

Estimating the Date of Earth Overshoot Day 2023

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Overview: Earth Overshoot Day Calculation

Earth Overshoot Day is the day of the year on which humanity's demand on nature exceeds the Earth's annual biological capacity to regenerate. **In 2023, Earth Overshoot Day falls on August 2nd**, meaning that between January 1st and August 2nd, humanity's demand for biological regeneration is equivalent to the planet's entire annual regeneration.

The Need for Nowcasting

The [National Footprint and Biocapacity Accounts](#) (NFBA) are built on official UN datasets. However, this data comes with a time delay. The most recently reported UN data has typically a time lag of about 3 to 4 years. As a result, the 2023 edition of the National Footprint and Biocapacity Accounts reports results based on UN data up 2019. As a new addition, the Accounts now also provide Footprint and biocapacity estimates for all covered countries up to 2022.

Since Earth Overshoot Day is based on the current year's consumption, nowcasting is needed to provide an estimate of where humanity's demand stands compared to the planet's biocapacity in 2023. To generate this 2023 result for the World's Ecological Footprint and biocapacity, Global Footprint Network uses input data from additional sources than those used in the NFBA.

Nowcasting is distinct from forecasting. While forecasting uses models to extrapolate data into the future, based on assumptions of how the forecasted item operated in the past. Nowcasting uses actual data associated with the nowcasted years. Generally, this is proxy data, such as yield fluctuations in some crops to estimate fluctuation in entire harvest, car usage, electricity intensity, and change in housing stock. Such proxy data can be used to estimate relative changes in Footprint of biocapacity related resource aspects and may be superimposed over the more complete NFBA's that end 4 years prior.

Timely estimates are needed by decision makers. Therefore, nowcasting is common for economic indicators like GDP, which in some cases are reported quarterly. Although Ecological Footprint and biocapacity does not shift rapidly and historical trends are informative, a 4-year time lag may be too long for decision makers as these results may not reflect how their resource consumption and their decisions impacted the trends. Thanks to the nowcasted estimates, the COVID-lockdown effect can now be seen in the trajectories of many countries.

Methodological Overview: Accounting for Biocapacity

The Ecological Footprint's underlying research question is straightforward: How much mutually exclusive, biologically productive area¹ is necessary to renew people's demand for nature's products and services? The demands on nature that compete for biocapacity include:

- food, fibre, and timber
- space for roads and structures,
- energy production (from hydropower to biomass), and
- waste absorption, incl. CO₂ from fossil fuel or cement production.

¹ Before adding up the areas, they are first productivity adjusted, hence measured in global hectares. This makes biocapacity and Footprints comparable across time and space, since the areas are weighed proportionally to their biocapacity.

Both biocapacity and Ecological Footprint can be tracked and compared against each other, based on two simple principles:

- (1) **Commensurability:** by scaling these areas proportional to their biological productivity, they become commensurable.
- (2) **Additionality:** all the competing demands on productive surfaces, i.e., the surfaces that contain the planet's biocapacity, can be added up.

The measurement unit used is “global hectare,” which is a biologically productive hectare with world-average productivity. More details about the principles and mechanics of this accounting system are documented extensively in [this literature](#) and on Global Footprint Network's [website](#). An overview of the principles is available in open-access papers in [Sustainability](#) and in [Nature Sustainability](#), as well as the [supplementary information](#) of the latter.

Calculations for countries and for the world are done through the National Footprint and Biocapacity Accounts, based on up to 15,000 data points per country per year.

Starting Point: National Footprint and Biocapacity Accounts

Nowcasting is an extension of the [National Footprint and Biocapacity Accounts](#), including the latest results (1961-2019) and estimates (2020-2022). They therefore now offer time series from 1961-2022. These accounts are comprehensive biophysical balance sheets that compare countries' demand on nature with what the planet or that country's ecosystems can renew. They build on the premise that materially, the most limiting factor for the human economy is our planet's ecosystems' capacity (its “biocapacity”). They inform us about every country's unique sustainability challenges, including climate change and resource constraints.

Recognizing the overarching biological constraints to human metabolisms, these accounts focus on tracking humanity's or a country's material demands (Footprint, red line in figure below).

