CASE 2

Stockholm, Sweden

Integrated Planning and Management through Systematic Stakeholder Collaboration Can Lead to Greater Life-Cycle Benefits

The City of Stockholm, the capital of Sweden, has pursued integrated city planning and management to become a sustainable city (figure 3.20). The city has a comprehensive urban vision, environmental programs, and concrete action plans to reduce greenhouse gas emissions and tackle climate change. It implements integrated urban planning approaches that consider ecological benefits and efficient resource use.

The ongoing redevelopment in the city's southern district, Hammarby Sjöstad, is a good model for understanding integrated approaches to sustainable urban planning and redevelopment. The area aims to be twice as sustainable as Swedish best practice in 1995. The area implements integrated resource management (waste, energy, water, and sewage) through systematic stakeholder collaboration and has transformed the linear urban metabolism into a cyclical one known as the Hammarby Model. According to Grontmij AB, a private consultancy firm in Stockholm, primary assessments of the initially developed districts of Hammarby Sjöstad show that the area has achieved, for example, 28 to 42 percent reductions in nonrenewable energy use and 29 to 37 percent reductions in global warming potential.

Figure 3.20 Stockholm Cityscape

Source: Photo by Lennart Johansson, Stockholm City Planning Administration.

Stockholm provides great leadership in planning and implementing sustainable urban development strategies. The city's one-system approach to resource use has been successful. In addition, Hammarby Sjöstad has applied the environmental load profile (ELP) tool to assess and monitor environmental performance in the development project.

Profile of Stockholm

Stockholm

- The capital of Sweden, located in the northern part of Europe
- Total area: 209 km^2 (land: 188 km^2; water: 21 km^2)
- Population (2008): 795,000
- Expected increase in population by 2030: 150,000.

Source: USK (2008).

Map 3.2 Location of Stockholm

Source: Map Design Unit, General Services Department, World Bank.

Stockholm's Approaches to Sustainable Development

Stockholm pursues comprehensive sustainable development policies. In 2007, the city adopted a strategic project, Vision 2030, that charts the way forward to strengthen sustainable urban development (City of Stockholm 2007). This project indicates that, by 2030, the population of Stockholm will have grown to more than 1.0 million people, while the greater Stockholm region will have grown to nearly 3.5 million. The city is expected to face new demands from globalization, trade shifts, migration, an increase in the number of the elderly, and environmental challenges. Based on the Vision 2030 project and other strategies, Stockholm has adopted an approach to urban development that recognizes the strategic level and local levels (City of Stockholm 2007).

Aligned with Vision 2030, the Stockholm Environment Programme established six environmental goals or principles for 2008–11: (1) environmentally efficient transport, (2) safe goods and buildings free of dangerous substances, (3) sustainable energy use, (4) sustainable land and water use, (5) waste treatment with minimal environmental impacts, and (6) a healthy indoor environment (City of Stockholm 2008).

In addition, Stockholm has implemented action programs on greenhouse gas emissions and climate change. The plans invite wide cooperation from public and private organizations and individuals who live and work in the city. Various measures have already been taken, including the adoption of biofuels, the expansion of districtwide heating and cooling management, and the promotion of vehicle driving behavior that is environment friendlier (City of Stockholm 2003). As a result, emissions of greenhouse gases fell from 5.3 tons to 4.0 tons of equivalent carbon dioxide (CO_2e) per person between 1990 and 2005 (City of Stockholm 2009). The city recognizes the importance of energy efficiency to reduce emissions and tackle climate change, but also prioritizes cost-effectiveness through resource conservation. Devising ways to engage stakeholders in actions that are environmentally and economically sustainable remains a challenge. Stockholm's long-term target is to be free of the use of fossil fuels by 2050 (City of Stockholm 2009).

