

Greenhouse gases

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Abstract

Climate change is under way and there is much evidence that greenhouse gases emissions due to human activities are the most significant cause of global warming.

The European Commission has set ambitious targets and released in March 2011 a “Roadmap for moving to a competitive low carbon economy in 2050”. The targets set for the Power sector (electricity) and the Residential and Tertiary sector are challenging.

Climate change is widely considered as an issue of concern of sustainable development.

Building sector has a significant effect on the overall release of greenhouse gases because of human activities.

The indicator is included in important methods and standards that give (partly or fully) LCA/LCI based guidelines for the environmental or sustainability assessment of buildings and or building products.

Guidelines for assessment exist and there is good understanding about the effect of different significant factors.

Recent research results show that the relative and partly also absolute importance of embodied CO₂ increases. When the energy-performance of buildings is remarkably improved and when the power sector will use more renewable sources, the share of material related GHGs becomes significant.

GHG indicator for design and construction SBs is mature enough to be applied for the target setting, monitoring, and steering.

Methods, guidelines (standards) should be developed for the support the early stages of design (tools which work on with the help of simplified inputs).



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Greenhouse gases - Validity

Validity

- Changes in the atmospheric abundance of GHGs and aerosols, in solar radiation and in land surface properties alter the energy balance of the climate system.
- The primary source of the increased atmospheric concentration of CO₂ results from fossil fuel use (with land-use change providing another significant contribution).
- Climate change is widely considered as an issue of concern of SD (as addressed by UN, EU..).
- The construction industry is a large contributor to CO₂ emissions, with buildings responsible for one third of the total European CO₂ emissions (targets set for residential and power sector bigger than for other sectors) .



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Greenhouse gases

Indicator name / short description

- Weighted sum of greenhouse gases due to building, including its operation
- Unit: kg (or tonnes) per m² (net floor area) calculated either per year or total amount during the chosen period

Assessment method

- Quantity survey
- Energy consumption assessment
- Life cycle inventory of greenhouse gases
- Status of method: Guidelines and calculation methods presented in CEN standards (EN 15978)



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Greenhouse gases - Comparability

Comparability

- Functional equivalent
- System boundaries (stages of life cycle, parts of building)
- Data quality
- EN 15978 gives good guidelines

Parametric study: Role of materials and Significance of factors

- Starting point: Real case in Finland; 6 storey residential building
- Minimum and maximum values were searched by studying alternative solutions to produce same function
- Material and operation related impacts were compared



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Role of building materials

Role of building materials is increasing due to several factors

- Buildings are becoming more energy efficient
 - > the GHG emissions from material production increase in absolute terms
- Energy efficient buildings use less operational energy and cause less GHG emissions over their lifetimes
 - > the relative importance of GHG emissions of materials increase
- Use of renewable energy is expected to lead to less GHG emissions from energy production
 - > the relative importance of GHG emissions of materials increase



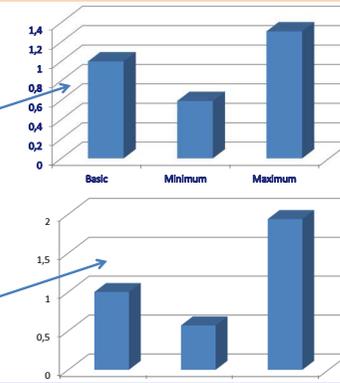
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Range of variation is significant

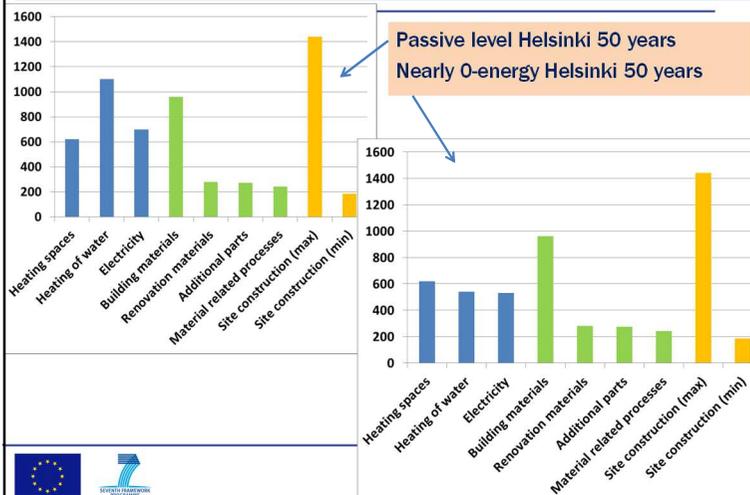
Similar spaces can be produced with varying GHG emissions

- The GHG emissions of a building with massive structures may cause 2.5 times the emissions of a building with light structures.
- If the possible variation of site quality is also considered the difference may be as high as 4-fold.



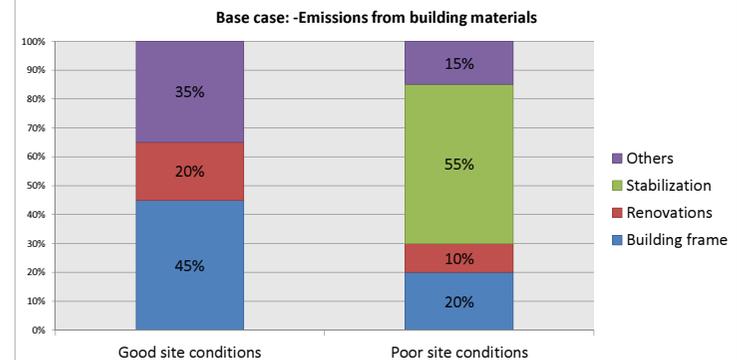
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Significance of different factors – base case



Importance of different factors

Site selection, frame type and renovations most important



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Importance of different factors

Recommendations

- Site selection should consider both accessibility and constructability
 - Poor site conditions may undo GHG reductions elsewhere
- The design process of the building frame should be guided in order to achieve low GHG emissions
 - The frame is the most important component when it comes to GHG emissions
- The renovations and material related processes over life-cycle are the biggest contributors to GHG emissions after building frame and site selection
 - Underlines the importance of durable and repairable structures



Discussion / conclusions

- GHG indicator for design and construction SBs is mature enough to be applied for the target setting, monitoring, and steering.
- Methods, guidelines should be developed for the support of early stages of design (tools which work with the help of simplified inputs).
- Embodied CO2 can vary significantly depending on the type of the solution and it may be significant compared to building operation related CO2. Should be considered when using the indicator.



Building systems

The importance rises when the systems become more complex

- In traditional buildings, the building systems' contribution to the GHG emissions of materials is almost insignificant
 - building systems contribute some 3% of the total GHG emissions of materials
- When the buildings have air-conditioning and solar energy systems, the situation changes
 - Building systems with AC and solar energy (PV and solar heat) systems may have a significant impact with a 20% share of the total emissions from materials
- Design of low-energy buildings with complex building systems should pay attention to GHG emissions of such systems



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Thank you for attention