Amendment to the 1. Milestone Report

26.06.2009

Cooperative Project

Shanghai: Integrated Approaches Towards a Sustainable and Energy-Efficient Urban Development - Urban Form, Mobility, Housing and Living

funded by the Federal Ministry of Education and Research

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CONTENT

1 Introduction

The following report offers an in-depth response to the critical and point-form statements made by experts, as provided to project management in a letter dated 10 June 2009, which was faxed on 16 June 2009.

The following pages describe the project and its components from a variety of perspectives, in order to sufficiently highlight the complex context of a developing applied research project. Such an approach appears to be necessary following the representation in reporting which has been used to date, since some content has either been unintentionally missed or not treated properly, or was no longer noticed or misunderstood. The authors hope that the explanations contribute to remove any doubts in the project, and that the guiding principle, work methodology, implementation and its effectiveness in detail is better communicated, also against the background of the collateral provisions. In this vein, already existing items have been illustrated more clearly, and have been continued and supplemented in the meantime, so that transparency can be achieved.

The criticism brought forward by the experts and project sponsor cannot be responded to in a few short lines, as are found in the next section. They will be extensively verified with facts and illustrations over the next fifty pages.

A In its current status, the project corresponds with the objectives of the Megacities focal point of support, and its focus on energy- and climate-efficient structures in urban growth centers, both in view of the overall goal of climate relevancy as well as methods, stakeholder integration and interdisciplinary nature. The guiding principle of the project is the answer to these questions. (Section 2)

B The project followed a time plan whose formal stringency sometimes deviates from the initially formulated time plan in view of the not always foreseeable consultations and obstinate decision-makers and structures but also due to external developments with stakeholders which could not be influenced. (Section 3)

C The project follows scientifically recognized methods and also develops innovative approaches in different areas, which are theoretically confirmed. (Section 4.1)

D To date, the project contains different implementation examples (methods, planning, and implementation) whose comprehensive effects regarding energy efficiency cannot be estimated. (Section 4.2)

1 The project contains a participatory component which has been shown to be meaningful for the project-specific contents and conditions, and which has been developed with stakeholders on a case-by-case basis.

2+3 The project defines three levels of decision-makers: the political level, investor level and citizen level. Work relationships exist with CAUPD of MoHURD, with the commission for construction and transit (currently: Shanghai Municipal Urban-Rural Development&Communications Commission), the Shanghai Chengtou Corporation, the Shanghai urban planning office.

4 The project is mainly managed by three stakeholders from the Megacity of Shanghai, but is also linked with other actors in Shanghai and

China. The Urban Planning and Administration Bureau Shanghai (SPA), Chengtou Corporation Shanghai (CC) and the commission for construction and transit ((currently: Shanghai Municipal Urban-Rural Development&Communications Commission) are mentioned first in this regard.

5 The project has turned the costs associated with the investment activities – both by the public sector as well as private investments - into a component of calculations and assessments for all modules. Not least, user behavior is influenced by costs.

6 The project and its investigation areas are based on an area typology which cannot be logically linked on a spatial map. The modules feature a clear assignment to certain task areas.

7 The project looks at the urbanization of rural areas to the extent that the peripheral locations of Shanghai Megacity form a component of the investigative area. The climate-relevant significance and effect of urban open space on energy consumption have flowed into the calculation methods to evaluate city areas.

8 The project answers the question of the benefit of maintaining open areas and expressly pleads for the integration of open areas as cooling islands and ventilation corridors in built-up areas beyond their obvious function as recreational areas. This is also reflected in the methods for energy-based assessments. In view of the exponentially increasing land prices in the Shanghai area, however, the question of using this space for agriculture - other than the already designated areas - is no longer a matter of debate.

9 The project will adjust project management to new conditions, once a qualified project partner has been found for module 4. An expanded advisory board will of course assume the task of external evaluation.

10 The project features essential innovative segments in the area of integrated and user-friendly approaches to evaluate the energy efficiency of urban quarters. Secondly, it also concerns an innovation block for the socio-economic development in the area of mobility, living and working – including participatory concepts in the neighborhood area.

11 The project integrates socio-economic aspects as part of the time series investigation in the Xinkai area, which will go beyond the term of the project. In this respect, the participatory approach based on the neighborhood committee (see Section 5.1) will play a key role.

12 The project contains active project-specific measures for capacity building and provides details for a further intensification.

A research project cannot be a planning project. Research projects which should and want to be planning projects cannot work because they are not subject to the formal criteria of planning processes. An applied research project can only progress in a dynamic and learning manner, and detours may also have to be incurred as long as the guiding principle and goal of the project are clearly pursued.

In contrast to the intended single example which was aimed for as part of the preliminary and application phase, the project has experienced a significant expansion which features both a larger diversity in project results as well as higher flexibility vis-a-vis stakeholders. Most of all though, the project approach which is pursued ensures a broad spectrum of stakeholders or potential users and a larger distribution of results. Because – it is not only about an implementation at the level of investors in a district capital, but rather also addresses the decision-making level of the commission for construction and transport based on its systematic and method diversity. Finally, the project has also garnered considerable interest – regardless of diplomatic protocols – at the China Academy of Urban Planning and Design at the Ministry of Housing & Urban Development, and is viewed as a current contribution to integrated urban development.

2 Project Guiding Principle

The giiding principle for the Shanghai cooperative project as guiding framework for all project partners and basis for implementing project-specific objectives.

The funding given by the Federal Ministry of Education and Research (BMBF) emphasizes mostly aid criteria and special requirements, which are the starting point for the following project concept.

Climate change caused by energy-induced CO_2 emissions and the limited quantity of fossil energy resources represent global problems for mankind. The interlinked transit system project is part of the solution of these problems.

- Improved energy efficiency can reduce energy-induced emissions of greenhouse gases and moderate climate change (mitigation).
- Integrated concepts in the working fields of urban planning and mobility raise the quality of life in the exemplary project sectors and adjust the city to the climate-induced changes (adaptation).
- Better energy efficiency leads to a more economical consumption of limited fossil energy resources and cushions the transition towards a post-fossil urban future.

The cooperative project works out integrative strategies for addressing a specific scientific problem.

- The cooperative project indicates how energy efficiency in the various interconnected working fields of urban planning/cityscape, building services engineering, mobility and renewable energy production can be improved in the Shanghai region.
- As far as guidelines and good practices are concerned, methods and implementation examples can be transferred to other cities.

The cooperative project is characterized by a cooperative, participatory and practical working methodology.

- Together with Chinese planning partners and investors as well as authorities and research institutes, working fields are selected, solution recommendations are worked out, and strategies for adaptation to local needs and particularities are developed, exemplarily accompanied and implemented in pilot projects.
- From the German and Chinese sides, the project team integrates relevant interest groups from politics, science, economics and society into the project.

Financially, the cooperative project represents a meaningful investment.

- The project supports the opening up of the Chinese market for German companies.
- The specialized subjects dealt with – traffic, energy supply, building services engineering and environmental technology – are areas of expertise of German industry and offer many different applications for companies.
- The project work also serves the purpose of integrating local and regional decision-makers into long-term contact networks.
- The project improves German research presence in the fields of energy efficiency and urbanization, of future importance. A lot of accompanying research and doctoral dissertations are initiated.
- German city and traffic planning also benefits from the project results.

Project selection

The original selection of the project field within the Shanghai Municipality was initiated by the Shanghai Urban Planning Office, which believes that the Fengxian District with its capital Nanqiao should be replaced by urban sectors that currently demand decisions – especially against the background of a fast implementation of planning into reality. The adaptation to the urban planning needs and working fields as well as to the following implementation levels has proven advantageous for variety and transfer possibilities, thus expanding research contents. The comparison given below clarifies this.

Fengxian District preliminary phase	**Shanghai Municipality** main phase
A large partial area	Several smaller research areas
A determination framework with one single, foreseeable emphasis	Several determination framework with different emphases
Planning sector without immediate prospect of implementation, dependent on one investor	Planning and implementation fields in various stages of completion
Surface area uses without systematics and mainly residential	Surface area uses for residential, office, educational and mixed purposes
Energetic assessment in one place	Energetic assessments in different places under different conditions
Not very adaptable, also with regard to basic conditions that cannot be influenced	Adaptable and flexible with regard to local, regional and global basic conditions
Only new urban construction in the periphery	Urban renovation and new construction close to the city center and in the periphery
one task, but with limited results	More closely linked to the large variety of everyday life planning, but with more varied results

3 Chronology of the Project Work

3.1 Survey of the different activities

Below the survey shows how the development of the methods and the different acitivties, which the project team works on, are connected and how they influence each other. The results of each activity slip in each adopted method and help to generalize the findings and to assign them to other regions or cities.

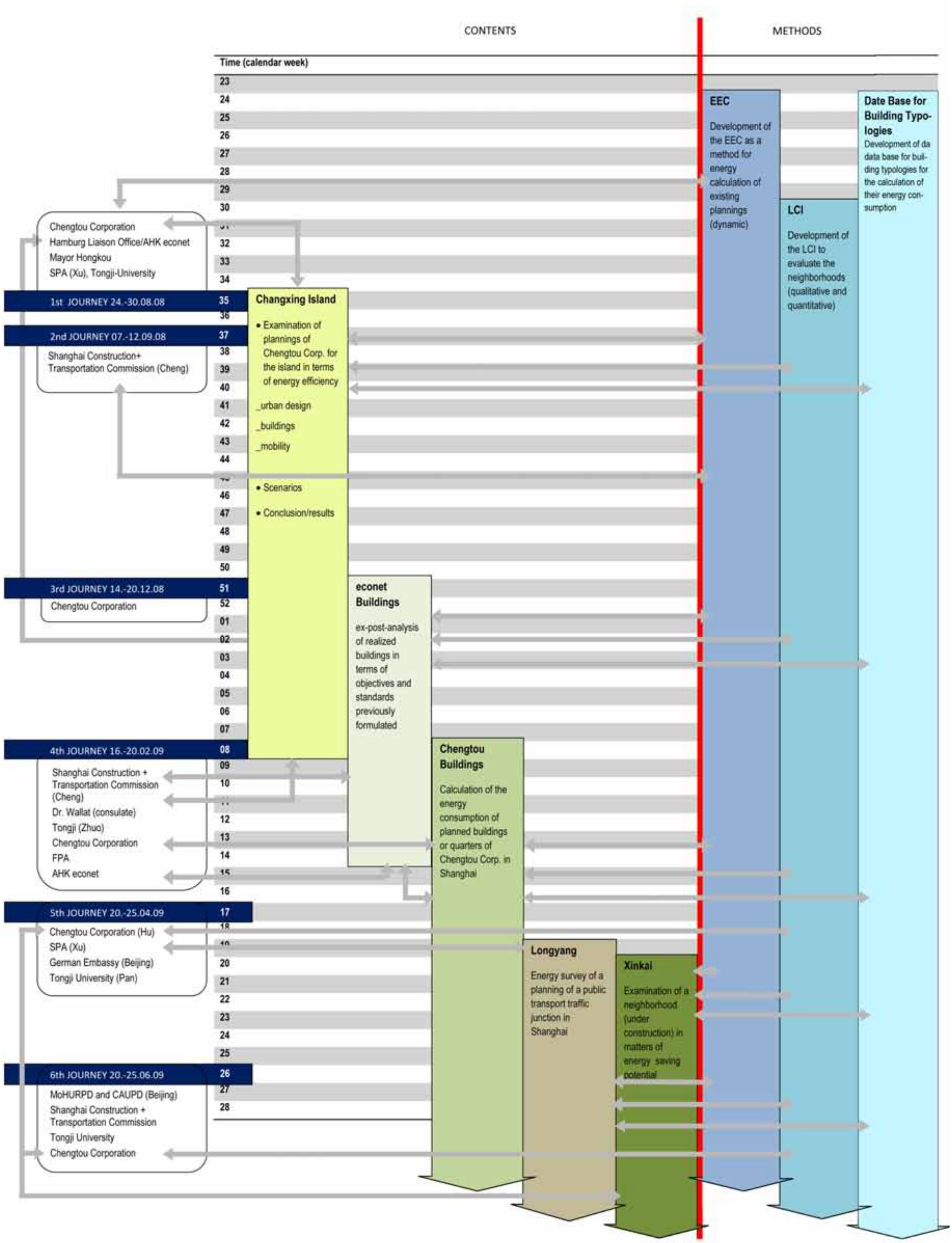

Figure 1 survey of the project work; Source: own exposure

3.2 Project Schedule

In the following you can find a schedule about the important appointments of the project team (journeys, meetings and other important events). This shows the previous project work and cooperations with partners and participants.

year	month	cw	date	content / participants
2008	June	23	01.06.2008	official start of the project (backdated)
		24		
		25		
		26	25.06.2008	1. meeting of project-partners
	july	27		
		28	08.07.2008	Jour Fixe (university and TRC) 12.30-14.00 pm
		29		
		30	21.07.2008	Jour Fixe (university and TRC) 9-11.00 Uhr am
			23.07.2008	1. partner meeting Module 1
	August	31		
		32	07.08.2008	receipt conveyance advice
			08.08.2008	Jour Fixe (university and TRC) 9-10.00 am
		33	15.08.2008	meeting with the law department of the university concerning contracts with undercontractors 10-11.30 am
		34	20.08.2008	Jour Fixe (university and TRC) 9-11.30 am
		35	24.-30.08.2008	1. journey to Shanghai for preparing the further project work. Appointments with: Chengtou Corporation Shanghai, urban planning bureau Shanghai, Tongji University, mayor of Hongkou district
	September	36	03.09.2008	Jour Fixe (university and TRC) 9-11.00 am
				appointment with webdesigner, concerning project homepage 16.30-18.00 pm
		37	07.-12.09.2008	2. journey to Shanghai for presentation of first results and for discussion about projects for realization. Appointments with: construction and traffic commission Shanghai
		38	17.09.2008	Jour Fixe (university and TRC) 9-11.00 am
				meeting with the law department of the university concerning contracts with undercontractors 15.30-16.30 pm
		39	26.09.2008	speech: Networks for Mobility
	October	40	bis 30.09.2008	Signing of cooperation contracts
				preparation of internet presence
			01.10.2008	Jour Fixe (university and TRC) 9-11.30 am
		41		
		42	15.10.2008	1. meeting of the leading board 13.30 -15.00 pm
		43	20.10.2008	Jour Fixe (university and TRC) concerning Changxing Island 10.30-12.00 pm
			23.10.2008	Jour Fixe (university and TRC) 9.30-11.00 am
		44	30.10.2008	Jour Fixe (university and TRC) 9-10.30 am
	November	45	03.-07.11.2008	participation in the Onlineconference Climate 2008
		46	12.11.2008	Jour Fixe (university and TRC) 9-11.00 am
		47		
		48	24.11.2008	Kick-Off meeting of projects in Berlin
			25.11.2009	Jour Fixe (university and TRC) 9-10.30 am

year	month	cw	date	content / participants
	November		26.11.2008	meeting with Jens Hartmann, Intergraph 9-12.00 pm
	December	49	05.12.2008	Jour Fixe (University and TRC) concerning Data-workshop of the DLR 9-11.30 am
		50	10.12.2008	Jour Fixe (university and TRC) 9-11.00 am
			14.-20.12.2008	3. journey to Shanghai/Beijing for establishing ties in Beijing
		51	17/18.12.2008	Workshop with Intergraph (GeoMediaPro) each 9.00-16.00 pm
			19.12.2008	Jour Fixe (university and TRC) 12-13.30 am
		52		chistmas
2009	January	01		new year
		02	07.01.2009	Jour Fixe (university and TRC) 9-11.00 am
				language course (Chinese) 16-18.00 pm
			08.01.2009	language course (Chinese) 16-18.00 pm
			10.01.2009	language course (Chinese) 11-16.00 pm
		03	14.01.2009	2. partner meeting module 1 10-12.00 Uhr
				1. partner meeting module 3 10-12.00 Uhr
				2. meeting project partner 12.30-15.00 Uhr
				language course (Chinese) 16-18.00 pm
			15.01.2009	language course (Chinese) 16-18.00 pm
			17.01.2009	language course (Chinese) 11-16.00 pm
		04		
		05	28.01.2009	Jour Fixe (university and TRC) 9-11.30 am
			29.01.2009	Data-workshop of DLR in Bonn
				Finish of delineation (Partner module 1)
	February	06	04.02.2009	language course (Chinese) 16-18.00 pm
			05.02.2009	language course (Chinese) 16-18.00 pm
			07.02.2009	language course (Chinese) 11-16.00 pm
		07	11.02.2009	final report / Intrerim report an die DLR
				Jour Fixe (university and TRC) 9-10.00 am
		08	16.-20.02.2009	4. journey to Shanghai Appointments with: Construstion and traffic commission (Mr. Cheng), German Consulate (Mrs. Wallat), Tongji-University, Chengtou Corporation, FPA, ahk/econet
		09	24.02.2009	Jour Fixe (university and TRC) 9-11.30 am
	March	10	03.03.3009	Workshop with the IFEU (Heidelberg): passive houses
			04.03.2009	Jour Fixe (university and TRC) 9-11.30 am
			05.03.2009	1. Networking-workshop (Urban Planning) in Berlin
		11	10.03.2009	Jour Fixe (university and TRC) 9-11.00 am
			11.03.2009	Jour Fixe (university and TRC) 9-10.30 am
		12		
		13		

year	month	cw	date	content / participants
	April	14		
		15		
		16	15.04.2009	Jour Fixe (university and TRC) 9-10.00 am
			16.04.2009	Meeting with Mrs Koch-Kraft in Essen
			20.-24.04.2009	5. journey to Shanghai Appointments with: German embassy (Beijing), Chengtou Corporation, SPA (Mr. Xu), Tongji-University (Pan)
		17	22.-25.04.2009	Participation in the conference Corp in Sitges
		18	29.04.2009	IHDP-conference
			30.04.2009	Delivery Milestone report
	May	19		
		20	15.05.2009	Implementation of a Server for module 1
		21		
		22		
	June	23	02.06.2009	Jour Fixe (university and TRC) 8-12.00 am
			03.06.2009	Jour Fixe (university and TRC) 9-12.30 am
			04.06.2009	Jour Fixe (university and TRC) 8.30-12.30 am
			05.06.2009	Participation at the European Climate-Teach-In Day
		24	08.06.2009	Jour Fixe (university and TRC) 9-10.00 am
			09.06.2009	Jour Fixe (university and TRC) 10-11.00 am
				3. Meeting of Project Partners 11.00-13.30 pm
			10.06.2009	Jour Fixe (university and TRC) 9-12.30 am
		25	15.06.2009	Telephone conference of project partners 13-14.30 pm
			15./16.06.2009	Participation at the conference Cities for mobility in Stuttgart
			16.06.2009	Appointment with Prof. Pan in Stuttgart
			18.06.2009	Jour Fixe (university and TRC) 8.30-12.30 am
			20.06.2009	Participation at the conference Kulturpavillon, Shenyang; Participation (speech and discussion) at the German-Chinese Promenade, Shenyang
		26	20.-25.06.2009	6. journey to Bejijing and Shanghai for signing of contracts respectively. letters of endorsement appointments with: German Embassy, Built and traffic commision, Chengtou Corporation, Tongji University
			22.03.2009	preparation meeting for the 2. Networkworkshop in the field of urban planning with other Megacities projects in Berlin
		27		

4 Implementation of the Guiding principle

4.1 Methods

An important part of the project represents the development and application of energy- and CO_2-related assessment methods of concepts, strategies and measures at the "planning" and "implementation" levels. The increased awareness in the Shanghai region agencies responsible for planning and implementation that they should strongly consider the national efficiency increase objectives already in the master planning phase, subsequently in the regional development planning phase and finally in the implementation is the project's main contribution to international climate protection goals. In doing so, and more important than the completion of an individual pilot project, is that the methods become a "normal" part of everyday planning and implementation. For this reason, the development and application of suitable in ex-ante and ex-post efficiency evaluation methods in accordance with the intended working steps for module 3 and their obligatory inclusion into everyday planning are given a decisive importance.

