



## THE DESCRIPTION OF THE MARTTI MATERIAL FLOW ACCOUNTING SYSTEM

### Background

Helsinki Region Environmental Services Authority has developed a system for compiling statistics to monitor the waste flows in the Helsinki Metropolitan Area. This system is called the Martti Material Flow Accounting. It compiles the statistics on all wastes generated annually in the metropolitan area (apart from wastes produced by agriculture and forestry) and monitors the various ways of treating them. The Martti system has been in use since 2007, and it can be found at [www.hsy.fi/martti](http://www.hsy.fi/martti).

The databank of the Martti Material Flow Accounting creates various yearly statistics as different schematic diagrams and tables. The most important statistics are published on HSY's web pages and are free to access. Information is also given for other environmental statistical purposes requested by HSY's member cities, for example.

Martti Material Flow Accounting system was further developed during 2010 as part of the Julia 2030 project. In this project the greenhouse gas emission calculation was developed in co-operation with Finnish Environment Institute. The calculation is based on the greenhouse gas emission factors for various types of waste. The factors include greenhouse gas emissions caused by waste transportation and treatment. The development of the factors was done by the Finnish Environment Institute, and the factors are specified for the waste management system in Helsinki Metropolitan Area. Julia 2030 project has gained EU Life+ funding.

### The waste statistics in the Martti Material Flow Accounting System

In Martti system the main branches, where waste is generated, are households, public services, private services, industry, energy and water resources management, electricity, gas and water supply, construction and civil engineering. The amount of waste generated in households and services is proportioned to the number of the population in the metropolitan area and the gross national product. On a most specific level, the source of waste generation is defined by Martti in 39 branches (table 1).

The waste amounts generated in service and industrial branches are estimated according to the branch-specific mean value information obtained from HSY's Waste Benchmarking Service Petra. Wastes generated by construction activities are estimated according to the appraised value set by the VTT Technical Research Centre of Finland. The estimations concerning the waste amounts generated by other branches are based on the information obtained from the environmental protection database VAHTI, operated by the environmental authorities.



Figure 1. The image capture from Martti Material Flow Accounting system concerning trends in waste generation in Helsinki metropolitan area in 2004-2008.

Martti follows mainly the waste classification according to EU Waste Statistics regulations. On a basic level, Martti has 55 waste categories. The main categories can be found in the Table 2. The system categorises the waste treatment in six different ways: recovery of material, material recovery in structures, composting and anaerobic degradation, recovery of energy, final disposal at landfills and other types of treatment.

Mining and quarrying	Sporting activities
Food industry	Recreational and cultural activities
Publishing	Other private services
Printing	Public administration offices
Chemical industry	Defence and judicial activities
Metal and machinery industry	Primary education
Electrical and electronics industry	General secondary education
Other industry	Technical and vocational secondary education
Electricity, gas and water supply	Higher education and other education
Construction of buildings	Hospitals
Civil engineering	Other health activities
Vehicle sales and repair	Nurseries
Wholesale of food	Social work activities with accommodation
Other wholesale	Other social work activities
Retail sale of food	Households
Other retail sale	Wholesale of waste and scrap
Hotels	Collection and treatment of sewage
Restaurants	Recycling
Catering	Collection and treatment of waste
Transport, storage and communication	Import of waste outside of Helsinki

*Table 1. The branches of industry used in Martti Material Accounting System, applied from the Standard Industrial Classification 2008.*

## **Greenhouse gas emissions in Martti Material Flow Accounting system**

The emission factors for different waste fractions are determined by the Finnish Environmental Institute and by HSY. The factors can be found in the table 2. The factors that Finnish Environmental Institute has calculated are marked with a star in table 2. More detailed description of these factors can be found in document "GHG emission factors for waste components produced, treated and recovered in the HSY area - Background document for the calculations" by Dahlbo, H., Myllymaa, T. and Korhonen, M-R.

Some factors were estimated by HSY. These were factors for rubber wastes and several mineral wastes. The transportation emission factors for these were determined by using LIPASTO - a calculation system for traffic exhaust emissions and energy consumption in Finland. The LIPASTO is developed by VTT Technical Research Centre of Finland. More information about these factors can be found in footnotes of the table 2.