Approaches to Sustainable Urban Development

Sustainable urban development is clearly a key aim. Stockholm can more easily implement integrated and sustainable land use and transportation plans because the city has traditionally exerted substantial authority over land use planning and ownership. In 1904, Stockholm started purchasing land for future development. As a result, around 70 percent of all urban land belongs to the city (Cervero 1998). This large share of city-owned land has prevented speculative land investments by developers and investors and empowered the city in planning and implementing development. The city thus has a solid platform for development. Developers construct buildings and housing on public land corresponding to city plans. Because rights-of-way are easily secured, transportation development has been straightforward, and other development has been promoted around transportation stations. Development benefits are now being returned to the public through planning in new town areas. In addition, parks and green areas cover 40 percent of Stockholm's land, and citizens enjoy an ecologically rich environment (USK 2008).

To promote sustainable development, Stockholm's planning strategy targets densification through the development of brownfield (already used) land inside the city before any unused greenfield land on the outskirts is developed (box 3.1, map 3.3). This is the overall objective of the comprehensive land use plan adopted by the city council in 1999.

Old and partly abandoned industrial and harbor areas (brownfields) adjacent to the inner city are being reused and redeveloped as part of the city development strategy. Several of these strategic development areas are directly linked to a new rapid tram system and also have direct access to other public transportation systems, such as the metro line. The areas have unique qualities because they are often located close to water and natural areas. Some areas have been under construction for several years and will provide housing as part of the city's housing programs. Other areas are at the planning stage. The areas are being targeted for mixed use development, with attractive housing and business facilities; these dense structures create a more urban atmosphere in formerly suburban areas.

Hammarby Sjöstad, one of the original and ongoing redevelopment areas, is a full-scale demonstration site. It represents an example of an integrated urban development approach illustrating system solutions, innovative technology, environmental awareness, and active cross-sector collaboration.

BOX 3.1

The Development Strategies of Stockholm

- Reusing developed land (brownfields)
- Locating new development in areas with good access to public transportation
- Respecting and enhancing the character of the city, for example, the cityscape, the built environment, and the green structure
- Redeveloping semicentral areas and transforming industrial areas into urban areas of mixed uses characterized by variation
- Establishing focal points in the suburbs
- Meeting local demand
- Developing public spaces

Source: City of Stockholm.

Hammarby Sjöstad

The ongoing redevelopment project for Hammarby Sjöstad—the name of the district means "city on Hammarby Lake" in Swedish—is set on a former industrial and harbor brownfield area on the south side of Hammarby Lake and to the south of the city center. The aim of the project is to expand the inner city into an at-

Profile of Hammarby Sjöstad

Hammarby Sjöstad

- A city district in southern Stockholm
- Total area: 200 hectares, including 50 hectares of water
- Planned population: 25,000
- 11,000 apartments projected
- 200,000 km² of retail and office area projected
- One of three ecocycle districts in Stockholm: Hammarby Sjöstad, Östberga, and Skärholmen
- About 35,000 people are expected to live and work in the area.
- Today, more than half of the development has been completed, and it is anticipated that the district will be fully developed by 2017.

Residential Area in Hammarby Sjöstad

Source: Photo by Lennart Johansson, Stockholm City Planning Administration.

Hammarby Sjöstad Cityscape

Source: Photo by Lennart Johansson, Stockholm City Planning Administration.

Map 3.3 The Inner City of Stockholm and Adjacent Development Areas

Source: Stockholm City Planning Administration.

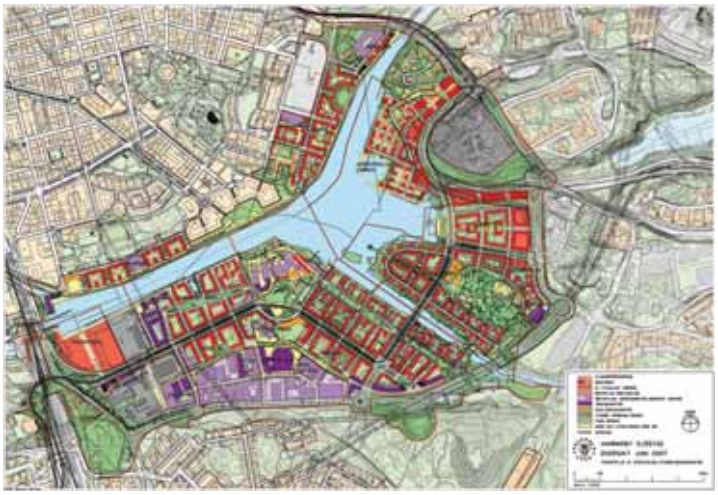
tractive water setting, while converting a rundown industrial area into a modern, sustainable, mixed used neighborhood. Soil will be decontaminated by removing tons of oil, grease, and heavy metals (Fryxell 2008). The ecosystem will be revitalized, and existing eco-assets, including trees and parks, will be preserved. The redevelopment will unlock land and property values by revitalizing brownfield land. Moreover, a once-shattered area will be reinvigorated, and about 11,000 new residential units and 200,000 square kilometers of new office and service area will be created.

