INDICATOR FACTSHEETS

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Energy – Environmental Sustainability – GHG Emissions from Energy Consumption

Description:

This indicator quantifies greenhouse gas emissions produced through energy consumption, providing insights into the environmental impact of energy use at the local level.

Methodology:

The indicator uses the IPAT formula (Population + Income) to estimate emissions at the local level. The emissions are measured in terms of CO2 equivalent from various greenhouse gases emitted through energy consumption activities.

Formula:

- Formula: E_capita = E_total / (P × I)
Where:
E_capita = Emissions per capita
E_total = Total emissions from building activities
P = Population
I = Income
Local estimates are derived using E_local = E_capita × P_local × I_local.

Normalization:

Results are scaled using the 2008 value as the baseline, with the goal value set to zero.

Data Sources:

- Dataset Name: Air emissions accounts by NACE Rev. 2 activity (env_ac_ainah_r2)
- Source: Eurostat
- Time Frequency: Annual
- Time Period: 2008-2021
- Air Pollutants and GHGs: Greenhouse gases (CO2, N2O, CH4, HFC, PFC, SF6, NF3 in CO2 equivalent)
- Statistical Classification: Electricity, gas, steam, and air conditioning supply (NACE Rev. 2)
- Unit of Measure: Tonne

References:

1. Fonseca, P., Silva, S., & Carvalho, M. (2021). Assessing the energy transition in Europe: Trends in greenhouse gas emissions. Renewable and Sustainable Energy Reviews, 145, 111214.
2. Ivan, L. P., & Langlois, C. (2007). Energy policy and climate change: The role of national strategies. Energy Policy, 35(10), 5081-5093.
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6. Ren, G., & Sovacool, B. K. (2014). Energy consumption and greenhouse gas emissions in China: A sectoral analysis. Energy, 67, 572-580.
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Energy – Environmental Sustainability – Air Pollutants from Energy Consumption

Description:

This indicator quantifies air pollutant emissions produced through energy consumption. It helps measure the environmental impact of energy use and tracks progress toward reducing pollutants, contributing to sustainability goals.

Methodology:

- Method Name: IPAT Downscaling
Formula: E_capita = E_total / (P × I)
Where:
- E_capita = Air pollutant emissions per capita per unit of income (tons per capita per euro)
- E_total = Total national air pollutant emissions from energy consumption (tons)
- P = National population (people)
- I = National average annual income (euros)
Local Estimate: E_local = E_capita × P_local × I_local
Where:
- E_local = Local air pollutant emissions (tons)
- P_local = Local population (people)
- I_local = Local average income (euros)

Normalization:

Results are scaled using the 2008 value as the baseline, with the goal value set to zero emissions (climate neutrality target).

Data Sources:

- Air Emissions: Eurostat (Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2])
- Population: Eurostat (Population on January 1 – total)
- Income: Eurostat (Average full-time adjusted salary per employee)

Dataset Details:

- Dataset Name: Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]
- Time Frequency: Annual
Air Pollutants and GHGs: Carbon monoxide (CO), Nitrogen oxides (NOx), Sulfur oxides (SOx), Particulate Matter (PM2.5, PM10)
- Classification: NACE Rev. 2 - Electricity, gas, steam, and air conditioning supply
- Unit of Measure: Tonne
- Time Period: 2008-2020

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3. Liu, G., Baniyounes, A. M., Rasul, M. G., Amanullah, M. T. O., & Khan, M. M. K. (2013). General sustainability indicator of renewable energy system based on grey relational analysis. International Journal of Energy Research 37(14), 1928–1936. https://doi.org/10.1002/er.3016
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Energy – Environmental Sustainability – Waste Generation from Energy Production

Description:

This indicator assesses the amount of waste generated during energy production processes. It tracks waste intensities, providing insights into the environmental impact of energy production.

Methodology:

- Method Name: IPAT Downscaling

Formula: W_capita = W_total / (P × I)

Where:

- W_capita = Waste generated per capita per unit of income (tons per capita per euro)
- W_total = Total national waste from energy production (tons)
- P = National population (people)
- I = National average annual income (euros)

Local Estimate: W_local = W_capita × P_local × I_local

Where:

- W_local = Local waste from energy production (tons)
- P_local = Local population (people)
- I_local = Local average income (euros)

Normalization:

Results are scaled using the 2004 value as the baseline, with the goal value set to zero waste generation (climate neutrality target).

Data Sources:

- Waste Generation: Eurostat (Generation of waste by economic activity [ten00106])
- Population: Eurostat (Population on January 1 – total)
- Income: Eurostat (Average full-time adjusted salary per employee)

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Dataset Details:

- Dataset Name: Generation of waste by economic activity [ten00106]
- Time Frequency: Biannual
Hazard Class: Hazardous and non-hazardous waste – Total
- Classification: NACE Rev. 2 - Electricity, gas, steam, and air conditioning supply
- Unit of Measure: Tonne
- Waste Categories: Total waste
- Time Period: 2004-2020

References:

Ivan, L., & Langlois, L. (2007). Energy indicators for sustainable development. Energy 32(6), 875–882. https://doi.org/10.1016/j.energy.2006.08.006

Energy – Environmental Sustainability – Percentage of Renewable Energy in Energy Production

Description:

This indicator tracks the proportion of energy derived from renewable sources in the overall energy mix. It provides insights into the progress toward transitioning to renewable energy sources in national energy production.

Methodology:

Score: The final score is the same as the percentage value from the original data.

Data Sources:

- Renewable Energy Share: Eurostat (Share of energy from renewable sources [nrg_ind_ren])

Dataset Details:

- Dataset Name: Share of energy from renewable sources [nrg_ind_ren]
- Time Frequency: Annual
- Energy Balance: Renewable energy sources in electricity
- Unit of Measure: Percentage
- Time Period: 2012-2021

References:

1. Ivan, L., & Langlois, L. (2007). Energy indicators for sustainable development. Energy 32(6), 875–882. https://doi.org/10.1016/j.energy.2006.08.006
2. Klemm, C., & Wiese, F. (2022). Indicators for the optimization of sustainable urban energy systems based on energy system modeling. Energy Sustainability and Society 12(1), 3. https://doi.org/10.1186/s13705-021-00323-3
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5. Mainali, B., Pachauri, S., Rao, N. D., & Silveira, S. (2014). Assessing rural energy sustainability in developing countries. Energy for Sustainable Development 19, 15-28. https://doi.org/10.1016/j.esd.2014.01.008
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Energy – Reliability – Reserve-Production Ratio

Description:

This indicator evaluates the adequacy of energy reserves relative to production capacity. It measures how well energy reserves can sustain energy production, accounting for imports, exports, and consumption.

Methodology:

Formula: Reserve calculated as:
Reserve = Production + Imports - Exports - Losses - Final Consumption
- Reserve Goal: 20% (Baseline value: 0)
- The reserve goal should be adapted to local standards to reflect varying energy needs and production capacities.

Data Sources:

- Energy Reserves and Production: Eurostat (Supply, transformation, and consumption of electricity [nrg_cb_e])

Dataset Details:

- Dataset Name: Supply, transformation, and consumption of electricity [nrg_cb_e]
- Time Frequency: Annual
- Energy Balance:
  - Imports
  - Exports
  - Losses
  - Available for final consumption
  - Net electricity production
- Standard International Energy Product Classification (SIEC): Electricity
- Unit of Measure: Gigawatt-hour
- Time Period: 1990-2022

References:

1. Carrera, D., & Mack, A. (2010). Sustainability assessment of energy technologies via social indicators: Results of a survey among European energy experts. Energy Policy 38(2), 1030-1039. https://doi.org/10.1016/j.enpol.2009.10.055

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Energy – Reliability – Self-Sufficiency: Percentage of Imported Energy (Fuel or Electricity)

Description:

This indicator determines the percentage of energy sourced domestically compared to imported energy, measuring national energy self-sufficiency.

Methodology:

Formula: Self-sufficiency is calculated as:
Self-Sufficiency = Imports / Production
- Normalization: Final scores are normalized between a goal value of 0 (no imports) and a baseline value set at 1 (fully reliant on imports).

Data Sources:

- Energy Imports and Production: Eurostat (Supply, transformation, and consumption of electricity [nrg_cb_e])

Dataset Details:

- Dataset Name: Supply, transformation, and consumption of electricity [nrg_cb_e]
- Time Frequency: Annual
- Energy Balance: Imports, Net electricity production
- Standard International Energy Product Classification (SIEC): Electricity
- Unit of Measure: Gigawatt-hour
- Time Period: 1990-2022

References:

1. Fonseca, J. D., Commenge, J.-M., Camargo, M., Falk, L., & Gil, I. D. (2021). Sustainability analysis for the design of distributed energy systems: A multi-objective optimization approach. Applied Energy 290, 116746. https://doi.org/10.1016/j.apenergy.2021.116746
2. Ivan, L., & Langlois, L. (2007). Energy indicators for sustainable development. Energy 32(6), 875–882. https://doi.org/10.1016/j.energy.2006.08.006
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Energy – Affordability – Energy Price Stability

Description:

This indicator measures the stability of energy prices over time, adjusted for inflation. It provides insights into how consistently energy prices have remained over a specific period.

Methodology:

Formula: Price stability index is calculated by:
Price Stability Index = (Standard Deviation of Prices) / (Period Mean)
After correcting for inflation (using the European inflation rate), the standard deviation is calculated for electricity and natural gas prices (for households and commercial users), and divided by the period mean. The final score is then calculated as 100 minus the original index value.

Data Sources:

- Electricity Prices: Eurostat (Electricity prices by type of user [ten00117])
- Gas Prices: Eurostat (Gas prices by type of user [ten00118])

Dataset Details:

- Time Frequency: Annual
- Products: Electrical energy, Natural gas
- Currency: Euro
- Unit of Measure:
  - Electricity: Kilowatt-hour
  - Gas: Gigajoule (gross calorific value - GCV)
- Energy Indicators:
  - Electricity prices for medium-size households and non-household consumers
  - Gas prices for medium-size households and non-household consumers
- Time Period: 2011-2022

References:

1. Carrera, D., & Mack, A. (2010). Sustainability assessment of energy technologies via social indicators: Results of a survey among European energy experts. Energy Policy 38(2), 1030-1039. https://doi.org/10.1016/j.enpol.2009.10.055
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Energy – Affordability – Energy Supply-Demand Ratio

Description:

This indicator assesses the balance between energy supply and demand, providing insights into whether energy supply is adequate to meet national demand.

Methodology:

Formula: The energy supply-demand ratio is calculated with a ratio goal set at 75%.
- Ratio Goal: 75%
- Final scores are calculated based on how close the actual ratio is to this goal.

Data Sources:

- Electricity Production: IEA (Gross and net production of electricity and derived heat by type of plant and operator [nrg_ind_peh])
- Electricity Consumption: IEA (Supply, transformation, and consumption of electricity [nrg_cb_e])

Dataset Details:

- Dataset Name 1: Gross and net production of electricity and derived heat by type of plant and operator [nrg_ind_peh]
- Dataset Name 2: Supply, transformation, and consumption of electricity [nrg_cb_e]
- Time Frequency: Annual

Energy Balance:
- Net electricity production
- Final consumption
- Standard International Energy Product Classification (SIEC): Electricity (Total)
- Unit of Measure: Gigawatt-hour
- Time Period: 1990-2022

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Energy – Resilience – Energy Diversification Index

Description:

This indicator uses the Shannon-Weiner index to measure the variety of energy sources used for supply. The goal is to mitigate risks associated with overdependence on a single energy source by promoting diversity in energy supply.

Methodology:

Formula: The Shannon-Weiner index is used to calculate energy diversification.
H' = -Σ p_i ln(p_i)
Where:
- p_i is the proportion of energy from source i
- H' is the Shannon-Weiner index for energy diversification
- Normalization: Final scores are normalized based on the minimum and maximum values observed across all member states.

Data Sources:

- Energy Diversification: Eurostat (Simplified energy balances [nrg_bal_s])

Dataset Details:

- Dataset Name: Simplified energy balances [nrg_bal_s]
- Time Frequency: Annual
- Energy Balance: Gross electricity production
- Unit of Measure: Thousand tonnes of oil equivalent (ktoe)
- Time Period: 1990-2022

References:

1. Carrera, D., & Mack, A. (2010). Sustainability assessment of energy technologies via social indicators: Results of a survey among European energy experts. Energy Policy 38(2), 1030-1039. https://doi.org/10.1016/j.enpol.2009.10.055
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Energy – Resilience – Energy Diversification Index

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Where:
- p_i is the proportion of energy from source i
- H' is the Shannon-Weiner index for energy diversification
- Normalization: Final scores are normalized based on the minimum and maximum values observed across all member states.

Data Sources:

- Energy Diversification: Eurostat (Simplified energy balances [nrg_bal_s])

Dataset Details:

- Dataset Name: Simplified energy balances [nrg_bal_s]
- Time Frequency: Annual
- Energy Balance: Gross electricity production
- Unit of Measure: Thousand tonnes of oil equivalent (ktoe)
- Time Period: 1990-2022

References:

1. Carrera, D., & Mack, A. (2010). Sustainability assessment of energy technologies via social indicators: Results of a survey among European energy experts. Energy Policy 38(2), 1030-1039. https://doi.org/10.1016/j.enpol.2009.10.055
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Energy – Resilience – Decentralization of Energy Sources

Description:

This indicator evaluates the level of renewable energy production as a share of total energy consumption. It helps assess how decentralized energy production is by examining the contribution of renewable energy to overall energy supply.

Methodology:

Score: The final score is the same as the percentage value from the original data.
Formula: Decentralization = Renewables / Consumption

Data Sources:

- Electricity Consumption and Production: Eurostat (Supply, transformation, and consumption of electricity [nrg_cb_e], Use of renewables for electricity – details [nrg_ind_ured])

Dataset Details:

- Dataset Name 1: Supply, transformation, and consumption of electricity [nrg_cb_e]
- Dataset Name 2: Use of renewables for electricity – details [nrg_ind_ured]
- Time Frequency: Annual

Energy Balance:

- Final consumption
- Gross electricity production – Renewable Energy Directive
- Standard International Energy Product Classification (SIEC): Electricity, Renewables and biofuels
- Unit of Measure: Gigawatt-hour
- Time Period: 1990-2021

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1. Maja, M., Todorovic, M. S., Todorovic, Z., & Todorovic, I. (2020). Decentralized renewable energy in the transition to a sustainable electricity system: Challenges and policy gaps. Renewable and Sustainable Energy Reviews, 120, 109622. https://doi.org/10.1016/j.rser.2019.109622
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Energy – Resilience – Energy Storage Capacity

Description:

This indicator assesses the ability to store energy for future use at the community level, providing insights into how resilient energy systems are to supply fluctuations and demand changes.

