The Young Cities Project – Evaluation, Monitoring and Ecotoxicology

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Federal Ministry of Education and Research
Future Megacities

Megacities of Tomorrow

> 5 Mill Inhabitants

(World Bank: World Development Report Entering the 21st Century)

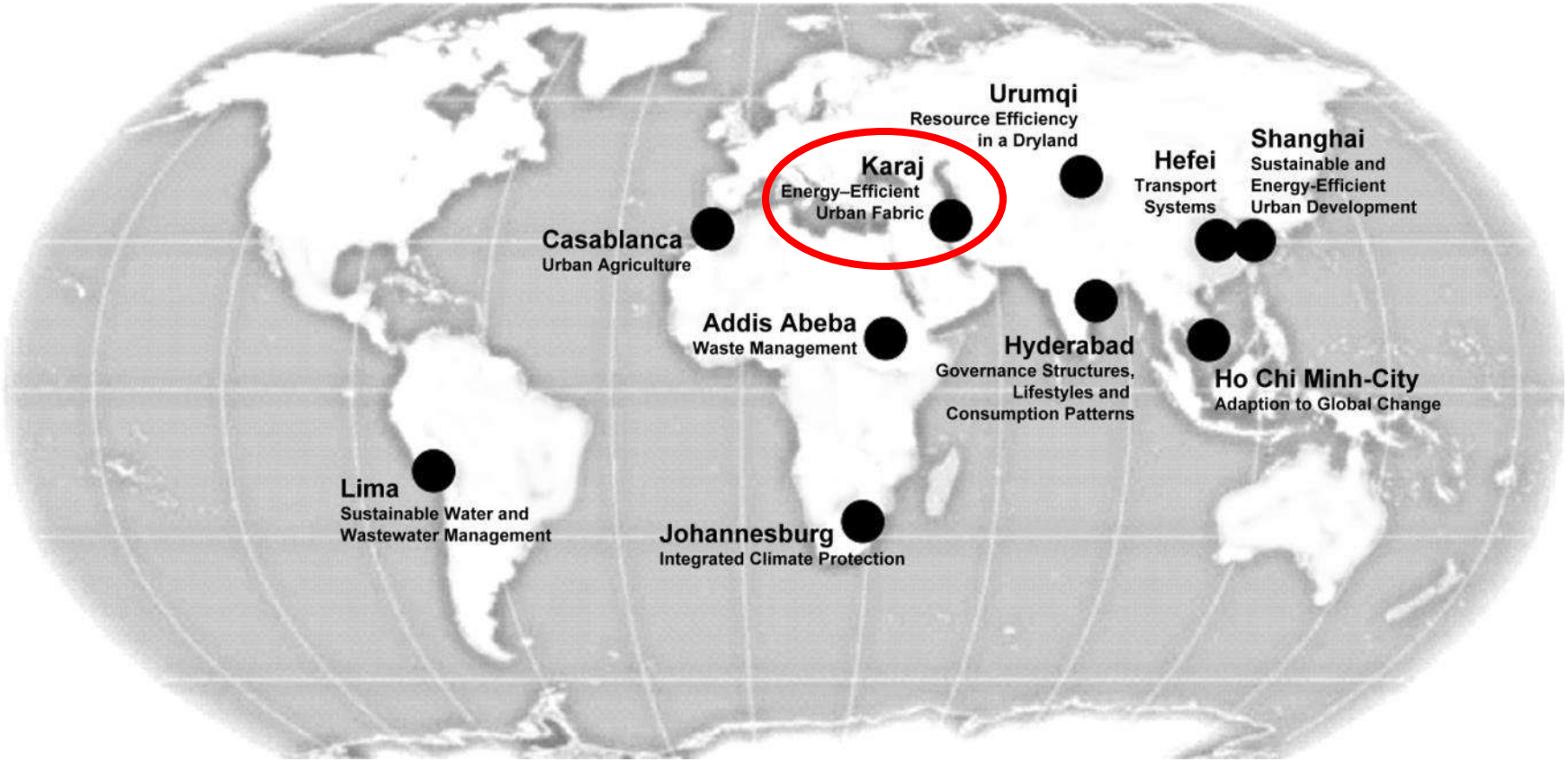
> 8 Mill Inhabitants (UN)

Tokyo = 12 Mill Inhabitants

Urban green

Quality of Life

Urban losses and drainage



Global spread and focus of the Megacities Projects

Future Megacities
Megastädte von morgen

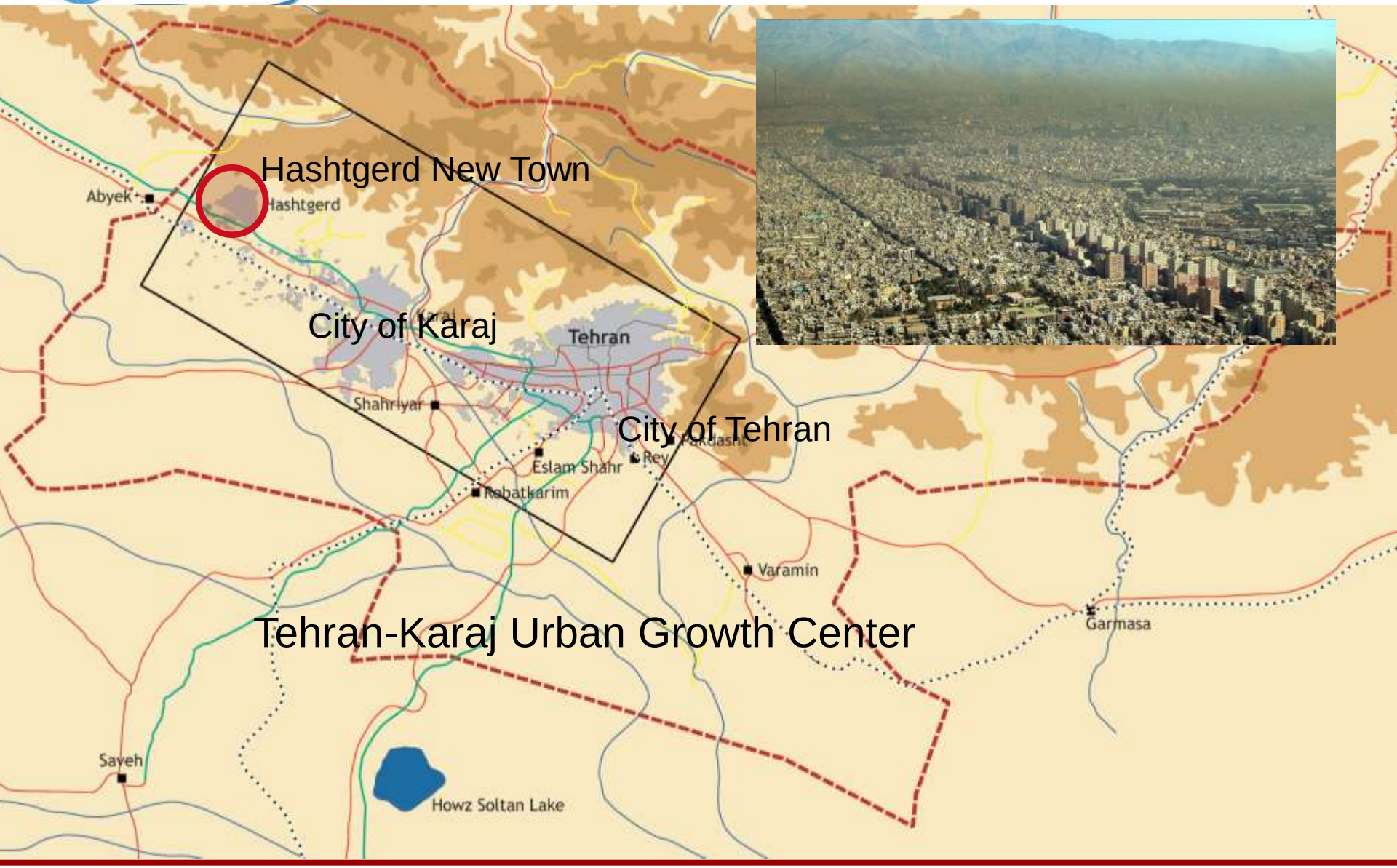
The "Future Megacities" Programme focus:

research for climate and energy efficient structures in fast growing urban centers:
www.future-megacities.org

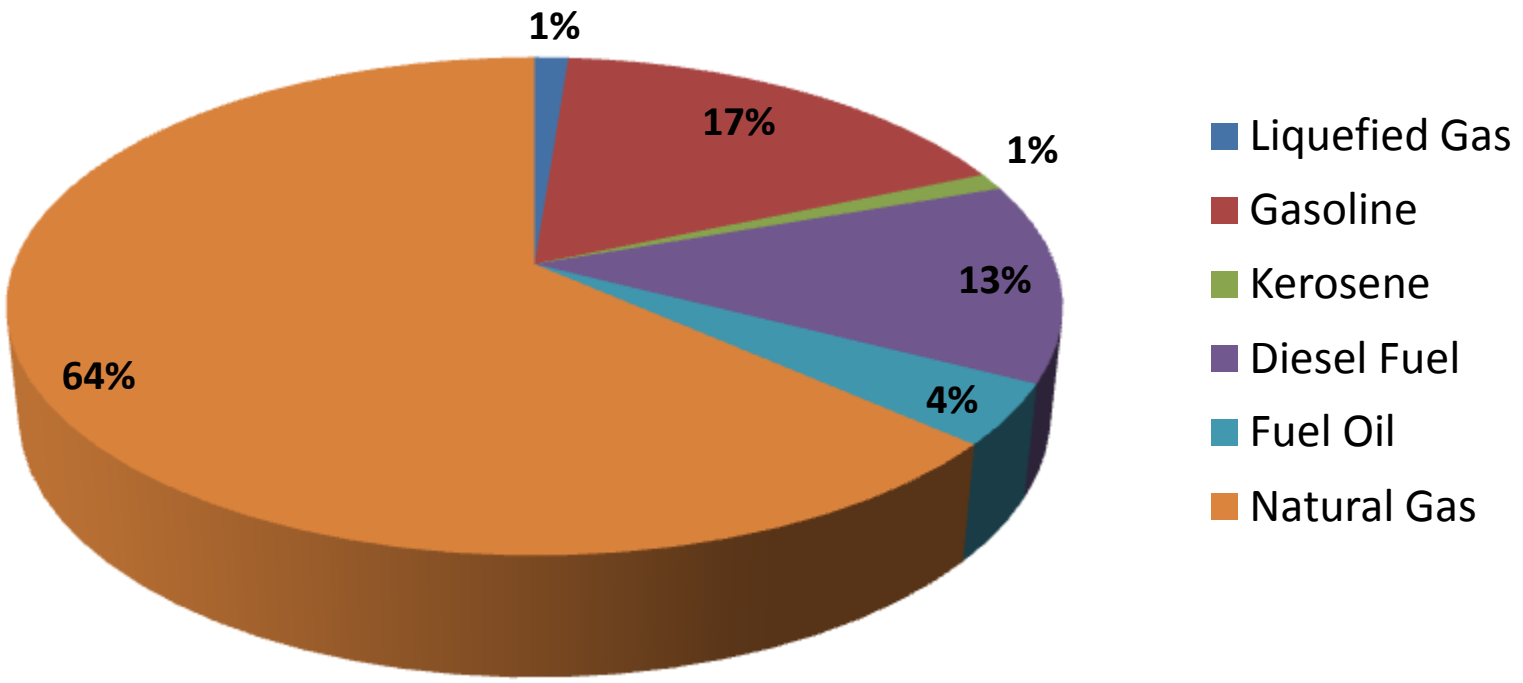
Young Cities Project will receive over the 5 year period of funding (2008-2013) from the German side 8,286,777 € and a set-up of an additional 2,700,000 € funding by the BMBF and the German Academic Exchange Service DAAD for approx. 72 scholarships (senior scientists, post docs and PhD students) and 3 summer schools in Germany

Part of the German Megacities research initiative (BMBF) along with DFG and Helmholtz

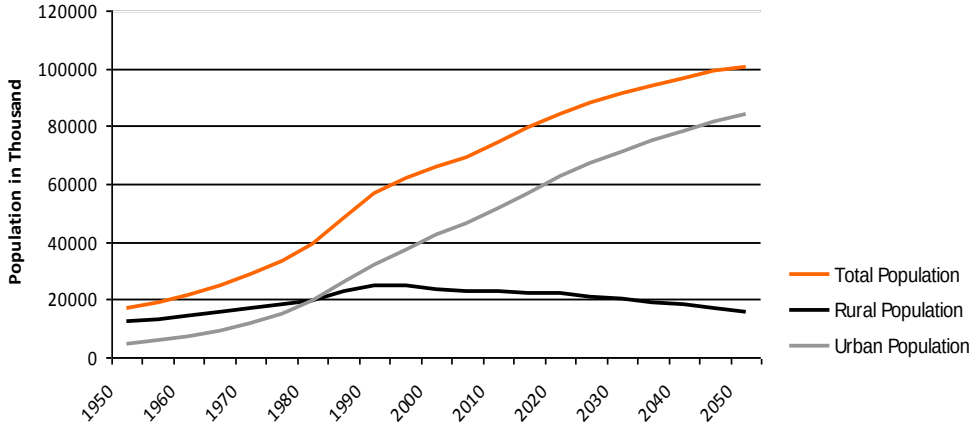
Future Megacities

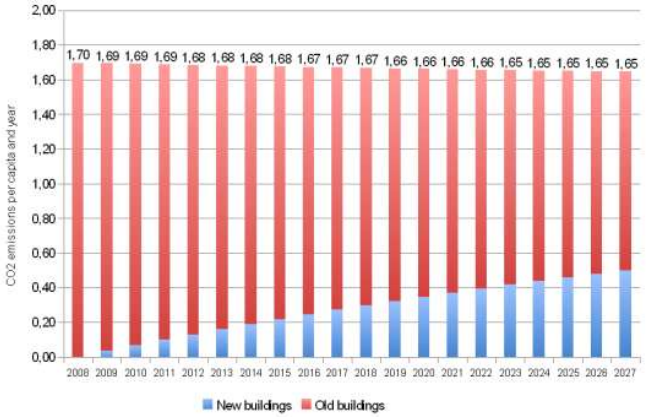

Hashtgerd New Town
Abyek
Hashtgerd
City of Karaj
Tehran
Shahriyar
City of Tehran
Eslam Shahr
Rey
Robatkarim
Varamin
Garmasa
Tehran-Karaj Urban Growth Center
Sayeh
Howz Soltan Lake