The urban vision and concept for this new district was born in the early 1990s. The area's natural continuation of Stockholm's inner city toward the waterfront has influenced planned infrastructure and building designs. Hammarby Sjöstad adds a new layer to Stockholm's development: a modern, semiopen zone comprising

a mix of traditional inner-city perimeter blocks and open and contemporary urban zones. Inner-city street dimensions, block lengths, building heights, and densities are well harmonized and offer openness, sunlight, parks, and water views (map 3.4).

The area is also well connected to public tramlines. According to a 2005 survey, two-thirds of all resident trips were made via public transportation, bicycles, and walking, and one-third by car (CABE 2009). Significant public transportation ridership and bicycling and walking have helped to reduce car emissions and the associated greenhouse gases. Mixed land uses are promoted, and land policy requires that ground floors along main streets be used for commercial applications. This encourages people to walk or cycle to visit streets with lively shop fronts. To attract shops and services to the new development area, the city has provided financial subsidies. Moreover, the area's economic activities were established in the development's early phases. Urban and building designs make the most of the waterfront. Myriad designs were created by different architects to provide diverse, lively, and high-quality urban environment.

Stockholm desired that Hammarby Sjöstad be twice as more sustainable than Swedish best practice in 1995 on a range of indicators (the environmental program was adopted in 1995), most notably energy efficiency per square meter. In Sweden, the average annual rate of energy use in some regular new developments is 200 kilowatt-hours per square meter. Cutting-edge Swedish developments and practices produce an efficiency of 120 kilowatt-hours per square meter. The Hammarby Sjöstad project aims for 100 kilowatt-hours per square meter. The project also sets other targets: water conservation, waste reduction and reuse, emissions reduction, the reduced use of hazardous construction materials, the application of renewable energy sources, and the implementation of integrated transportation solutions. Stockholm is already a sustainable city, but the city council expects this project to demonstrate additional innovations in sustainable urban development.



Map 3.4 Master Plan of Hammarby Sjöstad, Stockholm

Source: Stockholm City Planning Administration.
Note: For details of the Master Plan, see http://www.hammarbysjostad.se.

The Hammarby Model

The environmental goals for Hammarby Sjöstad, which was originally intended to be the Olympic Village in Stockholm's bid for the 2004 Summer Olympics, are audacious. The area's integrated environmental solutions may be understood as an ecocycle known as the Hammarby Model (figure 3.21). The ecocycle addresses energy, waste, water, and sewerage for housing, offices, and other commercial structures. Core environmental and infrastructure plans for this area have been developed jointly by three city agencies: the Stockholm Water Company, the energy company Fortum, and the Stockholm Waste Management Administration. Project management was spearheaded by a project team comprising representatives from city departments overseeing planning, roads and real estate, water and sewerage, and waste and energy. The project team is housed in the Department of Roads and Real Estate (now called the Development Administration).