The approaches for the energetic assessment of mobility and buildings (well known in Germany) cannot be simply transposed to Chinese reality. For this reason, and in cooperation with the project's Chinese partners, approaches for all assessment areas were adapted that must consider method dependency, type of region and phase in the planning process. In other words: There is no single correct method but rather a family of methods for mobility and buildings that find their way into everyday Chinese planning.

See chapter 6.1

The assessment methods must differentiate between a quantitative or qualitative characteristic of an indicator (f. ex., energy consumption or difference in energy consumption) and the assessment of these quantitative or qualitative characteristics. Whereas these quantitative or qualitative characteristics still describe a real problem objectively, a problem assessment takes place subjectively. The former is scientifically justified, but the latter (the problem assessment) is, on the other hand, subject to an individual or – as is the case in public planning – to politically legitimized preferences.

A further requirement resulted from the fast-paced planning processes. The Shanghai Urban Office required that the assessment processes had to elapse in synchrony to the development of a regional development plan or immediately afterwards within a 4-week time period in order to include the aspects needed for an energy-efficient in the draft.

This led to the obligatory development of an **initial method family for the fast checking** of drafts with regard to energy consumption and CO_2 emissions focused on a qualitative assessment with many individual indicators.

The qualitative method family was further expanded to a "**Low Carbon Index" (LCI)** for urban areas. The next paragraph explains this in more detail.

The "Low Carbon Index" (LCI) was newly drawn up as part of the project and tested in the development areas predetermined by the Urban Planning Office. The LCI is subdivided into the sectors of Urban Development, Mobility and Buildings; the essential quantities that determine energy consumption and CO_2 emissions are integrated into the LCI assessment. Easily computed auxiliary quantities serve for estimating the importance of the indicator in the specific energy consumption situation. (The assessment of a regional concept with regard to CO_2 emissions is then methodically developed in a subsequent step.) The auxiliary quantities are the basis for a qualitative evaluation of the actual indicators for energy consumption. For them, a scale ranging from -2 to +2 points is used for evaluating to what extent the regional development plan will exhaust the region's potentials with regard to energy efficiency. The specific approaches are listed in Appendix **Fehler! Verweisquelle konnte nicht gefunden werden.**.

Opposite this is the **second method family of the largely quantitative approaches**. Only in the urban development assessment sector are qualitative approaches for energetic assessment still being applied. This method family, suitable for comparative assessments of different concepts, is used in the subsequent assessment done under less time pressure.

See 1. Milestone Report chapter 6.1

Whereas the two method families mentioned above deal with an ex-ante problem, the **third method family** must be assigned to ex-post analysis because it deals with the dynamic estimate of daily consumption and emission results.

The quantitative approaches of the second and third method families have been integrated into the **"Energy Efficiency Controller" (EEC)**, developed as part of the project and explained in more detail in the following paragraph.

The EEC methods intended for implementation are subdivided into the ex-ante estimate and the ex-post analysis. Both method families based on German standards have been developed as part of the research project by the German-Chinese team. Within the scope of test calculations, the ex-ante estimate was used by the Urban Development Office (regional development planning) and the investor Chengtou (region under implementation) for the predetermined urban regions. They reflect regional types located in Shanghai's neighboring districts and represent examples for developing new regions in rural areas. The method family for the ex-post analysis has already been defined and put into specific terms in an initial version of the contract specifications for the EEC.

See chapter 6.2

More details about the implementation of the methods envisioned in the EEC are found in Annex 6.2.

An essential methodical component is the building type database that files away the building data as index for calculated and measured building energy demands and as reference values when the building is assessed. It encompasses a building categorization according to building types, uses, building components, systems engineering and also according to user behavior so that data from tenant surveys and expert interviews can be considered. The buildings are linked to energy demand calculations according to different standards; parameterization takes place in close cooperation with the Chinese builder-owners or investors.

For the LCI, the database supplies guiding values for estimating energy demand, which in turn can be used for extrapolating the building's energy demand and areas to be studied can be identified. For the EEC, the database is directly linked to the calculation.

See chapter 6.4

Apart from developing the methods themselves, it is also very important to **evaluate the methods** with regard to their reproduction accuracy. As part of the research project, a suitable approach that is currently being tested was drawn up for this. In the approach, a method family is compared to a method family of the next stage and assessed, i.e. the "first-stage method family for fast assessment" is compared with the quantitative methods of the second stage and the "second-stage method family" is compared with the empirically supported methods of the third stage.

In the building sector, methods are controlled by incorporating the values measured for energy consumption in buildings. User behavior is also included so that the calculation methods can be correspondingly adapted and refined.

Overall, the project team is on its way to bindingly introduce the important everyday planning and implementation factors for planning and implementing energy-efficient urban structures in the up-and-coming peripheral areas of the Shanghai megacity. All this keeping in mind that although comparable approaches are available in Germany, so far they have by no means become an obligatory planning component in metropolises of the federal territory – and this must be highly valued.

4.2 Implementation examples

The following pages present the current implementation examples as profiles containing information about the site, the participating project partners and participants, the pursued objectives and challenges, the methodology and the current and future results in the form of an overview. For a better understanding, the implementation examples are allocated to the respective modules.

See 1. Milestone Report chapter 6.3

Some implementation examples are the "Changxing Island" and "Longyang" planning projects as well as "Xinkai". The following profile for a building from the Econet building family was included in this section because the building's data has supplied us with essential insights into user behavior.

Profile for the Econet buildings (Wen Yuan and Pujiang Intelligence Valley (PIV))

Overview about the Ecobuild Projects , source Website Green Shanghai[1]

1 Type
Building

2 Site
The Econet buildings are located in downtown Shanghai (Wen Yuan) and in the Minhang district (PIV).

3 Brief description
[1] Ex-post analysis of the Econet buildings for verifying the objectives with regard to energy consumption [2] Optimization of the method for calculating the energy consumption of individual buildings

4 Team
University of Duisburg-Essen (ISS), TRC GmbH, SBA Shanghai, building operator: Tongji University, Pengchen Group

5 Challenge
[1] With regard to energy consumption, the buildings had clear objective functions during construction and planning [2] User behavior must be taken into account in the calculation, as it greatly influences energy consumption.

Perspective WenYuan Building

10 Methodology
[1] Assessment of the current situation (data, tenant survey) [2] Investigation of energy-efficient architecture and building services engineering [3] Energy consumption calculation according to different standards

11 Work status
Concluded.

Perspective Pujiang Intelligence Valley

Plan Pujiang Intelligence Valley

[1] Website Green Shanghai: www.green-shanghai.com

Profile for the Changxing Island area

1 Type
Planning project

2 Site
Changxing Island in the Yangtze delta

3 Brief description
[1] A satellite city for 90,000 inhabitants is being planned/built in the Shanghai region. [2] Planning done by Chengtou Corporation is being checked for energy efficiency and optimization potentials are pointed out. [3] Bewertung mit LCI und EEC

4 Participation
Stakeholder participation at the planning level: SPA; at the implementation level: Chengtou Investment Corporation.

5 Objectives
[1] The project team gains methodic insight, test run for the LCI and EEC.

6 Challenge
[1] A special challenge is the city's location, more or less far from the main employer (shipyard) and downtown Shanghai.

7 Methodology
[1] Concept improvement [2] Application of the LCI as test run [3] Application of the EEC as test run for module 1.

8 Work status/Results
[1] Concept improvement concluded [2] LCI in process

9 Outlook
Conclusion of LCI in 3rd quarter 2009. Conclusion of EEC assessment in 4th quarter 2009.

Location of Changxing Island

Planning of Chengtou Corporation

Allocation of functions: Planning of Chengtou Corporation

Energy-efficient scenario

Location of Longyang area

Longyang, draft

Integration in the surrounding

Evaluation board

Profile for the Longyang region

1 Type
Planning project

2 Site
Close to the city, in the Pudong district located in an important traffic hub, Longyang Road

3 Brief description
Planning foresees a commercial-industrial use for the 2,011,500 m² site. The gross floor surface of approx. 3,000,000 m² is mostly intended for offices and commerce. There are extensive residential areas as well as an international exhibition center and several large retail businesses in the immediate vicinity.

4 Team
SBA International, Stuttgart; University of Duisburg-Essen (ISS), Essen; TRC GmbH, Essen.

5 Participation
Stakeholder participation of the Shanghai Urban Planning Office.

6 Challenges
[1] Integration of planning into the existing surroundings. [2] Integration of the evaluation into the fast planning process while reliable statements are simultaneously guaranteed.

7 Methodology
[1] Application of LCI

8 Work status/Results
In process.

9 Outlook
Completion of LCI in the 3rd quarter.**Steckbrief für das Gebiet Longyang**

Profile for the Xinkai region

1 Standardization
Implementation project

2 Site
Southwest of Shanghai in the Songjiang district, approx. 25 km away from the city center.

3 Brief description
[1] Residential area withy mostly subsidized apartments and a small commercial area as part of a new town having approx. 15,000 inhabitants and a total usable floor space of about 300,000 m^2. Occupants are expected to move in by the autumn of 2009 [2] The subway station is nearby [3] The existing planning of Chengtou Corporation is being revised with regard to energy efficiency [4] Possibilities for improvement after completion are indicated

4 Team
University of Duisburg-Essen (ISS), TRC GmbH, SBA Shanghai, Viessmann, Prof. Heberer / Prof. Xianyang Yu (Beijing)

5 Participation
Stakeholder participation Chengtou Investment Corporation, community committee after the residential population moves in.

6 Objectives
[1] Analyze the dynamic changes in comfort during living and mobility. [2] Long-term examination as basis for the comfort furnishing of future residential settlements.

7 Challenge
[1] The buildings were built without heating or air conditioning to keep costs as low as possible. Although this is optimal from the energetic viewpoint, comfort is so low that occupants will subsequently install energetically very inefficient air conditioners (electrically powered)

8 Methodology
[1] Application of LCI [2] Application of EEC [3] Learning field for optimization of the life cycle cost planning for buildings.

9 Work status/Results
[1] LCI in process [data acquisition based on the data transfer agreement]

12 Outlook
A higher comfort concept for the region will be drawn up later and approved with the participating partners.

The project Xinkai for the Chengtou Corporation is a pilotproject as a preparation for a comparable neighborhood project. In this case at the start of planning the Megacity-Projectteam will have influence on several measures rearding the energyefficiency. The realization of the project is plannend in medium terms (2010/2011). Because of this it is possible toaccomplish an ex-post and an ex-ante analysis.

Extract of the planning for Xinkai

Model of Xingkai

Perspective of buildingtype 1

Perspective kindergarden

Perspective of public green open space

5 Meeting the thematic requirements of additional collateral provisions

Thematic requirements are met as part of the project and can be verified in the four modules, or can be assigned to different modules due to the overlapping thematics. The following illustration provides an overview on this point.

Requirement	MODULE 1	MODULE 2	MODULE 3	MODULE 4
1		X	X	
2		X	X	
3	X		X	
4	X	X	X	X
5	X	X	X	X
6	X	X	X	X
7		X	X	
8	X	X	X	
9	X	X	X	X
10	X	X		
11		X	X	
12	X	X	X	

Figure 2 Survey about the belonging of the thematic requirements to the 4 modules; source: own exposure

5.1 Social aspects/participation

Integrate social aspects and participation into the project!

China offers only limited opportunities for formal civil society participation, which has to be approved by the highest authorities. Selected resident committees of neighborhoods form an informal interim level, which the project can use as a medium to gain more information on the energy-relevant requirements regarding spatial comfort and residents' mobility (tenants and owners), and in turn emancipate them in terms of action research. In close cooperation with a Chinese expert, the implementation example Xinkai becomes a research field for the area of improving living and mobility comfort.

Civil society participation in China

Self-determined and formal participation by civil society, in the sense that this term is known in developed countries, only has limited applicability in China at this time, even if gradual changes have taken place or will take place in this context, such as the introduction and institutionalization of elections in villages and urban neighborhoods.[2] However, given the conditions of the authoritarian system, informal forms of participation remain dominant. [3]On the one hand, the Internet represents an increasingly public space. It has become an important instrument of both formal and informal participation, even if it may not play a central role in a neighborhood as regards energy efficiency and sustainability.

Within the competing areas of the one-party system and capitalistic system properties, the issue of how participation will continue to develop in terms of democratic structures is of special significance.

A dissertation at the Institut für Europäische Urbanistik at Bauhaus Universität Weimar has conducted extensive research in this area. Liu (2007)[4] reaches the conclusion that in 1990 civil participation is again officially mentioned and requested in the Law on Urban Planning for the first time since 1949; however, that a practical implementation of this insight has been carried out only hesitantly 10 to 15 years after the fact. Chinese administrators are finding it difficult: "Although such progress has not yet started to enable the citizens ‚share the power' with the authority, the citizens are getting more power of speaking in the planning."

Currently the CAUPD published a case study report[5] in cooperation with the CIM in which an inconvenient "bottom-up"-strategy was successfully proved within a project regarding urban renewal and modernization of old traditional neighborhoods in Peking.

The question was how social networks within the transformation of a neighborhood can be obtained and how this approach can be evaluated. The study deales with current decision making mechanisms and suggestive methods for neighborhood planning in traditional Hutong-quarters – especially under the new market-based relationships within a rapid urbanization.
With the aid of partizipant interviews, children drawings, and suchlike methods the partizipants named their desires and requirements regarding their neighborhood. In this study the planner is explicit nominated as a mediator with the function to interfere between the different interests. The CAUPD which supports the Ministry of Housing and Urban-Rural Deve-

2 The following explanations are mainly based on intensive interviews with experts Prof. Dr. Thomas Heberer/Ostasienwissenschaften, Universität Duisburg-Essen, and Prof. Dr. Dieter Hassenpflug/Stadtsoziologie, Bauhaus Universität Weimar
3 See also Heberer, Thomas. Schubert, Gunter (2008). Politische Partizipation und Regimelegitimität in der Volksrepublik China, Vol. 1: Der urbane Raum, Wiesbaden (VS Verlag)
4 Chong LIU (2006). The Contemporary Development of Qingdao's Urban Space. The Perspective of Civil Society's Participation in Chínese Urban Planning. Weimar (Dissertation)
5 China Academy of Urban Planning and Design/Falk Kagelmacher (2009) Community in Transition. A case Study of Understanding and Working with the Community in Huguosi Area, Xicheng Distrtct Beijing. CAUPD/Beijing, 3. Research Department, sponsored by CIM. Beijing

lopment regarding planning and research establihed with this action a paradigm change in the Chinese planning culture.

This approach is not applicable for development areas – in the developed countries it is not possible to plan development area with partizipation, too because the citizens move in later and start to develope social neighborhoods. In the same way the appoach of this project works because the project deals with emerging neighborhoods and planning concepts. Against this backdrop, this Megacity project integrates the topic of participation as follows (beyond the "political correctness" suspected behind the collateral provisions.

Residents committees as access to residents

Specifically when it comes to issues of social security, support for socially weak individuals (social assistance, support for seniors) or environment, residents committees (*jumin weiyuanhui),* which have existed in the 1950's, have taken on new areas of responsibilities at the level of the residential districts which were converted to neighborhood districts (*shequ*) across China at the end of the 1990's. According to the law, these committees must be elected by the residents, either by direct ballot (by all residents) or indirectly (through resident representatives). They are accountable to the people who elected them.

Furthermore, homeowner associations have developed in areas with condominiums and in luxury housing districts (gated communities); the associations elect autonomous homeowner committees (*yezhu weiyuanhui*) which are accountable to these associations. The homeowner committees primarily represent the interests of the homeowners vis-a-vis property administration (*wuye gongsi*) and the development companies (*kaifa gongsi*) who built and sold the homes.

