Evaluation of the state of recycling of photovoltaic panels and batteries in the context of the circular economy in five European countries

Vilém GABRHEL[a], Lenka WIMMEROVÁ[a], Olga ŠOLCOVÁ[b]
[a] Czech University of Life Sciences Prague, Faculty of Environmental Sciences, Kamýcká 129, 165 00 Praha - Suchdol, Czech Republic,
[b] Institute of Chemical Process Fundamentals of the CAS, Rozvojová 135, 165 02 Praha, Czech Republic,
e-mail: gabrhel@fzp.czu.cz; wimmerova@fzp.czu.cz; solcova@icpf.cas.cz

Summary

The aim of the study was to evaluate the status and development of recycling performance in selected European countries with a focus on photovoltaic panels (PV) and batteries within the context of the circular economy. The analysis is based on Eurostat data for five European countries: Belgium, the Czech Republic, the Netherlands, Germany, and Poland. The most comprehensive data tracking for photovoltaic panels and batteries focused on the recent five-year span from 2019 to 2023, while patents and investments in circular economy sectors were analysed based on data from 2017 to 2021. Monitoring was conducted on the recycling rates of electrical and electronic waste, material flows, processing capacities for PV panels and batteries, as well as socio-economic factors such as employment within the circular economy sectors. In the field of PV panels and batteries for the monitored variables, Germany was the dominant country in terms of the reported amount of waste. Only limited information regarding the processing capacities of batteries and PV panels was typically available, and this data was often specific to individual companies. Employment in circular economy sectors in the EU has been growing for a long time, with the Czech Republic and Poland accounting for the highest share of total employment, while Belgium and the Netherlands showed lower shares.

Keywords: *circular economy, photovoltaic panels, batteries, recycling, employment, Eurostat*

Introduction

The circular economy (CE) is a broad term and can be represented by up to 221 definitions[1]. For example, the circular economy is: 1. '*an industrial system that is restorative or regenerative by intention and design*'[2] or 2. '*a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops, which is achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling*'[3]. The circular economy is associated with sustainable development. In the field of circular economy, photovoltaic panels and batteries belong to the area of technical cycle[2] or waste management[1], depending on the CE definition applied. Due to the expected increase in PV installations, the subsequent need for energy storage, and the pressure for e-mobility, a significant rise in the volume of end-of-life PV panels and batteries is anticipated[4].

Monitored Countries and Data Sources

The following five European countries were selected for the study: Belgium, the Czech Republic, the Netherlands, Germany, and Poland. According to the EPI (Environmental Performance Index) report, Belgium, the Netherlands and Germany belong to the category of "Global West" countries, while Poland and the Czech Republic are categorized as countries of 'Eastern Europe'[5]. Poland was selected because it is geographically closest to the Czech Republic, while the other countries were chosen for their strong performance in circular economy and waste management. While Germany has been listed as a CE leader in general, Belgium and the Netherlands have been consistent leaders in waste management for many years[6].

This study utilized Eurostat data, focusing on datasets concerning recycling and waste processing, particularly those related to photovoltaic (PV) panels and batteries. For batteries, only the recycling dataset was used, even though data on the recycling input fractions were also available. The reason for that was the fact that this dataset exists only for batteries but not for PV panels. Socio-economic data, the relationship between employment in the circular economy sectors, and data related to patents and investments into recycling, reuse, and repair in waste management sectors were obtained from Eurostat, the data package dedicated to the circular economy. To ensure the use of the most recent data, the Eurostat library was accessed in this study[7]. Data visualization was conducted using the Highcharter library in RStudio (Posit, USA)[8]. Thus, the goal of the data analysis was to select the most recently published data and the most current and relevant five-year period for comparability across years. However, data from other institutions such as the United Nations Environmental Programme (UNEP) or the Organisation for Economic Co-operation and Development (OECD) were also sought[9], but due to insufficient data or a lack of updates, these data were not used in this study. Waste recycling/processing capacities for photovoltaic panels and batteries, and reports from organizations related to the issue of handling photovoltaic panels and batteries were searched across selected countries using internet search engines or information was obtained from responsible state institutions if these companies are obliged to report this data. Legislative documents issued by the EU were accessed through the Eurlex website. Specific information regarding recycling capacities in the Czech Republic was obtained via direct communication with the Ministry of Environment.

