



RECYCLING OF SOLAR PANELS, INVERTERS & BATTERIES: A WELL-ROUNDED PRACTICE IN THE EU

1.

90% OF SOLAR PANELS CAN BE FULLY RECYCLED

Current recycling processes for solar panels allow for a technical recycling yield of up to 90% by weight.



SOURCE: IEA-PVPS, 2017.

2.

SOLAR RECYCLING IS MANDATORY ACCORDING TO EU LAW

Take-back and treatment of solar panels, inverters and batteries is mandatory in the EU, leading to high collection, reuse and recycling rates.

85%
RECOVERY TARGET

80%
PREPARATION FOR REUSE & RECYCLING TARGET

SOURCE: European Parliament and Council, 2012.

3.

RECYCLING SOLAR PANELS WILL DRIVE LOCAL AND QUALIFIED JOB CREATION FOR EUROPE

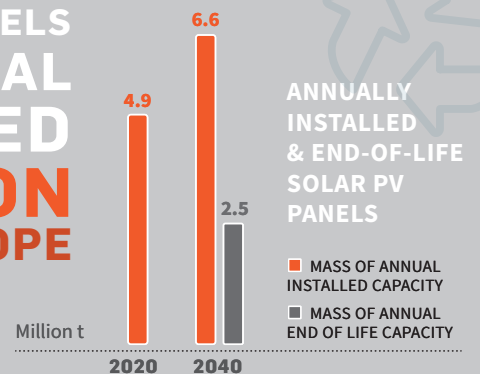


FIGURE: Annually installed and end-of-life solar panels 2020-2040, regular loss global scenario. SOURCE: IEA-PVPS and IRENA, 2016.



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1.

UP TO 90% OF A SOLAR PANEL CAN BE RECYCLED

Currently, solar panels at their end-of-life stage are processed in existing recycling plants for glass or metals. Mechanical processes are used to separate the materials. Technical recycling yields of up to 90% by weight are obtained, mostly comprising of aluminium frames and glass. Energy is also recovered from the incineration of the plastic fraction.

Effective end-of-life management practices are already in place today. However, a systematic circular approach can further contribute to a sustainable future for solar, with enhanced recovery of valuable materials and the ability to loop waste streams back into the supply chain. In the next few years, recycling waste materials from panels and second-life manufacturing will become a stand-alone business model, driving job creation in the EU.

2.

EU LEGISLATION ALREADY REQUIRES RECYCLING OF SOLAR PANELS

The set-up and financing of “take-back and recycling” schemes for solar panels and inverters are mandatory under the EU’s WEEE Directive. This legislation is based on the extended producer responsibility (EPR) principle, whereby companies putting panels on the market of member states (MS) are responsible for organising and financing its end-of-life management. Under the WEEE Directive, solar panels are in a category of electronic waste with an 85% recovery target, 80% of which consists of reuse and recycling. The annual collection target in each MS is calculated in two ways: 1) as a fraction of electronic waste generated in that MS (85% target), and 2) as a fraction of the average weight of sales over the past 3 years in that MS (65% target). EU authorities have issued a common methodology for the calculation of these targets, with a special focus on solar panels. Besides the mandatory obligations set out in EU legislation, voluntary sustainability standards for solar panels, such as the international standard NSF 457, include performance criteria for responsible end-of-life management and design for recycling.

3.

SOLAR RECYCLING WILL DRIVE JOB CREATION AS WASTE STREAMS INCREASE

Compared to other electronics like white goods or mobile phones, solar panels have a relatively long lifetime of around 30 years. It is only after this period that they will enter the waste stream. In 2020, the ratio between panels reaching their end of life and panels annually installed will be lower than 1%. However, this ratio will grow considerably after 2030, reaching about 40% in 2040 and eventually reaching installation levels. The industry is ready for this shift, with treatment and recycling processes and facilities already in place. These are only expected to improve with increased economies of scale and more innovative treatment options. By 2030, the solar recycling industry is anticipated to drive job creation while also strengthening the EU’s industrial base.

REFERENCES

EC-JRC (2016). *Analysis of Material Recovery from Silicon Photovoltaic Panels*. JRC Technical report. Available at: [http://publications.jrc.ec.europa.eu/repository/bitstream/JRC100783/2016.3057_src_en_final_2%20\(002\).pdf](http://publications.jrc.ec.europa.eu/repository/bitstream/JRC100783/2016.3057_src_en_final_2%20(002).pdf)

European Parliament and Council (2012). *Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE)*. Available at: <https://eur-lex.europa.eu/eli/dir/2012/19/oj>

IEA-PVPS (2017). *Life Cycle Inventory of Current Photovoltaic Module Recycling Processes in Europe*. Report T12-12. Available at: http://iea-pvps.org/index.php?id=460&elD=dam_frontend_push&docID=4239

Hoffmann, M., Suitner, H., and Thomas, R. (2017). *H2020 CABRISS public Business Plan*. CABRISS project report. Available at: https://zenodo.org/record/998558/files/CABRISS_Public-Business-Plan.pdf?download=1

IEA-PVPS (2017). *End-of-Life Management of Photovoltaic Panels: Trends in PV Module Recycling Technologies*. Report T12-10. Available at: http://www.iea-pvps.org/index.php?id=459&elD=dam_frontend_push&docID=4237

IEA-PVPS and IRENA (2016). *End-of-Life Management Solar Photovoltaic Panels*. Available at: http://iea-pvps.org/fileadmin/dam/public/report/technical/IRENA_IEAPVPS_End-of-Life_Solar_PV_Panels_2016.pdf

GlobalData (2012). *Solar Module Recycling: A Necessary Step to Maximise Environmental Benefits of Solar PV Industry*.

Thomas, R., Hoffman, M., and Pelletier, D. (2017). *Market analysis and business models for a circular economy in PV*. Available at: https://zenodo.org/record/815889/files/Thomas_CABRISS_Market_Analysis_Business_Models_SiliconDays2017.pdf?download=1