# I. EXECUTIVE SUMMARY

“Hammarby Sjöstad is a good example of not only focusing on the short term aspects and getting short term profits but also investing for the future and increasing revenue The cost for Hammarby was roughly 5 percent higher from a purely construction cost perspective but in the end you get back roughly 25 percent more property value out on the site over time which shows how real value is created over time.”

- Henrik Svanqvist, Director of Communities, Skanska

This case study is a part of China Development Bank Capital’s Green and Smart Urban Development Guidelines*.* The study is framed around the 12 Green Guidelines, hereafter referred to as the “Green Guidelines.” These 12 Green Guidelines define the foundational sustainability metrics that should be used to evaluate an urban development project. Our study shows that the 12 Green Guidelines are not only the foundation for sustainability, they are also key conditions for economic and social success.

This case study provides a comprehensive look at the sustainable urban development process of Hammarby Sjöstad. The study is organized around each of the Green Guidelines and expands on the goals, processes, and mechanisms that made Hammarby Sjöstad a sustainable and economically prosperous urban development.[[1]](#footnote-1)

The outline of the report is as follows:

**Section 1** *Presents the main findings of the report. A table showing the guidelines applied to Hammarby Sjöstad and the top lessons is provided to show the importance of the 12 Green Guidelines and the applications for other developments.*

**Section 2** *General introduction to Hammarby Sjöstad.*

**Section 3** *The foundational elements that acted as the basis of Hammarby’s development, including the goals, monitoring, and Hammarby Model.*

**Section 4** *The detailed planning process from master planning to property development, including the role of the national, regional, and local governments; the key organizations involved in Hammarby’s planning process; and the guidelines used in development.*

**Section 5**  *The key financing models that Hammarby used in its development process.*

**Section 6**  *Each Key Achievement (based on the 12 Green Guidelines) is presented in detail, including soil remediation, urban form, transportation, waste, water, energy, and green buildings.*

**Section 7**  *Further extrapolates on the major lessons and also discusses challenges.*

## 1.1 Overview of Hammarby and the 12 Green Guidelines

Hammarby Sjöstad was designed as a comprehensive infrastructure project. The heating, transport, and waste collection systems were intended to work in conjunction to reduce their long term usage of energy and resources. The project meets high environmental standards in comparison with similar developments internationally.

Hammarby Sjöstad demonstrates how high environmental targets can be met through the use of a well-developed master plan, high levels of initial investment in infrastructure, and a focus on environmentally-friendly housing and a high quality living environment.

Hammarby Sjöstad is an economically, environmentally, and socially successful district:

* The district fulfills the 12 Green Guidelines: The 12 Green Guidelines were chosen to comprehensively evaluate an urban development from a high level. Hammarby is a great model for the value of the 12 Green Guidelines in defining a sustainable urban development.
* The district is livable and attractive: A mix of housing units, parks and services are located within the Hammarby boundaries. It is easy to access the area from different parts of Stockholm. Located adjacent to the inner City of Stockholm, the area has become highly popular and is inhabited by a wide range of people.
* The district is economically successful: Property and tax-assessment values have increased. The tax-assessment values have increased more in Hammarby Sjöstad compared to the City of Stockholm as a whole. Even though construction costs were approximately five percent higher than normal, the property value increased by 25 percent.
* The district attracted private investment: Developers invested approximately 83 percent of the total expenditure of the project. The City of Stockholm contributed 17 percent. Funding from LIP Stockholm supported the development with 33 million Euros.

