# THE LONG ROAD TOWARDS SUSTAINABLE CITIES: THE DUTCH CASE

**Hugo Priemus**
*Research Institute for Housing, Urban and Mobility Studies, Delft University of Technology, The Netherlands*

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## Contents





## Summary

This contribution presents an approach to improvement of urban sustainability. We elaborate three pillars of sustainable urban systems: areas, actors and material flows. More specifically, we introduce the attractiveness of public transport infrastructure networks on the level of urban regions, and the opportunities of light rail. Urban district transport infrastructures have to be designed as a hierarchical system. A selective development of light rail at agglomeration level seems feasible and promising. Light rail could be the key to urban sustainability, as an effective instrument to generate synergy between high value public transport, real estate development and urban economic vitality.

## 1. Introduction

In this contribution we sketch the basics of an approach to improve urban sustainability, seen from a Dutch perspective. In section 2 we deal with the notion of the ecological footprint of cities and the carrying capacity of urban areas. Section 3 summarizes the three pillars of sustainable urban systems: areas, actors and material flows. In the sections 4, 5 and 6 we elaborate each of these three pillars. In section 7 we sketch the possibilities of an advanced public transport infrastructure in urbanized regions. Based on Dutch experience we introduce the attractivity of hierarchical public transport infrastructure networks and the opportunities of light rail, which could strengthen the economic vitality and accessibility of cities. In section 8 we formulate some conclusions.

## 2. The Ecological Footprint of Cities

In current Dutch spatial policy the key issue is combining housing, work, and services (Compact City policy). A one-sided focus on the compact city, however, may result in further pressure on the green areas in the city. They are pushed out of the city and become increasingly fragmented in the city itself. This occurs while it is becoming increasingly clear that environmental problems are concentrated in the city and that networks of greenery and water are needed in the city to increase biodiversity. Moreover, the availability of open-air recreation in the neighborhood where urban citizens live is important for their health and well-being. Furthermore, this form of functional mix also helps curb car-based mobility. The greater concentration and interrelationship of functions and larger level of scale in urban areas create opportunities for reducing the pollution of road traffic through high-quality public transport, more efficient energy consumption, and sustainable consumption patterns. For example, a recent Dutch study showed a positive relationship between living in a compact city and the degree of environmental friendliness of consumption behavior. This is caused in particular by more restricted car-based mobility and electricity consumption. Moreover, the share of services in the range of consumption activities appears to be greater in the city. This relationship remains significant when income and stage of life were taken into account in the analysis.

The bottlenecks mainly lie in the quality of the living environment in cities and the disturbing influence of cities on the ecology of the outer area. As a result of the high concentration of functions, the environmental pressure per spatial unit is high. In addition, nuisance is substantial because the functions of housing, work, and recreation are mixed. The living environment in cities is under great pressure through increasing nuisance, pollution, and lack of open green areas. There is more nuisance in urban areas, in particular in old urban districts, and people living in these areas often feel less healthy and more dissatisfied with their housing situation. Satisfaction with the living environment is lower in cities than elsewhere.

Various concepts, such as environmental capacity, the Bubble concept, and the ecological footprint are used to make the total environmental pressure measurable, visible, and communicable. The ecological footprint represents the land use (for a country, a city, a person or a household). Not only is the direct land use of the buildings

and infrastructure calculated, but also the space required for the production of the resources used (agricultural products, wood/paper, etc.) and for compensation of the $CO_2$ emissions from fossil energy. Although many environmental aspects have not been included in the ecological footprint (e.g. pollution, and ecological exhaustion of non-renewable resources), the concept gives a good indication of the space our current consumption and production patterns claim. Every city lays claim to space outside its borders. There, energy is generated, water collected, food produced, and waste material disposed of. Many urban dwellers find recreation and work there. For the Netherlands as a whole, actual land used would be fourteen times as large as the Netherlands itself. The aim of an ecological city should focus on the reduction of this ecological footprint, so that environmental problems are transferred to other areas to a lesser degree.