Results and Discussion

The most recent five-year span for photovoltaic panels and batteries individually covers 2019–2023, with 2023 marking the latest published year. Moreover, certain values for 2023 were indicated as provisional. The indicator '*Recycling rate of waste of electrical and electronic equipment (WEEE) separately collected'*, which is calculated as the proportion of WEEE waste that is recycled or reused out of the total amount of WEEE waste collected, showed that in the five-year average (2019–2023), Belgium scored 74.5%, the Czech Republic 92.7%, the Netherlands 73.56%, Germany 85.64% and Poland 85.42%[10]. Over the observed five-year period, recycling rates increased in Belgium, the Netherlands and Poland. The recycling rate in Germany fluctuated by several percentage points.

Photovoltaic (PV) panels

Eurostat's data does not indicate which specific types of PV panels it covers. Over 2.5 million tons of photovoltaic panels were placed on the market in Germany during the 2019–2023 period (the minimum of 272 thousand tons in 2019, the maximum of 802 thousand tons in 2023). Among the five selected countries, the Czech Republic had the lowest values. In total across all monitored years, it was 109 thousand tons, while for 2019, the lowest value was reported at 2.5 thousand tons. In descending order of the reported values, these were Germany, the Netherlands, Poland, Belgium and the Czech Republic. Notably, most waste PV panels from the Netherlands were processed abroad, but within the EU (95 – 100%). However, the overall development over time shows progress for the Netherlands in the processing of waste PV panels on its territory. The lowest values of PV panel waste treatment in a foreign country are reported by Poland, which, according to the data, processed all the waste generated on its territory. Belgium reported that most photovoltaic panels were processed on its territory with a range of 64 – 99% over the set five-year period. In 2019 and 2021, Czechia processed 100% of waste on its territory. In other years, the share of processed waste in its territory ranged from 24% to 57%. It is not clear whether Germany processes waste panels outside its territory, as such data is not available. Information on the processing of photovoltaic panels in non-EU countries is not available for Germany, other countries report zero (although the meaning of zero is not clearly interpretable). Due to higher values outside the range of values of other countries reported for Germany, Germany was excluded from the chart for clarity, and the values are described in the text. The lowest amount of recycling for Germany was reported in 2019 with the value of 12 thousand tons, while the maximum was reported for 2022 with a value of 15.2 thousand tons. In other years, the values ranged from 13.3 to 14.4 thousand tons.

The graph below shows the reported amount of recycled PV panels (**Figure 1**). Belgium and Poland reported the highest value of recycling in 2021 within the five-year period, for the country. The conversion of the number of recycled PV panels per capita, commonly used in waste, was not a suitable solution for displaying these data, due to the relatively low reported values of PV recycling in relation to the number of inhabitants.