Table . 12 Green Guidelines applied to Hammarby Sjöstad*[[2]](#footnote-2)*

|  |  |
| --- | --- |
| **Urban Growth Boundary** | Hammarby was developed on an old brownfield site. All contaminated soil was sanitized prior to development. 100% of the developed land is remediated and adapted for the district. Hammarby is located adjacent to the inner City of Stockholm, approximately 3 km from the city center. |
| **Transit-Oriented Development** | The Floor Area Ratio (FAR) is higher close to public transit stations and public transit stations are located centrally in commercial and business districts. The FAR ranges from 1.2 to 2.3 in the entire district. |
| **Mixed-use** | The job-housing ratio is about 0.53. Currently, there are 20,400 residents and 11,000 jobs. Many of the buildings also have commercial space on the bottom floors and housing on top floors. |
| **Small Blocks** | Typical block sizes are 50 x 70 or 70 x 100 meters. The general building layout consists of blocks built around an inner courtyard. |
| **Public Green Space** | A network of varied parks, green spaces, quays, plazas, and walkways runs through the district providing space for outdoor activities. The amount of public green space is about 19 percent of the total area. |
| **Non-motorized Transit** | The density of walking paths is about 25.8 km/km², the density of biking paths is about 10.5 km/km2. There are special paths for bikinglinked to Stockholm’s public bike share program Total distance of walking paths: 45 km; total distance of bicycle paths: 18.5 km. |
| **Public Transit** | Every residence is within 300 meters of a light rail tram stations. There are a number of public transit options: the tramline, pedestrian and cycling infrastructure, bike sharing, carpools, a ferry line, and bus line. |
| **Car Control** | There are 0.55 parking spaces per household. Car ownership is low. There are 210 cars per 1000 residents. |
| **Green Buildings** | The average building energy use in Hammarby is 113 kWh/m2/year. This is much lower than the 2012 Swedish average, which is over 200 kWh/m2/year. The green buildings in Hammarby are classified according to 4 different systems: Environmental Building, Green Building, LEED and BREEAM. |
| **Renewable and District Energy** | Integrated district system with approximately 50 percent of energy produced from renewable sources. 80% of the energy extracted from waste and wastewater is being used in Hammarby. |
| **Waste Management** | 100% of waste is sorted and only 0.7% of waste goes to landfill. 50% of waste is recovered as energy through the waste to energy system, 16% of waste is turned into biogas, 33% is materials recycling, and 1% is hazardous waste. The amount of waste delivered to the landfill is 60% less than comparable developments. |
| **Water Efficiency** | 100 percent of the water is recycled. All storm water is managed locally and purified before release. |

The successful development of Hammarby Sjöstad is a result of many coinciding factors; political, economic, historical, and cultural. These are all important factors to really understand why Stockholm is in the international forefront building and designing sustainable city districts.

## 1.2 Major Lessons ­

The following major lessons are presented as guidance and for future developments. The government (national, regional, and local), developers, financial institutions, and technology providers can all learn from these lessons. We hope that these major lessons will inspire fresh ways of thinking about development and project management to encourage sustainability and economic prosperity.

1. Sustainable urban development requires a holistic approach and the 12 Green Guidelines offer the framework for this approach.
2. Prioritize densifying areas that are adjacent to the city, even if these are brownfields.
3. Various departments from the government, private sector, and academia must all be deeply involved in the planning process.
4. A variety of channels (design and financial) must be used to change behaviors and mindsets.
5. Life-cycle assessments can reveal the true value of high environmental design standards.

**1. Sustainable urban development requires a holistic approach and the 12 Green Guidelines offer the framework for this approach.**

The eco-cycle strategy (the Hammarby Model, see Section 3.3) takes into account three different energy flows to find synergies. Taking into consideration all 12 of the Green Guidelines can help with this holistic approach. For instance ,the urban form of Hammarby helped to decrease transportation emissions, and the waste-to-energy system helped to decrease waste and improve energy efficiency.

**2. Prioritize densifying areas that are adjacent to the city, even if these are brownfields**.

Densify areas adjacent to the city. The soil remediation conducted by the City of Stockholm is a small sacrifice when compared to the substantial advantage of developing near the city. This development approach also makes it easier to integrate the transportation system and technologies for water and energy (electricity, district heating and cooling) into the existing city infrastructure.