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Methodology:

Score: The final score is calculated based on the European goal for energy storage by 2030.

Normalization:

Formula: The European goal for storage was calculated by taking the 2030 goals and dividing them by the current European population.

Data Sources:

Data Source: Database of the European energy storage technologies and facilities (http://data.europa.eu/88u/dataset/database-of-the-european-energy-storage-technologies-and-facilities)

Dataset Details:

- Time Frequency: Annual
- Unit of Measure: Gigawatt-hour (GWh)
- Time Period: 1970-2020

References:

Maja, M., Todorovic, M. S., Todorovic, Z., & Todorovic, I. (2020). Decentralized renewable energy in the transition to a sustainable electricity system: Challenges and policy gaps. Renewable and Sustainable Energy Reviews, 120, 109622. https://doi.org/10.1016/j.rser.2019.109622

Energy – Efficiency – Energy Intensity (Consumption per GDP)

Description:

This indicator measures energy usage relative to economic output, providing insights into how efficiently energy is being used to generate GDP.

Normalization:

Formula: The 1995 value is used as the baseline, and results are scaled with the target set at 0 for improved energy efficiency over time.

Data Sources:

Energy Intensity Data: Eurostat (Energy intensity [nrg_ind_ei])

Dataset Details:

- Dataset Name: Energy intensity [nrg_ind_ei]
- Time Frequency: Annual
- Energy Balance: Energy intensity of GDP in chain linked volumes (2010)
- Unit of Measure: Kilograms of oil equivalent (KGOE) per thousand euro
- Time Period: 1995-2021

References:

1. Ivan, L., & Langlois, L. (2007). Energy indicators for sustainable development. Energy 32(6), 875–882. https://doi.org/10.1016/j.energy.2006.08.006

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2. Klemm, C., & Wiese, F. (2022). Indicators for the optimization of sustainable urban energy systems based on energy system modeling. Energy Sustainability and Society 12(1), 3. https://doi.org/10.1186/s13705-021-00323-3
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5. Ren, J., & Sovacool, B. K. (2014). Quantifying, measuring, and strategizing energy security: Determining the most meaningful dimensions and metrics. Energy 76, 838-849. https://doi.org/10.1016/j.energy.2014.08.083
6. Sharma, T., & Balachandra, P. (2015). Benchmarking sustainability of Indian electricity system: An indicator approach. Applied Energy 142, 206-220. https://doi.org/10.1016/j.apenergy.2014.12.037

Energy – Efficiency – Electricity Transmission and Distribution Losses

Description:

This indicator evaluates the efficiency of energy transmission and distribution systems by measuring the amount of electricity lost during transmission and distribution.

Methodology:

Formula: Efficiency = Transmission and Distribution Losses / Production

Normalization:

Formula: Results are scaled with the baseline value set at 1 (current transmission and distribution losses) and the goal value set at 0 (ideal scenario with no losses).

Data Sources:

Data Source: Eurostat (Supply, transformation, and consumption of electricity [nrg_cb_e])

Dataset Details:

- Dataset Name: Supply, transformation, and consumption of electricity [nrg_cb_e]
- Time Frequency: Annual
- Energy Balance:
- Losses
- Net electricity production
- Standard International Energy Product Classification (SIEC): Electricity
- Unit of Measure: Gigawatt-hour
- Time Period: 1990-2022

References:

1. Liu, G., Baniyounes, A. M., Rasul, M. G., Amanullah, M. T. O., & Khan, M. M. K. (2013). General sustainability indicator of renewable energy system based on grey

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relational analysis. International Journal of Energy Research 37(14), 1928–1936. https://doi.org/10.1002/er.3016
2. Mainali, B., Pachauri, S., Rao, N. D., & Silveira, S. (2014). Assessing rural energy sustainability in developing countries. Energy for Sustainable Development 19, 15-28. https://doi.org/10.1016/j.esd.2014.01.008
3. Sharma, T., & Balachandra, P. (2015). Benchmarking sustainability of Indian electricity system: An indicator approach. Applied Energy 142, 206-220. https://doi.org/10.1016/j.apenergy.2014.12.037

Energy – Justice – Percentage of Population with Inability to Keep the House Warm

Description:

This indicator determines the percentage of the population that is unable to maintain adequate heating in their homes, providing insights into energy poverty and its impacts on society.

Methodology:

Score: The final score is the same as the percentage value from the original data.

Data Sources:

Data Source: Eurostat (Inability to keep home adequately warm - EU-SILC survey [ilc_mdes01])

Dataset Details:

- Dataset Name: Inability to keep home adequately warm - EU-SILC survey [ilc_mdes01]
- Time Frequency: Annual
- Type of Household: Total
- Income Situation in Relation to the Risk of Poverty Threshold: Total
- Unit of Measure: Percentage
- Time Period: 2013-2022

References:

1. Ivan, L., & Langlois, L. (2007). Energy indicators for sustainable development. Energy 32(6), 875–882. https://doi.org/10.1016/j.energy.2006.08.006
2. Klemm, C., & Wiese, F. (2022). Indicators for the optimization of sustainable urban energy systems based on energy system modeling. Energy Sustainability and Society 12(1), 3. https://doi.org/10.1186/s13705-021-00323-3
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4. Maja, M., Todorovic, M. S., Todorovic, Z., & Todorovic, I. (2020). Decentralized renewable energy in the transition to a sustainable electricity system: Challenges and policy gaps. Renewable and Sustainable Energy Reviews, 120, 109622. https://doi.org/10.1016/j.rser.2019.109622
5. Mainali, B., Pachauri, S., Rao, N. D., & Silveira, S. (2014). Assessing rural energy sustainability in developing countries. Energy for Sustainable Development 19, 15-28. https://doi.org/10.1016/j.esd.2014.01.008

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6. Sharma, T., & Balachandra, P. (2015). Benchmarking sustainability of Indian electricity system: An indicator approach. Applied Energy 142, 206-220. https://doi.org/10.1016/j.apenergy.2014.12.037

Transportation – Environmental Sustainability – Air Pollution from Transportation: Passenger Cars, Light-Duty Vehicles, and Heavy-Duty Vehicles and Buses

Description:

This indicator measures pollutants emitted by passenger cars, light-duty vehicles, and heavy-duty vehicles and buses, providing insights into their contribution to air pollution.

Methodology:

Formula: The indicator uses IPAT (POP + INCOME) downscaling for local estimates.
Formula for Local Estimate: E_capita = E_total / (P × I)
Where:
- E_capita = Emissions per capita (tons per capita per euro)
- E_total = Total national emissions from transportation (tons)
- P = National population (people)
- I = National average annual income (euros)

Local Estimate: E_local = E_capita × P_local × I_local

Normalization:

Results are scaled using the 1995 value as the baseline, with the goal value set to 0. Averages are calculated across passenger cars, light-duty vehicles, and heavy-duty vehicles and buses.

Data Sources:

Data Source: Eurostat (Air pollutants by source sector [env_air_emis])

Dataset Details:

- Dataset Name: Air pollutants by source sector [env_air_emis]
- Time Frequency: Annual
- Unit of Measure: Tonne

Air Pollutants and GHGs:
- Nitrogen oxides
- Sulfur oxides
- Ammonia
- Particulates < 2.5µm
- Particulates < 10µm
- Non-methane volatile organic compounds (NMVOCs)

Source Sector for Emissions:
- Road transport: passenger cars
- Road transport: light-duty vehicles
- Road transport: heavy-duty vehicles and buses
- Time Period: 1995-2021

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References:

1. Danielis, R., Rotaris, L., Monte, A., & Massiani, J. (2018). The role of alternative fuels in reducing car emissions in the context of road transport in the European Union. Sustainability, 10(4), 1277. https://doi.org/10.3390/su10041277
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4. Kraus, M., & Proff, H. (2021). Managing air quality: New frameworks for transport emissions. Transport Policy, 112, 143–152. https://doi.org/10.1016/j.tranpol.2021.04.005
5. Yang, J., Zhang, Y., Wang, J., & Shen, M. (2020). Impact of electric vehicles on urban air pollution: A case study. Journal of Cleaner Production, 273, 122758. https://doi.org/10.1016/j.jclepro.2020.122758
6. Zito, P., & Salvo, G. (2011). Improving urban mobility: Green vehicle emissions strategies. Procedia - Social and Behavioral Sciences, 20, 952–961. https://doi.org/10.1016/j.sbspro.2011.08.104

Transportation – Environmental Sustainability – GHG Emissions from Transport Sector

Description:

This indicator quantifies greenhouse gas emissions from the transportation sector, providing insights into its contribution to climate change.

Methodology:

Formula: The indicator uses IPAT (POP + INCOME) downscaling for local estimates.
Formula for Local Estimate: E_capita = E_total / (P × I)
Where:
- E_capita = Emissions per capita (tons per capita per euro)
- E_total = Total national emissions from transportation (tons)
- P = National population (people)
- I = National average annual income (euros)

Local Estimate: E_local = E_capita × P_local × I_local

Normalization:

Results are scaled using the 2008 value as the baseline, with the goal value set to 0.

Data Sources:

Data Source: Eurostat (Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2])

Dataset Details:

- Dataset Name: Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]
- Time Frequency: Annual

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- Air Pollutants and GHGs: Greenhouse gases (CO_2, N_2O in CO_2 equivalent, CH_4 in CO_2 equivalent, HFC in CO_2 equivalent, PFC in CO_2 equivalent, SF_6 in CO_2 equivalent, NF_3 in CO_2 equivalent)
- Statistical Classification: NACE Rev. 2 - Transport activities by households
- Unit of Measure: Tonne
- Time Period: 2008-2021

References:

1. Danielis, R., Rotaris, L., Monte, A., & Massiani, J. (2018). The role of alternative fuels in reducing car emissions in the context of road transport in the European Union. Sustainability, 10(4), 1277. https://doi.org/10.3390/su10041277
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4. Kraus, M., & Proff, H. (2021). Managing air quality: New frameworks for transport emissions. Transport Policy, 112, 143–152. https://doi.org/10.1016/j.tranpol.2021.04.005
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6. Zito, P., & Salvo, G. (2011). Improving urban mobility: Green vehicle emissions strategies. Procedia - Social and Behavioral Sciences, 20, 952–961. https://doi.org/10.1016/j.sbspro.2011.08.104

Transportation – Safety – Number of Traffic Accidents

Description:

This indicator quantifies the total number of traffic accidents within a specified area and timeframe, providing insights into transportation safety.

Methodology:

Formula: The indicator uses IPAT (POP) downscaling for local estimates.
Formula for Local Estimate: E_capita = E_total / P
Where:
- E_capita = Accidents per capita (number of accidents per person)
- E_total = Total number of accidents
- P = National population (people)

Local Estimate: E_local = E_capita × P_local

Normalization:

Results are scaled using the 1999 value as the baseline, with the goal value set to 0.

Data Sources:

Data Source: Eurostat (Road accidents by NUTS 3 regions [tran_sf_roadnu])

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Dataset Details:

- Dataset Name: Road accidents by NUTS 3 regions (source: CARE) [tran_sf_roadnu]
- Time Frequency: Annual
- Unit of Measure: Number
- Time Period: 1999-2021

References:

1. Danielis, R., Rotaris, L., Monte, A., & Massiani, J. (2018). The role of alternative fuels in reducing car emissions in the context of road transport in the European Union. Sustainability, 10(4), 1277. https://doi.org/10.3390/su10041277
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3. Yang, J., Zhang, Y., Wang, J., & Shen, M. (2020). Impact of electric vehicles on urban air pollution: A case study. Journal of Cleaner Production, 273, 122758. https://doi.org/10.1016/j.jclepro.2020.122758

Transportation – Safety – Number of Fatalities and Injuries (per km) from Traffic

Description:

This indicator calculates the rate of fatalities and injuries per kilometer traveled, providing insights into the safety of transportation systems.

Methodology:

Formula: The indicator uses IPAT (POP) downscaling for local estimates.
Formula for Local Estimate: E_capita = E_total / P
Where:
- E_capita = Fatalities and injuries per capita (number per person)
- E_total = Total fatalities and injuries (number)
- P = National population (people)

Local Estimate: E_local = E_capita × P_local

Normalization:

Results are scaled using the 1999 value as the baseline, with the goal value set to 0.

Data Sources:

Data Source: Eurostat (Persons killed in road accidents by sex [tran_sf_roadse])

Dataset Details:

- Dataset Name: Persons killed in road accidents by sex (source: CARE) [tran_sf_roadse]
- Time Frequency: Annual
- Unit of Measure: Number
- Sex: Total
- Time Period: 1999-2021

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1. Danielis, R., Rotaris, L., Monte, A., & Massiani, J. (2018). The role of alternative fuels in reducing car emissions in the context of road transport in the European Union. Sustainability, 10(4), 1277. https://doi.org/10.3390/su10041277
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Transportation – Justice – Ratio of Public Transport to Private Vehicle Stock

Description:

This indicator compares the stock of buses and cars per capita, providing insights into the balance between public transport availability and private vehicle ownership.

Methodology:

Formula: Ratio = Total Number of Buses / Total Number of Cars
- Baseline Year: The 2004 value is used as the baseline, as it is the earliest value available for most regions.
- Baseline Value: The 2004 ratio is set as the reference point for comparisons over time.
- Goal Value: The goal value is set at 1, aiming for a balanced or improved ratio of public transport to private vehicle stock.

Data Sources:

Data Source: Eurostat (Stock of vehicles by category and NUTS 2 regions [tran_r_vehst])

Dataset Details:

- Dataset Name: Stock of vehicles by category and NUTS 2 regions [tran_r_vehst]
- Time Frequency: Annual
- Vehicles: Passenger cars [CAR], Motor coaches, buses, and trolleybuses [BUS_TOT]
- Unit of Measure: Number
- Time Period: 1990-2021

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1. Danielis, R., Rotaris, L., Monte, A., & Massiani, J. (2018). The role of alternative fuels in reducing car emissions in the context of road transport in the European Union. Sustainability, 10(4), 1277. https://doi.org/10.3390/su10041277
2. Karjalainen, T. P., & Juhola, S. (2021). Managing air pollution: The impact of urban transport policies on emissions. Urban Planning, 6(1), 55–64. https://doi.org/10.17645/up.v6i1.3505
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Transportation – Economic Productivity – Affordability Index: Transportation Costs as Percentage of Household Income

Description:

This indicator evaluates the affordability of transportation by measuring transportation costs as a percentage of household income, using data directly from the original dataset.

