1. Milestone Report
April 2009

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

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Project Requirements

I Integrate social aspects and participation in this project!

A lot of different consulting projects deal with social aspects and participative approaches. In the following this will be demonstrated in detail.

Especially in the first concrete cooperation with the Chengtou Corporation Shanghai the users´ behavior regarding the energy demand is a very important element. Interviews help to evaluate if and how the inhabitants of the selected area comprising social housing deal with energy consumption mainly concerning cooling, heating and mobility. At the same time the project team analyzes aspects of relocation from the demolished traditional Lilong houses and other old existing buildings. This includes the monitoring of the users´ needs for comfort. This will be combined with a time period evaluation of the energy demand (see chapter 6.3).

II Integrate local stakeholders (focus participation) more than previously in your project!

The following local stakeholders took part in the previous activities (see chapter 3):

_Chengtou Corporation Shanghai: an agreement for the energetic evaluation of different research areas will be concluded presently.
_Shanghai Planning Authority (SPA): an agreement for the energetic evaluation of urban designs, alternative competitions drafts and the development of scenarios and energy-efficient alternatives will be concluded in the next few weeks.
_Shanghai Planning and Research Institute (SPI): there will be a partial cooperation in the context of the work for the Shanghai Planning Authority.
_Town Planning and Traffic Commission: the Commission has a great interest in the energetic assessment in order to develop general regulations for the Shanghai Region.
_Tongji University, CAUP and the Professors Pan and Zhuo: there is a close professional contact with the Tongji University concerning questions of mobility in the Shanghai Region. In addition the project team and the university detain workshops on an academic level including people from the planning routine.
_AHK/Econet: in cooperation with the AHK and Econet et al. four pilot projects in the context of the Ecobuild-buildings have been evaluated ex-post.

III Integrate important decision makers like the "Ministry of Construction" or the municipal level into your work!

After some initial problems the project team established contacts on the Ministry level in Beijing via the Ministry-assigned ACUP. The German CIM-expert Falk Kagelmacher who works at the AUCP has a great interest in cooperation with the project team. The first discussions show that the academy (AUCP) is very interested in an integrative consideration of mobility, urban form, and urban structure.

In order to achieve a better networking with the national energy research in the fields of mobility and buildings, dialogues took place with the German Embassy in Beijing with the aim to establish a direct contact between the German Federal Ministry of Education and Research (BMBF) and the MoST respectively the MHURD. The objective is an exchange

about the ongoing research programs in both countries in these subject areas. The Shanghai project touches on several levels political requirements and decisions, especially the topic of how global and national energy saving targets can be transferred on city or neighborhood level.

IV Specify the demand of your Chinese partner!

The previous discussions with the Chinese partners show that energy as a field of activity becomes more and more important. The main focus was on the building energy.

Less interest of the local political level exists in the reduction of energy demand and CO_2-emissions in the fields of mobility: It is not clear yet if there are enough saving potentials. The sympathetic respond of the department chief of the Town Planning and Traffic Commission to our question concerning the energy-efficiency of the public transport was: „However we expand the metro-net constantly....".

There is an obvious discrepancy between general political statements regarding global climate objectives and the daily local planning routine: the objective of energy-saving hasn't arrived at the operative level yet. Here, a large and continuous basic demand exists for education about objectives, methods, best practice etc., an eager task considering the already appreciable climate change (see chapter 6.2).

The direction of the Shanghai Planning Authority is already aware of the problem, but they fear that a consideration of energy-saving aspects reduce the general very rapid planning processes. The project team aspires to strike a balance between the validity of the executed energy calculation and the smooth cooperation with the SPA in the course of the typical work.

This includes an intensive preparation of the planning examples and especially a continuous presence and contact with the clients (see chapter 6). Altogether there is a constantly growing acceptance of the energy topic in conjunction with climate change.

V Calculate and integrate investment cots, maintenance costs and other relevant costs in your work!

The long term economic aspects are an important argument in the dialogue with the local agencies, politicians and investors in order to convince them that about the necessity of investments in energy-efficiency of buildings and mobility.

In order to strengthen this aspect and to connect it with the arguments for short-term cost saving and actions for climate protection, the evaluations in the building field have been extended to the life-cycle-analysis in cooperation with Prof. Dr. Alexander Malkwitz/ Construction Management within the Faculty of Engineering Sciences/University of Duisburg-Essen.

Other economic aspects possibly connected to this general question were not included in this work – for example the economic consequences of climate change for the Chinese national economy or the Shanghai Region, the health impacts in connection with global warming or the costs for measures for the adaptation of a city respectively the Shanghai Region to climate change.

VI Establish a clear reference between the working packages and the modules of the project; optimize the project coordination!

This question was immediately discussed between the project management and the project executing organization in the period from March till July 2008 and acceptably solved. This result can be found in diverse module graphics and working packages and is in the meantime effectually practiced (see chapter 3/Figure).

VII Strengthen the aspects in the project which deal with urbanization of rural areas; consider the importance of green open spaces in urban and rural areas in the scope of urban planning!

and

VIII Elaborate the benefit of the preservation of green open spaces considering climatic, agriculture and recreational aspects. Use the facilities a "megacity in statu nascendi" affords. The project should become a showcase for other Chinese regions with rapid urbanization processes.

Inner-city green open spaces are very important especially – amongst other things – regarding the urban climate (see chapter 6.2). The loss of previously green open spaces is the irreversible beginning of local climate change. Insofar this factor should be relevant in the first considerations of an urban planner.

Urban development concepts and land utilization concepts are potentials for necessary air lanes because green open spaces on strategic important locations absorb and balance the extreme heat waves in cities. Green and unsealed spaces do not heat up like sealed and dense parts of a city. They create "cold islands" in a heated city.

This affects the duration of air-conditioners which have a great influence in the warm summer months on the energy balance of Shanghai. Project observations show that the temperature in the city is higher at night than by day because thousands of residential air-conditioners used the entire night. The higher and more effective the cooling due to "cod islands", the faster a city can cool down in the evening.

The principle of densification of a city and resource- and surface saving construction must be proven in the context of urban climate. A balancing of interests and an appreciation of values is necessary in either case.

With regard to this, in most of the study cases, which are not planned and located outside of the existing urban pattern but are focused on the assessment and modification of existing concepts within the urban context, green open spaces have an important role in the mitigation of urban "heat islands".

The latest ExWoSt-study "Utilization of urban green open spaces for renewable energies" illustrates that urban open spaces also provide options for renewable energies. The study shows that cities have a great potential for "energetically useable surface" for the generation of renewable energies which now must reach the consciousness of the planners.

The planning approaches in this project integrate those analyses for Shanghai and are not only urban- and mobility-oriented. The open spaces are rather an important component of the overall strategy in terms of the above described aspects.

IX Encourage the project management and integrate external competences in the project evaluation!

The project leadership divided the project management into different parts like illustrated in the sketch (see Figure 1). For the different modules the responsibilities for the quality management and the leadership were defined. An advisory board was established as an external competence which comprises experts of different project topics (see chapter 3.4).

X Improve the innovative components: participation, improvement of the organizational structures and strategic consulting!

In all modules it is intended in the fields of consulting as well as planning of the module-specific projects to generate innovative proposals for innovation in the project, the process and strategies. Module 2 "urban systems consulting" includes strategic consulting in the range of optimization of organizational and planning processes. Such an innovative component is the „scenario manager" developed as an software by the partner PTV which is included in the EEC and enables the comprehensive and clear communication of the often unusual iterative approach to the Chinese partners.

XI Integrate socio-economic competences in your project which consider the demands of the civil society and the stakeholder!

Socio-economic aspects should be discussed by the convening of the China-expert Prof. Dr. Thomas Heberer of the chair of politics in East-Asia/Institute of East-Asia Sciences in the advisory board. With this socio-economic competence, the project or the project modules could gain a new dimension in certain fields.

XII Complement the academic oriented workshops and conferences by practice-relevant measures for capacity building!

At first the new scholarship-program of the DAAD with the focus on the megacity projects starting in 2009 has to be mentioned in this context. This program contains in particular the scientific exchange (Ph.D, Master, Senior Scientist etc.). A second call with the involvement of practical training is planned.

The invitation of Mr. XU for April 2009, which failed due to internal reasons (working load of the SPA due to the upcoming EXPO 2010), will be postponed until the fall 2009. Also invited for the fall 2009 is the chief architect of the Chengtou Corporation Shanghai, Dr. HU, in order to visit and view examples of energy-efficient urban developments in Germany and to have dialogues with comparable project developers and stakeholders (Hochtief, GAGFAH, etc.) in the fields of energy and -costs.

The workshop at Tongji-University – planned for September 2009 – will include both scientific experts and colleagues from the planning practice in Shanghai. Focus of the workshop is the public transport in Germany and best practice examples. In 2007 the project team organized a workshop in cooperation with the AHK in the pre-phase of the project to start a public discussion about the project approach and its effectiveness. Besides the representatives of the German economy also representatives of Chinese firms had an active part in this workshop. The project leadership will arrange such a workshop in cooperation with the AHK in spring 2010 if applicable in collaboration with the newly created ECEB-network (www.ecebnetwork.com).

Summary

Introduction

The project evaluates the Chinese Region of Shanghai. Even if this region is already a significant economic center, this region however integrates itself in the thematic context of the future Megacities: this metropolis expands steadily, the influx of rural population continues. Consequently new suburbs on the outskirts and New Towns in the surrounding area develop. Especially in these new urban formations it is essential to establish sustainable and energy-efficient urban structures to prevent the high increase of the consumption of fossil energy and of CO2-emissions.

An emerging country thereby faces other challenges than a developed country whose energy demand already reached certain saturation and therefore focuses first and foremost on savings by improving energy efficiency. Emerging countries on the other hand show a high backlog in comfort and economic and ecologic living quality which is so far directly connected with an increase of energy consumption and in particular with an increase of the consumption of fossil energy sources.

The project research should illustrate that a higher living comfort and higher mobility demands are also realizable with less energy input. The key is higher energy efficiency and the minimized input of fossil energy. Therefore the latest know-how of developed countries should be communicated and implemented in pilot projects. This report presents the work status up to April 30th 2009, the gained results and the challenges for the next project steps.

Objectives of the project

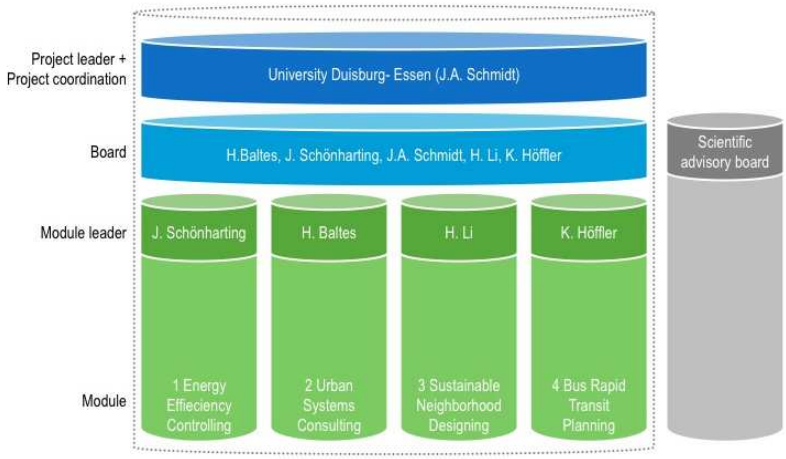
The project's aim is to contribute to the establishment of sustainable and energy-efficient urban structures in the Shanghai Region. Therefore single projects in Shanghai should be implemented and scientifically overseen in the planning- and realization phase. The results from the pilot phase should lead to recommendations and guidelines applied for an energy-efficient and sustainable urban development in the Shanghai Region (and also in comparable locations in China).

The project contains 4 Modules: 1. Assessment of energy efficiency with the help of a developed analysis- and control tool, 2. Consulting in the field of urban systems, 3. Planning and designing of a sustainable neighborhood, 4. Planning of a optimized public transport system with the focus on Bus Rapid Transit (BRT), which should ideally be implemented in an integrated way.

Project Structure

Direct project participants

In the project progress, the original project structure changed. Within the Chinese team a significant enlargement occurred. The Chengtou Corporation Shanghai (CC) as a major building contractor has been gained for the project. Within the German team important changes have occurred with Hamburg Consult (HC) leaving the project due to in-company and external reasons.



Project Structure; source: own exposure

The University-team on the German side (Prof. Dr. Malkwitz, Life Cycle Costs) and on the Chinese side (Prof. Zhou, public transport) has been reinforced. A networking with relevant Chinese energy research institutions is in preparation.

Overall due to these changes the German-Chinese team has been significantly strengthened in terms of the project objectives despite the withdrawal of HC.

Advisory Board

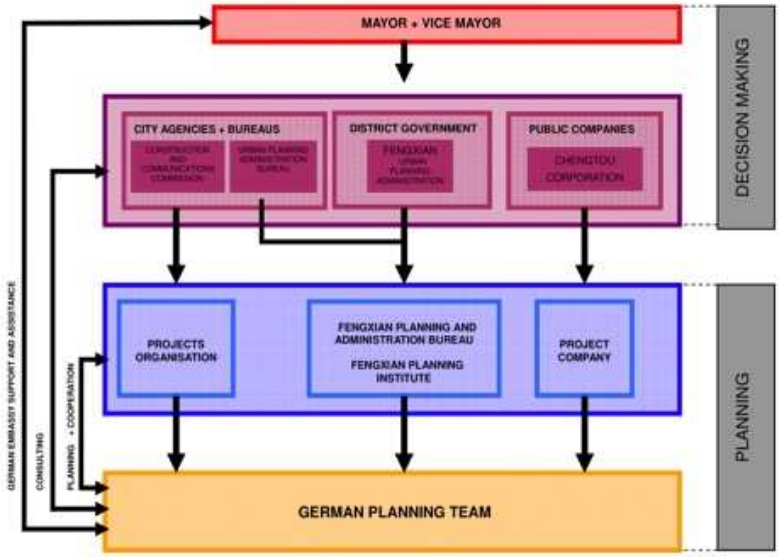
To initialize a quality management and a controlling function outside of the project team a scientific advisory board has been arranged. The advisory board is responsible for a regularly control and evaluation of the work of the project team from a scientific perspective. As members of the advisory team probably five sophisticated and respected scientists are assigned having adequate experience concerning the covered topics. This advisory board is currently in the start-up phase.

External organizational structures

Decision making level

The width of project topics leads to a large number of decision makers participating from the planning to the implementation of measures. Insofar the strategy of the project management was to win the Planning level (Urban Planning and Administration Bureau) and the Implementation level (municipal investor) for collaboration. In the fields of infrastructure and public transport the operational level is furthermore of high importance. Currently a deficit exists in this area which should be reduced in the further project progress.

It proved to be particularly difficult to establish contacts on the highest political level (Reform Commission, Mayor Level). The contacts on commission level are carried out by the assigned Department of International Relations, which on the other hand can only be contacted by the German Consulate in Shanghai and not directly by the project team.



Simplified overview of the organizational structures in Shanghai; source: own exposure

Project management aspires to diminish this deficit through a direct contact on Ministry level MOST and MHURD and the Research Institution CAUPD in Beijing. Also this contact can only be established by the BMBF and via the diplomatic path of the German Embassy in Beijing.

Networks

The project operates an intensive networking with other institutions and projects. There is an informal exchange with other Megacity projects (Urumqi, Young Cities, Casablanca, Ho Chi Minh City).

Within the University networks there are regular dialogues with the CAUP of the Tongji University in Shanghai.

In September 2009 a workshop with students and scientists in Shanghai is planned where different topic areas of the updated project and the Best Practice in the field of German/European public transport will be presented and discussed.

Work Status and Next Steps

Approaches for an Energetic Certification

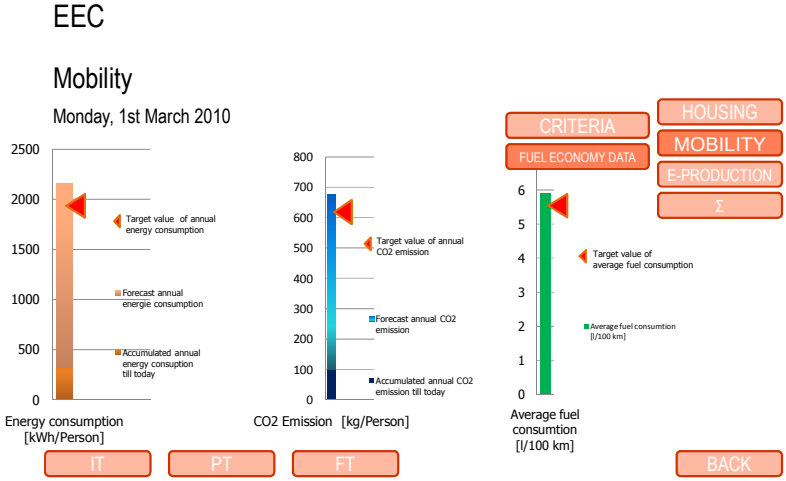
The previous experience with the Chinese partners showed that there is a high interest in statements about the energetic quality of buildings. Such an interest has also been declared in other Megacity projects (Teheran-Karay/Iran, Casablanca/Marocco and Ho Chi Min-City/Vietnam).

Less interest exists in corresponding statements about the quality of the mobility supply. As both aspects together will be of high importance for sustainable urban structures, the project team evaluated and discussed current approaches for the certification of buildings and infrastructure.

The analysis of existing certification systems could not identify appropriate solutions for these objectives. All approaches have a lack of the assessment of mobility. It is therefore necessary to develop an approach in this project which is easy to operate and comprises clear and less indicators. The EEC provides first hints in these fields.

Energy Monitor

The energy monitor should illustrate the accumulated energy consumption, the CO2-emissions, the production of renewable energy, the annual consumption forecasted from it and the annual target values for mobility and buildings. In the calculation all values are illustrated in total and in relation to people, groups of people, weight or surface area units.

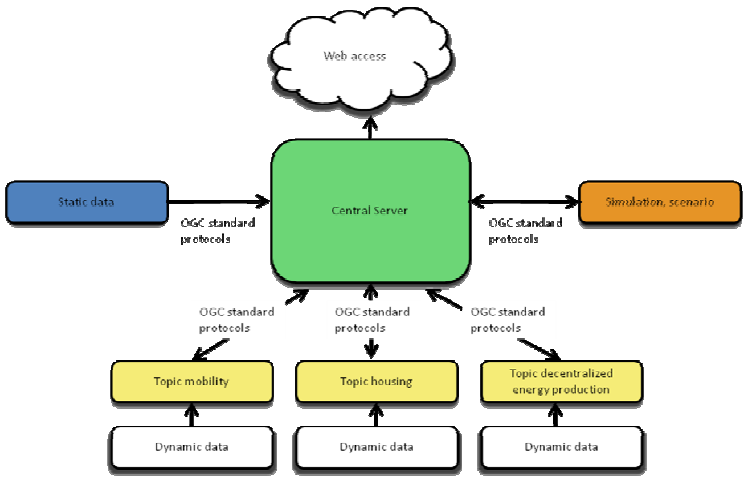


Reporting Example; source: own exposure

Within the project an initial draft for the Reporting was developed in the form of a PowerPoint-simulation in order to discuss the user-interface with the Chinese partners.