**3. Various departments from the government, private sector, and academia must all be deeply involved in the planning process.**

Political will and decisions based on a broad political consensus and commitment be must achieved to realize the project. The development of Hammarby Sjöstad is an example of the triple helix concept where government, the private sector, and academia all interact and take part in the development. It was vital that an interdisciplinary project group within the city administration together with the developers, researchers and other stakeholders was formed at the beginning of the project.

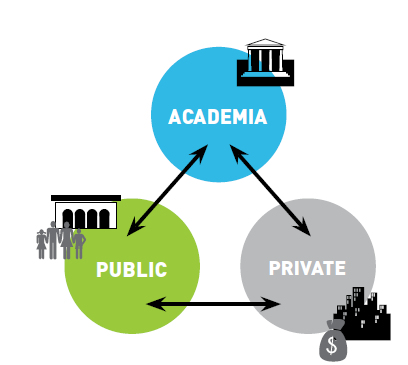


Figure . The Triple Helix Model (Source: The SymbioCity Approach, 2011)

**4. A variety of channels (design and financial) must be used to change behaviors and mindsets**: Planners, architects, and contractors wanted to make environmentally-friendly behavior the default choice for residents through the provision and design of the development's infrastructure. For Hammarby, it is often cited that 75 percent of pro-environmental behavior comes from the design. The remaining 25 percent is achieved through raising awareness and educational projects targeted at all the key stakeholders. Individuals are also financially incentivized to reduce their environmental impact by being billed for their utilities in proportion to their usage.

**5. Using life-cycle assessments can reveal the true value of high environmental design standards:** Using life-cycle cost analysis in planning decisions helped to justify the added cost of higher environmental design standards.

## 1.3 Major Economic and Social Achievements of Hammarby

**Increased tax assessment values:** The tax assessment values (based on historical property sales) have increased more in Hammarby Sjöstad compared to the city as a whole (the tax assessment values are updated every four years - thus the character of the development in the chart found in Appendix 3).

**Growth in value of the property market:** The property market in the region of Stockholm has been in an upwards trend as the region grows rapidly. The queue time to get rental apartments in the district has also increased despite higher rental levels than in the city as a whole. This indicates the higher profit level of Hammarby due to the growing property values in the district (see table in Appendix 3).

**Higher purchasing price:** The purchase price per square meter for condominiums is higher or the same as the city of Stockholm as a whole. The apartments are larger in Hammarby Sjöstad compared to the city average and therefore the prices, calculated per square meter, are slightly lower. Apartments of the same size are more expensive in Hammarby Sjöstad compared to the city average.

**Increasing quality of life and human capital:** The income level among the residents of Hammarby Sjöstad has increased more than in the city as a whole. The income level is also higher than Södermalm (an inner city district near Hammarby) and Liljeholmen (a recent developed neighborhood west of Hammarby). This indicates a high and increasing quality of life in Hammarby Sjöstad. In 2001 and 2002 many began to move into the newly developed neighborhood. In the years following, the trend has been clearly positive (see table in Appendix 3). There are many high-income earners in Hammarby Sjöstad – 21 percent have an income that is twice as high as or higher than the median income in Stockholm (see Appendix 3).

**Contributed to meeting demand for housing:** The city's authorities were proactive in their efforts to meet predicted population increases in Stockholm, and were thus able to bring high-quality housing onto the market at a time when demand was increasing.

**Low unemployment and high educational attainment:** The education level is high among the residents in Hammarby Sjöstad. The first residents that moved in to the new developed neighborhood had a high education level, and afterwards that levels have been high compared to other areas in Stockholm. The unemployment rate is also very low in Hammarby Sjöstad (see tables in Appendix 4).