The model is an attempt to turn a linear urban metabolism, which consumes inflowing resources and discards outflowing wastes, into a cyclical system that optimizes the use of resources and minimizes waste. The model

streamlines infrastructure and urban service systems and provides a blueprint for achieving sustainability objectives. For instance, it shows the interaction between sewage processing and energy provision, the way refuse should be handled, and the added value to society of modern sewage and waste processing systems. Highlights are as follows:

- *Building materials:* Environmental considerations apply to all materials, whether used visibly in facades, underground, or internally. This includes structural shells and installed equipment. Only sustainable and tested eco-friendly products are used. Potentially hazardous materials, such as copper and zinc, are avoided to prevent leakages of unwanted substances into the environment.
- *Water and sewerage:* Storm water is unconnected to sewerage systems to improve the quality of wastewater and sludge. Rainwater from streets or nondomestic storm water is collected, purified through a sand filter, and released into the lake. This reduces pressure on the wastewater treatment plant. Rainwater from surrounding houses and gardens flows through open drains to the channel. This water runs through a series of basins, known as an equalizer, and then to the lake. Hammarby Sjöstad has its own wastewater treatment plant built to test new technology. Four new and different processes for purifying water are currently being tested.
- *Biogas:* Biogas is produced in the wastewater plant from the digestion of organic waste and sludge. The wastewater from a single household produces sufficient biogas for the household's gas cooker. Most biogas is used as fuel in eco-friendly cars and buses.
- *Green spaces:* Roofs covered in stonecrop or sedum plants are attractive. In addition, the plants absorb rainwater that would otherwise drain into the sewerage system, adding pressure on the wastewater treatment plant. Moreover, the region's carefully preserved oak forests, green areas, and other planted trees help collect rainwater instead of draining it into the sewerage system. This vegetation also ensures cleaner air and balances the dense urban landscape.
- *Waste:* Combustible waste, food waste, newspapers, paper, and other discards are separated and deposited in different refuse chutes in or adjacent to buildings. The refuse chutes are linked to underground vacuum-powered pipes that lead to a central collection station. An advanced control system sends the waste to large containers, one for each waste category. Refuse collection vehicles thus collect the containers without driving into the area, and refuse collection workers avoid heavy lifting.
- *District heating and cooling:* Treated wastewater and domestic waste become sources for heating, cooling, and power. A combined heat and power plant uses domestic waste as fuel to produce district heating and electricity. Wastewater from the treatment plant fuels the production of district heating in the Hammarby heat plant. Cooled by heat pumps, the treated and cooled wastewater may also be used in the district cooling network.
- *Electricity (solar energy):* Solar energy is transformed into electrical energy in solar cells. The energy from a single solar cell module covering one square meter provides around 100 kilowatt-hours per year, which is equivalent to the energy used by three square meters of housing space. There are solar panels on many roofs used to heat water. Solar panels on residential buildings often provide sufficient energy to meet half of the annual hot water requirements of the buildings.

Hammarby Sjöstad has its own Environmental Information Center, GlashusEtt. This center facilitates communications on environmental considerations to area inhabitants and showcases Hammarby to international visitors.