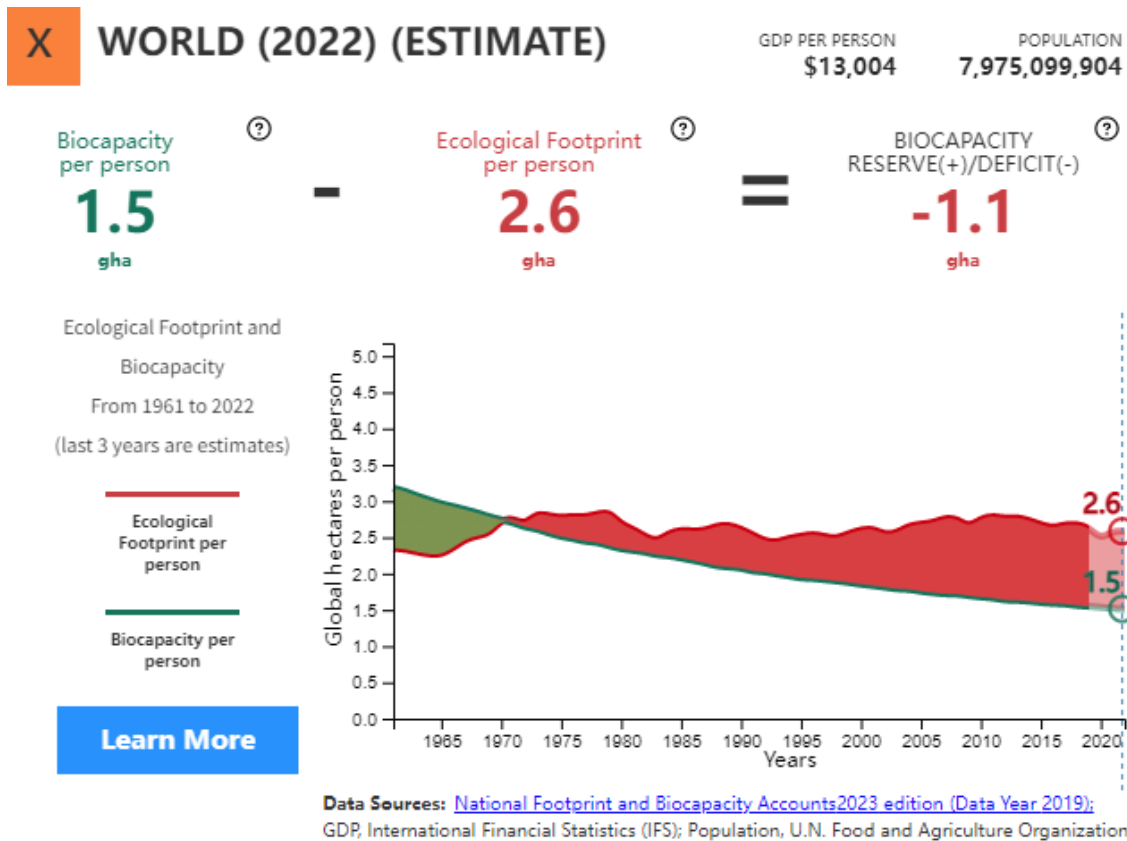


Figure 1 – Humanity’s Ecological Footprint and the planet’s biocapacity in global hectares per person from 1961 to 2022 (2023 edition). data.footprintnetwork.org

That demand is contrasted with how much biologically productive area is available within the world (or also within a country, when countries are analyzed (biocapacity, green line in figure above)). Figure 1 shows the per person results of the National Footprint and Biocapacity Accounts for the world. The same results can also be depicted as [absolutes](#), i.e. the total Ecological Footprint and total biocapacity of the world. The ratio between Footprint and biocapacity shown is the same for both perspectives.

While Footprint and biocapacity assessments are possible at any scale, National Footprint and Biocapacity Accounts are a useful reference point as they are based on data from UN statistics, rather than data that has been chosen arbitrarily. They are also based on clear accounting principles.²

² National Footprint and Biocapacity Accounts are the reference point for all other Footprint analyses at other scales, down to the product level. Footprint standards (www.footprintstandards.org) provide guidance on how to make assessments at any scale consistent.

The accounts have been published and improved annually since 1997. They have also been [tested by over ten national government agencies](#). The mechanics of the accounts and the results they produce have been confirmed. For instance, both the French and the Swiss government reviews reproduced the results within 3%.

Our priority is to emphasize the impartiality of the accounts. Thus, we have established a new organization with external partners to serve this very purpose. This new home for the National Footprint and Biocapacity Accounts is the “[Footprint Data Foundation](#)”, initiated by [York University](#) and Global Footprint Network. Its sole purpose is to maintain and improve the accounts. The [new institutional](#) arrangement for producing the accounts is governed through an independent board to secure neutrality and scientific rigor.

Results of the National Footprint and Biocapacity Accounts are available on the open data platform at data.footprintnetwork.org, as well as through a downloadable spreadsheet workbook ([public data package](#)). The 2023 edition, which is the latest edition, was completed in April 2023. Its results stretch to 2019, with estimates extending to 2022.