Figure . Investment in Hammarby by City versus Developers

## 1.4 Detailed Comparison of 12 Green Guidelines and Hammarby

Table . Detailed Comparison of 12 Green Guidelines and Hammarby

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Guideline** | **Description** | **Quantitative benchmarks (if applicable)** | **Target level of benchmark** | **Hammarby quantitative level of benchmark** | **Notes** |
| **1. Urban Growth Boundary** | Every city should establish one | NA (Not applicable) | NA | Yes - Hammarby is built within the urban growth boundary of Stockholm. | Hammarby is an infill development that seeks to promote compact growth within existing city limits. |
| **2. Transit-Oriented Development** | Emphasize development in TOD areas, which are defined as those within 500 m of a transit stop (or within 800 m of major transit stations, such as metro or Bus Rapid Transit) | % residents within TOD area | 70% for big cities | 100% |  |
| Floor Area Ratio (FAR) of buildings in TOD area should be higher than overall district average. | Ratio of TOD FAR to overall district level FAR | 2x | NA | The FAR ranges from 1.2-2.3 for the entire district of Hammarby, which is a TOD district. |
| **3. Mixed-use** | All residential units should be  close to at least six kinds of  amenities within a 500 m  radius of building entrance. | % of residential units within 500 m of these amenities | 100% | 100% |  |
| Achieve a balance of employment and local residential population. | The job to resident ratio (the number of  people employed divided by  the number of residents) | Should be between 0.5 and 0.7 | * 0.54 (today) * 0.40 * (expected in 2025) | 20,400 residents currently and 11,000 jobs (27,500 residents at completion in year 2025) |
| **4. Small Blocks** | Blocks should be small to promote non-motorized transit | Blocks size as measured by area  equal to 2 ha and 70% of blocks should comply with  this standard. | 70% of blocks ≤ 2 ha.  (excluding industrial areas) | 100% | Typical block sizes are 50x70 m and 70x100 m |
| **5. Public Green Space** | Well distributed access to green space | % of residents within 500 m of publicly accessible green space | 100% | 100% |  |
| Sufficient quantity of green space/blue space | % of land area devoted to publicly accessible green space/blue space. | 20-40% in commercial areas and higher levels in residential areas | 40% | 19% of total area consists of public green space with varied parks, green spaces, quays, plazas and walkways.  40% of the area is green/blue areas such as courtyards, lakes, and recreation grounds.  The Hammarby Lake occupies 25% of the blue space area.  25 m2 per person of free space. For all residents in Hammarby this implies an area of 650,000 m2 of public space. |
| **6. Non-motorized Transit (NMT)** | Promote NMT through well- developed pedestrian path networks | Density of pedestrian paths (km in length/ km2 of district land area) | ≥ 10 | Yes | 25.8 km/km²  Length of pedestrian path: 45.7 km |
| Promote NMT through well- developed bike path networks | Density of bike paths (km in length / km2 of district land area) | ≥ 10 | Yes | 10.5 km/km²  Length of bike paths 18.6 km |
| **7. Public Transit** | Prioritize development near transit | % of new development within 500 m of transit | 100% | 100% |  |
| **8. Car Control** | Put in place measures to cap car use. Limit parking where there is good transit. | NA | NA | Yes | Parking norm for the area was set to 0.55 cars per apartment unit and that was lower than the normal parking norm in the city (set at 1.0). |
| **9. Green Buildings** | Construct high quality, resource efficient buildings | MOHURD green building standard | ≥ 70% 1-star; 20% to 40% 2-star; 5% to 15% 3-star | NA in Sweden | Buildings are classified according by 4 classification systems: Environmental Building, Green Building, LEED, and BREEAM. The average energy use for buildings in Hammarby is 113 kWh/m2/year. |
| **10. Renewable and District Energy** | Every project should analyze the potential for district energy | N/A | NA | Yes | Hammarby boasts an impressive integrated district system. This includes district wide energy in the forms of heating, cooling, electricity, and biogas (for some 1000 household stoves). |
| Look for opportunities to use local sources of renewable energy | % of electricity from locally-generated renewable sources | 5% to 15% for residential areas  2% to 5% for commercial areas | Approximately 50.5%   * 50% of energy is recovered from waste * 0.5% rooftop solar used for heating supply not district heating |  |
| **11. Waste Management** | Classify waste for its best use[[3]](#footnote-3) | All buildings should have waste sorting facilities, enabling all waste to be sorted | 100% | 100% | In Hammarby, there are by Swedish definition no waste classification facilities. However there are systems in place to allow for source separation of waste. |
| Compost organic waste | % of waste composted | 30-50% | Food waste:  35% of total household waste by weight  50% of waste is separated and about 90% of the separated food waste is converted into biogas. | Most organic solid waste used as an energy source. None is composted. |
| Resource efficiency | % of waste recycled or reused | 35-50% | 33% material recycling  50% used for energy | Overall picture of waste usage:  0,7% Landfill  1% Hazardous waste  33% Material recycling  16% Biological treatment[[4]](#footnote-4)  50% Energy recovery |
| **12. Water Efficiency** | Avoid water waste | % of water use subject to metering | 100% | 100% |  |
| Conserve fresh water on supply side | % of water used should be from rainwater or recycled wastewater | 20-30% |  | Storm water from roof tops and non-street surfaces is collected separately from storm water that falls on the streets. Non-street storm water is led through open water ways in the area into the surrounding lake water system. Street storm water is purified before being channelled into the fresh water system. |