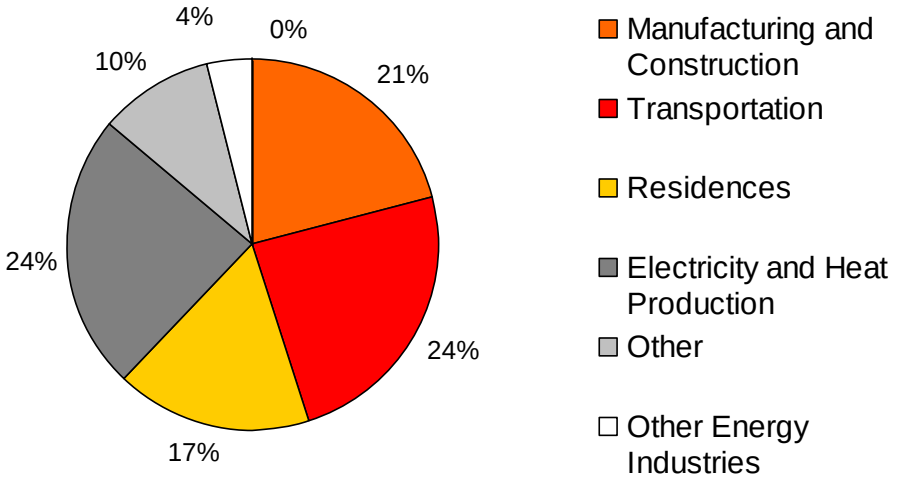
CO_2 Emission of Tehran by Type of Fuel



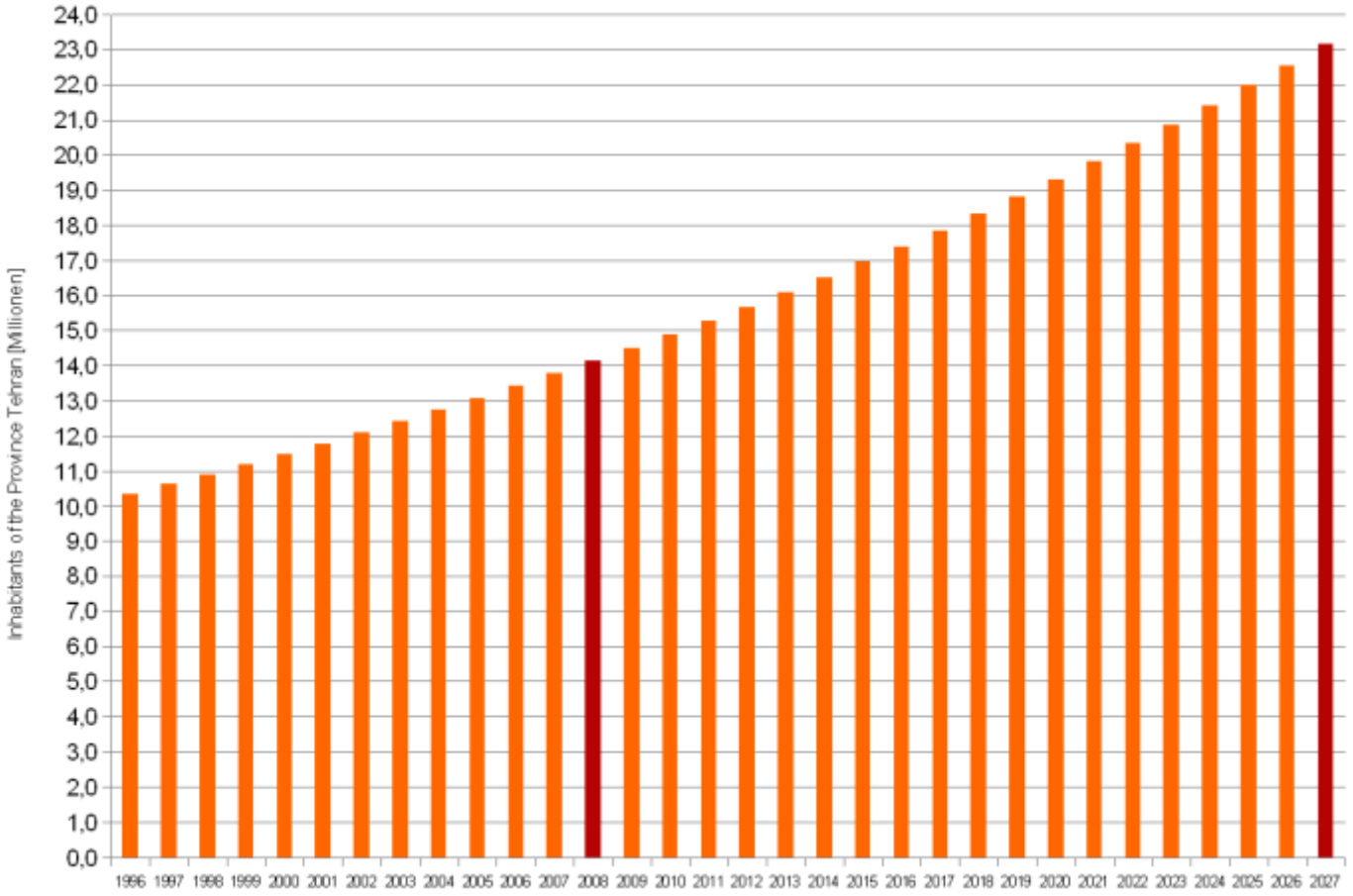
Reference: Farshad Nasrollahi; Young Cities, TU Berlin


Population in Thousand
120000
100000
80000
60000
40000
20000
0
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
Total Population
Rural Population
Urban Population


CO2 emissions per capita and year
2,00
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
1,70 1,69 1,69 1,69 1,68 1,68 1,68 1,68 1,67 1,67 1,67 1,66 1,66 1,66 1,66 1,65 1,65 1,65 1,65 1,65
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027
New buildings
Old buildings


4%
0%
10%
21%
24%
24%
17%
Manufacturing and Construction
Transportation
Residences
Electricity and Heat Production
Other
Other Energy Industries

- Demographic development of the province of Tehran



Reference: Young Cities, TU Berlin

Hashtgerd New Town

Content

1. Development and implementation of building and planning schemes and technologies allowing to plan and build **sustainable and energy-efficient towns & buildings ("energy-efficient urban fabric")**

2. Outcome of the Study: **Technologies, Methodologies (Indicator values and Quality of Life in Urban Areas)**

3. Scenarios and Pilot Projects for energy-efficiency in three areas:

   Urban Development and Design (Space), 35 ha study,
   Urban Infrastructure Systems (Networks), and
   Buildings and Objects (Objects)

The German consortium involves 12 chairs from different fields of TU Berlin (BIT), non-academic research institutions, companies and associations:

The Iranian consortium involves as main partners:

- Ministry for Housing and Urban Development
- Building and Housing Research Center
- Iranian New Towns Development Corporation

Overall Objectives of the Study:

Development and implementation of building and planning schemes and technologies allowing to plan and build sustainable and energy-efficient towns & buildings

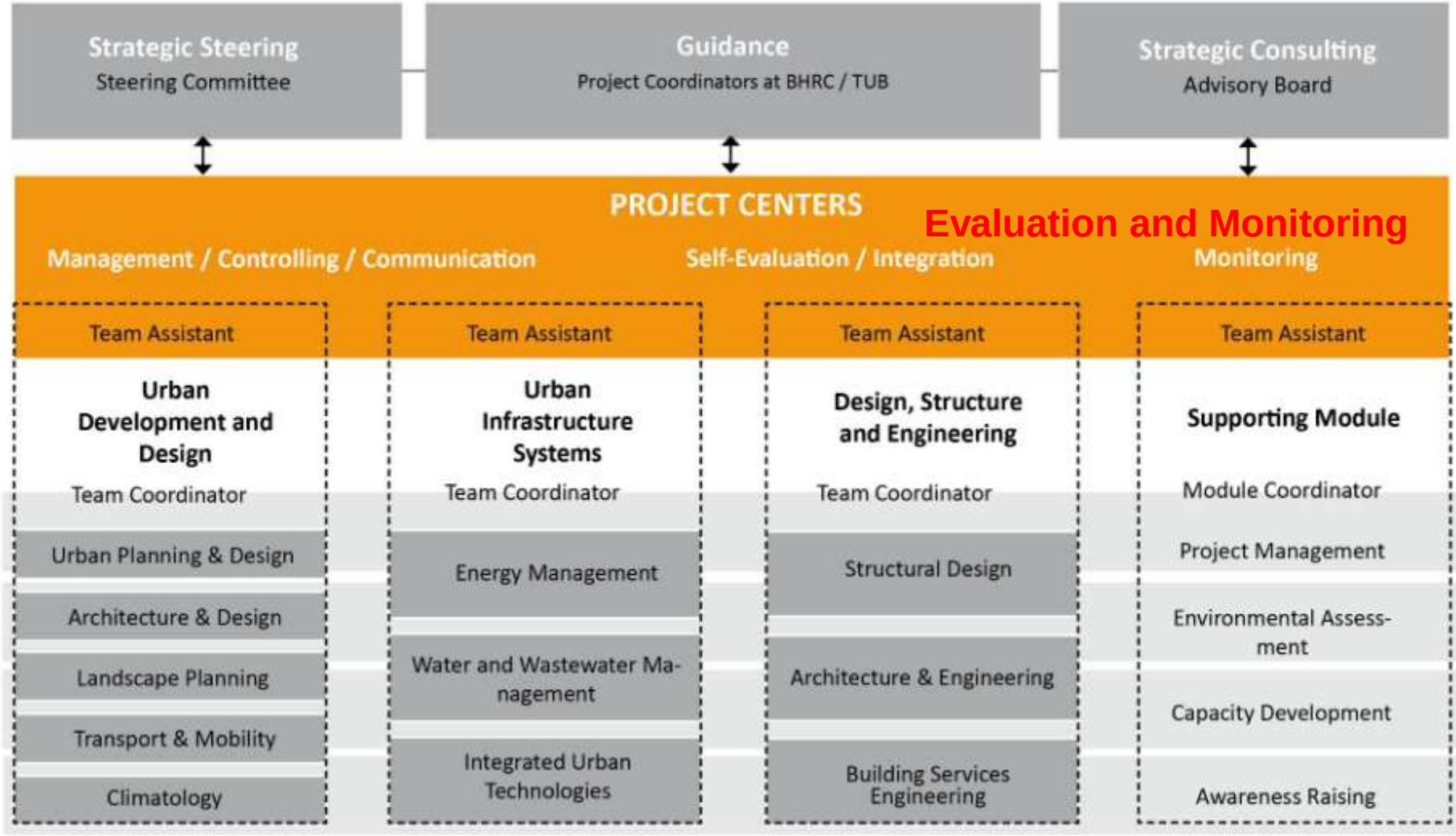
Categories:

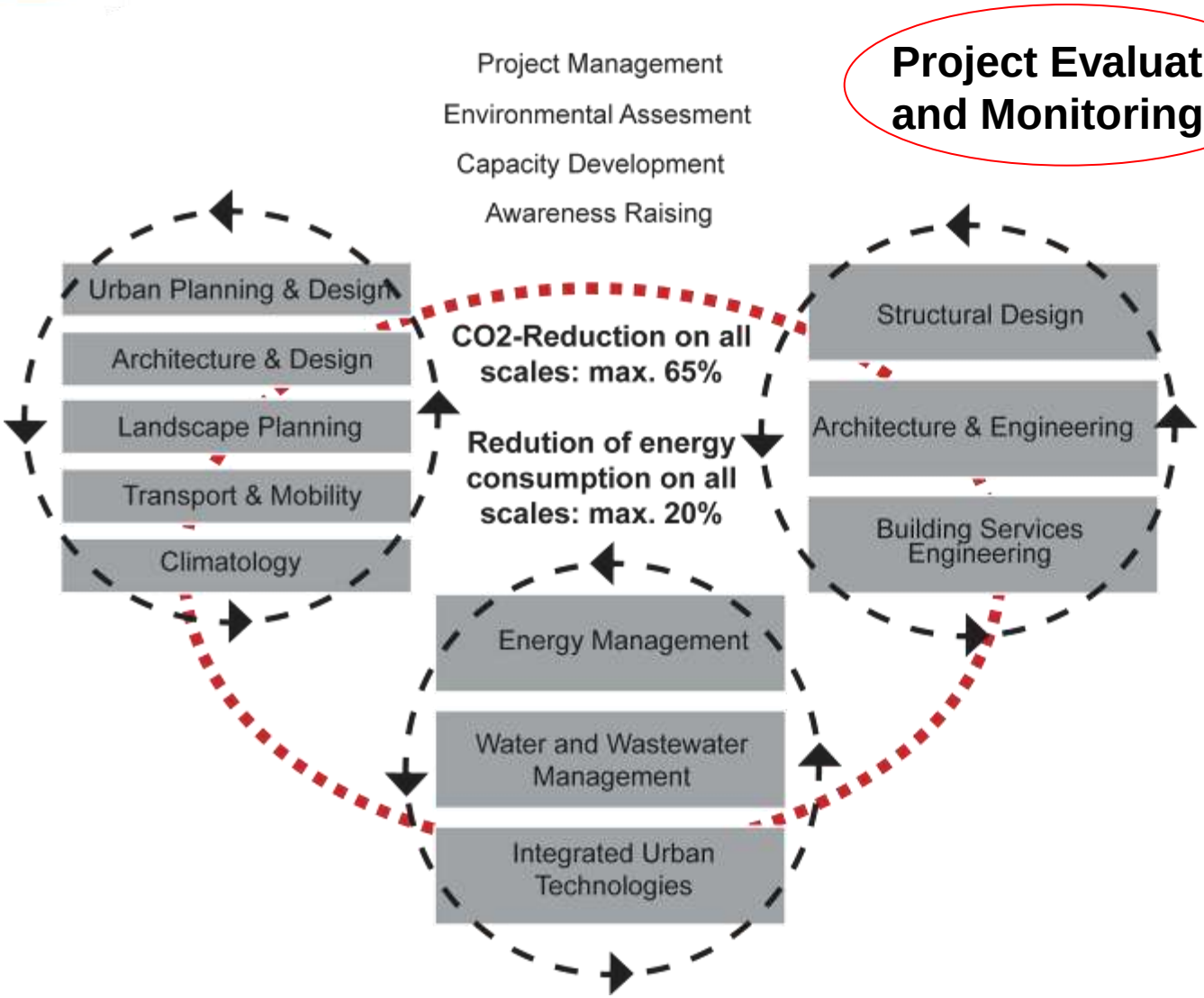
Mitigation of CO_2 emission
Energy consumption
Buildings
Transport
Water
Environmental Governance

Federal Ministry of Education and Research

Future Megacities

Project Management




Project Management
Environmental Assesment
Capacity Development
Awareness Raising
Project Evaluation and Monitoring
Urban Planning & Design
Architecture & Design
Landscape Planning
Transport & Mobility
Climatology
CO2-Reduction on all scales: max. 65%
Redution of energy consumption on all scales: max. 20%
Structural Design
Architecture & Engineering
Building Services Engineering
Energy Management
Water and Wastewater Management
Integrated Urban Technologies

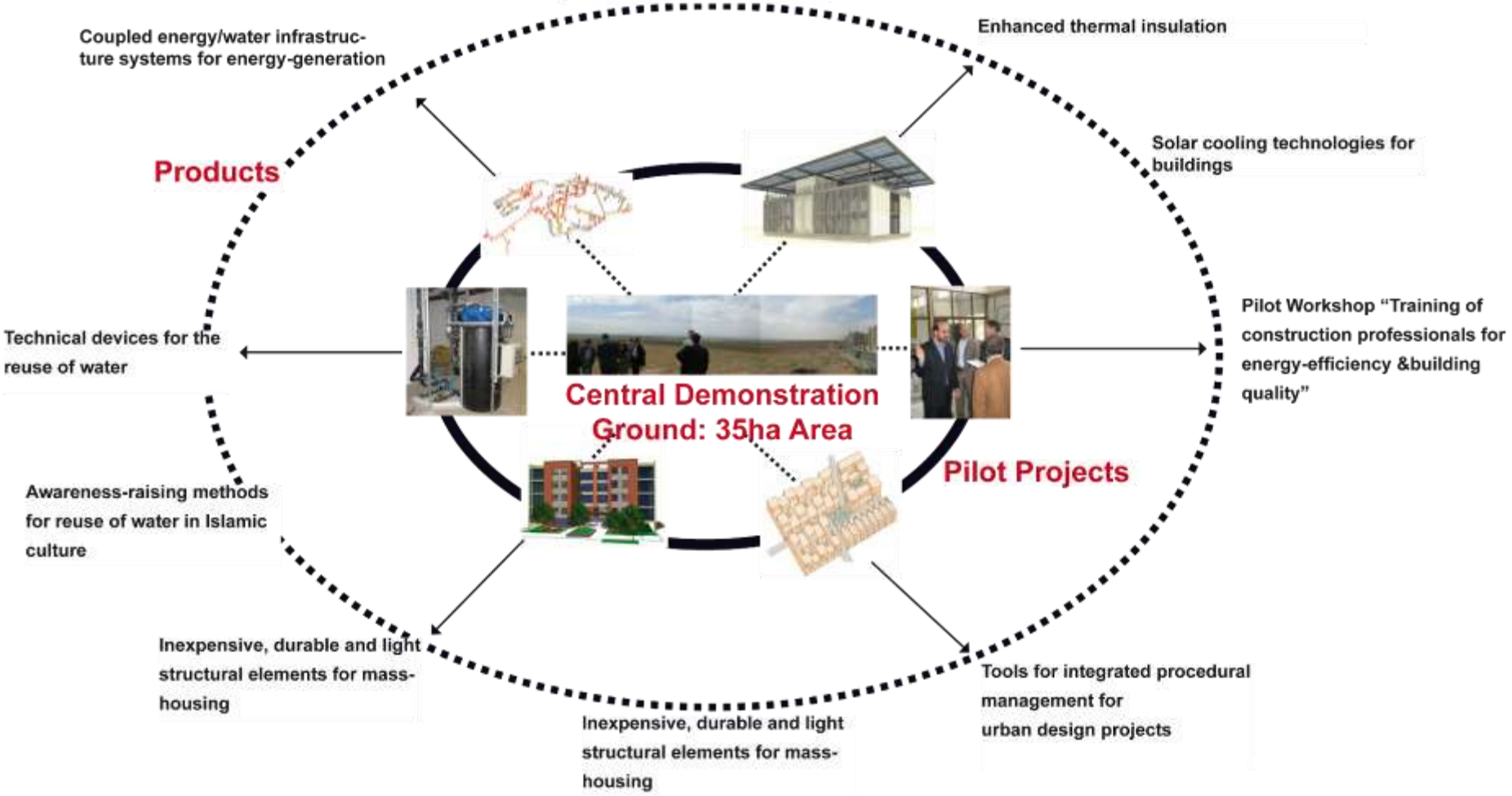
S. Seelig YC-BIT

Energy and Resource-Efficiency Goals and Achievements on 35 ha Area

35 ha Land Use

Courtyard with shops

Implementation and Products



Tasks and Objectives of the Evaluation / Monitoring of the Young Cities Project

- evaluation of the interaction of ecosystems and urbanisation
- quantification of risk
- development of a strategy for assessment and evaluation (qualitative and quantitative effects) of measures concerning climate, energy, resources, socio- economic benefit
- set of indicators to describe the effects of the measures proposed
- the set of indicators and list of valid indicator values will be completed by the progress up to the end of the project in 2013

