CIRCULARITY IN PV –
HOW TO INTEGRATE RE-USE IN THE PV SECTOR?

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- Founded in 1984 in Leuven, Belgium
- Independent non-for-profit organization
- Nanotechnology, digital and energy technologies
- Our mission is to **explore, validate and upscale technologies 3 -10 years ahead** of industrial needs

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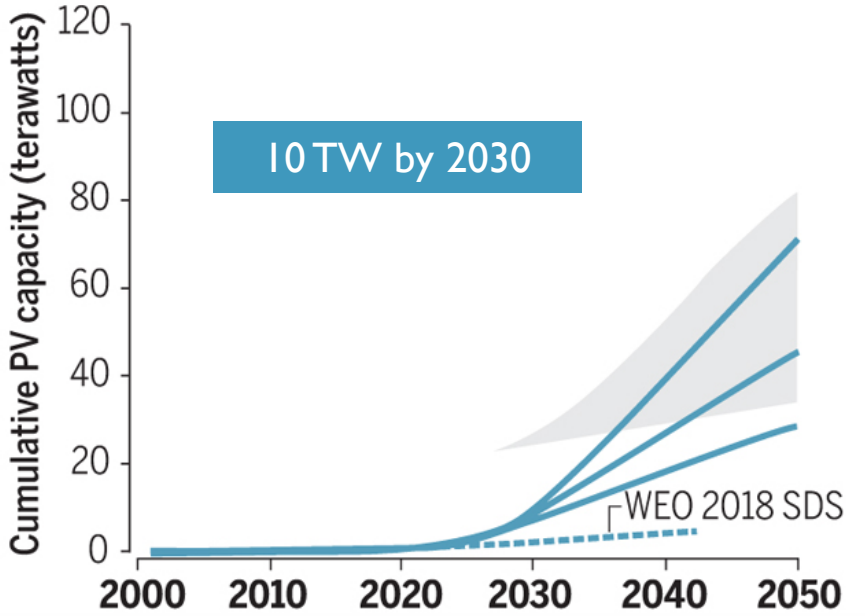
sustainable energy and **intelligent energy systems**

CIRCULAR APPROACH IN PV
FOR THE TERRAWATT ERA

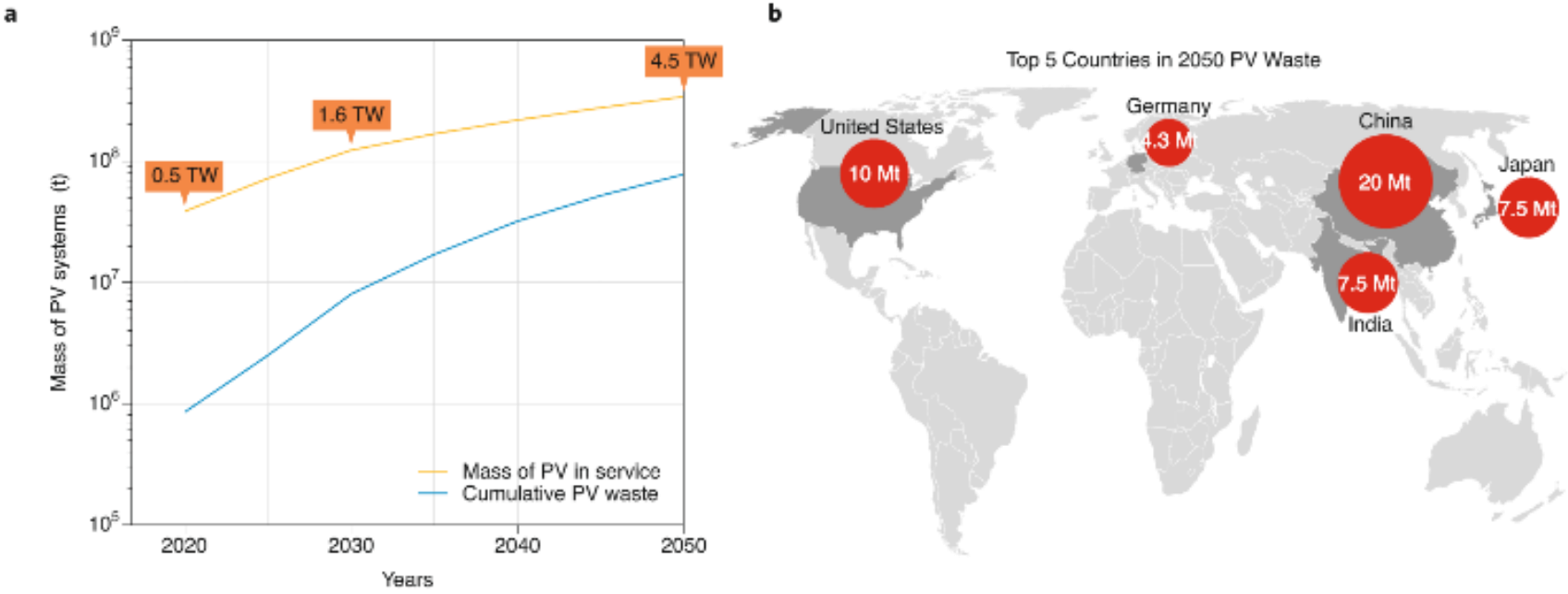
1 TW BY 2022-2025 IS JUST A HUMBLE START

