

Consumption-based emissions, Kuopio

Kulma-model, April 2023

Introduction

In order to mitigate climate change, it is still essential to replace fossil fuels with renewable forms of energy and invest in energy efficiency and energy saving. In climate work, however, attention should also be turned to emissions caused by consumption.

According to estimates presented by the Finnish Environment Institute, it would be possible to achieve a 40-70 percent reduction in emissions by changing the consumption of services and products to low carbon alternatives. Reducing emissions from consumption requires socio-cultural changes in behavior, such as switching to a more plant-based diet. However, significant changes in consumption-based emissions also require changes in infrastructure and the adoption of technology.

Municipalities play a significant role in climate work together with the state level. Municipalities have the opportunity to support their residents make climate-friendly choices, for example by investing in public transport, school meals and offering low-emission district heating. In addition, communication and information sharing are ways that municipalities can use to make an impact.



Kulma calculation model

Calculation model and model development

The Kulma calculation model for consumption-based emissions divides emissions into five sectors: energy consumption, construction, transportation, food and goods and services. The sectors are further divided into more specific sub-sectors.

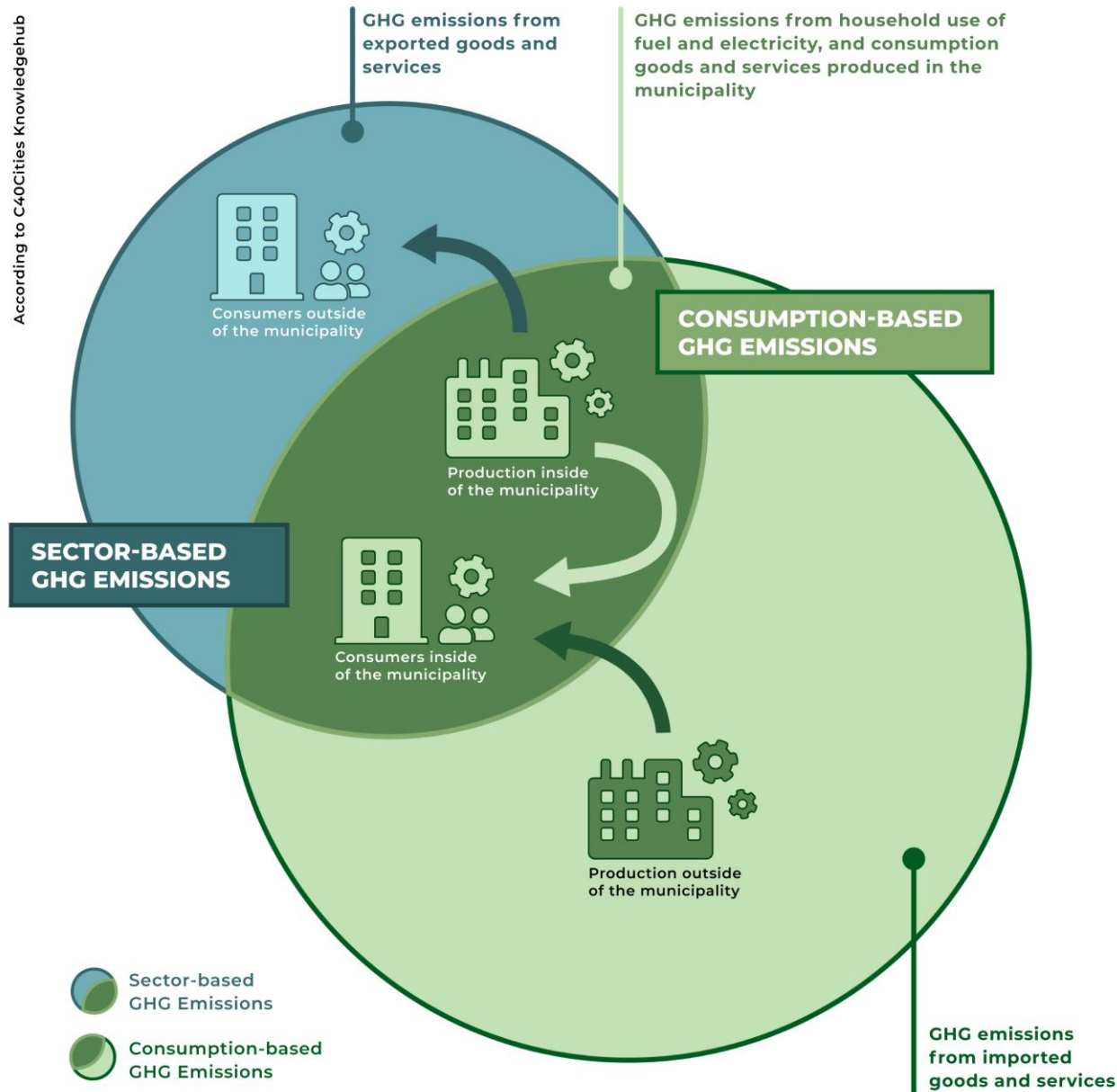
The calculation model developed in cooperation by Sitowise and Natural Resources Institute Finland is the first Finnish calculation model for consumption-based emissions, which has been comparably applied to a large number of municipalities. The calculation model was first piloted in a pilot project implemented in 2021. In the calculation round that ended in April 2023 consumption-based emissions were calculated for a total of 20 municipalities. The development of the model has been supported by a wide network of experts.