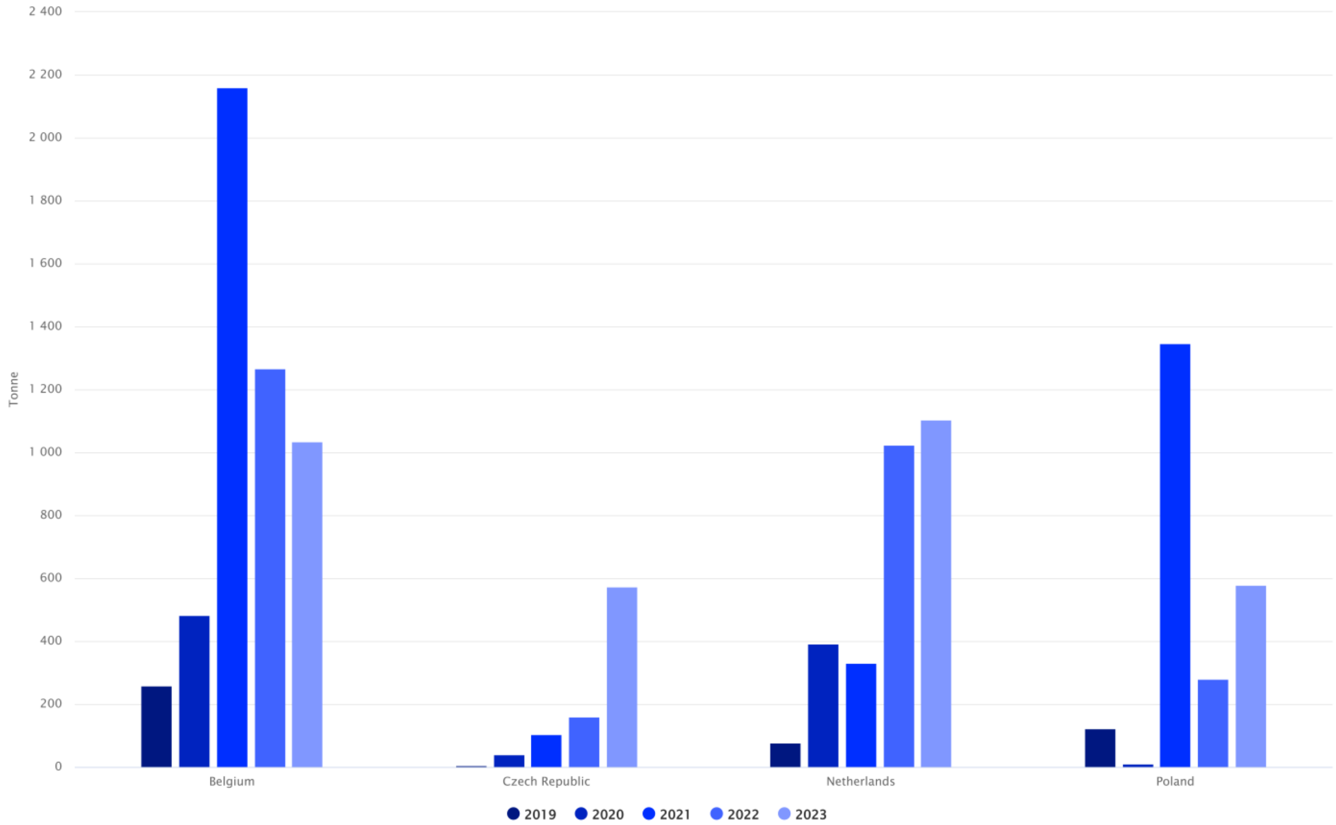

Figure 1: The reported amount (tonnes per year) of recycled PV panels in the 2019–2023 period in Belgium, the Czech Republic, the Netherlands and Poland (Note: colours, chronologically from dark to light, represent a specific year; data source: Eurostat[11])

The following details were found about PV processing procedures and available recycling capacities:

Belgium: Approx. 1,464 tonnes of photovoltaic panels are processed in Belgium[12]. The traced capacity for processing electrical waste is 60 tonnes/day[13].

Czech Republic: The capacity of lines processing photovoltaic panels is approximately 5,000 tonnes per year[14,15].

The Netherlands: Panels can be processed as part of their reuse. No specific recycling capacity was identified[16–19].

Germany: The recycling capacity of PV panels is at least 20–60 thousand tonnes per year[20].

Poland: The capacity for processing photovoltaic panels is 2,000 tonnes per year[21].

Unfortunately, in the Eurostat data there is no information available about the types of PV panels. Thus, it was not possible to identify which PV panels are most frequently collected as well as recycled. In addition to the information on the number of PV panels placed on the market, it would be advisable to also collect data on the number of installed solar panels, including information on panels that were damaged during installation. Currently, Eurostat data do not specify how PV panels are processed or which types are most or least commonly loaded. Moreover, the information on the recycling or processing capacities of PV panels or batteries for individual countries is not unified (often such information depends on whether the company itself publishes such information). It would be advantageous if such data were available within a single data portal (e.g., in the form of values for individual EU countries). This information could help monitor how processing or recycling capacity changes over time, whether it increases, decreases, or remains unchanged.

Batteries

Four types of batteries were available as follows: Cadmium batteries, Ni-Cd batteries, Lead batteries, and other batteries and accumulators. Data were available as the annual state sum of the amount of input fractions and of batteries processed. Over the entire observed five-year period, Lead batteries were the most represented across countries (81.76 – 99.06%). The second most represented type of batteries was the category of other batteries and accumulators, with the range of 0.50 – 16.54%. The least represented were Ni-Cd batteries (0.20 – 1.70%). Lead batteries were the most recycled in the Czech Republic, while other batteries and accumulators together with Ni-Cd batteries were the most recycled in the Netherlands (**Figure 2**). The dataset also contained the variables '*Cadmium content of batterie*s' and '*Lead content of batteries'*. Cadmium content from Ni-Cd batteries varied from the minimum 1.1% to maximum 37%, ascending by the share values: Poland 1.1 – 1.9%, the Czech Republic 6.9 – 7.1%, Germany 13.8 – 19.2%, Belgium 14.7 – 21.7%, and the Netherlands 36.9 – 37%. The lead content from Lead batteries for the Netherlands for each year corresponded to the share of 65%. For other countries, the share was in the range of 85 – 93%. According to the available literature, it is known that the typical value of lead weight in lead acid batteries is 65%[22], while the nickel content in Ni-Cd batteries (AB5 type) is between 15 – 20%[23].