The 2023 edition [included the following updates](#):

- Results up to year prior (2022 for the 2023 edition) are incorporated to produce estimates beyond the UN and para-UN data.
- Fishing grounds footprint was enhanced with unreported catch and aquaculture data.
- National crop intensity was improved to better reflect multi-cropping.
- Ocean carbon sequestration data was fully sourced from the Global Carbon Budget; this newer data set reports higher carbon sequestration of oceans, leading to a decrease in global Ecological Footprint estimates in the 2023 edition.
- Nationally reported land use and cover is used consistently for all European countries.

Nowcasting: Extending the Trends of the National Footprint and Biocapacity Accounts

To determine Earth Overshoot Day, we calculate the ratio between Earth's biocapacity and its Ecological Footprint. Ecological Footprint and biocapacity results are extended beyond 2019, the year or the latest reported results, through nowcasting. For that, some of the 2022-2022 estimates are used as well. Nowcasting incorporates data from recent reports and studies and applies these to the latest results.

Nowcast results for the world: 2023

For 2023, the total Ecological Footprint increased by 0.2 % compared to the previous year, while total biocapacity increased by 0.3% over the same time span³. These effects combined decreased the ratio of Footprint to biocapacity by 0.1%. The resulting decline corresponds to delaying Earth Overshoot Day by 8 hours, still enough to move it from August 1st to August 2nd.

The carbon Footprint nowcast is based on CO₂ emissions data from International Energy Agency (IEA) and Carbon Monitor⁴ and ocean carbon sequestration data from the Global Carbon Project (GCP).

As reported by IEA, the 2020 lockdowns induced by the global pandemic resulted in an initial sharp drop in CO₂ emissions, but they increased again in the second half of the year. At the end of the year, total emissions were reported to be 5% lower than 2019 emissions. In 2021, emissions are estimated to have bounced back to the 2019 emissions levels. From 2021 to 2022, emissions are estimated to have increased an additional 1.5%.

Carbon sequestration data from GCP, which includes land-use change emissions, ocean sink, land sink, and cement carbonation sink, is available until the year 2021. For 2022 and 2023 we assume that the data maintains the trajectory established since 2000.

When combined with the most recent data from GCP, the carbon Footprint is forecasted to decrease by 0.3% from 2022 to 2023.

³ This number represents the increase over the previous year using 'constant' global hectares, which are defined using data from the latest year. Because global hectares as a unit represent the productivity of a bioproductive hectare on earth with average productivity, any increase in world productivity is mirrored by a growth in the amount of productivity represented by a single global hectare. This means that if the value of a global hectare is recalculated for each year, world biocapacity – as measured by global hectares – should be constant.

⁴ <https://carbonmonitor.org/>

Figure 2 below shows the nowcasting results for the world. We will have more detailed results to verify our nowcast using UN data in the 2026 edition of the National Footprint and Biocapacity Accounts.

The nowcast produced the following estimates:

- The biocapacity for the world in 2023 is estimated at 1.5 global hectares per person.
- Humanity’s Ecological Footprint is 2.6 global hectares per person, of which 60% is carbon Footprint.

