



Climate-proof **city**

DEVELOPING A GREEN FACTOR TOOL FOR THE CITY OF HELSINKI

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1 BACKGROUND AND GOALS

Urban development reduces the amount of green areas in cities. Urban green space plays a vital role in the adaptation to climate change e.g. by reducing stormwater impacts, air pollution, and urban heat islands. The goal of the green factor approach is to mitigate the effects of construction by maintaining a sufficient level of green infrastructure while enhancing the quality of the remaining vegetation. The green factor is calculated as the ratio of the scored green area to lot area (Figure 1, left). Various green factor approaches with the same basic concept have been developed previously e.g. in Berlin, Malmö, Stockholm, Seattle, and Toronto.

The development of the **Helsinki Green Factor** is part of the *Climate-Proof City – Tools for Planning* (ILKKA) project. The aim of ILKKA is to create planning tools and best adaptation practices for urban planners and the construction and landscape industry regarding climate-proof urban planning. The ILKKA project is coordinated by the City of Helsinki and implemented during the years 2012-2014. The Helsinki Green Factor method was developed by Eero Paloheimo Ecocity Ltd (EPECC) and the Finnish Consulting Group (FCG).

$$\text{Green factor} = \frac{\text{scored green area}}{\text{lot area}}$$



FIGURE 1: CALCULATION OF THE GREEN FACTOR¹ (LEFT); VISUALIZATION OF THE GREEN FACTOR APPLIED TO THE KUNINKAANTAMMI PILOT AREA (RIGHT)

2 DEVELOPMENT

The specific phases for developing the Helsinki Green Factor included:

1. Comprehensive literature review on relevant topics; interviews and surveys with experts and developers of previous green factor methods

2. Establishing the list of green factor elements commonly used in urban planning to be included in the tool; calculating weighted scores for each element based on their importance to ecology, functionality, landscape, and maintenance
3. Developing a land use classification for identifying the correct levels of target and minimum green factor scores; setting specific target and minimum (required) levels for each land use class while factoring in regional and lot-specific attributes
4. Creating the Green Factor Tool, a user-friendly Excel interface guiding the user through the green factor calculation
5. Creating illustrative visualizations of specific green factor levels for the Kuninkaantammi pilot area
6. Testing the method in Kuninkaantammi and Jätkäsaari pilot areas (residential blocks); an interactive workshop for testing the Green Factor Tool

Element Scoring Approach

In developing the Helsinki Green Factor, we ran a thorough comparison of previous green factor approaches and included the best practices and applicable green factor elements. We conducted surveys with various groups of experts (e.g. land-use planners, landscape architects, developers, and environmental specialists). Based on the results, we added new elements found to be important for the City of Helsinki and did a thorough re-evaluation of element scoring to reflect the suitability of each element for local conditions and values.

We used a scientifically based, systematic scoring approach to determine “individual scores” (0-3) for the green factor elements, assessing the value of each element for ecology (e.g. stormwater purification and reduction, carbon sequestration, biodiversity), functionality (e.g. amiable microclimate, recreation, environmental education), landscape (e.g. amenity value, prominent landscape features), and maintenance (annual maintenance) (Figure 2).

One of the essential questions included in the survey concerned the relative importance of the four categories of ecology, functionality, landscape, and maintenance to the green factor scoring. From the results, the so called “expert score” was calculated. The survey valued ecological (1,6/3) and functional goals (1,5/3) considerably more important than landscape (0,8/3) and maintenance (0,7/3), reflecting the true values and goals for developing green infrastructure in the City of Helsinki.

The final score of an element, visible to users in the Green Factor Tool, is a weighted average of the individual score multiplied by the “expert score” across all four categories (Figure 2).

"Expert score"	Ecology	Functionality	Landscape	Maintenance		
	1,6	1,5	0,8	0,7		
* Weighting *						
"Individual Score"	Ecology	Functionality	Landscape	Maintenance	Weighted average	
<i>Large remaining tree > 10 m; à 25 m²</i>	3,0	3,0	3,0	2,5	3,4	

FIGURE 2: AN EXAMPLE OF THE SYSTEMATIC APPROACH FOR CALCULATING THE TOTAL SCORE (WEIGHTED AVERAGE) OF EACH ELEMENT

Developing Target and Minimum Levels

Different land use functions have different needs and boundary conditions with regard to urban green space. One of the main outcomes of the surveys was that city officials, land-use planners, and experts found it very important to develop land-use specific *target and minimum levels* for the Helsinki Green Factor. Four land-use classes were included: residential, services, commercial, and industrial/logistics (Table 1). Each land-use class has a target level that sets the goal for the green factor score; and a minimum level that is required of the land-use. The range between target and minimum levels, e.g. 0,8 –

0,5 (residential), allows the consideration of regional and lot-specific factors that may limit the available space for green surfaces or set specific requirements for the quality of the green surface.