Tool: Evaluation Matrices

- to develop a tool to check the complex progress and status of the project by a relevant self-understanding information flow
- the matrices summarize:

Objective – Strategy – Measure – Output – Indicator –

Target Value – Measuring Method

- permanent update of the project by internal and external evaluation
- feedback with the stakeholder and dissemination of the results

- Example: Field of Action 1 (Energy and Climate), Team (Strategic Dimension) 1 Workpackage 1. Mixed Used Schemes

SD	Dimen-sion	WP	Objective	Strategies	Measures	Impact	Impact Indicators	Objective Indicators	Target Values	Measuring Methods
Strategic Dimension 1	Urban Planning and Urban Design	1. Mixed-Use Schemes	Reduction of fossil energy use and carbon emissions	Reduction of distance travelled Reduction of energy consumption	Horizontal and vertical mix of uses combined with compact urban form Optimized use of energy through multiple and synergetic use	Short way structure decreasing motorized traffic Compact multi-use buildings	Inhabitants per ha working places per ha (compared to other quarters of HNT)	CO_2 in g/capiita (compared to other quarters of HNT)	Reduction of CO_2 emissions by 4-7% per capita (BBR, Germany)	Simulation and comparing results with realized projects

- apparently very complex information has to be condensed for dissemination and better understanding

For Compact Dissemination: Condensed Matrices

- need to obtain a general idea at first glance
- focussing the aspects of the original matrices to:

Target Values and Measures

- additional main focus:

Contribution to Sustainability

- Scheme of the Condensed Matrices

Field of Action
1 – Energy and Climate

⇩

Strategic Dimension (Team)
Urban Development and Design

⇩

Workpackage
1. Mixed-Use Schemes

⇩

Objective
Reduction of fossil energy use and carbon emissions

⇩

Target Values (qualitative / quantitative)
Reduction of CO_2 emissions by 4-7% per capita (Germany)

⇩

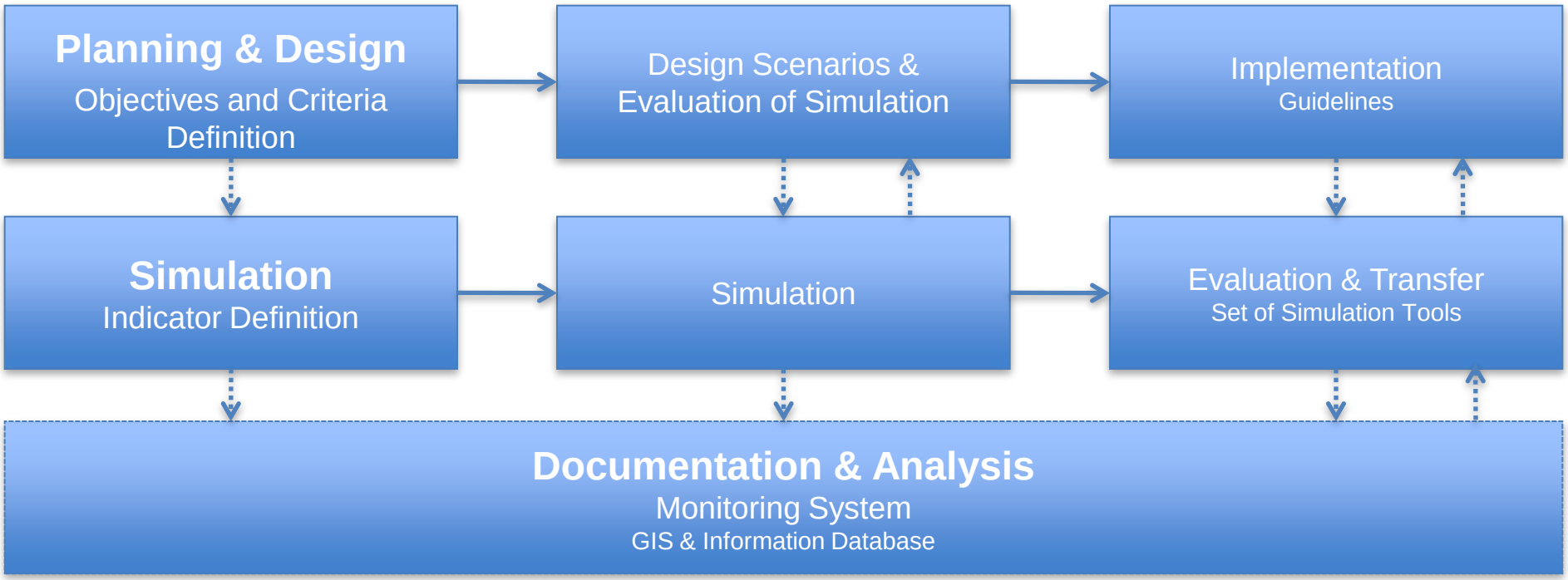
Contribution to Sustainability
saving fossil energy and reducing CO_2 emissions

Urban Planning and Urban Design

Field of Action (FoA): (1) Climate and Energy, (2) Resources, (3) Social

FoA	Strategic Dimension / Team	WP	Objective	Target Values qualitative / quantitative *	Contribution Sustainability
1			reduction of fossil energy use and carbon emissions	reduction of CO_2 emissions by 4-7% per capita (BBR, Germany)	saving fossil energy and reducing CO_2 emissions
2	Urban Planning and Urban Design	1. Mixed-Use Schemes	reduction of emissions (Air) and reduction of sealed soil (Soil)	optimized surface/volume ratio e.g. GFZ (Geschossflächen-zahl – floor space index) fraction of sealed soil on total land	reduction of the worldwide CO_2 emissions and the greenhouse effect. Responsible land use
3			enhanced economic value social Variety higher Security (qualitative)	realisation of certain mixed-uses (planning & building) which are approved by legally building plans	energy saving housing as future trend

Simulation Tools



Benchmark – international Standards after ISO and CEN

The Green City Index

GCI of Cities in Europe

The European Green City Index

- assessment of 30 European cities by the Economist Intelligence Unit under patronage of Siemens

- comparable Studies:
  - European Urban Ecosystem Survey
  - European Green Capital Award

- the 8 categories are structured in form of tables
- (CO_2, Energy, Buildings, Transport, Water, Waste & Land Use,
- Air Quality, Environmental Governance)
- (cf. categories of the YC-Project:
- CO_2, Energy, Buildings, Transport, Water, Environmental Governance)
- the overview is given by the following scheme :
    - Indicator
    - Type of Assessment
    - Weighting
    - Description of the Indicators
    - Normalisation technique

- Example: Categories CO_2 and Energy of the GCI

Category	Indicator	Type	Weighting	Description
CO_2	**CO_2 emissions**	Quantitative	33%	Total CO_2 emissions, in tonnes per head.
	CO_2 intensity	Quantitative	33%	Total CO_2 emissions, in grams per unit of real GDP (2000 base year).
	CO_2 reduction strategy	Qualitative	33%	An assessment of the ambitiousness of CO_2 emissions reduction strategy.
Energy	**Energy consumption**	Quantitative	25%	Total final energy consumption, in gigajoules per head.
	Energy intensity	Quantitative	25%	Total final energy consumption, in megajoules per unit of real GDP (in euros, base year 2000).
	Renewable energy consumption	Quantitative	25%	The percentage of total energy derived from renewable sources, as a share of the city's total energy consumption, in terajoules.
	Clean and efficient energy policies	Qualitative	25%	An assessment of the extensiveness of policies promoting the use of clean and efficient energy.

- Example: Categories CO_2 and Energy of the GCI

Category	Indicator	Type	Weighting	Normalisation technique
CO_2	CO_2 emissions	Quantitative	33%	Min-max.
	CO_2 intensity	Quantitative	33%	Min-max; lower benchmark of 1,000 grams inserted to prevent outliers.
	CO_2 reduction strategy	Qualitative	33%	Scored by Economist Intelligence Unit analysts on a scale of 0 to 10.
Energy	Energy consumption	Quantitative	25%	Min-max.
	Energy intensity	Quantitative	25%	Min-max; lower benchmark of 8MJ/€GDP inserted to prevent outliers.
	Renewable energy consumption	Quantitative	25%	Scored against an upper benchmark of 20% (EU target).
	Clean and efficient energy policies	Qualitative	25%	Scored by Economist Intelligence Unit analysts on a scale of 0 to 10.

Benchmarking
Copenhagen = "the greenest metropolitan city" in Europa (87.13%)
→ Berlin Ranking 8

Overall

	City	Score
1	Copenhagen	87,31
2	Stockholm	86,65
3	Oslo	83,98

CO_2

	City	Score
1	Oslo	9,58
2	Stockholm	8,99
3	Zurich	8,48

Energy

	City	Score
1	Oslo	8,71
2	Copenhagen	8,69
3	Vienna	7,76

Buildings

	City	Score
=1	Berlin	9,44
=1	Stockholm	9,44
3	Oslo	9,22

Transport

	City	Score
1	Stockholm	8,81
2	Amsterdam	8,44
3	Copenhagen	8,29

Water

	City	Score
1	Amsterdam	9,21
2	Vienna	9,13
3	Berlin	9,12

Waste and land use

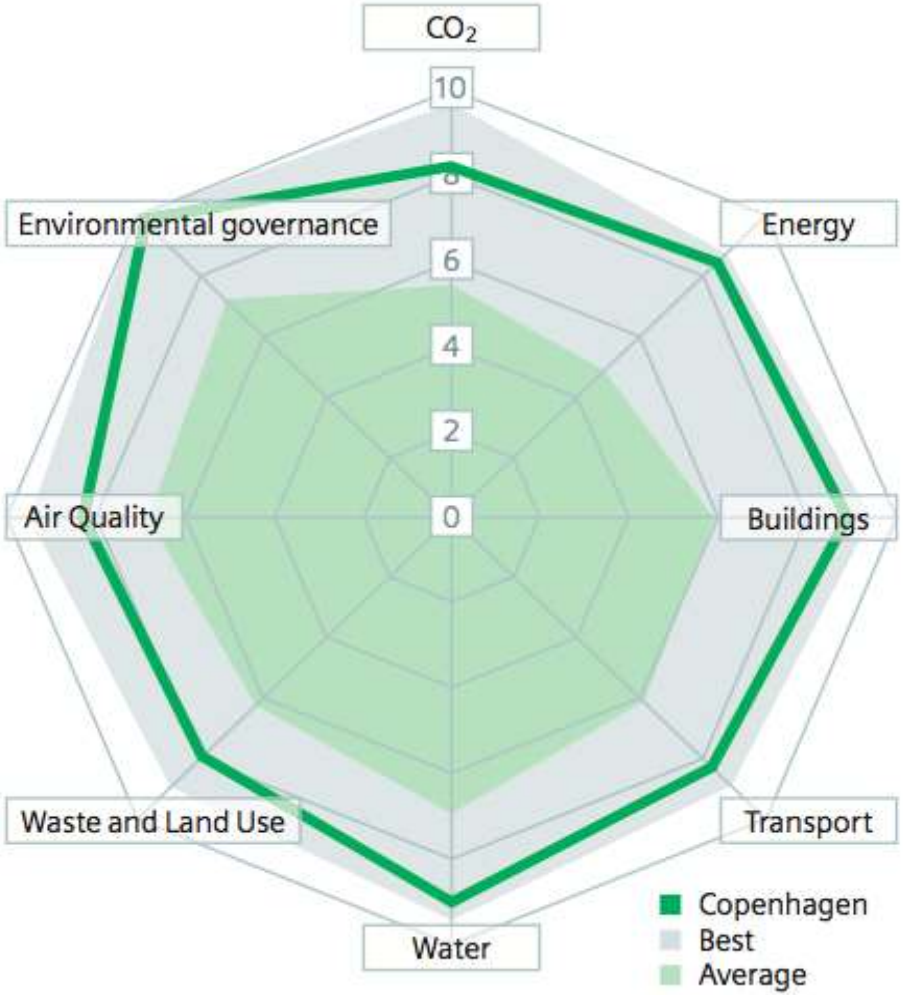
	City	Score
1	Amsterdam	8,98
2	Zurich	8,82
3	Helsinki	8,69

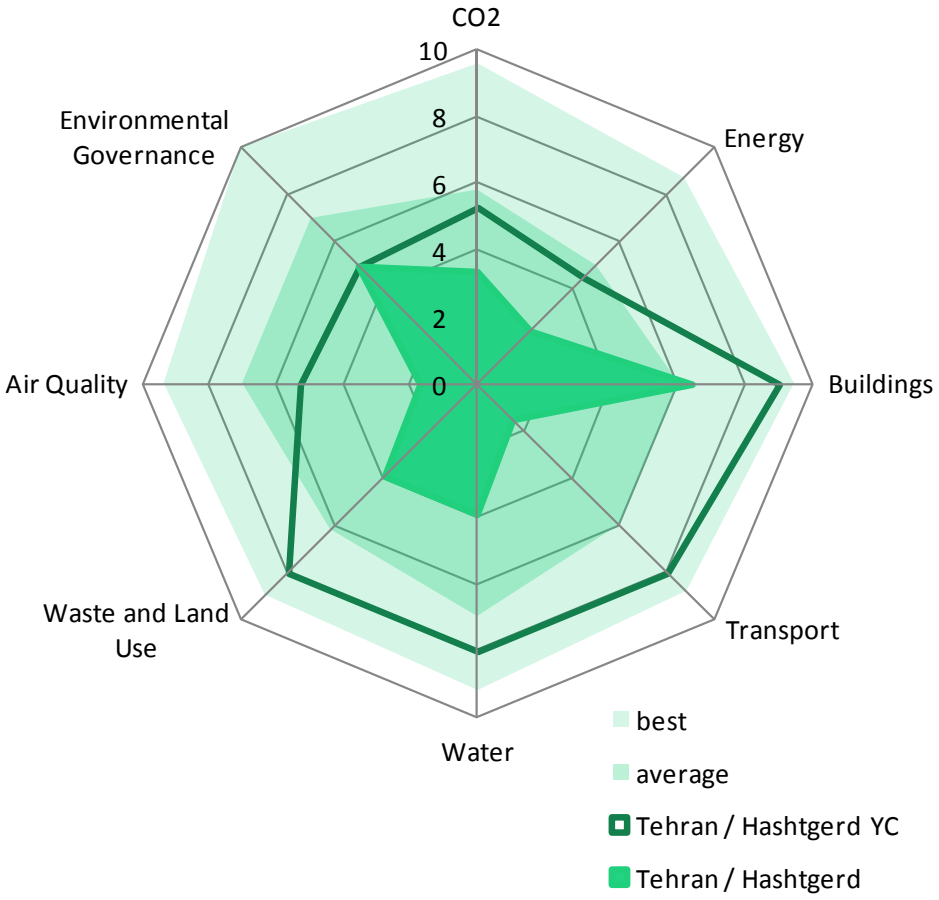
Air quality

	City	Score
1	Vilnius	9,37
2	Stockholm	9,35
3	Helsinki	8,84

Environmental governance

	City	Score
=1	Brussels	10,00
=1	Copenhagen	10,00
=1	Helsinki	10,00


CO2
10
8
6
4
2
0
Energy
Buildings
Transport
Water
Waste and Land Use
Air Quality
Environmental governance
Copenhagen
Best
Average


