Encouraging walking, the role of urban design

Experiences of the EU- ECOCITY project

Uwe Schubert
Institute for Regional Development and Environment, Vienna University of Economics and Business Administration, Nordbergstraße 15, 1090 Vienna, Austria. E-mail: uwe.schubert@wu-wien.ac.at

Franz Skala
Institute for Ecological Urban Development, Gerhardusgasse 26, 1200 Vienna, Austria

Abstract

The central proposition of the multi-national ECOCITY project to promote walking is the development of an urban design of “short distances”. Only if the most important destinations to be covered on a regular basis are within walking distance and can be reached safely and in comfort, can potential pedestrians be convinced to walk instead of driving.

The ECOCITY project carried out in the context of the 5th framework program (City of Tomorrow) consisted of essentially 2 parts :

-development a planning theoretical concept for the creation of new urban quarters on the basis of a “sustainable urban development “postulate

- the design of master plans following this concept.

The most important characteristics of an ECOCITY can be summarised as follows:

*An **ECOCITY** is composed of compact, **pedestrian-oriented**, mixed-use quarters or neighbourhoods, which are integrated into a polycentric urban system in **public-transport-oriented** locations and mainly composed of **solar-oriented** buildings. In combination with attractively designed public spaces, that integrate green areas and objects of cultural heritage to create varied surroundings, an ECOCITY should be an attractive place to live and work. Such **sustainable and liveable structures** contribute to the health, safety and well-being of the inhabitants and their identification with the ECOCITY.*

The contribution to the conference consists of introducing the concept with a special emphasis on “walking” and the key features such new quarters have to exhibit to make them truly “pedestrian” and oriented on public transport for medium and long distance coverage. In addition the master plans for some of the case study areas will be discussed that offer interesting and diverse solutions within the paradigm developed.

Biography of the Authors

Uwe Schubert studied law and economics in Vienna and San Diego, California. His main research fields are urban development, environmental economics and policy. He is professor emeritus in environmental economics at the Vienna University of Economics and Business Administration.

Franz Skala studied civil engineering at the Technical University Vienna. His research focus has been on transport and the environment. He is co-author of publications in the field of transport and environment and has co-operated in several multi-disciplinary studies.

Encouraging walking, the role of urban design

Experiences of the EU-ECOCITY project

Uwe Schubert
Institute for Regional Development and the Environment, Vienna University of Economics and Business Administration (Vienna, Austria)

Franz Skala
Institute for Ecological Urban Development (Vienna. Austria)

Introduction

How can mobility, i.e. the ability to reach a great number of destinations within the shortest possible time while covering the shortest possible distance, be preserved without violating the principles of sustainable development?

- By designing urban patterns not making mobility dependent on vehicles requiring large energy inputs.
- By designing urban patterns allowing to rely on a human being's own legs to the greatest extent possible.

The decision on urban patterns is of special importance for sustainable urban development because of its strong connection with the volume of induced traffic and the energy consumed. Corrections are very difficult and costly due to the slow change rate of the existing building stocks (unsustainable developments cause long-term problems).

It is mandatory, hence, to rely on the least energy consuming mobility mode: walking. Urban patterns appropriate for walking are a key element for designing an Ecocity as well as for its liveability.
In the present contribution an attempt is made to put the question of how to encourage walking into the wider context of sustainable (specifically "urban") development. The paper draws predominantly on the results of an international project sponsored by the EU (5^{th} framework programme) and national resources of the countries having participated.

The basic tenet of the study is that urban design and the resulting urban spatial pattern constitute an essential element of plans to achieve sustainability.

The paper is opened by a short paragraph on the view held by experts as the most important shortcomings of the present situation characterised by only a small share of walking in the total number of trips. Suggestions made to improve the situation and examples of actually implemented plans are sketched in the following section. The ECOCITY project is introduced next, followed by the most important principles developed for urban design for sustainable development in general and encouraging walking in particular. The Austrian case study (Bad Ischl) is used to demonstrate their practical applicability. A short summary and outlook end the contribution.

Encouraging walking, problems and suggestions for improvement

The following table gives an overview of problems related to walking and some first possible answers by planners.

