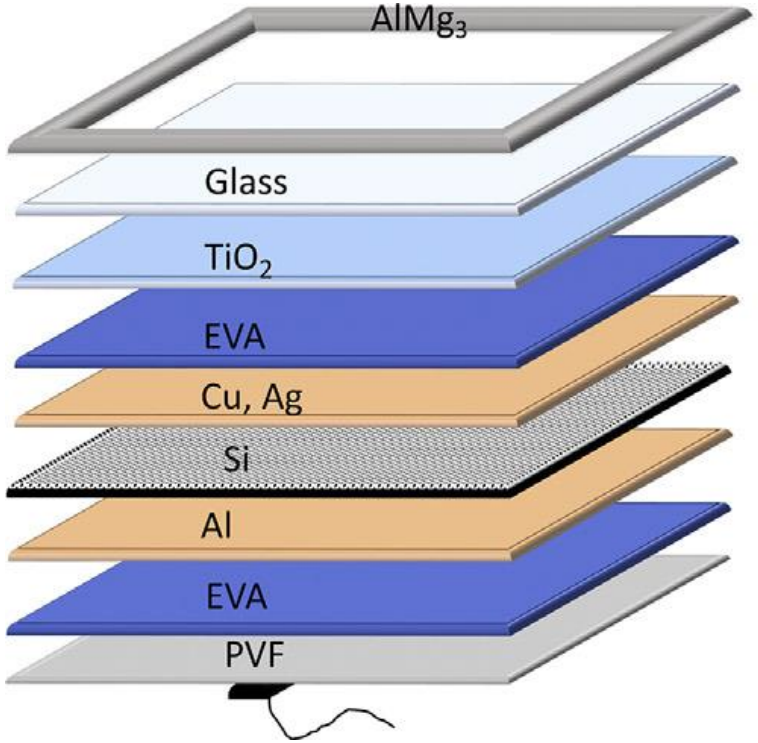
- ~1883 - First functioning solar panels Selenium was discovered to be photovoltaic by Willoughby Smith. **The first solar panels were affixed to a New York City rooftop**, but these panels are very inefficient with an energy conversion rate of only 1%.
- 1954 first commercially viable silicon solar panel
- 1983 first bifacial PV modules
- Next evolution -> perovskite semiconductors