Waste fraction	GHG coefficient, kg CO <sub>2</sub> e/t, produced emissions	GHG coefficient, kg CO <sub>2</sub> e/t, produced + avoided emissions	GHG coefficient for hazardous waste, kg CO <sub>2</sub> e/t
01.1 Spent solvents*	-	-	1400
01.2 Acid, alkaline or saline wastes*	-	-	1400
01.3 Used oils*	-	-	1400
01.4 Spent chemical catalysts*	-	-	1400
02 Chemical preparation wastes*	-	-	1400
03.1 Chemical deposits and residues*	-	-	1400
03.2 Industrial effluent sludges*	-	-	1400
05 Health care and biological wastes <sup>1</sup>	430	370	1400
06.1 Ferrous metal waste and scrap*	130	-970	-
06.2 Non-ferrous metal waste and scrap*	130	-970	-
06.31 Mixed metallic packing*	130	-970	-
06.32 Other mixed metallic wastes*	130	-970	-
07.11 Glass packaging wastes*	570	-170	-
07.12 Other glass wastes*	570	-170	-
07.21 Waste paper and cardboard packaging*	70	-70	-
07.23 Other paper and cardboard wastes*	1050	-420	-
07.3 Rubber wastes <sup>2</sup>	17	17	-
07.41 Plastic wastes*	70	-80	-
07.42 Other plastic wastes*	70	-80	-
07.51 Wood wastes*	40	-850	1400
07.52 + 07.53 Other wood wastes*	40	-850	1400
07.6 Textile wastes <sup>3</sup>	530	-620	1400
07.7 Waste containing PCB	-	-	1400
08.2 Discarded electrical and electronic equipment*	60	-1910	60 <sup>4</sup>
08.41 Batteries and accumulator wastes <sup>4</sup>	-	-	60 <sup>4</sup>
08.43 Other discarded machines and equipment components	-	-	60 <sup>4</sup>
09.11 Animal waste of food preparation and products*	60	20	1400
09.12+09.13.Vegetal and mixed wastes of food preparation and products (excluding animal waste of food preparation and products; and excluding animal faeces, urine and manure)*	60	20	-
09.2 Green wastes*	60	20	-
09.3 Slurry and manure <sup>5</sup>	50	-50	-

Waste fraction	GHG coefficient, kg CO <sub>2</sub> e/t, produced emissions	GHG coefficient, kg CO <sub>2</sub> e/t, produced + avoided emissions	GHG coefficient for hazardous waste, kg CO <sub>2</sub> e/t
10.1 Household and similar wastes, landfilling*	430	370	-
10.12 Street-cleaning residues <sup>1</sup>	430	370	-
10.21 Mixed packaging (energy waste)*	530	-620	-
10.22 Other mixed and undifferentiated materials <sup>1</sup>	430	370	-
10.3 Sorting residues <sup>1</sup>	430	370	-
11.1+11.2+11.4 Common sludges (excluding dredging spoils)*	50	-50	-
11.3 Unpolluted dredging spoils <sup>6</sup>	1	1	-
12.11 Concrete, bricks and gypsum waste <sup>6</sup>	1	1	-
12.12 Waste hydrocarbonised road-surfing materials <sup>6</sup>	1	1	1
12.13 Mixed construction wastes*	100	-120	-
12.2 Asbestos wastes	-	-	1
12.3 Waste of naturally occurring minerals <sup>6</sup>	1	1	1
12.41 Waste from flue gas purification <sup>6</sup>	4	4	4
12.42a Bottom ash from waste incineration <sup>6</sup>	1	1	1
12.42b Slag and fly ash from waste incineration <sup>6</sup>	1	1	1
12.42c Ash, slag and boiler dust from other than waste incineration <sup>6</sup>	4	4	4
12.42d Slag and ash from thermal treatment <sup>6</sup>	4	4	4
12.5 Various mineral wastes <sup>6</sup>	3	3	3
12.61 Polluted soils and rubble <sup>6</sup>	4	4	4
12.62 Polluted dredging spoils <sup>6</sup>	4	4	4
13 Solidified, stabilised or vitrified wastes <sup>6</sup>	1	1	1
14 Other wastes <sup>1</sup>	430	370	1400

Table 2. EWC-Stat- classes used in the Martti Material Flow Accounting System and the greenhouse gas emission factors.

\*: Based on calculations made in Finnish Environment Institute. More information can be found in <http://www.hsy.fi/julia2030/en/project/waste/Pages/default.aspx>

1: Factors are rough estimations based on the factors of the landfilled household waste when non-hazardous waste, and the factor is based on the factor of incinerated hazardous waste, when the waste is hazardous. Factors will be specified when more detailed information is available.

2: Greenhouse gas emission factor calculated for rubber wastes including waste transportation and management, but not avoided emissions. Waste management causes 14 kg CO<sub>2</sub>e and transportation 3 kg CO<sub>2</sub>e. Waste management information from Jari Väinölä, Kuusakoski Oy, Turku. Transportation emissions calculated using VTT's LIPASTO – system.

3: Rough estimations based on the factors of the mixed packaging. Factors will be specified when more detailed information is available.

4: Rough estimations based on the factors of the discarded electrical and electronic equipment. Factors will be specified when more detailed information is available.

5: Rough estimations based on the factors of the common sludge. Factors will be specified when more detailed information is available.

6: Greenhouse gas emission factors calculated for transport only by using LIPASTO - a calculation system for traffic exhaust emissions and energy consumption in Finland. GHG factor 0,0657 kg CO<sub>2</sub>e-km, assumptions: earth moving lorry, full loaded, gross vehicle mass 32 t, urban driving 50%. The LIPASTO is developed by VTT Technical Research Centre of Finland. Assumed transportation distances vary depending on the waste fraction.