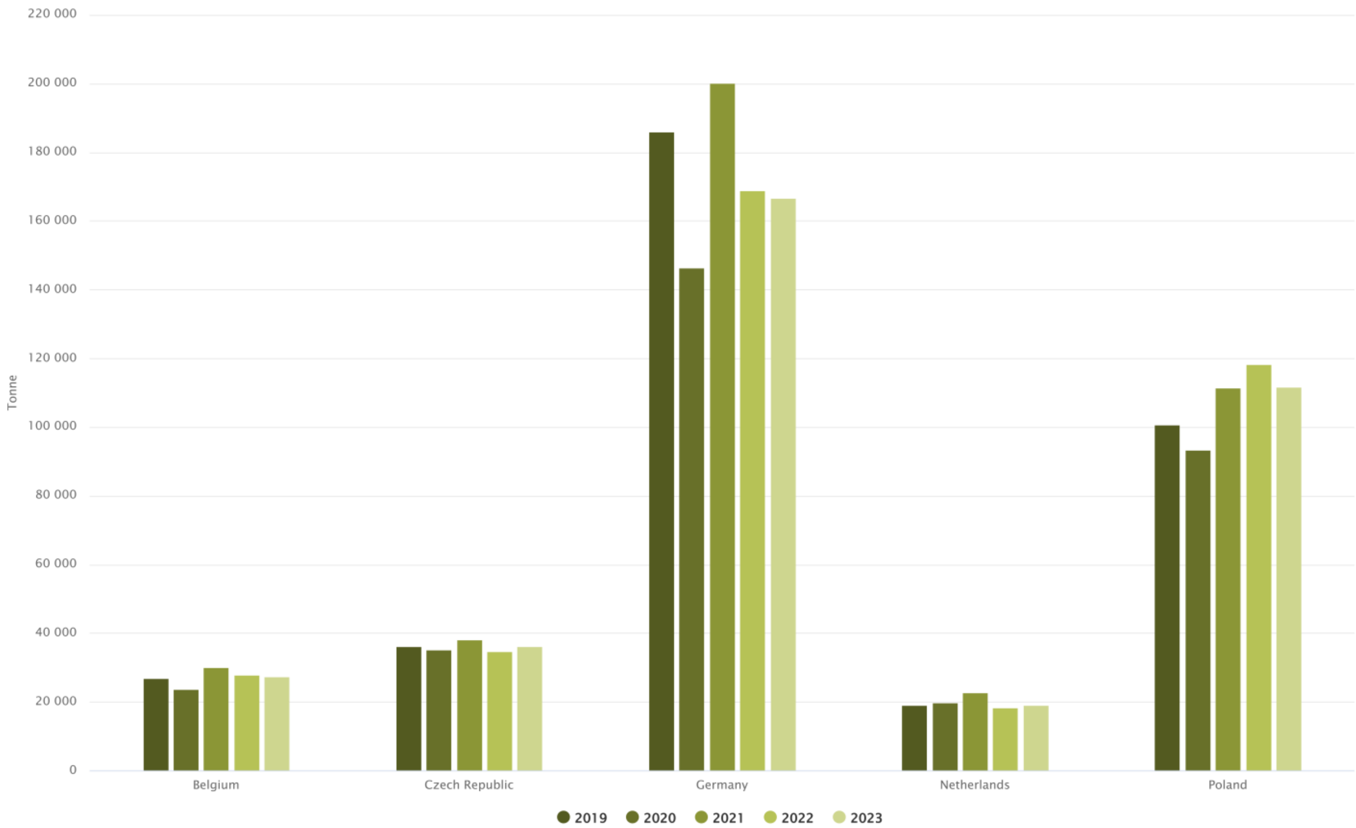

Figure 2: The total sum of recycled batteries (Ni-Cd batteries, other batteries and accumulators, and Lead batteries) in the 2019–2023 period in Belgium, the Czech Republic, Germany,the Netherlands and Poland (Note: Note: colours, chronologically from dark to light, represent a specific year; data source: Eurostat[24])

The following information was found about the available battery processing capacities:

Belgium: Processing capacity, specifically for lithium batteries is 7,000 tonnes/year[25].

Czech Republic: Information on the processing capacity was not found.

The Netherlands: Processing capacity, specifically for lithium batteries is up to 10,000 tonnes/year[26].

Germany: The processing capacity for lithium batteries is approx. 100,000 tonnes per year[27].

Poland: Processing capacity, specifically for lithium batteries is approx. 30,000 tonnes/year[28,29].