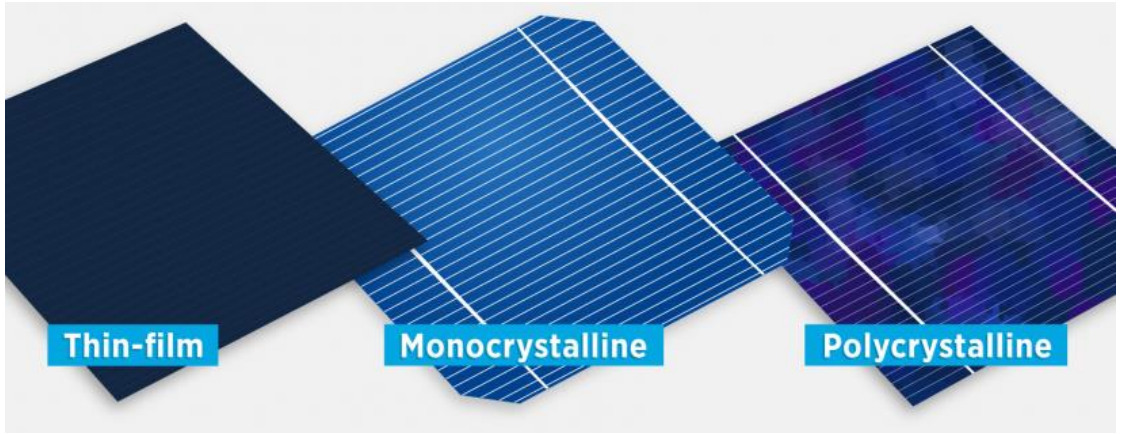
Silicon based Solar PV modules

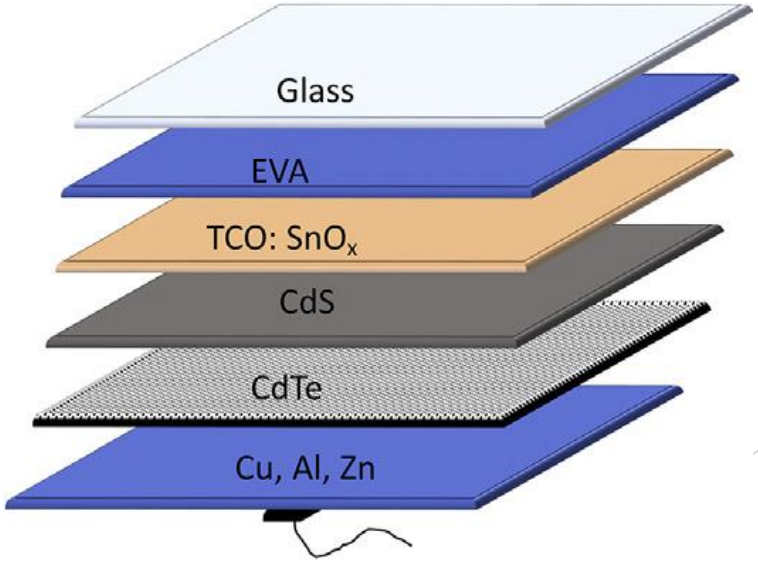
- Same basic layout
- Main components
  - Glass
  - Aluminum
  - Plastic (various types0
  - Copper



Thin Film Solar PV modules

- Layered
- Main components
  - Glass
  - Aluminum
  - Plastic (various types)
  - Copper
  - Cadmium, Selenium and Tellurium are main functional components





Why recycle Solar PV Modules???

Table 2
Summary of PV material components, percentage compositions (Bekkelund, 2013; Domínguez and Geyer, 2017; Frischknecht et al., 2015; Jungbluth et al., 2012; Sander et al., 2007a, 2007b; Stolz et al., 2016) and recycling yields (Domínguez and Geyer, 2019). Precious (Domínguez and Geyer, 2019),[Ψ] toxic and hazardous (Domínguez and Geyer, 2019)[Φ] and critical (Bauer et al., 2011)[ς] metals are shown with symbols and the remaining metals content is made up from base metals.

	c-Si			CdTe		
Material composition	[kg/m^2]	[%]	Recycling yield [%]	[kg/m^2]	[%]	Recycling yield [%]
Ag[Ψ]	1.06E-2	0.08	95	–	–	–
Al	2.32E+0	16.9	100	8.85E-3	0.05	100
Cd[Φ]	–	–		2.00E-2	0.12	95
Cr[ς]	–	–		3.00E−3	0.02	20
Cu	1.06E-1	0.77	100	1.10E-1	0.68	100
Mg	8.02E-2	0.58	37	–	–	–
Ni	1.63E-4	<0.01	41	–	–	–
Pb[Φ]	7.20E-4	<0.01	96	8.50E-4	<0.01	96
Si	8.61E-1	6.27	100	5.00E−2	0.30	100
Sn	9.05E-3	0.07	32	2.30E−7	<0.01	32
Te[ς]	–	–	–	2.00E-2	0.12	95
Ti	8.01E-7	<0.01	52	2.30E−8	<0.01	52
Zn	1.20E-6	<0.01	27	3.00E−8	<0.01	27
EVA	9.24E-1	6.73	–	6.10E-1	3.74	–
Glass	9.30E+0	67.8	100	1.60E+1	95.3	100
Total	13.7	100.00		16.8	100.00	

- Diversion of waste from landfill
- Recovery of hazardous fractions
- Recovery of Valuable resources such as:
  - Aluminium
  - Copper
  - Glass
  - Silicon
  - Silver
- 20% of todays global silver production is used in PV module manufacturing

Legal Background

- South African Constitution – Everyone has the right to a clean Environment!
- NEMWA 2013 Gazette No. 36784 – page 44 (n) all hazardous waste is banned from landfill in 8 years
- EPR Legislation – Extended Producer Legislation
  - All producer, importers or OEM's of EEE need to be compliant to EPR legislation
  - Need to be registered with a PRO – Producer Responsibility Organisation