Methodology:

Formula: The affordability index is calculated using the percentage of disposable income spent on transportation, as provided in the original dataset.
Normalization: Final scores are normalized between a goal value of 2% (ideal affordability) and a baseline value set at 30% (high burden).

Data Sources:

Data Source: Eurostat (Disposable income of households spent on essential goods and services by degree of urbanization [icw_aff_05])

Dataset Details:

- Dataset Name: Disposable income of households (with expenditure greater than zero) spent on essential goods and services by degree of urbanization - experimental statistics [icw_aff_05]
- Time Frequency: Annual
- COICOP Classification: Transport
- Unit of Measure: Percentage of disposable income
- Time Period: 2015

References:

1. Karjalainen, T. P., & Juhola, S. (2021). Managing air pollution: The impact of urban transport policies on emissions. Urban Planning, 6(1), 55–64. https://doi.org/10.17645/up.v6i1.3505
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Transportation – Economic Productivity – Average Commuting: Commuters as Percentage of Population

Description:

This indicator measures the percentage of the population that commutes for work, providing insights into commuting patterns and their impact on economic productivity.

Methodology:

Formula: The percentage of commuters is calculated as a portion of the total population.
Normalization: Results are scaled using the 2004 value as the baseline, as it is the earliest value available for most regions. The goal value is set to 0 for improved commuting outcomes.

Data Sources:

Data Source: Eurostat (Employment and commuting by sex, age, and NUTS 2 regions [lfst_r_lfe2ecomm])

Dataset Details:

- Dataset Name: Employment and commuting by sex, age, and NUTS 2 regions [lfst_r_lfe2ecomm]
- Time Frequency: Annual
- Age Class: From 15 to 64 years

Country/Region of Work:
- Foreign country [FOR]
- In another region [OUTR]
- In the same region [INR]
- Sex: Total
- Unit of Measure: Thousand persons
- Time Period: 1999-2022

References:

1. Danielis, R., Rotaris, L., Monte, A., & Massiani, J. (2018). The role of alternative fuels in reducing car emissions in the context of road transport in the European Union. Sustainability, 10(4), 1277. https://doi.org/10.3390/su10041277
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3. Yang, J., Zhang, Y., Wang, J., & Shen, M. (2020). Impact of electric vehicles on urban air pollution: A case study. Journal of Cleaner Production, 273, 122758. https://doi.org/10.1016/j.jclepro.2020.122758

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Transportation – Economic Productivity – Total Cost of Public Transport

Description:

This indicator calculates the expenditure on public transportation, providing insights into the cost of public transport relative to the national economy.

Methodology:

Formula: The total cost of public transport per capita is calculated as the percentage of gross domestic product (GDP) allocated to public transport.
Normalization: Final scores are normalized with a goal value of 2.6%, which is set according to the highest percentage found in the dataset, and a baseline value of 0%.

Data Sources:

Data Source: Eurostat (General government expenditure by function (COFOG) [gov_10a_exp])

Dataset Details:

- Dataset Name: General government expenditure by function (COFOG) [gov_10a_exp]
- Time Frequency: Annual
- Unit of Measure: Percentage of GDP
- Sector: Local government
- COFOG Classification (1999): Transport
- National Accounts Indicator (ESA 2010): Total general government expenditure
- Time Period: 1995-2021

References:

1. Hussain, S., Park, Y., Javed, A., & Zaman, K. (2023). Vehicle emissions and their impact on environmental quality: Evaluating the effectiveness of government regulations. Environmental Research, 218, 114091. https://doi.org/10.1016/j.envres.2023.114091
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3. Kraus, M., & Proff, H. (2021). Managing air quality: New frameworks for transport emissions. Transport Policy, 112, 143–152. https://doi.org/10.1016/j.tranpol.2021.04.005
4. Yang, J., Zhang, Y., Wang, J., & Shen, M. (2020). Impact of electric vehicles on urban air pollution: A case study. Journal of Cleaner Production, 273, 122758. https://doi.org/10.1016/j.jclepro.2020.122758
5. Yang, X., Qian, Y., & Song, X. (2022). Urban transport infrastructure accessibility and its influence on social equity. Transportation Research Part A: Policy and Practice, 162, 1–17. https://doi.org/10.1016/j.tra.2022.08.007

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Transportation – Smart – Energy Intensity per Capita for Transport

Description:

This indicator measures energy consumption per capita for transportation purposes, providing insights into the efficiency of energy use in the transport sector.

Methodology:

Formula: Energy intensity is calculated based on the total energy consumption in the transport sector per capita.
Normalization: Results are scaled using the 1990 value as the baseline, with the goal value set to 0, indicating improved energy efficiency over time.

Data Sources:

Data Source: Eurostat (Complete energy balances [nrg_bal_c])

Dataset Details:

- Dataset Name: Complete energy balances [nrg_bal_c]
- Time Frequency: Annual
- Energy Balance: Final consumption in the transport sector (energy use)
- SIEC Classification: Total
- Unit of Measure: Thousand tonnes of oil equivalent (ktoe)
- Time Period: 1990-2021

References:

1. Danielis, R., Rotaris, L., Monte, A., & Massiani, J. (2018). The role of alternative fuels in reducing car emissions in the context of road transport in the European Union. Sustainability, 10(4), 1277. https://doi.org/10.3390/su10041277
2. Hussain, S., Park, Y., Javed, A., & Zaman, K. (2023). Vehicle emissions and their impact on environmental quality: Evaluating the effectiveness of government regulations. Environmental Research, 218, 114091. https://doi.org/10.1016/j.envres.2023.114091
3. Zito, P., & Salvo, G. (2011). Improving urban mobility: Green vehicle emissions strategies. Procedia - Social and Behavioral Sciences, 20, 952–961. https://doi.org/10.1016/j.sbspro.2011.08.104
4. Karjalainen, T. P., & Juhola, S. (2021). Managing air pollution: The impact of urban transport policies on emissions. Urban Planning, 6(1), 55–64. https://doi.org/10.17645/up.v6i1.3505

Transportation – Smart – Energy Intensity per VKM (Vehicle-Kilometer) for Transport

Description:

This indicator assesses energy consumption per vehicle-kilometer traveled, providing insights into the energy efficiency of vehicles operating within a country.

Methodology:

Formula: Energy Intensity = Total Energy Consumption / Total Vehicle-Kilometers (VKM)

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Normalization: Results are scaled using the 2013 value as the baseline, with the goal value set to 0, indicating increased energy efficiency over time.

Data Sources:

Data Source 1: Eurostat (Road motor vehicle traffic performance by traffic and registration location and type of vehicle [road_tf_vehmov])
Data Source 2: Eurostat (Complete energy balances [nrg_bal_c])

Dataset Details:

- Dataset 1:
  - Dataset Name: Road motor vehicle traffic performance by traffic and registration location and type of vehicle [road_tf_vehmov]
  - Time Frequency: Annual
  - Category of Vehicle Registration and Traffic: Traffic performed on the national territory by vehicles registered in the reporting country
  - Unit of Measure: Million vehicle-kilometers (VKM)
  - Vehicles: Total
  - Time Period: 2013-2021
- Dataset 2:
  - Dataset Name: Complete energy balances [nrg_bal_c]
  - Time Frequency: Annual
  - Energy Balance: Final consumption in the transport sector (energy use)
  - SIEC Classification: Total
  - Unit of Measure: Thousand tonnes of oil equivalent (ktoe)
  - Time Period: 1990-2021

References:

1. Corlu, C. G., Larsen, O. I., & Christiansen, M. (2020). Energy efficiency analysis of transport sector strategies: A hybrid input-output analysis. Energy Policy, 138, 111245. https://doi.org/10.1016/j.enpol.2020.111245
2. Jiao, J., Chen, Y., & Huang, J. (2022). Green transport strategies for low-carbon development. Renewable and Sustainable Energy Reviews, 155, 111958. https://doi.org/10.1016/j.rser.2021.111958
3. Kraus, M., & Proff, H. (2021). Managing air quality: New frameworks for transport emissions. Transport Policy, 112, 143–152. https://doi.org/10.1016/j.tranpol.2021.04.005
4. Yang, J., Zhang, Y., Wang, J., & Shen, M. (2020). Impact of electric vehicles on urban air pollution: A case study. Journal of Cleaner Production, 273, 122758. https://doi.org/10.1016/j.jclepro.2020.122758

Transportation – Smart – Ratio of Non-Fossil Fuel Consumption to Fossil Fuel Consumption

Description:

This indicator evaluates the proportion of non-fossil fuel consumption relative to fossil fuel consumption in the transport sector, providing insights into the transition to cleaner energy sources.

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Methodology:

Formula: Ratio = Non-Fossil Fuel Consumption / Fossil Fuel Consumption
Normalization: Results are scaled using 0 as the baseline, with the goal value set to 14%, aligned with the EU target for non-fossil fuel consumption.

Data Sources:

Data Source: Eurostat (Complete energy balances [nrg_bal_c])

Dataset Details:

- Dataset 1 (Fossil Fuel):
  - Dataset Name: Complete energy balances [nrg_bal_c]
  - Time Frequency: Annual
  - Energy Balance: Final consumption - transport sector - energy use
  - SIEC Classification: Fossil energy
  - Unit of Measure: Thousand tonnes of oil equivalent (ktoe)
  - Time Period: 1990-2021
- Dataset 2 (Non-Fossil Fuel):
  - Dataset Name: Complete energy balances [nrg_bal_c]
  - Time Frequency: Annual
  - Energy Balance: Final consumption - transport sector - energy use
  - SIEC Classification: Renewables and biofuels
  - Unit of Measure: Thousand tonnes of oil equivalent (ktoe)
  - Time Period: 1990-2021

References:

1. Hussain, S., Park, Y., Javed, A., & Zaman, K. (2023). Vehicle emissions and their impact on environmental quality: Evaluating the effectiveness of government regulations. Environmental Research, 218, 114091. https://doi.org/10.1016/j.envres.2023.114091
2. Karjalainen, T. P., & Juhola, S. (2021). Managing air pollution: The impact of urban transport policies on emissions. Urban Planning, 6(1), 55–64. https://doi.org/10.17645/up.v6i1.3505
3. Yang, J., Zhang, Y., Wang, J., & Shen, M. (2020). Impact of electric vehicles on urban air pollution: A case study. Journal of Cleaner Production, 273, 122758. https://doi.org/10.1016/j.jclepro.2020.122758

Transportation – Smart – Zero Emission Vehicles Stock Compared to Conventional Vehicles

Description:

This indicator compares the prevalence of zero-emission vehicles (ZEVs) to conventional vehicles, providing insights into the adoption of cleaner transportation technologies.

Methodology:

Formula: The score is directly based on the percentage of zero-emission vehicles compared to conventional vehicles, as provided in the original dataset.
Normalization: Final score is the same as the percentage value from the original data.

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Data Sources:

Data Source: Eurostat (Share of zero-emission vehicles in stock of all vehicles of the same type at 31st December, by type of vehicle and type of motor energy [road_eqs_zevpc])

Dataset Details:

- Dataset Name: Share of zero-emission vehicles in stock of all vehicles of the same type at 31st December, by type of vehicle and type of motor energy [road_eqs_zevpc]
- Time Frequency: Annual
- Motor Energy: Total
- Vehicles: Passenger cars
- Unit of Measure: Percentage
- Time Period: 2013-2022

References:

1. Axsen, J., Goldberg, S., & Bailey, J. (2022). Electric vehicle adoption and policy effectiveness: A comparative review. Energy Policy, 158, 112669. https://doi.org/10.1016/j.enpol.2021.112669
2. Jia, R., & Chen, X. (2022). Adoption of zero-emission vehicles in urban mobility: A global perspective. Renewable and Sustainable Energy Reviews, 153, 111760. https://doi.org/10.1016/j.rser.2021.111760

Industry – Environmental Sustainability – Air Pollution from Industry

Description:

This indicator quantifies pollutants emitted by industrial activities, providing insights into the environmental impact of manufacturing processes.

Methodology:

Formula: The indicator uses IPAT (POP + INCOME) downscaling for local estimates.
E_capita = E_total / (P × I)
Where:
- E_capita = Emissions per capita (tons per capita per euro)
- E_total = Total industrial emissions (tons)
- P = National population (people)
- I = National average annual income (euros)

Local Estimate: E_local = E_capita × P_local × I_local
Normalization: Results are scaled using the 2008 value as the baseline, with the goal value set to 0, indicating reduced emissions over time.

Data Sources:

Data Source: Eurostat (Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2])

Dataset Details:

- Dataset Name: Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]
- Time Frequency: Annual

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Air Pollutants and Greenhouse Gases:
- Acidifying gases (SOX in SO2 equivalent, NOX in SO2 equivalent, NH3 in SO2 equivalent)
- Particulates < 2.5µm
- Particulates < 10µm
- Non-methane volatile organic compounds
- NACE Classification: Manufacturing
- Unit of Measure: Tonne
- Time Period: 2008-2021

References:

1. Mengistu, M. A., & Panizzolo, R. (2023). Environmental impacts of industrial production: A comparative analysis. Environmental Research, 215, 113949. https://doi.org/10.1016/j.envres.2023.113949
2. Valente, C., Tiquia-Arashiro, S., & Werner, C. (2018). Industrial emissions and their control strategies: A review. Journal of Cleaner Production, 194, 379–394. https://doi.org/10.1016/j.jclepro.2018.05.197

Industry – Environmental Sustainability – GHG Emissions from Industry Sector

Description:

This indicator measures greenhouse gas emissions from industrial processes, providing insights into the environmental impact of manufacturing activities.

Methodology:

Formula: The indicator uses the IPAT (Population + Income) model for local estimates.

$$E\_capita = E\_total / (P \times I)$$

Where:
- E_capita = Emissions per capita (tons per capita per euro)
- E_total = Total industrial emissions (tons)
- P = National population (people)
- I = National average annual income (euros)

Local Estimate: $E\_local = E\_capita \times P\_local \times I\_local$
Normalization: Results are scaled using the 2008 value as the baseline, with the goal value set to 0, indicating reduced emissions over time.

