Circular Economy Indicators related to materials

SDG and Environment Statistics Unit, 2025
Early Warning and Assessment Division, UNEP

Indicator 1: Domestic Material Consumption

Domestic Material Consumption (DMC)

This indicator of circular economy corresponds to the SDG 8.4.2/12.2.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP.

The presented methodology for this indicator is based on UNSD's Metadata for 8.4.2/12.2.2, UNEP's The use of natural resources in the economy: A Global Manual on Economy Wide Material Flow Accounting (2021), UNEP's Economy-Wide Material Flow Accounting Step-by-step guide to the compiler (2024).

SDG target 8.4 aims to improve progressively the global resource efficiency in consumption and production and decouple economic growth from environmental degradation and SDG target 12.2 aims to achieve the sustainable management and efficient use of natural resources

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Domestic Material Consumption (DMC)

Indicator Interpretation

Domestic Material Consumption (DMC) has high environmental relevance as an indicator of potential environmental pressure on a domestic territory.

DMC covers all materials used on the input side, which actually flow through the domestic economy and which are either emitted back to the environment as waste and emissions or contribute to the increase of the national physical stock with potential flows of waste and emissions in the future .

DMC reports the amounts of materials that are used in a national economy. It is a territorial or geographic bound (production side) indicator.

It can also be interpreted as long-term waste equivalent.

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Domestic Material Consumption (DMC)

Limitations in the use of this indicator

The main limitations is that DMC do not account for all global material flows related to final consumption in a country, as indirect materials of imported and exported products are not considered.

Countries can therefore apparently reduce their material consumption, by outsourcing material-intensive extraction and processing abroad.

DMC do not account for unused material extraction, neither its environmental pressures.

DMC cannot be disaggregated to economic sectors which limits its use and comparation within the System of National Accounts.

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Domestic Material Consumption (DMC)

Domestic Material Consumption, by type of material (tonnes) is calculated as:

$$DMC = DE + IM - EX$$

Where:
DMC: Domestic Material Consumption;
DE: Domestic Extraction;
IM: Direct imports;
EX: Direct exports.

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Domestic Material Consumption (DMC)

Disaggregation

The DMC indicator is disaggregated into four main categories:

- Biomass
- Fossil fuels
- Metal ores
- Non-metallic minerals

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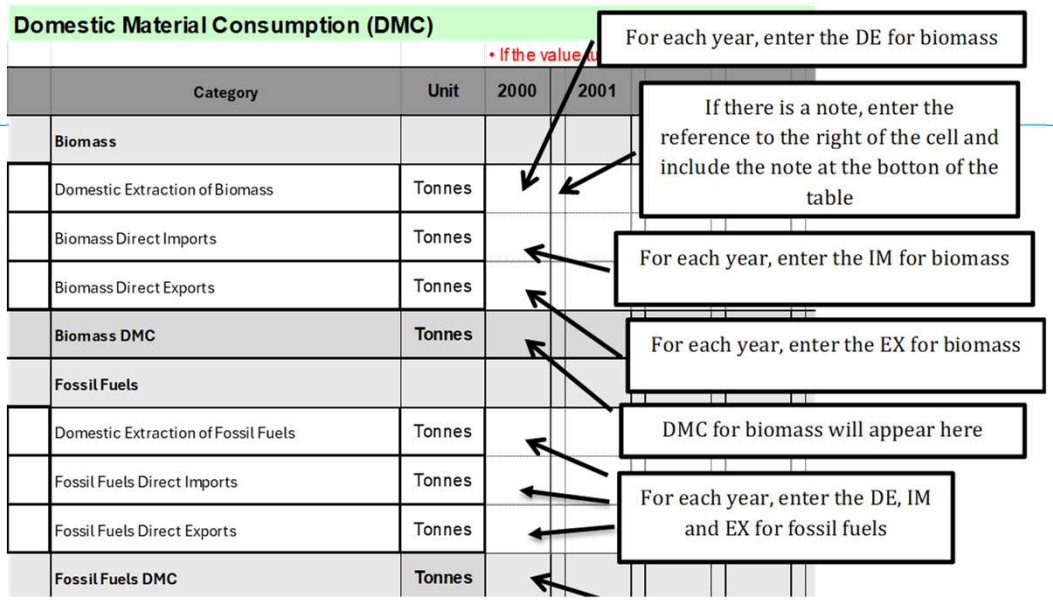