Table 1 Problem clusters and corresponding solution families (adapted from Rauhala 2007)

Problem Clusters		*Solution Families*	
A	Lack of or scarce provision of physical and social space	A1	Give priority to pedestrians in transport planning
		A2	Each Municipality should have a pedestrian policy
		A3	Living streets day and night
B	Lack of equipment and services in outdoor spaces	B1	Public space as a living room
		B2	Implementation of policy regarding localisation of facilities
C	Interference with motor vehicles	C1	In each development, considering that you have to move as a pedestrian and not only as a car driver
D	Poor support by and connection to other modes of transport	D1	Public transport for all
E	Poor natural, architectonic and psychological features of the environment	E1	A green network in every city
		E2	Pedestrians always have to feel at home
F	Poor environmental performance	F1	Integrate pedestrian scale in the city design
		F2	Noise control standards for outdoor spaces
		F3	A clean and healthy outdoor space

For additional information see the EU-projects PROMPT and WALCYNG [1].

The ideas and discussion of the last decades, what an “attractive” and “sustainable “ settlement is and which elements are important in the evolving concepts can be summarised in the following graph (Figure 1)

In this contribution the emphasis is on “pedestrian”, “car-free” and “ecological” concepts developed. In the following brief overview some of the ideas considered and (at least partially) implemented are summarised.

[1] PROMPT (2003), New Means to PROMote Pedestrian Traffic in Cities. EU 5.FW: Energy, Environment and Sustainable Development, Key Action 4: The City of Tomorrow and Cultural Heritage. Oraniemi, Finland, VTT Building and Transport. Available at http://prompt.vtt.fi.
WALCYNG (1998), How to enhance WALking and CYcliNG Instead of Shorter Car Trips and to Make These Modes Safer. EU 4.FW-DGVII Transport RTD Programme. Lund University, Sweden, Department of Traffic Planning and Engineering, and FACTUM Chaloupka, Praschl & Risser OHG, Vienna, Austria. Available at http://www.cordis.lu/transport/src/walcyngrep.htm.

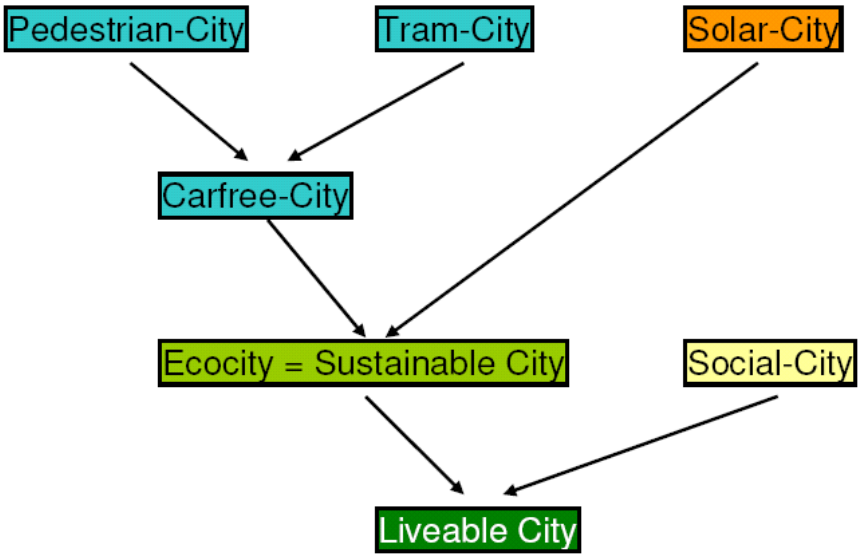


Figure 1 Elements of a Sustainable and Liveable City

Steps towards an Ecocity – examples of implemented models

Two prominent examples of urban quarters are presented in this section :

Car-free Settlements

Essential characteristics:
-sectoral approach
-mostly smaller projects - blocks of houses or single multi-storied buildings
-good accessibility of necessary infrastructure facilities (retail) and public transport
-greatly reduced ownership of cars as well as number of parking spaces, often providing a car-sharing-service

The largest existing example is “GWL-terrein”, Amsterdam (see figure 2 A)

“GWL-terrein” (completed 1998)

District of Westerpark, Amsterdam, Netherlands
600 dwellings (rental, ownership) and several businesses in an area of about 6 ha
http://wwwistp.murdoch.edu.au/publications/projects/carfree/carfree.html#gwl%20terrein
http://www.gwl-terrein.nl/ (only Dutch)

Figure 2 A Car-free Settlements, GWL-terrein
Source: http://www.gwl-terrein.nl/gWLTerrein/plattegrond/index.html

Ecological Model Quarters

-An integrated approach
-larger projects including ecological solutions for most relevant sectors (mixed use structure, transport, energy, social aspects etc.)