Processing: End-Of-Life (EOL) -management of Solar PV modules

Electronic Waste Treatment

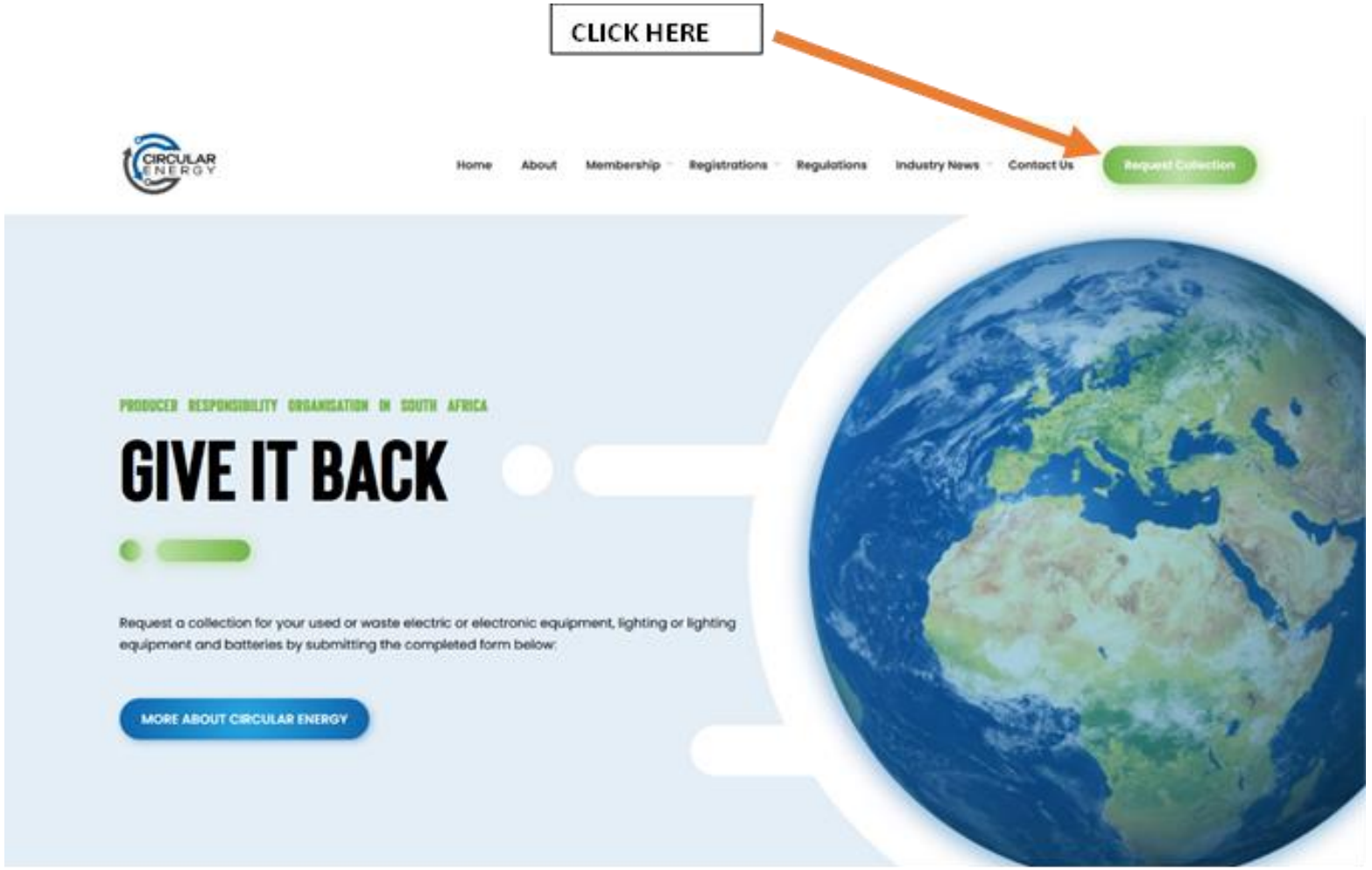
End-of-life Management chains – EPR S18(1)Legislation