The Eurostat data was only available as the summary values. Thus, it was not possible to determine the amount of lithium battery waste and its management, as such data is not available, although the lithium batteries are often cited as central to the CE[30–32]. Lithium, battery-grade nickel, and the silicon metal have been also identified as essential as well as strategic raw materials in the EU[33]. It is likely that these data will become available in the coming years. Especially because of the new legislative requirement, which states that information on lithium batteries should be collected[34]. So far it is known that details about lithium battery processing are anticipated to be released in 2028. Another drawback of the currently reported data lies in the time gap, which is mentioned in the metadata of datasets[35,36].

Socio-economic data

The share of employment in circular economy sectors in Europe has been growing for a long time[37]. The total values for the EU (27 countries as of 2020) ranged from 4.4 to 4.7 million people employed in circular economy sectors (full time equivalent – FTE workers) over the observed five-year period.

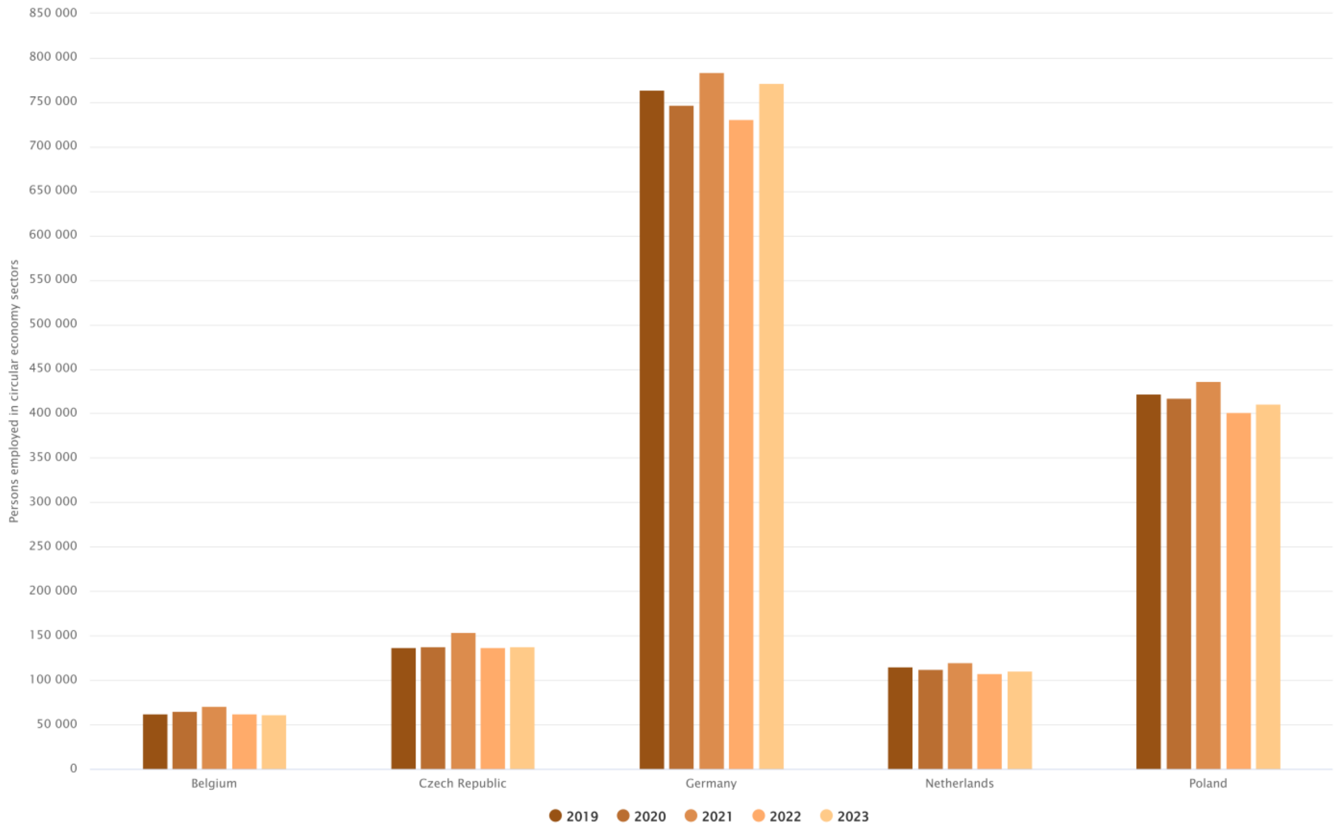

Figure 3: FTE persons employed in the CE sectors in the 2019–2023 period in Belgium, the Czech Republic, Germany, the Netherlands and Poland (Note: colours, chronologically from dark to light, represent a specific year; data source: Eurostat[38])

Between 2021 and 2022, the largest changes in the numbers were recorded[38], while the highest value was reported in 2021 (4.7 million FTE workers). The following year (2022), EU reported only 4.2 million

FTE workers. The countries, ranked in descending order according to the percentage of persons employed in circular economy sectors in relation to total employment over the five-year period was as follows: the Czech Republic 2.6 – 2.9%, Poland 2.3 – 2.5%, Germany 1.6 – 1.7%, Belgium 1.2 – 1.4% and the Netherlands 1.1 – 1.2%[38] (**Figure 3**).