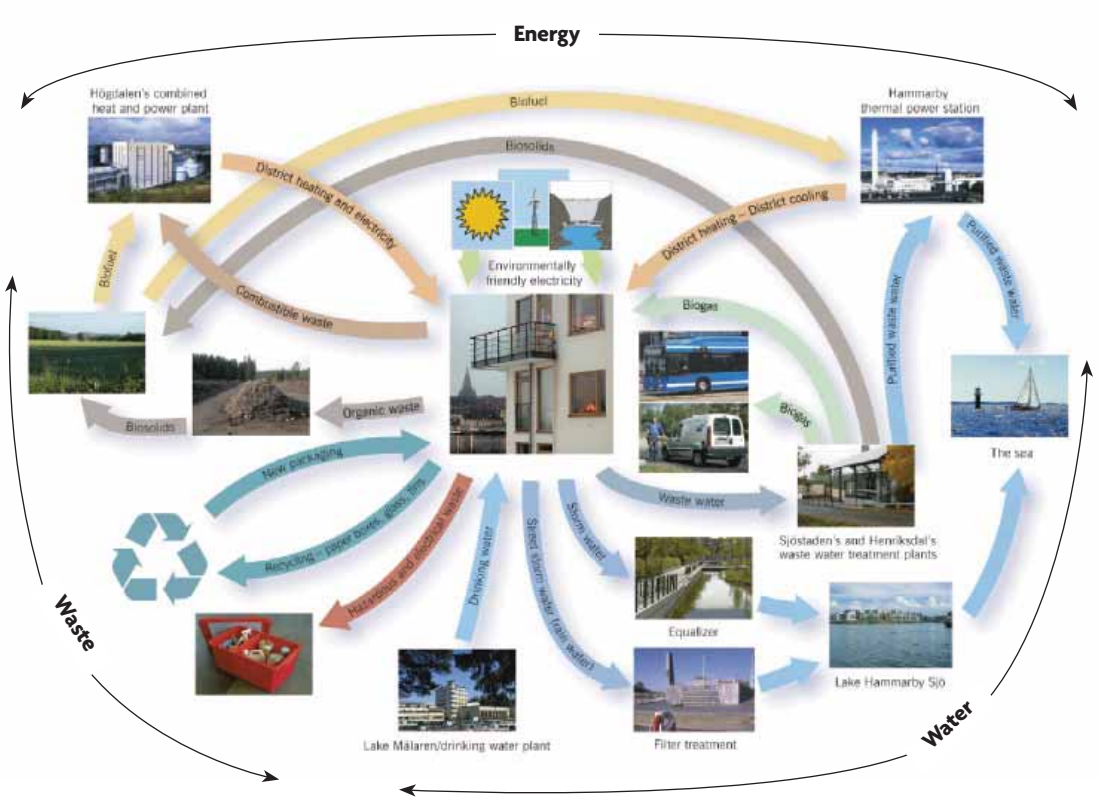


Figure 3.21 The Hammarby Model

Source: Fortum, Stockholm Water Company, City of Stockholm.

The environmental load profile

An environmental assessment tool, the ELP, has been developed through a cooperative effort by the City of Stockholm, the Royal Institute of Technology, and the consultancy firm Grontmij AB. The ELP assesses environmental performance and follows up on the targets set in the project's environmental program. It is a life-cycle assessment tool that defines relevant activities from an environmental perspective and quantifies the environmental loads originating from these activities, such as emissions, soil pollutants, waste, and the use of water and nonrenewable energy resources. It accounts for all project development and implementation activities, including material acquisition, the transport of inputs and people, construction methods, electricity, heating, and materials recycling.

The main strengths of the ELP are that the tool is flexible and dynamic, which makes it suitable for application under any conditions in planning, simulation, and evaluation. By factoring in well-constructed variables, one may use the ELP to calculate the environmental loads of various planning decisions during a project's construction, operation, demolition, or redevelopment. The tool thus facilitates a life-cycle approach. Testing scenarios are facilitated. For instance, different construction methods may be compared prior to taking decisions. Hence, decision makers understand environmental issues early in project planning. The ELP may also be used to evaluate the environmental performance of existing city districts or buildings based on the consumption of resources such as water and energy. The ELP enables analyses of environmental performance at multiple levels. The tool takes into account the activities and impacts of individuals (for example, cooking and laundry), buildings (building materials, dis-

trict heating, electricity, and so on), unbuilt areas (such as materials and working machines), and common areas (including materials and the transport of people and goods). By aggregating these factors, the environmental load of a whole city district may be analyzed. If each factor is analyzed separately, different urban activities provide useful information for urban planning.

Evaluation findings of the initially developed areas of Hammarby Sjöstad as compared with a reference scenario are illustrated in figure 3.22. The results are positive: a 28 to 42 percent reduction in nonrenewable energy use, a 41 to 46 percent reduction in water use, a 29 to 37 percent reduction in global warming potential, a 33 to 38 percent reduction in photochemical ozone creation production, a 23 to 29 percent reduction in acidification potential, a 49 to 53 percent reduction in eutrophication potential, and a 27 to 40 percent reduction in radioactive waste. By monitoring the environmental loads from Hammarby Sjöstad, one may plan suitable societal and financial environmental measures to continue the development of the district, while offering guidance for similar projects.

Project management

The two municipal administrations responsible for planning and managing the project are the City Planning Administration and the Development Administration. These entities are under respective committees and the city council.