An acknowledged example is Vauban (see figure 2 B)

Vauban

Freiburg, Southern Germany
About 5000 inhabitants in an area of about 42 ha
The urban quarter of **Vauban** was built following ecological principles and has proved to be very attractive for its inhabitants and has particularly encouraged walking (for details see: http://www.vauban.de/info/abstract.html).

Figure 2 B Ecological Model Quarters, Freiburg Vauban
Source: Der Freiburger Stadtteil Vauban, CD von Forum Vauban e.V., Freiburg

The ECOCITY project, a brief introduction

In the following paragraphs a short overview of the ECOCITY project (for details see ECOCITY Book I (Gaffron, Huismans, Skala 2006)) is presented.

The main goal of the project was to develop settlement patterns for sustainable cities (ECOCITIES), emphasising the implications for an environmentally compatible transport system and implying higher quality of life and reduced consumption of resources.

To intensify the implementation of agreed principles and to demonstrate the feasibility and desirability of future urban living compatible with sustainability requirements, model settlements for specific sites in the 7 participating municipalities in Europe were designed.

Figure 3 ECOCITY Case Study Sites

The map shows the participating cities and towns.

Principles of an ECOCITY

In the framework of the project a set of principles was worked out which are mandatory for sustainable urban development.

Most important is designing structures appropriate for

pedestrians, cyclists and **public transportation,**

as well as providing for efficient **distribution logistics**

(To consider efficient energy supply requires additionally structures appropriate for solar architecture and the utilisation of renewable energy sources).

The guiding principles for designing (or retro-fitting) new quarters in urban places were summarised in a “Vision of an Ecocity” (figure 4 below).