The relationship between the number of relevant patents (i.e., patents are related to recycling and secondary raw materials) and the FTE number of people employed in CE sectors was analysed. The specific CE sectors in the dataset included the recycling sector, the repair and reuse sectors, the rental and leasing sectors. The dataset on investments was also available for these identical CE sectors. In this case, the most recent five-year period with complete data was 2017–2021 (**Figure 4**). The five-year average of the investment in ascending order by country was as follows: the Czech Republic €1,605 million, Poland €3,700 million, Belgium €6,954 million, the Netherlands €9,607 million, and Germany €34,417 million[39].

Figure 4: The relationship between the number of patents issued and the FTE people employed in CE sectors in the 2017 – 2021 period in Belgium, the Czech Republic, Germany, the Netherlands and Poland (Note: The centre of the bubble represents a point where these two values intersect; the diameter of the bubble increases with the increased amount of investment; the centre of each bubble displays the reported year, showing only its last two digits; data source: Eurostat[38–40])

Conclusions

The evaluation of photovoltaic (PV) panel and battery recycling in Belgium, the Czech Republic, the Netherlands, Germany, and Poland showed that the transition toward the circular economy in these technical product streams is progressing but remains uneven across countries. Differences generally reflect national waste management systems and recycling infrastructure. For electronic waste, recycling rates over 2019–2023 indicated generally effective collection and recycling frameworks, though stability and consistency differed among observed countries.

In the case of PV panels, large disparities were observed in quantities placed on the market and in end-of-life treatment. Germany dominated in absolute volumes of PV panels introduced, while the Czech Republic reported the lowest values. Several countries rely partly on cross-border treatment of PV waste within the EU, most notably the Netherlands, although the gradual increase in domestic processing was also observed. The major limitation of this study is the absence of harmonized data on PV panel types, treatment pathways, and unified reporting of recycling capacities, which constrains cross-country comparison as well as long-term capacity planning. For batteries, Lead batteries overwhelmingly dominated the recycling streams in all countries, while other battery types, e.g., Ni-Cd batteries, represented only minor shares. Available Eurostat data consist solely of aggregated values, which does not assist in the identification of lithium battery waste flows and their management, despite their growing relevance for circular economy and critical raw material security. This represents a significant data gap for batteries. From the socio-economic perspective, employment in circular economy sectors remains highest in relative terms in the Czech Republic and Poland, whereas investment volumes and patent activity are strongly concentrated in the Western European countries, especially Germany. This indicates that while some Eastern European countries show higher workforce intensity in circular economy activities, financial and innovation capacities are still unevenly distributed across EU.

Overall, the findings highlight the need for more detailed, harmonized, and forward-looking data on PV panels and batteries, including panel types, installed capacities, lithium battery flows, and harmonized information on available recycling infrastructure. Improved data integration at the EU level would support better monitoring of circular economy performance and facilitate strategic planning for the management of critical raw materials.

Acknowledgement

The research work was co-financed by the project BIOCIRKL (no. TN02000044) supported from the state budget by the Czech Recovery Plan (NPO) and the Technology Agency of the Czech Republic (TAČR) within the National Centres of Competence Programme.

References

1 Kirchherr J., Yang N.H.N., Schulze-Spüntrup F., Heerink M.J., Hartley K. (2023). Conceptualizing the Circular Economy (Revisited): An Analysis of 221 Definitions. *Resour., Conserv. Recycl*. 194:107001. doi:10.1016/j.resconrec.2023.107001

2 Ellen MacArthur Foundation (2013). Towards the Circular Economy. Vol. 1. https://content.ellenmacarthurfoundation.org/m/27265af68f11ef30/original/Towards-the-circular-economy-Vol-1.pdf

3 Geissdoerfer M., Savaget P., Bocken N.M.P., Hultink E.J. (2017). The Circular Economy – A new sustainability paradigm? *J. Cleaner Prod.* 143:757-768. doi:10.1016/j.jclepro.2016.12.048

4 Kastanaki E. (2025). Dynamic assessment of photovoltaic waste streams in the EU-27 countries under the circular economy principles of 'Reduce, Reuse and Recycle.' *Resour., Conserv. Recycl*. 214:108033. doi:10.1016/j.resconrec.2024.108033