CO2
10
8
6
4
2
0
Energy
Buildings
Transport
Water
Waste and Land Use
Air Quality
Environmental Governance
best
average
Tehran / Hashtgerd YC
Tehran / Hashtgerd

Indicator Values and Evaluation of Measures

Federal Ministry of Education and Research
Future Megacities

Benchmarks and Scorecards

Overall

	City	Score
1	Copenhagen	87,31
2	Stockholm	86,65
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CO_2

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Environmental governance

	City	Score
=1	Brussels	10,00
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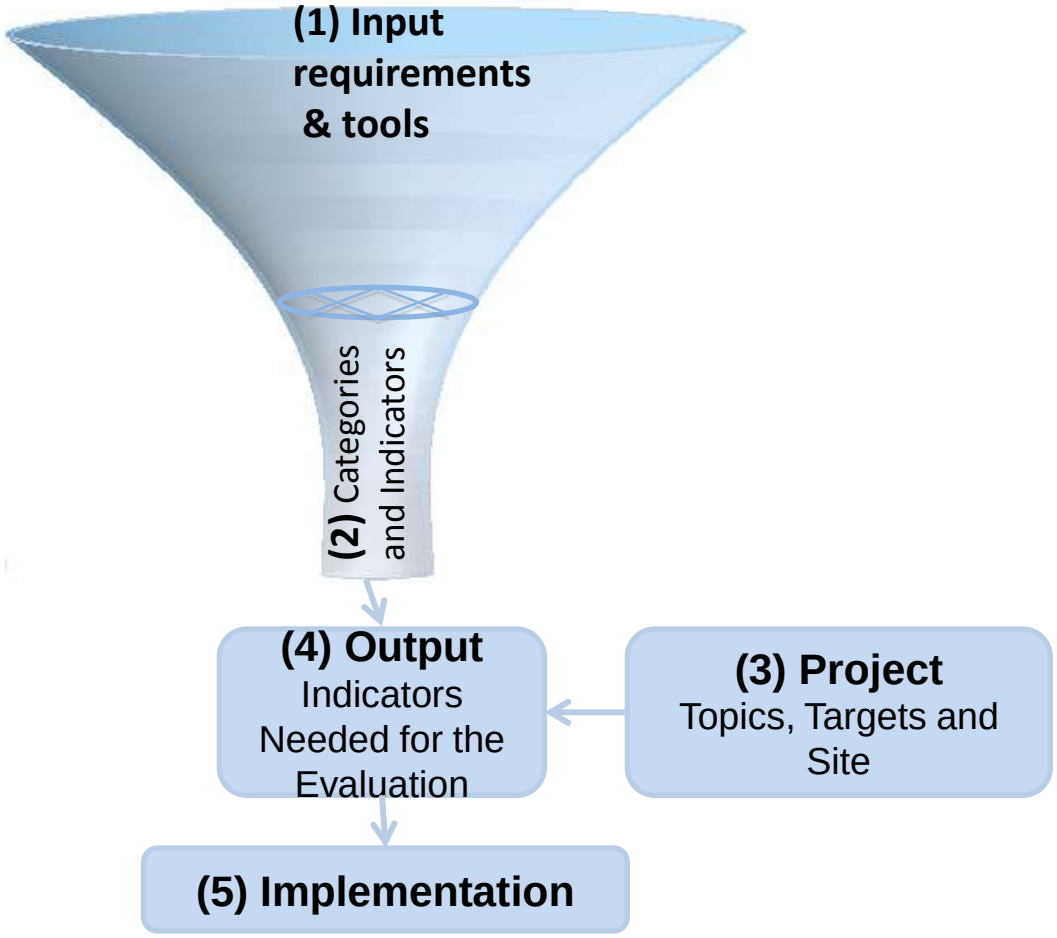
=1	Helsinki	10,00

Effects-Related Indicator Values: Methology (Level 1)



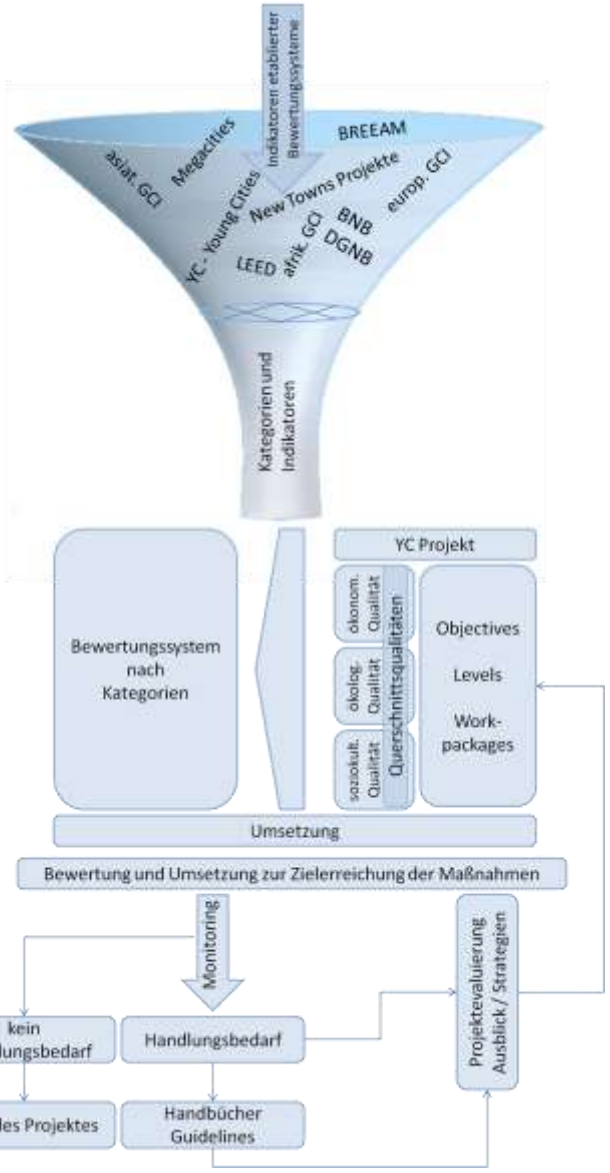
Level 2
Application 2.1 / 2.2

Part 1
Indicators and
Established
Evaluation Concepts

Part 2
General Indicator Set

Part 4
Project-Specific
Indicator Set

Part 5
Example/Preliminary
Results of YC Project



Down the Funnel:
Gprs
Estidama pearls

Part 3
Structure of
YC Project

Level 2
Application 2.1 / 2.2

Part 1
Indicators and
Established
Evaluation Concepts

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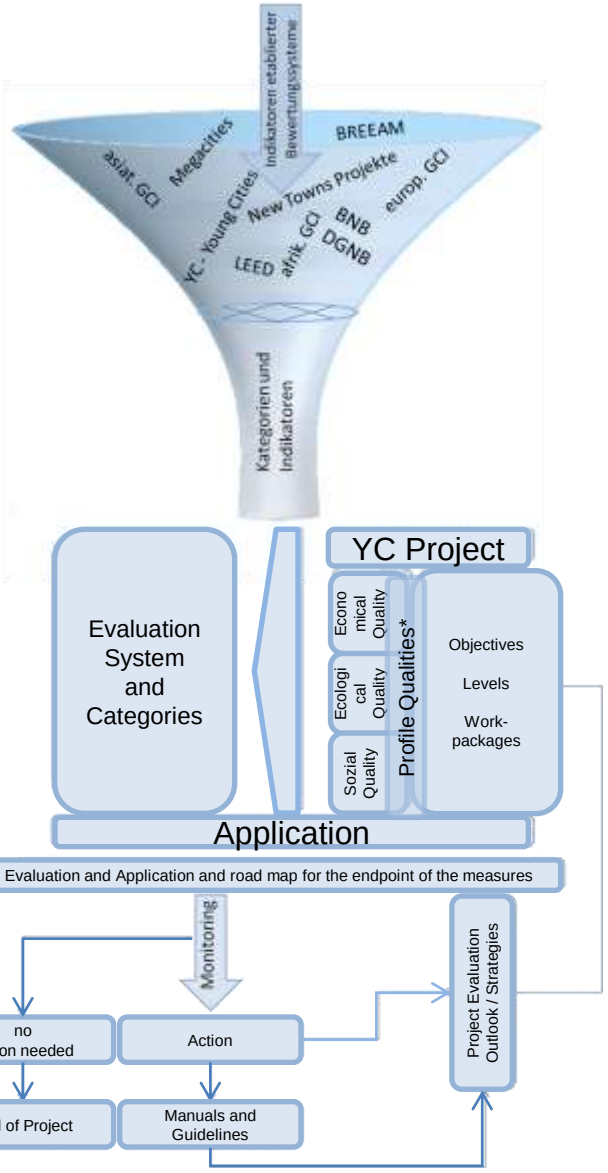
Part 4
Project -Specific
Indicator Set

Part 5
Example/Preliminary
Results of YC Project



Down the Funnel:
Gprs
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Part 3
Structure of
YC Project

Level 2
Application 2.1 / 2.2

Part 1
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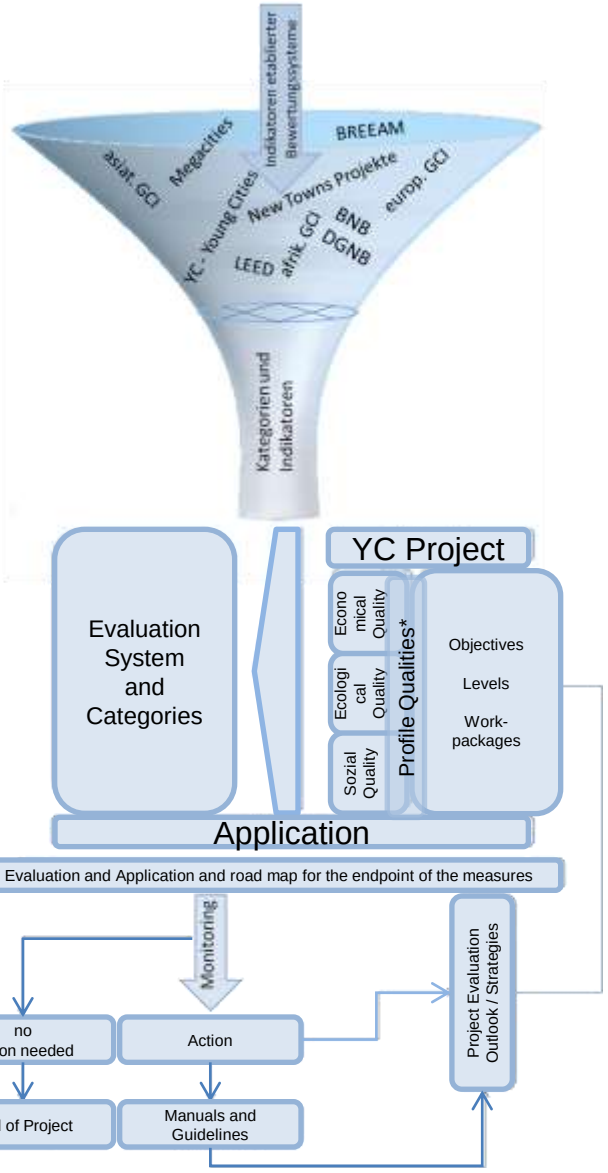
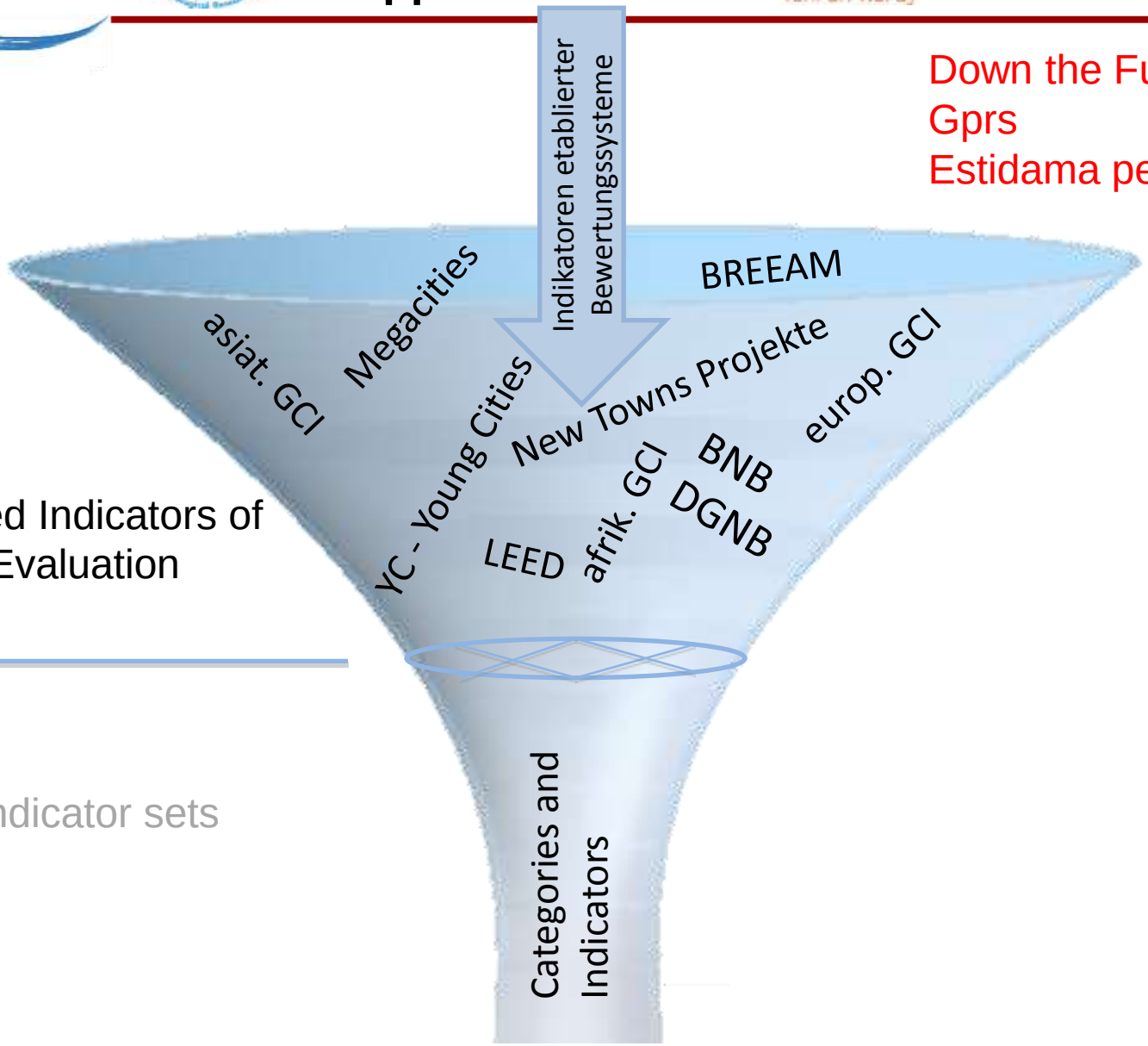