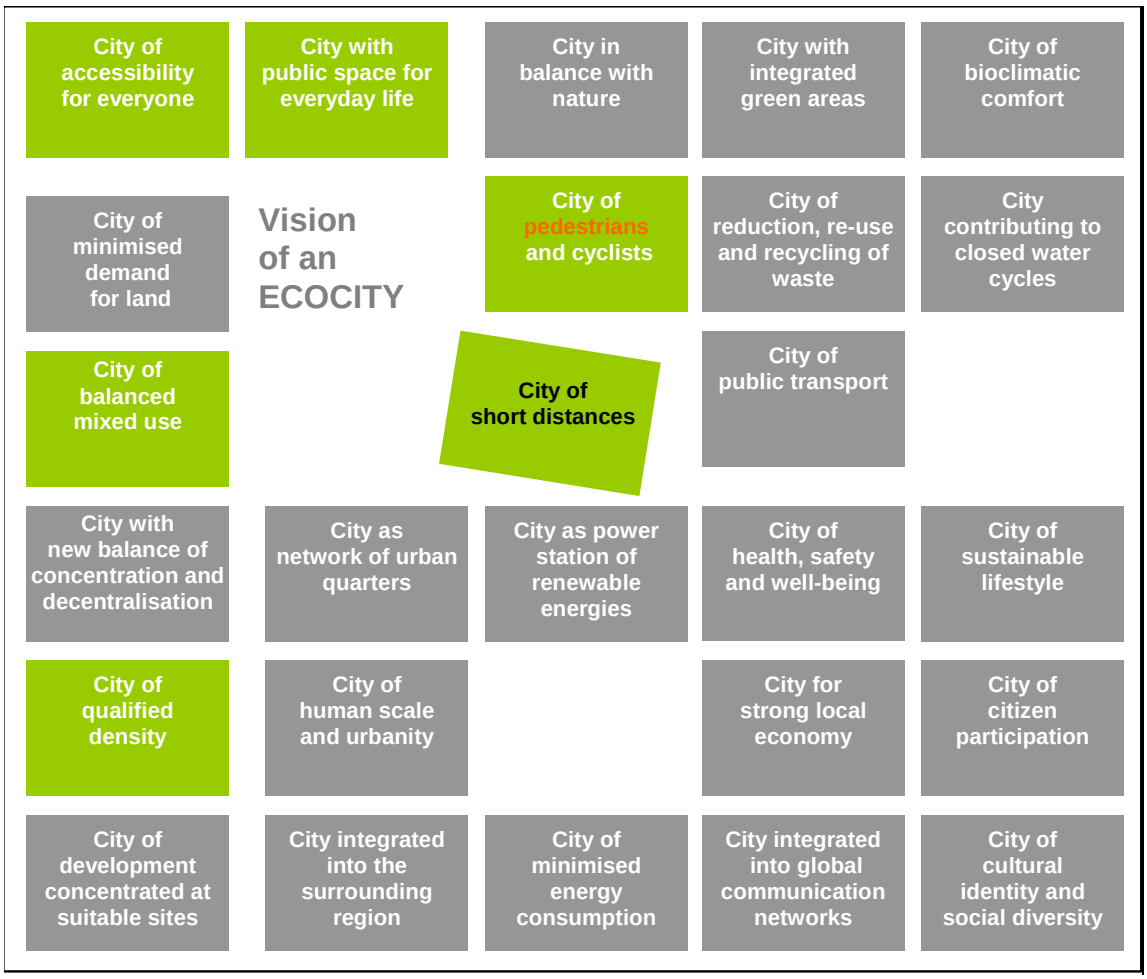


Figure 4 The Vision of an ECOCITY

Despite the fact that these elements of the vision of an Ecocity are all dependent on each other to some degree, some of these can be seen as central to answer the question as to which characteristics are indispensable to make a settlement attractive for walking (marked in green).

Looking at the figure above, **short distances** imply a high **accessibility** of the most essential destinations of everyday life for everyone (job, education, shopping, etc). This postulate can only bet met by a **qualified density** and **mixed land-use**. These distances are more likely to be covered walking if they take place in an attractive

environment, both in terms of the buildings, public spaces as well as the natural environment (**integrated green areas**, etc.). **Safety** and **bioclimatic comfort** have been identified as essential factors favouring commuting on foot.

How can planning contribute to the provision of these elements in urban places? The following section indicates the most important measures identified in the ECOCITY project to be taken into account.

Characteristics and measures making the urban structure appropriate for pedestrians

The most important measures to create and/ or enhance the characteristics desired were identified in the project.

Accessibility (see figure 5, next page)

In urban planning accessibility is defined by the time necessary to reach a desired destination. This time depends mainly on the physical distances between origin and destination but also on travel velocity. Maximising accessibility could thus in theory be achieved by increasing velocities. Since the inherent problems of the transport system (e.g. congestion) as well as the uneven availability of private cars and general sustainability requirements (including minimising pollution and energy consumption) set very definite limits to this option, the preferred alternative is to decrease the distances people need to cover.

Thus, in the context of the ECOCITY, good accessibility is understood as the provision of necessary facilities near in space and time, complemented by the availability of high-quality, environmentally compatible transport links (direct pedestrian and cycle routes free of obstacles and attractive public transport routes).

Qualified urban density

It can be achieved by balancing the requirements for

- reducing demand for land
- achieving short distances (minimising transport demand)
- promoting the viability of attractive infrastructure facilities (e.g. district heating systems) and public transport services, reducing the cost of their provision,

with the requirements of

- sufficient distance between buildings for day-lighting and utilisation of solar energy (and / or shading, depending on location and climate) and
- sufficient open and green space for social contact and recreation near the dwellings, minimising the area taken by the transport infrastructure.

Balanced mixed-use

It is achieved by organising a balance of residential, employment and educational uses as well as facilities for the supply of goods and services and recreation on all different levels - from buildings and blocks to neighbourhoods and quarters, city and region. Space needs to be provided for the following facilities:

- at the level of neighbourhoods and for basic daily needs: grocery, pubs and restaurants, kindergarten, primary schools, general practitioner, community and leisure facilities
- at the municipal or regional level and for medium- and long-term needs: e.g. specialised retail and gastronomy opportunities, higher schools and higher education institutions and hospitals