In the mid-1990s, Stockholm and its external stakeholders agreed to cooperate on planning objectives in the area. These stakeholders include the neighboring municipality of Nacka, the Stockholm Local Transport Authority, and the National Road Administration. After negotiating, the stakeholders agreed on a set of common planning features and infrastructure projects (1994–95). During this period, there was a political steering group and an official management group composed of representatives of key stakeholders. An organization was established to manage the project. All departments responsible for the planning, development, implementation, and maintenance of the area were involved from the beginning.[1] The city's Waste Collection Administration and the city's associated companies—the energy company and the water company—participated in preparing the project's environmental program; moreover,

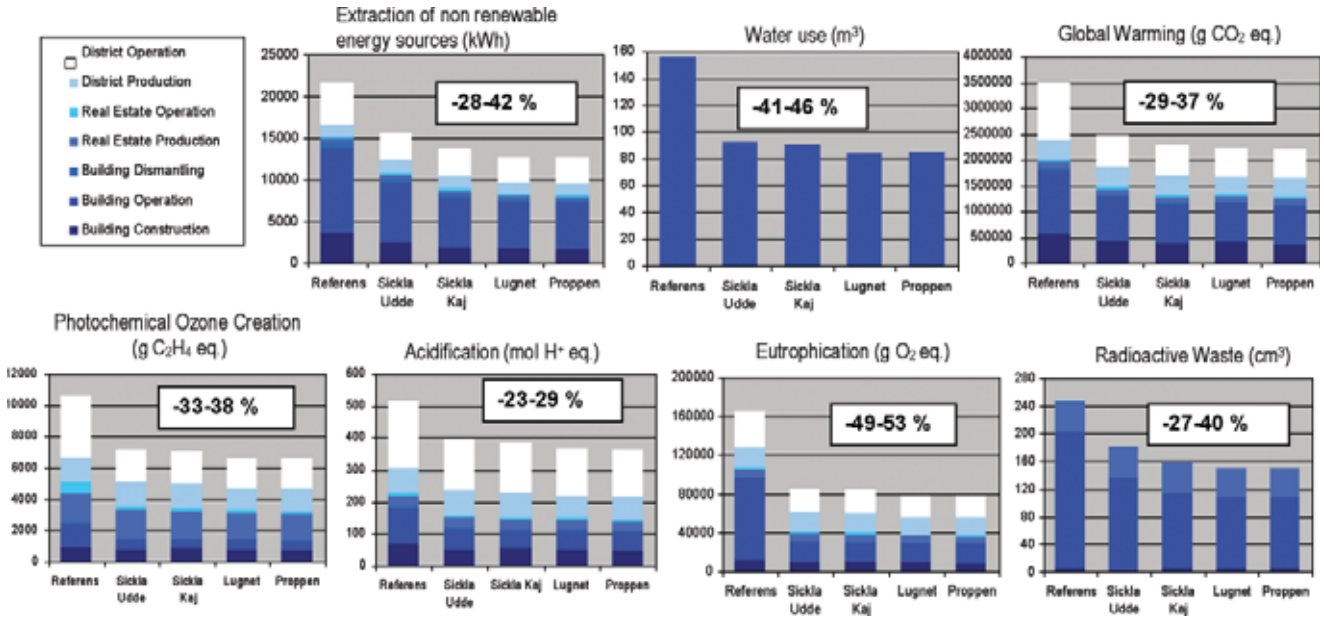


Figure 3.22 Monitoring Major Reductions in Environmental Loads, Hammarby Sjöstad, Stockholm

Source: Grontmij AB.

these companies had a vested interest because a power station and a wastewater treatment plant were located in the area.

A steering group composed of the executive officers of the departments involved and a cross-sector official management group have been active in the development of the project.[2] As a landowner, the city may initiate agreements and undertake contracts with developers. The city may specify various requirements depending on the issues that are important in each phase. Developers have contractual obligations to participate in the planning process (on the detailed development plan), the process of defining and implementing quality and design standards, and the implementation of relevant aspects of the environmental program.