Participation in the Xinnkai implementation example

As part of the Xinkai implementation example, residents and homeowners committees are contacted and familiarized with the project as soon as individuals have moved into their homes. In coordination with Prof. Dr. Heberer, it was possible to obtain the cooperation of Prof. Dr. Yu Xianyang, professor for sociology and an expert for neighborhood districts in China at Renmin University in Peking for carrying out this investigation. [6]

Prof. Dr. YU will begin with the analyses and inventory assessment, and will identify the options for participation once residents have organized and elected a neighborhood committee. It is likely that an approach involving interviews with the committee in view of the different residents group in the quarter will be conducted, in order to obtain a picture of the opinion of residents to the questions leading the project, such as energy, costs and value of energy, heating or cooling habits within residences etc. In this way, an investigative series that runs for the duration of the project is able to determine and assess residents' changing interests and growing energy requirements, as well as increasing requirements for living and mobility comfort. In line with an action research approach, suggestions and presentations for a conscious approach to energy are also envisioned.

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[6] Prof. Yu has been a visiting professor at Universität Duisburg-Essen in past years, and has been successfully working with Prof. Heberer since 2003.

The completion of initial discussions with the committee lends itself to a comparison and discussion of expectations by residents vis-a-vis profit-oriented action at state stakeholders and builders. It will also have to be discussed to what extent coercion can be turned into increased willingness, if one is required to plan and act in a customer-oriented manner and over longer life cycle phases.

5.2 Lokal Stakeholder

Integrate important stakeholder (focus participation) more than previously in your project!

See Chapter 5.3

5.3 Important Decision-Makers

Involve important-decision makers like the Ministry of Construction or the municipal level into your work!

The project defines the three levels of decision makers: the political level, the level of the investors and the level of the citizens. Eithin the project work there are relationships with the CAUPD – dedicated to the MoHURD -, with the Shanghai Municpal Urban-Rural Development & Communications Commission (commission for transport and construction), the Shanghai Chengtou Corporation and the Urban Planning and Administratiuon Bureau Shanghai.

Decision-makers are in our research project:

Stakeholder level 1: political level

Partner on this level is the City Planning Department Shanghai (SPA) acting on behalf of the municipal government. The SPA is directly linked to the research team in so far as the SPA has set forth the basic conditions within which the assessment methods may range as well as selects fields in which the methods developed by the research team will be explored. SPA will decide on the binding introduction of the assessment methods (Low Carbon Index) and EEC at master plan level.

Stakeholder level 2: Investor level

Partner at this level is the Chengtou Corporation as 100 % municipal company. Chengtou accounts for efficient application of funds and, therefore, plays a major role in the process of decision making. In the municipal area, too, the chance of Return of Investment (ROI) through lease or sale of apartments and buildings is a decisive factor of decision. Chengtou assesses whether a certain amount to be invested will suffice to (mainly) realize buildings of a certain quality in such a way that they would find tenants or buyers. With this in mind, it calls for reaching a consistency between building quality, (extra) costs for the investor and ROI via renting and solvency of the designated income bracket. Only if this is successfully accomplished will it be possible to get energy-efficient construction introduced into the daily practice at the implementation level.

Stakeholder level 3: Citizens

The inclusion of this stakeholder level is set out in detail in the paragraphs which are concerned with participation.

Ministry / research institutes

The MoHURD ministry is no direct stakeholder for the topics dealt with in the project. However, a cooperation has been initiated via the CAUPD acting as research institute of the MoHURD referring to the possibility of introducing assessment methods at national level (at least as recommendation). In this context, the methods for testing energy efficiency as developed by the research team and testing CO_2 energy efficiency in further fields as specified by CAUPD shall be tried and compared to competing methods.

The CAUPD, represented by Director Mr. Huang Luxin, Director Prof. Xie Yingxia and Mr. Kagelmacher, welcomes the intensification of contacts with the research team "Shanghai cooperation project: integrated approaches for sustainable and energy efficient urban development - urban form, mobility, building and housing (Förderkennzeichen 01LG0514)" . CAUPD is greatly interested on the approaches, methods and results of pilot applications for the evaluation of masterplans in terms of energy efficiency and CO_2 emission efficiency indicators. CAUPD is working on similar issues and considers an exchange within the framework of a workshop - which could take place in 2010 in Essen - to be very valuable. A regular exchange of experiences with the research team has been agreed. It will be aimed to apply from both sides developed evaluation procedures in pilot projects on a masterplan level. Mr. Kagelmacher (CAUPD) has been designated as the person from CAUPD who will keep and develop the contact.

5.4 Requirements of the Chinese partners

Specify the demand of your Chinese partner!

In the project especially three local stakeholder of the megacity of Shanghai are integrated but furthermore there are a lot of cooperations with other stakeholders in Shanghai and China. The Urban Planning and Administration Bureau Shanghai (SPA), the Chengtou Corporation Shanghai (CC) and the Shanghai Municpal Urban-Rural Development & Communications Commission (commission for transport and construction) should be named first.

The research project will be processed with the following Chinese partners and under the following requirements.

1. Shanghai Urban Planning and Administration Bureau (SPA)

The basic conditions for the introduction of energy efficiency into practical planning at master plan level was discussed in intensive talks with the SPA. SPA has specified the following: First, an estimated quick evaluation method is necessary that accompanies the drawing up of plans for the development of territories. The timescale for this is 4 weeks as a rule.

Second, an in-depth method is required for decision making in special cases where quantitative calculations are carried out concerning energy expenditure as well as CO_2 emission. A target of 2 months was specified for this. SPA plans to set these methods as target for competitions after having tested these methods.

2. Chengtou Corporation Shanghai (CC)

The municipal Chengtou investment trust has given the development of cost-effective solutions as requirement. Chengtou is interested to see the energy efficiency dealt with under the aspects of costs for the investor and costs for the future tenant. Latter shall be conciliated with the income situation of the targeted population group. This asks for conceptually different solutions. Hence, prototype approaches depending on the social standing of various population groups need to be developed.

3. Committee for Construction and Transportation

The competent committee for Shanghai's energy, transportation and standards is searching for possible solutions to introduce energy efficiency improvement into rules and standards (buildings) and traffic sector. In the committee's view, the introduction of a complex metro network has been successful which has to be continued by further developing public transportation at bus level.

Continuous control of energy consumption is a supplementing requirement of the committee. Here, the research team will introduce the energy efficiency controller of which development the experts from the committee will participate.

The further partners of the research project do not function as partners who will introduce any specifications (University of Tongji, SBA International, CAUPD, AHK/Econet).

5.5 Costs

Investment costs, maintenance costs and other relevant costs should be calculated in included in your research.

Costs associated with investments (such as investment costs and ongoing costs) form a part of calculations and assessments for all modules of the research project. Decisions taken by the public as well as private sector with regards to measures to be implemented are mainly characterized by the required costs. User behavior also depends on costs to a large degree.

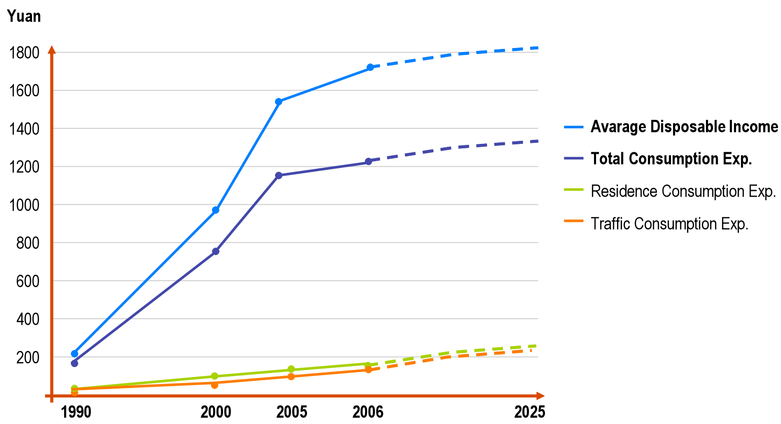

Figure 3 Development of private incomes and expenditures for living and mobility; source: Shanghai Statistical Yearbook 2007[7]

In this vein, the ROI (Return on Investment) also depends on the costs for the preparation and operation up to the renovation or recycling and marketability of the buildings and mobility products for which charges are applied.

Based on these considerations, the research team developed an approach for both state and private investors. The purchase power and users' willingness to pay form the starting position for both buildings and mobility. This purchase power depends on time; the next 5 to 10 years are examined and the expected average per population group is determined.

In the case of buildings, calculations are used to determine whether quality exceeding Shanghai standard in terms of annual costs (including operating costs) is more cumbersome, or whether this standard is marketable. User behavior plays a decisive role in the latter case: at this time, usage periods related to air-conditioning technology is on average still well below the assumptions used in the Shanghai calculation model.

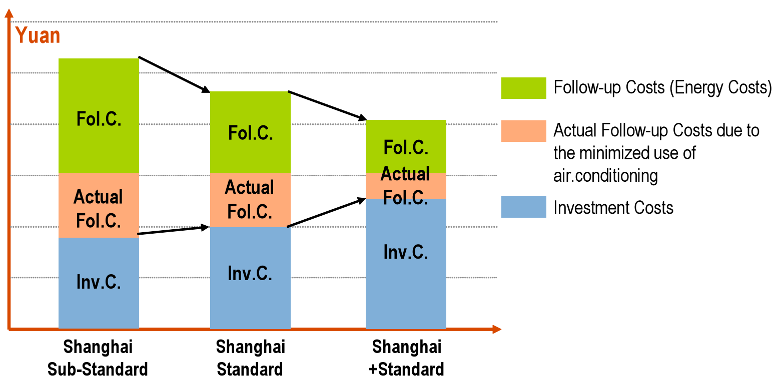

Figure 4: Comparison of costs for buildings of different standards, assuming air-conditioning technology usage in line with Shanghai calculation mode; Source: own exposure

The difference is described as the theoretical efficiency increase potential. If the calculation results in a negative efficiency increase potential, it means that there is no solution under the given energy costs which is

[7] Shanghai statistical Yearbook 2007: ttp://www.stats-sh.gov.cn/2004shtj/tjnj/tjnj2007e.htm#. access: 15.06.2009

better than that of the Shanghai standard. The purchasing power of potential users supplies another ancillary condition.

This approach, to which data is being applied, is currently being tested for the Xinkai implementation project selected in conjunction with the investor Chengtou. Xinkai is an already built but still unoccupied residential area which is being tested to see whether a better standard would have paid off for investor and/or tenant.

The result of the investor's decision is to be described with "achieved energy efficiency increase potential". It illustrates the difference of the energy required for the achieved building quality less the energy required for a building according to the Shanghai standard. Assumed user behavior with respect to cooling and heating as a time function of income development is variable in this respect.

Finally, actual energy requirements are determined by the combination "building quality“ and “user behavior”. The user of the building determines the extent to which the building’s achieved energy efficiency increase potential is utilized, or is countered by user behavior. These energy requirements are measured. The difference between actual energy requirements and achieved energy efficiency increase potential is to be described with "user-dependent efficiency”.

The population’s purchasing power still flows into the use of paid mobility (purchase of vehicles, use of toll roads, parking fees, taxis, user of public transit etc.) even when the population is mobile. It is represented as a time function over the transit behavior. The scope and equipment of public transit infrastructure (paths, roads, tunnels, bus stops, line operations) is measured depending on this demand structure.

Two large areas are examined with regard to energy efficiency increases in the mobility area: more energy-efficient urban structures with the corresponding path networks, which achieve a beneficial distribution of mobility to transit carriers and at the same time shorten route lengths.

On the vehicle side, the largest potential areas are considered in the area of energy-efficient vehicles and/or conversion to fuels containing a high portion of renewable energies (bio fuels, electro-mobility).

Supply and demand have an interactive relationship in this case: Supply can be used to influence demand as well as a strategic instrument on its own.

Since transit infrastructures generally last longer than buildings, a further-reaching target horizon for the mobility derived from the purchasing power/willingness of users must be examined. For this reason, a target horizon to 2025 has been selected.

In contrast to buildings, there are no firm specifications for the question of which transit infrastructure is required. Rather, an assessment of a public transit infrastructure is governed by the question whether intended measures and combinations thereof make sense at a macroeconomic level. Benefits would have to be above the costs required for the investment and operation.

As part of this research project, preparations are currently underway to develop an approach which can be used to analyze different city structures, route networks and vehicle fleet combinations with regard to their effects. These comparative calculations are used to yield the theoretical efficiency increase potential by comparing the worst solution from a collective of solutions with the best solution. The difference is the "theoretical efficiency increase potential“.

The municipal or private investor is free to choose the extent to which a solution which varies from the best solution is implemented. The result of the implementation is to be described with "achieved energy efficiency increase potential”, as is the case for the buildings.

In the end, and analogous to the process that is applied to buildings, the user of the infrastructure product will decide the extent to which he utilizes the potential or increases or decreases it depending on his behavior. This is to be described with "user-dependent efficiency”.

See chapter 6.2 and 6.5

A decision in favor of a transit infrastructure investment is not only dependent on its energy and CO_2 efficiency, but also on other indicators. The macroeconomic analysis must feature a high degree of benefit backflow.

Costs have been integrated into the analyses of activities as part of the development work.

See chapter 6.6

In this vein, both the ex-ante portion (scenario estimator) as well as ex-post portion of the energy efficiency controller (EEC) contain an expanded indicator catalogue as compared to the application, which includes costs but also the most important benefit components. As a result, energy efficiency is also reflected in the costs which are required for the activity.

This integrated approach, which combines city structure, buildings and mobility in the assessment, clearly goes beyond the methods currently in use in Germany. Of particular important in this regard is the ability to utilize the approach for practical planning. It forms one of the most important innovation components of the research project.

At an organizational level, the business competence of the research team was expanded by including the construction studies institute at Duisburg-Essen University. The institute’s life-cycle calculations form an important foundation for the evaluations.

The following diagrams corresponed to the contribtution of Prof. Malwitz (Institute of construction operation and construction management) and show life cycle costs analysis for three different energy-efficiency standards for buildings.

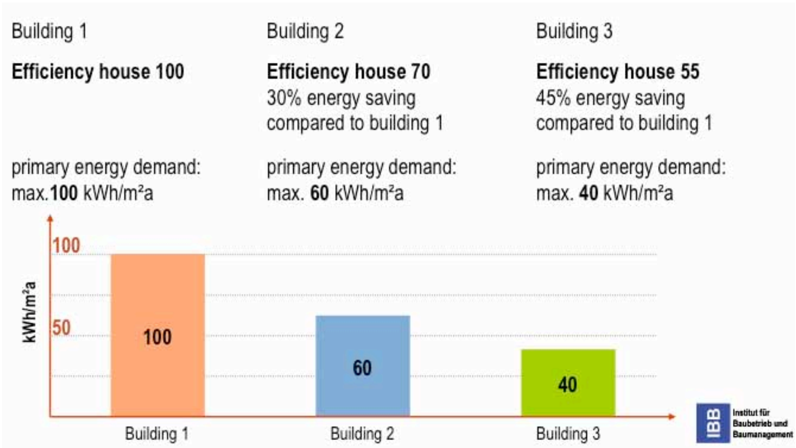

Figure 5 **Life Cycle Costs for different building standards ; source:** Institute of construction operation and construction management

Detached house - investment costs

	Building 1: 100 kWh/m²a thermal insulation	W/m²K	Building 2: 60 kWh/m²a thermal insulation	W/m²K	additional costs (€/m²)	Building 3: 40 kWh/m²a thermal insulation	W/m²K	additional costs (€/m²)
exterior wall (sand-lime brick 17,5 cm)	12 cm	0,30	20 cm	0,19	9,30	26 cm	0,15	16,30
roof	20 cm	0,23	26 cm	0,18	2,50	30 cm	0,15	4,30
floor slab	10 cm	0,32	14 cm	0,22	2,20	16 cm	0,19	3,20
windows	double glazed	1,40	double glazed	1,20	8,90	triple glazed	1,00	22,20
ventilation system	not installed		exhaust-air-plant		18,00	exhaust-air purification plant & heat recovery		43,00
additional investment					40,90 (€/m²) **5.685 €**			89,00 (€/m²) **12.371 €**

- 4 residents
- Total living space: 140 m²

Figure 6 Investmentcosts for different building standards**; source:** Institute of construction operation and construction management

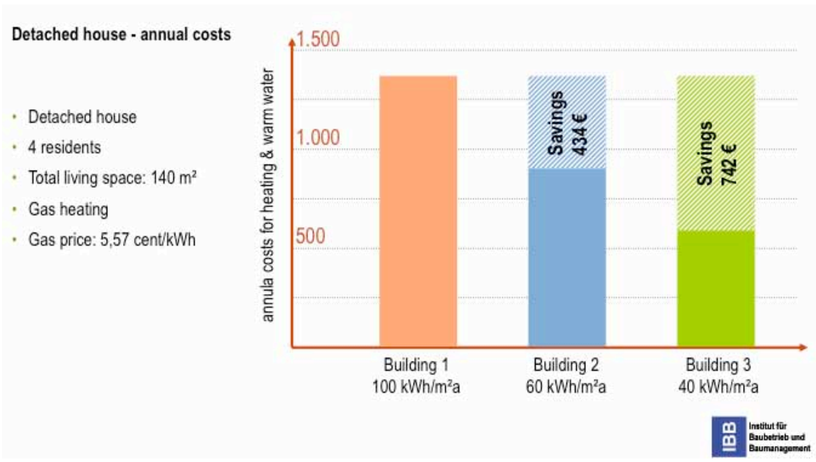

Figure 7 annual costs **for different building standards; source:** Institute of construction operation and construction management

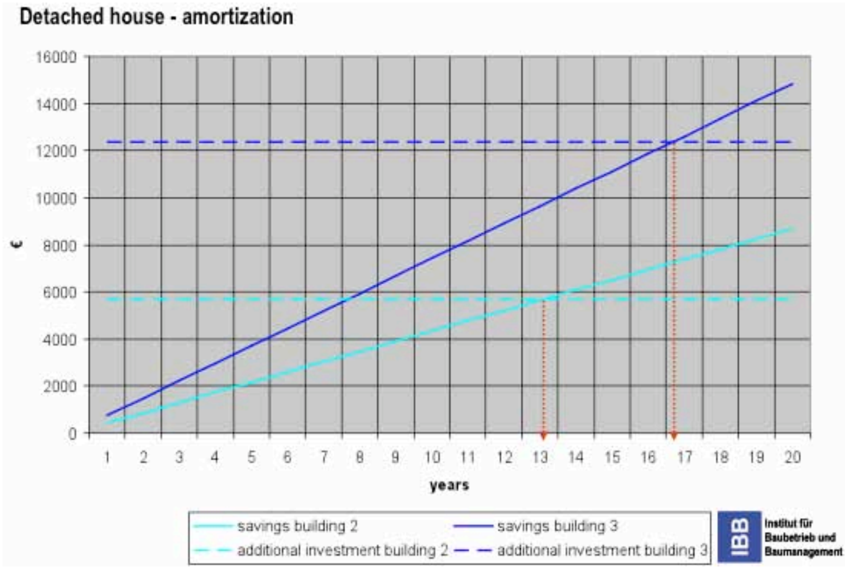

Figure 8 **Amortization of costs for different building standards; source:** Institute of construction operation and construction management

The Chinese partners Chengtou, SPA und SBA/Shanghai have already provided parts of the data required to determine the costs. The remainder will be provided in the next weeks on the basis of the data use contracts. Methods, tools and results have been discussed and exchanged on the basis of presentations; they will be examined in more depth at the fall workshops.