- EPR Regulations and Section Notices were Published on 05 Nov 2020 for implementation:
  - Section 18 Extended Producer Responsibility Regulations (All Industries)
  - Section 18 Sector Notices (EEE, Lighting & Paper & Packaging)
- Sectors not satisfied and requested amendments
- Amendment process granted by the Minister who subsequently issued amendment for implementation on 05 May 2021
- Producer Obligation starts from 05 May 2021
- Implementation started from November 2021
- EPR Fees payable from Jan 2022

- Applicable to ALL Sectors
- Provides Framework for all S18 EPR Schemes
- Minimum Requirements for EPR Schemes and PRO's to operate

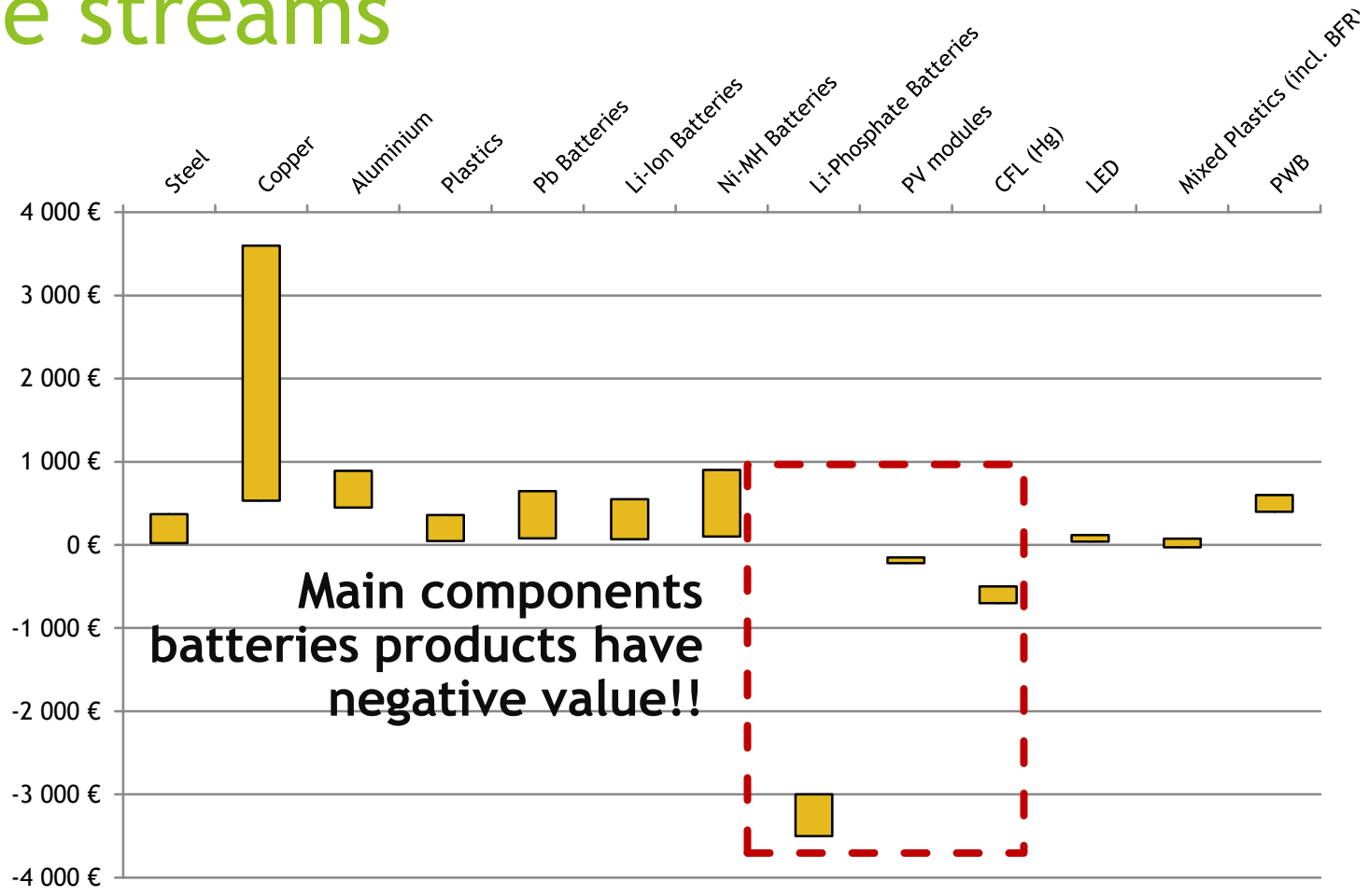
- Applicable to EEE & Lighting Sectors
- How implementation will be done
- Products and Class of products Identified
- Sets Targets

