

GARDEN CITIES AT THE URBAN SCALE

Can integration of garden cities at the urban scale create sustainability benefits?

Comparison of the sustainability performance between a compact city and a garden city

What is a sustainable urban development?

Sustainable development | Development which meets the needs of the present without compromising the ability of future generations to meet their own needs.

Density, layout, distribution of green areas, provision of facilities and services, variety of building types (physical characteristics, life cycle carbon footprint) and transport infrastructure (Jenks & Jones, 2010) are all important for the sustainability performance of a city.

What is a garden city?



Garden cities | a combination of the “advantages of the most energetic and active town life, with all the beauty and delight of the country” (Howard, 1898)

Swedish contemporary garden cities are characterised by moderate densities, with a variety of housing types, a mix of low-rise homes and services, private gardens and planted roads, allowing solar light to penetrate the houses

Why is this important?

- ✓ **Urbanization:** increasing demand for housing, high costs in the city center
- ✓ **Climate change**
- ✓ **Urban sprawl:** unsustainable cities

- ✓ **Preferences:** 7/10 Swedes want to live in a single-family house or semi-detached house

OBJECTIVES

Comparison of the sustainability performance between a compact city and a garden city located in a suburban area in Stockholm.



Main focus: carbon footprint of buildings in the two districts. Transportation and ecosystem services have also been analysed as well as some social aspects.

Characteristics of the two scenarios

Garden city	
ATTRIBUTE	VALUE
Number of housing units	476
Number of apartments	1 280
Inhabitants	3 806
Population density	59 pers/ha
Public green space	32 m ² /capita
Private and semi-private green space	61 m ² /capita

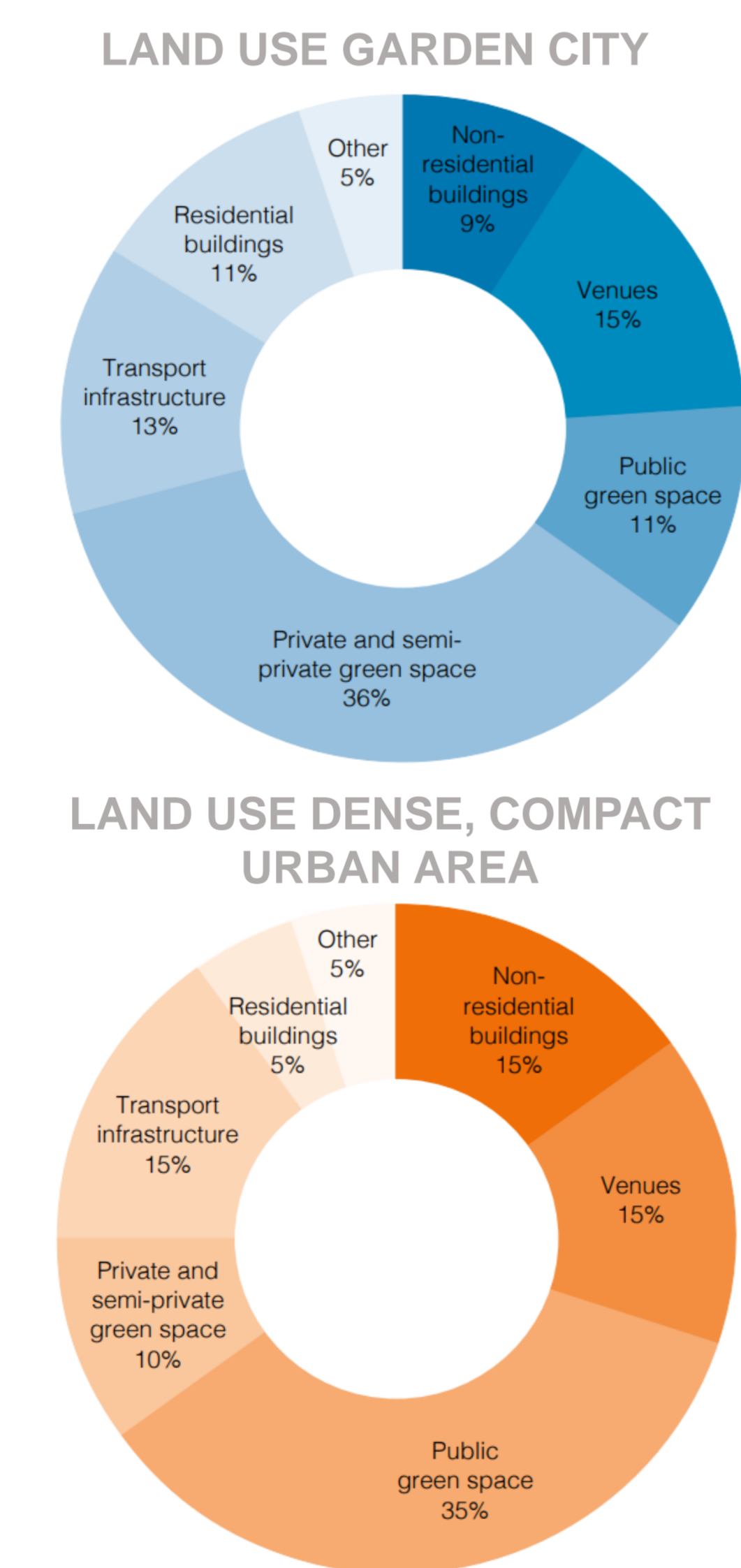
Type of housing units - 2 types of detached single-family houses, semi-detached 2-storey houses and 4-storey wooden multi-family buildings