The national level

The Hammarby Sjöstad project was partially supported by a national subsidy program that aimed to encourage municipalities to become part of an ecologically sustainable society, while providing project-related jobs in municipalities (Bylund 2003). The program lasted from 1998 to 2002 and allocated SKr 6.2 billion (€671 million) to 211 local investment programs involving 1,814 projects in 161 municipalities (figure 3.23). This national investment leveraged SKr 27.3 billion (almost €3 billion) from municipalities, businesses, and other organizations. Of this amount, SKr 21 billion (about €2.3 billion) were investments directly related to sustainability and the environment. It has been estimated that 20,000 full-time short-term or permanent jobs were created (Swedish EPA and IEH 2004).

A report of the United Nations (2004: 4) states that, according to local authority estimates, "the grants awarded to local investment programmes for the period 1998–2002 will lead to annual reductions in energy use by 2.1 TWh [terawatt hour] while carbon dioxide emissions will be reduced by 1.57 million tonnes per year (equalling 2.8 percent of Sweden's emissions) and landfill refuse deposits will be reduced by about 500,000 tonnes per year. Emissions to water will be reduced by 2,460 tons of nitrogen and 180 tons of phosphorous per year, which correspond to two percent and four percent, respectively, of the current total emissions to the sea."

The next phase

Lessons and experiences from Hammarby Sjöstad will be considered in planning and implementing Stockholm's new eco-profiled city districts. These new areas will use the latest environmental technology with a view to serving as a model of the sustainable city concept. Energy, transportation, lifestyle, and behavioral issues will be particularly important variables determining whether the project objectives will be met.

For instance, the Stockholm Royal Seaport is a new urban development with a unique environmental profile (figure 3.24). Developing a new ecologically sustainable district places extra demands on technology in the construction of houses, the use of efficient materials, and methods for handling energy. This urban development contains plans for 10,000 new residences and 30,000 new workspaces. Phase 1 started in 2009, and about 5,000 units will be developed over the next decade. The first residents will arrive in 2011.

The vision for the area may be summarized in three comprehensive objectives:

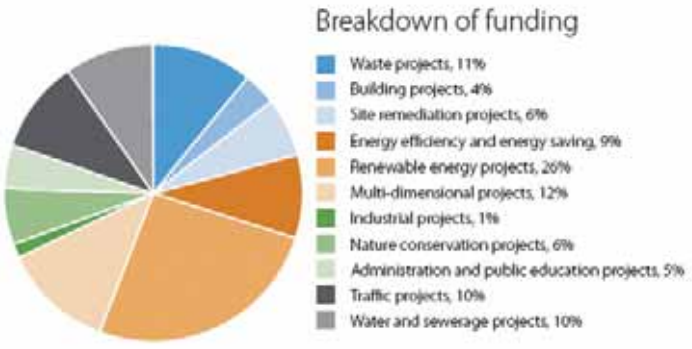


Figure 3.23 Local Investment Subsidy Program Funding across Types of Projects in Sweden

Source: Swedish EPA and IEH (2004).

Figure 3.24 Stockholm Royal Seaport: Vision of a New City District

Source: Lennart Johansson, Stockholm City Planning Administration.

1. By 2030, the area is to be a fossil-fuel-free city district.
2. By 2020, CO_2 emissions are to have been cut to 1.5 tons per person per year (CO_2 equivalent).
3. The area is to become adapted to the expected effects of climate change.

The project's focus areas are energy consumption and efficiency, sustainable transportation, climate change adaptation, ecocycle modeling, and the maintenance of high-quality lifestyles. Other important goals include implementation of a holistic and integrated process; constant evaluation and follow-up; and assessment and cooperation among private, public, and academic stakeholders.

Lessons Learned in the Stockholm Case

Great leadership in planning and implementing sustainable urban development strategies demonstrates Stockholm's strong commitment to sustainable development. Success in a project such as the one in Hammarby Sjöstad depends on good coordination among key stakeholders. For the project, Stockholm's various departments have been integrated into a single fabric led by a project manager and an environmental officer whose responsibilities have included guiding and influencing all stakeholders, public as well as private, to realize the environmental objectives of the project (Johansson and Svane 2002). Integrated planning and management through systematic stakeholder collaboration can lead to significantly greater life-cycle benefits.