Take Back System

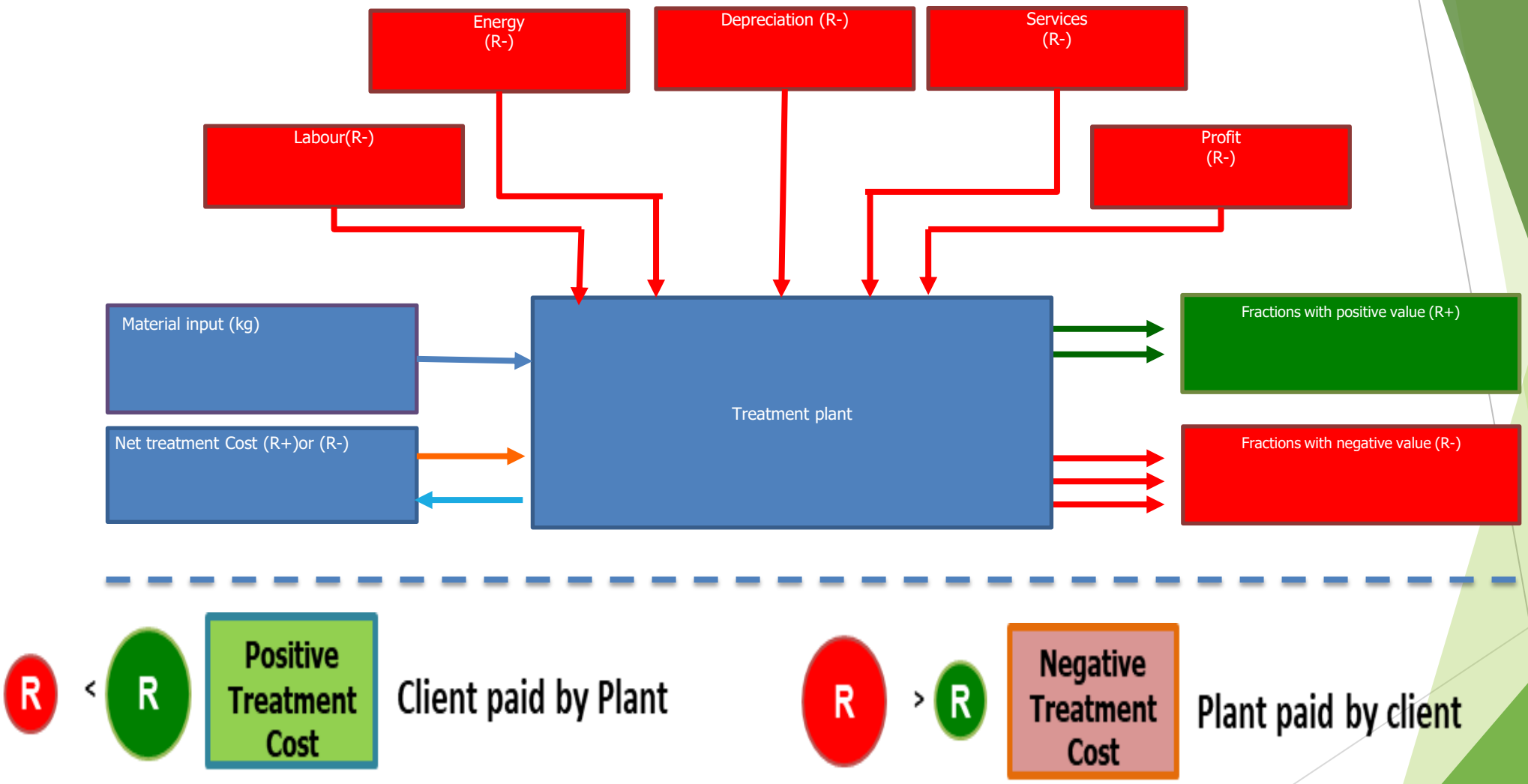


https://circular-energy.org/request-collection/