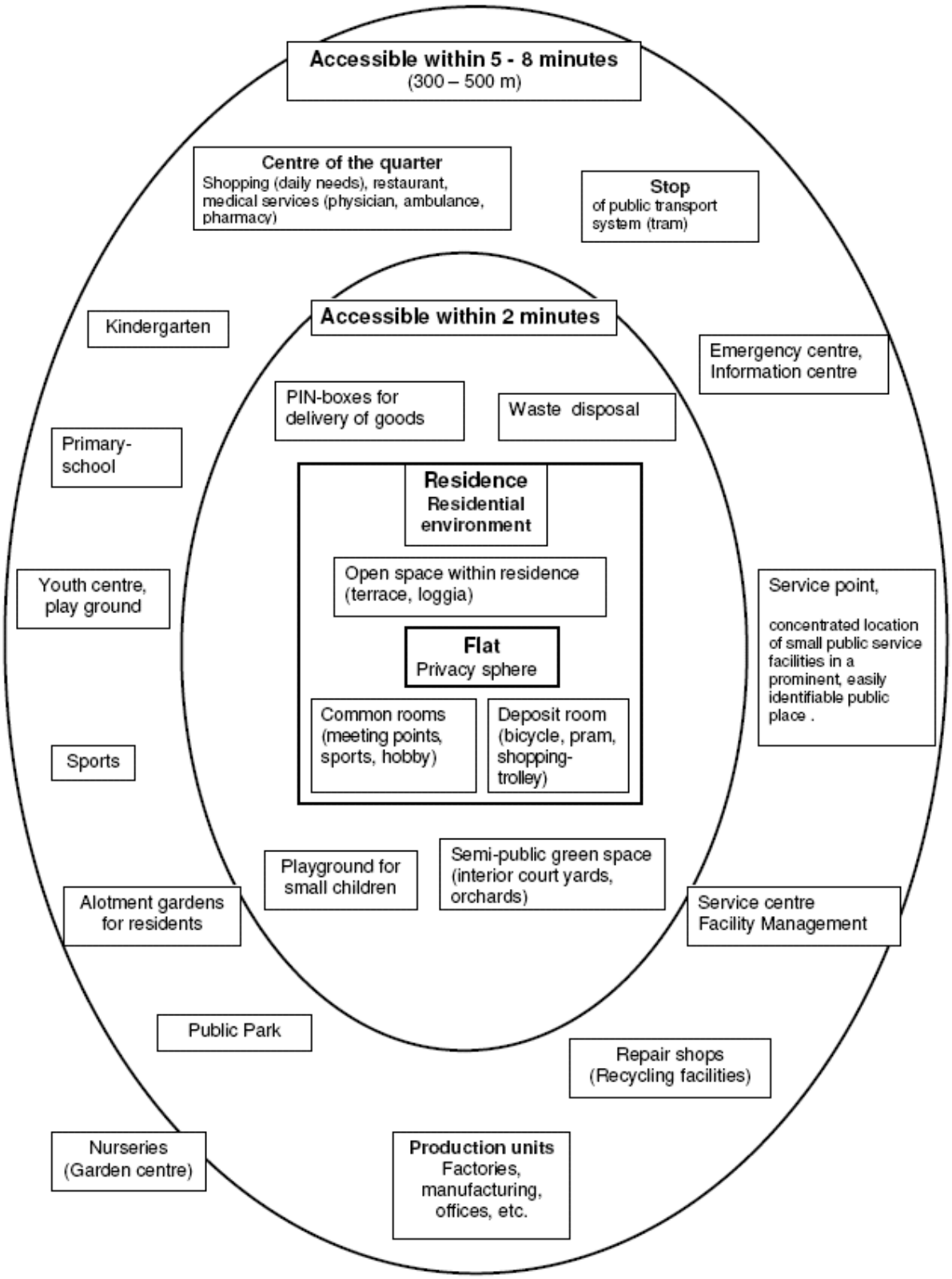


Figure 5 Accessibility and location of important facilities
Source: Arbeitskreis krisensichere Versorgung, Vienna 2007

The size, number and variety of such facilities should be in balance with the size of the neighbourhood. Ensuring their availability needs careful location management similar to that of shopping centres. Experiences from these also show the importance of "attractors", which serve the entire community (such as special shops, educational or leisure facilities suitable for an ECOCITY). The urban and building structures should offer sufficient variability and flexibility to allow adapting the uses to changing demands.

Attractive and liveable public space

The objectives for designing public space are (Mayerhofer, Skala 2005):

Allocate sufficient public spaces close to living and working environments as a network of various types of squares, streets and green areas in a balance with semi-public and private space. Plan this network as an interconnected system and avoid visual barriers

Design open space elements and buildings in a high aesthetic quality with changing attractions along spatial sequences (water design, surfaces in streets and squares, urban furniture, facades, etc.), integrating different fabric types and building types, considering the genius loci

Provide an attractive infrastructure for pedestrians - continuous weather protection (arcades, passages, roofed pavements) along the main routes, benches/seats etc.

Create opportunities for communication by providing places for people to meet, essential for strengthening the neighbourhood identity

Design the urban structure and details of public space for easy orientation, planning:

- a clearly arranged pathway network – hierarchy of ways towards the centre
- impressive land marks (signs) – elements of local identity (buildings, monuments) especially at crossings
- a guiding system: signposts on squares, street signs (names of streets) at each crossing, well visible house numbers, public maps

Dedicate public spaces as far as possible to pedestrians and minimise disturbance by car traffic, especially regarding safety and noise conditions.