Down the Funnel:
Gprs
Estidama pearls

Part 3
Structure of
YC Project

Level 2
Application 2.1

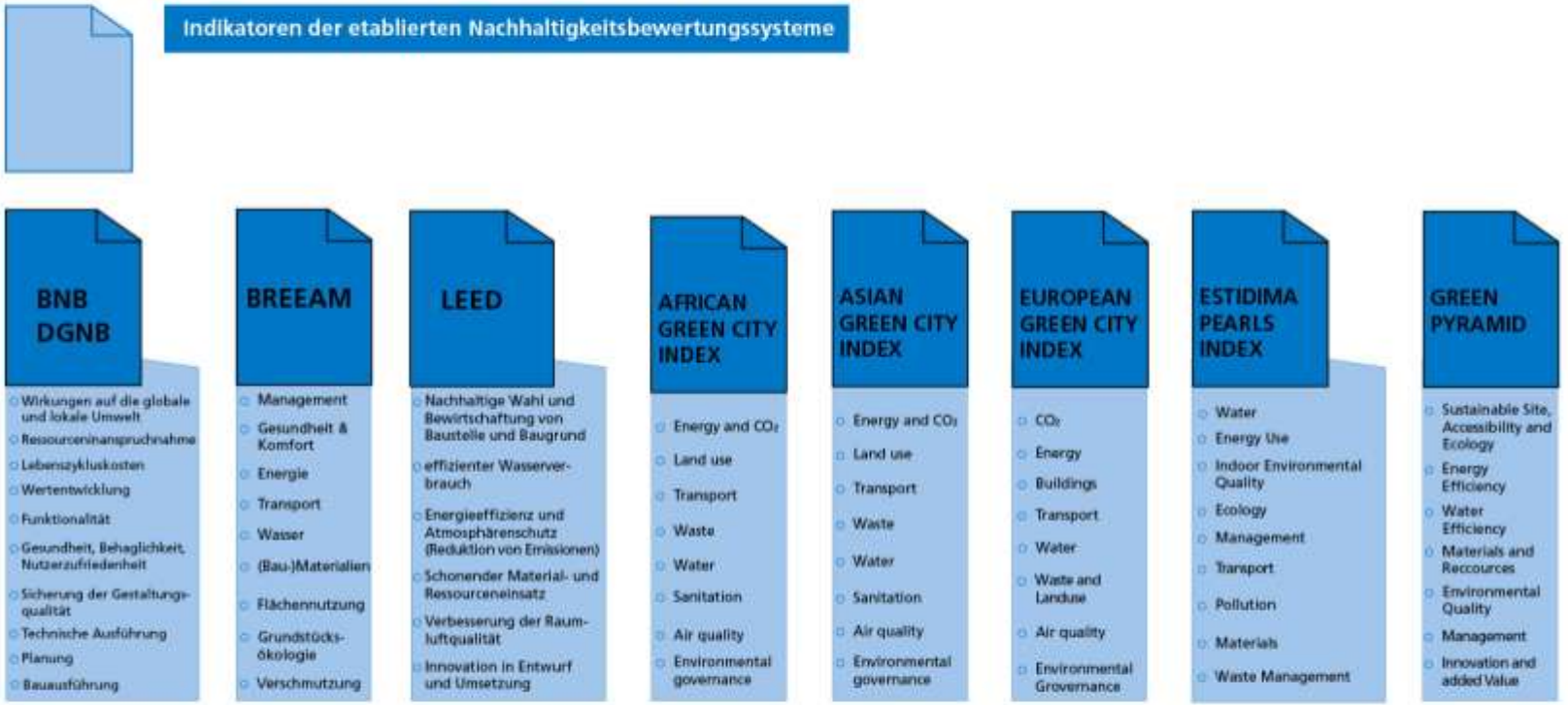
Down the Funnel
Gprs
Estidama pearls



Part 1
Established Indicators of Relevant Evaluation Systems

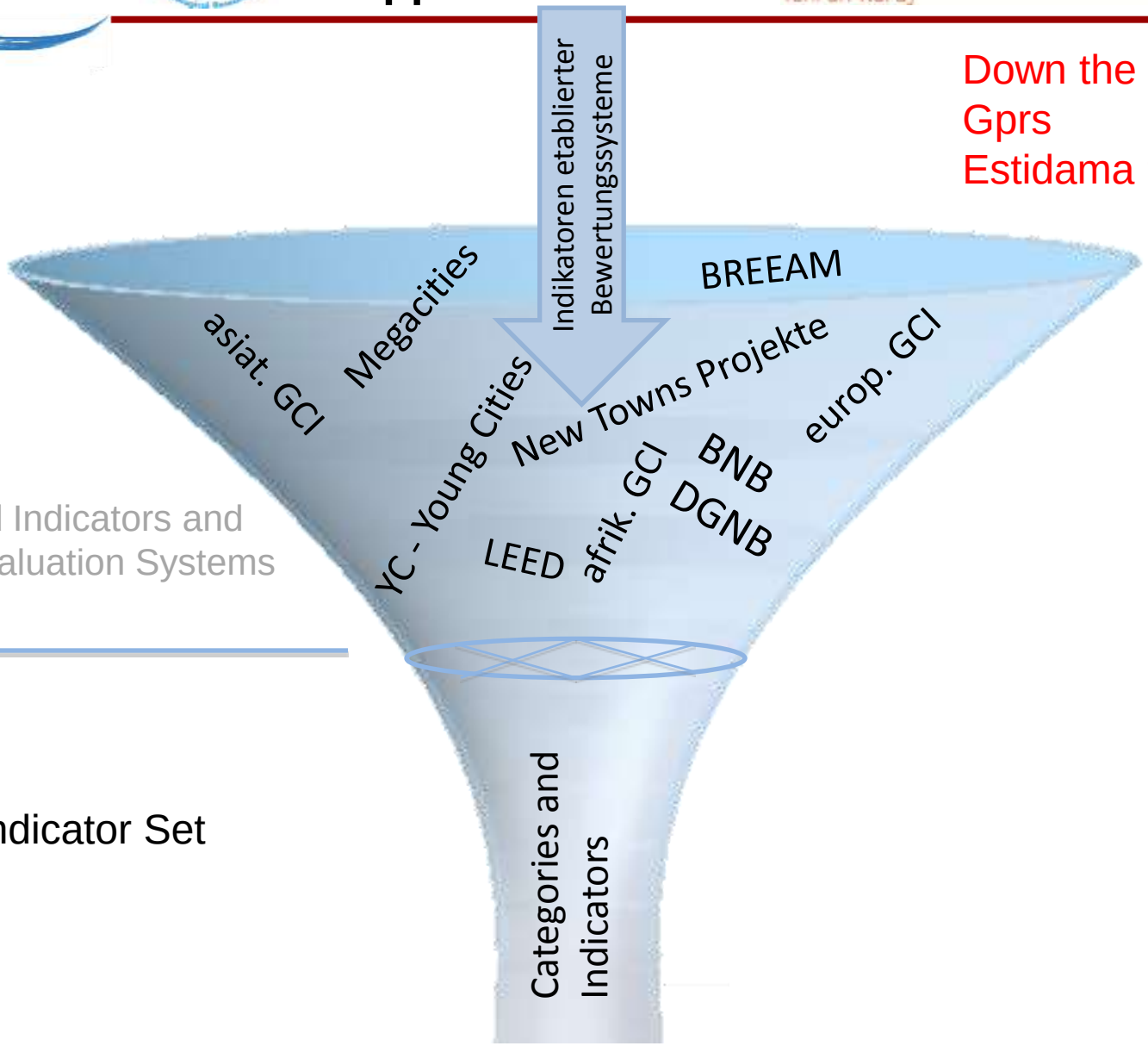
Part 2
General Indicator sets

Part 1: Established Indicators of Relevant Evaluation Systems



Level 2
Application 2.2

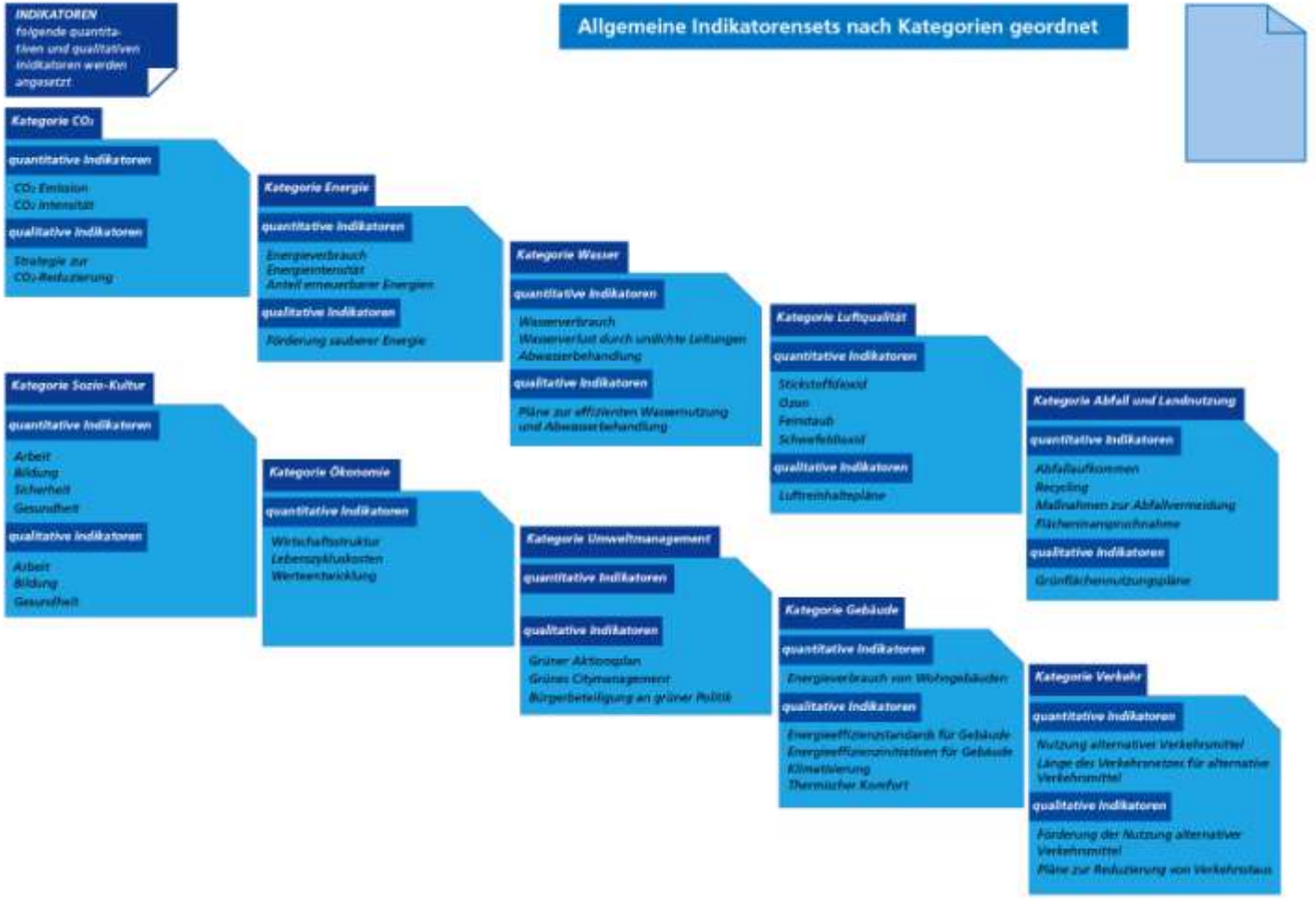
Down the Funnel
Gprs
Estidama pearls



Part 1
Established Indicators and relevant Evaluation Systems

Partl 2
General Indicator Set

Part 2 General Indicator sets



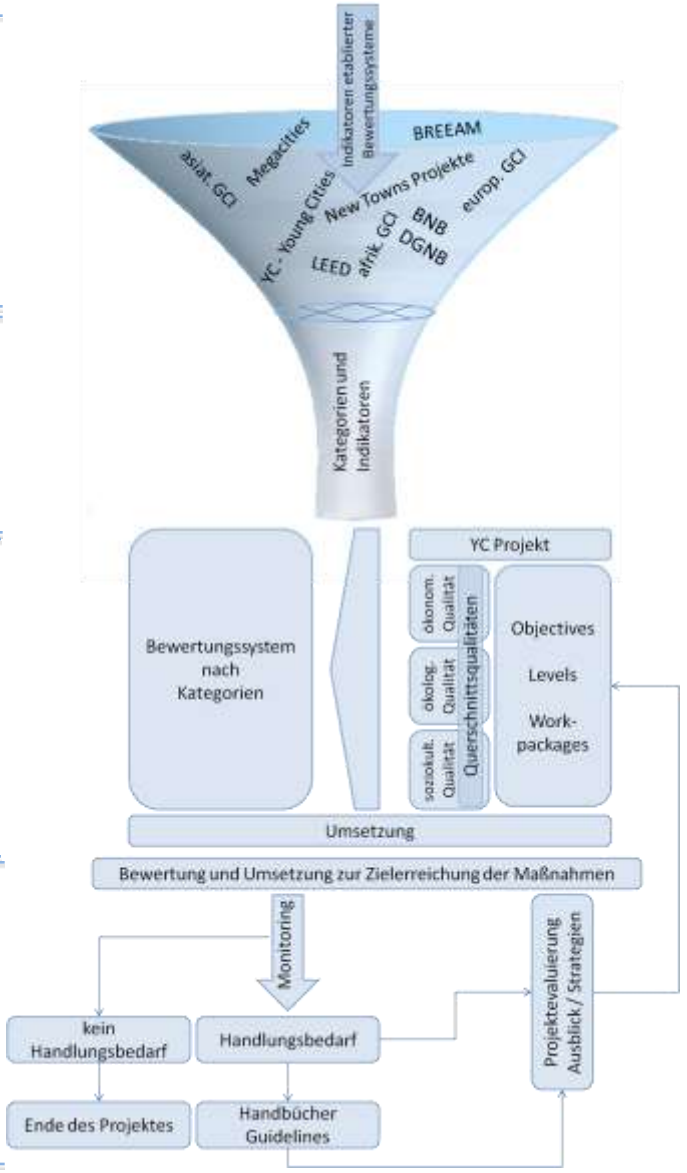
Level 2
Application 2.3 / 2.4

Part 1
Established Indicators and Relevant Evaluation Systems

Part 2
General Set of Indicators

Part 4
Project-Specific Set of Indicators

Part 5 Preliminary Results of the YC Project



Down the Funnel
Gprs
Estidama pearls

Part 3
Structure of YC Project

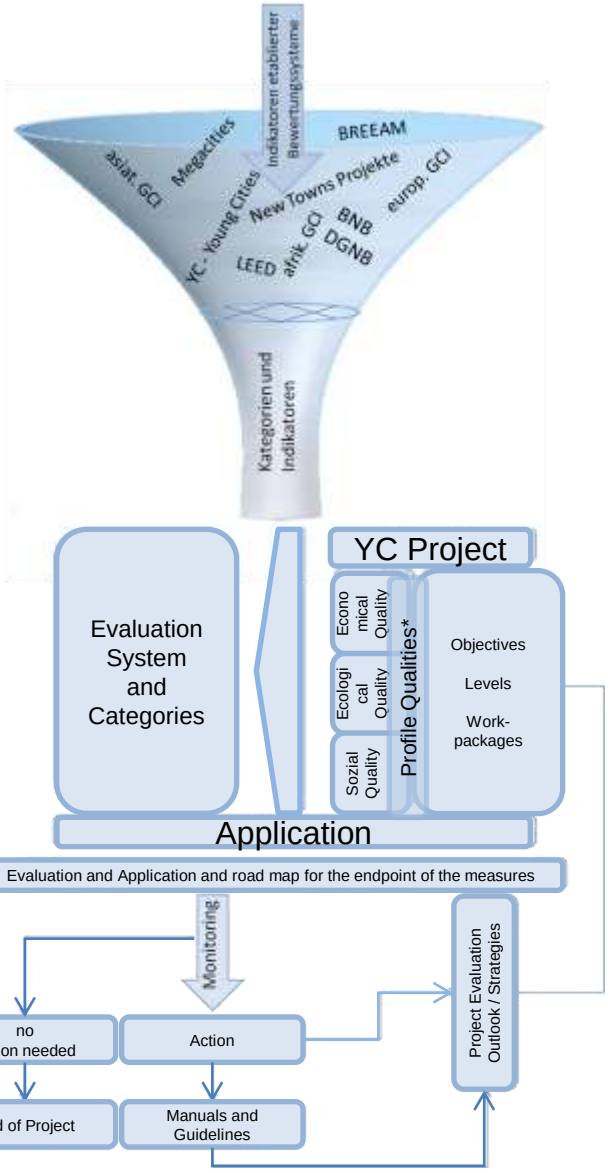
Level 2
Application 2.3 / 2.4

Part 1
Established Indicators and Relevant Evaluation Systems

Part 2
General Set of Indicators

Part 4
Project-Specific Set of Indicators

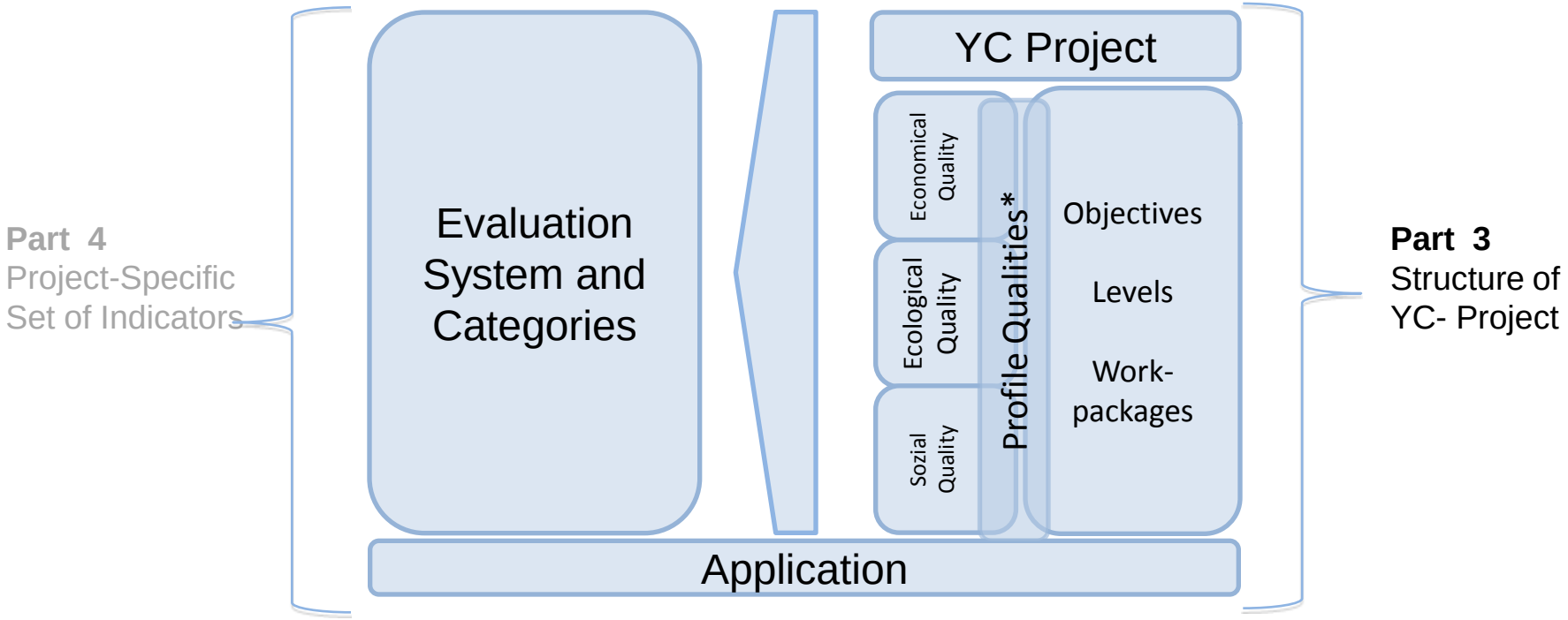
Part 5 Preliminary Results of the YC Project