The main research objective is to determine the energy and CO2 efficiency increase objective for building use and mobility taking into account current and expected socio-economic developments, using the example of selected prototype areas of the Shanghai region. In the process, the dynamically changing economic options for users of the new areas must also be included.

At a concrete level, the evaluations of Modules 3 and 4 differentiate according to the theoretical potential (what could be achieved taking into account user purchasing power?), real potential (what did the investor actually implement and what is the resulting potential?) and usage-dependent efficiency (what is the result of the interplay of supply and user behavior over time?).

5.6 Relationship of work packages and modules / project coordination

Present a clear relationship between the work packages and the modules of the project; optimize project coordination.

The project with its investigation areas is based on an area typology that cannot be logically connected on a spatial map. The modules show a clear allocation to certain tasks.

Requirements of the Shanghai City Planning Department as stakeholder were taken up in the course of the applied research project. A structure based on area types and hence also types of tasks were developed from a one-dimensional project concept that is derived from the requirements and discussions with the stakeholders.

The allocation of work packages to modules was completed and has been adapted to the changing conditions (see detail). The modules have proved to be useful also in view of the modifications in the project:

- Module 1 is explicitly dedicated to the development of the EEC (Energy Efficiency Controller),

- Module 2: This module contains consultations in the course of the project, also in connection with the contacts to the MoHURD and the Committee for Construction and Transportation that is basically responsible for guidelines, policies and codes.

- Module 3 contains all implementation-focused Urban Neighborhood projects which are recommended and accompanied by the stakeholders related to the project.

- Module 4 had been adapted to the requirements of Module 3 and contains implementation-focused projects "Integrated Public Transportation" which are discussed, recommended and accompanied by the stakeholders during the meetings.

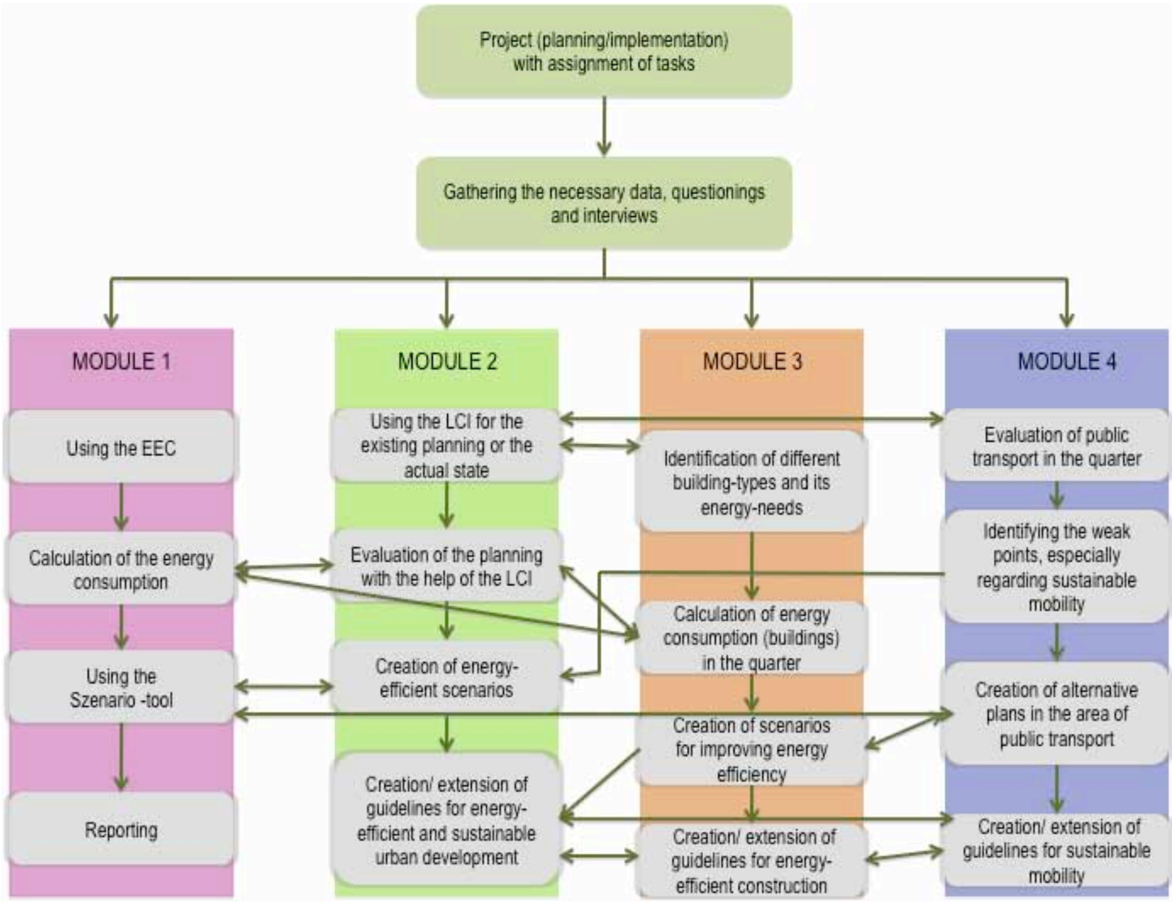

Figure 9 relationship between workpackages and modules in one avtivity; source: own exposure

5.7 Urbanization of rural areas / significance of open areas

Strengthen those aspects of the project which are concerned with the urbanization of what have until now been rural areas

The urbanization of rural areas forms a part of the project to the extent to which areas in the periphery form a part of the investigative program. The significance and effects of urban open space have been included in the LCI.

See chapter **Fehler! Verweisquelle konnte nicht gefunden**

The integration of aspects related to the urbanization of what have until now been rural areas, and the significance of open space in rural areas forms a part of the research to the extent that project areas located at the periphery of the Megacity are undergoing a transition from rural to urban space. Their significance for the local climate (cooling islands) is taken into account through the LCI. This also applies to urban open spaces.

However, the fact that Shanghai's building boom has slowed down in face of the economic crisis and that growth at the urban periphery has also slowed down also needs to be considered. For this reason, areas which are within the urban area but have not yet been built up are included instead of peripheral areas. This has been done at the express wishes of the stakeholders who are connected with this project.

5.8 Use of green open spaces

Determine the benefit of maintaining green open spaces in view of climatic, agricultural and recreational aspects. For this purpose, utilize the opportunities which are offered by a “megacity in statu nascendi". The objective of the project should be to take on a model character for China’s other rapidly urbanizing regions.

The diverse functions of inner-city open spaces are always taken into account as part of the project work. They are used particularly in the LCI evaluation diagram.

Open spaces within a city play a particularly significant role. They not only affect the quality of life, as they represent a space that features high 'resting' quality, that offers a number of recreational opportunities and also serves as a meeting place for strengthening societal relationships. In addition, open spaces also affect land prices and rents since residential units in the vicinity of open areas are in particularly high demand due to the higher quality of life and the increased valuation of the area due to aesthetic factors. Furthermore, inner-city open areas can reduce noise and air pollution and hence ensure a healthier environment. As regards this project, the most important significance of open areas is their effects on the city's microclimate.

Climatic aspects of green open spaces

Open areas within a city play a particularly significant role for the climate. Particularly very densely populated areas face the problem of differences between the microclimate within the city and the surrounding areas. The city heats up considerably and only cools down slightly at night, since sealed-up areas store heat.

The atmosphere in and above densely populated centers is unique: anthropogenous surface changes modify the atmosphere and result in changes in atmospheric variables and composition. This phenomenon and its effects create a burden on humans, animals and plants. Heat islands within the city can negatively affect the health of residents, and also influence energy requirements by increasing the demand for air-conditioning particularly in very hot regions.

Inner-city green space on the other hand creates heat and material balances which are similar to those found in natural spaces[8], because parks cool down more during the night than urban bodies - especially in areas with little wind – since there are no meso- and macroscale effects which would cover this effect[9]. The principle applies: the climate zone location of a city and its green space determine the climatic and air-hygiene situation[10] .

At the same time, temperature decreases are not only noticeable directly in the open areas but rather their effects can also be felt far away in neighboring quarters. Even smaller-sized green spaces affect ambient temperature. In general it can be said that green spaces at a size of 1-2 ha reduce temperatures by up to 2°C. At the same time, these effects depend on a number of different factors, such as size, design, orthographic factors, potentially irrigation, ground's ability to store water, portion and distribution of trees or tree tops, shrubbery, grass, ... In general, the effective area of open spaces is double that of the actual park area. Good cooling properties can be expected for areas which feature at minimum 2.2 times the height of neighboring buildings up to their center (Sky View Factor).[11] Smaller open areas produce proportionally more effects than large ones because distance effects do not increase proportionally with size.

The following also applies: The better the distribution of green space over the urban area, the higher their "climatic value".

The climatic distance effect created by open areas can be traced back to 3 main factors:
1 Bringing in cold air with superordinate winds
2 Suspension of thermally-induced microcirculation→ balances minimal air pressure differences between park and buildings
3 Combination of both phenomena

This phenomenon is of particular interest if residential units are located in the direct vicinity of the park. Green space increases sleeping comfort,

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[8] Bongardt, Benjamin. 2006: stadtklimatologische Bedeutung kleiner Parkanlagen – dargestellt am Beispiel des Dortmunder Westfalenparks. Essener ökologische Schriften:1

[9] IBID:10

[10] IBID:8

[11] IBID: 5

protects risk groups where there are stronger nightly heat burdens, reduce energy by using less air-conditioning (where they exist).

The distance effects outlined above can also be verified in the case of trees with a herbaceous environment[12] ; for example, the same wind speeds measured prior to the existence of the trees were now only found at a distance which corresponds with 5 times of the tree height. Effects are reduced along with reduced wind speeds. Effects are not so easily verified in relation to temperatures.

Park-based cooling islands

Park-based cooling islands represent temperature reductions caused by green spaces, hence a local reduction in temperature within an overheated urban body.

Park-based cooling islands originate from the same processes as the climate of the surrounding environment but are dependent on the intensity of urban heat islands. They are influenced by the overheated city, but at the same time form their own microclimate which corresponds with that of the urban environment based mainly on indigenous conditions[13] .

If a green space is located within or at the periphery of inner-city climatopes, a significant strengthening of the park-based cooling island can be expected.

The effects of inner-city open areas are diverse and also extremely important in view of an energy-based examination. For this reason this aspect is also used in the LCI – the energy-based assessment of quarters. Since the LCI is to become the foundation for the planning of regions, the significance of inner-city open space can flow into new planning.

Model character for other Chinese regions

See chapter 4.1 and **Fehler! Verweisquelle konnte nicht**

The project's goal is to translate the insights gained by the project into guidelines for Shanghai on site with the help of political decision-makers and project developers. These guidelines are to be subsequently transferred into other regions. However, this is not possible at this time as testing in Shanghai has not yet taken place.

The developed methods (LCI, EEC and the building type database) can already now be used in other regions, with minor adjustments (if required). However, these will continue to be further refined and optimized as the project progresses, and adapted to the current situation as best as possible.

5.9 Project management / external competencies

Strengthen project management by involving external competency for evaluation.

The project management will adapt the project to the new conditions once a qualified project partner has been found for Module 4. Of course, the

[12] Bongardt, Benjamin. 2006: stadtklimatologische Bedeutung kleiner Parkanlagen – dargestellt am Beispiel des Dortmunder Westfalenparks. Essener ökologische Schriften: 8

[13]IBID:11

advisory body in supplemented configuration will take over the task of external evaluation.

The project management will be adapted after the loss of the partner for Module 4 (cf. diagram). Since there is no certainty about the position of Module 4 due to the ongoing evaluation process, potential partners have not yet been contacted in place of HamburgConsult. In this respect, the position on the board has been represented by N.N. thus far.

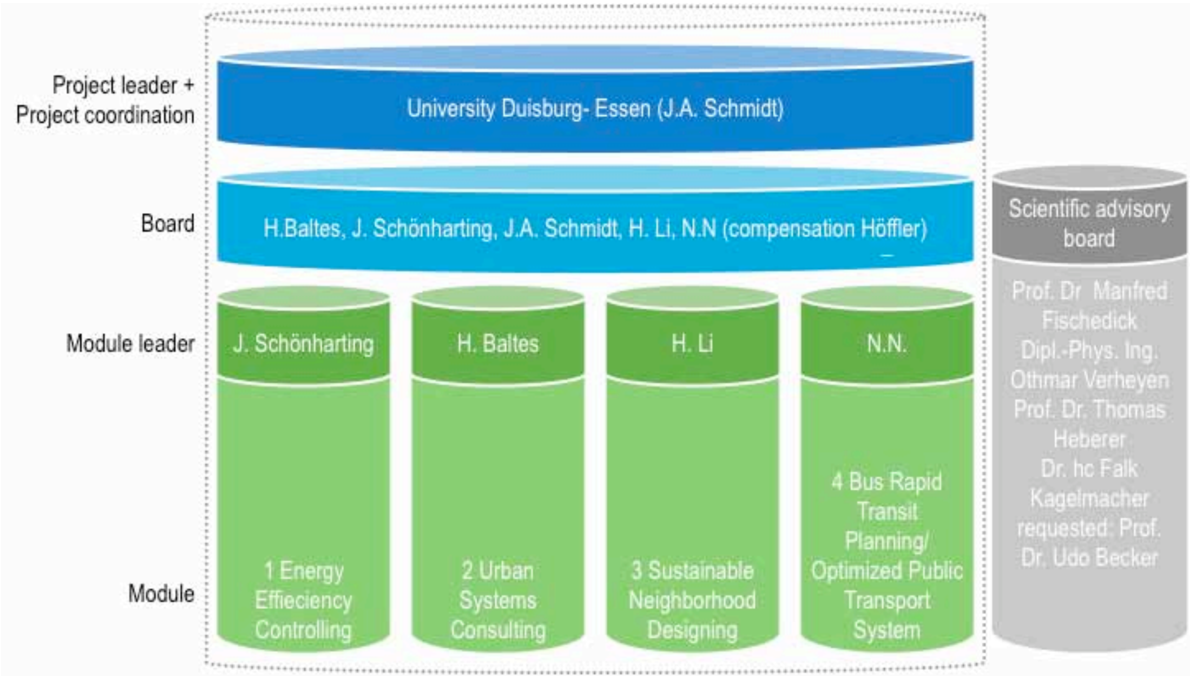


Figure 10 Diagramme of the project management; source: own exposure

By founding an advisory body, the project team has involved external competency for external evaluation. From summer 2009, the advisory body will evaluate the project at regular intervals, open up new perspectives and submit suggestions for improvement if necessary. The advisory body comprises experts from a broad range of disciplines who are familiar with the subject area dealt with in the project but who also have other main areas. Unfortunately, the advisory body could not yet be completely picked on account of two negative replies due to work overload and conflicting interests.

See 1. Milestone Report chapter 3.4

As to the field of the traffic sciences, Professor Dr. Udo Becker / Chair of Transport Ecology of the Technical University of Dresden, "Friedrich List" department was contacted to have sustainability represented on the advisory body with the emphasis on mobility, particularly with regard to CO_2 emissions and energy consumption. A number of personalities have been contacted for the field of urban planning / regional planning.

Finally, the advisory body was extended by a corresponding member. Dr. hc (PR China) Falk Kagelmacher works as Senior Consultant and CIM expert at the CAUPD (China Academy of Urban Planning and Design), the academy of research and planning assigned to the Ministry of Housing and Urban-Rural Development PRC. In this way, the project is indirectly tied to the Chinese decision-makers on the governmental level. In contrast, new results of research, too, may flow into the academy's work through the involvement of Dr. Falk Kagelmacher (cf. Chapter 5.3).

The relatively late foundation of the advisory body comes from the circumstance that this could guarantee that the members of the advisory body are also experts for the addressed and evolving details of the subject areas within the project framework. Experts of the overall subjects with the majority of challenges were specifically appointed as member of the advisory body so as to unleash innovative impetus.