Short description of concepts developed for the seven ECOCITY model settlements

The vision and the objectives for an ECOCITY formulated above are very ambitious. They set standards and describe a target state, toward which urban development should head. The concepts for the model settlements developed within the ECOCITY project meet these standards to different degrees, each having their own specific strengths and showing possible steps towards an ECOCITY. If these solutions fulfil the expectations can only be found out after the implementation of the plans.
The seven concepts are described in further detail in ECOCITY Book I (Gaffron, Huismans, Skala 2006).

GYOER

municipality:
130 000 inhabitants

Ecocity site:

about 11 000 inhabitants

brownfield development

The availability of an abandoned industrial area offers the opportunity for a long-term urban development adjacent to the historical city centre, but also to the green belt of the Danube river bed.

TAMPERE

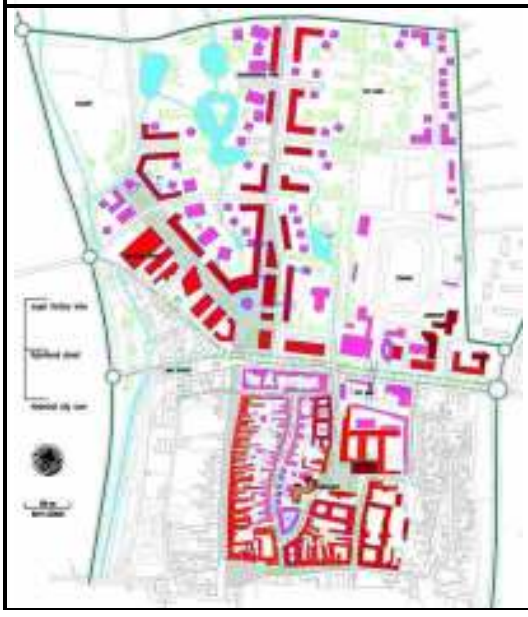
municipality:
198 000 inhabitants

Ecocity site Vuores:

16 000 inhabitants and employees

greenfield development

The Vuores greenfield area was selected to concentrate urban development in an area at the edge of Tampere (with parts also in the neighbouring municipality) instead of quite uncontrolled sprawl all around the city.



TRNAVA

municipality:
70 000 inhabitants

Ecocity site:

3000 new inhabitants, urban renovation and brownfield development

An existing part of the historical core was selected as site for an improvement of urban structure and the transport system combined with redevelopment of a neighbouring industrial site (brownfield).

TUEBINGEN

municipality:
70 000 inhabitants

Ecocity site:
about 3300 inhabitants, densification, brownfield and greenfield development

The Ecocity site encloses three different types of areas at medium distance from the town centre. In a participative planning process two scenarios were developed and brought together in the final masterplan.

UMBERTIDE

municipality:
15000 inhabitants

Ecocity site:

1350 inhabitants,

urban renewal project

The project focused on the development of an urban district around the local railway station linked with the historical city, in order to create a central node for the modern city and its mobility needs.

BARCELONA

municipality:
1.5 million inhabitants

Ecocity site Trinitat Nova:
1045 new housing units replacing 891 ones to be demolished
urban renewal project on a brownfield site

Trinitat Nova, on the outskirts of Barcelona,, is one of the areas of social housing created during the 1950s.
(only the part “urban and environmental planning” was worked on within the ECOCITY project)

Figure 6 Ecocity Concepts for 6 municipalities

The example Bad Ischl

The way the vision of an Ecocity of short distances can be realised is briefly analysed in the frame of the case study master-plan developed for Bad Ischl in Austria. This example is used in this contribution as the authors of the paper were directly involved in the study.

BAD ISCHL

municipality:
14 000 inhabitants

Ecocity site
Planned for about 2000 inhabitants, greenfield development
The site for the ECOCITY model settlement was selected to reinforce the development axis between the centre of Bad Ischl and the neighbouring communities Strobl and St. Wolfgang.

Figure 7 Ecocity Concept Bad Ischl, Location of Site

As an alternative to urban sprawl a new compact sub-centre for the community was designed within a radius of 300 m around the stop of the public transport line in the centre, on the main axis.

Key elements of the concept:

- location of facilities, necessary for a balanced mixed use in a central area to create short distances from all parts of the sub-centre and to allow easy trip chaining
- locating facilities, which are connected with transport of goods (supermarket, business yard, logistics centre), near the access to the main road passing by the edge of the site
- design of a liveable public space, providing a barrier-free network of pathways and squares by keeping car traffic in garages on the edge of the settlement
- conserving sensitive parts of the greenfield site (e.g. a small creek and its typical vegetation, green corridors, small forests) and integrating them into the settlement pattern
- giving priority to attractive multi-storeyed residential and commercial buildings with appropriate height (maximum 4, minimum 2 storeys) and with high insulation standards, most of them oriented to the South to promote the use of solar energy, thus minimising heating demand
- concentrating small public services in “service points” within public space to make these services easily and quickly accessible.