FIGURE 12 WORLD TOTAL SOLAR PV MARKET SCENARIOS 2019-2023



N. Haegel, Science, 2019 https://science.sciencemag.org/content/364/6443/836.full

PV WASTE ESTIMATES WILL FOLLOW...



Source: G. Heath, Nature Energy, 2020
Link: link to paper

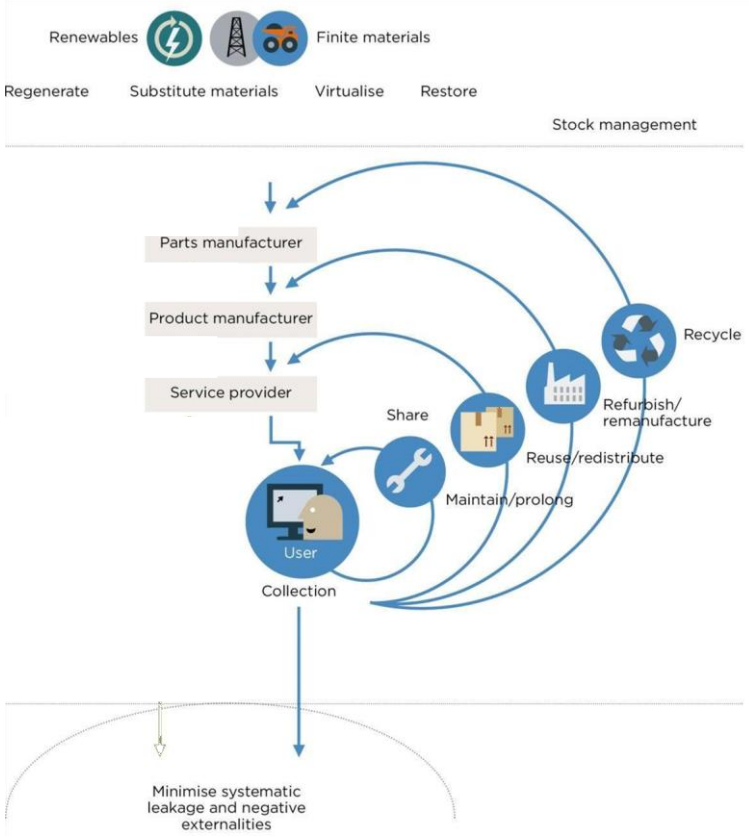
*"In a **circular economy**, the value of products and materials is maintained for as long as possible. Waste and resource use are minimized, and when a product reaches the end of its life, it is used again to create further value."*

EU Commission

CIRCULARITY IN GENERAL

Circular flow for technical products:

- **R**euse
- **R**epair
- **R**emanufacture
- **R**ecycling



Adapted from Ellen MacArthur Foundation

REVIEW OF THE CURRENT PV RE-USE SECTOR AND OUR RECOMMENDATIONS

REVIEW OF THE SECTOR THROUGH INTERVIEWS

- Report realized in collaboration with **PVCYCLE, bifa as independent evaluation** of the emerging PV RE-USE sector
  - No prior report/study/survey worldwide
  - Non-documented/tracked activities
- **Report largely prepared based on interviews** with field actors during 2020 1st semester

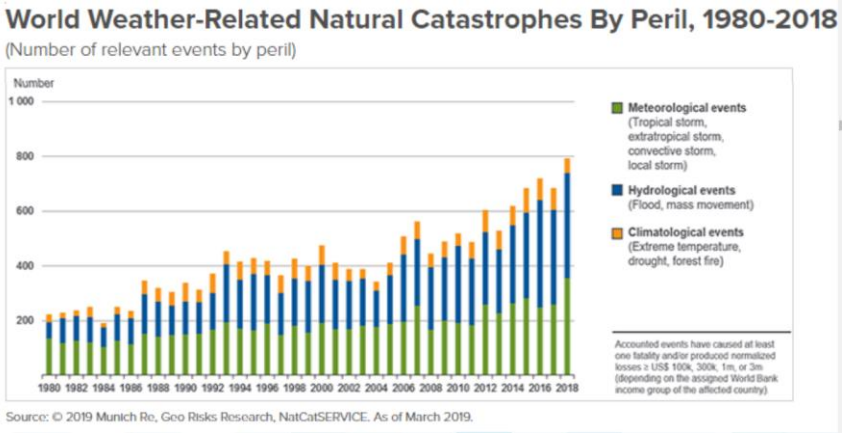
OUTLINE

- **Opportunities for re-use** of PV modules
- **Technical aspects:** Collecting and preparing PV modules for re-use
- **Economic** desirability and feasibility
- **Environmental** desirability and feasibility
- **Social** desirability and feasibility
- **Current market overview and examples**

ORIGIN OF RE-USE MODULES

1. Intact modules from commercial/utility PV systems partly damaged by extreme weather conditions
2. Repairable modules that are replaced by new ones by original provider
3. Repowering of commercial/utility-scale PV plants after 10-15 years

- Extreme weather conditions are more frequent in the last 5 years
- Trend is expected to continue with climate change



ENVIRONMENTAL DESIRABILITY & FEASIBILITY

- **Desirability: All good**
  - Positive impact by reducing environmental footprint (longer use for initial energy/material investment)
  - Positive impact in low-income countries by reducing the use of diesel generators

- **Feasibility: All good except end of life!**
  - Repair and re-use are environmentally feasible
  - Major risk at end of life in low-income countries (outside EU) → landfilling of PV

Recommendation for re-use modules: development of accredited Re-use Centers for re-usable and second-hand PV Modules

SOCIAL DESIRABILITY & FEASIBILITY

- **Desirability: All good**
  - With job creation both the decommissioning and re-use location
  - Preparing for re-use: 63 jobs/ 1000 t of WEEE (source: RRE-USE)
- **Feasibility: All good if quality is ensured**
  - Keep low price **while creating confidence** in second-hand product – product information, insurance, image/reputation of the vendor
  - **Recommendation: Develop technical standard, minimum product quality requirements and product warranty by re-use actor**

CURRENT RE-USE PV MARKET OVERVIEW

- Currently ~15 companies trade second-hand modules world-wide with 5 European (German) players
- Most companies operate from China and outside EU where legislation is limited

- Total volume of the market (estimate!): 500-550 MWp/year
- Biggest volumes from US, China → Africa and Southern Asia