## 3. Areas, Actors and Material Flows: The Three Pillars of Urban Sustainability

Dutch environmental policy in the last few decades has been effective in some respects and has reduced the emission of certain polluting substances. However, there is still no absolute disconnection of environmental pressure from economic growth as formulated in the objectives. As a result of continued economic growth, the environmental advantage will be more than compensated for in many cases by the expected volume growth, so that environmental pressure will show a further increase. The most important bottlenecks occur in environmental problems related to energy consumption (greenhouse effect, NOx, fine particulates, acidification, etc.). In many urban areas, further urbanization and mobility both exert great pressure on space and cause such problems as noise nuisance and air pollution, safety risks and damage to nature and landscape. The key to the reduction of environmental problems is to be found in the way we develop, manage and make use of our cities.In the urban habitat it is possible to distinguish three aspects of the urban system: people, the places where they live, and the material flows maintaining the relationships between people, and places. It seems fruitful to draw a distinction with respect to areas, material flows, and actors:

- *Areas* can be defined as the stage on which people live, work, move, and enjoy recreation. Area concerns the location and physical manifestation of the city. Areas are places with certain spatial qualities. The biodiversity defines the relationship between areas and the people, animals and plants living there.
- *Actors* use, manage, or develop areas. The features of the areas provide the actors with certain conditions for their behavior. A change in the development of areas may bring about a change in the behavior of actors. The actors or participants maintain relationships with the areas and with each other through information, communication, and cooperation. The behavior of the actors also determines the sustainability of an urban system.
- *Material flows* mutually connect areas and actors. This connection also applies to urban systems. Material flows may be influenced by changes in the development of areas and the behavior of actors. It is important, if sustainable development of the city to be realized, for material flows to be transformed into cycles.

The success of environmental measures depends on the degree to which the behavior of actors can be influenced through production and distribution. The behavior of actors

also determines the outward appearance of a city. The classification of an urban system according to areas, actors and material flows forms the basis for an overview of measures capable of increasing the sustainability of urban systems.

## 4. Areas

Natural environmental, spatial-economic and ecological features all have an important part to play in the environmental pressure exerted on an area and its sensitivity to such pressure. The features of areas vary markedly between cities and within cities, so that areas impose different conditions and opportunities for sustainable development; local tailor-made solutions are required. The spatial development of an area and the activities developed within it will have to be geared to these features. The ecological features of areas determine sensitivity to pollution and the resultant environmental quality. The type of soil determines the degree to which waste substances placed on the soil leach into it and the surface water. Soil type also determines the behavior of contaminating substances in it. On sandy soils, these substances leach more rapidly into the groundwater. They are then absorbed by crops and transferred to the soil. The risks of soil contamination and the possibilities and expenses of cleaning-up operations are closely related to these aspects. Furthermore, the type of soil has a great influence on the hydrology through differences in infiltration capacity and the capacity to retain moisture. The sensitivity to desiccation and pollution as a result of the inlet of non-regional water is closely connected to this.

Geomorphology, soil and hydrology are inextricably entwined with each other as a basis for the landscape pattern. They exert a major influence on the presence and opportunities for natural systems and the development of areas. Sustainable natural development requires the use of locally available qualities. Taking into account the existing patterns of soil, water level and relief and making use of them can save construction costs. Considerable expense can be avoided by gearing soil quality and purpose to each other from a spatial perspective. Promoting natural development not only creates a high-quality environment for the current generation, but also lays the foundation for a more solid ecological structure. The central element of a national nature policy is maintaining and increasing the diversity of species in nature. It is important to maintain and improve the ecological zones that connect the ecological core areas. In the urban environment an ecological network is a major condition for a rich flora and fauna. According to the 'island biogeography theory' the chances of survival of a species decline as the available area decreases and the corridors between (possible) habitats disappear. This cries out for the development and management of continuous water and green structures of a certain scale, within urban areas as well as without. The dilemma of the compact city is that a number of categories of environmental effects (such as biodiversity) benefit from a certain spatial spread of the urbanization, while other effects (such as the restriction of mobility) benefit from a concentration of activities in the city. The main issue is to find a good balance between spatial concentration and dispersion.