The idea of involving further external competencies for project management in the project aside from the advisory body was abandoned. Periodic meetings of the intra-company customers and steering group respectively are absolutely sufficient to carry out the project management. This helps avoid too many participants get involved in the project. In fact, value was placed on clarifying organizational but also factual questions due to short ways and quick communication over the phone. Furthermore, an internal area on the project homepage www.megacity-energy.de has been set up for the exchange of information which all project partners have access to.

5.10 Innovative components

Strengthen the innovative components: Participation, improvement of the organizational structures and strategic advisory service.

The research project has two substantial objectives in which innovations are planned.

The first innovation target area concerns the subject of "Introducing energy efficiency improvement and CO_2 reduction into the everyday planning work of a Chinese megacity." This asks for the development of assessment methods that are up to the everyday planning work of a Chinese megacity. Without abandoning the integrated handling of problems (city layout, buildings, mobility), new concepts were developed which can also be handled without external aid during the planning process showing high strength of conclusion for the decision-maker at the same time. The innovation here is the development of methods and processes tailored to the fast processes, the required statements necessary in the short term and the largely automated calculation allowing for the state of data. Actual products are the newly-developed Low Carbon Index (LCI) and the Energy Efficiency Controller (EEC).

For comparison: Major cities on the territory of the Federal Republic of Germany, in their daily planning and implementation decisions, use approaches of climate protection quantification goals only in very rare cases right now, and integration of the indicated fields of action is not state of the art up so far.

Therefore, the methods developed for Shanghai and partly still being in the testing represent the first block of innovations in the project with far-reaching consequences pertaining to the practical implementation of climate protection goals. The contents are elaborated in Chapter 4.1 and Annex 6.1. Chapter 4.2 reflects examples of the close cooperation in applying the methods between the research team and Shanghai urban planning as well as the main municipal investor Chengtou.

The second block of innovations concerns the gain in knowledge about the socio-economic development of up-and-coming megacities with regard to the implementation of quality of life in the fields of mobility, living and working (better city, better life, the motto of the EXPO 2010 in Shanghai). The analysis of the developments and their prognosis, supplemented by the issue of behavior influenceability can be regarded as part of participation development in which the interests of the citizens are increasingly determining the planning process.

See chapter 4.1, **Fehler! Verweisquelle konnte nicht gefun-**

The megacity is in the specific situation that decisions for the public sector are made in a hierarchic structure, however, that not only external investors but citizens are increasingly taking part as players on the market. This means that public investments increasingly need to be oriented to the wishes of future users. To accompany this process, to observe the stakeholders' behaviors at the various levels and interpret them yields valuable information about the processes of social changes to be expected in the future. Involving social-scientific and economic competence (Institute Prof. Heberer) guarantees that this exciting process will be optimally explored with regard to climate protection and energy consumption.

The research team also considers the process-oriented research approach to be innovative. The vital variables concerning the climate protection are highly dynamic and, therefore, can only be interpreted via time reference. This time reference in the analytical area opens the chance of scientifically established analysis enabling improved methods of prognosis. This, in turn, is a prerequisite for reliable forecasts on influence variables relevant to climate protection.

Among the most important determinants are income development, personal preferences (e.g., between a car and an apartment), solvency, and wishes with reference to quality of life. At the same time, there are large interdependencies between the individual factors.

5.11 Socio-economic competence

Integrate socio-economic competence which considers the concerns of civil society and stakeholders into your project.

The project integrates socio-economic aspects as part of the time series investigation in the Xinkai area, which will go beyond the term of the project. In this respect, the participatory approach based on the neighborhood committee will play a key role.

See chapter **Fehler! Verweisquelle konnte nicht gefunden**

In Shanghai, people’s requirements for more comfort will continue to increase in the coming years. This affects both residential aspects as well as mobility. Residential space is increasing, occupancy density per residential unit may be decreasing, cooling and heating requirements will increase; mobile people will have more demanding requirements and will want to buy their own car rather than sit in a crowded bus.

The issue of which comfort requirement will be implemented into reality, and when this will occur, plays a significant role in the project. It does not make sense to plan and build high-quality residential settlements and entire cities if they are then left unoccupied. As a result, consultation must aim to ensure that the right measures are implemented at the right time. This brings up the question when Shanghai's different population segments will be able to afford an increased level of comfort. Do they even want this comfort, and is an increasing level of comfort to be expected in residential spaces and generally in the building area, or rather more likely in the area of mobility? Where do the preferences lie? Finally, there is also the question of the significance accorded to the purchase of a vehicle by the population which lives in densely population urban areas? This may differ depending on the location. What is the image of the bike or Metro network?

See chapter **Fehler! Verweisquelle konnte nicht gefunden**

The Xinkai residential quarter is the location at which socio-economic issues are investigated. In its genesis, it offers a good starting point for an investigation.

The following research questions are suggested:
- Increased incomes will increase the desire for more comfort- how is this reflected in the different social classes, and vice versa: Can desires be differentiated and represented as a forecast on a time axis (which desires will likely appear, and when...?)
- What will the user pay? What can he pay? What does he want to pay? What is the value of the comfort?

Against the backdrop of these questions, an investigative approach has been developed in coordination with Prof. Dr. Heberer/Duisburg, which will have to be further developed on site in cooperation with Prof. Dr. Yu/Beijing as soon as the neighborhood committee has been elected and installed. To this end, the following work steps have been provided for thus far (the first structural-spatial and construction-related analyses as well as discussions with project managers on site have already taken place):

- Analysis of the existing social and spatial situation and given general conditions: Portion of condominiums / rental units in the neighborhood, social groups in the neighborhood, spatial and social environment of the neighborhood
- Inclusion of residents and homeowner committees into the socio-economic analysis, with the following questions: Function and method of committees (which tasks do they assume, division of labor, which offers are researched, satisfaction of residents etc.).
- Discussions/Interviews/Work meetings as a gentle method for achieving better understanding of existing socio-economic contexts.
- Organization of these contacts and discussions at regular intervals with the same questions, in order to record and understand the change in lifestyle, fundamental attitudes and general conditions
- Observations of the space and behaviors, supplemental informal discussions with residents.

The objective of such a socio-economic accompanying investigation is to qualify and if possible also quantify the development of desires with regard to the function of living, working, support as well as social and infrastructure services, the ability to influence these desires and their implementation into reality against the background of climate protection and dampening energy growth.

Finally, the aim is to develop guidelines and frameworks for sustained urban development, which in this context refer to buildings, urban space and mobility and also take into account the changes on the time axis. Installations, density, service quality, frequency of public transport and the meaningful technical building installations and infrastructure with a view to life cycle and feasibility. These types of results are also included in a forecast for energy efficiency.

For the government developer (Chengtou), the investigation results in concrete suggestions what really makes sense with regard to building in view of the rapid societal and socio-economic changes taking place. What comfort requirements are the new residential spaces supposed to meet? Does it make sense at an economic level, to create such sub-standard residential space and be certain that in 7 to 10 years no one will want to live in these spaces, and hence be forced to dismantle these buildings due to vacancies or undertake extensive redevelopments. More in-depth questions are therefore as follows: What energy standard should be used in the building process to ensure that the expected resident groups will be able to afford these rental rates or purchase prices? As incomes grow, this aspect will move constantly and result in new energy standards. Is a builder able to plan this into his calculations? Are buildings able to adjust to growing private household budgets and increasing energy-related requirements, and are they able to match this growth with supplementary measures?

With regard to Shanghai's construction and traffic commission, insights may be gained in view of the mobility-related questions of which requirements public transport will have to meet to match growing comfort requirements and dampen the change-over into individual vehicles. What will be the effect of higher incomes on expectations in the city with regard to the topic of mobility?

5.12 Capacity Building

Supplement your academically oriented workshops and meetings by practice-oriented measures on "Capacity Building".

The project contains active, project-specific measures on Capacity Building and provides for further stepping up in detail.

We understand under Capacity Building the long-term capacity development of stakeholders who are involved in the planning process to employ resources in such a way that the goal of energy-efficient and sustained urbanistic development will be effectively implemented.

Precondition for Capacity Building primarily is the awareness of the global and local climate protection goals (CO_2) and thus for energy efficiency at the local stakeholders, the involved stakeholders' willingness to cooperate as well as the openness and trust in the exchange of information process (partnership). Important are long-term time horizons, openness to changes or new planning and organization structures and instruments, personal responsibility but also support of the higher-level planning and political levels. Our efforts will show but limited impact if these preconditions should be unfavorable.

Capacity Building is an important task of the project. The question at whom capacities should be built up has already been identified in the course of the stakeholder analysis. Within this context, we could also clarify what the requirements of the respective stakeholders are, i.e. what capacities should be built up or strengthened. The profiles additionally clarify who will participate in the various projects and who is the target group (vd. Chapter 3).

See 1. Milestone Report chapter 4

Generally speaking, new knowledge and new skills should be gained, understood and integrated so as to implement energy-efficient city layouts and achieve CO_2 reduction targets with the help of our projects. Capacity Building plays a helpful role in translating the global CO_2 targets to the local level and hence it can be regarded as a means of transforming the administration approaches and operating principles into an environment-conscious and energy-efficient direction.

The main focus on the project is not only related to the German-Chinese knowledge transfer about energy efficiency and the CO_2 topic and development of certain competencies and capacities at various levels (administration, government, private sector, NGOs) but also the general development of the implementing capacity of these practices particularly at local level. In this way, decision-making and responsibility of the respective stakeholders in the planning and implementation process will be strengthened at local level in the long term. On the other hand, faster realization of our projects will come about by the increase of options for action on the cooperation partners' side. Thanks to Capacity Building, the transparency of our plans and projects will increase altogether. So Capacity Building is also marketing support in parts.

The explanation of common and appropriate legislation, regulations, analysis methods and the German status quo with regard to energy efficiency and CO_2 were carried on as well as the topic-specific exchange of knowledge and experience was stabilized with the respective project partners in situ (data interchange). Formulation of common goals and methods as well as the development of effective and efficient solutions (feasibility) was initiated. Development and improvement of organizational structure will be dealt with in future.

The following project-specific measures were already implemented for Capacity Building and will be continued in future.

In March 2009, a **workshop** in Heidelberg on the topic "Planning of Low-energy Houses" was attended for the purpose of knowledge transfer and knowledge exchange respectively. This event was initiated by the Urumqi project staff and Chinese partners participating in the project, an investor among them, took part. The discussions that developed could give a valuable insight into the mathematics of buildings and, above all, into the economic view in Shanghai/China. Furthermore, points of contact could be identified for a cooperation of both project teams and the next workshop scheduled for end of June 2009 during which the addressed subject areas will be deepened.

In addition, a networking meeting with other megacity projects on the topic of urban planning and urban development already took place in March and June (Young Cities, Teheran; Casablanca, Morocco and Ho Chi Minh City). A workshop scheduled by end of October is in the pipeline right now. A similar procedure for the key topic of Mobility is already being planned, but there are no concrete activities in form of meetings right now.

See 1. Milestone Report chapter 4.1 and 6.5

There are also discussions to cooperate more closely with the CAUP of the Tongji University and establish networks and and enhance existing ones. In this regard, a workshop at the Tongji University including students, scientists and professional colleagues from practical planning in Shanghai is planned for September this year, focusing on presenting and discussing Germany's public transportation system and best practice examples. In the preliminary phase, already two similar international workshops had taken place producing lively discussions and good results.

In 2007, the project team had organized a workshop jointly with AHL/econet within the framework of the preliminary stage to discuss the approach and its possible effects in public. Besides the representatives of the German companies, a number of Chinese company representatives were present too. The project management will organize such workshop in coordination with the AHK in spring 2010 once again, possibly jointly with the newly created ECEB network.

In future, **topic-specific workshops** will be held particularly with the participation of the SPA, SPI and the investor Chengtou and this modular and at shorter intervals than hitherto within the framework of a long-term exchange of information process. It will also deal with the transfer of professional, technical and organizational know-how but with the focus on the discussion of scenario techniques and the feasibility of individual projects.

Topic-specific and modular training courses in form of **courses/seminars** should take place for effective and efficient building of know-how or appropriate education and training to be held for a long period of time and at fixed intervals. Classrooms could be located at the Tongji University, at the AHK or directly at the respective project partners (SBA, Chengtou, SPI, SPA). PTV has an office in Shanghai and will continuously provide both rooms and possibly site personnel for training purposes, e.g. for the EEC. Possible is a capacity certificate on the respective subjects as proof of continued training or a basic contract for performing such training courses with the respective partners.

This was already accompanied by provision of **action guidelines** containing easy to understand explanations, diagrams and illustrations relating to the theoretical background and with the focus on practical application of energy efficiency strategies in the planning and design practice. Extensions to manuals are planned.

The establishment of German-Chinese **work groups** on various topics is also planned and for integrated contemplation in order to jointly develop goals, adapt methods and discuss the implementation potential of various projects.

Also planned is an **Internet forum** in form of an open-source platform to ensure accessibility of know-how, to make establishing networks and the exchange of know-how on the respective topics and methods easier, and to collect feedback on our plans and methods.

There will be annual **travelling** of the Chinese partners inside Germany for strengthening clearness and practical relevance through visiting best-practice projects. The failed invitation to Mr. XU because of internal reasons (stress on the City Planning Department due to the upcoming EXPO2010) that was scheduled for April 2009 will be be made up for in fall this year. Likewise, Dr. HU in his capacity as chief architect of the Chengtou Corporation Shanghai was also invited to Germany in fall 2009 to visit examples of energy-efficient city extensions in Germany and to hold discussions with comparable project developers and services providers (Hochtief, GAGFAH, etc.) with respect to energy issues and costs.

Furthermore, the participation in international **conferences** to present innovative project results, for exchange in information and research, for establishing networks and to increase public awareness of energy efficiency project will also be continued in China.

Records should be made of all efforts about Capacity Building in form of a **program/concept** consisting of topic-specific workshops, seminars, training courses, German-Chinese work group and travelling.

6 Annex

In the annex some topics already named in the previous chapters will be treated in detail for a better understanding.

6.1 LCI

Method family 1 for a quick assessment, Low Carbon Index (LCI)

LCI indicators represent energy efficiency and the efficiency regarding a minimization of CO_2 emissions for an area covering three detail levels. The difference between the two assessment areas is taken into account through the assessment weights.

At its uppermost level, the LCI is divided into buildings, urban development and traffic. The main points are defined on the middle level. Finally, the main points are composed of the individual criteria. Corresponding with the relevance for an energy-efficient structure, the areas, main points and individual criteria are weighted at all three levels. However, the weights of the area to be investigated are not independent but may have to be adjusted on a case-by-case basis. For this reason, the weights should be understood as examples of area-specific weighting.
The respective main point is further differentiated at the second level. The selected individual criteria are also dependent on the area. At the beginning of an assessment of an area, the respective relevant individual criteria within a sub-area must be defined and the weights must be adjusted.

1. **Buildings (50%)**
    - 1.1. Energy consumption (30)
    - 1.2. Wind conditions (5%)
    - 1.3. Solar orientation (10%)
    - 1.4. Building type (10%)
    - 1.5. Building shell (20%)
    - 1.6. **Sun protection** in summer (5%)
    - 1.7. Reduction of heat islands (Roof/Front) (5%)
    - 1.8. Efficiency of building technology (10%)
    - 1.9. Thermal comfort (5%)
2. **Urban construction (20%)**
    - 2.1. Site selection (5%)
    - 2.2. Functions/Usages (20%)
    - 2.3. Density (20%)
    - 2.4. Walkability (15%)
    - 2.5. Transit-Oriented-Development (15%)
    - 2.6. Public green spaces (20%)
    - 2.7. Quality and design of public space (5%)
3. **Traffic (30%)**
    - 3.1. Pedestrian traffic (30%)
    - 3.2. Bicycle traffic (30%)
    - 3.3. Public transit (20%)
    - 3.4. Motorized individual traffic (15%)
    - 3.5. Energy requirements for infrastructure (5%)

Example for the classification into three levels and weighting:

Upper level = Area:	Urban construction (Weight: 20%)
Middle level = Main point:	Density (Weight: 20%)
Lower level = Individual criteria:	Population density (Weight: 25%)

For example, with a weighting of 20% x 20% x 25% = **1.0** %, the individual criterion “population density” becomes part of the LCI.

Each individual criterion is assessed on a scale of -2 points to +2 points.

Assessment example:
Individual criterion: Population density

-2	-1	0	1	2
Population density is well below (min. 10%) average for Shanghai	Population density as somewhat under Shanghai average	Population density corre-sponds with Shanghai average	Population density as somewhat above Shanghai average	Population density is well above (min. 10%) average for Shanghai

If the examined area had a planned population density of at least 110% of the Shanghai average, it would achieve +2, hence full points, for the "population density" individual criterion.

As soon as all individual criteria are assessed and weighted, the total points for the area can be determined.

The name "LCI-Low Carbon Index“ was chosen intentionally since decentralized renewable energy production will also be assessed as part of the further development of the LCI. In this vein, an assessment of whether the potential of an area with respect to energy efficiency have been fully utilized will turn into a somewhat more detailed assessment of whether the potential of the area has been fully utilized in respect of CO2 reduction.