**Detailed Description of Guidelines as applied to Hammarby Sjöstad**

**1. Urban Growth Boundary:** The strategy used by theStockholm City Planning Administration was to re-use and transform old industrial sites and other brownfield sites into attractive mixed use areas with beautiful parks and public green spaces. Hammarby Sjöstad is an excellent example of an application of this strategy. Prior to development all the soil was sanitized. To avoid urban sprawl and increase the use of public transportation, bicycling, and walking in the area, the City adapted the concept of Smart Growth Theory. The theory focuses on concentrating urban growth in or nearby city centers through integrated planning and Transit Oriented Development (TOD). 100% of the developed land has been recreated and adapted for the City of Stockholm. Hammarby Sjöstad is located approximately 3 km from the city center. Hammarby Sjöstad is part of an regional urban planning strategy to create a polycentric urban structure as well as a city planning strategy to densify and build the city inwards.

**2. Transit Oriented Development:** TOD is one of the key components integrated in the area. Fast and attractive public transport combined with carpools and beautiful cycling and pedestrian paths have been implemented in the area in order to reduce private car usage. The FAR number ranges from 1.2-2.3 in the area. The FAR is higher along the main public transportation corridors due to the location of mixed use functions. However, the FAR ratio does not vary that much at every bus/tram station since the distance between stations are quite short which contributes to plots well connected to the public transportation services.

**3. Mixed-use:** Today 20,400 residents inhabit the area in 9000 apartments and approximately 11,000 business places are available. The following area amenities can be found: schools, kindergartens, post offices, banks, retail, clinics, petrol and biogas station, youth activity centers, hotels and restaurants. Many services are concentrated along the central boulevard with prioritized public transport, walking, and cycling.

**4. Small blocks**: Typical block size is 50 x 70 m or 70 x 100 m, exceptions are industry and schools. Small blocks less than 1 ha dominate the area. The general building layout combines traditional Stockholm inner city characteristics with Hammarby Sjöstad’s natural environment. Blocks are built around inner courtyards. Average height is 18-24 meters, or 7 stories.

**5. Public Green Space:** 19% of the area is intended for public green space .The development stipulates 25 m2 of public green space per apartment unit. When the district is fully developed it will consist of 300,000 m2 of public space. The public green space of Hammarby Sjöstad is connected to the citywide structure of green wedges and green links. The green networks also connects to walking and cycling paths in surrounding nature preserves and to eco-ducts over larger roads

**6.** **Non-motorized Transit:** Hammarby Sjöstad has a total of 45 km of walking paths and 18.5 km of cycling paths integrated into the area. Bicycling and walking was prioritized in the development and is integrated into the citywide network. All roads have sidewalks. Safe bicycle paths are prioritized and developed along all major routes. In Hammarby Sjöstad there are bicycle paths along the main transportation corridors as well as traffic separated bicycle paths along waterfronts and through residential areas.