Why consumption emissions should be monitored

A broader knowledge base of greenhouse gas emissions caused by activities of the municipality and its citizens helps municipalities plan and target climate actions to reduce greenhouse gas emissions and measure the effects of implemented actions.

Citizens are a significant and very important stakeholder group when municipalities strive for carbon neutrality. However, it is often the effects of climate measures taken by citizens that are excluded from sector-based emission calculations. Consumption-based emission calculation aim to meet this challenge.

In some municipalities consumption-based greenhouse gas emissions may be significantly higher than sector-based greenhouse gas emissions. Calculating consumption-based greenhouse gas emissions therefore complements the information provided by sector-based greenhouse gas emission calculations.



Overlaps and differences between consumption-based and sector-based calculations

When talking about municipal greenhouse gas emissions, we often mean greenhouse gas emissions calculated using sector-based, regional, calculation models. Sector-based calculation models mainly cover emissions caused by energy consumption within the municipality and waste management, as well as other emissions occurring within the municipality's geographical area. For example, emissions from agriculture and product manufacturing in the municipality are included in the calculation, regardless of where the products are consumed. When calculating consumption-based greenhouse gas emissions, the calculation includes all emissions caused by the consumption of citizens, regardless of where the consumed goods were produced. For example, emissions from food and goods consumed by citizens are included in the calculation, even if the production of the products takes place outside the municipality's or Finland's borders.

Figure 1: Sector-based and consumption-based emission calculations partially overlap. They are not alternatives to each other but complement each other and together provide a broader knowledge base of greenhouse gas emissions caused by activities of the municipality and its citizens.

Table 1: Consumption-based emissions in total (kt CO₂ eq) by sector in 2020 and 2022.

| Greenhouse gas emissions from consumption, kt CO ₂ eq | 2020 | 2022 |
|---|----------------|----------------|
| Energy consumption | 279,5 | 294,0 |
| Electricity consumption | 63,9 | 62,0 |
| District heating | 146,5 | 159,6 |
| Oil, natural gas and wood heating | 60,7 | 64,1 |
| Cottage living (electricity consumption and wood burning) | 8,3 | 8,2 |
| Construction | 89,4 | 125,9 |
| New buildings | 61,3 | 78,1 |
| Streets and roads | 28,1 | 47,4 |
| Bridges | 0,0 | 0,5 |
| <i>Carbon handprint of construction (positive climate impact achieved by choices of building materials)</i> | -45,8 | -54,2 |
| Transportation | 184,1 | 190,7 |
| Passenger car traffic | 122,6 | 121,0 |
| Aviation, international | 54,3 | 54,9 |
| Aviation, national | | 4,9 |
| Waterborne navigation, international | 7,3 | 7,4 |
| Waterborne navigation, pleasure boats | | 2,6 |
| Food | 246,6 | 247,6 |
| Goods and services | 206,6 | 227,0 |
| Private sector consumption | 178,9 | 173,7 |
| Public sector consumption | 27,8 | 53,2 |
| Total | 1 006,3 | 1 085,2 |

Table 2: Consumption-based emissions per capita (t CO₂ eq/capita) by sector in 2020 and 2022.

| Greenhouse gas emissions from consumption, t CO ₂ eq/capita | 2020 | 2022 |
|---|--------------------|--------------------|
| Energy consumption | 2,32 | 2,42 |
| Electricity consumption | 0,53 | 0,51 |
| District heating | 1,22 | 1,31 |
| Oil, natural gas and wood heating | 0,51 | 0,53 |
| Cottage living (electricity consumption and wood burning) | 0,07 | 0,07 |
| Construction | 0,74 | 1,04 |
| New buildings | 0,51 | 0,64 |
| Streets and roads | 0,23 | 0,39 |
| Bridges | 0,00 | 0,00 |
| <i>Carbon handprint of construction (positive climate impact achieved by choices of building materials)</i> | -0,38 | -0,45 |
| Transportation | 1,53 | 1,57 |
| Passenger car traffic | 1,02 | 1,00 |
| Aviation, international | | 0,04 |
| Aviation, national | 0,06 | 0,06 |
| Waterborne navigation, international | | 0,02 |
| Waterborne navigation, pleasure boats | | 0,02 |
| Food | 2,05 | 2,04 |
| Goods and services | 1,72 | 1,87 |
| Private sector consumption | 1,49 | 1,43 |
| Public sector consumption | 0,23 | 0,44 |
| Total | <u>8,37</u> | <u>8,93</u> |