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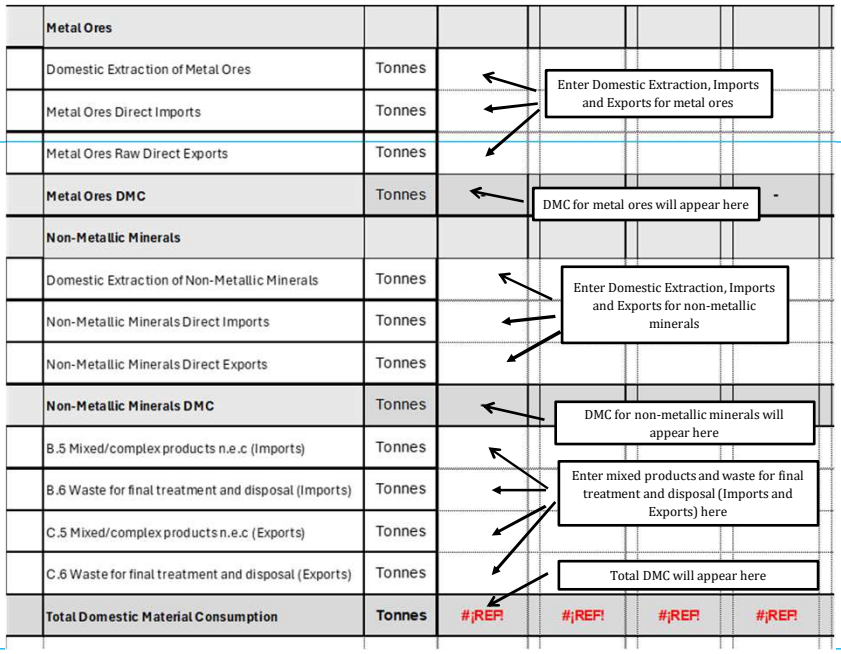

Notes:

- Please note that the unit in this table is "**Tonnes**".
- **If the requested data are not available, please leave the cell blank. If the requested variable is not applicable (the p**
- Please provide in the Footnotes Section below information on the source and data collection methodology for the valu

Footnotes

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Domestic Material Consumption per capita

Domestic material consumption per capita, by type of raw material (tonnes), is calculated as:

$$DMC\ per\ capita\ = \frac{DMC}{Annual\ average\ population}$$

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Domestic Material Consumption (DMC) per capita

• If the value turns red, please check if it is correct.

	Category	Unit	2000	2001	2002	2003	2004
	DMC per capita	Tonnes/hab	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
	Biomass DMC per capita	Tonnes/hab	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
	Fossil Fuels DMC per capita	Tonnes/hab	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
	Metal Ores DMC per capita	Tonnes/hab	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
	Non-Metallic Minerals DMC per capita	Tonnes/hab	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
	Annual average population	habitants	0.00	0.00	0.00	0.00	0.00

Notes:

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- **If the requested data are not available, please leave the cell blank. If the requested variable is not applicable (the pher**
- Please provide in the Footnotes Section below information on the source and data collection methodology for the values p

Footnotes

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Domestic Material Consumption by unit of GDP
Material Intensity

Material intensity illustrates the material consumption required to produce one unit of GDP. It is the reciprocal indicator of Material Productivity.