The following figures show the master-plan (Fig.8) and the details of the green space- (Fig.9), density- (Fig.10) and mixed use (Fig.11) concepts to illustrate the “Characteristics making the urban structure appropriate for pedestrians” presented above (p. 8).

Figure 8 Master-plan Bad Ischl

Figure 9 Green and Open Space Concept

Figure 10 Detail of density profile

Facilities

1 Hotel
2 Gastronomy
3 Shopping Mall
4 Shops, Services
5 Kindergarten
6 Cultural Center
7 School
8 Business Yard
9 Logistic - Center
10 Cogeneration Plant

0 100 200

M= 1 : 7500

Location of mixed use facilities
(1 – 10)

Figure 11 Mixed use facilities

Infrastructure for Pedestrians and Cyclists in the Eco-City

The pedestrian and cycling pathways of the Ecocity are integrated into the existing network in the surrounding settlements.

The Eco-City area in principle is free of car traffic. There are only exceptions for emergency-vehicles, some deliveries and waste collection. The cars of inhabitants are parked in garages on the edge of the area near the interregional road. Good bus connections to the city centre of Bad Ischl and to the railway station as well as to the lake Wolfgang and Salzburg (may be in future as a light rail system) and attractive and safe conditions to walk and to use bicycles for every day mobility should stimulate car-free living in the Eco-City. For occasional demand for car-use car sharing and good conditions for car-renting should be available in the Eco City.

Key elements of other concepts, linked with walking:

Examples of good solutions for pedestrians from two other towns are shortly mentioned below:

Tübingen

- urban development around stops of a light rail-line planned on existing tracks as part of a region-wide network, which will connect the site with the town centre
- attractive underpass under the railway tracks connecting the densification area with the car-free area on greenfields, forming an axis along which mixed use facilities are located

Umbertide

- design of a new multifunctional “bridge”-station as a core of the new urban development linking the (today marginal) project area to the medieval and the contemporary city

Summary and outlook

The question as to what makes a settlement attractive for pedestrians can be answered in a nut-shell:

A compact city of short distances, achieved by:

- An appropriate/qualified urban density given by attractive multi-storied buildings

- Mixed land use, characterised by a well balanced ratio of residential and business use. Location of necessary facilities, particularly for everyday needs, in a central area to create short distances from all parts of the quarter allowing combined trips

- Limitation of the total area for a quarter, roughly defined by a 300 m radius around the centre.

Attractive public space characterised by:

- A net of streets and squares with buildings showing varied facades as well as open space elements and architecture in a high aesthetic quality

- Limitation of automobile traffic to only absolutely indispensable trips within the quarter

- Pathways for prams, wheel-chairs and shopping trolleys free of obstacles

- Seamless weather protection for pedestrians (arcades, etc.), particularly in the central area.

Benefits

Living in an Ecocity, attractive for pedestrians and users of public transport creates many benefits for the stakeholders involved. The following table 2 shows a brief overview.

Table 2 Transport and land-use related benefits for different actors in an ECOCITY

Benefits for from	the public sector	the private sector	residents	the (natural) environment
Appropriate patterns for pedestrians (compact high density, mixed use structure)	less spent per capita on infrastructure and utilities than typical suburban development	more customers in the nearby catchment area	good accessibility of necessary elements of a liveable environment	less land demand; lower energy consumption and emissions (gases, noise, particulates)
Appropriate patterns for public transport (linear polycentric structure)	less subsidy demand for operating costs of public transport	increased cost recovery for the operating company due to higher passenger potential	attractive timetable of public transport with short intervals	lower energy consumption and emissions (gases, noise, particulates)

For the general public an ECOCITY offers reduced air and noise pollution and a lower risk of injuries by traffic accidents. There is more space for people in an attractive, quiet, safe and wholesome environment (car-free streets and squares, a great variety of green areas), promoting a slower-paced, more relaxed, wholesome and thus more sustainable lifestyle. This allows more personal interaction with neighbours, resulting in the presence of more people in public areas, thus creating a greater sense of community and possibly lower crime rates.