Compact city	
ATTRIBUTE	VALUE
Number of housing units	72
Number of apartments	1 746
Inhabitants	5 940
Population density	92 persons/ha
Public green space	47 m ² /capita
Private and semi-private green space	11 m ² /capita

Type of housing units - identical multi-storey concrete buildings

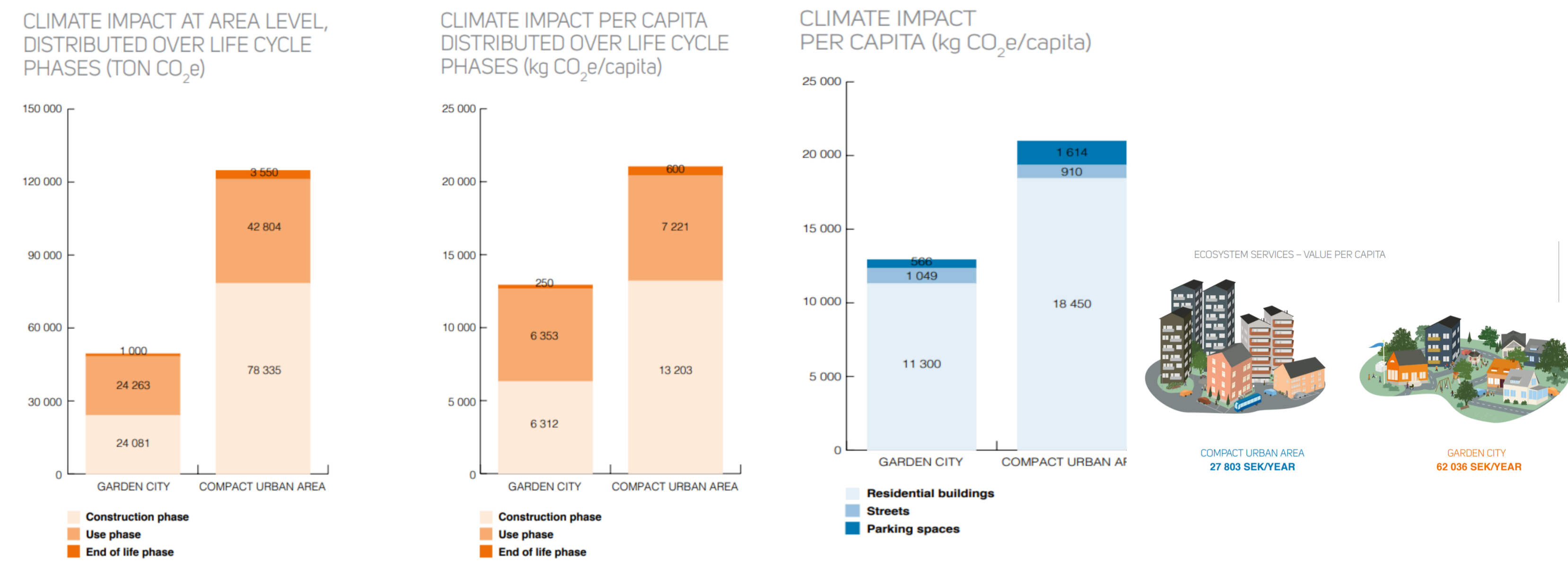
Transport - mobility

- **No clear connection between building type and car ownership**, but car ownership per capita is generally greater in areas with single-family houses than in denser urban areas, while the total car number in compact cities is higher due to larger population.
- **Provision of public transportation:** A residential area with more than 50 inhabitants/hectare can support an efficient public transport system. - therefore the garden city assumed here can provide a basis for a well-functioning public transport system
- **Why is car ownership per capita higher in the Garden city?**
 - Increased parking space supply - easier access
 - Socioeconomic aspects, e.g. families with children
 - Functional mix - access to urban qualities and services