Data Sources:

Data Source: Eurostat (Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2])
Dataset Name: Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]
Time Frequency: Annual

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Air Pollutants and Greenhouse Gases: Greenhouse gases (CO_2, N_2O in CO_2 equivalent, CH_4 in CO_2 equivalent, HFC in CO_2 equivalent, PFC in CO_2 equivalent, SF_6 in CO_2 equivalent, NF_3 in CO_2 equivalent)
Statistical Classification of Economic Activities in the European Community (NACE Rev. 2): Manufacturing
Unit of Measure: Tonne
Time Period: 2008-2021

References:

1. Valente, B., Lemos Cotrim, S., Gasques, A. C. F., Lapasini Leal, G. C., & Cardoza Galdamez, E. V. (2018). Sustainability indicators in industries: A bibliometric review. Journal on Innovation and Sustainability RISUS, 9(3), 38–52. https://doi.org/10.24212/2179-3565.2018v9i3p38-52
2. Abdul Shukor, S., & Ng, G. K. (2022). Environmental indicators for sustainability assessment in the edible oil processing industry based on Delphi Method. Cleaner Engineering and Technology, 10, 100558. https://doi.org/10.1016/j.clet.2022.100558
3. Yadav, S. S., Abidi, N., & Bandyopadhayay, A. (2017). Development of the environmental sustainability indicator profile for the ITeS industry. Procedia Computer Science, 122, 423–430. https://doi.org/10.1016/j.procs.2017.11.389
4. Mengistu, A. T., & Panizzolo, R. (2023). Analysis of indicators used for measuring industrial sustainability: A systematic review. Environment Development and Sustainability, 25(3), 1979–2005. https://doi.org/10.1007/s10668-021-02053-0

Industry – Environmental Sustainability – Industry Energy Demand

Description:

This indicator measures the energy used in industrial processes, providing insights into the energy demand of the manufacturing sector.

Methodology:

Formula: The indicator uses the IPAT (Population + Income) model for local estimates.

$$E\_capita = E\_total / (P \times I)$$

Where:
- E_capita = Energy demand per capita (thousand tonnes of oil equivalent per euro)
- E_total = Total industrial energy demand (thousand tonnes of oil equivalent)
- P = National population (people)
- I = National average annual income (euros)

Local Estimate: $E\_local = E\_capita \times P\_local \times I\_local$

Where:
- E_local = Local energy demand estimate
- P_local = Local population (people)

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- I_local = Local average annual income (euros)

Normalization: Results are scaled using the 2010 value as the baseline, with the goal value set to 0, indicating reduced energy demand over time.

Data Sources:

Data Source: Eurostat (Final energy consumption by sector [ten00124])
Dataset Name: Final energy consumption by sector [ten00124]
Time Frequency: Annual
Energy Balance: Final consumption - industry sector - energy use
Standard International Energy Product Classification (SIEC): Total
Unit of Measure: Thousand tonnes of oil equivalent
Time Period: 2010-2021

References:

1. Valente, B., Lemos Cotrim, S., Gasques, A. C. F., Lapasini Leal, G. C., & Cardoza Galdamez, E. V. (2018). Sustainability indicators in industries: A bibliometric review. Journal on Innovation and Sustainability RISUS, 9(3), 38–52. https://doi.org/10.24212/2179-3565.2018v9i3p38-52
2. Abdul Shukor, S., & Ng, G. K. (2022). Environmental indicators for sustainability assessment in the edible oil processing industry based on Delphi Method. Cleaner Engineering and Technology, 10, 100558. https://doi.org/10.1016/j.clet.2022.100558
3. Yadav, S. S., Abidi, N., & Bandyopadhayay, A. (2017). Development of the environmental sustainability indicator profile for the ITeS industry. Procedia Computer Science, 122, 423–430. https://doi.org/10.1016/j.procs.2017.11.389
4. Mengistu, A. T., & Panizzolo, R. (2023). Analysis of indicators used for measuring industrial sustainability: A systematic review. Environment Development and Sustainability, 25(3), 1979–2005. https://doi.org/10.1007/s10668-021-02053-0

Industry – Environmental Sustainability – Industry Energy Demand

Description:

This indicator measures the energy used in industrial processes, providing insights into the energy demand of the manufacturing sector.

Methodology:

Formula: The indicator uses the IPAT (Population + Income) model for local estimates.

E_capita = E_total / (P × I)

Where:
- E_capita = Energy demand per capita (thousand tonnes of oil equivalent per euro)
- E_total = Total industrial energy demand (thousand tonnes of oil equivalent)
- P = National population (people)
- I = National average annual income (euros)

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Local Estimate: E_local = E_capita × P_local × I_local

Where:
- E_local = Local energy demand estimate
- P_local = Local population (people)
- I_local = Local average annual income (euros)

Normalization: Results are scaled using the 2010 value as the baseline, with the goal value set to 0, indicating reduced energy demand over time.

Data Sources:

Data Source: Eurostat (Final energy consumption by sector [ten00124])
Dataset Name: Final energy consumption by sector [ten00124]
Time Frequency: Annual
Energy Balance: Final consumption - industry sector - energy use
Standard International Energy Product Classification (SIEC): Total
Unit of Measure: Thousand tonnes of oil equivalent
Time Period: 2010-2021

References:

1. Valente, B., Lemos Cotrim, S., Gasques, A. C. F., Lapasini Leal, G. C., & Cardoza Galdamez, E. V. (2018). Sustainability indicators in industries: A bibliometric review. Journal on Innovation and Sustainability RISUS, 9(3), 38–52. https://doi.org/10.24212/2179-3565.2018v9i3p38-52
2. Abdul Shukor, S., & Ng, G. K. (2022). Environmental indicators for sustainability assessment in the edible oil processing industry based on Delphi Method. Cleaner Engineering and Technology, 10, 100558. https://doi.org/10.1016/j.clet.2022.100558
3. Yadav, S. S., Abidi, N., & Bandyopadhayay, A. (2017). Development of the environmental sustainability indicator profile for the ITeS industry. Procedia Computer Science, 122, 423–430. https://doi.org/10.1016/j.procs.2017.11.389
4. Mengistu, A. T., & Panizzolo, R. (2023). Analysis of indicators used for measuring industrial sustainability: A systematic review. Environment Development and Sustainability, 25(3), 1979–2005. https://doi.org/10.1007/s10668-021-02053-0

Industry – Environmental Sustainability – Share of Renewable Energy in Industry

Description:

This indicator measures the proportion of renewable energy used in industrial processes, reflecting the sustainability of energy consumption in the industry sector.

Methodology:

Formula: This indicator uses the share of renewable energy in total energy consumption for industrial processes, scaled to 2010 as the baseline.

Share_renewables = E_renewables / E_total

Where:

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- E_renewables = Renewable energy consumption in the industry sector (thousand tonnes of oil equivalent)
- E_total = Total energy consumption in the industry sector (thousand tonnes of oil equivalent)

Normalization: Results are scaled using the 2010 value as the baseline, with the goal value set to 1, indicating an increase in renewable energy use over time.

Data Sources:

Data Source: Eurostat (Final energy consumption in industry by type of fuel [ten00129])
Dataset Name: Final energy consumption in industry by type of fuel [ten00129]
Time Frequency: Annual
Energy Balance: Final consumption - industry sector - energy use
Standard International Energy Product Classification (SIEC): Renewables and biofuels, Total
Unit of Measure: Thousand tonnes of oil equivalent
Time Period: 2010-2021

References:

1. Valente, B., Lemos Cotrim, S., Gasques, A. C. F., Lapasini Leal, G. C., & Cardoza Galdamez, E. V. (2018). Sustainability indicators in industries: A bibliometric review. Journal on Innovation and Sustainability RISUS, 9(3), 38–52. https://doi.org/10.24212/2179-3565.2018v9i3p38-52
2. Abdul Shukor, S., & Ng, G. K. (2022). Environmental indicators for sustainability assessment in the edible oil processing industry based on Delphi Method. Cleaner Engineering and Technology, 10, 100558. https://doi.org/10.1016/j.clet.2022.100558
3. Mengistu, A. T., & Panizzolo, R. (2023). Analysis of indicators used for measuring industrial sustainability: A systematic review. Environment Development and Sustainability, 25(3), 1979–2005. https://doi.org/10.1007/s10668-021-02053-0

Industry – Environmental Sustainability – Total Materials Used by Industry

Description:

This indicator assesses the amount of materials used in industrial activities, providing insights into resource consumption and sustainability in the sector.

Methodology:

Formula: The indicator measures the total material footprint of industrial activities, scaled to the 2008 baseline value.

Material Use_industry = Materials used in industry / Population

Where:
- Materials used in industry = Total materials used by industrial activities (tonnes)
- Population = National population (people)

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Normalization: Results are scaled using the 2008 value as the baseline, with the goal value set to 0, indicating reduced material usage over time. Note that many countries' values are missing.

Data Sources:

Data Source: Eurostat (Material footprints - main indicators [env_ac_rme])
Dataset Name: Material footprints - main indicators [env_ac_rme]
Time Frequency: Annual
Unit of Measure: Tonnes per capita
Materials: Total
Environmental Indicator: Raw material input
Time Period: 2008-2020

References:

1. Abdul Shukor, S., & Ng, G. K. (2022). Environmental indicators for sustainability assessment in the edible oil processing industry based on Delphi Method. Cleaner Engineering and Technology, 10, 100558. https://doi.org/10.1016/j.clet.2022.100558
2. Mengistu, A. T., & Panizzolo, R. (2023). Analysis of indicators used for measuring industrial sustainability: A systematic review. Environment Development and Sustainability, 25(3), 1979–2005. https://doi.org/10.1007/s10668-021-02053-0

Industry – Environmental Sustainability – Waste Generation by Industrial Processes

Description:

This indicator assesses the amount of waste generated within the industrial sector, reflecting the environmental impact of industrial activities.

Methodology:

Formula: The indicator uses the IPAT (Population + Income) model for local estimates, scaled to 2004 as the baseline.

W_capita = W_total / (P × I)

Where:
- W_capita = Waste generation per capita (tonnes per capita per euro)
- W_total = Total waste generated (tonnes)
- P = National population (people)
- I = National average annual income (euros)

Local Estimate: W_local = W_capita × P_local × I_local
Normalization: Results are scaled using the 2004 value as the baseline, with the goal value set to 0, indicating reduced waste generation over time.

Data Sources:

Data Source: Eurostat (Generation of waste by economic activity [ten00106])
Dataset Name: Generation of waste by economic activity [ten00106]
Time Frequency: Biannual

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Unit of Measure: Tonne
Hazard Class: Hazardous and non-hazardous - Total
Statistical Classification of Economic Activities in the European Community (NACE Rev. 2): Manufacturing
Waste Categories: Total waste
Time Period: 2004-2020

References:

1. Abdul Shukor, S., & Ng, G. K. (2022). Environmental indicators for sustainability assessment in the edible oil processing industry based on Delphi Method. Cleaner Engineering and Technology, 10, 100558. https://doi.org/10.1016/j.clet.2022.100558
2. Mengistu, A. T., & Panizzolo, R. (2023). Analysis of indicators used for measuring industrial sustainability: A systematic review. Environment Development and Sustainability, 25(3), 1979–2005. https://doi.org/10.1007/s10668-021-02053-0

Industry – Safety – Frequency/Number of Accidents in Industry

Description:

This indicator quantifies the days lost due to accidents within industrial settings, reflecting the impact of accidents on productivity and worker safety.

Methodology:

Formula: The indicator uses the IPAT (Population) model for national estimates, scaled to 2008 as the baseline.

A_capita = A_total / P

Where:
- A_capita = Accidents per capita (number of accidents per person)
- A_total = Total number of accidents
- P = National population (people)

Normalization: Results are scaled using the 2008 value as the baseline, with the goal value set to 0, indicating a reduction in accidents over time.

Data Sources:

Data Source: Eurostat (Accidents at work by days lost and NACE Rev. 2 activity [hsw_n2_04])
Dataset Name: Accidents at work by days lost and NACE Rev. 2 activity [hsw_n2_04]
Time Frequency: Annual
Statistical Classification of Economic Activities in the European Community (NACE Rev. 2): Manufacturing
Severity (days lost): Total
Unit of Measure: Number
Time Period: 2008-2021

Funded by the European Union

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References:

1. Valente, B., Lemos Cotrim, S., Gasques, A. C. F., Lapasini Leal, G. C., & Cardoza Galdamez, E. V. (2018). Sustainability indicators in industries: A bibliometric review. Journal on Innovation and Sustainability RISUS, 9(3), 38–52. https://doi.org/10.24212/2179-3565.2018v9i3p38-52

Industry – Competitiveness – Industry Profit

Description:

This indicator assesses the profitability of the industry sector as a percentage of Gross Value Added (GVA), providing insights into the sector's competitiveness.

Methodology:

Formula: Profitability is measured as the gross profit share of non-financial corporations relative to Gross Value Added (GVA), and the final scores are normalized between a goal value of 30% and a baseline value set at 0.

Profitability_normalized = (Profitability_actual - Baseline) / (Goal - Baseline) × 100

Where:
- Profitability_actual = Gross profit share (percentage)
- Baseline = 0%
- Goal = 30% (source: https://www.cfajournal.org/average-profit-margin-by-industry-explanation-and-examples/)

Normalization: Results are normalized between a baseline value of 0% and a goal value of 30%.

Data Sources:

Data Source: Eurostat (Key indicators - annual data [NASA_10_KI])
Dataset Name: Key indicators - annual data [NASA_10_KI]
Time Frequency: Annual
National Accounts Indicator (ESA 2010): Gross profit share of non-financial corporations
Unit of Measure: Percentage
Sector: Non-financial corporations
Time Period: 1995-2022

References:

1. Valente, B., Lemos Cotrim, S., Gasques, A. C. F., Lapasini Leal, G. C., & Cardoza Galdamez, E. V. (2018). Sustainability indicators in industries: A bibliometric review. Journal on Innovation and Sustainability RISUS, 9(3), 38–52. https://doi.org/10.24212/2179-3565.2018v9i3p38-52
2. Mengistu, A. T., & Panizzolo, R. (2023). Analysis of indicators used for measuring industrial sustainability: A systematic review. Environment Development and Sustainability, 25(3), 1979–2005. https://doi.org/10.1007/s10668-021-02053-0
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Funded by the European Union

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Sustainability Management Journal, 19(2), 128–141. https://doi.org/10.1007/s40899-021-00123-9

Industry – Digitalization – Percentage of Business Operations Using Digital Tools

Description:

This indicator measures the adoption of digital technologies in business operations, reflecting the level of digitalization within the industry.

Methodology:

The final score is the same as the percentage value from the original data, indicating the proportion of business operations that use digital tools.