The previous Figure shows an extract from the reporting that depicts energy consumption, CO2 emission and average fuel consumption in the partial section of mobility on a certain day, based on the chosen indicators. Apart from the total values for the annual energy consumption or annual energy production, the calling up of daily values is also possible on the temporal level – and in the case of passenger service of hourly values as well.

The core of the EEC is the central server. All data flow into it, where they are processed and made available to the partners and published via an Internet interface. The server uses an Oracle database in which geographical data and parameters for the simulation or scenario administration are deposited. Data can be accessed on a daily or even hourly basis.



Server concept; source: own depiction

The methodical concept for the generation of target functions for the energy demand, the CO2-emissons and the production of renewable energy on small-scale level is still undecided. This gap, illustrating the strong political dimension of the topic, should be closed by the already described networking with the national Chinese research institutions and Ministries.

The cores of the previous project are the client specifications reports. In these documents, the requirements on the energy monitor are noted. All client specifications of the participants within the EEC development have been turned in:

Client specifications EEC TRC.1: TRC – total concept
Client specifications EEC ISS.1: ISS – building utilization
Client specifications EEC PTV.1: PTV – traffic situation
Client specifications EEC TFG.1: TraffGo – traffic flow simulation - street
Client specifications EEC AVI.1: AVISO – energy consumption calculation
Client specifications EEC ABS.1: Abstracture – server concept

For a first system trial the Xinkai area in the north of Shanghai in the Sonjiang district has been chosen. It is a residential area with approx. 15.000 inhabitants and a commercial area. Two metro lines are tangent to the development area which will be inhabited by residents who will be relocated from the city center by the end of 2009. The data acquisition has begun. Later also areas with the focus on other uses will be analysed.

The focus of the next steps is the development of a software concept. The coordination process took place on interface level. It is apperent that the further discussions will require a re-design. It can be expected that special requests regarding the reporting will require modifications.

Urban Systems Consulting

The Town Planning and Traffic Commission requested consulting within this module for energy-related topics which are partly related to the EXPO 2010.

With the Urban Planning and Administration Bureau Shanghai (SPA) consulting topics regarding energy have been discussed, which will be stipulated in detail in the next few weeks within a contract.

The main focus is on the consulting regarding energy efficiency calculations of urban designs in the fields of buildings, mobility and urban form. Also applications in the field of competing urban designs or competitions have been discussed. The SPA insists on the integration of these analyses in the Shanghai-specific rapid planning processes.

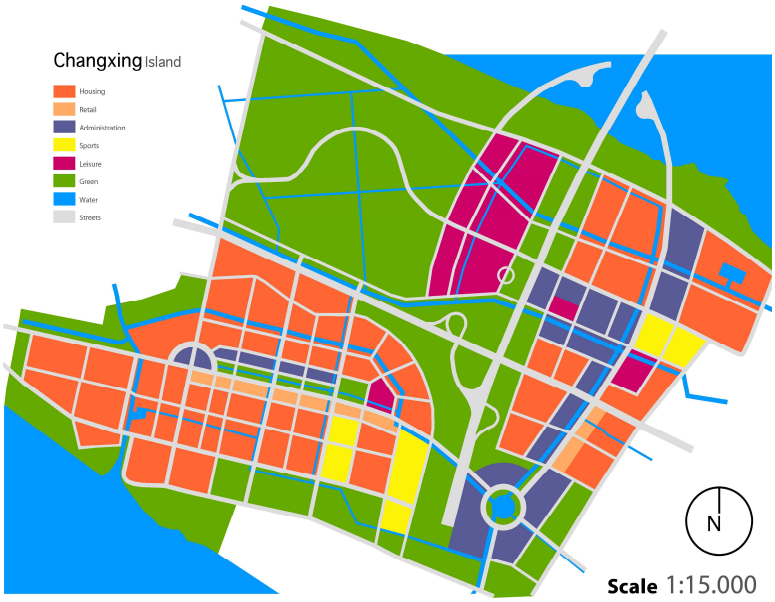
The Consulting service also comprises the evaluation of open space planning which is also directly connected to the energy- and CO2-balance: urban development concepts and land utilization concepts are potentials for necessary air lanes which also absorb and balance the extreme heat waves in the City.

The latest ExWoSt-study “Utilization of urban green open spaces for renewable energies“ illustrates that urban open spaces also provide options for renewable energies. The planning approaches in this project integrate those analyses for Shanghai and are not only urban- and

mobility-oriented. The open spaces are rather an important component of the overall strategy in terms of the above described aspects.

Changxing Island

The collaboration with Chengtou Investment Corporation led to a partly assessment and optimization of the project New Town Changxing Island, an island in the Yangtze delta with approx. 90,000 inhabitants. The current planning of the Chengtou Investment Corporation was assessed according to town planning criteria, mobility and energy consumption. Afterwards, an alternative scenario was developed that kept the basic conditions and structures of the existing planning but indicated optimization possibilities in some points that would lead to a qualitative upward revaluation of the city and also to a more energy efficient mobility.

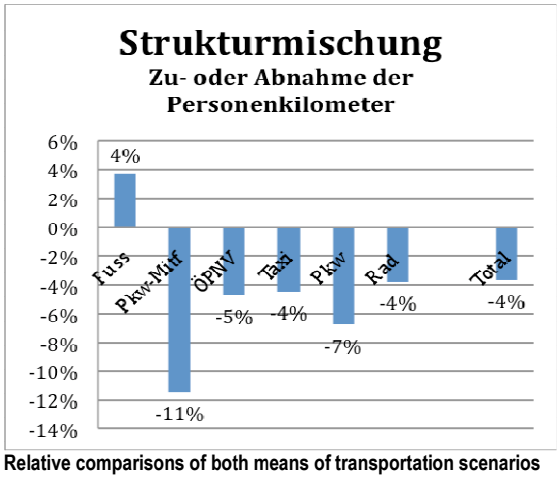


Use distribution according to master plan, source: own exposure

The plan for the Fenghuan New Town was assessed according to a town planning point of view. Apparent weaknesses in the draft were the clear division of functions in the individual cells as a result of which no meaningful mixture of use was achieved. Furthermore, the city was not built depending on the important traffic axes or the public transportation network. Both resulted in the streets within the urban area to become longer, the non-motorized traffic to become less attractive. Thus, the urban structure made it harder for public passenger transportation to achieve an attractive and extensive coverage.

These facts show that, regarding a sustainable and energy efficient urban development, this plan still contains improvement potential which has been implemented in an optimized design alternative.

The improved mixture of uses in the optimized alternative design leads to a reduction of the path lengths within the island. For all means of transport there is a reduction of the path lengths. The highest decline appears in the motorized private transport. On the other hand the pedestrian-kilometers increase due to the higher pedestrian ratio.



Relative comparisons of both means of transportation scenarios

Additional urban and traffic measures such as increase of building density, improvement of bicycle paths, improvement of short-distance public passenger transportation choices, etc. are another general measure to prevent traffic as are targeted reductions of motorized individual traffic.

Energy Calculation for Buildings

The building energy demand has been systematically calculated for both alternatives using a geographical information system (GIS). Alternative approaches (Shanghai Standard, EnEV with Shanghai U-values and new EnEV 2009 with improved U-values) have been chosen, firstly to evaluate the differences in the results and also to illustrate saving potentials.

With the help of the GIS-approach the energy demands could be determined efficiently – also for alternative approaches. Nevertheless questions remain about the different calculated results which will be evaluated in detail as the project progresses.

Final energy demand according to the Shanghai standard (residential/non-residential buildings); source: own exposure

Planning and Implementation of an urban neighborhood

Energetic Assessment of the Ecobuild-Buildings

In Shanghai at the end of 2006 several so-called Ecobuild-buildings have been constructed according to German energy standards as Low-Energy-Buildings and put into operation. The energy calculation for two of the Ecobuild-buildings served (in close cooperation with the AHK/Shanghai

and Econet) as test runs and entry into the real Module objective, namely the planning and implementation of an urban neighborhood.

By this means the planned and actual energy consumption should be evaluated, energy savings and the dependence of energy demand from the components building envelope, systems engineering, energy sources and especially the users' behavior should be illustrated. The Ecobuild buildings represent new and existing structures, different building types, building uses, building technologies and energy sources. The energy efficiency evaluation of the Ecobuild buildings also serves as a test for the data acquisition and analysis, as a benchmark for the target value assessment in the building area and a useful test for the EEC.

The new Pujiang Intelligent Valley (PIV) business park and the renovated office building of the Tongji-University have been analyzed. The main focus was the evaluation of the user behaviour.

The calculation of the energy demand is – like for the Changxing consulting – based on the "Energy Conservation Design Standard for Residential Buildings in Shanghai" (DG/TJ08-205-2000) and on the German Energy Savings Ordinance (EnEV).

The Shanghai standard calculates only the electricity demand for winter heating and summer cooling and must therefore be modified with regard to other energy sources. The standard assumes a 32-day heating period and a 58-day cooling period, thus becoming apparent that the comfort level is very low (especially in the summer) and that the energy demand for cooling is more important. Generally speaking, however, this standard depicts the building sector, the users' behavior and therefore the actual energy consumption in Shanghai very accurately and realistically.

When using the alternative calculations according to the EnEV, however, the calculation must be modified according to the specific local climate conditions and the users' behavior (heating and cooling days, ventilation, external and internal temperature in summer & winter).

The Pujiang Intelligent Valley (PIV) business park consists of research and development facilities and offices. The evaluated egg-shaped building has a floor space of approx. 2,400 sq.m and a usable space of approx. 9,900 sq.m. The building uses geothermal power for heating and cooling and incorporates several modern and energy-efficient building technologies.

According to the building proprietor calculations, the heating energy demands should be 243,300 kWh/a, and the cooling energy demands 487,000 kWh/a. In reality 64% less energy is consumed for heating and cooling resulting from the lower comfort demand and the users´ behavior. The lower demand for electricity results from the still incomplete occupation.

WenYuan building: Renovation of a 1950s office building

The WenYuan building is a public building under historical monument protection from the 1950s, used by the College of Architecture and Urban Planning (CAUP) of Tongji University. It was renovated in 2006. The building draft was drawn up by Tongji University, and IGS advised in the working out of the concept. The integrated renovation included a significant improvement of the building shell (heat insulation), the safeguarding of an energy- efficient supply and the use of various kinds of renewable energy (geothermal power). The requirements of the future

building user regarding the layout and the thermal, visual and acoustic comfort demands were set at the start of the project.

View and location of the WenYuan building of Tongji University

As in the Pujiang building, the Shanghai standard and the EnEV were taken as basis and correspondingly modified in the energy demand calculation.

According to the proprietor's calculations, the heating energy demand should be 125,000 kWh/a, and the cooling energy demand 175,000 kWh/a, i.e. 1.4 times of the heating energy demand. The target consumption corresponds almost completely to the actual consumption.

In the *calculation according to the Shanghai standard,* the heating energy demand is relatively realistic, but the cooling energy demand is too high. In the *calculation according to the EnEV a,* the calculation results for heating and cooling differ completely from the actual energy demand. Only the calculated final energy demand for heating corresponds to the actual consumption. In the *calculation according to the EnEV b,* the calculated value for the heating demand is closer to the actual consumption than in the EnEV a, the value for the final energy demand for heating is however too low.

Generally speaking, the calculation shows that this public building uses relatively little energy for heating and cooling if square meters are taken into account (desired = actual: 40.5 kWh/m²a), but an additional energy savings of about 15% could be achieved if the U-values are observed.

The calculations according to the Shanghai standard correspond rather closely to reality regarding heating and cooling energy demand, while the calculation according to the EnEV a correspond rather closely to the target value obtained by the proprietor. The modified EnEV b lies between the actual and the target value. For the subsequent approach – i.e., during the analysis of the Chengtou buildings and the EEC – the Shanghai standard and the modified EnEV (EnEV b) are thus taken as basis. The EnEV calculations cannot be renounced because the EnEV contains specifications about the Final- and Primary Energy Demand, the specific HVAC-systems, the auxiliary energy and the individual building components.

Within the consulting service stipulated with the Chengtou Corporation Shanghai in February and April 2009, an energy efficiency assessment will be executed for different already implemented and planned urban neighborhoods with recommendations for improvement with regard to life-cycle-costs as a basis for the definition of new quality standards.

These urban neighborhoods will be implemented with their data – as already described – in the EEC. They therefore will be available for a continuous energy efficiency analysis and -control.

Public Transport in Shanghai with focus on BRT

In the fields of public transport since the beginning of the project fundamental decisions on political level lead to a renunciation of the BRT-activities: in the original planning area of Nanqiao the director of the Planning Administration Bureau (FPA) has been relocated to another City as Vice Mayor leaving the FPA without a director. Different developments within Shanghai lead to the decision to force the development of the metro-system instead of the BRT-system. This decision as well as the introduction of a LRT-line (to be opened in 2009) shows that the important component of an attractive public transport must be examined and implemented in a different way.

Main focus should be on the optimization of the bus system with its' internal connections and the connections to the other means of transport (intercity railway, airport, metro, LRT, taxi, bicycle, car). This general approach will be transferred to the neighborhood level. By this means it is possible to assess the energy efficiency on neighborhood level also for mobility. With the optimization of the connections as well as other components also here efficiency improvement potentials can be demonstrated and if necessary implemented.

In the run-up the project team evaluated the development status especially of the bus system in Shanghai, the stakeholders and the funding structures.

With the planning and realization of a public transport line far more planning authorities and therefore more decision makers are involved. These decision- and collaboration-structures, which should be known in order to achieve an implementation of planning proposals, have been examined. In this module in addition to technical, economical and organizational issues, the specific requirements on fuel supply are evaluated which should be designed in an ecologically compatible way.

The circumstances in Shanghai are often unclear and less transparent. Already in the planning phase a large number of administrative departments are involved, which are responsible for all technical, economic and contract decisions, the careful consideration of different interests and the organization of the cooperation with private companies.

In Shanghai the Urban Planning and Administration Bureau, the Urban Planning and Design Research Institute and the Urban Planning and Traffic Commission play a decisive role in the planning process. Also relevant are environment-relevant departments and administrations responsible for energy issues. In more complicated cases, especially with the introduction of a new system, the creation of project groups has proved to be beneficial with the collaboration of all responsible administrative offices. The knowledge of the decision makers involved in planning and implementation should be used for the further evaluation of the topic "public transport with a higher attractiveness".

Due to the modified project definition the partner Hamburg Consult will leave the project because the new focus does not correspond with the company's objectives and tasks. If no substitute partner can be found for

Hamburg Consult, the project recommends to assign the University with most parts of this module; single topics which demand a specific know-how however will be awarded to external experts.

Trips, Dialogues, Contacts

In 2008 and 2009 several trips with different people took place.

Within the German project team a series of meetings and dialogues with the cooperative partners in the modules and with the entire team was necessary. In order to keep the partners up-to-date on a regular basis, newsletters will be sent by project management informing about the most important activities and developments.

Thus, the project website has been re-established as required and continuously updated and expanded (www.megacity-energy.de).

Apart from the website, several flyers and information brochures were designed in three different languages (German, English and Chinese) which make the project known to a wider public.

In the University area three DAAD-students (Megacity-Program) (two as PhD-students, one Master-student) have been integrated in the project.

The project will participate on the European Climate Teach-in Day (05.06.09), a Europe-wide online-event for school students about the climate change topic, with a Powerpoint presentation. A further presentation took place within the conference Real CORP in Sitges/Span in April 2009 about the topic “Sustainable Development of Megacities: Energy-Efficient Structures for the Shanghai Region – the Fengxian Enxample”. In 2009 a further participation at the conference „Cities for Mobility” in Stuttgart is planned.

In September a further workshop with the Tongji-University and with other Megacity projects at the end of October is intended.

Challenges

A very distinguished challenge in is the complexity of the project topic.

Another challenge is the data acquisition. This challenge is already solved and on a good way.

Due to the rapid urbanization in China, re-organizations and re-structuring of responsibilities on political and planning level often occur. The project team witnessed this within the project both on the level of the Fengxian District and the Shanghai Region.

Time- and work-schedules

Time- and work-schedules of the project remain in comparison to the application almost unchanged. There is only a small temporal delay based on a different project start, which will not effect the final deadline.

The Module “optimized public transport system with focus on BRT” had to be adjusted due to the modified project task.

CONTENT

1 Introduction

The project evaluates the Chinese Region of Shanghai. Even if this region is already a significant economic center, this region however integrates itself in the den thematic context of the future Megacities: this metropolis expands steadily, the influx of rural population continues. Consequently the city center gets more and more dense and at the same time the city steadily grows towards the suburbs. The Shanghai Administration therefore set up a development concept for the region planning nine satellite cities around the City of Shanghai which mitigate the population growth to Shanghai and exculpate the city. These so-called New Towns however are built without context to existing urban pattern ort he existing employment situation. These towns are a good chance to establish sustainable and energy-efficient urban structures which result in short distances and less traffic. This structure can be complemented by an efficient (public) transport system to prevent a high increase in private transport and by modern buildings complying with latest standards regarding energy efficiency so that a high comfort level with a low energy demand can be guaranteed. By this means the attractiveness of the new towns can be enhanced and incentives can be created fort he future inhabitants.

Since the worldwide economic crisis, also in China the construction boom and therefore the rapid and partly inconsiderate development of New Towns decreased. The construction boom in Shanghai slightly decreased and the pressure to supply large quantities of residential space within a short period of time declined. This enables a long-term planning in the fields of urban development.

Also in China the private investments decrease and many construction projects are delayed, downsized or entirely cancelled. Therefore “economic stimulus packages“ have been resolved to boost the economy. In the Public Transport sector e.g. expensive and labor-intensive solutions are preferred in order to create short-term employment.

In Shanghai a stagnation processes is apparent, even though in 2010 the EXPO takes place. In the course of the EXPO many construction projects – especially infrastructure projects – are implemented, but the development in the peripheral areas significantly decelerated.

Therefore the project team dealt with the impacts of the economic crisis in a long-term as the realization of the Modules 3 & 4 depends on investments and the long-term planning in urban development. This context shows how much the project progress depends on current developments and political decisions. Due to the current circumstances it is necessary to question the previously assured decisions and if necessary to modify parts of the project contents and adapt these to the latest conditions.

2 Objectives of the project

2.1 General objectives

The project’s aim is to contribute to the establishment of sustainable and energy-efficient structures in the Shanghai Region. Therefore single

projects in Shanghai should be implemented and scientifically overseen in the pilot phase and if necessary optimized. Ideally the results from the pilot phase should lead to recommendations and guidelines to be applied for construction and planning in Shanghai.

The project contains 4 Modules: 1. Assessment of energy efficiency with the help of a developed analysis- and control tool, 2. Consulting in the field of urban systems, 3. Planning and designing of a sustainable neighborhood, 4. Planning of a optimized public transport system with the focus on Bus Rapid Transit (BRT).