Sustainable cities have an open network structure of interconnected terrestrial and aquatic habitats, so that the compact city should be put into perspective. A transformation will have to be made towards compact regions with a more network-like,

polynuclear structure, with veins of green and water structures. This involves introducing parks and landscapes in urban areas, and creates conditions for a higher degree of cost coverage for public transport. In the urban development approach to an area, a distinction is often drawn between red (developed) and green (undeveloped) areas. The principle of the compact city should not mean that all the red areas are concentrated, while the green around these red areas remains unaffected. In conformity with the ideas of urban landscapes, a combination of red and green structures is desirable, so that the biodiversity may also be high in urban areas and residents can enjoy open-air recreation in the vicinity of their homes. The presence of green is a pre-condition for sustainable development. A green environment is (literally) of vital importance: trees and plants supply oxygen. Without green areas, a city has a dusty and dry microclimate. In a more humid climate the temperature fluctuations are less large. Without green areas a city is incomplete. Flora and fauna stimulate the way residents experience the environment. Moreover, flora and fauna may limit the harmful effects of human activities. For a number of plant and animal species the urban environment is an important habitat. Planting may serve as a windshield and dust collector. In summer a row of trees may serve as a sun shield, while in winter when the trees lose their leaves sunlight may reach the house. Vegetation on a house front prevents graffiti (limiting cleaning costs). Vegetable gardens and fruit trees have an educational and productive value. Organic waste material (garden waste) can be composted and used later as fertilizer.

A flexible plan for a building can be adapted to developments with respect to living, work, recreation, forms of transport, energy supply and waste processing. A sustainable and flexible plan takes into account that the purpose of a building may change during its life with respect to its use. In this case no expensive adaptations are necessary. This also reduces the use of materials. Within built-up areas a relatively high building density is desirable and a wide range of services is required to limit the encroachment of the buildings on green areas, promote cycling and public transport and restrict car-based mobility. The findings differ with regard to the relationship between housing density and car-based mobility. Some researchers establish a weak positive effect between moving to large development locations and commuter kilometers covered. In other research no relationship between housing density and car-based mobility has been observed. People should be able to live without nuisance from industry or traffic. The pollution of air, water and soil must be limited. Nuisance in the form of noise and odor must be prevented. Measures against nuisance may be source-oriented, or effect-oriented. While source-oriented measures are preferable it is often only possible however to take effect-oriented measures.

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## Biographical Sketch

**Hugo Priemus** (1942) was educated as a building engineer (architecture), Delft University of Technology (1965; cum laude). He published his dissertation, 'Housing—creativity and adaptation' in 1969 (in Dutch) and he completed his doctoral examination in General Economics at the Erasmus University Rotterdam (1975; cum laude). He was Professor of Housing at Delft University of Technology from 1977 to 2003, and Managing Director of OTB Research Institute for Housing, Urban and Mobility Studies at the University from 1985 to 2003.

His current responsibilities include:

Since 2003, Professor of Systems Innovation Spatial Development, Delft University of Technology, and since September 2003, Dean of the Faculty of Technology, Policy and Management, Delft University of Technology

- Visiting professor Department of Urban Studies, University of Glasgow;
- Chair Editorial Board European Journal of Housing Policy;
- Member Editorial and Advisory Board Open House International;

- Member National Advisory Commission on Spatial and Infrastructure Planning of the Social-Economic Council (SER-RIB), The Netherlands;
- Member of the Advisory Board Tender Investment Projects Provinces (TIPP).

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