

# THE ECOTOPIA MODEL

A quantitative, multi-critical analysis tool for greater certainty in decision-making concerning the sustainable development of smart cities.

Using Graz as an example

## THE ECOTOPIA MODEL. WHAT IS IT?

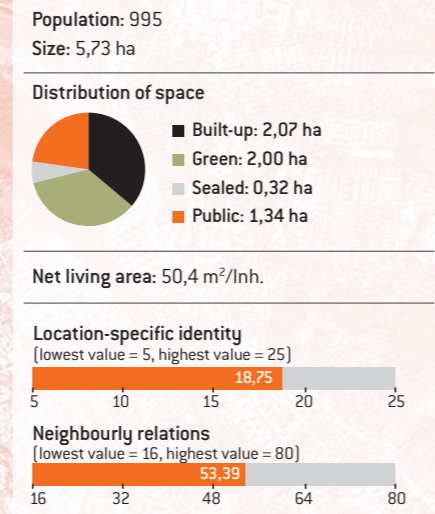
The ECOTOPIA model is a multifactorial list of criteria with which urban, technical, environmental and social aspects of a sustainable urban development can be linked and quantified. The ECOTOPIA model is the result of the interdisciplinary research project ECOTOPIA at the FH JOANNEUM. From 2009 to 2014, methods for the collection and evaluation of comprehensive data on the interactions of urban development, infrastructure and social coexistence in cities were developed. In line with the ECOTOPIA model, the criteria compiled on the various aspects of urban life are incorporated into a rating system that not only provides an overall picture of the sustainability of a district or a municipality, but also allows individual evaluations at different levels.

### LEGAL NOTICE

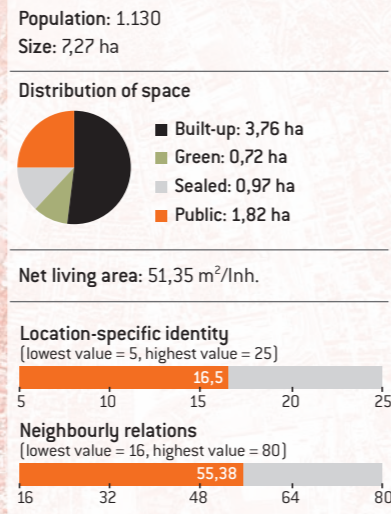
Responsible for content:  
FH JOANNEUM Gesellschaft mbH  
Alte Poststraße 149, A-8020 Graz  
Department Building, Energy and Society  
FH-Professor apl. Professor Dr. Bernhard Plé  
bernhard.ple@fh-joaanneum.at  
DI Alexandra Würz-Stalder  
alexandra.wuerz-stalder@fh-joaanneum.at  
FH-Professor DI Hans-Georg Frantz MPBL  
hans-georg.frantz@fh-joaanneum.at

Editorial staff: DI Alexandra Würz-Stalder,  
FH-Professor apl. Professor Dr. Bernhard Plé  
Text: Mag. Werner Schandor  
Graphics, Layout: Renate Woditschka BA,  
DI Verena Dörflinger  
Print: Bachernegg GmbH Kapfenberg  
Background image aerial photo: © City Surveyors  
Office