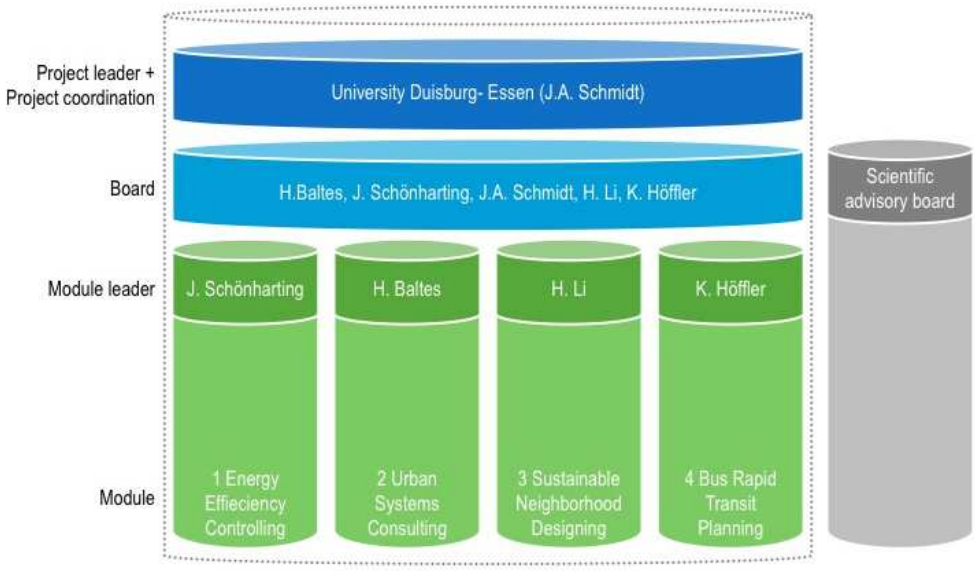


Figure 1 Project Structure; source: own exposure

Besides the investigation and analysis of the "State of the Art" in the area of urban planning, mobility and the building sector in China / Shanghai as well as in the area of the German policy on subsidies in the area of energy-efficient buildings, an important partial objective is to gain experience and knowledge in the data provision, data analysis and data processing, in the energy demand calculation of buildings, in methods as well as in handling the planning and implementation of an energy-efficient urban district.

2.2 Module 1: assessment / controlling of energy-efficiency

With the development of the EEC an analysis and forecast instrument will be created which enables the comparison of the energy consumption of the main consumer groups – mobility and buildings –, the production of renewable energy and a target function. In addition the EEC should enable scenario calculations supporting the political decision makers to illustrate the effects of measures, in particular concerning the energy consumption.

To serve as a regulation instrument, a political target function must be assigned to the EEC. The objective is therefore to work towards a definition of suitable indicators and their time-spatial progress on political level, without misunderstanding this as paternalism by a foreign research

team in Shanghai. It is therefore indispensable to discuss the further steps for the development of the EEC with the policy makers and the national research institutes and to transfer the general political specifications regarding energy saving and reduction of CO2-emissions in operational principles for urban and mobility planning.

In addition to this political objective, the technical objective is to develop a functioning dynamic system for an energy efficiency analysis in a consortium of companies and science which can be used for other applications in the urban space, also in Germany.

Finally, the scientific objective should be pointed out. Up to now spatially and temporarily differentiated analyses concerning the complex parameters influencing the energy consumption are rare. It is expected that with the use of the EEC for a certain time period new knowledge can be gained about the interrelation between the technical supply and user's behavior helping to improve the basis for forecasts in the future.

To sum up, the EEC is an analysis instrument which enables a target/actual comparison. In addition strategies can be presented which can be used if the targets are not achieved. By this means, different scenarios can be developed supporting the decision making process of political and technical committees. In this respect the ECC also contains a regulation function which allows interventions using the governmental regulation framework.

2.3 Module 2: urban systems consulting

In this Module the main focus lies on the knowledge transfer between Germany and China regarding concrete applications and issues from daily planning routines. Current issues in the Shanghai Region should be analyzed based on the latest state of the art. New knowledge and innovative, sustainable and – in term of the project idea – CO2-reducing solutions can be generated within the cooperation between the German and Chinese partners. Besides, the German team can gain a better insight into specific issues and needs of the Chinese partners in politics, construction and administration. Therefore, the associated cooperation with different local partners guarantees that the project will meet the requirements and wishes of the Chinese partners.

Furthermore the consulting should help to communicate the methods and integrated approaches in close cooperation with the local and regional planning authorities and commissions. It is still a big problem, that the necessity to save energy is not generally recognized and implemented in China. At the moment – especially in connection with the financial crisis – the main focus lies on economic growth and economic prosperity. Hence, a lot of effort must be invested into raising awareness of investors and politicians for the fact that a long-term growth is only possible under stringent inclusion of sustainable principles, energy efficiency and comprehensive CO2-reduction.

There is in view of the threatening economic- and climate crisis furthermore the chance of connection. The economic crisis could provide a chance for the mitigation of environmental effects and the adaptation of the cities to the effects of climate change. Long-term and high following costs emerging from neglecting energy efficiency and sustainability could be avoided by now by the use of an appropriate connection.

2.4 Module 3: sustainable neighborhood designing

The main objective of this Module is to accompany the development and implementation of an urban district under the aspects of urban planning, traffic planning and building planning in the direction of energy-saving structures to reduce the specific energy consumption and to force the adoption of renewable energy without limiting the mobility and the residential comfort of the inhabitants.

The Module aims at designing an energy-efficient, i.e. mixed use, dense, walkable, bicycle- and public transport-friendly, comfortable, accessible and high-quality urban district.

It is expedient and clear that the project does not aim at a complete new development of an urban neighborhood as a “Greenfield” development. It is rather intended in view of the already planned New Towns and urban neighborhoods in the Shanghai Region that the project integrates itself in these existing planning and modifies the according objectives in cooperation with politics, the planning authorities and the investors. Intervention is the keyword and not comprehensive re-planning, revision of existing planning to reduce CO2-emissions and sustainably design with the integrated approach. The aims is therefore the design of an energy-efficient, i.e. mixed use, dense, walkable, bicycle- and public transport-friendly, comfortable, accessible and high-quality urban district.

Important preliminary work has been operated in the development of a universally applicable “action manual” as an "aid" for the planning of energy-efficient neighborhoods. Thereby the transferability on other projects or other urban areas is guaranteed. This development should be recessed with the superior responsible parties like e.g. the commission for construction and traffic with which conversations have already been held.

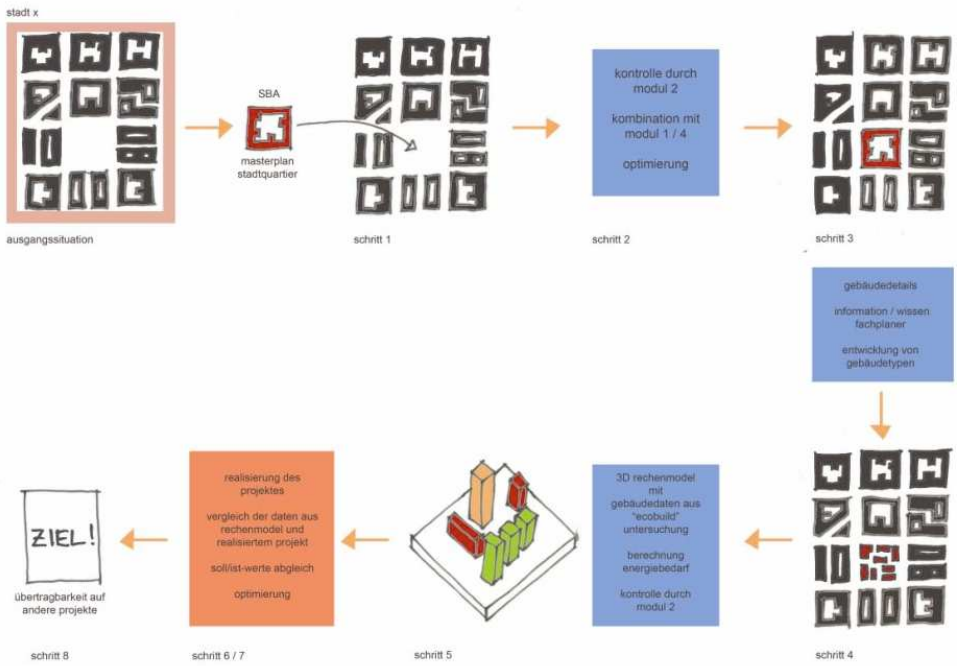


Figure 2 Process diagram Module 3; Source: own exposure

In the building area draft criteria should be developed for the minimization of energy demand and the improvement of the thermal comfort level in buildings. Therefore first building analyses were carried out exemplified by two Ecobuild buildings regarding the energy demand. By this means experiences were gained and important preliminary work was operated concerning data provision and data analysis (quantity, quality), the expenses and complexity of the energy calculation, the analysis of the influence of the specific user's behavior in Shanghai, of the climate conditions, of the systems technology and of the building insulation on the energy consumption. Additionally an optimal calculation basis should be found in executing and modifying energy calculations based on the Shanghai- and the EnEV-standard.

In analyzing single buildings in terms of energy consumption, first knowledge has been gained concerning the target function development or possible limiting values for new construction and existing buildings (passive house standard).

A further objective besides selective energy demand calculations of buildings were energy calculations with the help of a Geo Information System (GIS) for an entire neighborhood or a district in which different building types and building uses are located. Using GIS-applications an automation of the energetic analyses of buildings should be enabled. These GIS-based calculations constitute an important element for the EEC as well as an important basis for the test run of the EEC.

Furthermore knowledge in the area of the decentralized and building-integrated energy production should be gained. Also here the Ecobuild buildings served as an important test field.

A very crucial objective was the establishment of cooperation with an investor, which was successfully achieved with the Chengtou Corporation Shanghai in the building area and will be officially regulated in April.

A new objective is the analysis of the economic efficiency of buildings. Especially towards investors the first investment barrier should be minimized in demonstrating that energetic and economic efficiency do not exclude each other. It also should be clarified that energy-efficient construction – contrary to the common construction practice in China – is a construction for more than 10 – 15 years.

2.5 Module 4: optimized public transport system

The project team is firmly convinced that public transport plays a key role in transforming Shanghai into an energy-efficient and sustainable megacity. In order to reduce the undesirable and climate relevant motorized private transport, the attractiveness of public transport must be increased.

Within the scope of this Module the positive influences of the public transport on energy efficiency of a town should be identified and optimized. Therefore an exemplary recently implemented public traffic line (metro line, LRT-line, BRT- or bus line) is outlined. This line is analyzed and assessed according to environmental effects and energy efficiency. The objective of the project team is to optimize the energy efficiency of the public transport exemplified with this line. Two fundamental approaches can increase energy efficiency:

_Recommendations of the project team indicating the methods to achieve an increase of attractiveness of this line. By this means, a higher capacity ratio of the line and a higher occupation ratio of the vehicles can be achieved. Thereby the energy expenditures per passenger kilometer decrease.

_Recommendations of the project team indicating the methods to technically reduce the energy consumption of the line. Therefore the optimization of the vehicles, of the control and communication system and/or the routes is qualified.

The evidence of an improved energy efficiency and reduced CO2-emissions will be provided first as an “ex ante”-statement using the EEC and – after implementing the modification proposal – empirically verified.

3 Structure of the project

In this chapter the current project structure as well as the competences of the different (network) partners are explained. Within the Chinese team a significant enlargement occurred. Within the Chinese team a significant enlargement occurred. The Chengtou Corporation as a major building contractor has been gained for the project which directly aims at implementation of projects. Within the German team important changes have occurred with the Hamburg Consult company leaving the project due to in-company and external reasons (see Chapter 6.4).

3.1 Cooperative Partners

University of Duisburg-Essen / Institute of City Planning and Urban Design

The Institute of City Planning and Urban Design of the University Duisburg-Essen (ISS) forms the project-leading team; here the project management and project coordination is allocated. The content aspects of the project as well as the organizational work are coordinated by the ISS. The ISS is in close cooperation with all further involved partners (German and Chinese) of this project. Besides, the University of Duisburg-Essen is a leading coordinator of the EEC and also provides an adequate data management.

The University of Duisburg-Essen is equally involved in all four Modules.

TraffGo Road Ltd

TraffGo Road GmbH deals with the simulation and optimization of traffic flows, e.g. for the traffic management. Within the research project TraffGo Road GmbH works on the microscopic simulation model for a traffic forecast in the component "traffic" within the Module 1 (EEC) and is responsible for archiving. Additionally TraffGo Road GmbH determines input data for the energy consumption calculation in the field of traffic.

AVISO Ltd

The AVISO Ltd Company is involved in Modules 1 and 2. Within Module 1 (EEC) AVISO is responsible for the calculation of the energy consumption of the motorized traffic in the field of mobility. All motorized modes of transport are captured with exception of air traffic.

For the large-scale calculation of the energy consumption a "traffic planning model" (PTV) is applied. For a small area a microscopic simulation model (TraffGo Road) is used providing more differentiated parameters of the traffic flow for the energy consumption model.

Data for the current fleet composition are taken in semi-annual cycles from the existing statistics (SBA China). In the public transport the energy consumption is determined based on the driven routes and the used coach types / trains.

The energy consumption model should be used in the project process within the scope of concrete analysis and projects in Module 2.

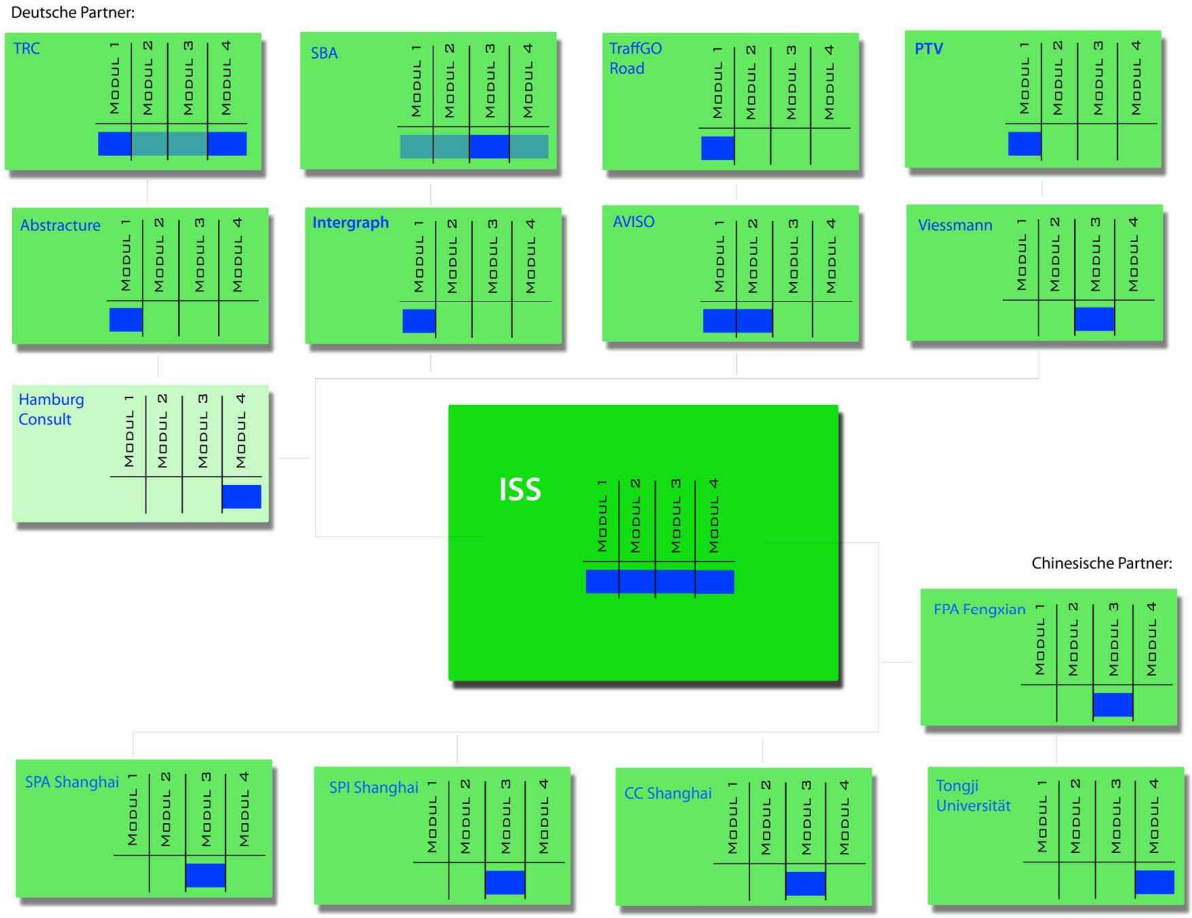


Figure 3 Overview of the project partners; source: own exposure

PTV AG

Within the scope of the Module 1 PTV AG provides a central functionality group for the calculation of the energy consumption in the fields of mobility.

The PTV AG provides basis data to AVISO and TraffGo for their calculations which are generated on the basis of the present models and methods. In this case it concerns data about the energy consumption of the single modes of transport and traffic information which will be further analysed within the scope of computer-aided microscopic calculation methods.

Hamburg Consult Ltd

Hamburg-Consult as a specialist for traffic consulting and traffic management and specified on the local public transport is responsible for the entire Module 4 “optimized public transport system with focus on BRT“.

Hamburg Consult agreed on cooperation mostly with regard to a concrete planning for a BRT-system, also to feature such a project in their portfolio for acquisition reasons. Because of the fact that the current developments don’t allow a solely BRT-oriented public transport planning and with regard to therewith occurring internal balance problems, Hamburg Consult announced the pullout of the project in April 2009 (see chapter 6.4).

3.2 German Partner

TRC Ltd

Within the project the Transportation Research & Consulting Ltd (TRC) is represented in all four Modules. Besides, the most extensive responsibilities were adopted for Module 1 and 2. In these Modules TRC is responsible for the quality control as well as for the project management. Because of these responsibilities TRC cooperates with all involved in this Module especially in Module 1. In the Modules 2 and 3 TRC offers consulting for all traffic- and transportation-related issues. In addition TRC is a member of the steering board.

SBA International

SBA international is an office for urban planning and architecture with locations in Stuttgart and Shanghai. Within the research project on the one hand SBA is responsible for the coordination between the project partners in Germany and China and on the other hand is conducive, as a direct project partner, to the elaboration and realization of Module 3 “sustainable neighborhood designing” and Module 4 “optimized public transport system with focus on BRT”.

Among others, the main activities refer to:
_Translation of reports, protocols, correspondence and general inquiries of the project partners
_Data transfer between Chinese and German project partners
_Organization of meetings in China for the different project partners
_Acquisition, collection and transfer of basic data in the area of mobility, housing and living
_Providing contacts/new project partners for the German project team.