LCI overview of areas and main points

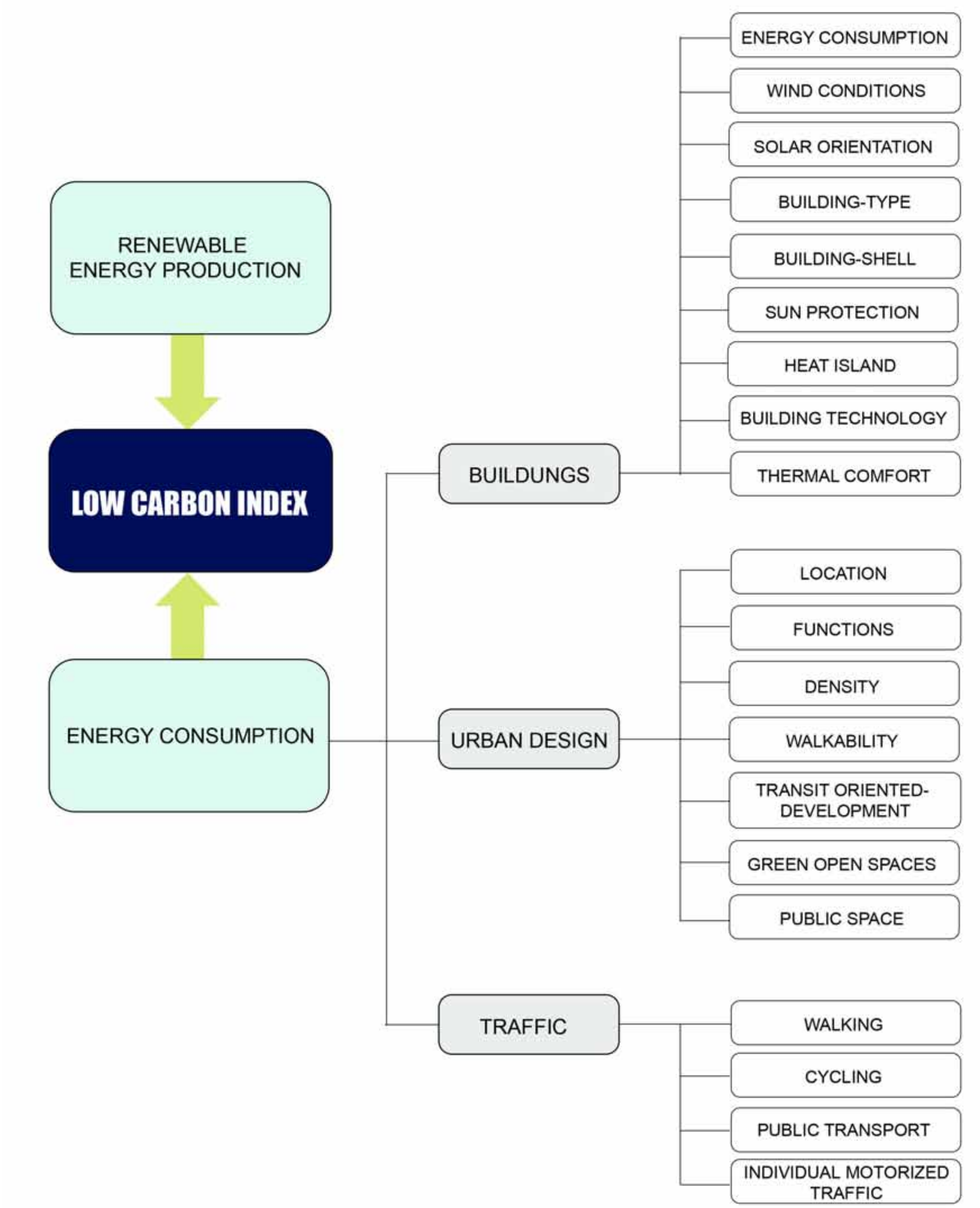


Figure 11 Overview of areas and main points of the LCI; source: own exposure

LCI- Gerneral Survey

Buildings (50%)

					-2	-1	0	1	2
Buildings (50%)	Energy con-sumption	30%	Average energy consumption compared to the Shanghai average	50%	The average energy consumption is 0 - 15% lower	The average energy consumption is 15 - 30% lower	The average energy consumption is 30 - 45% lower	The average energy consumption is 45 - 60% lower	The average energy consumption is > 60% lower
			Average energy consumption compared to the Shanghai standard	50%	The average energy consumption is 15 - 30% higher	The average energy consumption is 0 - 15% higher	The average energy consumption is equivalent to the standard	The average energy consumption is 0 - 10% lower	The average energy consumption is > 10% lower
	Wind Conditions	5%	Wind exposure (cooling down in winter)	50%	More than 25% of the buildings have a exposed position	Less than 25% of the buildings have a exposed position	The buildings are located on a free plane	0 - 25% of the buildings have a sheltered position	More than 25% of the buildings have a sheltered position
			Wind use to cool down the buildings	50%	Wind use for cooling wind is not available	Wind use for cooling wind is 25% available	Wind use for cooling wind is 50% available	Wind use for cooling wind is 75% available	Wind use for cooling wind is 100% available
	Solar Orientation	10%			Less than 25% building (blocks) are east-west-oriented	More than 25% building (blocks) are east-west-oriented	More than 50% building (blocks) are east-west-oriented	More than 75% building (blocks) are east-west-oriented	All building (blocks) are east-west-oriented
	Building-Type	10%	Proportion surface /volume and compact-ness	50%	The Surface/Volume-coefficient is > 0.6	The Surface/Volume-coefficient is 0.5 to 0.6	The Surface/Volume-coefficient is 0.4 to 0.5	The Surface/Volume-coefficient is 0.3 to 0.4	The Surface/Volume-coefficient is < 0.3
			Selection of residential building-types	25%	The area consists only of single-family homes	The area consists of single-family homes, semi-detached houses, row houses	The area consists of row houses (50%), multi-family houses (50%)	The area consists of row houses (30%), multi-family houses (70%)	The area consists only of multi-family houses
			Selection of non-residential building-types	25%	The area consists of high-rise (50%) and multi-storey-buildings (50%)	The area consists of high-rise (30%) and multi-storey-buildings (70%)	The area consists of high-rise (10%) and multi-storey-buildings (90%)	The area consists of high-rise (<10%) and multi-storey-buildings (L & P-Type)	The area consists only of multi-storey-buildings (mainly L-Type)

Buildings (50%)

					-2	-1	0	1	2
Buildings (50%)	Building-Shell	20%	Building material - wall /roof	25%	Wall Concrete / lime, cement / sand, gravel /	Dry screed	brick, solid wood	Light plaster	Fill of Cellulose
			Building material -	25%	Only single-layer glass	single- & double-layer glass	only double-layer glass	only thermal protection glass	only three-layer glass
			Insulation – wall & roof	20%	No Insulation	cork, foam glass, coconut	polystyrene, stone, glass, wool	XPS/EPS	PU-foam
			Energy expenses for production of materials and insulation	20%	very high	high	medium	low	very low
			Window area [%] depending on the orientation	10%	North 40%, South 50%, East/West 25 %	North 35%, South 45%, East/West 20 %	North 30%, South 40%, East/West 15%	North 25%, South 35%, East/West 10%	North 20%, South 30%, East/West 5%
	Sun protection in summer	5%			No sun protection available	Interior & exterior-lamellar / blinds available to 25%, < 15% of south walls have shading devices	Interior & exterior-lamellar / blinds available to 50%, < 15% of south walls have shading devices	Interior & exterior-lamellar / blinds available to 75%, > 15% of south walls have shading devices	Interior & exterior-lamellar / blinds available to 100%, > 25% of south walls have shading devices

Buildings (50%)

					-2	-1	0	1	2
Buildings (50%)	Reduction of heat islands (roof / facade)	5%	Colour	33%	Only dark colours, low albedo	Mainly dark colours, low albedo	Bright and dark colours, medium albedo	Mainly bright colours, high albedo	Only bright colours, high albedo
			Green roof/ facade	33%	No green roof	0 – 15 % green roofs	15 – 30 % green roofs	30 – 45 % green roofs	> 45 % green roofs
			Trees, other landscape elements	33%	No south-facade has trees or other landscape elements	0 – 5 % of south-facade has trees or other landscape elements	5 – 10 % of south-facade has trees or other landscape elements	10 – 15 % of south-facade has trees or other landscape elements	> 15 % of south-facade has trees or other landscape elements
	Efficiency of building technology	10%	Heating	33%	> 10% less efficient than the standard	0 - 10% less efficient than the standard	Corresponds to the standard	0 - 10% more efficient than the standard	> 10% more efficient than the standard
			Cooling	33%	> 10% less efficient than the standard	0 - 10% less efficient than the standard	Corresponds to the standard	0 - 10% more efficient than the standard	> 10% more efficient than the standard
			Ventilation	33%	> 10% less efficient than the standard	0 - 10% less efficient than the standard	Corresponds to the standard	0 - 10% more efficient than the standard	> 10% more efficient than the standard
	Thermal Comfort	5%	Thermal Comfort in winter	33%	Interior temperature < 18 °C	Interior temperature 18 – 19 °C	Interior temperature 19 – 20 °C	Interior temperature 20 – 21 °C	Interior temperature 21 – 22 °C
			Thermal Comfort in summer	33%	Interior temperature > 30 °C	Interior temperature 30 – 28 °C	Interior temperature 28 – 26 °C	Interior temperature 26 – 24 °C	Interior temperature < 24 °C
			Air exchange rate (window) heating period	33%	> 1.5 per hour	1.5 per hour	1 per hour	0.5 per hour	< 0.5 per hour

Urban Design 20%

					-2	-1	0	1	2
Urban Design (20%)	Location	5%	Internal Develop-ment	50%	Planning in the free landscape	Planning on the outskirts	Planning on a built-up area	Planning on fallow land	Planning on fallow land in the city centre
			Transport connection	50%	Poor Transport connection	Incomplete Transport connection	Good Transport connection	Good Transport connection; public transport & motorized individual traffic	Good Transport connection; different types of public transport & motorized individual traffic
	Functions	20%	Arrangement of functions	30%	Mòn structured area (>90% of the study area)	2 functions, the main function is 70-80% of the area	major function is 50-60% of the area	3 functions, the main function is 30-50% of the area	no dominant function
			Spatial distribution of uses	50%	Spatial separation of the uses with conflicts	Spatial separation of the uses; without conflicts	Mainly separation of the uses with meaningful arrangement of uses within the study area	Approach to mix the uses within the study area	Mainly mixed area with a reasonable arrangement of uses
			Uses	20%	Large logistic problems caused by the proposed / existing use	Smaller logistic problems caused by the proposed / existing use	Basic needs are fulfilled	Basic needs are fulfilled close to the flats; additional facilities are available nearby	Basic needs are fulfilled in the study area, even for the surrounding area; additional attractions
	Density	20%	Population density	25%	Population density is significantly lower (<90%) than the average density of Shanghai	Population density is lower than the average density of Shanghai	Population density is similar like the average density of Shanghai	Population density is higher than the average density of Shanghai	Population density is significantly higher (>110%) than the average density of Shanghai
			Workplace density	25%	Workplace density is significantly lower (<90%) than the average density of Shanghai	Workplace density is lower than the average density of Shanghai	Workplace density is similar like the average density of Shanghai	Workplace density is higher than the average density of Shanghai	Workplace density is significantly higher (>110%) than the average density of Shanghai
			Building density	25%	Density is significantly lower (<90%) than the average of Shanghai	Density is lower than the average of Shanghai	Density is similar like the average of Shanghai	Density is higher than the average of Shanghai	Density is significantly higher (>110%) than the average of Shanghai
			Density allocation	25%	Density does not correspond to the use, seems to be arbitrary	Density does partly correspond to the use	Density does correspond to the use	Density corresponds to the distribution of uses	Density of key facilities is particularly high; low at the edge of the areas

Urban Design 20%

					-2	-1	0	1	2
Urban Design (20%)	**Walkability**	15%	Foot paths-Quota	40%	Area is not complete equipped with foot paths	Area is complete equipped with foot paths	Foot paths are sometimes separated from roads	Short & direct connections to major facilities	Good links to surrounding
			Cycle paths-Quota	40%	Area is not complete equipped with cycle paths	Area is complete equipped with cycle paths	Cycle paths are sometimes separated from roads	Short & direct connections to major facilities	Good links to surrounding
			Foot paths-Quality	10%	Paths are too narrow, barely usable	Paths have sufficient width	Paths are safe; separation from the road	Paths are diversified and offer shadow	Paths are illuminated, surface is comfortable, there are park benches, paths are largely free from stairs and ramps
			Cycle paths-Quality	10%	Paths are too narrow, barely usable	Paths have sufficient width	Paths are safe; separation from the road	Paths are diversified and offer shadow	Paths are illuminated; surrounded by green areas; surface guarantees low friction
	Transit-Oriented-Develop-ment	15%	Uses close to nodes and transport hubs	50%	Mainly undeveloped areas	No public uses	Few public uses	Private and public uses	Specific attractors
			Density close to nodes and transport hubs	50%	Very low density	Comparatively low density	Average density of the area	Density slightly above average	Highest density of the area at the nodes and transport hubs

Urban Design 20%

					-2	-1	0	1	2
Urban Design (20%)	**Green Open Spaces**	20%	Green Open Spaces-Quota	30%	No public green open space	Narrow green spaces besides the roads	One large green open space	More than one green open space	Many green open space distributed over the entire area
			Green Open Spaces-Quality	10%	Narrow green spaces besides the roads; without quality	Low amenity values; poor design, poor location on the edge of area	Average amenity values; average design, little shade	High amenity values but only for a few user groups	High amenity values but only for many user groups
			Impacts on the microclimate	50%	No impact on the climate (too small)	Only little impact (wrong location)	Low impact due to poor location and design	Significant impact on the climate (good location)	High impact by good location, large and very effective planting
			Uses in the green open spaces	10%	Unimportant uses	Only workplaces	Mixed use	Mixed use with a large proportion of housing	Mainly housing
	Quality and design of public space	5%	Safety	30%	Public space without function, cut off from the rest, small narrow streets, dark zones	Public space poorly accessible and without a clear function, poor lighting	Structured, functional space with security-lighting	Public space accessible with wide pathways and lighting accents to danger spots	Public space especially good designed, good overview, good signage and bright lights at key locations
			Public accessibility	20%	No access due to lack of connections for pedestrians and cyclists	Access by at least 1 side, links are unattractive	Access by at least 2 sides with some attractive paths	Area is accessible from all sides, quality is not always sufficient	From all sides attractive and barrier-free access
			Design of public space	50%	Unattractive design and location of the public space without amenity values, no-go-areas	No design of public space	Some approaches to design public spaces, little use for residents	Attractive design of public spaces, little flexibility in the use	Attractive design with many different uses for various groups of residents

Traffic 30%

					-2	-1	0	1	2
Traffic (30%)	Walking	31%	Foot paths-Quota	30%	Length of footpaths/ length of roads < 0.5	Length of footpaths/ length of roads = 0.5 to 1.0	Length of footpaths/ length of roads = 1.0 to 1.5	Length of footpaths/ length of roads = 1.5 to 2.0	Length of footpaths/ length of roads > 2.0
			Foot paths-Quality	30%	Paths are too narrow, barely usable	Paths have sufficient width	Paths are safe; separation from the road	Paths are diversified and offer shadow	Paths are illuminated, surface is comfortable, there are park benches, paths are largely free from stairs and ramps
			Direct way or detours	20%	High amount of motorized traffic and no regular crossing for pedestrians	Normal amount of motorized traffic and no regular crossing for pedestrians	Some regular crossings for pedestrians	Many regular crossings for pedestrians	Many regular crossings for pedestrians; no detours
			Crossroads & conflict points with motorized individual traffic & cyclists	20%	No regular crossing for pedestrians; barely footpaths	Regular crossings for pedestrians; but insufficient safety; mixed cycle and foot paths	Safe crossings for pedestrians; without speed humps; mixed cycle and foot paths	Safe crossings for pedestrians; traffic lights or speed humps; separated cycle and foot paths	Grade separation for main roads; speed humps for smaller roads; separated cycle and foot paths

Traffic 30%

					-2	-1	0	1	2
Traffic (30%)	Cycling	31%	Cycle paths- Quota	20%	No cycle paths	Length of cycle paths/ length of roads < 0.25	Length of cycle paths/ length of roads < 0.25 to 0.5	Length of cycle paths/ length of roads < 0.5 to 1.0	Length of cycle paths/ length of roads > 1.0
			Cycle paths- Quality	20%	Paths are too narrow, barely usable	Paths have sufficient width	Paths are safe; separation from the road	Paths are diversified and offer shadow	Paths are illuminated; surrounded by green areas; surface guarantees low friction
			Direct way or detours	10%	High amount of motorized traffic and no regular crossing for cyclists	Normal amount of motorized traffic and no regular crossing for cyclists	Some regular crossings for cyclists	Many regular crossings for cyclists	Many regular crossings for cyclists; no detours
			Crossroads & conflict points with motorized individual traffic & pedestrians	10%	No regular crossing for pedestrians; no cycle paths	Regular crossings for cyclists; but insufficient safety; mixed cycle and foot paths	Safe crossings for cyclists; without speed humps; mixed cycle and foot paths	Safe crossings for cyclists; traffic lights or speed humps; separated cycle and foot paths	Grade separation for main roads; speed humps for smaller roads; separated cycle and foot paths
			Bicycle stands; quantitatively	15%	No bicycle stands	Number bicycle stands/ (number of residents + employees) <0.1	Number bicycle stands/ (number of residents + employees) = 0.1 to 0.3	Number bicycle stands/ (number of residents + employees) = 0.3 to 0.5	Number bicycle stands/ (number of residents + employees) > 0.5
			Bicycle stands; qualitatively	15%	No bicycle stands	Simple bicycle stands	Nice bicycle stands	Canopied bicycle stands	Canopied bicycle stands; parking garage
			Bicycle Rental Concepts	5%	-	-	No Bicycle Rental Concepts	-	Bicycle Rental Concepts are existing
			Further ideas or activities to increase bicycle traffic demand (e.g. air-stations)	5%	No further ideas or activities	Little ideas or activities	Some ideas or activities	A number of ideas or activities	Many ideas or activities