5 Yale University (2024). Environmental Performance Index 2024. https://epi.yale.edu/downloads/2024-epi-report-20250106.pdf

6 Castillo-Díaz F.J., Belmonte-Ureña L.J., Diánez-Martínez F., Camacho-Ferre F. (2024). Challenges and perspectives of the circular economy in the European Union: A comparative analysis of the member states. *Ecological Economics* 224:108294. doi:10.1016/j.ecolecon.2024.108294

7 Lahti L., Huovari J., Kainu M., Biecek P. (2017). Retrieval and Analysis of Eurostat Open Data with the Eurostat Package. *The R Journal* 9(1):385. doi:10.32614/RJ-2017-019

8 Kunst J. (2022). Highcharter: A Wrapper for the 'Highcharts' Library. https://jkunst.com/highcharter/, https://github.com/jbkunst/highcharter

9 OECD Data Explorer (2025). https://data-explorer.oecd.org/vis?pg=0&bp=true&snb=5&lc=en&tm=weee&df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_EWASTE%40DF_EWASTE&df[ag]=OECD.ENV.EPI&df[vs]=1.0&dq=AUS.A..T.GEN&pd=2010%2C&to[TIME_PERIOD]=false

10 Eurostat dataset: cei_wm060. https://ec.europa.eu/eurostat/databrowser/view/cei_wm060__custom_19869946/default/table

11 Eurostat dataset: env_waseleeos. https://ec.europa.eu/eurostat/databrowser/view/env_waseleeos__custom_19608799/default/table

12 PV Cycle (2024). PVC Belgium Annual Report 2024. https://pvcycle.be/en/annual-reports/2024-annual-report

13 PV Cycle (2018). BNE Trading & Recycling – Investing in local sustainable recycling. https://pvcycle.be/en/news/bne-trading-recycling-investing-in-local-sustainable-recycling

14 Dekonta (2025). Recyklace solárních panelů. https://www.dekonta.cz/cs/recyklace-solarnich-panelu/

15 TECHNOWORLD (2025). Přední zpracovatel solárních panelů v České republice a držitel certifikace WEEELABEX. https://www.technoworld.cz/#zpracovani

16 Lijzen J., Heens F., Dekker E., van Bodegraven M., Hof M. (2024). *Recycling of Solar Panels. Comparison of Scenarios for a More Circular and Safe Product Chain*. Rijksinstituut voor Volksgezondheid en Milieu RIVM. doi:10.21945/RIVM-2023-0442

17 Weee Netherlands (2025). Reuse of electrical appliances for circular economy. https://www.weee.nl/en/reuse-of-electrical-appliances

18 NL Times (2025). Solar panel recycling faces major hurdles in the Netherlands. https://nltimes.nl/2025/05/05/solar-panel-recycling-faces-major-hurdles-netherlands

19 TNO (2022). Balancing costs and revenues for recycling end-of-life PV panels in the Netherlands. https://www.stichting-open.org/wp-content/uploads/2022/12/22-12822_tno_rapport_recycling_zonnepanelen_16mvd_hr.pdf

20 PVPS (2024): Status of the PV recycling industry in Germany. https://iea-pvps.org/wp-content/uploads/2024/03/IEA-PVPS-T12-27-Report-PV-Recycling-in-Germany.pdf

21 Iwańczuk A., Krukurka P. (2025). Recycling strategies for decommissioned photovoltaic module panels. *Rocznik Ochrona Środowiska*. 27:421-436. doi:10.54740/ros.2025.035

22 May G.J., Davidson A., Monahov B. (2018). Lead batteries for utility energy storage: A review. *J. Energy Storage* 15:145-157. doi:10.1016/j.est.2017.11.008

23 Veloso L.R.S., Rodrigues L.E.O.C., Ferreira D.A., Magalhães F.S., Mansur M.B. (2005). Development of a hydrometallurgical route for the recovery of zinc and manganese from spent alkaline batteries. *J. Power Sources* 152:295-302. doi:10.1016/j.jpowsour.2005.03.133

24 Eurostat dataset: env_wasbat. https://ec.europa.eu/eurostat/databrowser/view/env_wasbat__custom_17874377/default/table

25 Umicore (2025). Battery recycling solutions. https://www.umicore.com/en/about/battery-materials-solutions/battery-recycling-solutions/start

26 SK Tes (2024). SK Tes opens new battery recycling facility in Netherlands. https://www.sktes.com/press-release/sk-tes-opens-cutting-edge-battery-recycling-facility-in-netherlands-to-meet-surging-demand-in-electric-vehicle-market