Within the Module 3 SBA primarily works together with the Institute of City Planning and Urban Design of the University Duisburg-Essen. The objective of the Module and therefore of the project team is to modify and accompany the planning for an urban neighborhood according to our objectives in cooperation with the Shanghai Urban Planning Administration Bureau, the Fengxian Urban Planning Administration Bureau and with other relevant stakeholders (e.g. investor). By the means of this pilot project strategies and concepts for the reduction of the increasing energy demand on different levels (neighborhood and building) should be developed.

These activities refer to:

_Acquisition and assessment of data in the area of housing and living (i.e. data acquisition of Ecobuild buildings as a basis for other calculations),
_Analysis and optimization, modification of an urban design master plan.

Abstracture Ltd

The Abstracture Ltd is responsible for the development of the central server in Module 1. This task contains the elaboration of a concept as well as the installation and implementation of the system. Besides, Abstracture might be responsible for the software-technical maintenance of the system in the further process of the project.

Intergraph Ltd

Intergraph (Germany) Ltd provides engineering-solutions, geo-information systems and application-management-system for data demonstration and data analysis and consults the project team in terms of using GeoMediaPro. In China Intergraph Ltd. Shanghai provides the GeoMedia GIS-software. Intergraph supports the system transfer and is also responsible for the establishment of the data base (digital city) within the scope of the Module 1.

Viessmann

The Viessmann group of companies is one of the international leading manufacturers of heating technology systems. With twelve factories worldwide – also in China – Viessmann is internationally oriented. The Viessmann company has joined the project at a later date. Up to now their responsibility was to show the energy-saving potential of modern house technologies and different construction methods using model calculations. A further cooperation might be possible especially in the field of Module 3.

3.3 Chinese Partners

Tongji University

Contact person: Prof. Haixiao Pan, Prof. Chen, Prof. Jian Zhuo

At the Tongji University Prof. Pan Haixiao, PhD, Director of Land Use Transport Studies at the Department of Urban Planning, College of Architecture and Urban Planning is available as an advisory and supporting research institution for the project. In that way the project has constant access to Chinese scientists and is able to pick up current development and data for the project work.

Both other contact persons also work in the transport sector. Mrs. Pro. Cheng has written a study for BRT planning in Shanghai which is incorporated in this project.

Beside the activities at the university Mr. Prof. Zhuo works at the company Veolia Transport so that the project can account for contacts to economic companies in Shanghai. Especially in the implementation phase cooperation can be generated.

Urban Planning and Administration Bureau Shanghai (SPA)

Contact person: Hr. Xu (director), Mr. Xia, Jian Zhong

Shanghai Urban Planning Administration Bureau (SPA) is the higher authority for the Shanghai Region. The SPA has the decision taking authority if planning should be changed or new projects are planned. Besides, the SPA supports the project team in the decision-making process at the political level. A processing of projects in the Shanghai Region can only be successful in agreement with the SPA.

At present the SPA is highly interested in the calculation of the energy efficiency and the mitigation of CO2-emissions of urban planning (including the planned building types). The SPA is therefore about to arrange data fort he planned areas. A contract with the SPA is being prepared.

Fengxian Urban Planning Administration Bureau (FPA)

The Fengxian Urban Planning Administration Bureau (FPA) was a central public facility for the pre-phase of the project in the Fengxian District and the District capital Nanqiao. With the continuation of the project in August 2008 radical changes within the FPA occurred: the director of the FPA has been transferred to another important district of the Shanghai Region, several other persons since then bridge an interim period justified mostly with the time-consuming re-organization of the department responsibilities (District- and City Urban Planning Administration Bureau are being merged). Also party-political reasons can be pointed out. Furthermore it became clear in the dialogues with the FPA that the development pressure declined in this district also due to the economic crisis.

Insofar the project team is – in cooperation with the SPA and the Chengtou Corporation (see below) – at present in negotiations for an alternative planning location.

Shanghai Urban Planning and Design Research Institute (SPI)

Contact person: Hr. Liu

The Shanghai Urban Planning and Design Research Institute (SPI) is an independently working planning office which supports the FPA with the approval and realization of urban planning. In is planned that the SPI (as in the pre-phase) will be a competent dialog partner for the German project team which consults and supports the team. The institute is also an important provider of data and information.

Chengtou Corporation Shanghai (CC)

Contact person: Hr. Dr. Hu

The Chengtou Corporation Shanghai is one of the biggest investors in Shanghai and is strongly involved in the project. The CC has a big interest in a sustainable and especially energy-efficient urban development and provides for single buildings and neighborhoods with different building types important data for the calculation of energy efficiency. Partly this data covers New Towns where also the mobility topic is included.

In the dialogues with CC the topic “life-cycle-costs” has been more emphasized within the field of energy efficiency. For this topic the project team is supported by Prof. Dr. Alexander Malkwitz/Construction Management within the Faculty of Engineering Sciences/University of Duisburg-Essen.

3.4 Advisory Board

To initialize a quality management and a controlling function outside of the project team a scientific advisory board has been arranged. The advisory board is responsible for a regularly control and evaluation of the work of the project team from a scientific perspective.

As members of the advisory team five sophisticated and respected scientists are assigned having adequate experience concerning the covered topics.

This advisory board is currently in the start-up phase. Its members will be regularly informed about the working status of the project by the project manager. The Advisory Board will approximately meet every six months in Essen, in advance the members will receive an updated report about all project activities. At these meetings current reports and work results will be discussed, debated and evaluated. Arising problems will also be discussed if necessary.

The advisory board should consist of the following persons:

1 Prof. Dr. Manfred Fischedick, Vice-President of the Wuppertal Institute of Climate, Environment and Energy (requested)

2 Dipl.-Phys.Ing. Othmar Verheyen, University of Duisburg-Essen, Faculty of Civil Engineering, Institute of Energetic and Environmental Process Engineering, original member and member of the managing board of the „Bundesverband Kraft-Wärme-Kopplung e.V.“, member of the „Landesinitiative Zukunftsenergien Arbeitskreise KWK und Biomasse“(requested)

3 Prof. Dr. rer. nat. Hans H. Blotevogel, University of Dortmund, Faculty of Spatial Planning, Department of Regional Policy and Planning (requested)

4 Prof. Dr. Thomas Heberer, Universitäy of Duisburg-Essen, Faculty of Social Sciences, chair of Political Sciences Focus: politics of East Asia (accepted)

5 Dr.-Ing. Irene, Wiese-von Ofen, Deputy Mayor a.D., former president of the International Alliance of Housing, Urban Design and Regional Policy (IVWSR) (requested and conditional acceptance).

4 Organizational structure

This chapter in general deals with organizational structures which are crucial for the project work. The focus lies on the structures in Shanghai especially on political level. To know these is very important for the project team because only in this way suitable contacts can be found.

4.1 Decision making level

The chart below shows the different organizational institutes which are interesting for the decision making process in the project.

The German project team has to work on both levels: the planning- and implementation level and the decision making level.

It proved to be particularly difficult to establish contacts on the highest political level. The contacts on commission level are carried out by the

assigned Department of International Relations, which on the other hand can only be contacted by the German Consulate and not directly by the project team. Therewith barriers are being established which handicap a fast communication.

Nevertheless the first dialogue with important members of the Town Planning and Traffic Commission was very positive. The three head of department, responsible for mobility, building standards and energy, were open-minded about our project. A further cooperation has been agreed upon.

The connection with the Urban Planning and Administration Bureau Shanghai (SPA) is very strong. With SBA/Mr. LI Hong a direct connection to the direction level is established. In this manner dialogues and also an informal exchange about the project regularly take place.

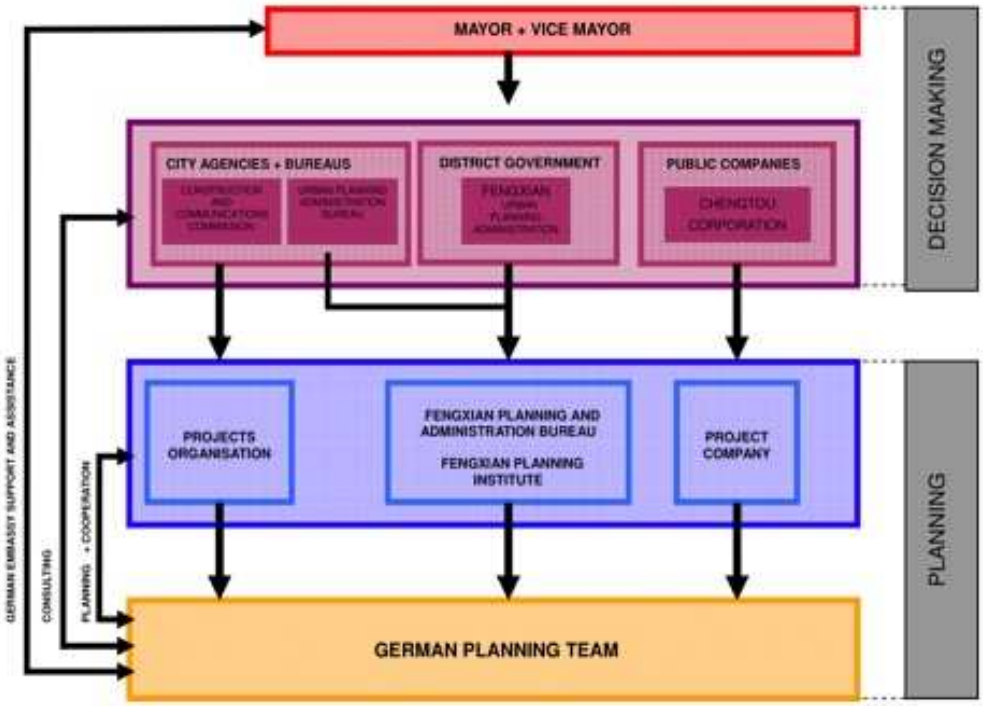


Figure 4 Simplified overview of the organizational structures in Shanghai; source: own exposure

With the Fengxian Urban Planning Administration Bureau (FPA) constructive dialogues are – due to the unclear human resources – only conditionally possible. In the last seven months three meetings took place to discuss the respective situation, the project status quo and a future cooperation. Commitments on the basis of the dialogues could not be complied because later the assigned personnel have been exchanged.

With the Chengtou Corporation Shanghai similar connections are established as with the SPA: also with Chengtou regular meetings take place which are usually held by Mr. LI as a mediator.

The contact on Ministry level in Beijing has been established after several attempts by the Research Institute CAUPD. The German CIM expert Mr. Kagelmacher, who is working at CAUPD which is allocated at MHURD (Ministry of Housing and Rural Urban Development), showed great interest for cooperation.

To achieve a network with the national Energy Research in the fields of mobility and buildings, a dialogue took place in the German Embassy. Thereby it has been recommended to establish a direct contact between the BMBF and MoST or MHURD aiming at an exchange about the ongoing research programs in those fields. The Shanghai-project touches on various levels on political specifications and decisions, especially the question how global and national energy saving targets can be transferred on city urban level.

4.2 Networks

The project team is interested in an intensive networking with other institutions and projects in order to discuss the main topics, to work out collective solutions and generate new aspects for the ongoing work. Therefore several meetings and dialogs with other megacities-projects took place in the last few months.

In March 2009 some project members joined a workshop in Heidelberg (IFEU) organized and initiated by the team of the megacities-project in Urumqi. The workshop focused on the topic „Planning of low-energy-houses“. For that purpose the project team of Urumqi invited some of their Chinese partners.

Figure 5 Workshop in Heidelberg

The project team of the Shanghai Project joined this workshop for one day. The emerged discussions between the two project teams and also between the German and the Chinese participators were of great professional interest. Especially the Chinese investor was able to illustrate his own opinion from the economic point of view. This meeting will lead to more common activities in the future because both projects – the one in Shanghai and the one in Urumqi – deal with similar topics and both teams see opportunities and benefits from this contact. Concrete arrangements do not exist yet.

Another workshop between different project teams took place in March 2009 at TU Berlin. Here members of the megacities-projects Young Cities, Casablanca, Ho Chi Minh City and Shanghai met dealing with urban planning. At this meeting the project teams exchanged their experiences, discussed about different topics and arranged the thematic frame for the ongoing networking activities like workshops, collective events and other cooperation.

Figure 6 Workshop in Heidelberg

This meeting was beneficial for all participators and the following topics for future networking and cooperation were established: simulation-models and -methods, methodic guidelines for an energy-efficient and climate-conscious guidelines for urban planning and their practical implementation in large-scaled pilot-projects, possibilities for the generalization and transferability of guidelines in the context of megacities with their specific basic conditions, megatrends within climate change, performance options for mitigation and adaptation and complex functional chains.

Furthermore other collective activities were planned. The next workshop will take place at the end October 2009 in Cottbus. During this workshop the participants will examine the named topics in detail.

In addition the project team meets with members of CAUP (Tongji University Shanghai) to discuss a closer cooperation and to establish a bigger network in Shanghai or in China.

Figure 7 Workshop at Tongji University October 2006; source: own photo

Referring to this a workshop at Tongji University is planned in September 2009. Participants of this workshop are the project team, students of Tongji University and other interested scientists. In this workshop the project team will present the actual work status and the first results in

order to initiate a discussion with all participants. In the pre-phase of the project two similar workshops took place – as can be seen in the picture above – which generated a lot of interesting results and opinions which were used for the ongoing work within the project.

5 Approaches for an Energetic Certification

The Shanghai Project also deals with the attempt to define energetic qualities which enable an integrated assessment in the fields of mobility and buildings.

With the new topic „Certification“ a cooperation with the Megacity Projects in Teheran-Karay/Iran, in Casablanca/Morocco and Ho Chi Min-City/Vietnam and a stronger networking with these should be established and on the other hand the Module 1 (EEC) comprises an integrated assessment of buildings and mobility on neighborhood-/city level and therefore creates a basis for a certification.

There is a wide range of public and private initiatives for the assessment of sustainability of buildings on national and international level. The analysis of the regulative legal framework to promote energy efficiency in the building sector – in Germany and in China but also in other countries – serves to gain knowledge and to confirm the lack of a tool to energetically evaluate a city.

Therefore, based on the EEC and a critical analysis of the existing approaches, a certification tool is planned which focuses on the energy field and which develops clear and measurable rating criteria. The complexity of criteria should be kept clear in order to guarantee the comparability of unequally developed Megacities. The weighting of the criteria should be adapted according to the development status of the Megacity.

Overall it is necessary to mention that certification initiatives are voluntary engagements and are often used as a publicity-oriented marketing instrument to improve the image of the respective company, but still they constitute a crucial milestone on the way to energy-efficient and sustainable cities. Energy-efficient buildings are no longer a „vision of the future“; they are feasible and companies and household are increasingly aware of them.

The **DGNB** (*German Sustainable Building Council*) awards a certificate for outstanding buildings as an objective pass for building quality and as an instrument to promote sustainable construction [1]. It is based on the life cycle of a building and for the evaluation of building quality 6 topics (ecological, economical, socio-cultural and functional, technical and process quality) are analyzed; the location quality is analyzed separately so that every project can be assessed location-independently. Each topic is divided into 49 criteria which are defined by measurable target values and weightings.

The DGNB-Certificate is a very complex and therefore slightly confusing instrument for the evaluation of the sustainability of buildings, which however doesn't assess the energy aspect as an independent topic. The

[1] Source: DGNB - Deutsche Gesellschaft für Nachhaltiges Bauen e.V.: Das deutsche Gütesiegel nachhaltige Bauen, Aufbau – Anwendung – Kriterien; 1. Auflage 01/2009, Stuttgart 2009, siehe http://www.gesbc.org/

mobility – also barely and not individually assessed – is not energetically analyzed.

LEED („*Leadership in Energy and Environmental Design*") is a nationally accepted benchmark for the design, the construction and the operation of high performance green buildings[2]. LEED evaluates the buildings performance in 6 key areas with different weightings: sustainable site (20%), water efficiency (7%), energy & atmosphere (25 %), materials & resources (19%), indoor environmental quality (22%) and innovation & design process (7%)[3]. LEED awards new constructions and bigger renovations, whereat the LEED for Neighborhood Development[4] is worth mentioning, which as the first national system for the design of neighborhoods integrates the principles "smart growth", "new urbanism" and "green building". LEED-ND aims at the development of compact, walkable, vibrant, mixed-use neighborhoods with good connections to nearby communities.

Although the LEED-certificate raised awareness for green buildings, the rating system often refers to the (efficient) use of fossil energy and less to the use of renewable energy. Overall 3 categories refer the energy-related topics (sustainable site, energy & atmosphere, indoor environmental quality), but the energetic evaluation is not holistically examined as an individual category especially not in the fields of mobility.

The **BREEAM** (*Building Research Establishment Environmental Assessment Method*, http://www.breeam.org/) provides an extensive assessment of ecologic, economic and socio-cultural aspects of sustainability of buildings. BREEAM uses 9 categories which are weighted individually: Management 12 %, Health and Wellbeing 15 %, Energy 19 %, Transport 8 %, Water 6 %, Materials 12.5 %, Waste 7.5 %, Land Use and Ecology 10 % and Pollution 10 %. BREEAM can be awarded to nearly all new and existing buildings types and can be certified for Design and the Operation of a building and for developments outside of the UK. The planned *BREEAM Communities* will help planners and developers to improve measure and independently certify the sustainability of development proposals at the planning stage[5]. The rating basis are "Regional Sustainability Checklists" comprising criteria which can be summarized to 8 categories: climate change and energy (u.a. energy-efficient design and management[6]; ratio of renewable energy), community, place making, buildings, transport and movement, ecology, resources and business[7].

A positive aspect of this certification instrument is that the energy- and mobility topic are analyzed individually as a separate category and a big variety of building uses are evaluated. Under the „energy"-category the

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2 Source: USGBC: Green Buildings by Numbers, March 2009; http://www.usgbc.org/ShowFile.aspx?DocumentID=3340

3 Source: U.S. Green Building Council, LEED, Green Building Rating System for Core and Shell Development, September 2003; http://www.usgreenbuildingcouncil.com/Docs/LEEDdocs/LEED-CS%20Pilot%20Rating%20System.pdf

4 Source: Website USGBC: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=148

5 Source: Website BREEAM: BREEAM Communities; http://www.breeam.org/page.jsp?id=117

6 Orientierung, passive Solarnutzung, Gebäudestruktur, Gebäudemasse und -dämmung, effizientes HVAC-System, Energiebedarfsberechnung, BHKW, Erneuerbare Energie

7 Source: BREEAM Communities: Draft Technical Guidance Manual; 2008; http://www.breeam.org/filelibrary/BREEAM_Communities_Pilot_Program_Draft_Issue_1_0.pdf

energy- and water-efficiency, the renewable energies, the energy consumption during construction, the CO2-emissions and the energy management are analyzed. The "transport"-category is linked to the energy-category in order to minimize the CO2-emissions of transport between buildings.

CASBEE (*Comprehensive Assessment System for Building Environmental Efficiency*, http://www.ibec.or.jp/CASBEE/english/overviewE.htm) is a certificate for green buildings which is commonly used in Japan for new and existing buildings, renovations as well as urban development, urban area + buildings and homes. The certificate uses 4 assessment categories: energy efficiency, resource efficiency, local environment and indoor environment. The Building Environmental Efficiency (BEE) for the classification of a building or a district is generated which enables the comparison of buildings.