TABLE 1: TARGET AND MINIMUM LEVELS FOR LAND-USE CLASSES

Land use class	Target level	Minimum level
1 Residential	0,8	0,5
2 Services	0,7	0,4
3 Commercial	0,6	0,3
4 Industrial / logistics	0,5	0,2

Limiting factors include the availability of non-built surface (represented by the ratio of building footprints to lot size), yard type (inner courts, decks), soil depth, groundwater level, and small-scale renewable energy systems (e.g. windmills, solar panels). These factors allow 0,1 to 0,2 reductions to the lot's target level. Requirements to preserve some reminiscent vegetation (e.g. a remaining tree or soil) may follow at close proximity to specific environmental conditions, e.g. water bodies, protection areas, or green corridors. Also, if the area lacks sufficient stormwater piping, a stormwater solution (e.g. rain garden, detention pond) may be required. However, if there are no limiting factors or environmental conditions present in the area, the minimum level is equal to the target level.

3 GREEN FACTOR TOOL

The Excel-based Green Factor Tool has a straight-forward user interface that guides the user through the three phases of green factor assessment: 1) Setting the target and minimum levels; 2) Calculating the green factor; 3) Score card (Figure 3).



FIGURE 3: FLOW OF CALCULATION USING THE GREEN FACTOR TOOL

Phase 1: Setting Target and Minimum Levels

In the first phase of green factor assessment, the user defines general information (e.g. lot area, building footprint, id number) and lot attributes (e.g. land-use class, yard type, stormwater systems, environmental factors) for the lot. As a result, the tool calculates the target and minimum level, and determines whether specific element groups are required in the lot (Figure 4).

Rajaukset	Nro	Kysymys	Vastaus
Rakennuskohde	1	Oinko kyseessä uudisrakennuskohde?	<input type="checkbox"/> Kyllä <input type="checkbox"/> Ei
Maankäyttö	2	Asuinalueet	<input type="checkbox"/>
		Palvelujen alueet	<input type="checkbox"/>
Pihatyypit	3	Kaupunki- ja liikenäkennämissen alueet	<input type="checkbox"/>
		Teollisuuslaitosten ja logistiikan alueet	<input type="checkbox"/>
Viemäriverkosto	4	Oinko kyseessä ympäristö?	<input type="checkbox"/> Kyllä <input type="checkbox"/> Ei
		Kansijäljän osuus alle 25 % (ei vaikutusta)	<input type="checkbox"/>
Ympäristöalueet	5	Kansijäljän osuus 25-75 %	<input type="checkbox"/>
		Kansijäljän osuus yli 75 %	<input type="checkbox"/>
Maaperä/pohjavesi	6	Oinko tontilla mahdollisuutta liittyä ennalleselvityksiin?	<input type="checkbox"/> Kyllä <input type="checkbox"/> Ei
		Oinko $S \le 50$ m etäisyydellä tontista luonnonsuojelualuetta/vesistöä/luonnonsuojelusta koostuvaa viherkäytävää?	<input type="checkbox"/> Kyllä <input type="checkbox"/> Ei
Energjaratkaisut	7	Oinko läpäsennätön maaperä/pohjavesi keskimäärin vähintään 100 cm maanpinnan alapuolella?	<input type="checkbox"/> Kyllä <input type="checkbox"/> Ei
		Oinko tontilla tilaa viedä uusituvan energian tuotantoratkaisuja (esim. aurinkopaneeli, pientuulivoimala)?	<input type="checkbox"/> Kyllä <input type="checkbox"/> Ei

Tavoitetaso	0,8
Minimitaso	#JAKO/01
Elementtikohtaiset minimitasot	-
Korttelinumero	-
Tonttinumero	-
Tontin pinta-ala, m ²	-
Rakennusten peittopinta-ala, m ²	-
Kerrosala, k-m ²	-
Rakennusten peittopinta-ala suhteessa tontin pinta-alaan	#JAKO/01
Kerrosalan suhde tontin pinta-alaan	#JAKO/01

FIGURE 4: PHASE 1 – SETTING THE TARGET AND MINIMUM LEVELS FOR THE GREEN FACTOR: 1) DATE, 2) INSTRUCTIONS, 3) ATTRIBUTES, 4) TARGET AND MINIMUM LEVELS, AND REQUIRED ELEMENTS, 5) LOT ID NUMBER AND NAME, 6) LOT SIZE, BUILDING FOOTPRINT, AND FLOOR AREA, 7) CALCULATED EFFICIENCY FACTORS

Phase 2: Calculating the Green Factor

Next, the user will fill in the green factor element table to calculate the green factor score. The total green factor score is updated with each change to the element table. More information about the elements can be found by clicking the buttons next to element groups (Figure 5).