Down the Funnel
Gprs
Estidama pearls

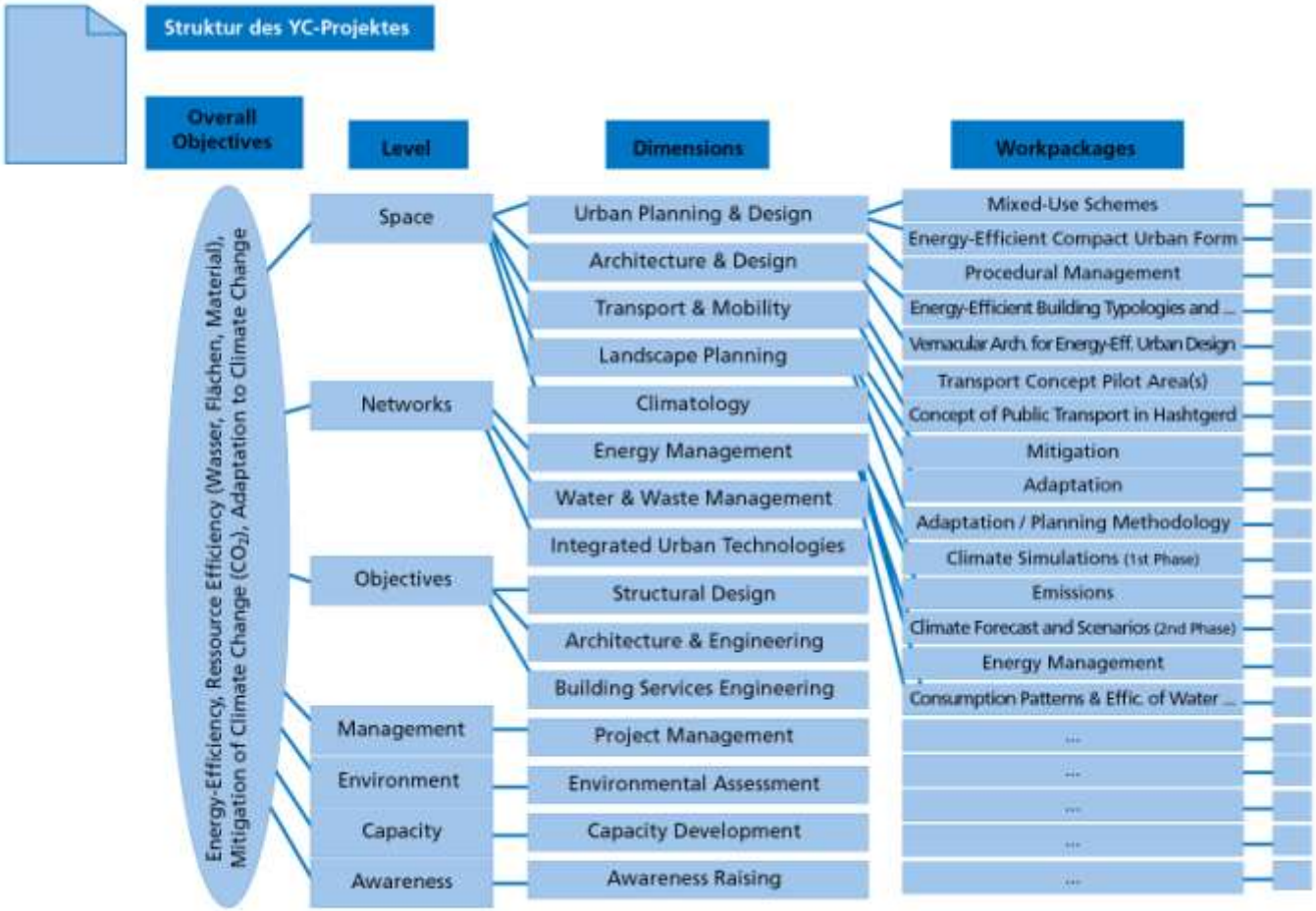
Part 3
Structure of YC Project

Level 2
Application 2.3



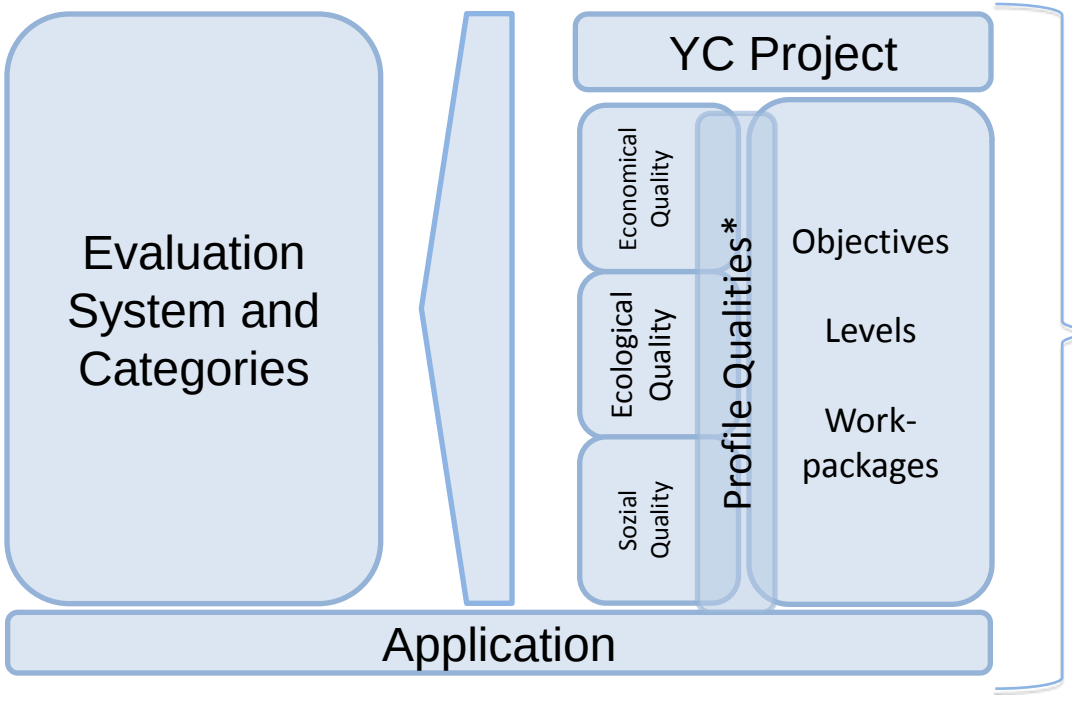
* Technical Quality / Processquality are evaluated after the classical dimensions of sustainibility

Part 3: Structure of the YC-Project



Level 2
Application 2.4

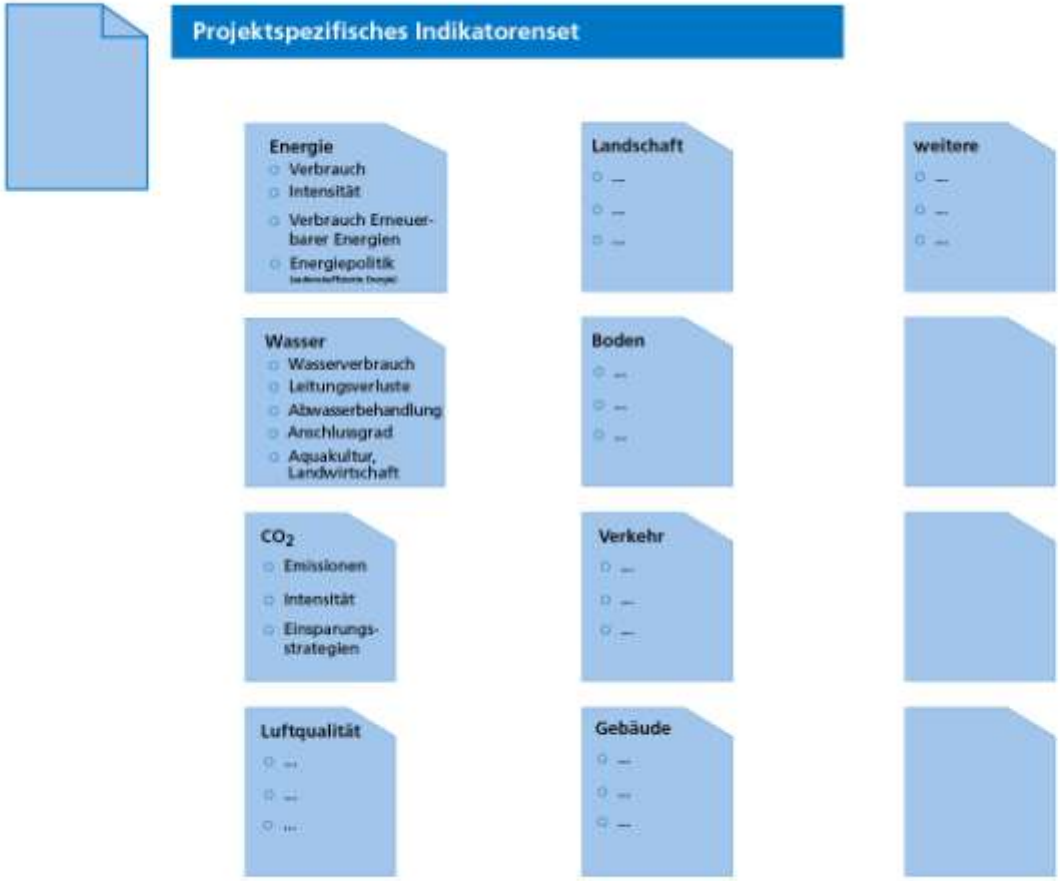
Part 4
Project-Specific
Set of Indicators



Part 3
Structure of
YC Project

* Technical Quality / Processquality are evaluated after the classical dimensions of sustainibility

Part 4: Project-Specific Set of Indicators



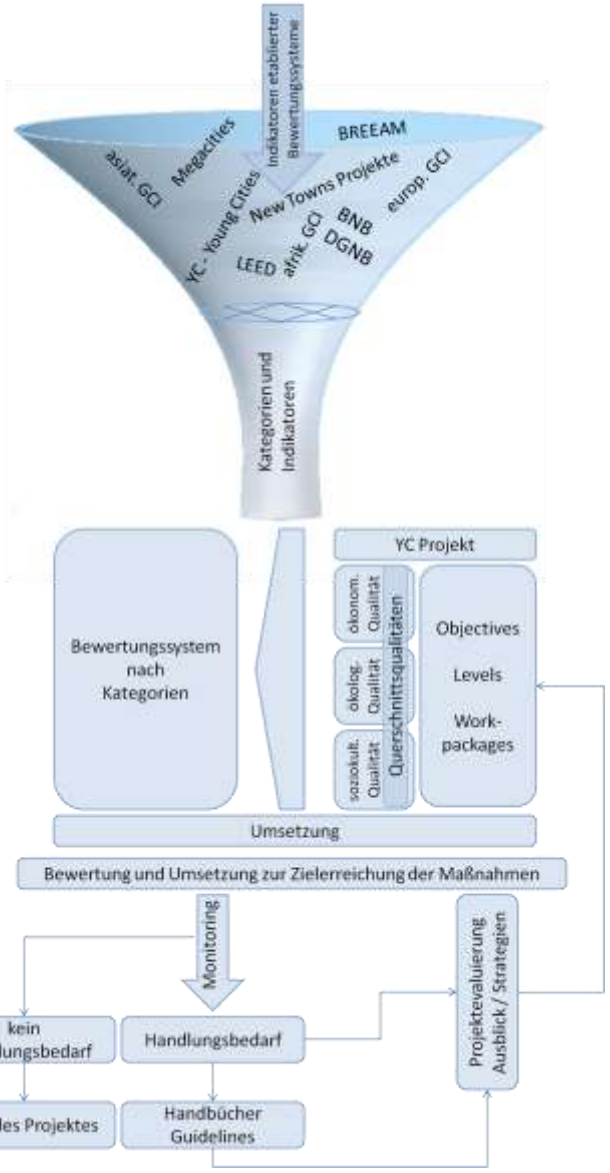
Level 2
Application 2.5

Part 1
Established
Indicators and
Relevant Evaluation
Systems

Part 2
General Set
Of Indicators

Part 4
Project_specific
Set of Indicators

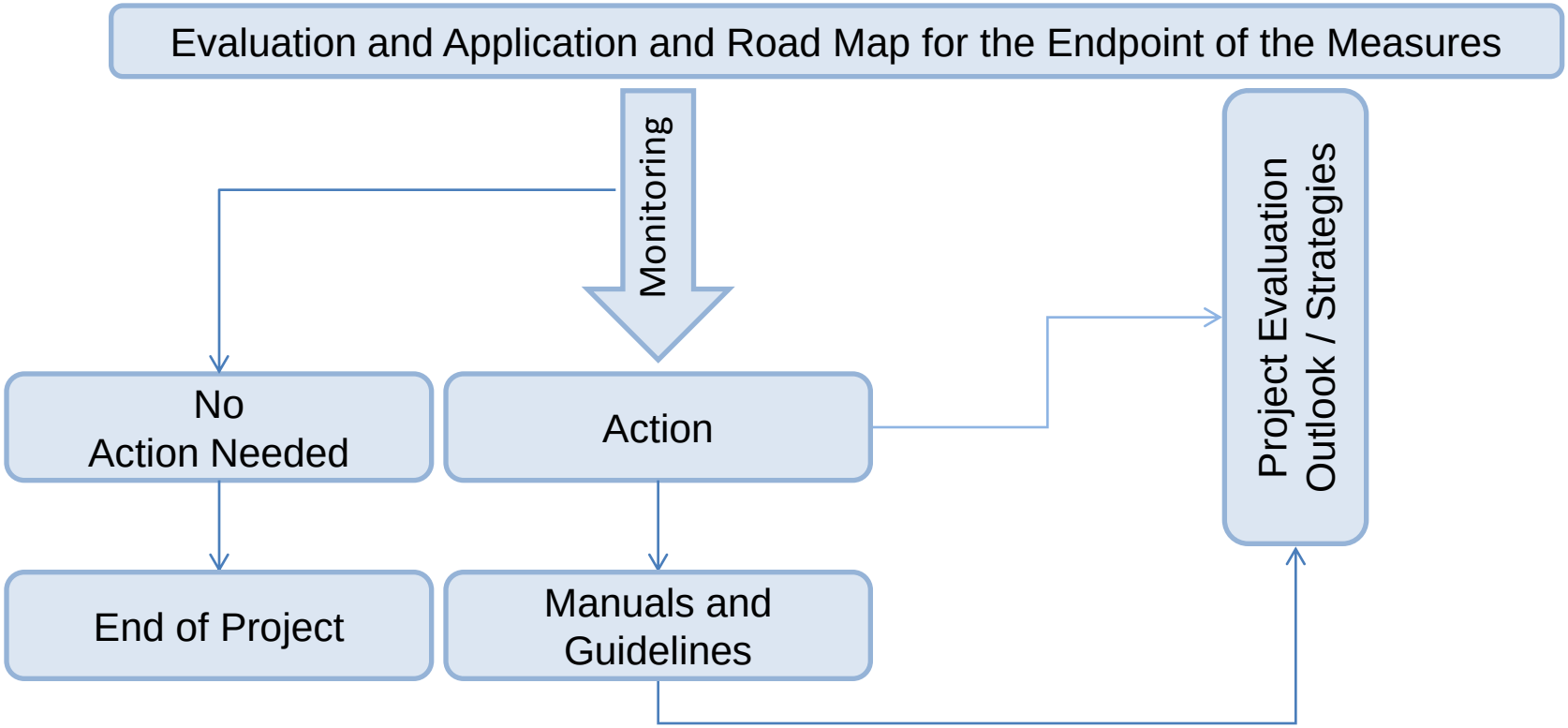
Part 5 Preliminary
Results of the
YC Project



