1.2. Avoided greenhouse gas emissions from reduced building energy consumption

Project Name: UNaLab (Grant Agreement no. 730052)

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Avoided CO_2 emissions related to building energy consumption	**Climate Resilience**
Description and justification	Building energy consumption is the fraction of greenhouse gas (GHG) emissions that can be affected by nature-based solutions in an urban environment.
Definition	CO_2 emissions related to building energy consumption (direct via, e.g., residential combustion and indirect via, e.g., electric heating and cooling) with and without NBS implementation (kWh/y and t C/y saved)
Strengths and weaknesses	+ Can be fairly easily measured + Indicates changes in building heating and cooling needs - Not sensitive to energy production details - Analysis can be lacking in accuracy and comparability between different communities and regions
Measurement procedure and tool	First, the community housing energy sources are identified and methods for their quantification on yearly basis are recorded (IPCC, 2006). These energy sources include electrical energy use, as well as supplemental energy sources such as district heating and local combustion for heating. Numerical values for the community as a whole (MWh), as well as population equivalent (MWh/person), are recorded, thus allowing for compensation for population change. All forms of energy need to be taken into account, including electricity consumption, natural gas or thermal energy for heating and cooling, and fuels. CO_2 emissions related to building energy consumption are calculated as follows: $$Emissions_{buildings} = Energy\ (MWh/a) \times National\ emission\ factor\ (t\ CO_2/MWh)$$ $$Decrease\ (\%) = 100\% - \left(\left(\frac{Emission_{buildings\ (after)}}{Emission_{buildings\ (before)}}\right) \times 100\%\right)$$

Scale of measurement	Building, street and district scale
Data source	
Required data	Information about building energy sources and electrical energy use, as well as supplemental energy sources such as district heating and local combustion for heating. These data can typically be obtained from municipal sources or from records of building- or district-level energy consumption from the building owner or utility company.
Data input type	Quantitative
Data collection frequency	Annually to enable tracking of changes to CO_2 emissions due to building energy consumption with time; at minimum before and after NBS implementation
Level of expertise required	Low – requires ability to follow the calculation procedure and to convert different units of energy to kWh of energy to achieve the total energy consumption
Synergies with other indicators	Possibility to combine with *CO_2 emissions related to vehicle traffic* indicator to obtain the total decrease due to NBS implementation
Connection with SDGs	SDG 11 Sustainable cities and communities, SDG 13 Climate action
Opportunities for participatory data collection	No opportunities identified
Additional information	
References	Intergovernmental Panel on Climate Change (IPCC). (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston, S., Buendia, L., Miwa, K., Ngara, T., & Tanabe, K. (Eds.). Hayama, Japan: Institute for Global Environmental Strategies (IGES). Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2006gl/.