After a few modifications, the ELP may serve as a decision-making tool in cities in developing countries in a fashion similar to the use of this ELP in the Swedish context. The ELP provides a systematic and standardized methodology to quantify the costs and benefits of the steps in development. For the application of an ELP in developing countries, one might propose the following:

1. Expanding the ELP to include assessments of other input variables, such as the impacts that efficient spatial planning, integrated land use, and the improved management of solid waste may have on output indicators.
2. Improving and fine-tuning the existing program by filling in gaps and streamlining the inclusion of the inputs. Moreover, the complete model needs to be adapted to large-scale use and adjusted to fit developing country contexts.
3. The outputs in the current ELP area are associated with environmental indicators, such as carbon emissions. Converting these indicators from environmental indicators to economic and fiscal indicators is necessary to help policy makers reach better decisions.

Notes

1. The departments included the City Planning Administration; the Real Estate, Streets, and Traffic Administration (now split into the Development Administration and the Traffic Administration); the City District Administration; and the Environment and Health Protection Administration.
2. The departments and companies involved included the City Planning Administration, the Development Administration, the Traffic Administration, the City District Administration, the Environment and Health Protection Administration, the Water Company, and the Housing Service Company.

References

Bylund, Jonas R. 2003. "What's the Problem with Non-conventional Technology? The Stockholm Local Investment Programme and the Eco-cycling Districts." In *ECEEE 2003 Summer Study Proceedings: Time to Turn Down Energy Demand,* ed. Sophie Attali, Eliane Métreau, Mélisande Prône, and Kenya Tillerson, 853–62. Stockholm: European Council for an Energy Efficient Economy. http://www.eceee.org/conference_proceedings/eceee/2003c/Panel_4/4214bylund/.

CABE (Commission for Architecture and the Built Environment). 2009. "Hammarby Sjöstad, Stockholm, Sweden." http://www.cabe.org.uk/case-studies/hammarby-sjostad.

Cervero, Robert. 1998. *The Transit Metropolis: A Global Inquiry.* Washington, DC: Island Press.

City of Stockholm. 2003. "Stockholm's Action Programme against Greenhouse Gas Emissions." City of Stockholm, Stockholm. http://www.stockholm.se/KlimatMiljo/Klimat/Stockholms-Action-Programme-on-Climate-Change/Downloads/.

———. 2007. "Vision 2030: A World-Class Stockholm." Executive Office, City of Stockholm, Stockholm. http://international.stockholm.se/Future-Stockholm/.

———. 2008. "The Stockholm Environment Programme." City of Stockholm, Stockholm. http://international.stockholm.se/Stockholm-by-theme/A-sustainable-city/.

———. 2009. "The City of Stockholm's Climate Initiatives." City of Stockholm, Stockholm. http://www.stockholm.se/vaxthuseffekten.

Fryxell, Stellan. 2008. "Planning Hammarby Sjöstad, Stockholm." Presentation at the Urban Land Institute, "Europe Trends Conference: Rethinking Tomorrow; Real Estate in a Fast Changing World," Stockholm, May 29.

Johansson, Rolf, and Örjan Svane. 2002. "Environmental Management in Large-Scale Building Projects: Learning from Hammarby Sjöstad." *Corporate Social Responsibility and Environmental Management* 9 (4): 206–14.

Swedish EPA (Swedish Environmental Protection Agency) and IEH (Swedish Institute for Ecological Sustainability). 2004. "Local Investment Programmes: The Way to a Sustainable Society." Investment Programmes Section, Swedish EPA, Stockholm. http://www.naturvardsverket.se/Documents/publikationer/91-620-8174-8.pdf.

United Nations. 2004. "Human Settlement Country Profile: Sweden." Division for Sustainable Development, Department of Economic and Social Affairs, United Nations, New York. http://www.un.org/esa/agenda21/natlinfo/countr/sweden/Sweden_HS.pdf.

USK (Stockholm Office of Research and Statistics). 2008. "Data Guide Stockholm 2008." USK, Stockholm.