Down the Funnel
Gprs
Estidama pearls

Part 3
Structure of
YC Project

Level 2
Application 2.5



Part 5 Preliminary Results of the YC Project

Beispielhafte Ergebnisse des YC-Projektes

Category	Indicator	Description	YC Data	
CO_2	emissions	total CO_2 emissions, in tonnes per head	5,4	(tonnes/head)
	intensity	total CO_2 emissions, in grams per unit for real GDP	682,34	(grams / Euro GDP))
	reduction strategy	assessment of the ambitiousnes of CO_2 reductions strategies	20% (Score 9)	

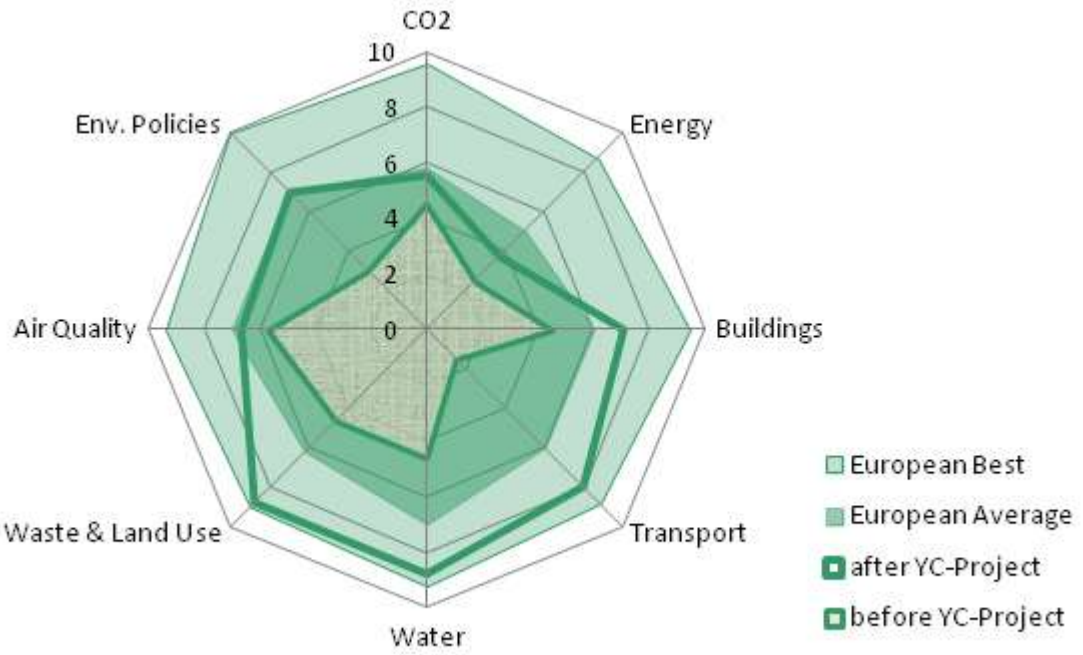
Category	Indicator	Description	YC Data	
Energy	consumption	total final energy consumption, in gigajoules per head	67,40	(GJ/head)
	intensity	total final energy consumption, in megajoules per unit of real GDP (Euro)	8,52	8,52 (MJ/Euro GDP)
	renewable energy consumption	percentage of total energy derived from re-newable sources, as a share of the city's total energy consumption, in terajoules	0	(%)
	clean and efficient energy policies	percentage of total energy derived from real assessment of the extensiveness of policies pro-moting the use of clean and efficient energy	2,5 / 7,5	

- Example: Categories CO_2 and Energy of the YC-Project calibrated by the GCI

Category	Indicator	Description	YC Data	
CO_2	emissions	total CO_2 emissions, in tonnes per head	5,4	[tonnes/head]
	intensity	total CO_2 emissions, in grams per unit for real GDP	376	[grams / € GDP]
	reduction strategy	assessment of the ambitiousness of CO_2 reductions strategies	9	Score

Category	Indicator	Description	YC Data	
Energy	consumption	total final energy consumption, in gigajoules per head	73,3	[GJ/head]
	intensity	total final energy consumption, in megajoules per unit of real GDP [€]	9,25	[MJ/€ GDP]
	renewable energy consumption	percentage of total energy derived from renewable sources, as a share of the city's total energy consumption, in terajoules	0	[%]
	Clean and efficient energy policies	An assessment of the extensiveness of policies promoting the use of clean and efficient energy.	9	Score

Teil 5 Preliminary Results of the YC-Project



Summary

Energy: Reduction of energy consumption of residential buildings by 65%

Urban Form: Reduced cooling demand by shading up to 5.3 % and through orientation up to 23% (cooling) and up to 16% (heating).

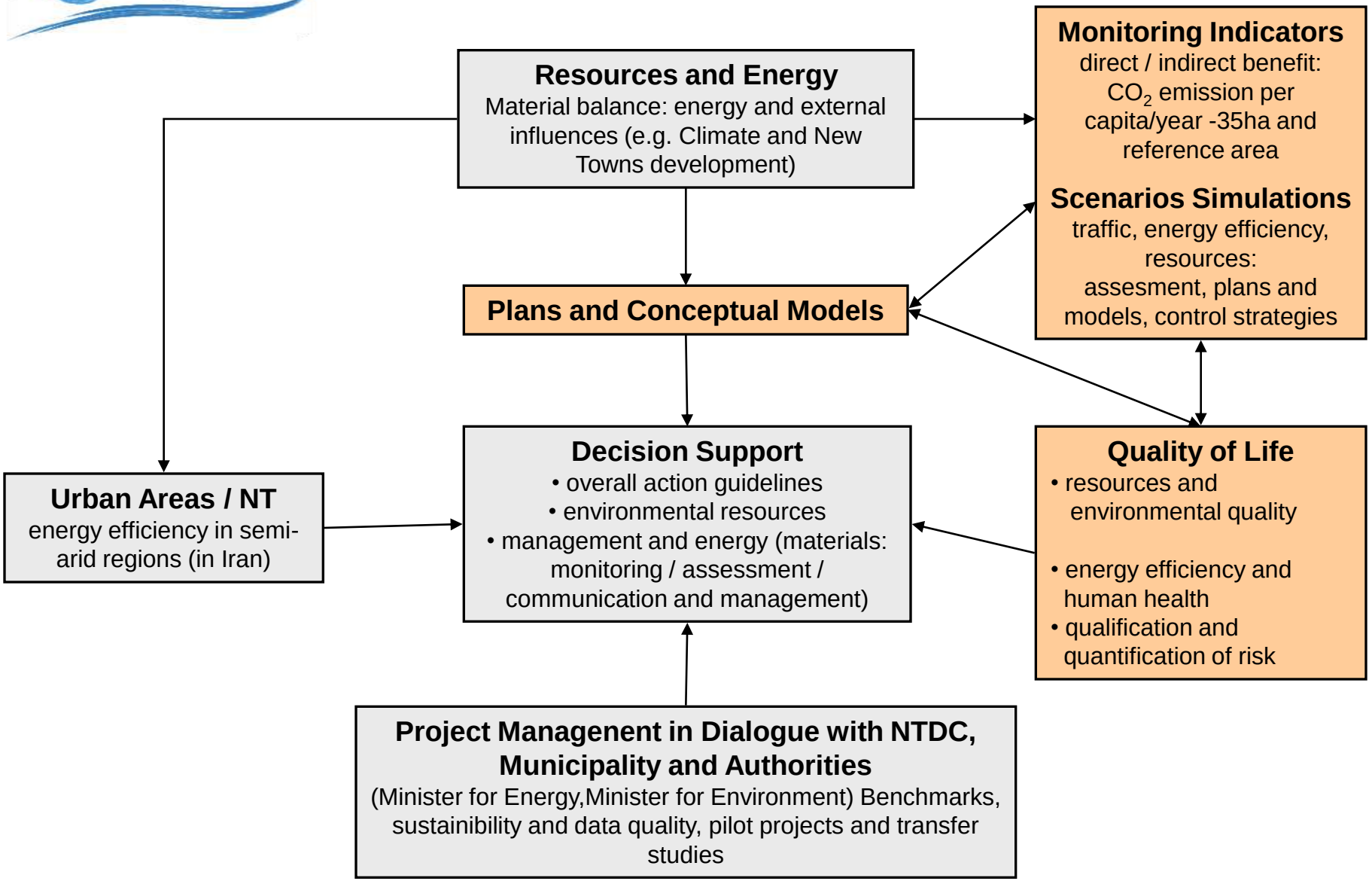
Transport: Reduction of individual car trips by 3% as well as trips with public transportation by 7% only through land use.

Landscape: Expansion of open spaces by 15% for higher share of recreational areas for all inhabitants.

Environment: Preservation of a water course and highly valuable vegetation structures and compensation.

Waste water: 50% of the used water from the households can be recycled on the 35 ha for irrigation, recharging ground water etc.

Region: Potential to reduce CO_2 emissions in Tehran Province by 11% by 2027 if Young Cities standards are used in every building built.



Monitoring of Urban Developments and indicator-based Decision Support System

Dissemination of the results

Federal Ministry of Education and Research

DLR

Future Megacities

References

Green City Index, Asian GCI, African GCI, LEEDS. BREAM

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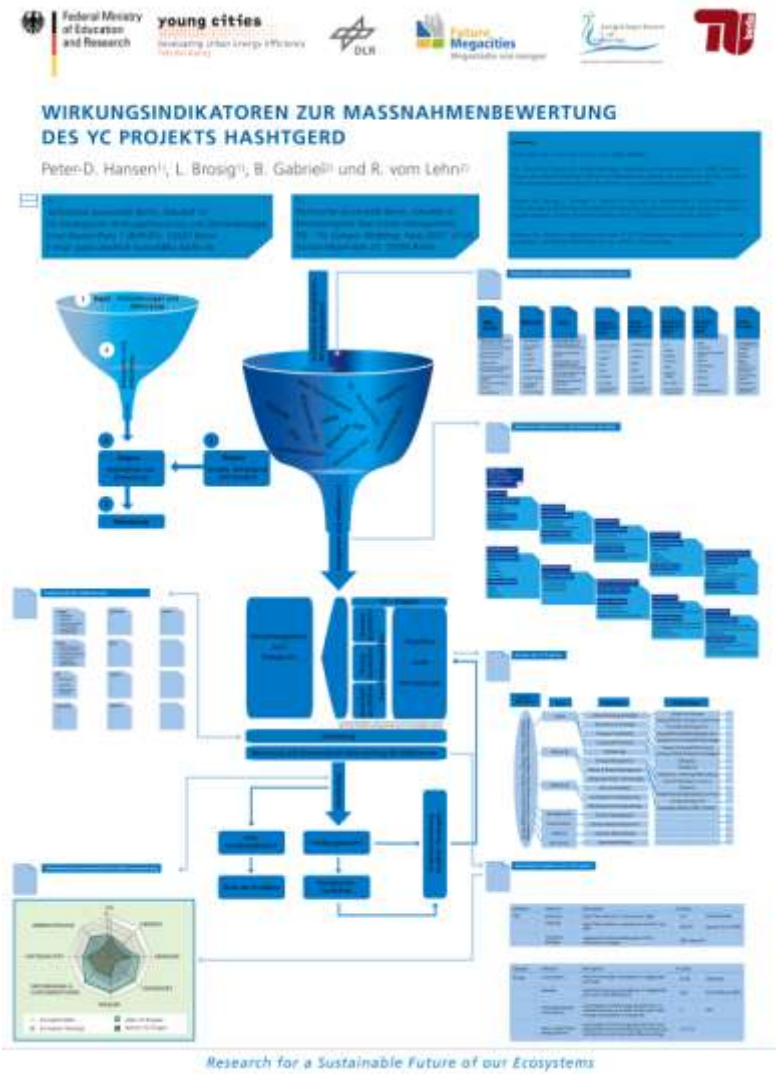
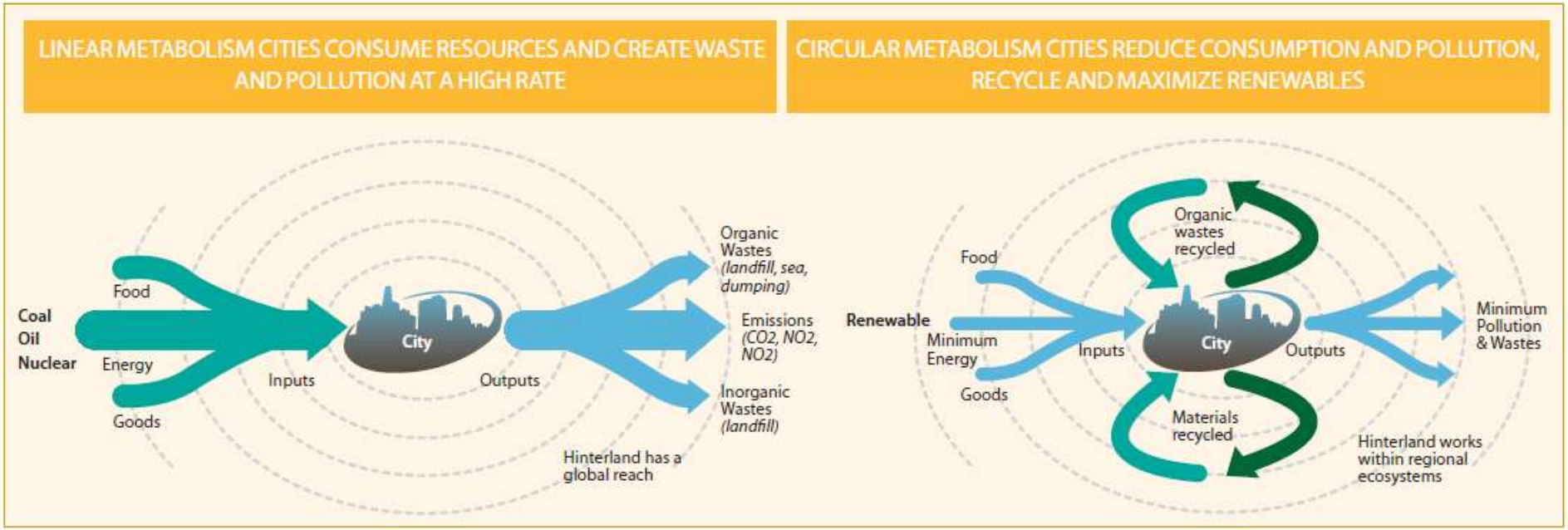


Thank You very much for Your Attention!