RESULTS

Carbon footprint from the residential sector, roads and parking spaces (LCA)



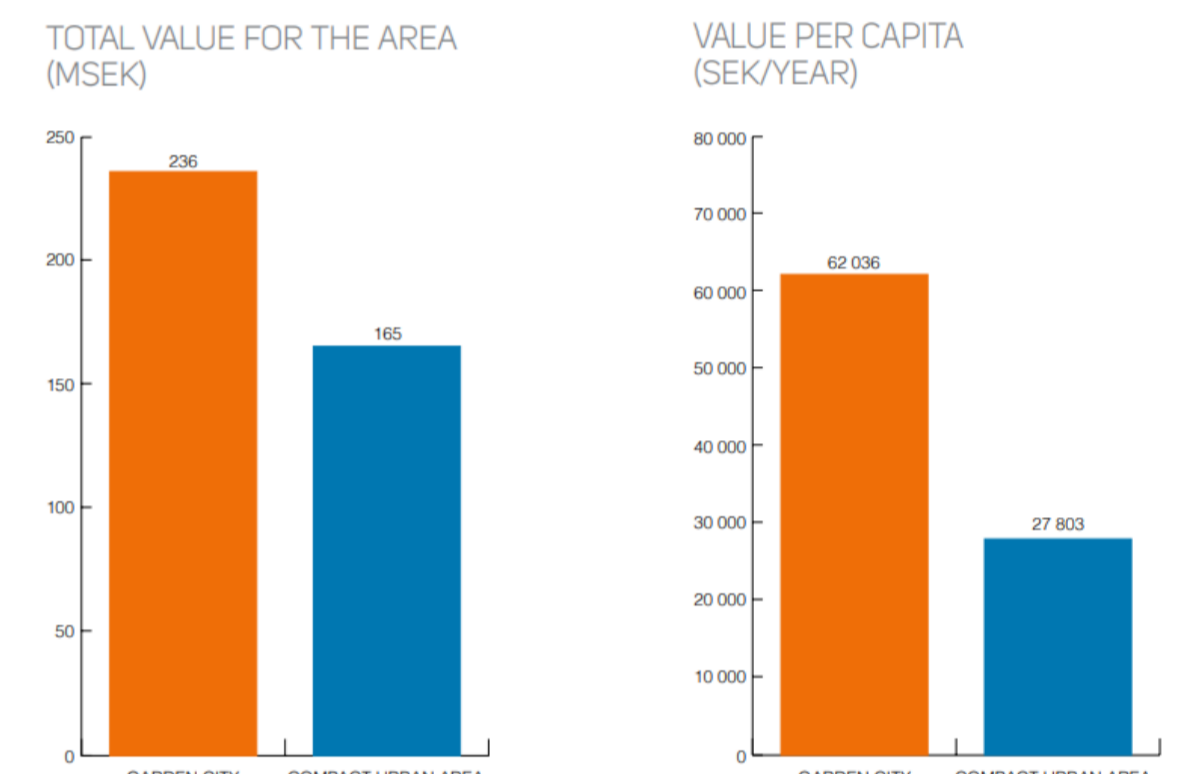
Garden city - in the district:
60% lower CO₂e emissions in the district
30% higher monetary value of ecosystem services in the district

Garden city - per capita:
38% lower CO₂e emissions per capita
55% higher monetary value of ecosystem services per capita

Ecosystem services (Monetary evaluation)