A positive aspect of this certification is the category „energy efficiency" as an independent field of analysis, the evaluation of the building environment and entire city districts and the urban development respectively. A negative aspect is the lacking economic level and the mobility assessment.

The **Green Star** is a system in Australia and New Zealand aiming at the improvement of the energy efficiency in residential buildings which has been established by the *Green Building Council of Australia* (GBCA[8]) on the basis of LEED and BREEAM. The 8 performance categories are weighted differently due to different local conditions: Management (10%), Indoor Environment Quality (12%), Energy (24 %: GHG emissions, energy sub-metering, peak energy demand reduction), Transport (8 %: provision of car parking, fuel efficient transport, cyclist facilities, Public Transport, trip reduction – mixed use), Water (19%), Materials (10%), Land Use & Ecology (9%) and Emissions (8%)[9].

Also this certification comprises the energy- and mobility-topic as an independent assessment category, in which the energy-category has the highest weighting with 24%. But the emission topic does not refer to the energy consumption and the assessment of many building types and -uses are still in pilot phase.

The **Energy Star**-Program of the *US Environmental Protection Agency* and the *U.S. Department of Energy* analyses commercial and residential buildings according to their energy efficiency and provides Energy Star-qualifications for objects meeting the standard for energy-efficient construction The Energy Star also refers to household appliances and to the energy management (measuring the current energy performance, target development, implementation of economy measures) and provides an innovative Energy Performance Rating System[10].

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[8] Source: Website GBCA; http://www.gbca.org.au/ und http://www.gbca.org.au/green-star/rating-tools

[9] Source: Rating tool factsheet: Green star - Retail centre; Status: Version 1 (v1) released August 2008; http://www.gbca.org.au/uploads/221/1757/Retail%20Centre%20Fact%20Sheet_260808.pdf

[10] Source: Website EnergyStar; http://www.energystar.gov/index.cfm?c=home.index und http://www.energystar.gov/index.cfm?c=new_homes.nh_features

Overall the Energy Star-Program is a transparent and user-friendly certification which only refers to energy efficiency, but only focuses on the building level.

The Research- and Demonstration Project „Sustainable Renovation of Buildings for Sustainable Neighborhoods – **HQE²R**" (*Haute Qualité Environnementale et Economique Réhabilitation*, Source: http://hqe2r.cstb.fr*)* was funded by the European Commission with the cooperation of 10 Research Institutes and 13 municipal case studies from 7 European countries. With the HQE²R-approach systematic framework has been developed, which can be generally applied in European cities. The HQE²R-project provides decision aid tools for municipalities and their local partners promoting sustainable development and the quality of life at the level of urban neighborhoods and derives concrete operational methods and tools (Action Plan) for the municipalities. The HQE²R contains 6 leading principles: participation/governance, global embedding, long-term consideration, social acceptability, compatibility of environment and economical efficiency. The analysis framework is supported by a aspects- and indicator-system which enables the sustainability assessment of city districts using 5 main global objectives, 21 targets with 51 key issues and overall 61 indicators (ISDIS: „Issues and Sustainable Development Indicators System). For the "ex-ante-Evaluation" the tool *ENVI* („Environmental Impact") is offered assessing the environmental impacts of projects in the fields of energy, water, area, waste and CO2 on neighborhood level[11].

The HQE²R is therefore an integral approach for the assessment of neighborhoods which first and foremost aims at the revitalization of neighborhoods with the energy component (concerning buildings and mobility) as a secondary aspect.

Das **Green Building Tool /Sustainable Building Tool** was developed by the iiSBE (*International Initiative for a Sustainable Built Environment*, Website http://www.iisbe.org/) with the collaboration of 20 countries and serves as a rating framework for new constructions and existing buildings. It requires the adaption to the respective regional situation by setting weighting factors, benchmarks and comparison standards. There are 2 input masks: Module A for the Benchmarking, the weighting and the fuel emissions and Module B for the location, the buildings data and the energy assessment. There are 8 assessment criteria: choice of location, energy- and resource consumption (consumption of fossil energy in the life cycle, forecast of energy peak consumption, renewable energy, coordination of HVAC-system, materials- and water consumption), environmental impacts (et al. CO2-emissions), internal building quality (air quality, -circulation, -temperature, relative humidity, daylight influence and lighting), functionality and controllability of building systems, long-term availability, social and economic aspects as well as cultural and perception aspects.

Positive aspects are the separate assessment of the criterion "energy- and resources consumption", the estimation of environmental impacts, the flexible adaptivity to regional specifics due to an open design and the web-based information tool.

[11] Source: Blum, Andreas: Entwicklung nachhaltiger Nachbarschaften – Das Europäische Instrumentarium HQE²R; Leibniz-Institut für ökologische Raumentwicklung (IÖR), 2005

China

The real estate market has been dominated since the last 20 years by economic profit resulting in the construction of mediocre buildings of low quality and low energy efficiency. The severe consequences of the economic boom in terms of high resource consumption and environmental degradation threaten to undermine economic growth (damages from pollution total nearly 10 % of annual GDP in China, Source: SEPA). Environmental problems have prompted national and local governments to emphasize environmental protection.

Building energy efficiency is one of the 10 key programs targeting energy efficiency improvement in the 11th Five-Year Plan (2006-2010) with the buildings sector contributing 40% of the total energy-saving targets for the period[12]. In 2004 the *National Development and Reform Commission* (NDRC) issued the *Medium and Long Term Energy Conservation Plan*, which sets energy saving targets for buildings (New buildings: 50% energy saving, major cities such as Beijing 65 %; reconstruction of existing residential and public buildings with an improvement of 25% of building areas in big cities, 15% in medium cities and 10% in small cities) as a key aspect for a sustainable socio-economic development.

The *Regional Finance Research Division of the Research Institute for Fiscal Science* (under the Ministry of Finance) and the *China National Institute of Standardization* are designing tax and fiscal policies to encourage commercialization of energy efficient appliances and equipment. In 2008 500 billion Yuan were supposed to be invested in energy efficiency[13].

As the current building energy standards are narrow in their scope and lack a strong regulatory framework to incorporate energy efficient standards in construction, offer no incentives to stimulate technological innovations and no economical incentives to implement energy-efficient buildings, the MoC (Ministry of Construction) together with the MoST (Ministry of Science and Technology) have become increasingly interested in LEED and other international green building certification systems. The MoC introduced the "Evaluation Standard for Green Building" (GB/T 50378-2006), which is similar to LEED in structure and rating process. The building energy consumption data will be collected by MoC, which will be used to asses building performance, a three-star Green Building certificate will be awarded to the qualified buildings. MoST with technical support from Beijing's Qinghua University, has introduced The *Green Olympic Building Assessment System* (GOBAS) for the 2008 Olympics which is modeled primarily on Japan's CASBEE and, to a lesser extent, LEED.

LEED is increasingly seen as the international standard, as well as the rating system that can bring Chinese projects the most international recognition and can be used as a marketing instrument for publicity reasons. But it is also compatible with the economic efficiency as energy efficiency increases the building value and hence the sales price. The cost premium of the green building project amounts only 2 – 5 % of the original

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[12] Asia Business Coucil. "Building Energy Efficiency: Why Green Buildings Are Key to Asia's Future (Part III)". http://www.asiabusinesscouncil.org/docs/BEE/BEEBookPartIII.pdf

[13] UNEP SBCI: Policies for Energy Efficient Buildings in China; http://www.unepsbci.org/SBCINews/latestNews/showNews.asp?what=Briefing__Policies_for_Energy_Efficient_Buildings_in_China

design cost and green buildings have returns-on-investment (ROI) that are highly competitive with other projects [14].

There are various LEED-demonstration projects in China (see website USGBC, http://www.usgbc.org/LEED/Project/RegisteredProjectList.aspx), even LEED ND-projects (Neighborhood Development) are planned like e.g. large mixed-use development of the Coastal Greenland Group (800.000 m²) in Beijing and the Chinese Modern Group in cooperation with Steven Holl Architects. The *US Natural Resource Defense Council* assists the MoC to develop energy efficiency standards for government and commercial buildings and residential buildings in the Yangtze River and southern regions that reduce energy consumption by 50 % and works with the MoC and the MoST to translate and adapt LEED China[15].

The *World Green Building Council (WGBC)* has assisted the MoC in to establish national green building councils. Under the auspices of the CBCSD a CEEB (China Energy Efficiency in Buildings) program is in development.

The trend and commitment toward sustainable buildings is clear through the emergence of governmental programs, municipal green building councils, demonstration projects and, more recently, large commercial projects. Energy-efficient buildings are being promoted by government and economy[16]. Thus it is possible that the building sector will make a full circle to traditional Chinese architecture, where their buildings exist in, and not apart, from nature.

Conclusions

The research clearly shows that there is a wide range of international certification systems for a multitude of building types as a volunteer and promotion measure for the quality assessment of sustainability. These certificates are to be seen as awards, which are especially important in countries which don't have established systems to promote and secure energy efficiency in buildings yet. With these "flagship initiatives" the awareness for energy efficiency – especially in China – can be heightened.

A few of the certification systems comprise all three levels of sustainability; most of them however focus on the ecologic component. Overall it can be stated that most of the systems assess most criteria in the width but not in depth, due to the holistic approach. In addition the certification systems refer to single buildings and in only a few cases to the building environment and mobility; and even the systems fort he assessment of entire neighborhoods – which are still in pilot phase – remain on the "surface" due to the assessment of a multitude of topics. All systems have in common that the energy topic especially in relation to mobility is an inferior topic. Thus many topics can't only be evaluated only in a quantitative way (especially with regard to the urban environment); therefore there is a lack of a qualitative evaluation.

Within this project, which first and foremost deals with energy efficiency, a certification system should be developed which only focus on energy and consequently on C02-emissions. The rating catalogue and the indicators

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[14] Langer, Kenneth; Watson, Robert: Bringing LEED to China; http://www.sustainablebusiness.com/index.cfm/go/news.feature/id/1289

[15] Website NRDC, www.nrdc.org/default.as

[16] Source: UNEP SBCI: Policies for Energy Efficient Buildings in China; http://www.unepsbci.org/SBCINews/latestNews/showNews.asp?what=Briefing__Policies_for_Energy_Efficient_Buildings_in_China

resp. (qualitative, quantitative) should be clear in order to enable the comparability with other regions of different development level, and refer to the building types of the uses residential, office/administration, schools, retail and if necessary industry in the context of neighborhoods or a city district, with mobility as an equally important component.

A good basis is the HQE²R-approach which allows a qualitative and quantitative assessment and exclusively refers to neighborhoods. Here however not the "entire" living quality of a neighborhood should be evaluated but only the living quality relating to energy efficiency in buildings and mobility. BREEAM is another good approach which comprises mobility- and energy criteria and also enables an international application. Especially in China/Shanghai a new certification approach would be valuable in the energy field as the energy efficiency standards are still in development and can therefore be modified.

6 Work Status/ Results/ Next Steps

The previous work refers mostly to preliminary work in the single modules. Different topics and smaller projects have been executed which partly concern several modules. Therefore the following elaborations are structured according to topics and not according to modules.

The following Figure gives an overview about concrete projects in Shanghai, which are already in evaluation.

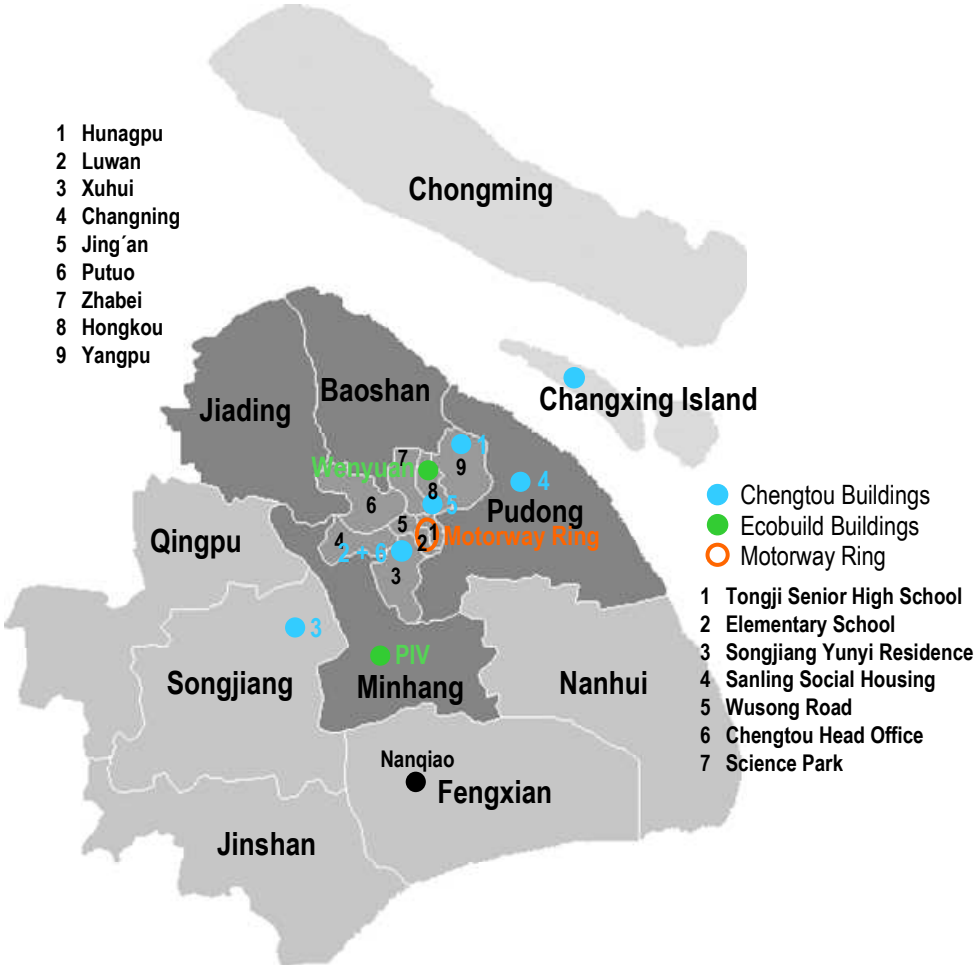


Figure 8 Overview about projects in Shanghai

6.1 Energy Monitor

Work Status

Module 1 comprises the development of an energy efficiency control system (EEC) to be tested and applied in one of the Shanghai districts. Ideally, this district should also include the neighborhood planning and implementation schemes from Module 3 as well as the planning and implementation of an optimized short-distance public passenger transportation system concept relying on a bus rapid transit (BRT) network. However, according to a current assessment, it cannot be ruled out owing to various basic conditions that will occur when the measures take place that the spatially integrated consideration is allocated to several urban districts.

The project participants have met several times for working out the Module. A detailed list of these meetings can be found in the Annex.

Furthermore, a fixed scheduled day was introduced, held on a rotating basis every two weeks, for coordinating all issues related to the project's progress.

Representatives of Module 1 participated in the kick-off held in Berlin and in the data management meeting held in Bonn, which discussed the subsequent approach of data handling affecting the entire project.

Additionally, a workshop with the Intergraph Co. took place at the end of 2008. During the two-day event, the Geomedia Professional software and its application in the project was explained and tested.

As part of EEC development, the 2008 reporting period (which included the 1st quarter of 2009) provided for the project steps 1 - objective functions, 2 - coordination of methods, and 3 - coordination of the hardware/software concept. Parallel to them, the database was expected to be developed. Furthermore, the first quarter of 2009 stipulated the start of system development.

Because the specific planning region could not yet be definitely fixed, the working points were partly changed: The coordination of methods was done by developing the entire concept through TRC and could be completed by the development of the client specifications of all EEC development participants, in an initial stage as expected. The same applies to the coordination of the software and hardware concept.

Regarding the database, the requirements for all interface data were defined and the data requirements were communicated to the Chinese partner. Data transmission is currently being put into concrete terms.

The Chinese partners still need to lay down their objective functions, and the German team has defined this preliminary work (i.e., the relevant indicators). These indicators are still being coordinated with the Chinese side. The preliminary work for the desired values derived from them has not concluded. This step may still drag on into 2009 and possibly into 2010 because it can be expected that the objective function discussion will need more time owing to the political opinion-shaping process. Possibly, the objective function will have to be adapted every now and then over time. Since the working point is not on the critical path, however, the timetable is not jeopardized by it.

The most important results of the individual working steps will be described below.

As part of determining **objective functions** for energy consumption and generation of renewable energies, indicators were suggested. They are explained in the EEC reporting described below. The final energy consumption, CO2 emission and – for street traffic – the average fuel consumption should also be shown for illustrative purposes as well. Additionally, the production of renewable energies is recorded and visualized.

As the basis of **method coordination**, TRC initially developed the system concept, documenting it in the form of client specifications, whose essence is the task concept that describes the stakeholders and their tasks as well as the interface concept that fixes the interface data.

The individual tasks are connected by the information and data flows shown. These connecting lines represent interfaces that were also put into concrete terms in the total concept. Every interface was exactly defined with regard to the exchanged data by the partners involved. Specifically, type of data, contents, dimension, spatial and temporal reference as well as information (whether the data are static or dynamic) are recorded.

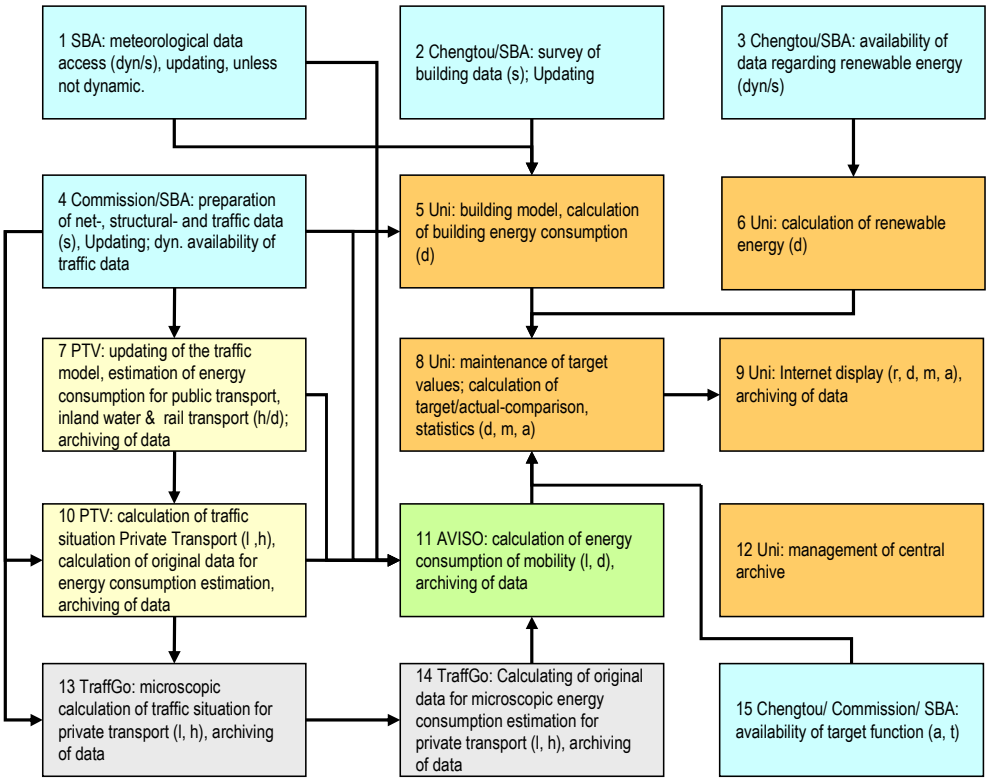


Figure 9 Task concept, Source: own exposure

The core of the previous project is the client specifications reports. In these documents, the requirements on the energy monitor are noted. The development of the client specifications reports based on the overall concept of the project. This overall concept is equal to the client specifications report of the company TRC. It contains information about the objectives of the project, the data bases, the methodology and the results. It defines how the parties within the project are situated and how the different parties interact. In addition, it defines tasks and data interfaces and it defines the workflow of the project in a work-plan and timetable. The project participants shall cooperate in accordance with the

requirements of the overall concept. Their contributions will be documented in detail. Detailed client specifications reports are written by all project participants.