Domestic material consumption per unit of GDP, by type of raw material (kilograms per constant 2015 United States dollars) or Material Intensity, is calculated as:

$$DMC\ per\ GDP\ = \frac{DMC}{GDP\ per\ constant\ 2015\ USD}$$

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Domestic Material Consumption (DMC) per unit of GDP or Material Intensity

• If the value turns re

	Category	Unit	2000	2001	2002	2003	2004
	DMC per unit of GDP	Kilograms/$	#¡DIV/0!	#¡DIV/			
	Biomass DMC per unit of GDP	Kilograms/$	#¡DIV/0!	#			
	Fossil Fuels DMC per unit of GDP	Kilograms/$	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
	Metal Ores DMC per unit of GDP	Kilograms/$	#¡DIV/0!	#¡DIV/0!			
	Non-Metallic Minerals DMC per unit of GDP	Kilograms/$	#¡DIV/0!	#			
	GDG in constant 2015 United States Dollars	$	0.00				

Total DMC per GDP will appear here

Biomass DMC per GDP will appear here

Fossil Fuels DMC per GDP will appear here

Metal Ores DMC per GDP will appear here

Non-metallic DMC per GDP will appear here

For each year, enter the GDP in constant 2015 United States Dollars

Notes:

- Please note that the unit in this table is "Kilogram
- **If the requested data are not available, please le** ...able (the phe
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Footnotes

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Material Productivity

Material productivity is defined as the ratio between GDP and DMC.

It indicates the economic value generated per unit of material consumption. Over time this indicator illustrates whether decoupling of material use from economic growth is achieved. This indicator is also called **resource efficiency** and is the reciprocal indicator of Material Intensity.

Material productivity, by type of raw material (Constant 2015 United States dollars per kilogram), is calculated as:

$$Material\ productivity = \frac{1}{Material\ Intensity} = \frac{GDP\ in\ constant\ 2015\ USD}{DMC}$$

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Indicator 2: Material footprint or raw material consumption

Material footprint or raw material consumption

This indicator of circular economy corresponds to the SDG 8.4.1/12.2.1 Material footprint, material footprint per capita, and material footprint per GDP.

The presented methodology for this indicator is based on the UNSD's Metadata for 8.4.1/12.2.1, UNEP's The use of natural resources in the economy: A Global Manual on Economy Wide Material Flow Accounting (2021), UNEP's Economy-Wide Material Flow Accounting Step-by-step guide to the compiler (2024).

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Material footprint or raw material consumption

Disaggregation

The Material Footprint (MF) indicator is disaggregated into four main categories:

- Biomass
- Fossi fuels
- Metal ores
- Non-metallic minerals

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Material footprint or raw material consumption

Interpretation (I)

In the era of globalization, supply chains are increasingly organized at the international level.

A country production can be consumed abroad, and part of its own national consumption can also be produced abroad.

Production and consumption are not always taking place in the same country thus means disconnecting the location of production from final consumption.

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Material footprint or raw material consumption

Interpretation (II)

Production-oriented indicators (as DMC) cannot account for the totality of the actual environmental consequences induced by the consumption of certain products, as they do not include those impacts located in other geographical regions.

The indicator Material Footprint tries to better explain these “teleconnections” between distant places of production and consumption.

The material footprint indicator is calculated by transforming the weights of direct import and export flows into their respective weights of Raw Material Extraction (RME). RME refers to the supply chain-wide primary material extractions required to produce a certain imported or exported product.

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Material footprint or raw material consumption

Interpretation (III)

Examples:

Imports of beef: the respective RMEs refer, among other aspects, to the fodder plants that were required to feed the cattle.

Imports of cars: the RMEs comprise all primary raw material extractions that were required to produce the car (e.g. crude iron or copper ore to produce steel or copper wires; crude oil to produce plastic parts).

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Material footprint or raw material consumption

Interpretation (IV)

The MF indicator thus corrects the national material balance for international trade.

Material footprint of consumption reports the amount of primary materials required to serve final demand of a country and can be interpreted as an indicator of the material standard of living/level of capitalization of an economy.

The DMC reports the actual amount of material in an economy, MF the virtual amount required across the whole supply chain to service final demand.

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Material footprint or raw material consumption

Interpretation (V)

A country can, for instance, have a very high DMC because it has a large primary production sector for export or a very low DMC because it has outsourced most of the material intensive industrial process to other countries.

The material footprint corrects for both phenomena.

It is also important to note that MF do not account for unused material extraction, such as overburden from metal or coal mining or harvest residues in agriculture. However, these unused material flows cause various environmental pressures, such as water pollution and landscape changes.