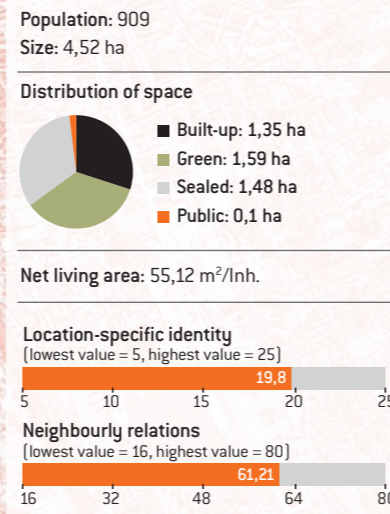
### GEIDORF DISTRICT AREA



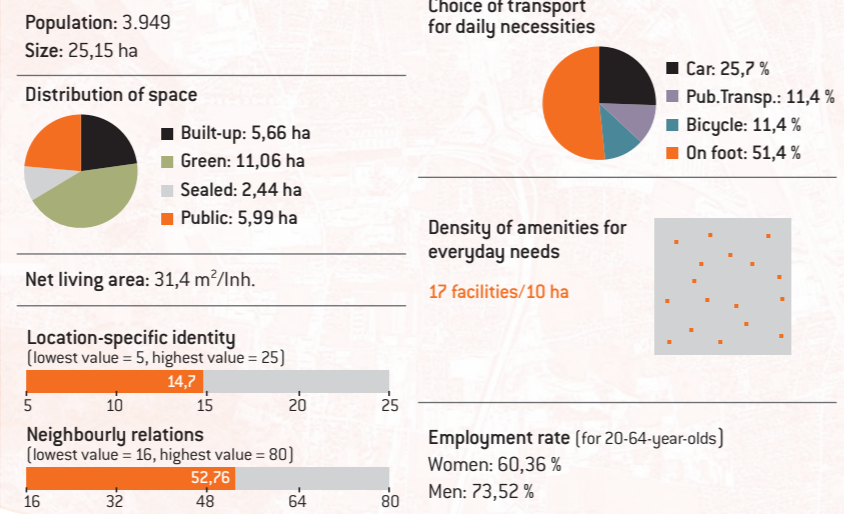
### GRIES DISTRICT AREA



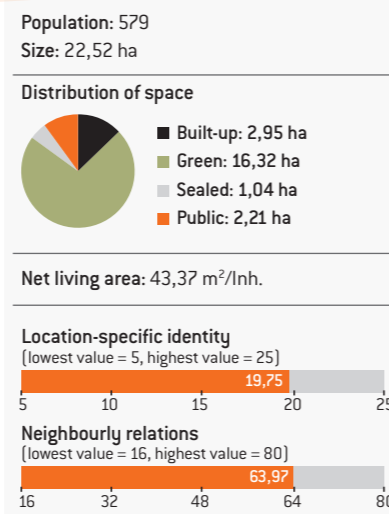
### TERRASSENHAUS ESTATE



### TRIESTER ESTATE



### MURFELD AREA



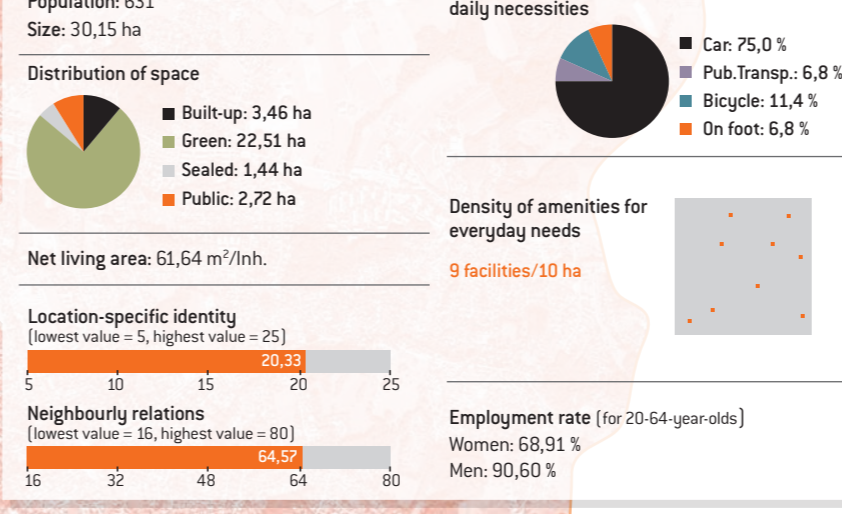
## GRAZ, FOR EXAMPLE

Between 2009 and 2014, during the ECOTOPIA project, areas in Graz comprising building forms and settlement structures were investigated and analysed according to the following quantitative and qualitative indicators:

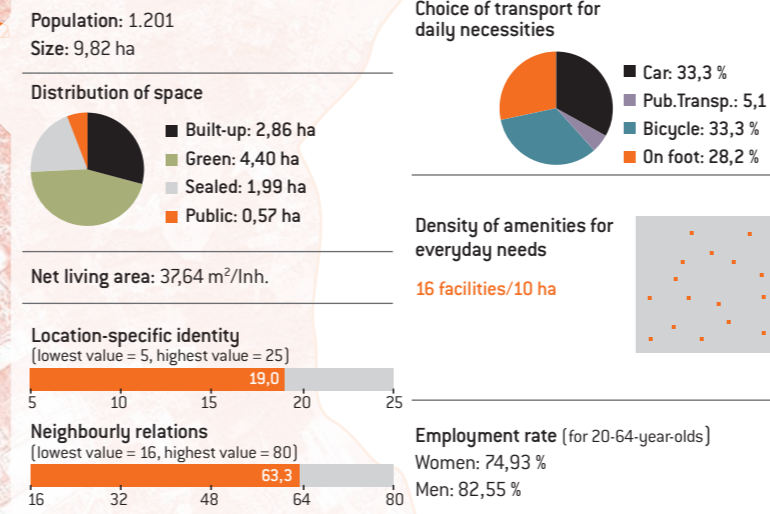
- Spatial and structural resources
- Energy supply and energy consumption
- Transport
- Social resources and social behaviour regarding the relationships between neighbours, sense of safety, identity of the local area, civic engagement, proactivity in old age

Some of the common assumptions made by urban planners could be empirically proven; in many cases the evaluation and analysis of comprehensive data led to new contexts – concerning, for example, supply and use of public transport and eco-friendliness.

### RUCKERLBERG AREA



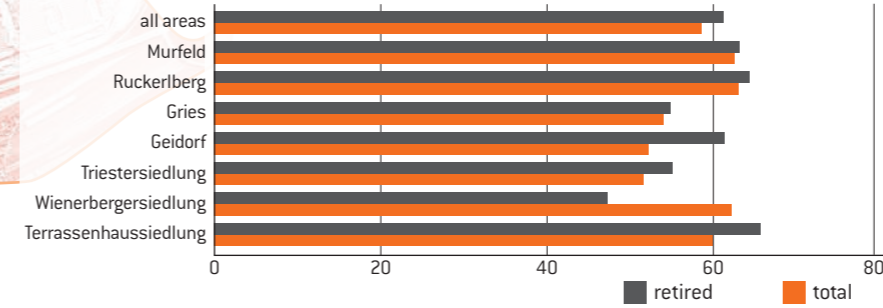
### WIENERBERGER ESTATE



## NEIGHBOURLY RELATIONS, FOR EXAMPLE

For more than 50% of the people of Graz who were interviewed the neighbourhood relations showed great intensity. Among the individual areas of investigation, there are significant differences in the intensity of neighborhood relations [Kruskal-Wallis test, p < 0.01]. In a comparison between pensioners and those not yet retired respondents, higher test values were shown among the retired population [U-test, p < 0.05].

### Index of neighbourhood relations (NCI) by area



„It is to be assumed that the interaction between residents is strengthened by the emotional affiliation to the residential area. A positive perception of the residential environment and visually pleasing locations may positively influence this emotional affiliation.“

[\* Sagl & Feuerstein: Wohnumfeld und soziale Ressourcen älterer Stadt-Bewohnerinnen und Bewohner]

### REFERENCES:

\* Quotations taken from the Ecotopia anthology "Ressourcenschonung in der Stadtentwicklung. Primärforschung in Grazer Stadtgebieten und empirische Planungsgrundlagen", hg. von B. Plé, M. Schloffer, A. Würz-Stalder, M. Bobik, M. Kofler, K. Posch, Frankfurt a. M. u. a.: Peter Lang Verlag 2013

\*\* Quotation taken from the Ecotopia anthology „Stadtforchung zwischen Vision und Planungspraxis“, Conference proceedings of the 2nd Ecotopia Symposium, published by B. Plé, M. Schloffer, A. Würz-Stalder, K. Helms. Graz: FH JOANNEUM Gesellschaft mbH 2013 publishing IMAGES:

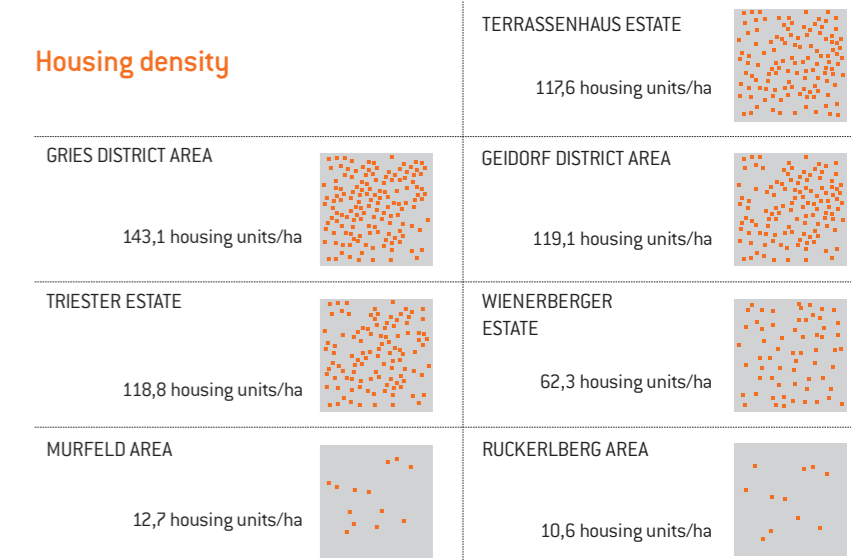
Background picture: <http://data.graz.gv.at/daten/geographie-und-planung>

## RESOURCES, FOR EXAMPLES

The unrestricted growth in the population of cities and urban peripheral areas must be contained using denser building developments and not by the use of larger areas.

„If certain characteristics of cities are combined with energy requirements, building structure, the energy consumption of households, as well as mobility behaviour and social resources, specific observations can be made about the sustainability performance of entire settlement areas. The evaluation of these findings can provide evidence of future viability, which will protect the resources.“ [Liegl, Würz-Stalder: Resource Consumption in Land Use Management]

### Housing density



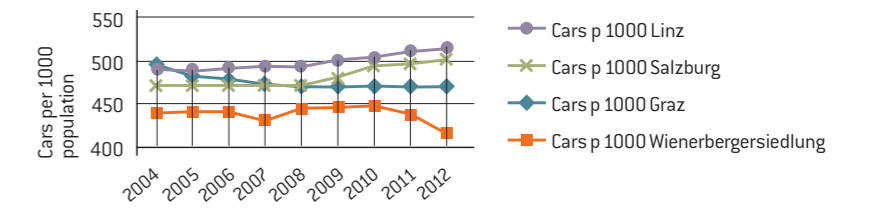
Housing density, urban development parameters

## TRANSPORT USE, FOR EXAMPLE

Choice of transport is dependent on availability of the basic needs [supply, work/education, errands, housing] and also correlates with the subjectively perceived travel time using the respective forms of transport. In order to curb an increase in the number of private vehicles, a less efficient infrastructure could be compensated for by a good quality public transport system, as is the case, for example, in the Wienerberger Estate in Graz, which was connected to the tram in 2007.

„The household survey in the Wienerberger Estate shows a connection between the increasing number of private cars owing to the difficulty of fulfilling the basic needs, but also because of the impact of the reduction in car density because of a good-quality connection to a tram.“

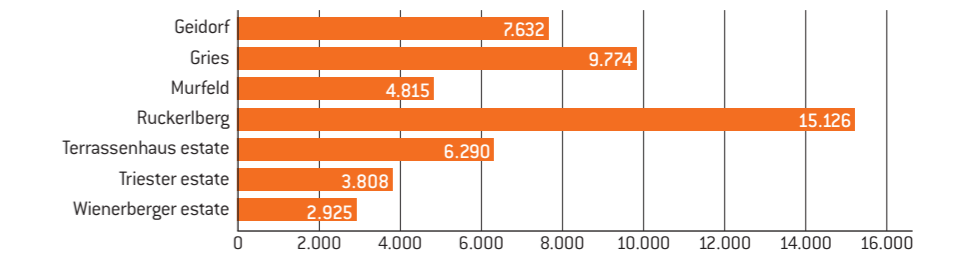
[\*\*Frantz, v. Dulmen, Feigl, Reuser: Wienerbergersiedlung – Analysis of the impact of tram construction]



## HEATING DEMAND, FOR EXAMPLE

The development of residential areas has a major impact on heating requirements and can be influenced on the demand side mainly through either profit-maximizing and / or loss-minimizing strategies.