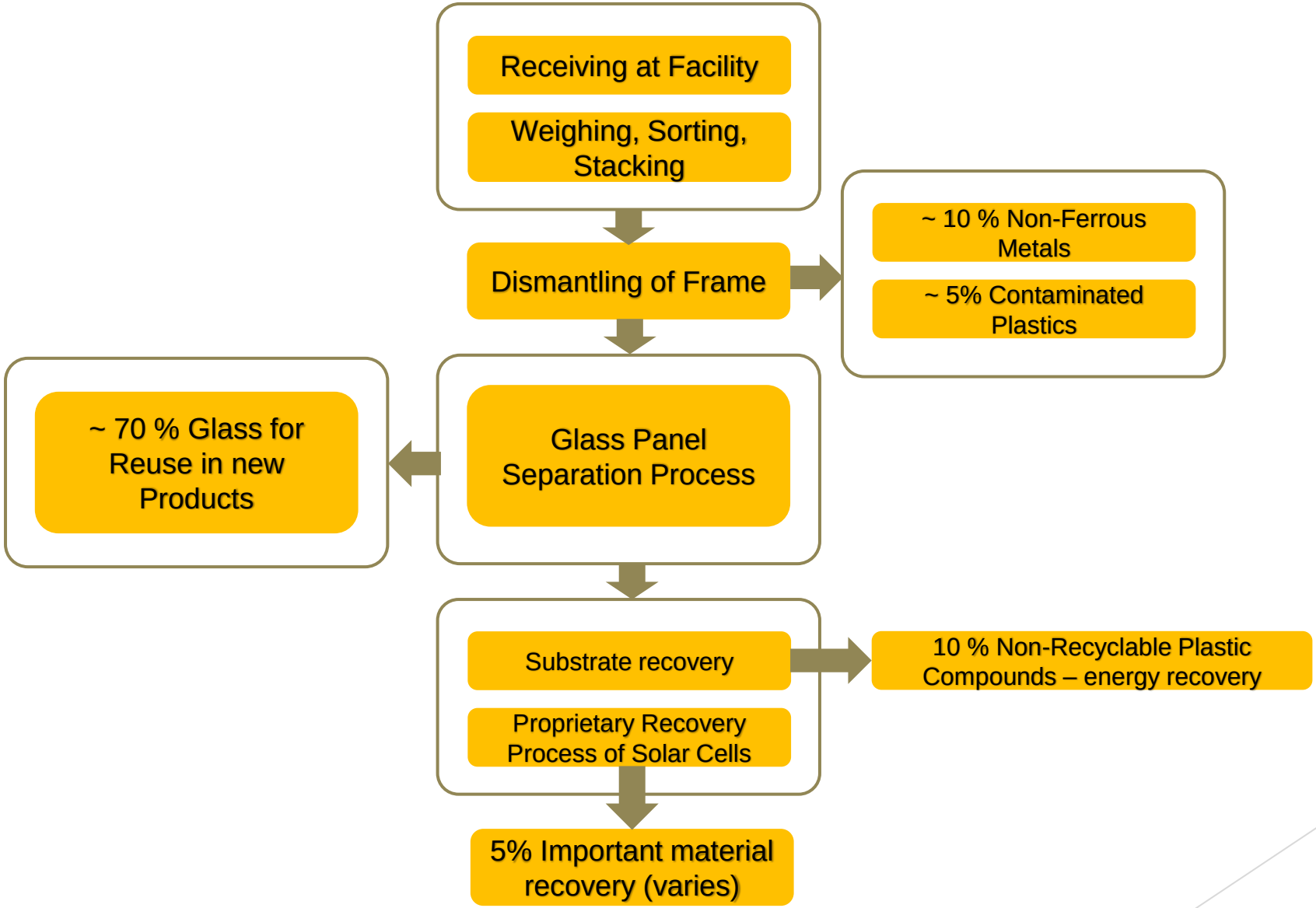
Financial implications of various WEEE waste streams