Traffic 30%

					-2	-1	0	1	2
Traffic (30%)	**Public transport**	**23%**	Accessibility of stops (radius of 250m)	7%	Less than 35% of the area is covered	More than 35% of the area is covered	More than 50% of the area is covered	More than 65% of the area is covered	More than 80% of the area is covered
			Canopy for stops	2%	No canopy for stops	Majority of stops without canopy	Majority of stops without canopy	All stops with canopy	All stops with canopy + attractive architecture
			Barrier-free stops	2%	No stop is barrier-free	Majority of stops are not barrier-free	Majority of stops are barrier-free	All stops are barrier-free	All stops are barrier-free + attractive architecture
			Passenger information	2%	No passenger information	Insufficient passenger information	Sufficient passenger information	Extensive Information & good overview	Electronic boards with on-line passenger information
			Shopping at stops	4%	No shops far and wide	Shops more than 250m away	Shops at stops or close	Shopping directly integrated at the stops; architecturally unattractive	Shopping directly integrated at the stops; architecturally attractive
			Costs for the user	25%	Commuting by public transport causes higher costs than gasoline costs of an average car (7l per 100km)	Commuting by public transport causes similar costs than gasoline costs of an average car (7l per 100km)	Commuting by public transport is cheaper than gasoline costs of an average car (7l per 100km)	Commuting by public transport < 70% of gasoline costs of an average car (7l per 100km)	Commuting by public transport < 50% of gasoline costs of an average car (7l per 100km)
			Ticket System	5%	Ticket System absolutely difficult to understand; many exceptions	Ticket system difficult to understand; Poor networking of the entire metropolitan	Ticket system is understandable	Ticket system easy to understand; Good networking of the entire metropolitan	Ticket system very easy to understand; Perfect networking of the entire metropolitan
			Easy Payment	5%	Tickets only at special outlets	Tickets at special outlets and only at a few stops	Tickets at special outlets and at stops	Tickets at special outlets, at stops and in the vehicles	Tickets at special outlets, at stops and in the vehicles + innovative approaches (e.g. prepaid cards)
			Type of vehicle	10%	Buses; old, used up and overcrowded	Buses; old but in good shape	Buses; modern and seldom overcrowded	Rail-system	Modern Rail-system

Traffic 30%

					-2	-1	0	1	2
Traffic (30%)	Public transport	23%	Separate lanes	2%	No separate lanes for public transport	Little number of separate lanes for public transport	Bigger number of separate lanes for public transport; still partially congestions	Bigger number of separate lanes for public transport; no congestions	All lanes are separated from motorized individual traffic
			Crossings with prioritized public transport	2%	No prioritized public transport	Little number of crossings with prioritized public transport	Some crossings with prioritized public transport	All important crossings with prioritized public transport	Important crossings with prioritized public transport
			Connection to the city centre	10%	With more than two switch	With two switch	With one switch	No switch and less than 20 min.	No switch and less than 10 min.
			Capacity	2%	Every peak leads to overloads	Most peaks lead to overloads	Only some peaks lead to overloads	Nearly no overloads	No overloads
			Speed	5%	Commuting during the rush hour: Travel time (public transport) / travel time (motorized individual traffic) > 2	Commuting during the rush hour: Travel time (public transport) / travel time (motorized individual traffic) > 1.2	Commuting during the rush hour: Travel time (public transport) / travel time (motorized individual traffic) = 1.0 to 1.2	Commuting during the rush hour: Travel time (public transport) / travel time (motorized individual traffic) = 0.8 to 1.0	Commuting during the rush hour: Travel time (public transport) / travel time (motorized individual traffic) < 0.8
			Technology of the vehicles	5%	Old combustion engines (diesel / petrol)	Combustion engines (diesel / petrol)	Economical combustion engines (diesel / petrol) or bio-diesel	Hybrid, hydrogen, bio-diesel on road	Electric engines
			Average occupancy rate	5%	Average occupancy rate < 0.1	Average occupancy rate = 0.1 to 0.2	Average occupancy rate = 0.2 to 0.3	Average occupancy rate = 0.3 to 0.4	Average occupancy rate > 0.4
			Altitude profile	2%	Large incline, stops with incline	Large incline	Little incline	Little incline; stops without incline	Optimized altitude profile
			Energy consumption of the stops	5%	No single energy-saving measure	almost no energy-saving measure	Some energy-saving measures	Many energy-saving measures	Perfect energy-saving measures

Traffic 30%

					-2	-1	0	1	2
Traffic (30%)	Motorized individual traffic	15%	Traffic calming	20%	No traffic calming, quite the opposite, main road through residential area	No traffic calming	Traffic calming-some approaches	Good concept for traffic calming	Traffic calming + attractively furnished road space
			Parking fee	10%	No parking fee + oversized car parks	No parking fee	Parking fee	Parking management	Restrictive parking management, reduced number of car parks
			Concept of "Car Free Living"	5%	-	-	Concept of "Car Free Living": NO!	-	Concept of "Car Free Living": YES!
			Car Rental	5%	-	-	Car Rental: NO!	-	Car Rental: YES!
			Congestion Charge	8%		-	If area is near the centre: Motorists pay no congestion charge	If area is near the centre: Motorists pay congestion charge	If area is near the centre: Motorists pay high congestion charge
			Promotion of electric vehicles	7%		-	No promotion of electric vehicles	Some parking especially for e-vehicles	Free parking + free charging for e-vehicles
			Traffic searching for parking	10%	Almost no parking	Too limited number of parking	Too limited number of parking at peak times	Sufficient number of parking (under normal conditions)	Sufficient number of parking (even for special events)
			Congestion	25%	Long lasting daily overload	Daily overload	Overloads only in the rush hours	Seldom overloads	No overloads
			Connection to the expressway network	10%	Connecting more than 5 km away	Connecting less than 5 km away	Connecting less than 1 km away	Connecting on the edge of the area	Direct connection in the area

Some aspects of this first method family are seemingly doubled up as part of an examination which spans across areas. In fact however, different situations should be represented. The objective is to achieve the correct representation of the real energy efficiency increase potential with this method family by applying the weighting.
Furthermore, the valuation will be changed depending on the scale of the planning to be assessed. Not all individual criteria can be used for all applications, since large-scale planning is also assessed using this method; this applies particularly to the building area.

This method for energy-related "rapid assessment" will be tested as part of the project for the intended area development plans of the Shanghai urban planning office. In particular, the weighting of the rapid method is to be evaluated using the results determined with the second method family.

6.2 Method family 2 (in the Energy-Efficiency-Controller (EEC), “Scenario Manager” part of implemented methods)

Introduction: currently implemented methods also include end energy consumption. An addition to derive CO2 emission is in the preparation stage. Also in preparation is an addition concerning primary energy consumption.

Urban Planning

See chapter **Fehler! Verweisquelle konnte nicht gefunden**

This area is identical to method family 1.

Buildings

In the building area, energy requirement calculation methods are based on a "building type database“: The purpose of the building type database is to archive building data in the form of an index for calculated and measured building energy requirements and as reference values for building assessments.

Categorization takes place according to the age of the building, type of building, use, building components, building technology, **energy resources** and user behavior.

The building type database supplies orientation and reference values for the buildings‘ energy consumption models and therefore also serves as a monitoring tool for the plausibility of method family 1 in this area. Not only calculated energy requirements but also measured energy consumption is assigned to individual buildings. Energy requirement values for individual buildings are also based on different optimized calculation standards. Square-meter based energy consumption and CO2 emissions per building are represented as the result.

The building type database is projected on the basis of the expected changes in user behavior (increasing requirements for comfort). Each calculation / measurement therefore has a time stamp, so that time series can be used as the project progresses to derive consumption and dependencies from socio-economic variables.

"Energy consumption model Shanghai": This calculation basis is based on the Energy Conservation Design Standard for Residential Buildings in Shanghai" (DG/TJ08-205-2000). Using a GIS, the evaluating party is able to quickly and systematically assess and visualize large urban areas (quarters, city parts, cities). The Shanghai energy consumption model represents the estimated energy requirements (status-quo) dependent on current average Chinese user behavior and the user's comfort requirements, and also in dependence of the aimed-for ideal status of building quality.

Absolute and square-meter based energy consumption per building are calculated separately according to use and represented as the result. This method is used as part of **scenarios of measures** in order to determine possible savings potentials.

"Optimized energy consumption model": the calculation model according to the Shanghai standard provides a very simplified illustration of annual energy requirements. Therefore it can only be used with larger areas. A building-based calculation requires the inclusion of other variables.

This optimized calculation basis was developed and implemented as part of the research project. It is based on the German energy savings ordinance (EnEV) and includes calculation standards for other climatically similar countries. Other variables – which are not represented in the Shanghai Standard – are also taken into account (specific data regarding user behavior/comfort requirements, energy resources, energy technology, individual building components, end and primary energy requirements). The method was implemented in a GIS. It enables the user to quickly and systematically assess larger urban areas (quarters, city parts, cities) from an energy point of view on the basis of individual buildings. Absolute and square-meter based energy consumption per building – similar to the Shanghai model - are calculated separately according to use and represented as the result. This method was implemented as the more accurate approach in the EEC.

See chapter 6.6

Comparative value model – building: the calculated energy consumption and CO2 emissions for an area can be compared to alternative designs. A statement on efficiency is derived from the difference between the square-meter based values (kWh/m²a). Of particular interest in this regard is the building-based comparison of buildings which are to be built according to the Shanghai standard, with buildings for which improved standards are designed. In this vein, life cycle costs of the buildings to be compared are calculated.

However, in the case of CO2 emissions, CO2-free renewable energy production was deducted, analogous to the aforementioned method.

"Cost model – building": a feasibility study (investment and user costs, life cycle analysis) is carried out for individual building types and entire city quarters as a basis for the determination of changed quarter standards, in order to show the economic efficiency of energy-efficient buildings. The investigation looks at the cost of the energy-related benefit of energy-efficient as compared to the current reference standard. This work has not been completed to date.

Renewable energy production

The production of renewable energy is not taken into account as part of the energy assessment. As part of the CO2 assessment, energy produced in a renewable manner is deduced from fossil-based energy requirements, and the remaining CO2 emission is calculated. The life cycle costs of the installation flow into the costs.

Mobility

"Total transit model": passenger transit for a particular area on normal work days were modeled as day transit with the transit types pedestrian transit, bicycle transit, public transit and motorized individual transit. External origin and destination transit as well as in-transit traffic has been shown separately. Goods traffic is taken into account in a simplified manner in the form of an additional model. Working day transit is projected to a full year using factors for the non-considered day types. A method that is specific to a group of persons is used for passenger transit. This method is provided for in the EEC, scenario manager for implementation.

"Multiple transit model“: additional passenger transit (due to migration) for a particular area on normal work days were modeled as day transit with the transit types pedestrian transit, bicycle transit, public transit and motorized individual transit. This approach also considers goods traffic in a simplified manner as an additional project in this approach. Working day transit is projected to a full ear using factors. A method that is specific to a group of person is again used for passenger transit. This method is intended as an alternative to an implementation into the EEC, scenario manager.

"Energy consumption model“: both approaches of transit modeling utilize a route-related energy consumption and emissions model on the basis of the Handbook for Emission Factors, version 2009. This method is intended to be implemented into the EEC, scenario manager. Energy consumption is determined once as the entire energy consumption of a year. Second, energy consumption is shown relative to the route length. In the process, the routes of all transit carriers, weighted by demand, are added together. The same method is applied to CO2 emissions.

"Comparative model – mobility“: the calculated energy consumption and CO2 emissions are compared with comparative values of alternative regional development concepts. If no comparative region is available, average values for all of Shanghai are used in the comparison. An efficiency statement is then derived from the difference of kilometer-based values.

"Comparative model – overall”: the calculated energy consumption is added to the values for building use and qualified to suitable reference variables. Reference variables may include individuals, other structural variables (workplaces etc.), a combination of structural variables or areas. At this time it has not been decided which reference variables should be selected from the view of the stakeholders.

Method family 2 is used for several of the areas suggested by the Shanghai urban planning office (no definite numbers exist at this time). These can be used to assess an interesting spectrum of different area types with regard to energy efficiency increase and CO2 reduction potentials. This process is accorded particular significance in view of the expected dynamic changes that will take place with regard to the population's demands for living and mobility comfort or mobility requirements.

6.3 Methodical approach for optimizing and assessing public transit offerings

With Module 4, the research project includes an optimization component for public transit. Linkages to Module 3 and 4 form a connection between the planned areas and the public transit assessment for the regions. To this end, the following typology has been developed:

The typology includes the following variables:

(a) Location of the area in view of the Megacity's centre.
(b) Use, type of use and building density.
(c) Socio-economic variable re: population.
(d) Existing / planned offerings (public transit, motorized individual transit and non-motorized transit).
(e) Quality of offerings.

The scientific objective of the typology is to gain insights regarding transit behavior depending on the area type and changes in transit behavior over time. To this end, public transit offerings are analyzed in the context of competing offerings, and users of the offerings are compiled with regard to their transit behavior. Changes in transit behavior have a direct effect on the target variables energy requirements and CO2 emissions.

All area types intended for Module 3 are analyzed in view of public transit and demand behavior. In addition, recommendations for improved public transit offerings will be developed. At this time it s not clear which of the recommendations for improvement can be implemented in line with pilot projects. The goal is to obtain results in the form of an improved public transit offering for the dimensions "theoretical energy efficiency increase potential", "energy efficiency increase potential which can be implemented at a practical level" and "real increase in efficiency".

6.4 Building type database method

The purpose of the building type database is to archive building data as an index for calculated and measured building energy requirements and as a reference value for building assessments.

The building type database supplies orientation and reference values for the building's energy consumption models and therefore can also be used for monitoring plausibility. It also serves as the basis for estimating and assessing the building's energy consumption for research areas, for example in line with the LCI.

Both calculated energy requirements and measured energy consumption are assigned to individual buildings. Measurement values perform an important monitoring function for energy calculations, since it is particularly difficult to estimate the variable user behavior. Measurement values already exist for some buildings, and are continuously expanded for the additional buildings.

Energy requirement values for individual buildings are also based on different optimized calculation standards. One important standard is the “Energy Conservation Design Standard for Residential Buildings in Shanghai” (DG/TJ08-205-2000), which shows energy requirements very close to reality but contains only a few components. This calculation standard is compared in parallel with an optimized calculation method, which is based on the current German EnEV (Energy Savings Ordinance 2009) and the calculation standards of other climatically similar countries, in order to represent other energy-relevant variables such as user behavior, comfort requirements, energy resources, energy technology, individual building components as well as end and primary energy requirements.

Square-meter based energy consumption and CO2 emissions per building are represented as the result. This methodology represents an important basis for the EEC and LCI in the building area.

The categorization takes into account the following components, which also flow into the LCI analysis:

_Site: the climatic conditions at the site, i.e. temperature, sun radiation and wind conditions, influence heating requirements in the winter and air-conditioning needs in the summer.

_Age of the building: the age of the building is an indication of energy consumption. Measured in terms of consumption per square meter, old buildings use more energy than newer buildings, since building efficiency standards have improved over time. For Shanghai the following gradients are recommended on the basis of the historical development of building-design standards: Prior to 1970, 1970 – 1980, 1980 – 1990, 1990 – 2000, after 2000. In particular the time after 2000 will be investigated in more detail.

_Type of building: energy consumption depends on the building type, i.e. on the relationship between the outside area and volume. On a per square meter basis, in the case of residential construction single family homes use more energy than semi-detached homes, and those in turn use more energy than multi-family homes built in a linear construction.

_Uses: energy consumption depends on the use or user based on comfort requirements, user behavior and number of users. In general, non-residential buildings use more energy than residential buildings (again on a square meter basis).

_Building components: other factors influencing energy requirements include the proportion of window surfaces (solar energy gains), building shell (material, insulation) and building details such as color and e.g. green roofs and facades.

_Installation technology: the efficiency of the installation technology (heating, ventilation, air-conditioning) affects energy consumption

_Energy resources: energy sources (fossil-based or renewable) are essential to CO2 issues.

_User behavior: user behavior and user comfort have a great effect on a building‘s energy consumption. This refers to heating patterns in winter (heating days, inside room temperature), cooling patterns (cooling days, inside room temperature) and ventilation patterns.

Figure 12 Example and methodology of the building type database; source: own exposure

6.5 Energy-Efficiency-Controller (EEC)

The EEC evolved as part of the project developed in accordance with the wishes of the Chinese side with respect to its placement. Several smaller areas have taken the place of one large area. All of these areas are located within Shanghai's borders, but differ in several respects (distance to centre, size, transit connection as well as use mixture and density). This differentiation in characteristics guarantees that a lot of insights regarding different settlement characteristics can be gained and thus facilitates the transferability of the method to other areas.

To enable the EEC to be used in areas with an incomplete transit data position, the "multi transit method" described in Section 27 has been developed. It enables an energy consumption estimate for the Mobility segment even if information on the transit situation in the neighboring area is not available. However, as part of this process the interdependencies between planning and the remaining grid will be abandoned.

The assumption of a cost-benefit examination (Section 5.5) forms another important point in the further development of the EEC. This component is used both in the ex-post as well as ex-ante examination. This activity aims to achieve a better integration of economic factors into energy efficiency estimates. It ensures that especially effective but at the same time also especially expensive optimization measures without any economic weight do not flow into the valuation and are thus viewed as virtually unbeatable. It ensures that more cost-effective improvement options are given the appropriate position when making decisions on their use. This appears particularly important in view of the fact that the ability to implement projects that increase energy efficiency is strongly dependent on economic factors. The very common lack of financial funds for "Megacity Project Countries" (developing and emerging states) again underlines the necessity to integrate cost-benefit considerations into an overall examination.

6.6 Explanations regarding costs

Cost structure:
(a) Costs of public sector, costs of user, costs of society
(b) Costs for mobility, costs for building use, costs for the production of renewable energies
(c) Investment costs, operating costs

Public and private investors are the cost carriers. Both make their investments with the intention of achieving a return on their investment. In this context, the public sector places macroeconomic aspects in the foreground. Private investors generally prefer business aspects.