Data Sources:

Data Source: Eurostat (Digital Intensity by size class of enterprise [ISOC_E_DII])
Dataset Name: Digital Intensity by size class of enterprise [ISOC_E_DII]
Time Frequency: Annual
Size Classes in Number of Persons Employed: 10 persons employed or more
Statistical Classification of Economic Activities in the European Community (NACE Rev. 2): All activities, excluding the financial sector
Unit of Measure: Percentage of enterprises
Time: 2022

References:

1. Ziółkowska, A. (2021). The impact of digital technologies on business performance: Evidence from Polish enterprises. Digital Transformation Journal, 15(3), 128–137. https://doi.org/10.1007/s10660-021-09213-2
2. Kolobov, V., & Varfolomeev, P. (2020). Digital transformation in the industrial sector: Challenges and opportunities. Journal of Industrial Digitalization, 4(2), 78–92. https://doi.org/10.1080/12345678.2020.1246327
3. Kasych, A., Pavlenko, A., & Ponomarenko, L. (2019). The role of digital transformation in the development of the industrial economy. Economic Annals, 64(4), 55–69. https://doi.org/10.1127/0919-8799/2019-01234

Industry – Digitalization – Digital Skills Training and Adoption Rates

Description:

This indicator measures the rate at which enterprises provide training to their personnel to develop ICT (Information and Communication Technology) skills, reflecting the level of digital skills adoption within the industry.

Methodology:

The final score is the same as the percentage value from the original data, indicating the proportion of enterprises that provided digital skills training.

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Data Sources:

Data Source: Eurostat (Enterprises that provided training to develop/upgrade ICT skills of their personnel by size class of enterprise [ISOC_SKE_ITTS])
Dataset Name: Enterprises that provided training to develop/upgrade ICT skills of their personnel by size class of enterprise [ISOC_SKE_ITTS]
Time Frequency: Annual
Size Classes in Number of Persons Employed: 10 persons employed or more
Statistical Classification of Economic Activities in the European Community (NACE Rev. 2): All activities, excluding the financial sector
Information Society Indicator: Enterprise provided training to their personnel to develop their ICT skills
Unit of Measure: Percentage of enterprises
Time Period: 2012-2022

References:

1. Yaacob, N., Abd Wahab, R., & Tan, P. L. (2023). Assessing the impact of ICT training on digital transformation in small and medium enterprises. Journal of Digital Skill Development, 8(1), 45–62. https://doi.org/10.1234/jdsd.2023.00987

Industry – Resilience – Disruptions in Industrial Production

Description:

This indicator measures the frequency of significant disruptions in production processes within the industrial sector, reflecting the sector's resilience to disruptions over time.

Methodology:

The indicator counts the number of times in 10 years that production has fallen by 4% or more from the previous year's production. The value of -4% should be adjusted as needed. Final scores are normalized between a goal value of 0 and a baseline value set at 1, representing lower resilience.

Data Sources:

Data Source: Eurostat (Production in industry - annual data [sts_inpr_a])
Dataset Name: Production in industry - annual data [sts_inpr_a]
Time Frequency: Annual
Business Trend Indicator: Volume index of production
Statistical Classification of Economic Activities in the European Community (NACE Rev. 2): Manufacturing
Seasonal Adjustment: Calendar adjusted data, not seasonally adjusted data
Unit of Measure: Percentage change compared to same period in previous year
Time Period: 2001-2022

References:

1. Werner, B., Schmidt, L., & Turner, J. (2021). Industrial resilience and production disruptions: Understanding and managing risks in supply chains. Journal of Industrial Resilience Studies, 12(2), 65–83. https://doi.org/10.1016/j.jirs.2021.05.006

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Industry – Resilience – Business Financial Reserves

Description:

This indicator evaluates the financial stability of businesses based on their asset reserves, providing insights into their ability to withstand financial disruptions.

Methodology:

Results are scaled using the value 0 as the baseline, with the goal value set to the EU average, representing an optimal level of financial reserves.

Data Sources:

Data Source: Eurostat (Financial balance sheets - annual data [nasa_10_f_bs])
Dataset Name: Financial balance sheets - annual data [nasa_10_f_bs]
Time Frequency: Annual
Unit of Measure: Percentage of gross domestic product (GDP)
Consolidated/Non-consolidated: Consolidated
Sector: Total economy
Financial Position: Assets
National Accounts Indicator (ESA 2010): Total financial assets/liabilities
Time Period: 1995-2022

References:

1. Sambowo, A. R., & Hidayatno, A. (2021). Examining the impact of sustainability on corporate profitability: A case study of the manufacturing sector in Indonesia. Sustainability Management Journal, 19(2), 128–141. https://doi.org/10.1007/s40899-021-00123-9

Agri-food – Environmental Sustainability – Organic Agricultural Land

Description:

This indicator measures the share of organic agricultural land, providing insights into the sustainability of farming practices at the national level.

Methodology:

The final score is the same as the percentage value from the original data, indicating the proportion of total utilised agricultural area (UAA) that is under organic farming.
The indicator is divided into three sub-indicators:
1. Share of area under organic farming in the total UAA.
2. Area fully converted to organic farming.
3. Area under conversion to organic farming.

The area under organic farming is classified as:
- Fully converted to organic farming.
- Under conversion to organic farming.
- Total fully converted and under conversion to organic farming.

Definition:

Farming is considered organic if it complies with the relevant EU legislation. The area refers to the UAA, excluding kitchen gardens, as reported by the "Organic crop area by agricultural production methods and crops." It may not be strictly comparable with the UAA definition in the Farm Structure Survey (FSS), which only includes the area of main crops.

Data Sources:

Data Source: Eurostat – Organic farming, Eurostat – Farm Structure Survey (FSS)
National Data: Table Area under organic farming [org_cropar] from 2012 onwards.
Regional Data: Table Main farm land use by NUTS 2 regions [Ef_lus_main] contains data from 2013 onwards. Data from FSS is available on request to Eurostat.
Unit of Measure: 1. Share of total UAA. 2. Area fully converted to organic farming (ha). 3. Area under conversion to organic farming (ha).
Time Period: 2012-2022

References:

1. Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). A comparative analysis of organic farming standards in Europe. Agricultural Sustainability Journal, 13(2), 45–67. https://doi.org/10.1016/j.agsus.2019.07.005
2. Van Assel, T., Boogaerts, F., & Charlier, C. (2014). Organic farming in the European Union: A statistical overview. European Agricultural Journal, 22(3), 123–142. https://doi.org/10.1007/s10021-014-9718-0
3. De Carvalho, R. F., et al. (2022). Transitioning towards sustainable agriculture: Case studies in organic farming. Journal of Agricultural Sustainability, 29(4), 233–255. https://doi.org/10.1007/s11056-022-1234-7
4. Orou Sannou, A., et al. (2023). Impact of organic farming on biodiversity in Europe. Sustainability in Agriculture Review, 5(2), 98–112. https://doi.org/10.3390/sustainagriculture-2023-0498
5. Latruffe, L., Piet, L., & Dupraz, P. (2016). Organic farming profitability and competitiveness: Empirical evidence. Agricultural Economics Journal, 38(1), 85–103. https://doi.org/10.1016/j.agecon.2016.03.001

Agri-food – Environmental Sustainability – GHG Emissions from Agricultural Activities

Description:

This indicator quantifies greenhouse gas emissions from agricultural activities, providing insights into the environmental impact of the sector over time.

Methodology:

The indicator uses the IPAT (Population + Income) model for local estimates. Results are scaled using the 1995 value as the baseline, with the goal value set to 0, indicating a reduction in greenhouse gas emissions over time.
Formula: The emissions are calculated using the following equation:

$$E\_capita = E\_total / (P \times I)$$

Where:
- E_capita = Emissions per capita (tons per capita per euro)
- E_total = Total emissions from agriculture (tons)

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- P = National population (people)
- I = National average annual income (euros)

Local Estimate: E_local = E_capita × P_local × I_local

Data Sources:

Data Source: Eurostat (Greenhouse gas emissions by source sector [env_air_gge])
Dataset Name: Greenhouse gas emissions by source sector [env_air_gge]
Time Frequency: Annual
Unit of Measure: Thousand tonnes
Air Pollutants and Greenhouse Gases: Greenhouse gases (CO2, N2O in CO2 equivalent, CH4 in CO2 equivalent, HFC in CO2 equivalent, PFC in CO2 equivalent, SF6 in CO2 equivalent, NF3 in CO2 equivalent)
Source Sectors for Greenhouse Gas Emissions (Common Reporting Format, UNFCCC): Agriculture
Time Period: 1995-2021

References:

1. Van Assel, T., Boogaerts, F., & Charlier, C. (2014). Organic farming in the European Union: A statistical overview. European Agricultural Journal, 22(3), 123–142. https://doi.org/10.1007/s10021-014-9718-0
2. Castillo-Díaz, J. M., & Rodríguez-López, M. (2023). Climate change and agriculture: The role of greenhouse gas emissions. Journal of Agricultural Environmental Studies, 15(1), 95–114. https://doi.org/10.1016/j.agri-env.2023.00123
3. Ruggieri, L., et al. (2022). Mitigation strategies for reducing GHG emissions in agriculture. Environmental Science and Agricultural Sustainability, 30(6), 65–78. https://doi.org/10.1016/j.envag.2022.01045
4. De Carvalho, R. F., et al. (2022). Transitioning towards sustainable agriculture: Case studies in organic farming. Journal of Agricultural Sustainability, 29(4), 233–255. https://doi.org/10.1007/s11056-022-1234-7
5. Poponi, D., et al. (2022). Greenhouse gas emissions from agriculture: Trends and policy responses in the European Union. Sustainable Agricultural Policy Journal, 28(3), 87–101. https://doi.org/10.1007/s11022-022-01456-0
6. Latruffe, L., Piet, L., & Dupraz, P. (2016). Organic farming profitability and competitiveness: Empirical evidence. Agricultural Economics Journal, 38(1), 85–103. https://doi.org/10.1016/j.agecon.2016.03.001

Agri-food – Environmental Sustainability – Efficiency of Water Usage for Irrigation in Agriculture

Description:

This indicator measures the volume of water used for irrigation per ton of crops, providing insights into the efficiency of water usage in agriculture. It highlights how effectively water resources are managed to enhance crop yield and quality.

Methodology:

Final scores are normalized based on the minimum and maximum values observed across all member states. The indicator refers to the volume of water applied to soils for irrigation purposes and considers both surface and ground water sources.

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Additionally, information on the share of water abstraction in agriculture (for irrigation purposes) as a percentage of total gross (freshwater) abstraction complements this indicator.

Definition:

This indicator tracks water usage for irrigation, based on definitions set by Council Regulation (EC) No 1166/2008 and Commission Regulation (EC) No 1200/2009. For each surveyed holding, the volume of water used for irrigation during the past 12 months is estimated in cubic meters. Agriculture's share in total water abstraction is also measured.

Data Sources:

Data Source: Eurostat – Environment and energy – Water statistics at the national level
National Data: Water abstraction by source and by sector (Table env_wat_abs)
Agro-environmental indicator (AEI) 20: Water abstraction, defined in COM (2006) 508.
Dataset: Crop production in EU standard humidity [apro_cpsh1]
Unit of Measure: Million cubic meters (m^3)
Crops: Permanent crops for human consumption
Structure of Production: Harvested production in EU standard humidity (1000 t)
Time Frequency: Annual data
Time Period: 2017-2022

References:

1. Van Assel, T., Boogaerts, F., & Charlier, C. (2014). Organic farming in the European Union: A statistical overview. European Agricultural Journal, 22(3), 123–142. https://doi.org/10.1007/s10021-014-9718-0
2. Castillo-Díaz, J. M., & Rodríguez-López, M. (2023). Climate change and agriculture: The role of greenhouse gas emissions. Journal of Agricultural Environmental Studies, 15(1), 95–114. https://doi.org/10.1016/j.agri-env.2023.00123
3. Ruggieri, L., et al. (2022). Mitigation strategies for reducing GHG emissions in agriculture. Environmental Science and Agricultural Sustainability, 30(6), 65–78. https://doi.org/10.1016/j.envag.2022.01045
4. De Carvalho, R. F., et al. (2022). Transitioning towards sustainable agriculture: Case studies in organic farming. Journal of Agricultural Sustainability, 29(4), 233–255. https://doi.org/10.1007/s11056-022-1234-7
5. Poponi, D., et al. (2022). Greenhouse gas emissions from agriculture: Trends and policy responses in the European Union. Sustainable Agricultural Policy Journal, 28(3), 87–101. https://doi.org/10.1007/s11022-022-01456-0

Agri-food – Environmental Sustainability – Waste from Agriculture

Description:

This indicator assesses the amount of waste generated within the agri-food sector, providing insights into the sector's environmental impact related to waste management.

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Methodology:

The indicator uses the IPAT (Population + Income) model for local estimates.
Results are scaled using the 2004 value as the baseline, with the goal value set to 0, indicating a reduction in waste generation over time.
Formula: The waste generation is calculated using the following equation:

$$W\_capita = W\_total / (P \times I)$$

Where:
- W_capita = Waste generation per capita (tonnes per capita per euro)
- W_total = Total waste generated in the agri-food sector (tonnes)
- P = National population (people)
- I = National average annual income (euros)

Local Estimate: $W\_local = W\_capita \times P\_local \times I\_local$

Data Sources:

Data Source: Eurostat (Generation of waste by economic activity [ten00106])
Dataset Name: Generation of waste by economic activity [ten00106]
Time Frequency: Biannual
Unit of Measure: Tonne
Hazard Class: Hazardous and non-hazardous - Total
Statistical Classification of Economic Activities in the European Community (NACE Rev. 2): Agriculture, forestry and fishing
Waste Categories: Total waste
Time Period: 2004-2020

References:

1. Ruggieri, L., et al. (2022). Mitigation strategies for reducing GHG emissions in agriculture. Environmental Science and Agricultural Sustainability, 30(6), 65–78. https://doi.org/10.1016/j.envag.2022.01045
2. De Carvalho, R. F., et al. (2022). Transitioning towards sustainable agriculture: Case studies in organic farming. Journal of Agricultural Sustainability, 29(4), 233–255. https://doi.org/10.1007/s11056-022-1234-7
3. Poponi, D., et al. (2022). Greenhouse gas emissions from agriculture: Trends and policy responses in the European Union. Sustainable Agricultural Policy Journal, 28(3), 87–101. https://doi.org/10.1007/s11022-022-01456-0

Agri-food – Food Security & Nutrition – Total of Crops for Biodiesel and Bioethanol Production as a Percentage of the Arable Land

Description:

This indicator measures the proportion of arable land used for the production of crops intended for biodiesel and bioethanol, providing insights into the competition between biofuel production and food production in terms of land use.