WAASLAND CO-HOUSING EQUIPPED WITH 2ND PV MODULES QUALITY CONTROLLED

Circusol

SUNCRAFTER DEPLOYS SECOND PV MODULES IN OFF-GRID INSTALLATIONS

SunCrafter

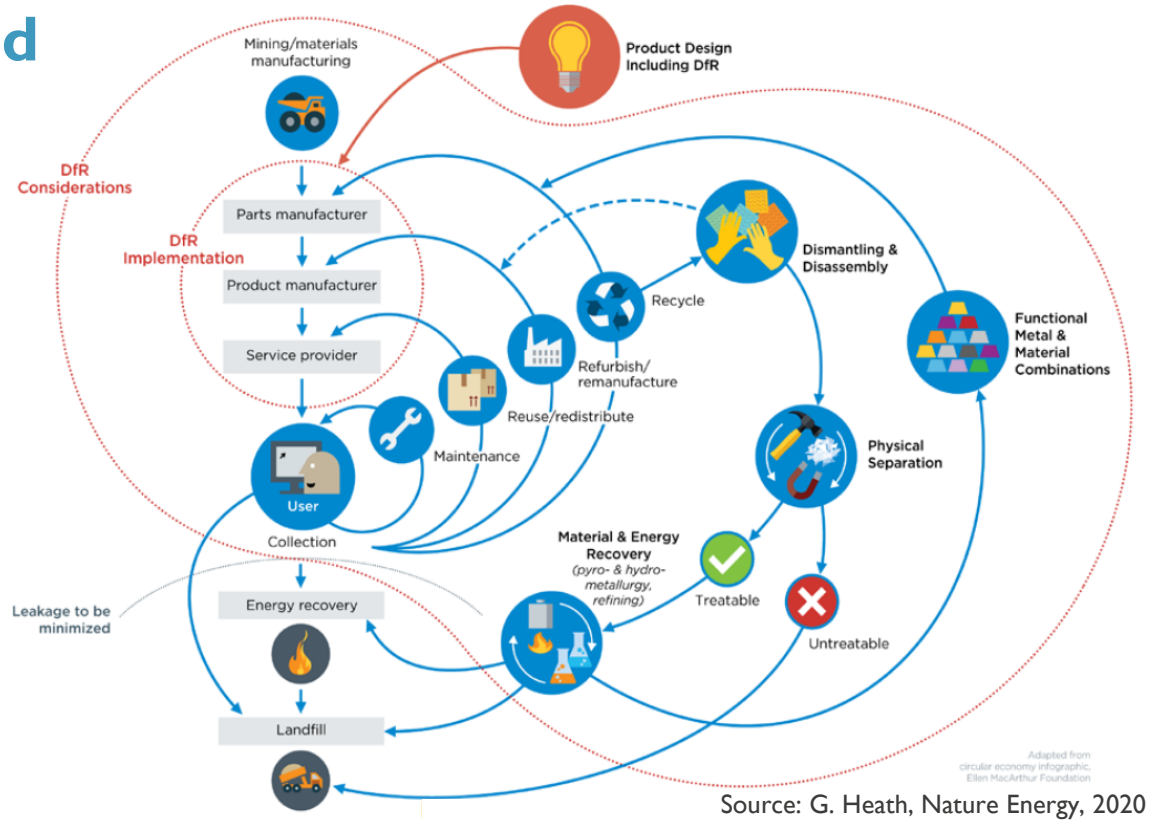
let the sun be in charge!

Circusol

SUMMARY: PV RE-USE IS STARTING!

- ✓ **Increasing opportunities for re-use and market of 500-550 MWp/year**
- ! **Technical aspects of preparing PV modules for re-use :**
  - ✓ Quality testing and fast and low-cost repairs are possible
  - ! Detailed recommendations are made to avoid current lack of requirements and confidence in quality
- ? **Economic feasibility** in low-income countries but circularity/CO_2 regulations are needed
- ✓ **Environmental desirable** if end-of-life treatment at the last use location is available
- ✓ **Socially very desirable** with additional job creation + alleviating energy poverty
- ! **Legislation on waste and re-use** to improve for higher quality products

Going a step further: **design for repair and recycling in PV**:



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