Buildings are financed by private and public investors. Public investors focus on their own requirements as well as on social tasks (residential space for socially weak classes, subsidizing rents). Private investors build for their own use or view the building as an investment property. In the latter case, the investment must make business sense.

The preparation and operation of transit infrastructure is a classic responsibility of the public sector. Something is built when it makes sense from a macroeconomic point of view. The calculation includes the macroeconomically relevant costs and benefits. An advantage exists if benefits exceed costs.

The use of renewable energies can be done both at a public as well as private level. The same criteria apply as for buildings.

Depending on the project and beneficiaries, different benefit components are compared with cost components. Private investors generally consider rental income or the increasing value of a building or renewable energy production site as benefits. A property makes business sense if rental income sufficiently exceeds annual costs, or if the market value of the property sufficiently exceeds production costs less depreciation. This applies also to the public sector for projects destined for own use.

In the case of transit infrastructure projects, the main benefit components which are considered include operating costs, attainability of activity sites (time costs) and accident costs. Energy requirements are a part component of operating costs. CO2 emissions are recorded in line with environmental benefit components. As part of the research project, energy requirements and CO2 emissions are highlighted as separate benefit components in order to utilize the option of applying separate weighting.

One fundamental question refers to the mathematically determined operating hours. The life-cycle costs over the entire operating cycle of a property does not address the rapid change processes taking place in Shanghai, instead a uniform operating cycle (10 years) is defined.

The following diagrams correspond to the contribtution of Prof. Malwitz (Institute of construction operation and construction management) and show life cycle costs analysis for three different energy-efficiency standards for buildings.

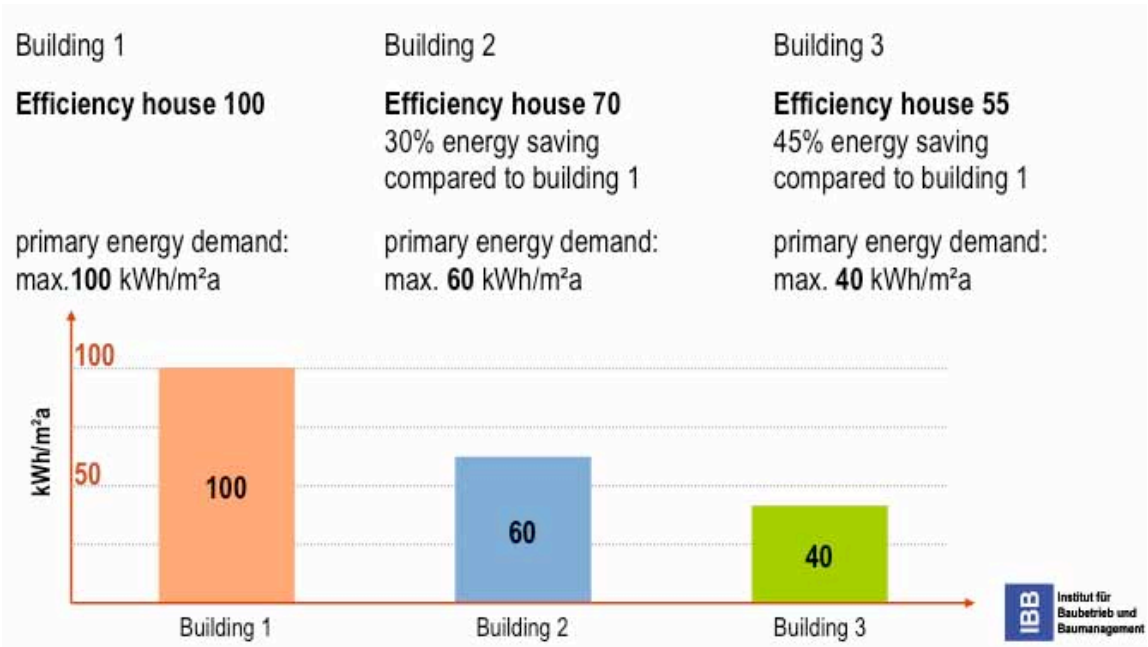


Figure 13 **Life Cycle Costs for different building standards ; source:** Institute of construction operation and construction management

Detached house - investment costs

	Building 1: 100 kWh/m²a		Building 2: 60 kWh/m²a			Building 3: 40 kWh/m²a		
	thermal insulation	W/m²K	thermal insulation	W/m²K	additional costs (€/m²)	thermal insulation	W/m²K	additional costs (€/m²)
exterior wall (sand-lime brick 17,5 cm)	12 cm	0,30	20 cm	0,19	9,30	26 cm	0,15	16,30
roof	20 cm	0,23	26 cm	0,18	2,50	30 cm	0,15	4,30
floor slab	10 cm	0,32	14 cm	0,22	2,20	16 cm	0,19	3,20
windows	double glazed	1,40	double glazed	1,20	8,90	triple glazed	1,00	22,20
ventilation system	not installed		exhaust-air-plant		18,00	exhaust-air purification plant & heat recovery		43,00
additional investment					40,90 (€/m²) **5.685 €**			89,00 (€/m²) **12.371 €**

- 4 residents
- Total living space: 140 m²

IBB Institut für Baubetrieb und Baumanagement

Figure 14 **Investmentcosts for different building standards; source:** Institute of construction operation and construction management

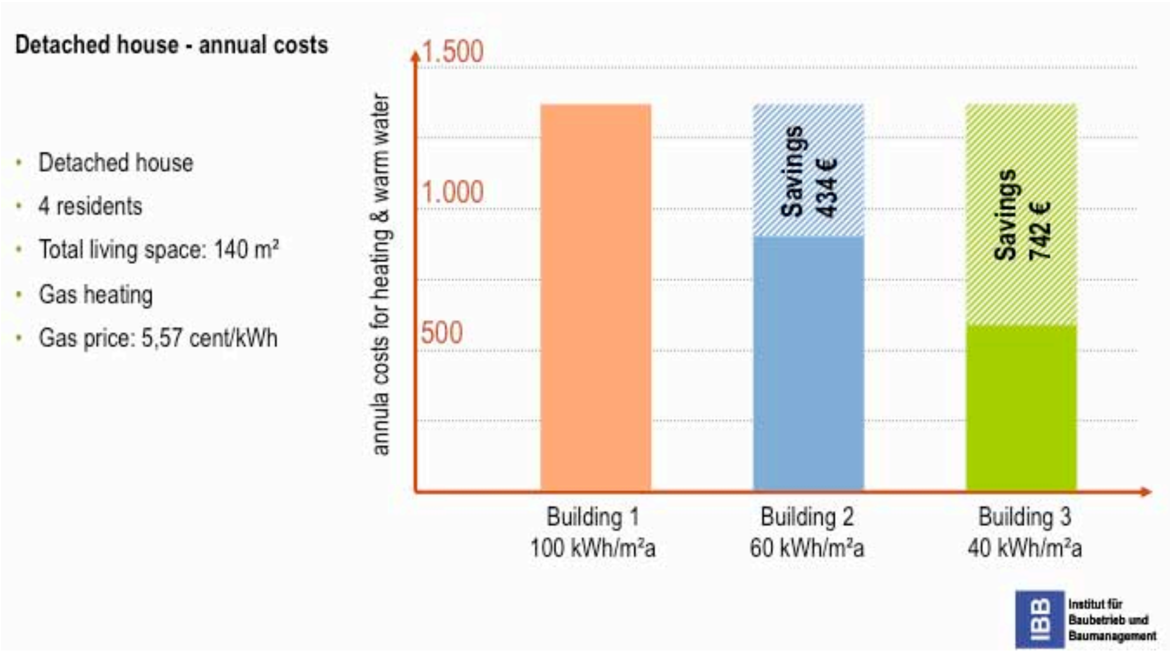


Figure 15 annual costs **for different building standards; source:** Institute of construction operation and construction management

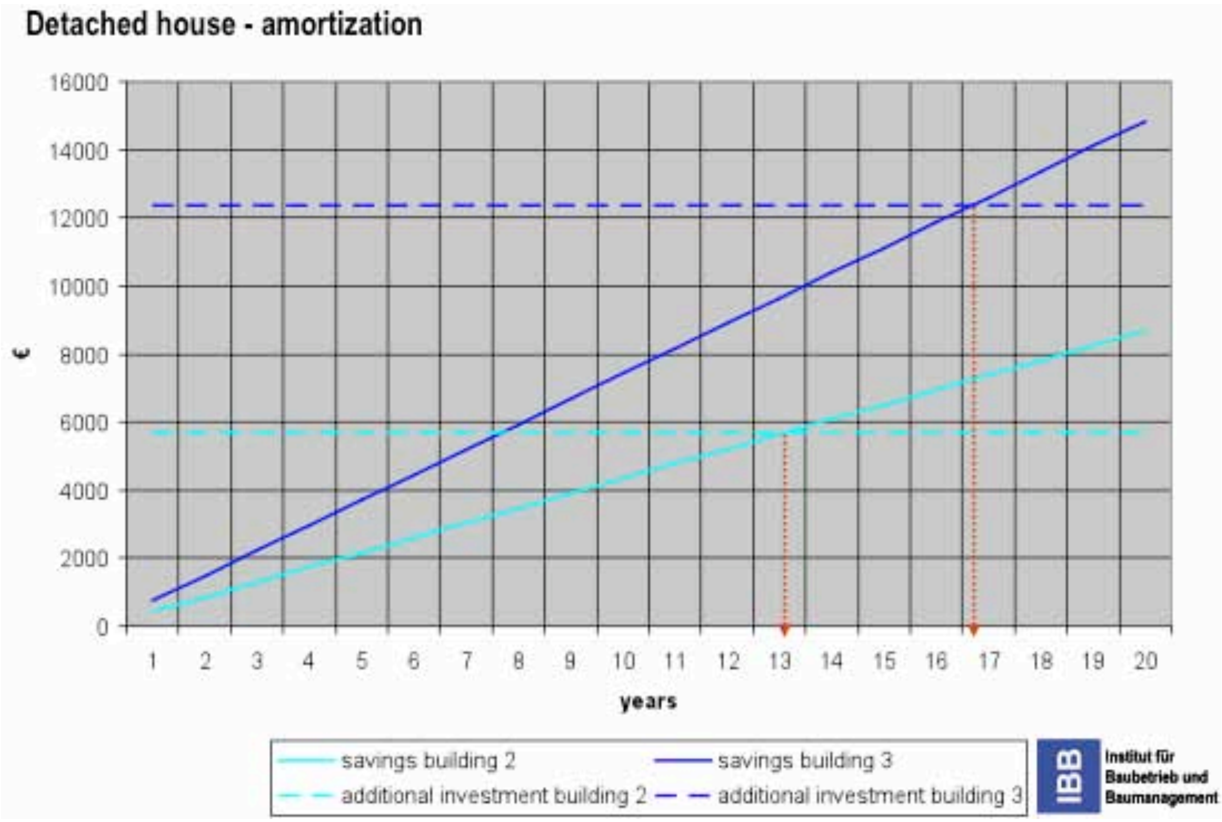


Figure 16 **Amortization of costs for different building standards; source:** Institute of construction operation and construction management

The cost model for the infrastructure is based on the German regulations for evaluating transit infrastructure[14], whereby parameters have been or will be changed in cooperation with the Chinese partners.

The issue of the income situation and resulting willingness to pay for renting space is dynamically included in the economic comparative analysis for buildings. Ex-ante calculations therefore also include a probability for vacancies. Buildings which require high rental incomes that cannot be achieved on the market will therefore be determined as unprofitable. The objective of the calculation is to determine the right point in time for achieving buildings which are favorable from an energy point of view.

The question of the population's income situation also flows indirectly into the analysis of transit infrastructure projects through private motorization and the willingness/ability to pay for mobility. At this time, the average Shanghai resident uses motorized transit (taxis, vehicles, public transit) to cover about half the distance covered by a similar resident of a large German city. This situation will change in the future as incomes increase and there is greater specialization of workplaces and supply facilities.

6.7 Documents/Agreements

Here the signed agreemtens respectively letters of endorsement of some Chinese partner are shown. These documents show that the project has support of different levels and in different institutions in China.

[14] EWS, BVWP, Standardisierte Bewertung von ÖPNV-Investitionen.

Letter of Endorsement: Chengtou Corporation, Herr Dr. Hu

Letter of Endorsement
Mr. Dr. HU, Chengtou Corporation

Since August 2008 we are acquainted with the project „Megacity Shanghai: Integrated Approaches towards a Sustainable and Energy-efficient Urban Development: Urban Form, Mobility, Housing, and Living". The objective of our co-operation is to establish the calculation and the proof of energy-efficiency as criteria in the evaluation of neighborhoods und buildings. Our following endorsing remarks stem from the ongoing co-operation.

1 The excellent work being done within the context of the project „Megacity Shanghai" can be evaluated as very meaningful for our practical everyday planning routine in the development of the infrastructure and new developments within the city of Shanghai.

2 We are aware that this project and the translation and application of the basic issues in urban planning, transportation and building issues is very important for the success in the everyday planning. It has to be acknowledged that the results of the megacity-project can not be implemented immediately. It is necessary to bridge the cultural and technological gaps and to overcome a lot of obstacles.

3 The megacity-project has proved the possibility of improving the energy efficiency in the field of building, i.e. residential, office, educational facilities. Especially the topic of the life-cycle costs for every construction job is important in order to make future building more sustainable despite higher building cost. It is a research task to combine high living comfort with low energy consumption.

4 We have to bring forward the developed approach into the chinese planning context. This can be done with the help of the preliminary work of the megacity-project's teamwork.

5 The basic results of the project give us the chance in the Chengtou Corporation to develop new guidelines or policies, which result in the currently running surveys and projects being carried out by the megacity-team's efforts. This also will reach the political decision-makers.

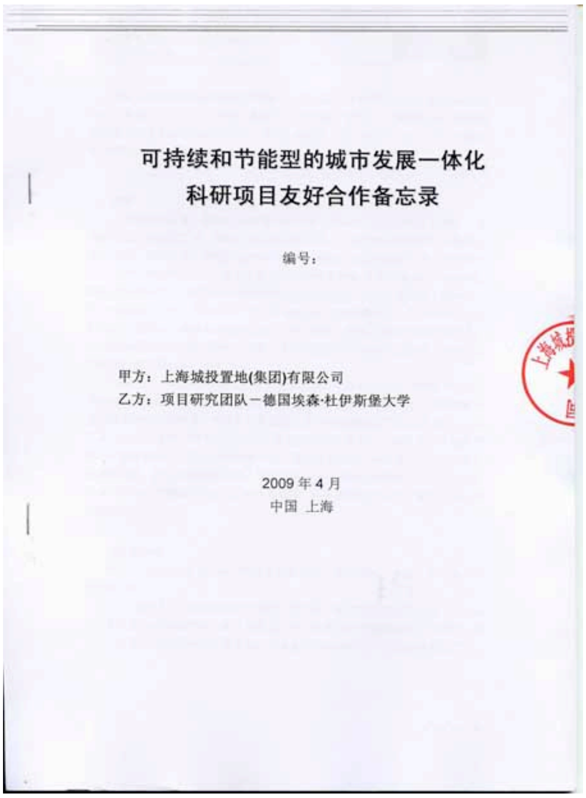
6 In general the issue of the economics and the derived strategies will support the economic power of the Peoples Republic of China and increase the comfort regarding the quality of housing and residential areas, office parks, and educational facilities.

...

Signing of the agreement with the Chengtou Corporation in Shanghai

Abstracts from the agreement with Chengtou Corporation

Here only some abstracts from the agreement are shown because the whole agreement has an amount of ca. 30 pages. On inquiry the whole agreement can be shown.



可持续和节能型的城市发展一体化
科研项目友好合作备忘录

编号：

甲方：上海城投置地(集团)有限公司
乙方：项目研究团队－德国埃森·杜伊斯堡大学

2009 年 4 月
中国 上海

可持续和节能型的城市发展一体化
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UNIVERSITÄT DUISBURG ESSEN

（此页为签署页）

甲方：上海城投置地（集团）有限公司

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日期：

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Letter of Endorsement Mr. Xu,
Shanghai City Planning Authority

25/06 2009 17:14 FAX +4971125859531 SBA GmbH 0001/0001

Letter of Endorsement
Mr. XU, Shanghai City Planning Authority

In Fall 2007 we have signed a Letter of Intent in order to support the project „Megacity Shanghai: Integrated Approaches towards a Sustainable and Energy-efficient Urban Development: Urban Form, Mobility, Housing, and Living". We have supported the project and the examples within the Shanghai region after it came up with many interesting and innovative impulses for the future development in the District Fengxian and the City of Nanqiao. For the second phase we have found together new and promising investigation areas and projects for the integrated planning with the subjects of urban planning and mobility. The objective of our co-operation is to establish the calculation and proof of energy-efficiency as criteria in the evaluation of new urban developments.

1 The work being done within the context of the project „Megacity Shanghai" can be evaluated as very meaningful for our practical everyday planning towards a future oriented urban development of the city of Shanghai.

2 We are aware that this project and the translation and application of basic issues in urban and transportation planning is important for the success in the everyday planning. It has to be acknowledged that the results of the megacity-project can't be translated immediately into the implementation. For this a necessary requirement is to bridge the cultural and technological gaps. Currently we are dealing with the problem to translate the relevant work of the project into concrete projects.

3 The megacity-project and the particularly conducted sub-projects have proved the possibility of improving the energy efficiency. The produced data and facts help us to follow the line of arguments in understanding and implement the issue of integrated approach of urban and transportation planning.

4 We have to bring forward the developed approach into the chinese planning context. This can be done with the help of the preliminary work of the megacity-project's teamwork.

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