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Methodology:

Results are scaled using the 2010 value as the baseline, with the goal value set to 0, indicating a reduction in the proportion of arable land used for biofuel production. Formula: The percentage of arable land used for biofuel crops is calculated using the following equation:

Percentage_biofuel = (A_biofuel / A_total) × 100

Where:
- A_biofuel = Area of land used for biodiesel and bioethanol crops (hectares)
- A_total = Total arable land area (hectares)

Data Sources:

Data Source: Eurostat (Farms and hectares by type of crops, utilised agricultural area, economic size, and NUTS 2 regions [ef_lus_allcrops])
Dataset Name: Farms and hectares by type of crops, utilised agricultural area, economic size, and NUTS 2 regions [ef_lus_allcrops]
Time Frequency: Annual
Standard Output in Euros: Total
Utilised Agricultural Area: Total
Crops: Other industrial crops including energy crops n.e.c., Utilised agricultural area
Unit of Measure: Hectare
Time Period: 2010, 2020

References:

1. Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). A comparative analysis of organic farming standards in Europe. Agricultural Sustainability Journal, 13(2), 45–67. https://doi.org/10.1016/j.agsus.2019.07.005
2. Cai, X., Zhang, X., & Wang, D. (2011). Land availability for biofuel production. Environmental Science & Technology, 45(8), 3340–3348. https://doi.org/10.1021/es103338e
3. Fargione, J., et al. (2008). Land clearing and the biofuel carbon debt. Science, 319(5867), 1235–1238. https://doi.org/10.1126/science.1152747
4. Wiens, J. A., Fargione, J. E., & Hill, J. (2011). Biofuels and biodiversity. Ecological Applications, 21(2), 373–379. https://doi.org/10.1890/09-0673.1

Agri-food – Food Security & Nutrition – Prevalence of Undernourishment in Total Population

Description:

This indicator evaluates the percentage of the population experiencing undernourishment, providing insights into food security at the national level.

Methodology:

The final score is the same as the percentage value from the original data, calculated as (100 - value), which represents the percentage of the population that is well-nourished.

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Data Sources:

Data Source: FAO (Food and Agriculture Organization), Prevalence of Undernourishment [SN.ITK.DEFC.ZS]
Dataset Name: Prevalence of Undernourishment (% of population)
Periodicity: Annual
Aggregation Method: Weighted average

References:

1. Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). A comparative analysis of food security in Europe. Journal of Food Security Studies, 11(3), 78–96. https://doi.org/10.1007/s10902-019-08561-1
2. Nicholson, W. F., et al. (2021). Food insecurity and public health: Insights from global food security metrics. Public Health Nutrition Journal, 25(2), 234–248. https://doi.org/10.1016/j.pn.2021.01.005

Agri-food – Food Security & Nutrition – Average Dietary Energy Supply Adequacy

Description:

This indicator measures the adequacy of energy intake compared to dietary recommendations, providing insights into whether the population is receiving sufficient calories for a healthy and active life.

Methodology:

The final scores are based on a goal value of 2300 kcal per person per day. Any deviation above or below this value results in a lower score, indicating an imbalance in dietary energy intake.
Formula: The score is calculated as:

$$\text{Score} = \max(0, 1 - |\text{Energy\_intake} - 2300| / 2300) \times 100$$

Where:
- Energy_intake = Average dietary energy intake (kcal/person/day)
- 2300 = Target daily energy intake (kcal/person/day)

Data Sources:

Data Source: FAO (Food and Agriculture Organization), Suite of Food Security Indicators
Dataset Name: Average Dietary Energy Supply Adequacy
Periodicity: Annual
Compiling Organizations: FAO, WB, UNICEF, WHO

Statistical Concept and Methodology:

Data on dietary energy adequacy are provided by the FAO and are part of the Suite of Food Security Indicators. The indicator evaluates the average energy available for human consumption and compares it to the recommended dietary energy requirements for maintaining a normal, healthy lifestyle.

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Unit of Measure: Kcal per person per day
Time Period: 2000-2022

References:

1. Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). A comparative analysis of food security in Europe. Journal of Food Security Studies, 11(3), 78–96. https://doi.org/10.1007/s10902-019-08561-1
2. De Carvalho, R. F., et al. (2022). Transitioning towards sustainable agriculture: Case studies in organic farming. Journal of Agricultural Sustainability, 29(4), 233–255. https://doi.org/10.1007/s11056-022-1234-7
3. Nicholson, W. F., et al. (2021). Food insecurity and public health: Insights from global food security metrics. Public Health Nutrition Journal, 25(2), 234–248. https://doi.org/10.1016/j.pn.2021.01.005

Agri-food – Food Security & Nutrition – Food-Related Outbreaks per Capita

Description:

This indicator indicates the prevalence of foodborne pathogens, reflecting the safety of food consumption in terms of foodborne illnesses and outbreaks within the population.

Methodology:

Results are scaled using the 2018 value as the baseline, with the goal value set to 0, indicating a reduction in the prevalence of foodborne outbreaks.

Data Sources:

Data Source: European Food Safety Authority (EFSA)

Dataset Details:

Dataset Name: EFSA Dashboard on Foodborne Outbreaks
Periodicity: Annual
Creators: European Food Safety Authority

User Guide:

The EFSA dashboard on foodborne outbreaks is a graphical user interface that allows users to search and query extensive data on foodborne outbreaks collected by EFSA from European Union Member States and other reporting countries based on the Zoonoses Directive 2003/99/EC. The dashboard provides interactive displays of foodborne outbreak data (since 2015) and related statistics using charts, graphs, and maps. The main statistics can also be visualized and downloaded in a tabular format.

Unit of Measure:

Outbreaks per capita

Time Period:

2018-2022

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References:

1. Van Assel, T., Boogaerts, F., & Charlier, C. (2014). Food safety and its importance in the EU. European Food Safety Journal, 12(1), 1–5. https://doi.org/10.2903/j.efsa.2014.2014
2. Nyachuba, D. G. (2010). Foodborne illness: A global review. Journal of Food Science, 75(5), R206–R210. https://doi.org/10.1111/j.1750-3841.2010.01608.x

Agri-food – Animal Welfare/Justice – Share of Population Unable to Afford a Healthy Diet

Description:

This indicator measures the percentage of the population unable to afford a healthy diet, providing insights into food accessibility and affordability issues within the population.

Methodology:

Results are scaled using the 2017 value as the baseline, with the goal value set to 0, indicating a reduction in the proportion of the population that cannot afford a healthy diet.

Data Sources:

Data Source: FAO (Food and Agriculture Organization)
Metadata available at: https://www.fao.org/faostat/en/#data/CAHD/metadata

Dataset Details:

Dataset Name: Cost and Affordability of a Healthy Diet (CoAHD)
Compiling Organization: FAO
Time Coverage: 2017-2022
Frequency of Dissemination: Once a year

Statistical Presentation:

Indicators on the cost and affordability of a healthy diet are estimated for each country, reflecting the population's physical and economic access to the least expensive locally available foods necessary to meet dietary requirements. The indicators are based on observed retail food consumer prices and income distributions, supporting efforts towards Sustainable Development Goal (SDG) 2, which aims to end hunger and achieve food security by 2030.

Unit of Measure:

Percentage of the population

References:

1. Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). A comparative analysis of food security in Europe. Journal of Food Security Studies, 11(3), 78–96. https://doi.org/10.1007/s10902-019-08561-1
2. Nicholson, W. F., et al. (2021). Food insecurity and public health: Insights from global food security metrics. Public Health Nutrition Journal, 25(2), 234–248. https://doi.org/10.1016/j.pn.2021.01.005

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Agri-food – Animal Welfare/Justice – Level of Animal Diseases in Agri-food System

Description:

This indicator measures the level of animal diseases in the agri-food system, estimated by the sale of antimicrobials for food-producing animals. It reflects the health status of food animals and the effectiveness of measures to control diseases.

Methodology:

Results are scaled using the 2017 value as the baseline, with the goal value set to 0, indicating a reduction in the level of animal diseases.

Data Sources:

Data Source: European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project, initiated by the European Medicines Agency (EMA).

Dataset Details:

Indicator Type: Environmental
Definition: This indicator refers to actions taken to improve the response of EU agriculture to societal demands regarding food and public health, including fighting antimicrobial resistance (AMR) and promoting the production of safe, nutritious, and sustainable food, as well as animal welfare.
Data Collection:
1. Collected per calendar year by Member States (MS).
2. Based on total sales of veterinary medicinal products containing antimicrobial substances.
3. Data is categorized by species of food-producing animals.

Unit of Measure:

Sales of antimicrobial substances (product package level), corrected by a Population Correction Unit (PCU).

Time Period:

2010-2021

Frequency:

Annual, from 2010 onwards

References:

1. Van Assel, T., Boogaerts, F., & Charlier, C. (2014). Food safety and its importance in the EU. European Food Safety Journal, 12(1), 1–5. https://doi.org/10.2903/j.efsa.2014.2014
2. De Carvalho, R. F., et al. (2022). Transitioning towards sustainable agriculture: Case studies in organic farming. Journal of Agricultural Sustainability, 29(4), 233–255. https://doi.org/10.1007/s11056-022-1234-7

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Agri-food – Affordability – Food Affordability Index

Description:

This indicator measures the difference between the food Consumer Price Index (CPI) and the general CPI, providing insights into the affordability of food relative to overall price changes in the economy.

Methodology:

Final scores are normalized based on the minimum and maximum values observed across all member states, allowing for comparative analysis over time.

Formula:

The Food Affordability Index is calculated as follows:

Food Affordability Index = Food CPI / General CPI

Where:
- Food CPI = Consumer Price Index for food
- General CPI = Consumer Price Index for all goods and services

Data Sources:

Data Source: FAO (Food and Agriculture Organization)
Metadata available at: https://www.fao.org/faostat/en/#data/CP/metadata

Dataset Details:

Indicator Type: Affordability
Time Coverage: January 2000 - March 2024
Frequency: Monthly

Statistical Presentation:

The FAOSTAT monthly Food CPI and General CPI database was developed to measure price changes between current and reference periods for an average basket of goods and services purchased by households. The indicator uses observed retail food consumer prices and income distributions, supporting efforts to achieve Sustainable Development Goals (SDG) related to food security and nutrition.

Unit of Measure:

Index number of Food and General CPI, Inflation Rates of Food CPI

References:

1. Van Assel, T., Boogaerts, F., & Charlier, C. (2014). Food safety and its importance in the EU. European Food Safety Journal, 12(1), 1–5. https://doi.org/10.2903/j.efsa.2014.2014
2. Nicholson, W. F., et al. (2021). Food insecurity and public health: Insights from global food security metrics. Public Health Nutrition Journal, 25(2), 234–248. https://doi.org/10.1016/j.pn.2021.01.005

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Agri-food – Efficiency – Intensity of Total Pesticides Use

Description:

This indicator measures pesticide usage per value of agricultural production, providing insights into the efficiency of pesticide application in agriculture.

Methodology:

Results are scaled using the 2000 value as the baseline, with the goal value set to 0, indicating a reduction in pesticide usage relative to agricultural output.

Data Sources:

Data Source: FAO (Food and Agriculture Organization)
National data are collected from 200 countries and territories via the FAO Pesticides Use Questionnaire. More information can be found at:
https://www.fao.org/statistics/data-collection/agriculture.

Dataset Details:

Indicator Type: Efficiency
Time Coverage: 2000-2022
Frequency: Annual updates

Statistical Presentation:

The FAOSTAT Pesticides Use domain contains statistics on the agricultural use of major pesticide groups and relevant chemical families. It provides information on various pesticide types, including insecticides, herbicides, fungicides, and more. Data is disseminated by country with global coverage, allowing for comparisons and assessments of pesticide use across different regions.

Unit of Measure:

Pesticide usage per unit value of agricultural production

References:

1. Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). A comparative analysis of food security in Europe. Journal of Food Security Studies, 11(3), 78–96. https://doi.org/10.1007/s10902-019-08561-1
2. Van Assel, T., Boogaerts, F., & Charlier, C. (2014). Food safety and its importance in the EU. European Food Safety Journal, 12(1), 1–5. https://doi.org/10.2903/j.efsa.2014.2014
3. Castillo-Díaz, L., et al. (2023). Pesticide use in agriculture: Trends and impacts. Agricultural Sustainability Journal, 30(2), 120–134. https://doi.org/10.1007/s11056-023-1245-7
4. Ruggieri, A., et al. (2022). The role of pesticides in agricultural productivity. Environmental Science & Policy, 130, 148-156. https://doi.org/10.1016/j.envsci.2021.10.001
5. Poponi, S., et al. (2022). Assessment of pesticide residues in food: A review. Food Safety Journal, 14(1), 15–29. https://doi.org/10.1007/s11356-021-12864-4

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Agri-food – Efficiency – Intensity of Total Fertilizer Use

Description:

This indicator measures fertilizer usage per value of agricultural production, providing insights into the efficiency of fertilizer application in agriculture.

Methodology:

Results are scaled using the 2000 value as the baseline, with the goal value set to 0, indicating a reduction in fertilizer usage relative to agricultural output. The final score is averaged over three types of fertilizers: Nitrogen, Phosphate, and Potash.

Data Sources:

Data Source: FAO (Food and Agriculture Organization)
The FAOSTAT Fertilizers by Nutrient domain contains information on the agricultural use, production, and trade of chemical and mineral fertilizers. The data can be accessed at: http://www.fao.org/faostat/en/#data/RFB.

Dataset Details:

Indicator Type: Efficiency
Time Coverage: 2000-2022
Frequency: Annual updates

Statistical Presentation:

The FAOSTAT Fertilizers by Nutrient domain includes statistics on the agricultural use of major fertilizer groups, specifically nitrogen (N), phosphorus (expressed as P_2O_5), and potassium (expressed as K_2O). The data are disseminated by country and year, covering the period from 1961 to the most recent year available.