Living in close proximity to various facilities in mixed-use neighbourhoods means shorter routes to public transport stops, to jobs, to school, for shopping, recreation, etc., thus saving time and energy. Varied green areas (an important factor for residents' satisfaction), integrated into compact settlements as well as the surroundings are easily accessible and solar architecture provides convenient temperatures and daylight for high indoor comfort. A balanced social mix and social services and facilities for all groups of residents foster their well-being.

These benefits can be experienced by all people, but they are of additional importance for some individual groups: ECOCITY patterns privilege **non-drivers** (who are disadvantaged by car-dependent transport and land use patterns), increasing their mobility and accessibility options. An internal pathway system free of private cars and barriers but with sufficient social control combined with short distances, creates an attractive and safe environment for **children** (to play safely outdoors and walk on their own) as well as for the mobility of **senior citizens** and the **handicapped**. [2]

The attempt to build an Ecocity attractive for pedestrians, however, tends to encounter many obstacles. The most prominent among these are linked to the widespread public attitude that life in a neighbourhood where each dwelling is not directly reachable by private automobile is not attractive. Frequently the legal frame, supposedly acting in favour of the citizens, has made the creation of car-free areas legally difficult. The provision of reduced parking space is even often not possible by the same token.

References

Gaffron, P., Schubert, U., Skala, F. and Wagner, T. (2007), Planning Urban Structures for Sustainable Transport. *In Land use and Transport - European Research Towards Integrated Policies,* Marshall S. and Banister D. (eds.), p. 71-103. Oxford: Elsevier.

Gaffron, P., Huismans, G., Skala, F. (eds.) (2005). *ECOCITY Book I 'A better place to live'.* Hamburg, Utrecht, Vienna

Gaffron, P., Huismans, G., Skala, F. (eds.) (2006).*ECOCITY Book II, 'How to make it happen'.* Hamburg, Utrecht, Vienna'

Mayerhofer R. and Skala F. (2005); Objectives for a Transit Oriented Ecocity Development, Full paper available from: http://www.oekostadt.at/docs/AESOP_Beitrag.doc [Accessed 18 September 2007].
Abstract in Voigt, A. and Kanonier, A. The Dream of a greater Europe: Book of Abstracts of the International Congress AESOP05 held at the Vienna University of Technology. Vienna

Rauhala, K. (2007), Promotion of Walking: A Complex Interdisciplinary Task. *In Land use and Transport - European Research Towards Integrated Policies,* ed. Marshall S. and Banister D. (eds.), p. 293-311. Oxford: Elsevier.

[2] Sources:
CarFree City USA, Benefits, Berkeley, CA http://www.carfreecity.us/benefits.html
NewUrbanism.org, Benefits of new urbanism, Alexandria, VA, http://www.newurbanism.org/pages/416429/index.htm
Todd Litman 2005, Rail Transit In America, A Comprehensive Evaluation of Benefits, Victoria Transport Policy Institute, Victoria, BC, CANADA, http://www.vtpi.org/railben.pdf

APPENDIX

ECOCITY Project Team (Participating institutions)

N°	Institution/Organisation
1	Department of Environmental Economics and Management, Vienna University of Economics
2	Resource Management Agency
3	NAST Consulting Ziviltechniker GmbH
4	Stadtgemeinde Bad Ischl
5	Treberspurg & Partner ZT GmbH
6	Institut fuer Raumplanung und laendliche Neuordnung, Universitaet fuer Bodenkultur
7	Technical Research Centre of Finland
8	City of Tampere
9	University of Tampere
10	Plancenter Ltd.
11	TUHH-Technologie GmbH
12	Joachim Eble Architektur
13	Stadt Tuebingen
14	eboek - Ingenieurbuero für Energieberatung, Haustechnik und oekologische Konzepte GbR
15	Slovak University of Technology, Faculty of Civil Engineering
16	Municipality Authority of City Trnava
17	Slovak University of Technology, Faculty of Architecture
18	Peter Raksanyi, Autorizovany inzinier, Planning Bureau
19	Szechenyi Istvan University
20	City of Gyoer
21	SCET-Hongrie SA. d' Amenagement Urbain
22	Grupo de Estudios y Alternativas 21 S.L.
23	John Thompson & Partners
24	Progettazione per il Restauro L'Architettura e L'Urbanistica
25	Agenzia per l'energia e l'Ambiente della Provincia di Perugia S.P.A.
26	SenterNovem
27	Institut für Angewandte Wirtschaftsforschung
28	ECOAZIONI S.n.c. di M.Bastiani & C.
29	Arbeitsgemeinschaft Mayerhofer Stadlmann
30	Graz University of Technology, Institute of Thermal Engineering