### Heating requirement in kWh/Year per household



„A purely technical optimisation process of the heat demand in which it will be possible to determine quantifiable parameters for urban design concepts seems [...] to be rather ineffective and more consideration should be placed on a variety of aspects and interests. Sustainable resource-conserving urban development therefore needs an interdisciplinary approach in which economic, ecological, energy, sociological and creative aspects are taken into account in the preliminary planning phases.“

[\*Staller: Bebauungsstruktur und Energiebedarf]



# AREA ASSESSMENT BASED ON SELECTED CRITERIA



## THE ECOTOPIA LIST OF CRITERIA

The list of criteria is at the heart of the ECOTOPIA model and includes elementary characteristics for a sustainable development of districts, municipalities, such as:

### Energy

- Energy supply - heat [Energiebereitstellung Wärme]
- Power supply - electricity [Energiebereitstellung Strom]
- Power consumption [Energieverbrauch]

### Society

- Participation [Partizipation]
- Equal opportunities [Chancengleichheit]
- Social resources [Soziale Ressourcen]
- Covering basic needs [Deckung Grundbedürfnisse]
- Sense of security - crime [Sicherheitsempfinden Kriminalität]
- Sense of security - traffic [Sicherheitsempfinden Verkehr]
- Satisfaction with pathways [Zufriedenheit Gehwegenetz]

### Traffic

- Quality index of public transport [Qualitätsindex Öffentlicher Verkehr]
- Accessibility index of public transport [Erreichbarkeitsindex Öffentlicher Verkehr]

### Urban Design

- Surface quality of pathways [Oberflächenqualität Gehwegenetz]
- Diversity in usage [Nutzungsdiversität]
- Ecological density [Ökologische Dichte]
- Heating demand [Heizwärmebedarf]
- Amount of sealing of undeveloped area [Versiegelungsgrad unbebaute Fläche]
- Noise pollution [Lärmimmissionen]

WALKABILITY

## EVALUATION USING SCIENTIFIC METHODS

The data collected on these criteria are evaluated with the plural scientific methods of the natural sciences, technical and social sciences involved in ECOTOPIA. In this way, for example, the focus can be placed on social and urban development aspects.

Using this as a basis, it is possible to show how living spaces can be improved regarding environmental protection and high quality of life.

With the ECOTOPIA model, however, comparable overall evaluations can also be made across a variety of districts or cities which form the basis for urban planning decisions.

## THE CHALLENGE FOR MUNICIPALITIES

The responsibility of the cities or municipalities exceeds the providing of facilities to cover the basic needs of living, working, relaxation, supply and disposal and education. It lies in the interest of balancing

- different spatial conditions and social transparency,
- centrally-organised provision of infrastructure and individual usage
- both public and private tasks and economic needs.

The ECOTOPIA model provides decision makers with a reliable and scientifically based foundation to cope with these challenges.

## WHAT IS SPECIAL ABOUT THE ECOTOPIA MODEL?

**UNIQUE:** It considers the social side of urban development. What distinguishes ECOTOPIA from other models for urban development is the scientifically founded, interdisciplinary view of urban planning, including structural, infrastructural, ecological and - essentially - social aspects. After all a city is primarily a habitat for people.

### Established and practical

The ECOTOPIA model as a quantitative method for decision analysis using a variety of criteria for urban development projects fulfills, on the one hand, scientific quality criteria [quality, validity, reliability] of the collected data and on the other hand takes into account the practical and economic requirements of town planning and town development.

### In focus: sustainability

The focus of the ECOTOPIA model is on the conservation of resources or sustainability as defined in the 1987 Brundtland Report. The results of the ECOTOPIA research project clearly show that sustainability in urban development is not simply a matter of technical innovations, but is essential to consider social components as well as the behaviour of users.

### Used flexibly in city development

With the ECOTOPIA model both future scenarios and smarter towns as well as networked solutions for fixed construction plans can be determined.

### Greater decision security

The ECOTOPIA model offers managers in business, politics and administration an essential pre-requisite for greater security when making decisions due to scientific accuracy collecting and evaluating the data.