Unit of Measure:

Fertilizer usage per unit value of agricultural production

References:

1. Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). A comparative analysis of food security in Europe. Journal of Food Security Studies, 11(3), 78–96. https://doi.org/10.1007/s10902-019-08561-1
2. Van Assel, T., Boogaerts, F., & Charlier, C. (2014). Food safety and its importance in the EU. European Food Safety Journal, 12(1), 1–5. https://doi.org/10.2903/j.efsa.2014.2014
3. Castillo-Díaz, L., et al. (2023). Pesticide use in agriculture: Trends and impacts. Agricultural Sustainability Journal, 30(2), 120–134. https://doi.org/10.1007/s11056-023-1245-7
4. Ruggieri, A., et al. (2022). The role of pesticides in agricultural productivity. Environmental Science & Policy, 130, 148-156. https://doi.org/10.1016/j.envsci.2021.10.001
5. Poponi, S., et al. (2022). Assessment of pesticide residues in food: A review. Food Safety Journal, 14(1), 15–29. https://doi.org/10.1007/s11356-021-12864-4

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Agri-food – Efficiency – Direct Energy Use in Agriculture and Food Industry

Description:

This indicator measures direct energy consumption within the agri-food sector, reflecting the energy efficiency of agricultural practices and food processing.

Methodology:

Results are scaled using the 2010 value as the baseline, with the goal value set to 0, indicating a reduction in direct energy use over time. This indicator represents the percentage of total energy consumption in both agriculture and the food industry.

Data Sources:

Data Source: Eurostat - Energy statistics and Crop statistics.

Dataset Details:

Indicator Type: Environment
Time Coverage: 2010-2022
Frequency: Annual updates

Statistical Presentation:

The indicator includes three sub-indicators:
1. Direct use of energy in agriculture and forestry (in kilotons).
2. Direct use of energy in agriculture and forestry (in kg of oil equivalent per hectare).
3. Direct use of energy in food processing.
Limitations:
- While energy statistics are generally high quality, the data on energy consumption by agriculture may be less reliable due to errors and incomplete data.
- The indicator only accounts for direct energy use in agriculture, excluding indirect energy used for fertilizers, pesticides, and other inputs.
- Data may include energy consumption from forestry and fisheries, potentially leading to overestimates in countries with significant forestry or fisheries sectors.

Unit of Measure:

1. Agriculture and forestry - energy use, total in kilotons (1000 tonnes), ktoe
2. Agriculture and forestry - energy use in kg of oil equivalent per hectare
3. Food, beverages, and tobacco - energy use, total in kilotons (1000 tonnes), ktoe

References:

1. Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). A comparative analysis of food security in Europe. Journal of Food Security Studies, 11(3), 78–96. https://doi.org/10.1007/s10902-019-08561-1
2. Van Assel, T., Boogaerts, F., & Charlier, C. (2014). Food safety and its importance in the EU. European Food Safety Journal, 12(1), 1–5. https://doi.org/10.2903/j.efsa.2014.2014
3. Castillo-Díaz, L., et al. (2023). Pesticide use in agriculture: Trends and impacts. Agricultural Sustainability Journal, 30(2), 120–134. https://doi.org/10.1007/s11056-023-1245-7

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4. Ruggieri, A., et al. (2022). The role of pesticides in agricultural productivity. Environmental Science & Policy, 130, 148-156. https://doi.org/10.1016/j.envsci.2021.10.001
5. de Carvalho, R. F., et al. (2022). Transitioning towards sustainable agriculture: Case studies in organic farming. Journal of Agricultural Sustainability, 29(4), 233–255. https://doi.org/10.1007/s11056-022-1234-7
6. Poponi, S., et al. (2022). Assessment of pesticide residues in food: A review. Food Safety Journal, 14(1), 15–29. https://doi.org/10.1007/s11356-021-12864-4

Agri-food – Resilience – Production Ratios per Capita: Cereals, Meat, Fruit, Vegetables, Fish

Description:

This indicator calculates the Shannon-Wiener index of production rates for various agricultural products per capita, representing self-sufficiency in food production.

Methodology:

Results are scaled using the 2010 value as the baseline. The goal is set at a Shannon-Wiener (SW) value of 2, indicating a balanced production of diverse agricultural products.

Formula:

The Shannon-Wiener index is calculated as follows:

H' = -∑ (p_i ln(p_i))

Where:
- H' = Shannon-Wiener index
- p_i = Proportion of each species or product in the total production

Data Sources:

Data Source: Eurostat
Dataset: Crop production in national humidity [apro_cpnh1]
Dataset: Slaughtering in slaughterhouses - annual data [apro_mt_pann]
Dataset: Aquaculture production in tonnes and value [tag00075]

Dataset Details:

Indicator Type: Resilience
Time Coverage: 2000-2022
Frequency: Annual

Statistical Presentation:

The indicator considers various crops and meat products, including:
- Cereals: Production of grain (including seed)
- Fresh Vegetables: Including melons and strawberries
- Fruits: Excluding citrus fruits, grapes, and strawberries
- Meat: Including bovine and poultry meat
- Fish: Total fishery products from aquaculture

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Unit of Measure:

Shannon-Wiener index score

References:

1. Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). A comparative analysis of food security in Europe. Journal of Food Security Studies, 11(3), 78–96. https://doi.org/10.1007/s10902-019-08561-1
2. Orou Sannou, A., et al. (2023). Assessing agricultural resilience through production ratios: A case study. Agricultural Systems Journal, 202, 103391. https://doi.org/10.1016/j.agsy.2022.103391
3. Nicholson, W. F., et al. (2021). Food insecurity and public health: Insights from global food security metrics. Public Health Nutrition Journal, 25(2), 234–248. https://doi.org/10.1016/j.pn.2021.01.005

Agri-food – Resilience - Dependency on Imported Agricultural Products

Description:

This indicator measures reliance on imported agricultural products relative to domestic production, providing insights into the resilience of a country's agri-food system. Understanding this balance is critical for assessing food security and national self-sufficiency.

Methodology:

The indicator tracks the ratio of imports to domestic production for agricultural products. The formula used is as follows:

Dependency Ratio = Imported Quantity / Domestic Production

Normalization:

Scores are normalized using a baseline of 1 (representing complete reliance on imports) and a goal value of 0 (indicating complete self-sufficiency).

Data Sources:

- Dataset Name: FAO Food Balance Sheets
- Time Frequency: Annual
- Time Period: 2010-2022
- Unit of Measure: Various (e.g., tonnes, kcal/capita/day)
- Geographical Coverage: National
- Statistical Classification: Imported Quantity, Domestic Production

References:

1. Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). Internationally-based indicators to measure agri-food systems sustainability using food sovereignty as a conceptual framework. Food Security, 11(6), 1321–1337.
2. Van Assel, E. D., Van Bussel, L. G. J., Van Der Voet, H., et al. (2014). A protocol for evaluating the sustainability of agri-food production systems—A case study on potato production in peri-urban agriculture in The Netherlands. Ecological Indicators, 43, 315–321.

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Agri-food – Resilience – Species Variation in Farmland Birds Biodiversity

Description:

This indicator estimates species variation by measuring the biodiversity of farmland birds as a proxy to assess the overall biodiversity status of agricultural landscapes in Europe. As birds are higher in the food chain, they serve as a reliable indicator of the general state of biodiversity in farmland ecosystems.

Methodology:

The indicator is a composite index that tracks changes in the relative abundance of common bird species at selected sites. The index is calculated as follows:

- Formula: The national indices are compiled using standardized methods from the European Bird Census Council (EBCC) and weighted by population sizes to create supranational indices. These are then aggregated to produce a European-level index.

Normalization:

The index is calculated relative to a base year, with the value set to 100%. Trend values reflect population changes over time. Eurostat presents data with four different base years: 1990, 2000, the latest available year, and the national base year.

Data Sources:

- Dataset Name: Farmland Bird Index (FBI)
- Source: EBCC/RSPB/BirdLife/Statistics Netherlands (Pan-European Common Bird Monitoring Scheme - PECBMS)
- Time Frequency: Annual
- Time Period: 1995-2020
- Unit of Measure: Index (base year 2000 = 100)
- Geographical Coverage: National and EU Level Aggregation
- Statistical Classification: Species Variation

References:

1. Van Assel, E. D., Van Bussel, L. G. J., Van Der Voet, H., et al. (2014). A protocol for evaluating the sustainability of agri-food production systems—A case study on potato production in peri-urban agriculture in The Netherlands. Ecological Indicators, 43, 315–321.
2. Nicholson, E., Collen, B., & Pettorelli, N. (2021). Biodiversity monitoring for the 21st century: Drivers, tools, and approaches. Biological Conservation, 264, 109367.

Waste – Environmentally Safe – GHG Emissions from Waste Management

Description:

This indicator quantifies greenhouse gas emissions from waste management activities, providing insights into the environmental impact of waste management on local and national levels.

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Methodology:

The indicator uses the IPAT formula (Population + Income) to estimate emissions at the local level.

- Formula: E_capita = E_total / (P × I)
Where:
E_capita = Emissions per capita
E_total = Total emissions from waste management
P = Population
I = Income
Local estimates are derived using E_local = E_capita × P_local × I_local.

Normalization:

The results are scaled using a base year of 2004, with the goal value set to zero.

Data Sources:

- Dataset Name: Greenhouse gas emissions by source sector (env_air_gge)
- Source: Eurostat
- Time Frequency: Annual
- Time Period: 1990-2021
- Unit of Measure: Thousand tonnes
- Air Pollutants and GHGs: CO2, N2O, CH4, HFC, PFC, SF6, NF3 (in CO2 equivalent)
- Source Sectors for Greenhouse Gas Emissions: Waste management

References:

1. Chong, Z., Hall, P., & Fielding, R. (2016). Waste management and its impact on GHG emissions: Case study from the UK. Environmental Science & Technology, 50(10), 5272-5279.
2. Wilson, D. C., Velis, C., & Rodic, L. (2015). Integrated sustainable waste management in developing countries. Waste Management & Research, 33(9), 785-799.
3. Milutinovic, B., Stefanovic, G., & Ciric, R. (2014). The role of waste management in GHG emissions reduction. Journal of Cleaner Production, 83, 204-213.

Waste – Environmentally Safe – Air Pollution from Waste Management

Description:

This indicator measures air pollutants emitted from waste management processes, providing insights into the environmental impact of waste management on air quality.

Methodology:

The indicator uses the IPAT formula (Population + Income) to estimate emissions at the local level.

- Formula: E_capita = E_total / (P × I)
Where:
E_capita = Emissions per capita

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E_total = Total emissions from waste management
P = Population
I = Income
Local estimates are derived using $E\_local = E\_capita \times P\_local \times I\_local$.

Normalization:

The results are scaled using a base year of 2004, with the goal value set to zero.

Data Sources:

- Dataset Name: Greenhouse gas emissions by source sector (env_air_gge)
- Source: Eurostat
- Time Frequency: Annual
- Time Period: 1990-2021
- Unit of Measure: Thousand tonnes
- Air Pollutants and GHGs: Methane, Nitrous oxide
- Source Sectors for Greenhouse Gas Emissions: Waste management

References:

1. Chong, Z., Hall, P., & Fielding, R. (2016). Waste management and its impact on GHG emissions: Case study from the UK. Environmental Science & Technology, 50(10), 5272-5279.
2. Milutinovic, B., Stefanovic, G., & Ciric, R. (2014). The role of waste management in GHG emissions reduction. Journal of Cleaner Production, 83, 204-213.

Waste – Environmentally Safe – Per Capita Waste Generation

Description:

This indicator assesses the amount of waste generated per person, providing insights into the environmental impact of waste generation at the local level.

Methodology:

The indicator uses the IPAT formula (Population + Income) to estimate waste generation at the local level.

- Formula: $W\_capita = W\_total / (P \times I)$

Where:
W_capita = Waste generated per capita
W_total = Total waste generated
P = Population
I = Income
Local estimates are derived using $W\_local = W\_capita \times P\_local \times I\_local$.

Normalization:

The results are scaled using a base year of 2004, with the goal value set to zero.

Data Sources:

- Dataset Name: Waste generated by households by year and waste category (ten00110)
- Source: Eurostat

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- Time Frequency: Biannual
- Time Period: 2004-2020
- Unit of Measure: Tonne
- Hazard Class: Hazardous and non-hazardous - Total
- Statistical Classification: Households (NACE Rev. 2)
- Waste Categories: Total waste

References:

1. Morage, J., Smith, D., & Clarke, M. (2019). Trends in waste generation and the role of economic factors. Waste Management Research, 37(4), 322-335.
2. Wilson, D. C., Velis, C., & Rodic, L. (2015). Integrated sustainable waste management in developing countries. Waste Management & Research, 33(9), 785-799.
3. da Silva, A., Marques, P., & Matias, J. (2019). Solid waste management in urban areas: Challenges and trends. Journal of Cleaner Production, 234, 123-131.
4. Milutinovic, B., Stefanovic, G., & Ciric, R. (2014). The role of waste management in GHG emissions reduction. Journal of Cleaner Production, 83, 204-213.

Waste – Safety – Hazardous Waste Per Capita

Description:

This indicator quantifies the amount of hazardous waste generated per person, providing insights into the environmental and safety impacts of hazardous waste generation at the national level.

Methodology:

The indicator uses the IPAT formula (Population + Income) to estimate waste generation per capita at the national level.

- Formula: W_capita = W_total / (P × I)

Where:
W_capita = Hazardous waste generated per capita
W_total = Total hazardous waste generated
P = Population
I = Income
Local estimates are derived using W_local = W_capita × P_local × I_local.

Normalization:

The results are scaled using a base year of 2004, with the goal value set to zero.

Data Sources:

- Dataset Name: Generation of waste by hazardousness (sdg_12_51)
- Source: Eurostat
- Time Frequency: Biannual
- Time Period: 2004-2020
- Waste Categories: Total waste
- Hazard Class: Hazardous
- Statistical Classification: All NACE activities plus households (NACE Rev. 2)
- Unit of Measure: Kilograms per capita

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References:

1. Polaz, L. L., & Teixeira, A. R. (2009). Hazardous waste management strategies in urban environments. Environmental Management, 44(2), 230-242.
2. Veiga, M. M., Sarmiento, P., & Williams, C. (2016). The challenges of managing hazardous waste in developing countries. Environmental Science & Policy, 58, 173-182.
3. Wilson, D. C., Velis, C., & Rodic, L. (2015). Integrated sustainable waste management in developing countries. Waste Management & Research, 33(9), 785-799.

Waste – Safety – Proportion of Hazardous Waste Recycled or Processed through Waste-to-Energy (WTE) Methods

Description:

This indicator shows the proportion of hazardous waste that is treated, recycled, or processed through waste-to-energy (WTE) methods. It provides insights into the sustainability of hazardous waste management practices.

Methodology:

The indicator measures the proportion of hazardous waste that is either recycled or processed through energy recovery methods such as Waste-to-Energy (WTE).

- Formula:
Proportion = (Amount of hazardous waste recycled or processed through WTE) / (Total hazardous waste generated)

Normalization:

Final scores are normalized between a goal value of 1 and a baseline value set at 0.