Net Recycling Cost Principle



Silicon Solar Panel Recycling Flowchart



PV MODULES

AND RELATED COMPONENTS

90% recoverable materials

80% recyclable materials

RECYCLABILITY

Photovoltaic (PV) modules – commonly known as solar panels – contain toxic substances such as lead and cadmium that can leach into soil and groundwater if the modules end up in landfill. Additionally PV – modules contain rare metals such as Silicon, Indium, Gallium among others.

Some PV modules have the potential for second life and can be re-certified for re-use (with our customers' permission) in our non-profit community projects and other applications.

For end-of-life PV modules, we safely recover 90% of the main components (aluminium, glass and copper) and supply the recovered materials to manufacturing streams. No Silicon based PV modules end up in landfill no matter what state they are in.

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COLLECT RECOVER RECYCLE SUPPLY

OUR TREEFROG STANDARD

In everything we do we strive to eliminate harmful materials from going into landfills and seeping into soil and groundwater that might make it impossible for our tree frog mascot to survive.

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SILICON PV PANELS

SINGLE SIDED SILICON BASED PV MODULES

95% recoverable materials

80% recyclable materials

RECYCLABILITY

Single Side PV Modules have been in the renewable energy market for more than 25 years and we are slowly seeing the first modules needing to be recycled. These Panels contain various components and some still contain lead in the solder joints before manufacturers knew of the impact. It is important that all PV-Modules are properly treated in licensed facilities to ensure recovery of the valuable resources and to minimise the use of precious landfill space.

We provide a holistic approach to collection, grading, recovery and treatment of all PV-Modules. Where possible more recent single sided Silicon based PV-Modules can be re safety tested and re-used in much need community projects and energy generation in areas where this technology is usually not affordable. Once at end-of-life the modules are completely recycled, and all components are recycled with exception to the plastic back sheet.

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In everything we do we strive to eliminate any harmful materials from going into landfills and seeping into soil and groundwater that might make it impossible for our tree frog mascot to survive. To ensure we move with the time Reclite is developing it's processes to ensure double sided PV-module recycling also becomes this efficient.