FIGURE 5: PHASE 2 - CALCULATING THE GREEN FACTOR: 1) THE TOTAL GREEN FACTOR SCORE AND TARGET AND MINIMUM LEVELS, 2) LOT AREA AND SCORED GREEN AREA, 3) DATE OF ASSESSMENT AND LOT ID, 4) ELEMENTS, 5) UNIT, 6) COLUMN TO BE FILLED BY THE USER, 7) ELEMENT SCORE, 8) SCORED AREA/ELEMENT, 9) BUTTON FOR MORE INFORMATION, 10) BUTTON FOR INSTRUCTIONS, 11) NAVIGATION BUTTON

1.		2.		3.		4.		5.	6.	7.	8.
Vihkerroin	Elementti-tyyppi	Yksikkö	Pinta-ala tai lukumäärä	Painotus	Painotettu pinta-ala, m ²						
0,9	Säilytettävä kasvillisuus	kgf	3,4	0,0	0,0						
0,8	Istutettava kasvillisuus	kgf	3,0	0,0	0,0						
0,7	Pinnotteet	kgf	2,3	0,0	0,0						
0,7	Hulevesien hallintarakenteet	kgf	2,1	0,0	0,0						
0,7	Bonus-elementit	kgf	2,3	0,0	0,0						
	Istutettava / kylvettävä kasvilaji	kgf	2,7	0,0	0,0						
	Parviokas	kgf	2,2	0,0	0,0						
	Parviokas	kgf	1,7	0,0	0,0						
	Parviokas	kgf	1,5	0,0	0,0						
	Parviokas	kgf	1,6	0,0	0,0						
	Parviokas	kgf	1,8	0,0	0,0						
	Parviokas	kgf	2,2	0,0	0,0						
	Parviokas	kgf	1,1	0,0	0,0						
	Parviokas	kgf	1,8	0,0	0,0						
	Parviokas	kgf	1,3	0,0	0,0						
	Parviokas	kgf	1,5	0,0	0,0						
	Parviokas	kgf	1,1	0,0	0,0						
	Parviokas	kgf	1,0	0,0	0,0						
	Parviokas	kgf	1,3	0,0	0,0						
	Parviokas	kgf	2,5	0,0	0,0						
	Parviokas	kgf	1,9	0,0	0,0						
	Parviokas	kgf	1,4	0,0	0,0						
	Parviokas	kgf	2,6	0,0	0,0						
	Parviokas	kgf	1,7	0,0	0,0						
	Parviokas	kgf	1,2	0,0	0,0						
	Parviokas	kgf	0,9	0,0	0,0						
	Parviokas	kgf	0,9	0,0	0,0						
	Parviokas	kgf	1,0	0,0	0,0						
	Parviokas	kgf	1,0	0,0	0,0						
	Parviokas	kgf	1,1	0,0	0,0						
	Parviokas	kgf	1,1	0,0	0,0						
	Parviokas	kgf	1,0	0,0	0,0						
	Parviokas	kgf	1,0	0,0	0,0						
	Parviokas	kgf	1,1	0,0	0,0						
	Parviokas	kgf	1,1	0,0	0,0						
	Parviokas	kgf	1,0	0,0	0,0						
	Parviokas	kgf	1,0	0,0	0,0						
	Parviokas	kgf	1,1	0,0	0,0						
	Parviokas	kgf	1,1	0,0	0,0						
	Parviokas	kgf	0,9	0,0	0,0						
	Parviokas	kgf	0,8	0,0	0,0						
	Parviokas	kgf	0,6	0,0	0,0						
	Parviokas	kgf	0,7	0,0	0,0						
	Parviokas	kgf	1,2	0,0	0,0						
	Parviokas	kgf	0,8	0,0	0,0						