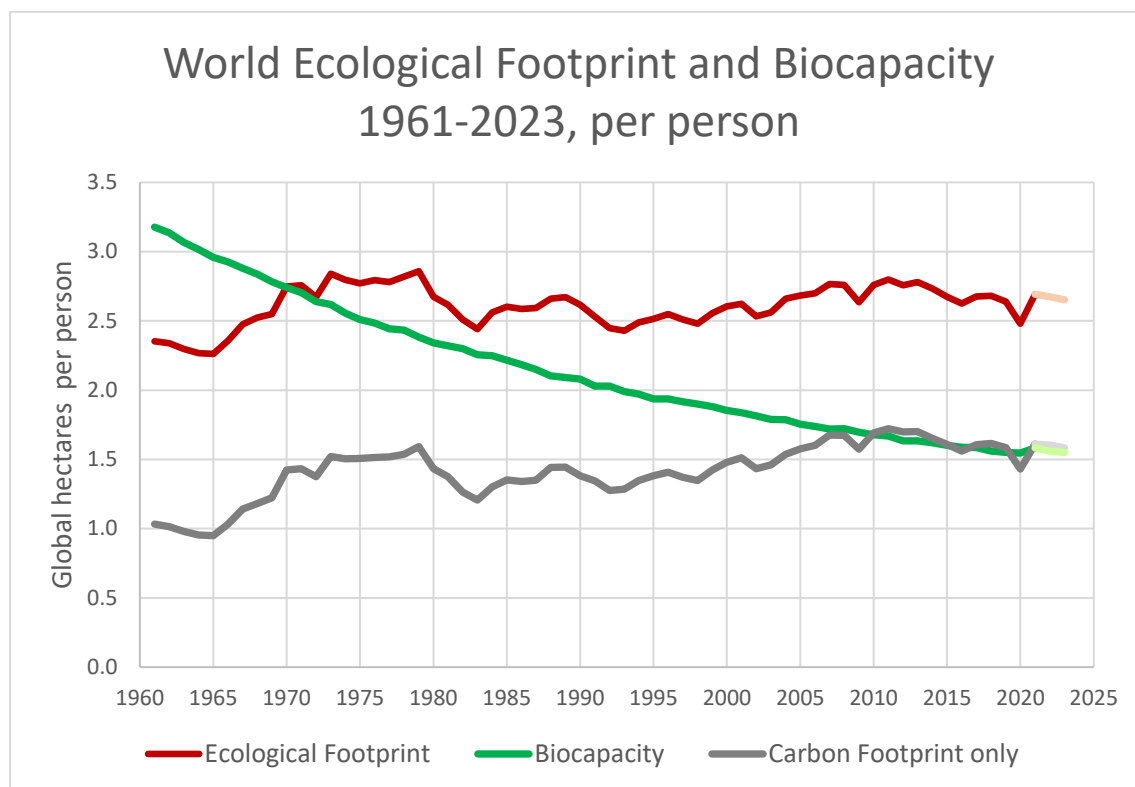


Figure 2 – The global Ecological Footprint and biocapacity from 1961 to 2023 in global hectares per person. The red line is the total Ecological Footprint per person, and the gray line is the Carbon Footprint per person (a subset of the Ecological Footprint). The green line shows the biocapacity per person. Results for 2019-2023 are nowcast estimates; remaining data points are directly taken from the National Footprint and Biocapacity Accounts, 2023 edition.

Relevant publicly available references

- Video introduction to the National Footprint and Biocapacity Accounts, including its underlying method: www.youtube.com/watch?v=T5M3MiPFW4 (2.5 min)
- Ecological Footprint Results for countries: data.footprintnetwork.org
- The basics on the accounting method, including a [guidebook](#) on the National Footprint and Biocapacity Accounts and a detailed [paper on the calculation method](#) are provided here: www.footprintnetwork.org/resources/data/
- National Footprint and Biocapacity Accounts 2023 edition: Miller, E., Basturk, S., Dworatzek, P., & Nithianantha, A. 2023. National Ecological Footprint and Biocapacity Accounts, 2023 Edition. (Version 1.0). [Data set and metadata]. Produced for Footprint Data Foundation by York University Ecological Footprint Initiative in partnership with Global Footprint Network. <https://footprint.info.yorku.ca/data>
- Release Notes: National Ecological Footprint and Biocapacity Accounts, 2023 Edition, Eric Miller, April 20, 2023. https://footprint.info.yorku.ca/files/2023/04/NFBA2023_release_notes_v1_0.pdf
- Accounting Method and recent improvements in the accounting method: www.mdpi.com/2079-9276/7/3/58 (*Ecological Footprint Accounting for Countries: Updates and Results of the National Footprint Accounts, 2012–2018*)
- A free click-through license gives you access to a sample workbook (for Hungary 2014) www.footprintnetwork.org/licenses/workbook-learning-license
- A comprehensive workbook with the newest Ecological Footprint and biocapacity contains key results www.footprintnetwork.org/licenses/public-data-package-free
- Limitations and Criticisms: The Ecological Footprint has clear limitations. And criticism drives the scientific process. All sincere criticism is helpful, whether based on misunderstandings, new insights, or flaws in the methodology. Global Footprint Network summarized www.footprintnetwork.org/our-work/ecological-footprint/limitations-and-criticisms/
- Nowcasting the global Ecological Footprint for Earth Overshoot 2022: www.overshootday.org/2022-calculation
- Rationale and interpretation of country level results: www.mdpi.com/2071-1050/11/7/2164/htm (*Defying the Footprint Oracle: Implications of Country Resource Trends*); Section 2 discusses key premises, comparison Footprint to other metrics
- EU [fact sheet on the Ecological Footprint](#) as part of the EC's [Beyond GDP website](#) and results for European countries on the [EEA website](#) (last updated in 2020).
- Biodiversity and other Ecological Footprint applications: <https://www.bipindicators.net/indicators/ecological-footprint/>; <https://doi.org/10.1016/j.biocon.2013.10.019> (Ecological Footprint: Implications for biodiversity)
- The new platform for National Footprint and Biocapacity Accounts: FoDaFo.org; footprint.info.yorku.ca; www.OnePlanetAlliance.org

- Short video from 2005 explaining the Footprint concepts in 3 min (it is a bit dated, but still provides an accurate description)
www.youtube.com/watch?v=EjyrAHzthTo. A more general introduction is provided in the new book [Ecological Footprint: Managing our Biocapacity Budget](#)