The total concept is the basis for the client specifications of the partners involved. All the client specifications of the participants in the EEC development have been turned in:
Client specifications EEC TRC.1: TRC – total concept
Client specifications EEC ISS.1: ISS – building utilization
Client specifications EEC PTV.1: PTV – traffic situation
Client specifications EEC TFG.1: TraffGo – traffic flow simulation - street
Client specifications EEC AVI.1: AVISO – energy consumption calculation
Client specifications EEC ABS.1: Abstracture – server concept

Further steps served for coordinating the hardware and software concept, and the development of the server concept plays a key role in it. The server represents the core of the EEC: All data flow into it, where they are processed and made available to the partners and – as far as reporting is concerned – published via an Internet interface. Figure 10 shows the functional set-up for the server, which uses an Oracle database in which geographical data and parameters for the simulation or scenario administration are deposited. Data can be accessed on a daily or even hourly basis.

The EEC also makes a scenario calculator available whose data can also be administered via a server. The scenario calculator will allow the creation of alternative scenarios with the objective of influencing the development of energy consumption, if necessary with suitable measures.

The data and log formats (the OGC standards, for example) for their exchange via the interfaces between clients and servers should conform to a standard to achieve interoperability, better maintainability and easier system expansion (by linking additional clients, for example). A data management concept was created for explaining how to deal with these data.

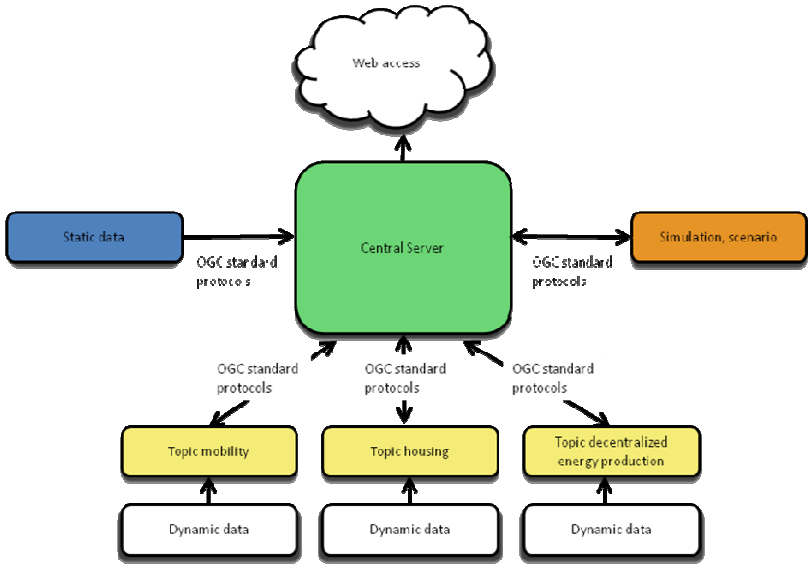


Figure 10 Server concept; source: own depiction

The energy monitor shows accumulated energy consumption until the present, the annual consumption forecasted from it and the objective

value for the year. In the calculation, energy consumption is based on people, groups of people, weight or surface area units. For example, in private transport, the average fuel consumption in liters per 100 kilometers and person is also shown. In freight traffic, the cargo load is the basis, not the people. In a building section, the energy consumption is based – apart from the total values in kWh per time unit (year, month, week or day) – once more on residents (apartment buildings), workplaces (office & commercial buildings), customers (trade) or generally speaking on usable floor space.

It should be pointed out here that the reporting as described is an initial suggestion coming from the German side, coordinated with the Chinese partners. This coordination process has not concluded yet.

Since the reporting shows the interface towards the outside and this is the most important part of the EEC for the user (the Chinese side), the initial draft of the Man-Machine-Interface (MMI) was interactively developed using Power Point as basis. The MMI presentation encompasses the essential functions of the EEC tool, serves the purpose of illustrating the possibilities of the final product, and is therefore important both for development and external depiction. The MMI should especially provide the opportunity of presenting the Chinese partners the results of the energy demand analysis in a sufficiently clear way so changes can be made without much effort.

Figure 11 shows an extract from the MMI that depicts energy consumption, CO2 emission and average fuel consumption in the partial section of mobility on a certain day, based on the chosen indicators. Apart from the total values for the annual energy consumption or annual energy production, the calling up of daily values is also possible on the temporal level – and in the case of passenger service, of hourly values as well.

Here it should be mentioned that the reporting as illustrated is a first proposal of the German side which will be agreed upon with the Chinese partners. This adjustment process is not finalized yet.

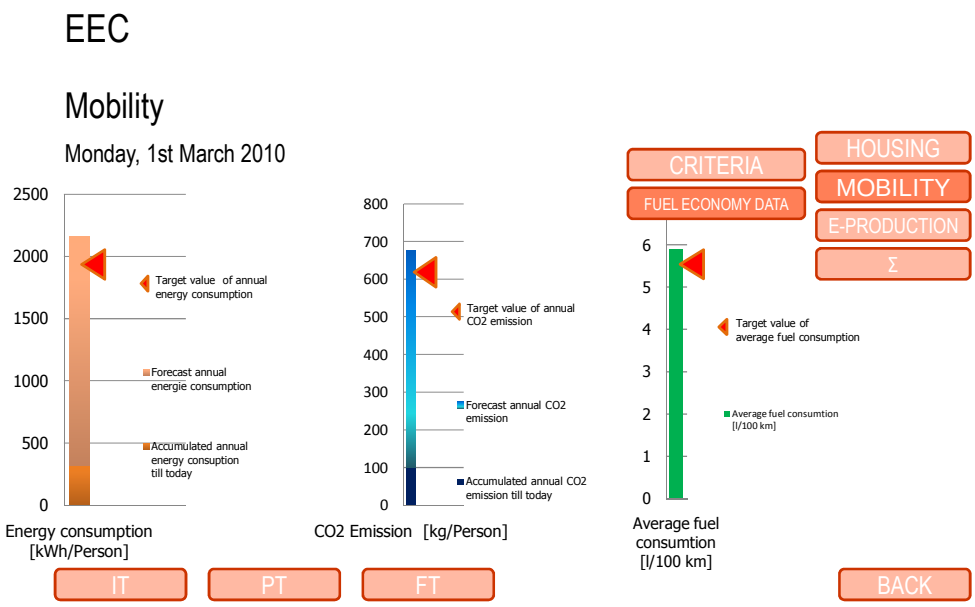


Figure 11 MMI; source: own exposure

As the reporting is the „external“ interface and therefore the most important part of the EEC for the user (Chinese side), a first draft of the MMI (man-machine interface) has been developed interactively using Power-Point. The presentation comprises the most important functions of the EEC tool. The MMI-presentation demonstrates the possibilities of the final product and is of relevance for the development and the external presentation. The MMI should above all present the results of the Energy Demand Analysis to the Chinese partners in a clear and comprehensible way and should enable simple adjustments.

For a first system trial several areas can be chosen as a test field. On the one hand it could be the City of Nanqiao / the Fengxian District known from the pre-phase of the project. A second alternative is an area located on Changxing Island (see following chapter). It is still unclear to what extent this satellite city could be the final planning area. Another alternative is the area around the inner-city motorway ring in Shanghai, which is of great interest especially regarding the dynamic traffic data. For this motorway ring dynamic data for the traffic situation have been approved by the Town Planning and Traffic Commission.

Next steps: assessment/controlling of energy efficiency

The working packages should be further processed in Module 1, EEC, as follows:

Objective functions: The efforts made so far for a quantitative fixing of binding objective functions have shown that the meaningful and promising path goes only through the level of the responsible Beijing ministry in connection with research institutions that are working on energy efficiency increase issues. The corresponding contacts are already underway. Talks in which the possible approaches at the regional level will be discussed with representatives from the MHURD, the Ministry of Science and Technology and CAUP will take place in late April.

The regional interest in increasing energy efficiency in the Shanghai megacity is keen at the planning level, but when it comes to the specific implementation of measures, other viewpoints such as those in the mobility sector (congestion reduction though infrastructure) or informal measures in the building use sector (cost efficient building, etc.) are at the fore. These insights mean that energy consumption analysis should be initially emphasized.

The coordination of methods has already reached an advanced level. As mentioned before, the reporting method still remains open. Based on the developed drafts, reporting will be the focus of the next bilateral talks with the Chinese side.

The emphasis of the work done in working sector 3, Coordination of the Hardware & Software Concept is software development. Although the coordination process takes place at the interface level, further discussions require a re-design in individual cases. It should also be expected that special requests made on reporting will make additions necessary.

The hardware needed for the test run is already ready for use. It is a sever with the technical data below:

processor: Dual Intel Xeon, 2,8 GHz-user memory, 2GB DDR SDRAM-hard disk capacity,146 GB SCSI operating system of the computer, WIN Server 2003.

The System Development section below describes the use of the server in more detail.

After the current handling of working sector 4, Database, pertained to the use structures and traffic data estimated by the German team, the 2009 working sector will concentrate on the procurement of actual traffic data for the planning region. The actual building data will be obtained in the same way.

Traffic data can be subdivided into dynamic traffic flow data and traffic behavior data. The latter were obtained from an extensive household survey that was carried out in Shanghai.

In the next trip to Shanghai in April 2009, the needed data transfer provisions will be discussed with the Chinese partners on location. To this end, project management will hold talks with the Shanghai Town Planning and Traffic Commission.

The System Development (working sector 5) has already begun. The next step in the development of the system will be an expanded test run based on the data for the Changxing Island region. In it, the exchange of data and visualization of results will take place this time via the test server. The objective of the test run is above all to test the exchange of data among the project partners.

Accompanying the steps mentioned in the preliminary stages, quality management (QM) will be followed up. Here, QM stands both for the consistent development of the entire system and for the content-related control of the applied methods as well as for the operational stability of the EEC. To accomplish this, a quality management handbook was drawn up that will be continuously expanded.

Once the total concept has been described, control algorithms are developed (currently being done) for use in the next project step for data testing, interim results and specific results. In this case, data access is done through the server mentioned above. QM will focus on the results achieved. An initial application of the QM system will take place as part of the planned test run.

6.2 Urban Systems Consulting

Work Status

In the Module 2 the work planned for the various institutions in Shanghai and Fengxian has begun. After some conversations on location and taking advantage of existing contacts of the project partner SBA, the subject of energy efficient and sustainable urban development was discussed with Shanghai's building commission, with high-ranking representatives of the municipal administration, with the new managers of the Fengxian urban planning office, with the mayor of the Hongkou/ Shanghai district, with the ECONET company network of the AHK in Shanghai as well as with Shanghai's biggest project developer, Chengtou Investment Corporation.

Inquiries about consulting services within the scope of the project module were made by the Town Planning and Traffic Commission regarding the subjects of "energy-efficient waste disposal logistics", "energy-efficient lighting", "sustainable tourism development" and "freedom from barriers in public spaces as part of sustainable urban development". These subjects

were partly inquired about in larger connection with the EXPO 2010. The project team gave – partly after consulting with other experts – an initial overview about the subjects and possible working methods and presented them to the commission, which was very interested and is now negotiating or discussing whether these subjects can be further pursued in collaboration with the project team.

Furthermore, work is underway to transfer the results of the preliminary phase and other knowledge gained from investigations and additional research in guidelines for a sustainable urban development for Shanghai or, generally speaking, for other megacities as well. Specific results are not yet available, however.

Next steps: urban systems consulting

The pending working steps and plans cannot always be planned for the long-term in this Module, as work is performed especially on Chinese request.

Nevertheless, collaboration with the Town Planning and Traffic Commission – which has already participated in various sectors – will be deepened. To this end, there will be more consultations with the responsible persons in the next trip in April. It has already been orally announced that there are still a series of further subject areas for which the Chinese need assistance from the German side.

In addition, various subject areas keep being reviewed so consulting services can be offered later. Initially, there are plans for reviewing and generalizing the results of the preliminary phase obtained during work done in the Fengxian district, from which then detailed action guidelines for how the city should handle the different subject areas will be drawn up. At first, they could apply to Shanghai, but later they should be generalized to the extent that with some adaptations they can be ideally applicable to various cities and regions as well. This work has already begun, but must first be performed on a deeper level. The insights resulting from it could then be applied in the other Modules – especially in Module 3.

Furthermore, other subjects should also become more important within project work. An example, the functions of free spaces within a city, is a very important subject. Open spaces serve an essential function, especially in very dense and large cities, and therefore attention must be centered on them. The effects on urban climate and the environment in particular should be investigated more precisely. First basics have been already gained which will be analyzed in detail in the further project process.

Furthermore, socio-economic aspects – such as the needs of Shanghai's residents – should be emphasized even more. Here, it will be especially important to bring together the wishes of the residents and those of the politicians and investors. Close cooperation with the local partners will be essential for this; possibly this subject area can be examined more closely in collaboration with Tongji University or other research facilities. This aspect is important so the plans and constructions do not miss the needs of the population, but part of this is also the strengthening of the awareness for energy-efficient action and sustainable way of life on location.

Urban Designs

With the Urban Planning and Administration Bureau Shanghai (SPA) consulting topics regarding energy have been discussed which will be stipulated in detail in the next few weeks within a contract.

The main focus is on the consulting of energy efficiency calculations of urban designs in the fields of buildings, mobility and urban form. It is about applying the EEC (Energy Efficiency Controller) in the process of classic urban designing, which are developed by the Shanghai Planning and Research Institute (SPI) or which are designed by independent planners. Also there is a range of application in the field of competing urban designs or competitions, which require a comparative calculation of energy efficiency for the evaluation and in the decision making process.

Intensely discussed has been the modality of integration of the energy efficiency calculations with the help of the EEC parallel to the usual assessment of the mobility- and infrastructure-related design issues. The SPA definitely wants to avoid a over-complication and deceleration of the Shanghai-specific optimized and rapid processes. Insofar it is to be analyzed in a (to be selected) case, how the energetic assessment of one or several designs can be adjusted to the rapid planning processes. In addition the SPA could have different wishes – in a first case only one design should be evaluated,, in another case sustainable alternatives are to be or scenarios are to be developed, in a third case three designs have to be compared regarding energy efficiency using alternatives. Also possible is an iterative analysis in cooperation with a planner like e.g. the SPI in terms of capacity building. This definitely should be discussed and practiced.

6.3 Changxing Island

Work Status

The collaboration with Chengtou Investment Corporation led to the New Town Changxing Island project on an island in the Yangtze delta, where the local shipyard – one of the world's largest – is the main employer. Chengtou is expected to build this new city of approx. 90,000 inhabitants and is interested in statements about the energy efficiency of available planning. The current planning of the Chengtou Investment Corporation was assessed according to town planning criteria, mobility and energy consumption. Afterwards, an alternative scenario was developed that kept the basic conditions and structures of the existing planning but indicated optimization possibilities in some points that would lead to a qualitative upward revaluation of the city and also to a more energy efficient mobility.

Work on Changxing Island is based on the competition for the 'Fenghuan New Town' in the western part of Changxing Island. Bidding started in 2005 and the 'Master Plan of Fenghuan New Town' was set up in 2006. The project team will act in this as consulting partner in energy efficient and sustainable housing and urban development.

The objectives formulated for the Changxing Island Region are:
_Promotion and development of the urban development process and integration into the region
_Optimization of a uniform spatial structure

_Protection of the environment and water, “eco island”’, creation of a forest and garden island
_Development of areas for the ship construction component industry
_Development of an ecologically friendly residential island with space for recreation and leisure
All objectives follow the ‘sustainable development’ principle.

General information about Changxing Island

The island of Changxing belongs to the administrative district of Chongming of the City of Shanghai and lies directly in front of the Pacific coast of Shanghai, on the mouth of the Yangtze River delta. With a total area of about 88 km², Changxing is the country’s largest alluvial island and the third-largest overall. Due to its central location, the island is very important for the region’s development, which becomes additionally clear by the planned Yangtze Tunnel Project and plans for bridge projects.

Once the Fenghuan New Town Project is completed in the coming years, the region will offer living space for about 130,000 inhabitants.

Changxing Island master plan

The master plan for the Changxing Island region was completed in June 2005 and contains statements about functional, industrial and infrastructural coordination, planning and layout.

The guiding principles according to which the master plan was conceived include the following aspects:
_Promotion of the local economy
_Promotion of the socio-economic development
_Social and ecological sustainability
_Safeguarding of efficient, user-oriented, spacious and adequate space utilization
_Creation of a scientifically-oriented identity
_Creation of a characteristic and attractive Changxing
_Safeguarding of a well-balanced, sustainable development of persons and nature
_Development of Changxing to a high-level site for instruments and installations of ship building.

The island can be roughly subdivided into two axes, five districts and one downtown area. The two axes mentioned describe the island’s development lines.

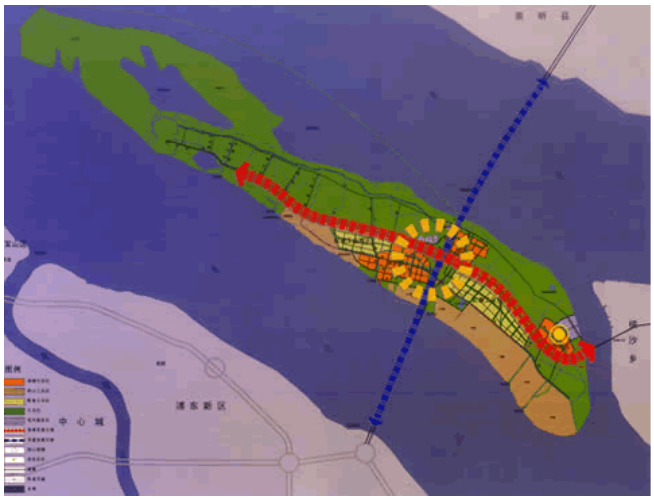


Figure 12 Changxing Island master plan

On the one hand, it is the north-south connection that connects the island with the Chongming urban districts to the north and to Shanghai's downtown to the south. This is where the bridge and tunnel projects mentioned above are taking place. On the other hand, it is the west-east connection that connects the industrial area in the east with the nearby island of Heng Sha. The intersecting point of both axes constitutes the downtown of Changxing Island.