Phase 3: Score Card

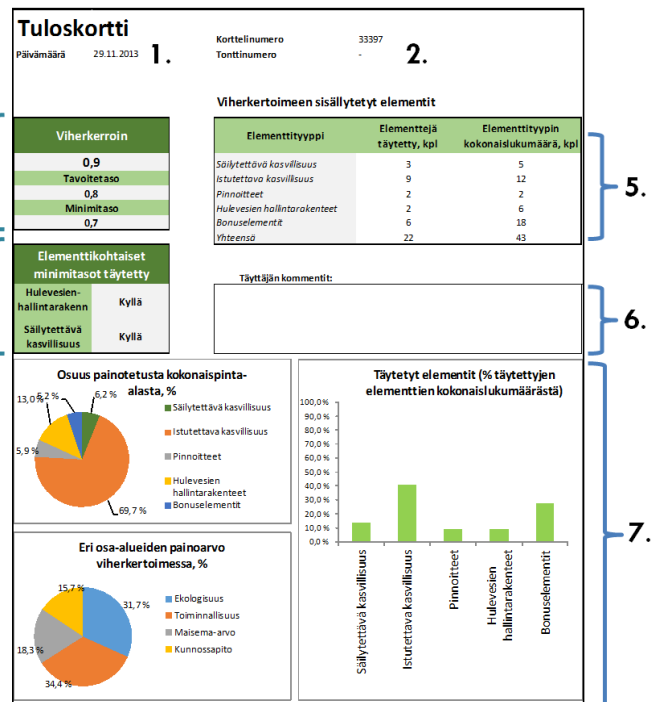
The printable green factor score card presents the essential results and summary statistics of the assessment, including the date and lot id, green factor score, target and minimum levels, summary of used elements, user comments, and graphs visualizing the results (Figure 6).

Testing the Green Factor Tool

The Green Factor Tool was tested at the workshop arranged for city officials, land-use planners, and environmental experts in Fall 2013. Useful feedback was received for improving the tool. Overall, the tool was found straight-forward and easy to use.

Different stakeholders found different functions of the tool useful: Land-use planners could mostly see themselves using Phase 1 of the assessment in their work while landscape architects found Phases 2 and 3 important for their line of work.

FIGURE 6: PHASE 3 – SCORE CARD: 1) DATE, 2) LOT ID, 3) GREEN FACTOR SCORE, TARGET LEVEL, AND MINIMUM LEVEL, 4) ELEMENT-SPECIFIC MINIMUM LEVELS, 5) SUMMARY OF ELEMENTS USED IN LOT, 6) COMMENTS/NOTES BY USER, 7) GRAPHS PRESENTING RESULTS.



4 PILOT AREA: KUNINKAANTAMMI

The Kuninkaantammi pilot area was selected for testing the Helsinki Green Factor in practice and visualizing various levels of green factor. The Kuninkaantammi lot (id 33397) is a residential block consisting of buildings of 2-6 floors with a total floor area of 10 800 m² on a lot of 9 500 m². The plan has several environmental goals and requirements (e.g. stormwater solutions, green roofs, and remaining

trees) and is thus more ecological than the average land-use plan in Helsinki. Phase 1 of the green factor assessment resulted in a target level of **0,8**, minimum level of **0,7**, and a requirement to preserve at least one remaining element in the lot due to the bordering green corridor.

Three different options for yard design were explored and assessed, comprising of different levels of vegetation cover and various element combinations. The three options are presented in Figure 7. Option 1 (O1 - “Average”), included a simple grass swale, some remaining vegetation on top of extensive lawn, and a shallow green roof, resulting in a green factor score of **0,7**. Option 2 (O2 - “More ecological than average”) exceeded the target level by a green factor score of **0,9** due to having more remnant vegetation and deeper green roofs. Option 3 (O3 - “Very ecological”) had a diverse combination of remaining and planted vegetation, deep green roofs, and an extensive rain garden qualifying for a respectable green factor score of **1,1**. O3 represents an ideal case of ecological landscape design; however, preserving such large amounts of remaining vegetation is rarely possible in urban lots.



FIGURE 7: THREE LEVELS OF GREEN FACTOR CALCULATED FOR THE KUNINKAANTAMMI PILOT AREA O1: “AVERAGE”, O2: “MORE ECOLOGICAL THAN AVERAGE”, O3: “VERY ECOLOGICAL”.

5 NEXT STEPS

The Helsinki Green Factor is now in its final pilot stage for residential areas and additional pilot areas of different land uses are being considered for further testing. As with previous green factors, the Helsinki Green Factor is still finding its place in the city’s land-use planning process. Experiences from ongoing and future pilot projects will most likely determine whether the Helsinki Green Factor is accepted as a means to promoting ecosystem services in the urban green infrastructure. Discussions with city officials, land-use planners, and landscape architects made it clear that the Green Factor Tool could benefit several groups of specialists at different stages of the planning process.

New advances related to Helsinki Green Factor are continuously updated on the website for the ILKKA project (see below).

6 MORE INFORMATION

Website for the *Climate-Proof City – Tools for Planning (ILKKA)* project: www.ilmastotyokalut.fi/en

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¹ http://www.ilmastotyokalut.fi/files/2014/02/HENVI_jarvela_131113.pdf [4.3.2014]