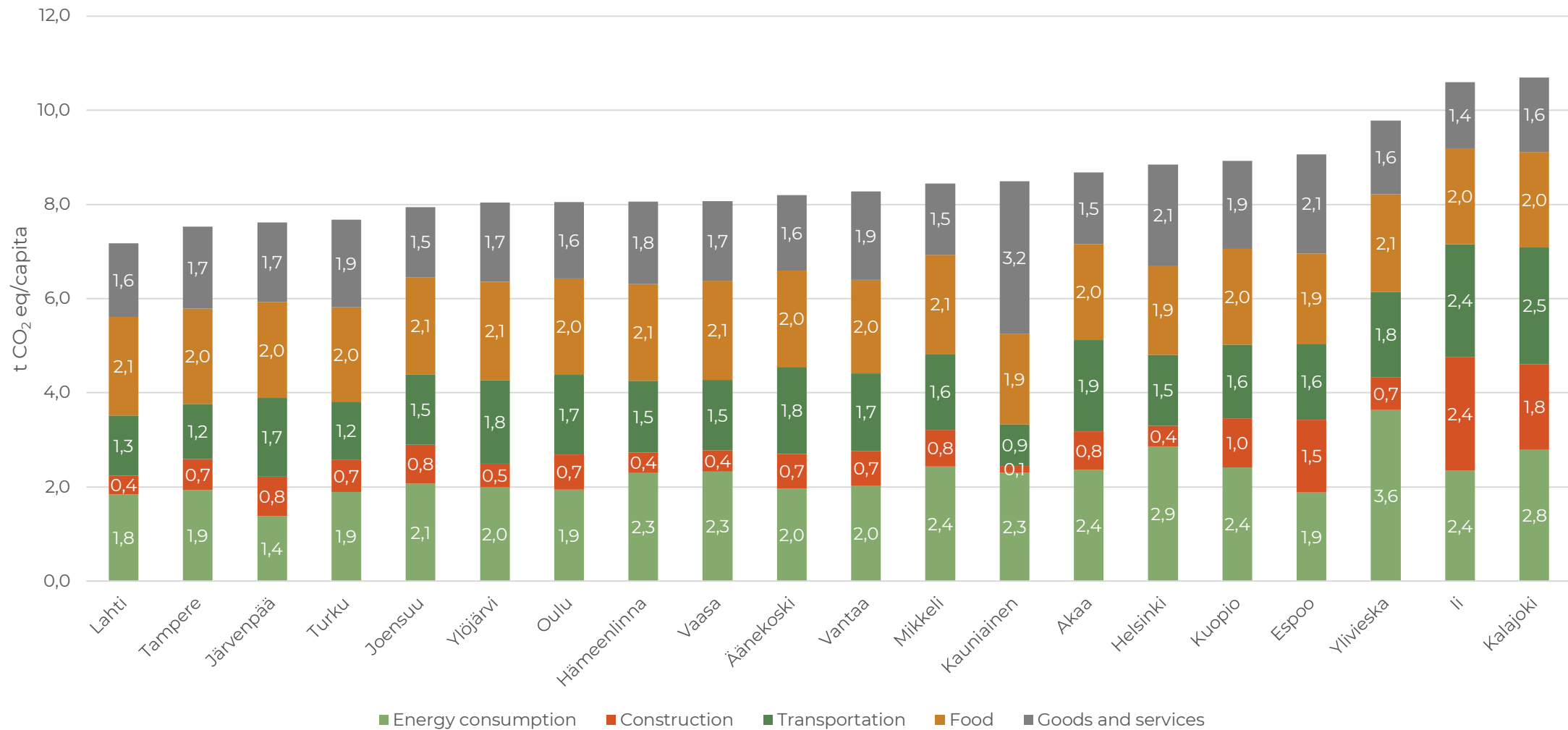


Figure 2: Consumption-based emissions of Kuopio and other Kulma-municipalities in year 2022 (t CO₂ eq/capita). The carbon handprint effect of construction is not shown in the picture.

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