27 Battery-News (2026). Europa Batterie-Recycling. https://battery-news.de/batterierecyling

28 Eneris (2026). Recykling baterii i akumulatorów. https://eneris.pl/recykling-baterii-i-akumulatorow

29 BDO (2025): Registr subjektů. https://rejestr-bdo.mos.gov.pl/Registry/Index?pageNumber=1&placeType=residenceOrBusinessAddress&t=1770049987501&tables=ActivityScope5Table2

30 Goyal M., Singh K., Bhatnagar N. (2023). Circular economy conceptualization for lithium-ion batteries- material procurement and disposal process. *Chem. Eng. Sci.* 281:119080. doi:10.1016/j.ces.2023.119080

31 Harper G.D.J., Kendrick E., Anderson P.A., et al. (2023). Roadmap for a sustainable circular economy in lithium-ion and future battery technologies. *J Phys Energy* 5(2):021501. doi:10.1088/2515-7655/acaa57

32 Sheth R.P., Ranawat N.S., Chakraborty A., Mishra R.P., Khandelwal M. (2023). The Lithium-Ion battery recycling process from a Circular Economy perspective—A review and future directions. *Energies* 16(7):3228. doi:10.3390/en16073228

33 Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020Text with EEA relevance

34 Commission Delegated Regulation (EU) 2025/606 of 21 March 2025 Supplementing Regulation (EU) 2023/1542 of the European Parliament and of the Council by Establishing the Methodology for Calculation and Verification of Rates for Recycling Efficiency and Recovery of Materials from Waste Batteries, and the Format for the Documentation

35 Eurostat dataset: env_waspb. https://ec.europa.eu/eurostat/cache/metadata/en/env_waspb_esms.htm

36 Eurostat dataset: env_waselee. https://ec.europa.eu/eurostat/cache/metadata/en/env_waselee_esms.htm

37 EEA (2024). Employment in the circular economy. https://www.eea.europa.eu/en/circularity/thematic-metrics/business/employment-in-the-circular-economy

38 Eurostat dataset: cei_cie_011. https://ec.europa.eu/eurostat/databrowser/view/CEI_CIE011__custom_19609227/default/table

39 Eurostat dataset: cei_cie012. https://ec.europa.eu/eurostat/databrowser/view/cei_cie012/default/table?lang=en

40 Eurostat dataset: cei_cie020. https://ec.europa.eu/eurostat/databrowser/view/cei_cie020/default/table?lang=en

Zhodnocení stavu recyklace fotovoltaických panelů a baterií v kontextu cirkulární ekonomiky v pěti evropských státech

Vilém GABRHEL[a], Lenka WIMMEROVÁ[a], Olga ŠOLCOVÁ[b]

[a] Česká zemědělská univerzita v Praze, Fakulta životního prostředí, Kamýcká 129, 165 00 Praha - Suchdol,

[b] Ústav chemických procesů AV ČR, v.v.i., Rozvojová 135, 165 02 Praha,

e-mail: gabrhel@fzp.czu.cz; wimmerova@fzp.czu.cz; solcova@icpf.cas.cz

Shrnutí

Cílem studie bylo zhodnotit stav a vývoj recyklace ve vybraných evropských státech se zaměřením na fotovoltaické panely a baterie v kontextu cirkulární ekonomiky. Analýza vychází z dat Eurostatu a je zaměřena na pět vybraných evropských zemí: Belgie, Česká republika, Nizozemí, Německo, Polsko. S ohledem na dostupnost dat bylo sledováno nejvíce současné pětileté období 2019–2023 pro fotovoltaické panely a baterie a období 2017–2021 bylo vybráno pro srovnání patentů a investic v sektorech cirkulární ekonomiky. V rámci studie byly sledovány ukazatele míry recyklace elektroodpadu, materiálové toky, zpracovatelské kapacity (FV panelů a baterií) a socio-ekonomické proměnné (zaměstnanost v sektorech CE). V oblasti FV panelů a baterií za sledované proměnné bylo Německo dominantním státem z pohledu reportovaného množství tohoto odpadu. Z hlediska zpracovatelských kapacit baterií a FV panelů byly však identifikovány často jen dílčí údaje na úrovni jednotlivých firem. Zaměstnanost v sektorech cirkulární ekonomiky v EU dlouhodobě roste, přičemž relativně nejvyšší podíl na celkové zaměstnanosti vykazuje Česká republika a Polsko, zatímco Belgie a Nizozemí dosáhly podílů nižších.

Klíčová slova: *cirkulární ekonomika, fotovoltaické panely, baterie, recyklace, zaměstnanost, Eurostat*