Panyuan Road is the main connecting road that crosses Changxing from north to south and at the same time is the dividing line between the ecological district and the industrial district. The road running parallel to the coast is the island's most important development and accommodates most of the urban traffic.

The five districts describe the residential and industrial districts focused on ship building as well as related industries and component plants in addition to a modern service district and the environmental district.

Another important aspect of the master plan is the ship building industry. This potential can also be seen by the already existing 16.4-km-long deep water coastal barrier along which well-known Chinese ship building companies have established themselves, such as the 'ship-building base of CSIC and China Shipping', the 'port machinery base of ZPMC' and the 'Changxing building material wharf'. This potential is expected to be further expanded and promoted.

From the available data, maps and use distributions were drawn up that can be supplemented by meaningful assumptions and logical conclusions if data are lacking. Initially, maps with the planned use distribution – subdivided according to residential, retail, sports, cultural, recreational and leisure facilities, administration and services – are drawn up.

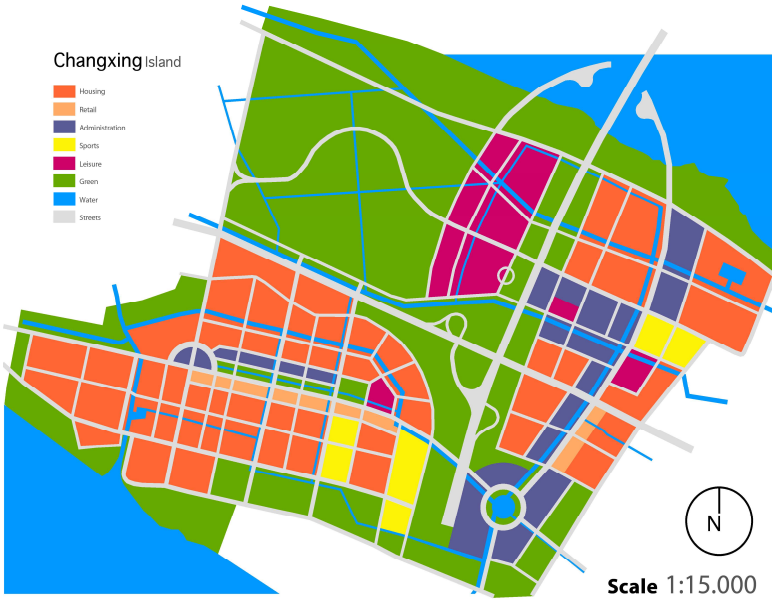


Figure 13 Use distribution according to master plan, source: own exposure

Urban Planning Assessment

The plan for the Fenghuan New Town was assessed according to a town planning viewpoint so specific improvement recommendations could be made based on demands on the city's quality and mode of operation,

residential quality and on a sustainable and energy efficient urban development. Apparent weaknesses in the draft were the clear division of functions in the individual cells as a result of which no meaningful mixture of use was achieved. Furthermore, the city was not built depending on the important traffic axes or the public transportation network. Both resulted in the streets within the urban area to become longer, the non-motorized traffic to become less attractive. Thus, the urban structure made it harder for public passenger transportation to achieve an attractive and extensive coverage. These points show that, regarding a sustainable and energy efficient urban development, this plan can still be improved upon a great deal.

The residential and recreation quality was likewise not optimized and therefore green areas and recreational facilities are often divided by residential districts. In addition, public green spaces are often located on busy streets.

Optimization of urban planning

The various apects can still be optimized to advance an energy efficient urban development. For this reason, an optimized variant of the plan was drawn up that shows an enhanced fucntional subdivision in certain places. This means, specifically, a stronger mix of uses, residential and occupational development along the main thoroughfares, a polycentric urban structure with several small centers instead of a single large one and a better consideration of green and open areas to ensure a higher recreational quality.

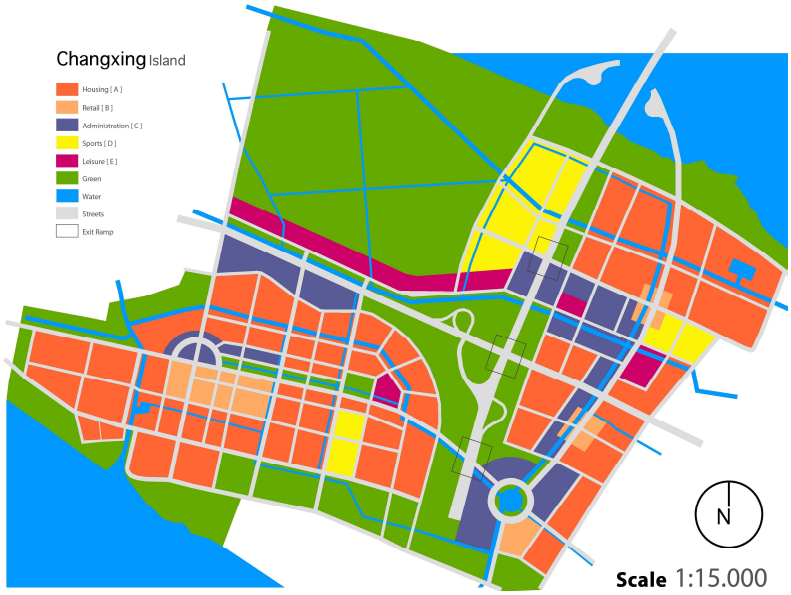


Figure 14 Optimized variant; source: own exposure

Urban planning optimization analysis of the effects on traffic

In order to improve the traffic situation in the Fenghuan New Town plan, the main traffic flows among working, living and spare time were initially considered. Parallel to this, traffic analysis zones roughly oriented to the functional analysis zones (yet encompassing a larger area) were set up. Based on the previously calculated number of inhabitants, assumptions for the number of residents and employees were forecasted for the traffic

analysis zones. These traffic analysis zones allowed the calculation of a traffic model for Fenghuan New Town.

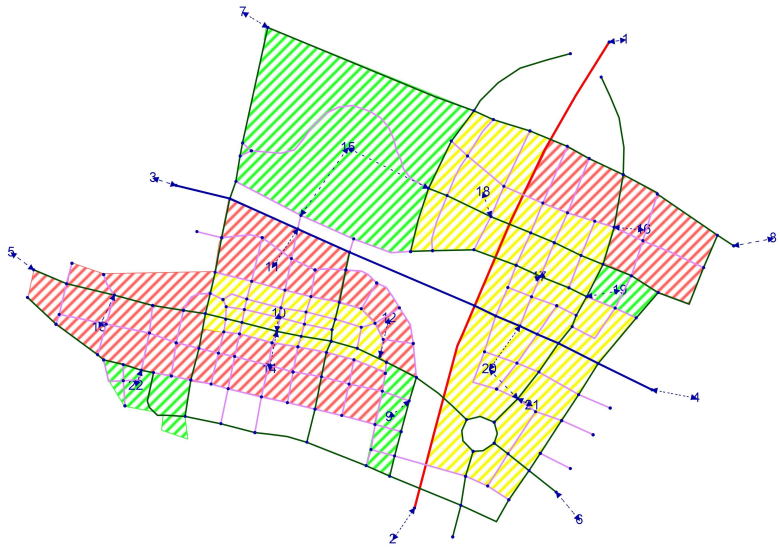


Figure 15 Traffic model- Fenghuan New Town- division into districts

Traffic model – two scenarios:
Existing planning Fenghuan New Town
Town planning optimized planning

The expected traffic flows were calculated and analyzed for both scenarios (existing planning for Fenghuan New Town & optimized variant). The traffic model calculates traffic generation (traffic sources), traffic distribution (source-destination matrices) and choice of transportation (distribution of the vehicles on the various means of transportation). The total vehicles were subdivided into means of transportation (pedestrians, cyclists, short distance public transportation, taxis, automobile drivers, automobile passengers). The resulting path lengths were determined and comparatively juxtaposed for both scenarios, separated according to means of transportation.

Depiction of traffic flows within the districts

Improvements made to hybrid use mixing can significantly reduce traffic flows within the districts. Commuter flows between Fenghuan New Town and Shanghai/Chongming as well as through traffic between Shanghai and Chongming were not determined. These extensive traffic flows cannot be influenced – or only marginally so – by town planning measures within the district borders of Fenghuan New Town.

Results of the traffic model

Improved hybrid use of the optimized variant leads to a reduction of the traffic flows within the island, leading to a reduction of trips made with all means of transportation. Merely the footpath kilometers increase by 4%. It is interesting that especially unwanted motorized traffic is reduced.

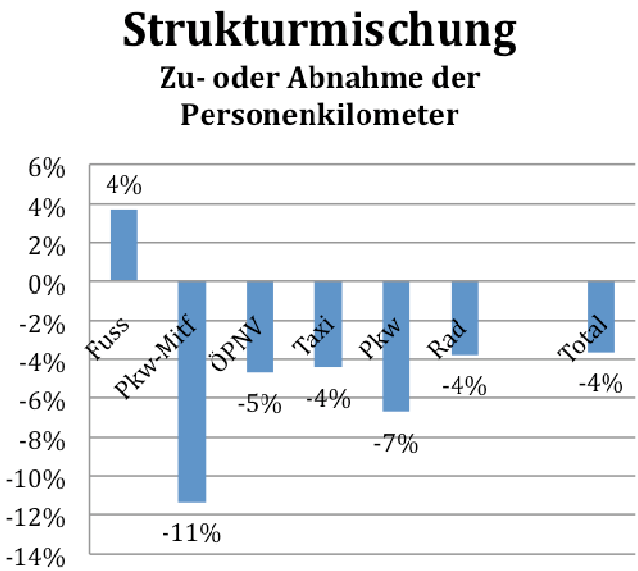


Figure 16 Relative comparisons of both means of transportation scenarios

Traffic avoidance through mixture of use

Just one simple town planning optimization (mixture of use improvement) can successfully prevent traffic. For the traffic flows within the district of Fenghuan New Town, the figure for the savings potential resulting from improved hybrid use is approx. 6,600 vehicle kilometers per day (for comparative purposes, the distance Frankfurt-Shanghai is 8,800 km).

Additional urban and traffic measures such as increase of building density, improvement of bicycle paths, improvement of short-distance public passenger transportation choices, etc. are another general way of preventing traffic as are targeted reductions of motorized individual traffic.

Energy Calculation for Buildings

In order to systematically calculate and illustrate the building energy demand for larger building complexes or for neighborhoods and districts, a building analysis using a geographical information system (GIS) was carried out for Changxing Island. The result shows the absolute and square meter-related energy consumption per building calculated and shown separately according to uses. The monitor is capable of displaying characteristic consumption values for the individual buildings.

The calculation steps according to the Shanghai standard and to the German Energy Savings Code (EnEV) are included in the GIS and modified. The characteristic consumption values can be visualized at the end.

The building analysis for Changxing Island was carried out for three different scenarios. The first scenario is based on Shanghai standard, the second variant is based on the calculation method of the EnEV with U-values of the Shanghai standard and the third variant is based on the EnEV 2009 (improved U-values) in order to illustrate the possible saving potentials. The results are illustrated in the Table 1.

Figure 17 Final energy demand according to the Shanghai standard (residential/non-residential buildings); source: own exposure

When calculating according to the Shanghai standard, high thermal transmission coefficients (U-values) – meaning bad building insulation standards – and an electrical heating and cooling system cause characteristic consumption values with peak values exceeding 500,000 kWh/a for residential buildings and 2,500,000 kWh/a for commercial structures. Thus, only one residential building with approx. 3,000 m² of usable space with apartment customizations of approx. 100 m² per unit and an approx. 3-person household 70 kWh/m²a and therefore 7,000 kWh/a per residential unit. This is not extraordinarily high, it even underperforms the German low energy standard stipulated for new constructions (70 kWh/m²a only for heating energy demand). If one takes the EnEV as calculation basis, however, the double energy demand is calculated for the same building. This is explained, among other things, by the fact that the EnEV indicates the final or primary energy demand, while the Shanghai standard merely indicates the electricity demand, and by the different complexities of the calculation method. In the EnEV method, the absolute peak values are partly found in the residential areas exceeding 600,000 kWh/a by a wide margin and the values that refer to square meters in up to 250 kWh/m². If one takes the future U values from the EnEV 2009 as basis for the EnEV calculation, then energy savings of up to 75% per year can be demonstrated.

Energy consumption		GWh/a	kWh/m²
Shanghai	WG	52.9	55.3
	NWG	91.1	88.0
EnEV	WG	185.3	193.5
	NWG	258.6	249.7
EnEV 2009	WG	47,7	49,8
	NWG	61,7	59,6

Table 1 Results of the energy calculation

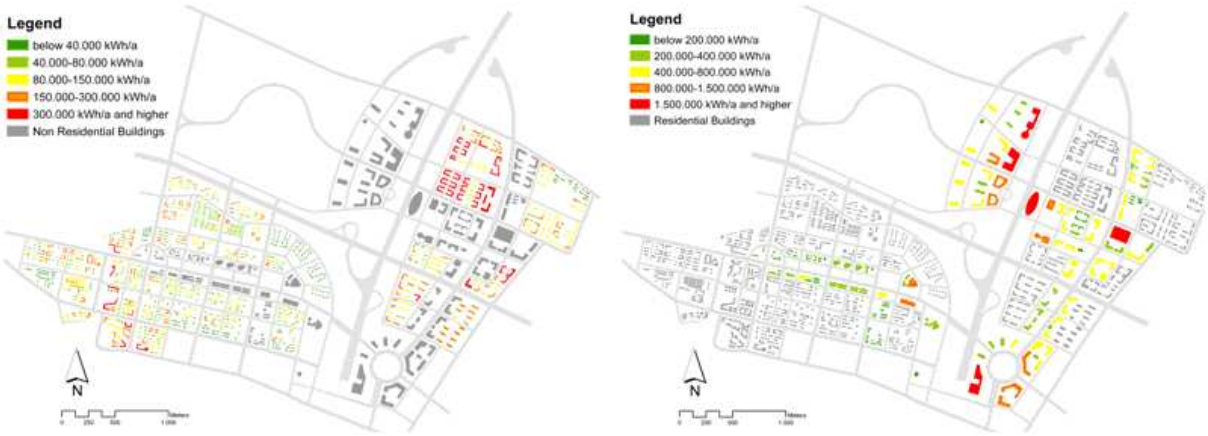


Figure 18 Final energy demands according to the EnEV 2009 (residential/ non-residential buildings); source: own exposure

The building analyses carried out with the help of the GIS application highlight quickly and accurately current energy consumption and with the help of scenarios illustrate the effects of certain measures or the energy saving potentials.

Energetic assessment of the Ecobuild-Buildings

Figure 19 Overview of the Ecobuild projects; source: Website www.green-shanghai.com

The calculations for the Ecobuild structures (see Module 2) and of Chengtou Investment Corporation and the consulting services concerning energy efficient buildings serve as test runs and entry into the real Module objective, namely the planning and implementation of an urban neighborhood. It is extremely important to communicate to stakeholders the financial usefulness of sustainable planning with the Shanghai situation as a special backdrop. Now, as part of the consulting services agreed upon with Chengtou, a profitability calculation as a basis for the definition of modified neighborhood standards is carried out using buildings and neighborhoods as examples.

Part of the next trip will be devoted to further negotiations with the responsible parties on location to achieve specific agreements for the Module in order to start with the exact planning for a neighborhood.

The calculations for the Ecobuild buildings (see below) and in the future for the Chengtou Investment Corporation buildings as well as the consulting services regarding energy efficient buildings serve as test runs and entry into the real objective of this Module, the planning and implementation of a neighborhood.

Finally, client specifications were also drawn up for this Module that include the further details and definitions of the working packages, more details about achieving the objective, the delimitation of the responsibility of the partners and the time horizon of the individual planning steps.

Results of the Ecobuild building analysis

Using the buildings of the ”Ecobuild Shanghai 2006 project – which compared to conventional Shanghai buildings are expected to consume 75% less energy – as example, planned and actual energy consumption should be evaluated, energy savings and the dependence of energy demand from the components building envelope, building technologies, energy sources and especially the users’ behavior should be illustrated.

The Ecobuild buildings represent new and existing structures, different building types, building uses, systems engineering and energy sources. The energy efficiency evaluation of the Ecobuild buildings also serves as test for data acquisition and analysis, as benchmark for the target value assessment in the building area and a useful test for the EEC. The Pujiang Intelligence Valley office complex, the renovated Tongji University office building, the renovated mixed-use building in Hongkou and the new Triumphal Palace apartment building belong to it. Both of the last buildings mentioned, however, were not evaluated owing to unavailable data.

In principle, the building evaluation should include the steps sketched in Figure 20, but due to missing data, the town planning surroundings were not included. Instead, user behavior influence was emphasized.

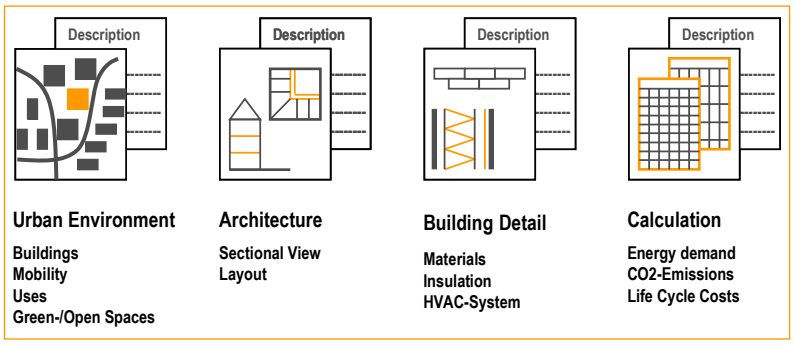


Figure 20 Building evaluation Modules; source: own exposure

The **calculation of energy demand** is based on the "Energy Conservation Design Standard for Residential Buildings in Shanghai" (DG/TJ08-205-2000) and on the German Energy Savings Ordinance (EnEV).

The Shanghai standard calculates only the electricity demand for winter heating and summer cooling and must therefore be modified with regard to other energy sources. The standard assumes a 32-day heating period and a 58-day cooling period, thus becoming apparent that the comfort level is very low (especially in the summer) and that the energy demand for cooling is more important. Furthermore, systems engineering is differentiated only into two components – namely conventional and new air conditioning – and the energy demand for hot water treatment is neglected. Generally speaking, however, this standard depicts the building sector, the users' behavior and therefore the actual energy consumption in Shanghai very accurately and realistically.

Apart from the final energy demands, the EnEV also accounts for the primary energy demands for heating and hot water based on 185 heating days and therefore encompasses additional information about the energy structure and consumption. To provide a realistic picture of energy consumption in Shanghai, however, the EnEV must be modified according to the specific local climate conditions and the users' behavior (heating and cooling days, ventilation, external and internal temperature in summer & winter).