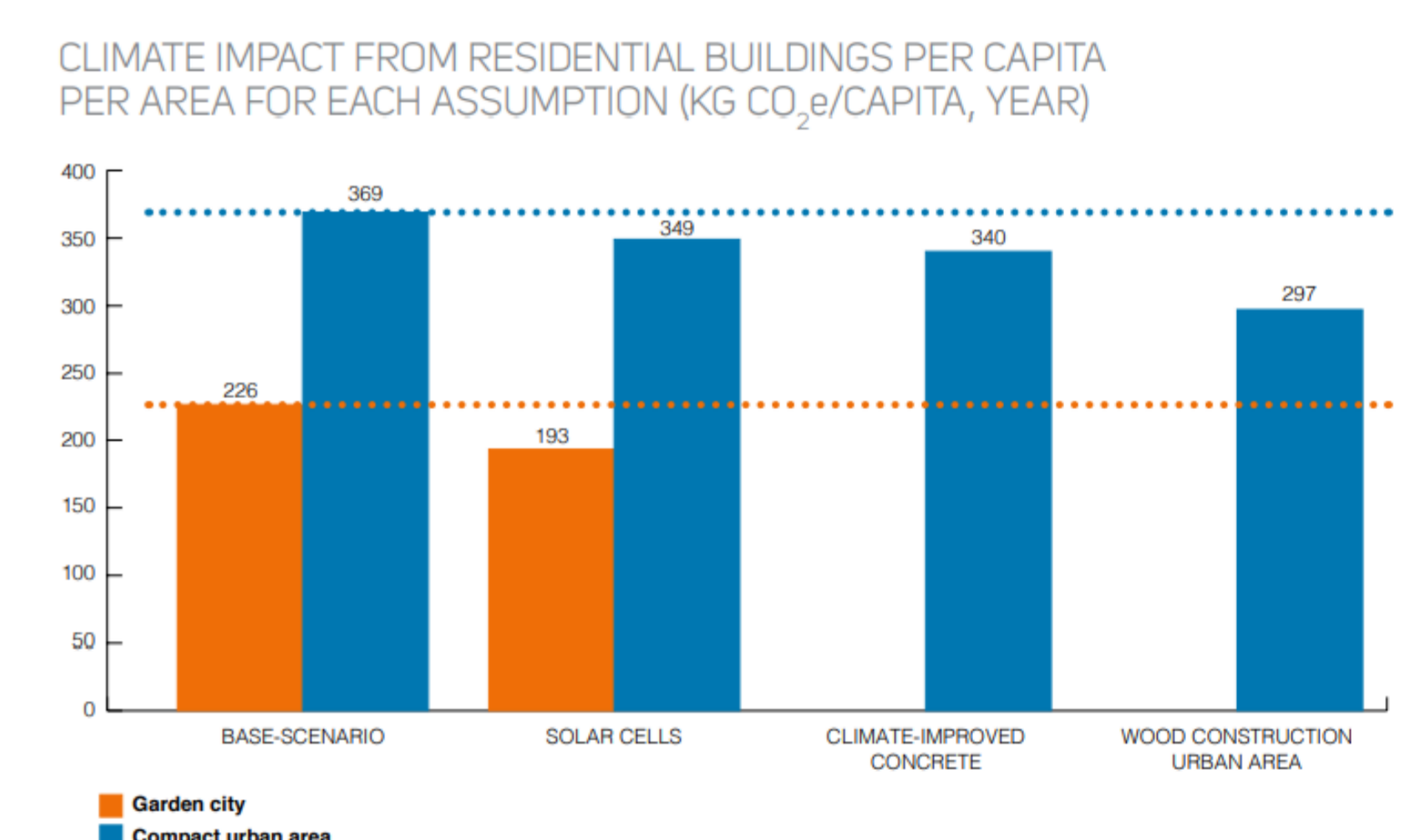
- Ecosystem services are crucial for creating resilient urban environments that are planned and developed in interaction with nature.
- Value in monetary terms for the ecosystem services marked in blue