**7. Public Transit:** Distance from housing to public transportation is 250-300 m at most. All blocks are within 500 m distance from public transportation stations (bus and light rail) and have easy access to convenient and beautiful pedestrian links. Carpools, bicycle sharing, and a ferry service are also transportation alternatives found in the area.

**8. Car control:** Car ownership in Hammarby is low: 210 cars per 1000 residents. The parking norm for the area is set to 0.55 cars per apartment unit, which was lowered from the development’s initial target of 1 car per apartment. Public transport, bicycling, and walking are prioritized ahead of private car use. Car pools were introduced. Ground level public parking is regulated and minimized to parking along streets. All other parking is underground. Underground parking is organized by housing associations or rental housing companies and put under buildings or as larger parking facilities under open spaces or parks. Special parking lots are provided for disabled people and for carpool cars. In order to minimize car use, the City of Stockholm fully developed the tram and bus line before residents moved in.

**9. Green Buildings:** Buildings in Hammarby Sjöstad are classified according to the Sweden Green Building Council (SGBC) environmental classification system. The four most used classification systems in Sweden are *Miljöbyggnad* (Environmental Building), Green Building, BREEAM and LEED.

SGBC facilitates the process for citizens, property owners, tenants, and customers to choose sustainable long term solutions in the built environment by making it easier to understand the environmental certification and classifications systems of buildings and neighborhoods.

The overall planning of land use, transportation, and the eco-cycle made it possible for every building to achieve a high level of environmental performance. However, the energy consumption of buildings did not reach the original goal which first was set at 60/m²/year. In 2005 the goal was revised to 100 kWh/m². Average energy consumption in Sweden is 150 kWh/m², whereas in Hammarby it is 118 kWh/m².

**10. Renewable and District Energy:** Extraction of non-renewable energy resources decreased 28-42% compared to comparable project in 2008 (Grontmij, 2008). Greenhouse gas emissions decreased 29-37% compared to technology levels used in the early 1990s (Grontmij, 2008).

100% of the buildings in Hammarby Sjöstad are heated by district heating. The base production is from the waste incineration in the Combined Heat and Power plant and the heat pumps in the wastewater treatment plant. Excess heat from WWTP is reused in the district heating and cooling system for the city. Approximately 80% of the total energy use in Hammarby Sjöstad is renewable.

**11. Waste Management:** In Hammarby Sjöstad waste is thoroughly sorted in practical systems, with material and energy recycling maximized wherever possible.

**12. Water Efficiency:** In Hammarby Sjöstad, water use decreased by 41-46% per person compared to early 1990’s levels. Water consumption was reduced through the use of eco-friendly installations, low flush toilets, and air mixer taps. Eutrophication decreased 49-53% compared to early 1990s levels (Grontmij, 2008). Decreasing over-fertilization is largely attributed to improvements at the Henrikdal Wastewater Treatment Plant.

1. This case study is a *collection of facts, figures, and earlier writings.* Thismeans that the report is primarily based upon secondary materials and the authors cannot be held accountable for their accuracy. The work has focused on compiling, analyzing, and concluding existing material. Supporting material produced by Sweco includes some of the images, diagrams, tables, and analysis. [↑](#footnote-ref-1)
2. See Table 2 for an in-depth comparison of Hammarby’s metrics to those of the 12 Guidelines. [↑](#footnote-ref-2)
3. In a Swedish context this would be referred to as source separation of waste to enable best treatment. [↑](#footnote-ref-3)
4. Waste goes to biological treatment which utilizes its component nutrients for plant cultivation and also utilizes its energy content (GlashusEtt, 2007). [↑](#footnote-ref-4)