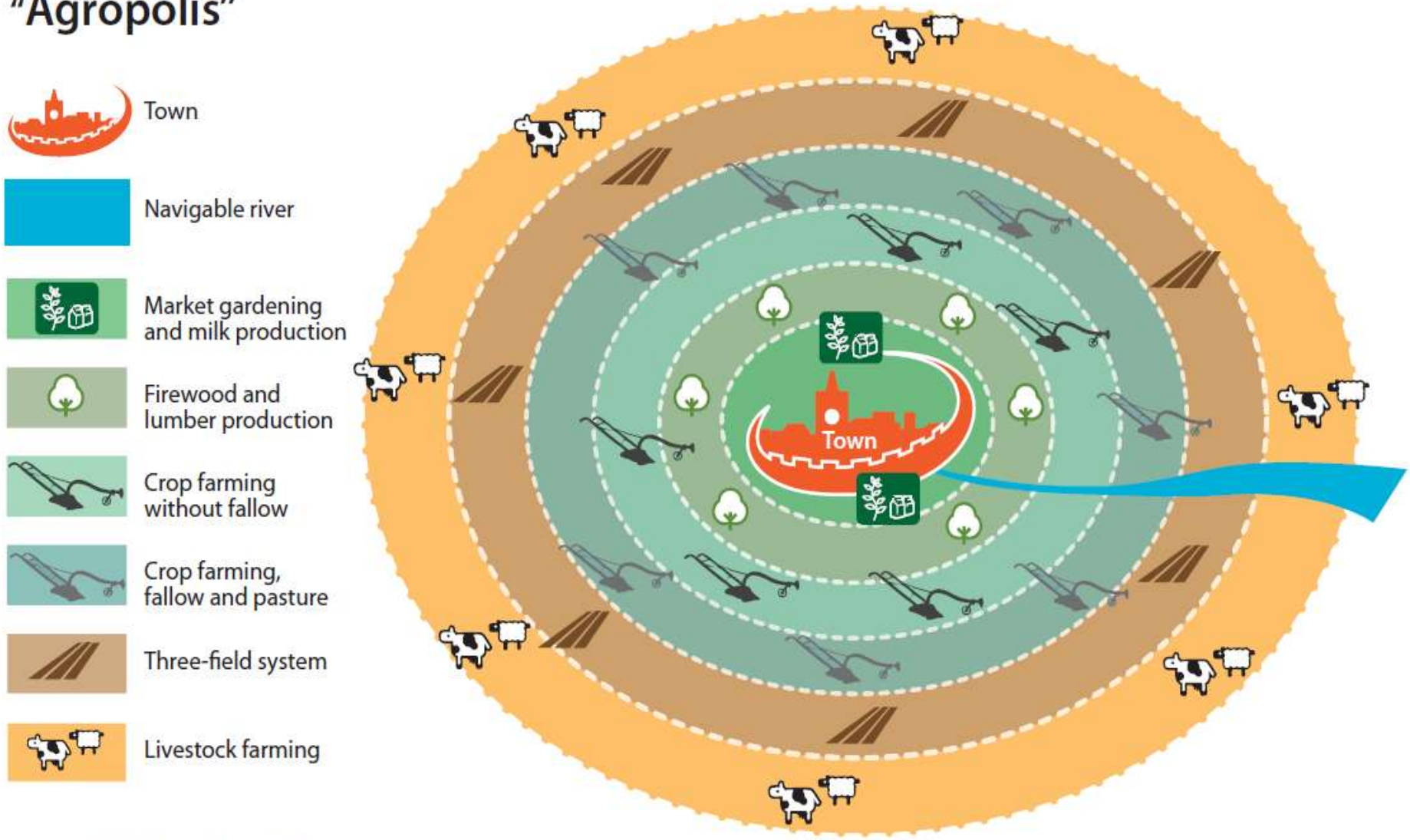
Additional Slides



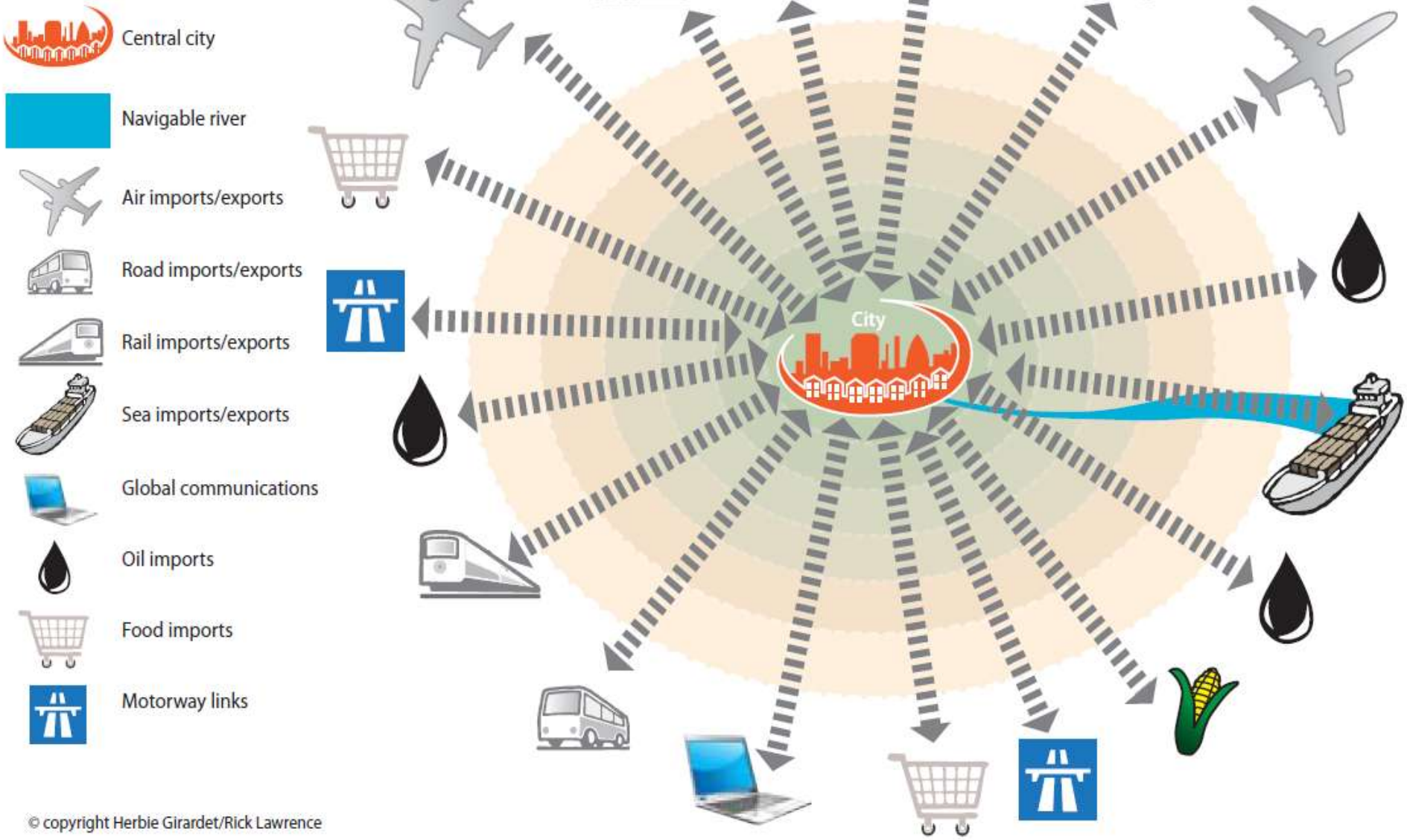
A key component of the sustainable city is a 'circular metabolism' which assures the most efficient possible use of resources
© *Herbert Girardet / Rick lawrence*

Cities as ecological and economic systems

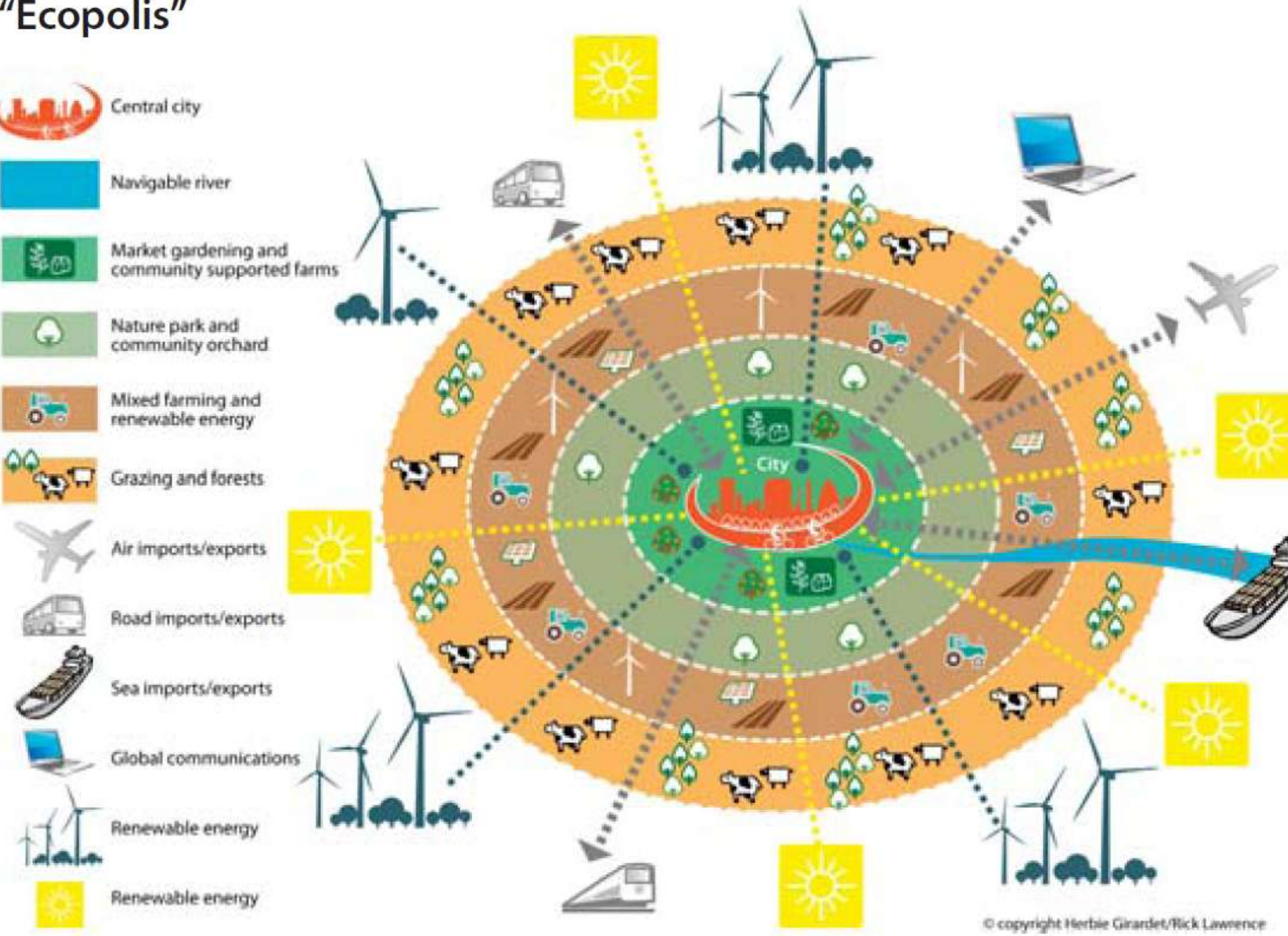
"Agropolis"



"Petropolis"



"Ecopolis"


Central city
Navigable river
Market gardening and community supported farms
Nature park and community orchard
Mixed farming and renewable energy
Grazing and forests
Air imports/exports
Road imports/exports
Sea imports/exports
Global communications
Renewable energy
Renewable energy
City
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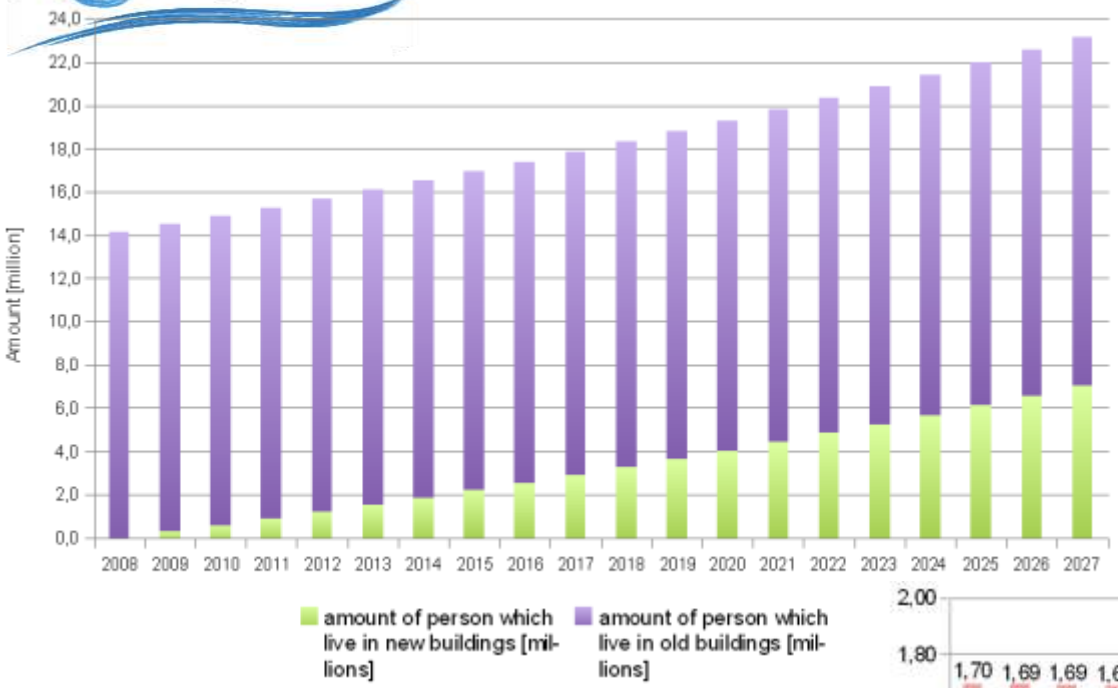
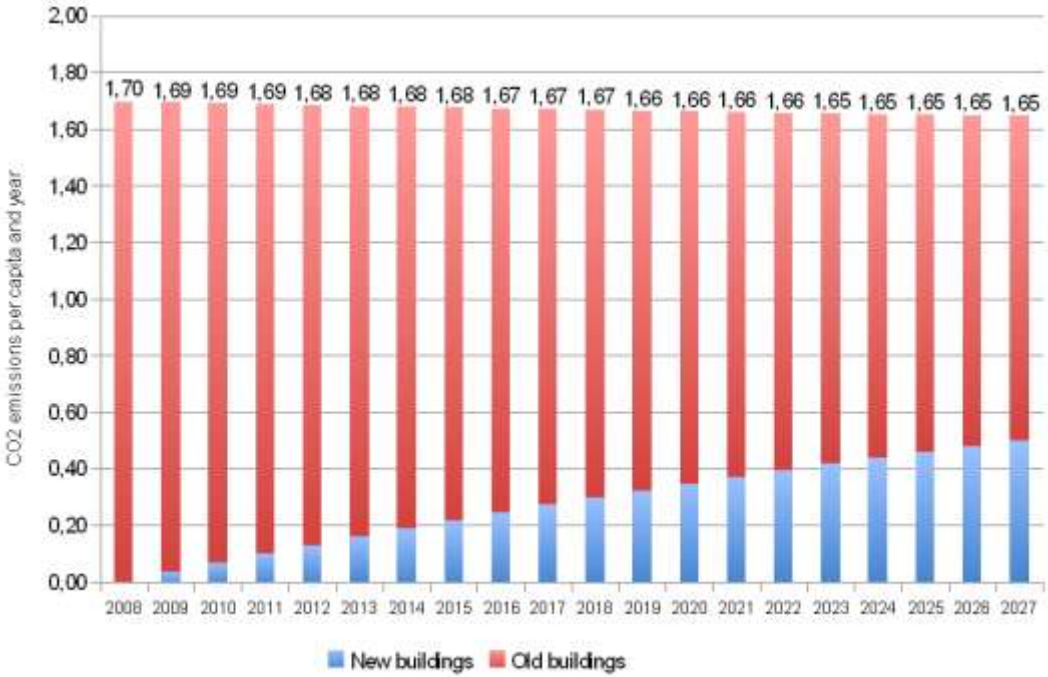


- Amount of Inhabitants which live in „new“ and „old“ buildings



- CO_2 emission per capita and year in the province Tehran, Scenario “BAU 2027”