Sensitivity analyses

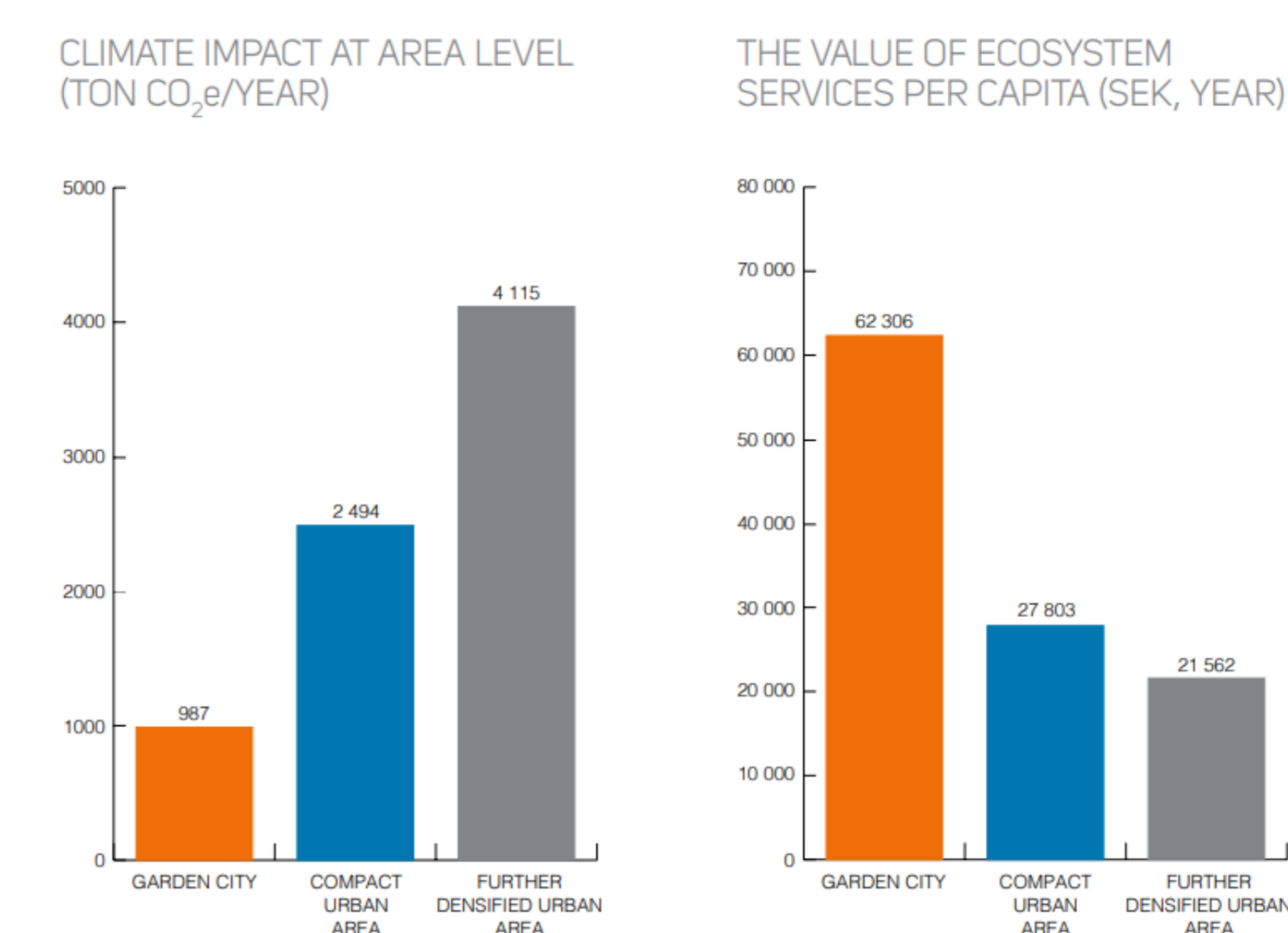
Alternative materials in the buildings of the compact city-like neighbourhood

- Installation of **silicon solar cells** on 50% of the roofs in both the garden city and the dense, compact urban area.
- Choosing **low-carbon concrete** for the residential buildings in the dense, compact area (a part of the Portland cement replaced by fly ash and slag)
- Choosing **wood instead of concrete** for the residential buildings in the dense, compact area.



Regardless of material choice - the garden city has a lower climate impact than the dense, compact urban area.

Alternative planning (densification) of the compact city-like neighbourhood



- Population: 9 900 residents, compared to 5 940 in the dense compact urban area, and 3 806 in the garden city.
- Green Area factor (GAF): still 0.5, made possible by partially replacing the green areas on the ground with green roofs.

Results:
The further densified urban area generates:
70% higher CO₂ emissions and
22% lower ecosystem services value per capita than the compact area.

Notes on energy mix used

For heating and electricity of the buildings the following have been assumed (based on current praxis in Sweden): compact city's buildings use district heating with an emission factor of 62g CO₂-eq/kWh and electricity with an emission factor of 102g CO₂-eq/kWh. The multifamily building of the garden city uses geothermal heat pump and solar panels, while the single-family and semi-detached houses use exhaust-air heat pumps, which is the dominating heat source in new Swedish single-family houses.

CONTACT

Efstathia Vlassopoulou Efstathia.vlassopoulou@anthesisgroup.com
Agneta Persson Agneta.Persson@anthesisgroup.com