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Material footprint or raw material consumption

Limitations in the use of the indicator

No global reference method for calculating material footprints exists yet.

Because of the global characteristics of supply chains and the differences in industry structure among countries, no national statistical office can run their own demand-based accounts reliably.

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Material footprint or raw material consumption

Calculation methods

3 types of methods for the calculation of material footprint:

Top-down approach: input-output analysis (IOA)

It focuses on the economic structure of a country in the form of matrices that depict inter-industry flows.

- Single-region IO models assume that imported products are produced with the same technology as domestic products.
- MRIO models, country IO tables are linked together via bilateral trade data, considering different technologies applied in each country.

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Material footprint or raw material consumption

Calculation methods (II)

Bottom-up approach: material intensity coefficients

"Apparent consumption" of a country is derived by calculating production plus imports minus exports. The quantities of each product consumed in a country are multiplied with coefficients reflecting the related upstream resource use. A high level of detail which can be applied.

The availability of coefficients for finished products is therefore limited.
Double counting is possible, especially in cases where products are passing more than one border along processing stages.

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Material footprint or raw material consumption

Calculation methods (III)

Hybrid approaches: complementing input-output analysis with coefficients

Hybrid approaches aim to exploit the advantages from IOA in combination with physical trade accounts and process-based coefficients.

Hybrid models are increasingly applied in all areas of resource flow accounting, acknowledging their respective strengths and capabilities.

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Material footprint or raw material consumption

Calculation

Material footprint by type of raw material (tonnes) or Raw Material consumption (RMC) is calculated as:

$$\text{MF = RMC} = DE + RME_{IM} - RME_{EX}$$

MF: material footprint;
RMC: raw material consumption
DE: domestic extraction of materials;
RME_{IM}: raw material equivalent of imports;
RME_{EX}: raw material equivalents of exports.

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Material Footprint by raw material tab

Material footprint of consumption

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	Category	Unit	2000	2001	20
	Biomass				
	Domestic Extraction of Biomass	Tonnes			
	Biomass Raw Material Equivalent of Imports	Tonnes			
	Biomass Raw Material Equivalent of Exports	Tonnes			
	Biomass Material Footprint	**Tonnes**			
	Fossil Fuels				
	Domestic Extraction of Fossil Fuels	Tonnes			
	Fossil Fuels Raw Material Equivalent of Imports	Tonnes			
	Fossil Fuels Raw Material Equivalent of Exports	Tonnes			
	Fossil Fuels Material Footprint	**Tonnes**			

For each year, enter the DE for biomass

If there is a note, enter the reference to the right of the cell and include the note at the botton of the table

For each year, enter the RMEIM for biomass

For each year, enter the RMEEX for biomass

MF for biomass will appear here

For each year, enter the DE, RMEIM and RMEEX for fossil fuels

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	Metal Ores			
	Domestic Extraction of Metal Ores	Tonnes		
	Metal Ores Raw Material Equivalent of Imports	Tonnes		
	Metal Ores Raw Material Equivalent of Exports	Tonnes		
	Metal Ores Material Footprint	Tonnes	-	
	Non-Metallic Minerals			
	Domestic Extraction of Non-Metallic Minerals	Tonnes		
	Non-Metallic Minerals Raw Material Equivalent of Imports	Tonnes		
	Non-Metallic Minerals Raw Material Equivalent of Exports	Tonnes		
	Non-Metallic Minerals Material Footprint	Tonnes	-	