Greenhouse gas emissions in Martti are determined automatically, when the produced waste amounts are filled in. The GHG emissions are shown in several diagrams, bar charts and tables in Martti. Both produced and both produced plus avoided greenhouse gas emissions are shown in Martti.

Greenhouse gas emissions are shown in following charts:

- Greenhouse gas emissions caused by waste in Helsinki metropolitan area in 2004-2008, pie diagram and bar chart
- Greenhouse gas emissions caused by household waste in 2004-2008, bar chart
- Greenhouse gas emission caused by household wastes in 2008, table
- Greenhouse gas emission caused by waste generated in private services in Helsinki metropolitan area in 2004-2008, bar chart
- Greenhouse gas emission caused by waste generated in public services in Helsinki metropolitan area in 2004-2008, bar chart
- Greenhouse gas emissions caused by municipal waste in 2004-2008, bar chart

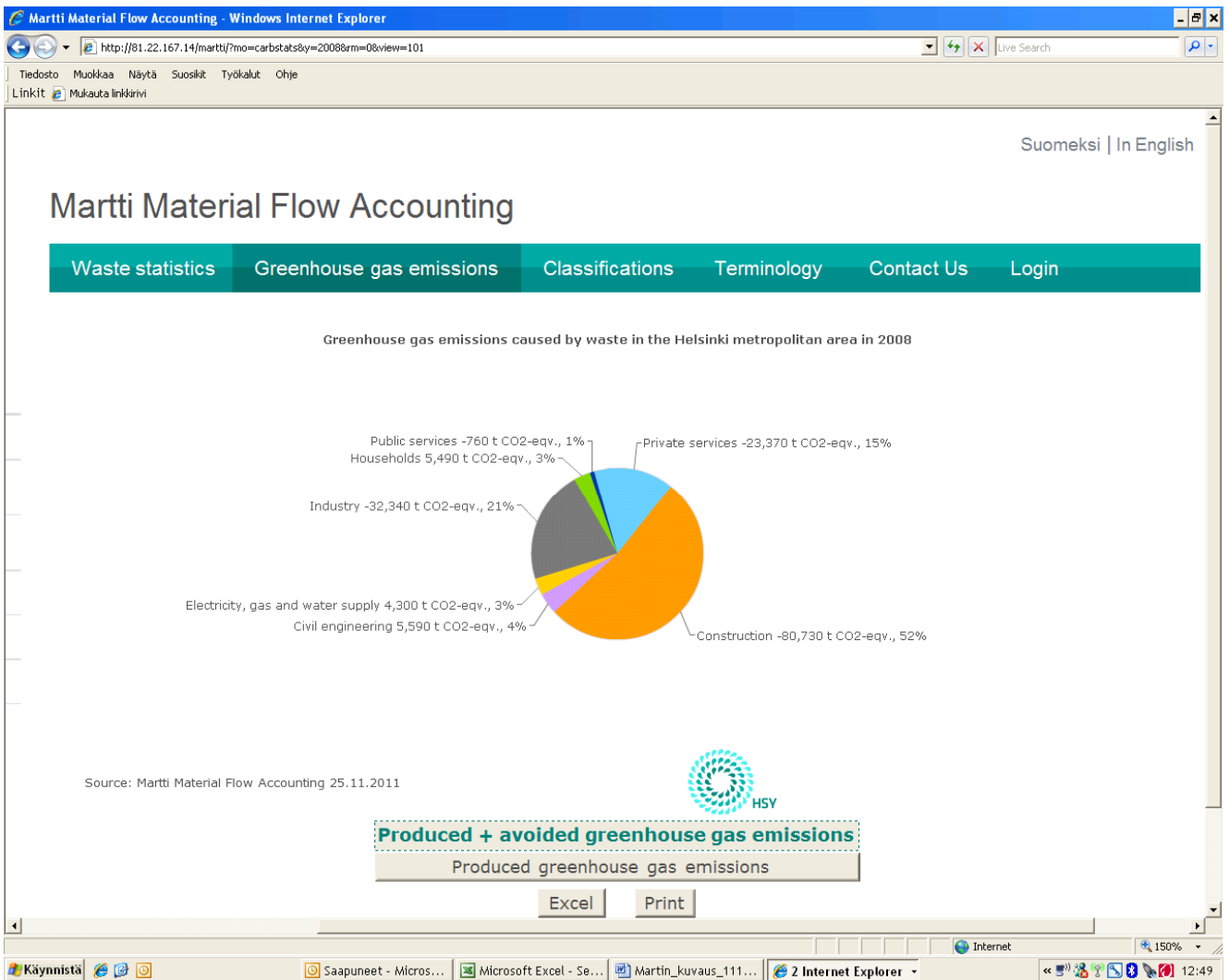


Figure 2. The image capture from Martti Material Flow Accounting system concerning greenhouse gas emissions caused by waste in Helsinki metropolitan area in 2008, produced plus avoided emissions.



Figure 3. The image capture from Martti Material Flow Accounting system concerning greenhouse gas emissions caused by municipal waste in Helsinki metropolitan area in 2008, produced plus avoided emissions.