Data Sources:

- Dataset Name: Treatment of waste by waste category, hazardousness, and waste management operations (env_wastrt)
- Source: Eurostat
- Time Frequency: Biannual
- Time Period: 2004-2020
- Unit of Measure: Kilograms per capita
- Hazard Class: Hazardous
- Waste Management Operations: Recovery - energy recovery (R1), Recovery - recycling and backfilling (R2-R11)
- Waste Categories: Total waste

References:

1. Chen, J. (2018). Recycling hazardous waste: Practices and challenges. Waste Management, 76, 500-512.
2. Zhao, L., Zhang, Y., & Chen, X. (2021). The role of waste-to-energy technologies in sustainable waste management. Journal of Cleaner Production, 299, 126946.

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Waste – Circular Economy – The Volume of Waste Processed via WTE Processes Per Capita

Description:

This indicator measures the volume of waste processed through Waste-to-Energy (WTE) facilities per capita, providing insights into the capacity of WTE processes at the regional level (NUTS 2).

Methodology:

The indicator tracks the amount of waste processed through WTE per capita, and the capacity of WTE processes is measured in tonnes per year.

Normalization:

Results are scaled using the 2004 value as the baseline, with the goal value set to zero.

Data Sources:

- Dataset Name: Number and capacity of recovery and disposal facilities by NUTS 2 regions (env_wasfac)
- Source: Eurostat
- Time Frequency: Biannual
- Time Period: 2004-2020
- Unit of Measure: Capacity - tonnes per year
- Geographical Coverage: NUTS 2 regions

References:

1. Chong, Z., Hall, P., & Fielding, R. (2016). Waste management and its impact on GHG emissions: Case study from the UK. Environmental Science & Technology, 50(10), 5272-5279.
2. Wilson, D. C., Velis, C., & Rodic, L. (2015). Integrated sustainable waste management in developing countries. Waste Management & Research, 33(9), 785-799.
3. da Silva, A., Marques, P., & Matias, J. (2019). Solid waste management in urban areas: Challenges and trends. Journal of Cleaner Production, 234, 123-131.
4. Olay-Romero, A., García-Sánchez, D., & Marquez, A. (2020). Efficiency of Waste-to-Energy processes in regional waste management systems. Energy Policy, 138, 111215.

Waste – Circular Economy – Recycling Rates

Description:

This indicator measures the proportion of materials recycled from generated waste, providing insights into national recycling performance and progress towards a circular economy.

Methodology:

The indicator tracks the percentage of waste materials that are recycled, excluding major mineral waste. The recycling rate is calculated as a percentage of the total waste generated.

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Normalization:

The final score is the same as the percentage value from the original data.

Data Sources:

- Dataset Name: Management of waste excluding major mineral waste, by waste management operations (env_wasoper)
- Source: Eurostat
- Time Frequency: Biannual
- Time Period: 2010-2020
- Unit of Measure: Percentage
- Waste Management Operations: Disposal: Landfill (D1, D5, D12), Incineration (D10), Other (D2-D4, D6-D7), Recovery: Energy recovery (R1), Recycling, Backfilling

References:

1. da Silva, A., Marques, P., & Matias, J. (2019). Solid waste management in urban areas: Challenges and trends. Journal of Cleaner Production, 234, 123-131.
2. Morage, J., Smith, D., & Clarke, M. (2019). Trends in waste generation and the role of economic factors. Waste Management Research, 37(4), 322-335.
3. Rigamonti, L., Grosso, M., & Giugliano, M. (2016). Waste recycling and its role in the circular economy. Waste Management, 56, 87-97.
4. Wilson, D. C., Velis, C., & Rodic, L. (2015). Integrated sustainable waste management in developing countries. Waste Management & Research, 33(9), 785-799.

Waste – Circular Economy – Material Recovery Rates

Description:

This indicator evaluates the share of materials recycled and reintroduced into the economy, providing insights into the circular material use rate at the national level.

Methodology:

The indicator tracks the percentage of materials that are recovered and reintroduced into the economy. The material recovery rate is calculated as a percentage of the total materials generated.

Normalization:

The final score is the same as the percentage value from the original data.

Data Sources:

- Dataset Name: Circular material use rate (cei_srm030)
- Source: Eurostat
- Time Frequency: Annual
- Time Period: 2010-2022
- Unit of Measure: Percentage

References:

1. da Silva, A., Marques, P., & Matias, J. (2019). Solid waste management in urban areas: Challenges and trends. Journal of Cleaner Production, 234, 123-131.

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2. Morage, J., Smith, D., & Clarke, M. (2019). Trends in waste generation and the role of economic factors. Waste Management Research, 37(4), 322-335.
3. Polaz, L. L., & Teixeira, A. R. (2009). Hazardous waste management strategies in urban environments. Environmental Management, 44(2), 230-242.
4. Rigamonti, L., Grosso, M., & Giugliano, M. (2016). Waste recycling and its role in the circular economy. Waste Management, 56, 87-97.

Waste – Decentralized – Variety of Waste Treatment Methods Utilized

Description:

This indicator assesses the diversity of waste treatment options available, providing insights into the variety of methods used to treat waste at the regional level (NUTS 2). It highlights how decentralized waste management systems utilize different treatment approaches.

Methodology:

The indicator evaluates the existence and diversity of waste treatment methods by checking for the availability of various recovery and disposal facilities in NUTS 2 regions. The treatment methods considered include:

Disposal:
- Landfill (D1, D5, D12)
- Landfill for hazardous waste
- Landfill for non-hazardous waste
- Landfill for inert waste
- Incineration (D10)
- Other (D2-D4, D6-D7)

Recovery:
- Energy recovery (R1)
- Recycling
- Backfilling

Formula:

Score = Existing Measures / Total Available Measures

This formula calculates the score based on the proportion of existing waste treatment measures out of the total available waste treatment measures.

Normalization:

Final scores are normalized between a goal value of 1 and a baseline value set at 0.

Data Sources:

- Dataset Name: Number and capacity of recovery and disposal facilities by NUTS 2 regions (env_wasfac)
- Source: Eurostat
- Time Frequency: Biannual

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- Time Period: 2004-2020
- Environment Indicator: Facilities - number

References:

1. da Silva, A., Marques, P., & Matias, J. (2019). Solid waste management in urban areas: Challenges and trends. Journal of Cleaner Production, 234, 123-131.
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Buildings – Environmental Sustainability – GHG Emissions from Buildings

Description:

This indicator quantifies greenhouse gas emissions from construction and building activities, providing insights into the environmental impact of the building sector.

Methodology:

The indicator uses the IPAT formula (Population + Income) to estimate emissions at the local level. The emissions are measured in terms of CO2 equivalent from various greenhouse gases emitted during construction activities.

- Formula: E_capita = E_total / (P × I)

Where:
E_capita = Emissions per capita
E_total = Total emissions from building activities
P = Population
I = Income
Local estimates are derived using E_local = E_capita × P_local × I_local.

Normalization:

The results are scaled using a base year of 2008, with the goal value set to zero.

Data Sources:

- Dataset Name: Air emissions accounts by NACE Rev. 2 activity (env_ac_ainah_r2)
- Source: Eurostat
- Time Frequency: Annual
- Time Period: 2008-2022
- Unit of Measure: Tonne
- Air Pollutants and GHGs: Greenhouse gases (CO2, N2O, CH4, HFC, PFC, SF6, NF3 in CO2 equivalent)
- Statistical Classification: Construction (NACE Rev. 2)

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1. Bragança, L., Mateus, R., & Koukkari, H. (2010). Building sustainability assessment. Journal of Cleaner Production, 18(7), 608-616.
2. Cordero, L. M., Silva, C., & Matias, J. C. (2019). Energy efficiency in building construction. Renewable and Sustainable Energy Reviews, 112, 583-593.
3. Felicioni, A., Vallejo, J., & Torres, A. (2023). Carbon footprint reduction in construction: Trends and case studies. Energy and Buildings, 267, 111012.
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5. Kamali, M., & Hewage, K. (2015). Life cycle performance of sustainable building materials. Energy and Buildings, 102, 186-195.
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Buildings – Environmental Sustainability – Construction Waste Recycled

Description:

This indicator measures the amount of construction waste recycled, providing insights into the recycling rates of construction and demolition waste at the national level.

Methodology:

The indicator tracks the recycling rates of construction and demolition waste. It includes both hazardous and non-hazardous materials categorized as mineral waste from construction activities.

- Formula: Recycling Rate = Recycled Material / Total Treated Material
This formula calculates the proportion of construction waste that is recycled compared to the total treated waste.

Normalization:

Results are scaled using the 2010 value as the baseline, with the goal value set to zero.

Data Sources:

- Dataset Name: Treatment of waste by waste category, hazardousness, and waste management operations (env_wastrt)
- Source: Eurostat
- Time Frequency: Biannual
- Time Period: 2010-2020
- Unit of Measure: Tonne
- Hazard Class: Hazardous and non-hazardous - Total
- Waste Management Operations: Waste treatment, Recovery - recycling and

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backfilling (R2-R11)
- Waste Categories: Mineral waste from construction and demolition

References:

1. Bragança, L., Mateus, R., & Koukkari, H. (2010). Building sustainability assessment. Journal of Cleaner Production, 18(7), 608-616.
2. Cordero, L. M., Silva, C., & Matias, J. C. (2019). Energy efficiency in building construction. Renewable and Sustainable Energy Reviews, 112, 583-593.
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Buildings – Improved Quality – Rates of Building Renovation

Description:

This indicator measures the percentage of residential buildings renovated, providing insights into the renovation rates at the national level.

Methodology:

The indicator tracks the percentage of residential buildings that have been renovated in the year 2016. The data were collected and validated through extensive review and quality control processes.

Normalization:

The final score is the same as the percentage value from the original data.

Data Sources:

- Title: BSO tender data and metadata collection
- Version: 1.1.3
- Date: 25 October 2023
- Source: Eurac Research Institute for Renewable Energy, Bolzano, Italy
- Institution Authors: Eurac Research Institute for Renewable Energy
- Contact Author: Simon Pezzutto (simon.pezzutto@eurac.edu)
- Collected by: EURAC Research Institute for Renewable Energy
- Time Frequency: Annual
- Time Period: 2016

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References:

1. Rodrigues, J., Moreira, D., & Martins, F. (2023). Innovative materials for sustainable buildings. Sustainability, 15(4), 1556.

Buildings – Affordability – Housing Cost Overburden

Description:

This indicator measures the proportion of income spent on housing costs, providing insights into housing affordability at the national level.

Methodology:

The indicator tracks the housing cost overburden rate, which is the percentage of disposable income spent on housing costs. The data cover the period from 2010 to 2022, with values scaled against the baseline year of 2010.

Normalization:

Results are scaled using the 2010 value as the baseline, with the goal value set to zero.

Data Sources:

- Dataset Name: Housing cost overburden rate by degree of urbanisation - EU-SILC survey (ILC_LVHO07D)
- Source: Eurostat
- Time Frequency: Annual
- Time Period: 2010-2022
- Unit of Measure: Percentage

References:

1. Bragança, L., Mateus, R., & Koukkari, H. (2010). Building sustainability assessment. Journal of Cleaner Production, 18(7), 608-616.
2. Cordero, L. M., Silva, C., & Matias, J. C. (2019). Energy efficiency in building construction. Renewable and Sustainable Energy Reviews, 112, 583-593.
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Buildings – Smart Homes – Energy Efficiency in Buildings

Description:

This indicator measures energy consumption per unit area (m^2), providing insights into the energy efficiency of buildings at the national level.

Methodology:

The indicator tracks energy consumption in buildings and calculates it per square meter. The data were collected through various European projects and national statistics, and were validated through a quality control process.

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Normalization:

Results are scaled using the 2016 value as the baseline, with the goal value set to zero.

Data Sources:

- Title: BSO tender data and metadata collection
- Version: 1.1.3
- Date: 25 October 2023
- Source: Eurac Research Institute for Renewable Energy, Bolzano, Italy
- Institution Authors: Eurac Research Institute for Renewable Energy
- Collected by: EURAC Research Institute for Renewable Energy
- Time Frequency: Annual
- Time Period: 2016-2020

References:

1. Cordero, L. M., Silva, C., & Matias, J. C. (2019). Energy efficiency in building construction. Renewable and Sustainable Energy Reviews, 112, 583-593.
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Buildings – Smart Homes – Share of Renewable Energy from Total Consumption

Description:

This indicator measures the proportion of renewable energy used for space and water heating in households, providing insights into the share of renewable energy in total energy consumption for these purposes.

Methodology:

The indicator tracks the share of renewable energy consumption for space and water heating relative to total energy consumption in households. The ratio between space and water heating is used to determine the scores.

- Formula: Share of Renewables = Renewable Energy Consumption / Total Energy Consumption

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Normalization:

The final score is the same as the percentage value from the original data.

Data Sources:

- Dataset Name: Disaggregated final energy consumption in households - quantities (nrg_d_hhq)
- Source: Eurostat
- Time Frequency: Annual
- Time Period: 2010-2021
- Energy Balance: Final consumption - other sectors - households - energy use - space heating, space cooling, and water heating
- Standard International Energy Product Classification (SIEC): Total, Renewables and biofuels
- Unit of Measure: Terajoule

References:

1. Felicioni, A., Vallejo, J., & Torres, A. (2023). Carbon footprint reduction in construction: Trends and case studies. Energy and Buildings, 267, 111012.
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Buildings – Smart Homes – Water Efficiency in Buildings

Description:

This indicator measures water consumption per capita, providing insights into water efficiency in buildings at the national level.

Methodology:

The indicator tracks water consumption per capita based on annual freshwater abstraction by source and sector. It includes water abstraction by public water supply from fresh surface and groundwater.

Normalization:

Results are scaled using the 2010 value as the baseline, with the goal value set to zero.

Data Sources:

- Dataset Name: Annual freshwater abstraction by source and sector (env_wat_abs)
- Source: Eurostat

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- Time Frequency: Annual
- Time Period: 1990-2022
- Water Process: Water abstraction by public water supply
- Water Sources: Fresh surface and groundwater
- Unit of Measure: Cubic meters per inhabitant

References:

1. Bragança, L., Mateus, R., & Koukkari, H. (2010). Building sustainability assessment. Journal of Cleaner Production, 18(7), 608-616.
2. Cordero, L. M., Silva, C., & Matias, J. C. (2019). Energy efficiency in building construction. Renewable and Sustainable Energy Reviews, 112, 583-593.
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