For each year, enter the DE, RMEIM and RMEEX for metal ores

MF for metal ores will appear here

For each year, enter the DE, RMEIM and RMEEX for non-metallic minerals

MF for non-metallic minerals will appear here

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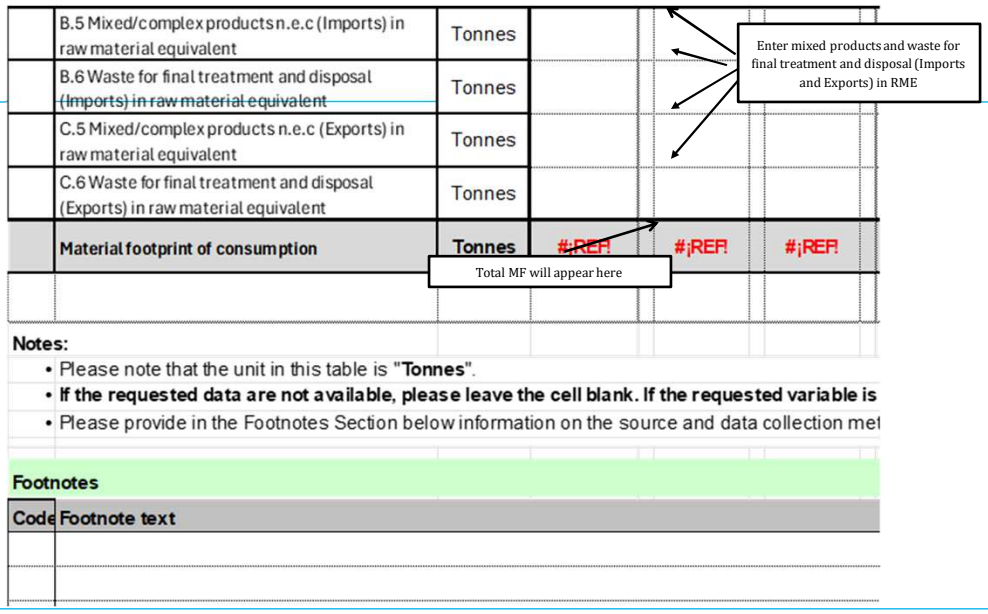

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Material footprint per capita

Material footprint per capita, by type of raw material (tonnes), is calculated as:

$$\text{MF per capita} = \frac{MF}{Annual\ average\ population}$$

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Material footprint of consumption per capita

• If the value turns red, please check if it is correct.

	Category	Unit	2000	2001			
	Material Footprint per capita	Tonnes/hab	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
	Biomass MF per capita	Tonnes/hab	#¡DIV/0!	#¡DIV/0!			
	Fossil Fuels Material Footprint per capita	Tonnes/hab	#¡DIV/0!	#¡DIV/0!			
	Metal Ores Material Footprint per capita	Tonnes/hab	#¡DIV/0!	#¡DIV/0!			
	Non-Metallic Minerals Material Footprint per capita	Tonnes/hab	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
	Annual average population	habitants					

Biomass MF per capita will appear here

Metal Ores MF per capita will appear here

Fossil Fuels MF per capita will appear here

Non-metallic MF per capita will appear here

For each year, enter the annual average population

Notes:

- Please note that the unit in this table is "**Tonnes and habitan**
- **If the requested data are not available, please leave the ce**
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Material footprint per unit of GDP
Raw material intensity (RMI)

Material footprint per unit of GDP, by type of raw material (kilograms per constant 2015 United States dollar) or raw material intensity (RMI), is calculated as:

$$\text{MF per GDP} = \frac{MF}{GDP\ in\ constant\ 2015\ USD}$$

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Raw material productivity (RMP)

Raw material productivity (RMP), by type of raw material (Constant 2015 United States dollar per kilograms), is calculated as:

$$\text{RMP} = \frac{1}{Raw\ material\ intensity} = \frac{GDP\ in\ constant\ 2015\ USD}{MF}$$

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Raw Material Productivity

	Category	Unit	2000	200			
	Raw Material Productivity	$/Kilograms	0.00	0.00	0.00	0.00	0.00
	Biomass Raw Material Productivity	$/Kilograms	0.00	0.00			
	Fossil Fuels Raw Material Productivity	$/Kilograms	0.00	0.00			
	Metal Ores Raw Material Productivity	$/Kilograms	0.00	0.00			
	Non-Metallic Minerals Raw Material Productivity	$/Kilograms	0.00	0.00			

Biomass RMP will appear here

Fossil Fuels RMP will appear here

Metal Ores RMP will appear here

Non-metallic RMP will appear here

Notes:

- Please note that the unit in this table is **"Constant 2015 United States Dollars ($) per Kilogram".**

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Thank you

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