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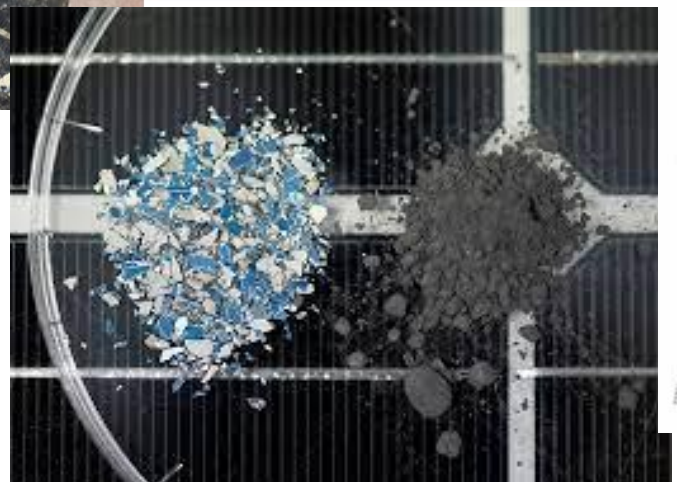
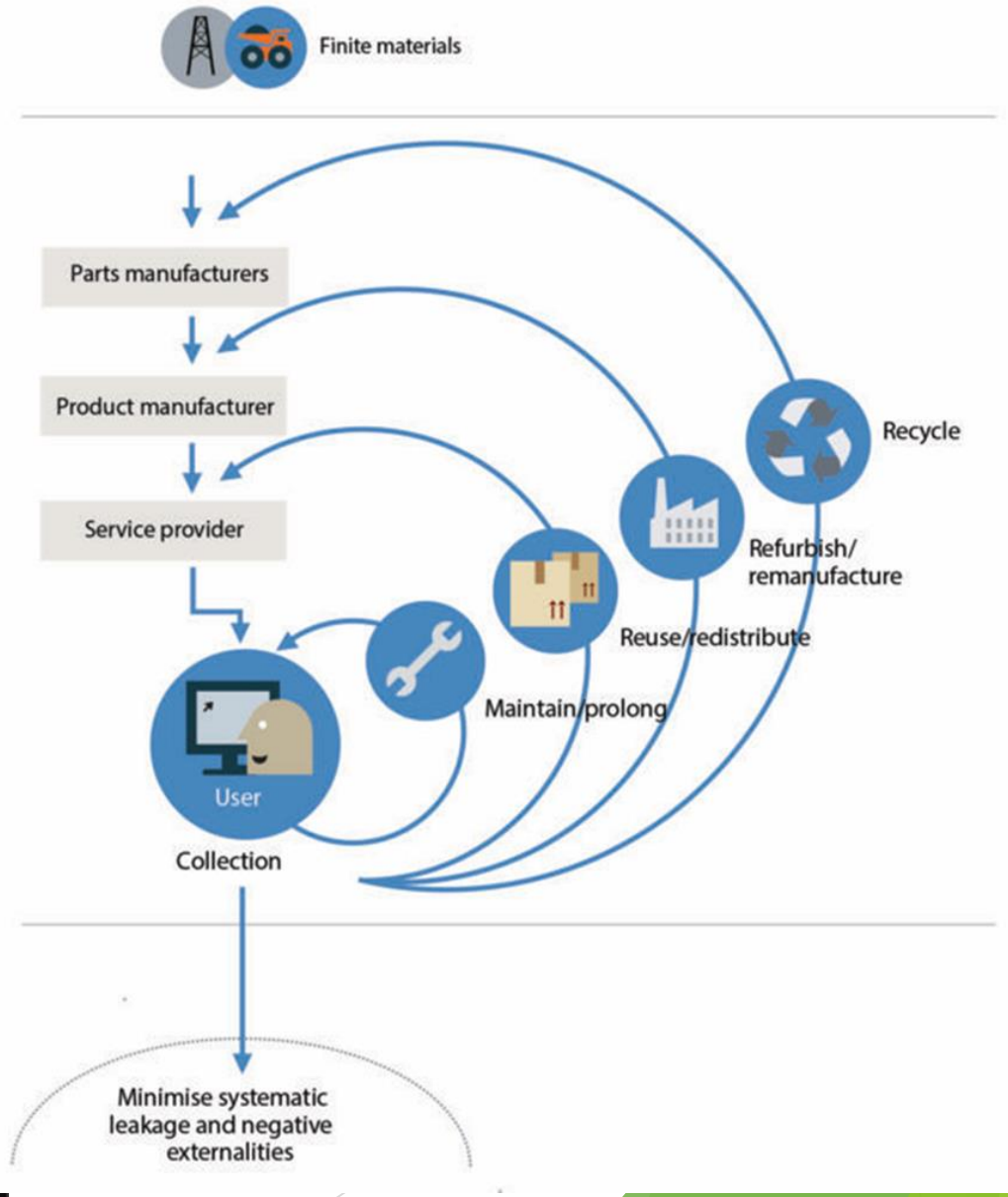
Silicon based PV module Recycling





Local beneficiation of Solar PV Glass into new sustainable products

- Recovery of Silver and Metallic Silicon from Si-PV Modules
- Recovery of CIGS matrix from Thin Film technology Modules

Always handle your renewable energy products with care!
Especially at end of life!

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