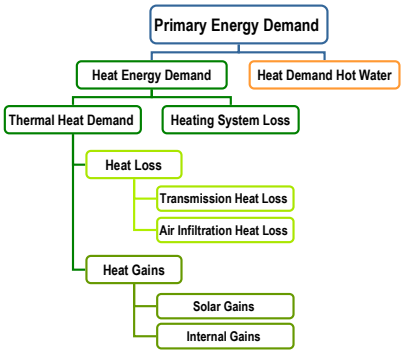


Figure 21 Structure of the EnEV; source: own exposure

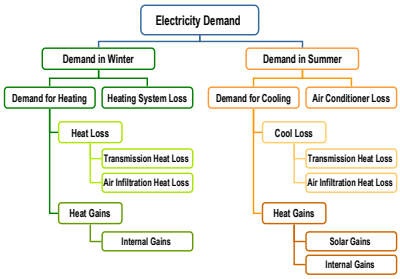


Figure 22 Structure of the DG/TJ08-205-2; source: own exposure

Pujiang Intelligence Valley: New office complex

The Pujiang Intelligent Valley (PIV) business park (http://www.piv-park.com/en) is located in the city of Pujiang (Minhang district) and it is the first Chinese building built according to German energy standards and the first one that obtained the "German Building Energy-Saving Certificate" (2006). The industrial park consists of research and development facilities and offices located in an area of 1.5 sq.km, the "egg" building itself has a floor space of approx. 2,400 sq.m and a usable space of approx. 9,900 sq.m. The developer and user is the Pengchen Group, while the concept was drafted by the German office of Dittert & Reumschüssel (Hamburg/Hanover) in cooperation with MUDI (Munich Urban Design International), the expanded draft is from Obermeyer China Ltd. with Kancha Shejiyuan. The building uses geothermal power for heating and cooling and incorporates several modern and energy-efficient building technologies.

U value	PIV	WY	SH	EnEV 09
Walls	0.4	0.94	0.45	0.28
Floor	1.503	0.83	0.4	0.35
Roof	0.368	0.62	0.3	0.2
Windows	2.4	2.4	1.7	1.3

Table 2 Comparison of heat transfer ratios (U values) in W/m

The information about building's dimensions, its orientation, the building materials and their heat transfer coefficients (U-values), the HVAC-system and the energy sources served as the **database** for the calculation of the energy demand. Also very important were information about the users and their behavior or comfort demands to the building.

According to the building proprietor **calculations**, the heating energy demands should be 243,300 kWh/a, and the cooling energy demands 487,000 kWh/a – in other words, twice the heating energy demands (s. Table 3). In reality 64% less energy is consumed for heating and cooling resulting from the lower comfort demand and the users´ behavior. The lower demand for electricity results from the still incomplete occupation.

	Energy cons.	Target		Actual		
		kWh/a	kWh/m²	kWh/a	kWh/m²	
Proprietor data	Heating	243.300	24,64	79.565	8,06	
	Cooling	487.000	49,31	183.908	18,62	
	Electricity	800.000	81,00	284.860	28,84	
Calculation		Primary Energy		Sum		FinalE
Target	H & C	**730.300**	**73,95**	**263.473**	**26,68**	
SH Standard	Heating	85.251	8,63	**341.828**	**34,13**	
	Cooling	256.577	25,50			
EnEV a	Heating	310.740	32,38	**811.441**	**83,08**	106.592
	Cooling	500.701	50,70			451.082
EnEV b	Heating	171.304	18,26	**672.005**	**68,96**	60.114
	Cooling	500.701	50,70			451.082

Table 3 Energy characteristic values and energy calculations for the PIV building

In the *calculation according to the Shanghai standard,* modifications in the annual number of heating and cooling days, in the internal heating gains, average internal temperature, efficiency of HVAC-system, sums of global radiations and the heat transfer coefficients (U-values) were made. The calculation results almost correspond to the building's actual energy consumption.

In the *calculation according to the EnEV a,* the EnEV formulas were retained and adaptations were made only for the incoming solar radiation when calculating the heat energy demand. In the calculation of the cooling energy demand, adaptations for the solar radiation during the cooling period were also made, as well as internal gains and cooling degree days. The results completely diverge from the actual energy consumption but are close to the target estimations of the proprietor.

In the *calculation according to the EnEV b,* the EnEV formulas were fully adapted and correspondingly modified to Shangai's local climate conditions (solar radiation, heating days, heating degree days). The cooling energy demand was taken from the previous calculation. The results lie between the actual- and target values and are closer to the actual consumption values that the EnEV a.

Generally speaking, the calculation shows that this office building uses relatively little energy for heating and cooling when square meters are taken into account (desired: 73.95 kWh/m²a, actual: 26.68 kWh/m²a), but if the U-values are retained according to the EnEV 2009 standard an additional energy saving of about 10% would be possible.

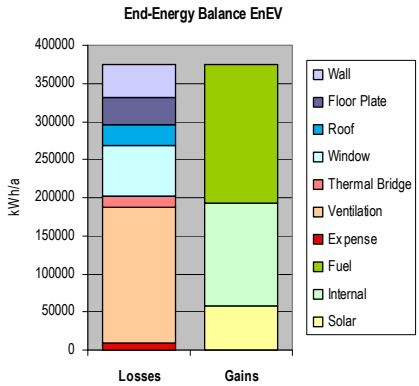


Figure 23 Final energy balance according to EnEV b; source: own exposure

The calculation according to the Shanghai standard corresponds rather closely to reality regarding heating and cooling energy demand, while the calculation according to the EnEV a corresponds rather closely to the

target value obtained by the proprietor. The modified EnEV b lies between the actual and the target value. For the subsequent approach – i.e., during the analysis of the Chengtou buildings and the EEC – the Shanghai standard and the modified EnEV (EnEV b) are thus taken as basis. The EnEV calculations cannot be renounced because the EnEV contains specifications about the Final- and Primary Energy Demand, the specific HVAC-systems, the auxiliary energy and the individual building components.

Wen Yuan building: Renovation of a 1950s office building

The WenYuan building is a public building under historical monument protection from the 1950s, used by the College of Architecture and Urban Planning of Tongji University. It was renovated in 2006. The building draft was drawn up by Tongji University, and IGS advised in the working out of the concept. The integrated renovation included a significant improvement of the building shell (heat insulation), the safeguarding of an energy-efficient supply and the use of various kinds of renewable energy (geothermal power). The requirements of the future building user regarding the layout and the thermal, visual and acoustic comfort demands were set at the start of the project.

Figure 24 View and location of the WenYuan building of Tongji University

As in the Pujiang building, the Shanghai standard and the EnEV were taken as basis and correspondingly modified in the **energy demand calculation**. Also the almost same **database** – except the U-values (see Table 2) – was used.

According to the proprietor's calculations, the heating energy demand should be 125,000 kWh/a, and the cooling energy demand 175,000 kWh/a, i.e. 1.4 times of the heating energy demand. The target consumption corresponds almost completely to the actual consumption (see Table 4).

	Energy cons.	Target		Actual		
		kWh/a	kWh/m²	kWh/a	kWh/m²	
Proprietor data	Heating	125.000	16,75	122.500	16,41	
	Cooling	175.000	23,45	180.000	24,12	
	Electricity	720.000	96,48	736.200	98,65	
Calculation		**Primary Energy**		**Sum**		**FinalE**
Target	H & C	**300.000**	**40,20**	**302.500**	**40,53**	
SH Standard	Heating	104.036	13,94	**471.001**	**63,11**	
	Cooling	366.965	49,17			
EnEV a	Heating	402.779	53,97	**1.009.783**	**135,30**	134.260
	Cooling	607.004	81,33			546.850
EnEV b	Heating	204.130	27,35	**811.134**	**108,69**	68.043
	Cooling	607.004	81,33			546.850

Table 4 Characteristic energy values and energy calculations for the WenYuan building

In the *calculation according to the Shanghai standard,* the heating energy demand is 104,036 kWh/a, and the cooling energy demand is 366,965 kWh/a - i.e. 3.5 times more. Especially the calculated cooling demand does not correspond to the desired/actual energy consumption.

In the *calculation according to the EnEV a,* the calculation results for heating and cooling differ completely from the actual energy demand. Only the calculated final energy demand for heating corresponds to the actual consumption.

In the *calculation according to the EnEV b,* the calculated value for the heating demand is closer to the actual consumption than in the EnEV a, the value for the final energy demand for heating is however too low.

Generally speaking, the calculation shows that this public building uses relatively little energy for heating and cooling if square meters are taken into account (desired = actual: 40.5 kWh/m²a), but an additional energy savings of about 15% could be achieved if the U-values are observed.

The calculation according to the Shanghai Standard or to the modified EnEV (EnEV b) corresponds more closely to the desired/actual heating energy demand, but not to the cooling equivalent, which should still be verified.

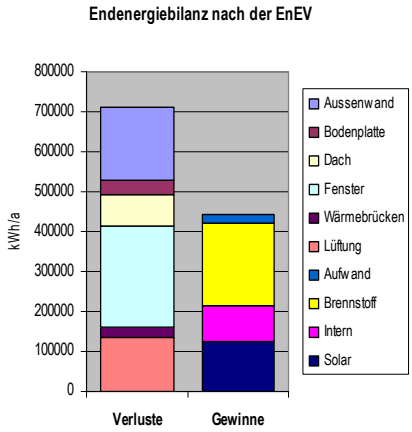


Figure 25 Final energy balance according to the EnEV b; source: own exposure

Next steps: urban neighborhood designing

It is essential to make clear to stakeholders the energetic and financial advantages of sustained planning, especially when taking the Shanghai situation into account. In the dialogues with the Chengtou Corporation Shanghai (CC) approaches have been developed for a constructive and sustainable cooperation. In the Agreement („Friendly Cooperative Memorandum“) there is for the most part a consensus regarding the content of cooperation. The CC will solely undertake few redrafts and an assessment with a legal adviser of the company.

Cooperation objectives

In a first step energy demand- and profitability calculations will be executed. Project management however aims at extending this topic.

Location selection

_four single objects of different use:
Offices: Chengtou Corporation head office and offices at Wusong Road Nr.150
Educational institutions: Tongji Senior High School and Shanghai Conservatory of Music
_four residential areas/urban developments:
Songjiang Yunyi mixed residence
Songjiang Xinkai social housing
Sanling social housing
Science Park

Data

The data request comprises information about the building shape and building technology, the user behavior, the economic evaluation and Mobility/Urban Environment.

Cooperation

In advance of the coordination of procedures in the following case studies, the area of Songjiang Xinkai has been chosen with approx. 5.000 residential units in social housing. This area is a part of a New Town with approx. 15.000 inhabitants and a total floor space of 300.000 sq.m with residential units of 40/60/80 sq.m. This area is partly mixed-used and is located close to an already existing metro station.

The buildings of the social housing are almost completed and are expected to be occupied in the forth quarter of 2009. They will mainly serve those inhabitants of Shanghai, who will be relocated from the city center due to other construction projects. The original equipment of the buildings reflects in the current standard in social housing. There is (yet) no air-conditioning (and no heating).

Therewith a new interesting research field has been identified. Because with the selection of this field a research of a time series can be established in the next three years, which provides a long-term valuable insight into the rising comfort demands of the urban residents reflected in the purchase of air-conditioners, in the individual form of motorization (at the same time with proximity to public transport) and in other characteristics. Especially the studies on energy consumption make the change visible. In the phase of first occupancy of the buildings the energy consumption is determined by lighting and cooking and electric appliances, first installations of air-conditioners will increase the former low energy consumption – to what extent it can't be predicted yet. The consumption of fossil energy due to the increased mobility (solely due to the relocation from the city center in the suburbs) will also rise with the level of motorization.

The results from a first evaluation will – requested by the CC – lead to general guidelines about the energy demand and the economic feasability of the social housing. Therefore a life cycle analysis of the building types should be accomplished by the "Operational Construction Management Department" of the University of Duisburg-Essen (Professor Dr.-Ing. Alexander Malkwitz).

Further urban research areas are still in the planning phase, at the beginning of a planning or in pre-arrangements, so that the results of the survey in Songjiang Xinkai can be integrated here.

Also the both school projects can be interesting as there is still no heating or air-conditioning in schools and the students are being sent home at extreme climate conditions in summer and winter. Also here a rise in comfort is expected.

The planned progress of the further steps in this module and the cooperation between the German and the Chinese team is illustrated in the following Figure.

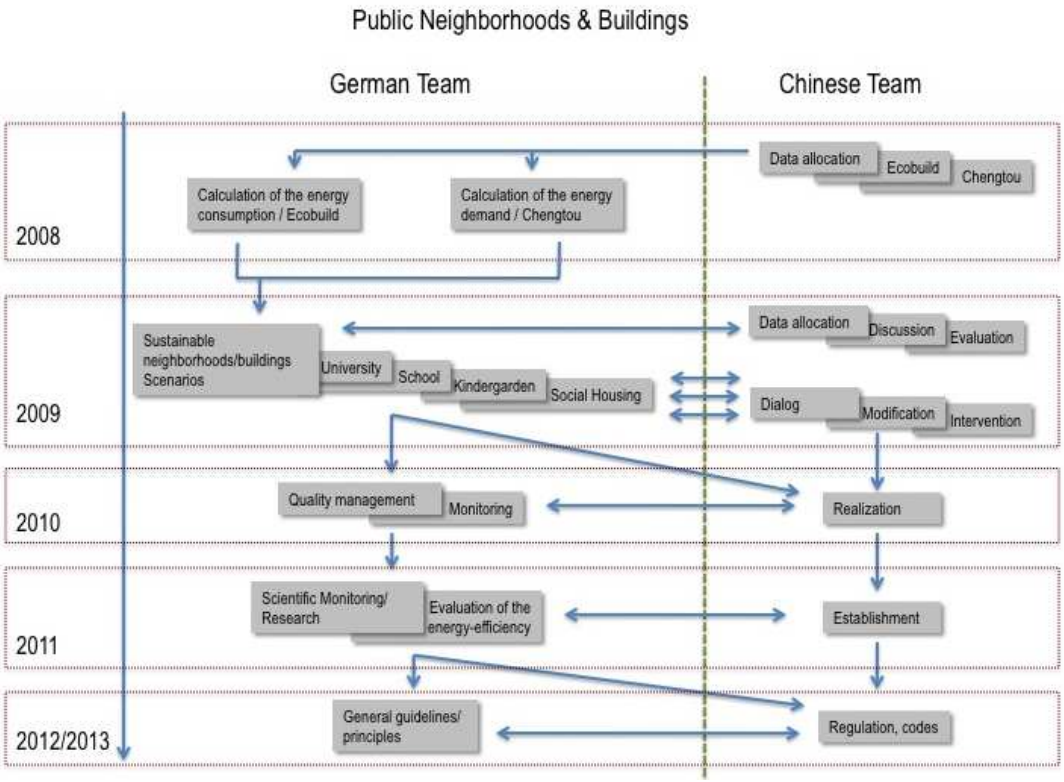


Figure 26 Flussdiagramm Modul 3

6.4 Public Transport in Shanghai with focus on BRT

Work Status

In an initial trip made in August 2008, intensive conversations took place with the Shanghai Urban Planning Office in order to develop the further steps and strategies for implementing the project modules in the Fengxian District. When doing so, it became apparent that political change in the highest urban authorities would make specific talks about potential urban districts with the new Fengxian leadership only possible until the end of 2008.

However, conversations with the mayor of Hongkou district/Shanghai and with a member of the city's Building Commission and of Chengtou Investment Corporation took place simultaneously. Highly interesting project approaches became evident in them which however differ from the original idea to plan a bus rapid transit.

The previous work in the fields of public transportation mainly referred to organizational preliminary work and research.

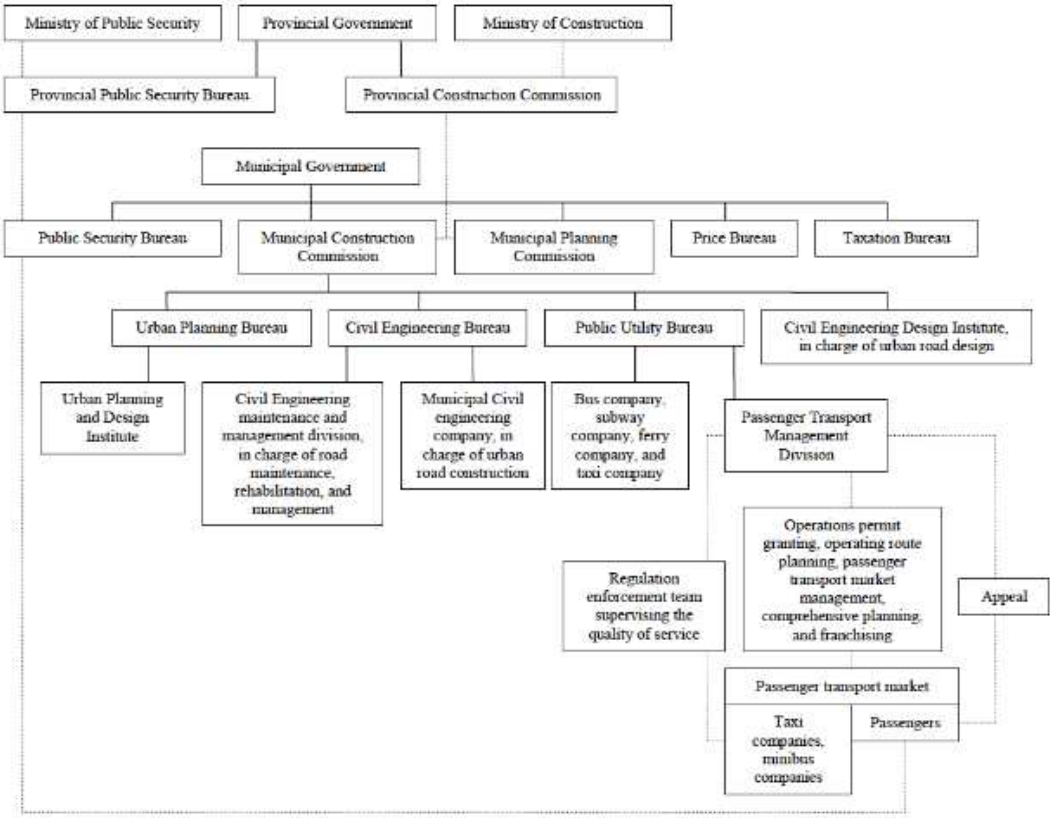


Figure 27 Institutional Arrangement for Urban Transport Administration and Operation [Wu et al. 1996]

The research referred mainly to the following subjects:
_Environmentally friendly busses available in Shanghai for public transportation,
_Decision structures for planning and implementing bus rapid transit systems.
_Experiences made in Asia's mass transit feeder systems.

Special attention was given to the changed value appreciation of feeder bicycle systems.

Public Transport in Shanghai

In Shanghai several public transport systems already exist, which are continuously extended and improved. Here possibilities exist to modify existing planning of a system or to substitute means of transport, which is more adequate alternative.

Metro system

Shanghai metro system started with line 1 in 1995. Until 2006, the number of lines exceeded to 6 (without Maglev) with 236 km length and 151 stations.

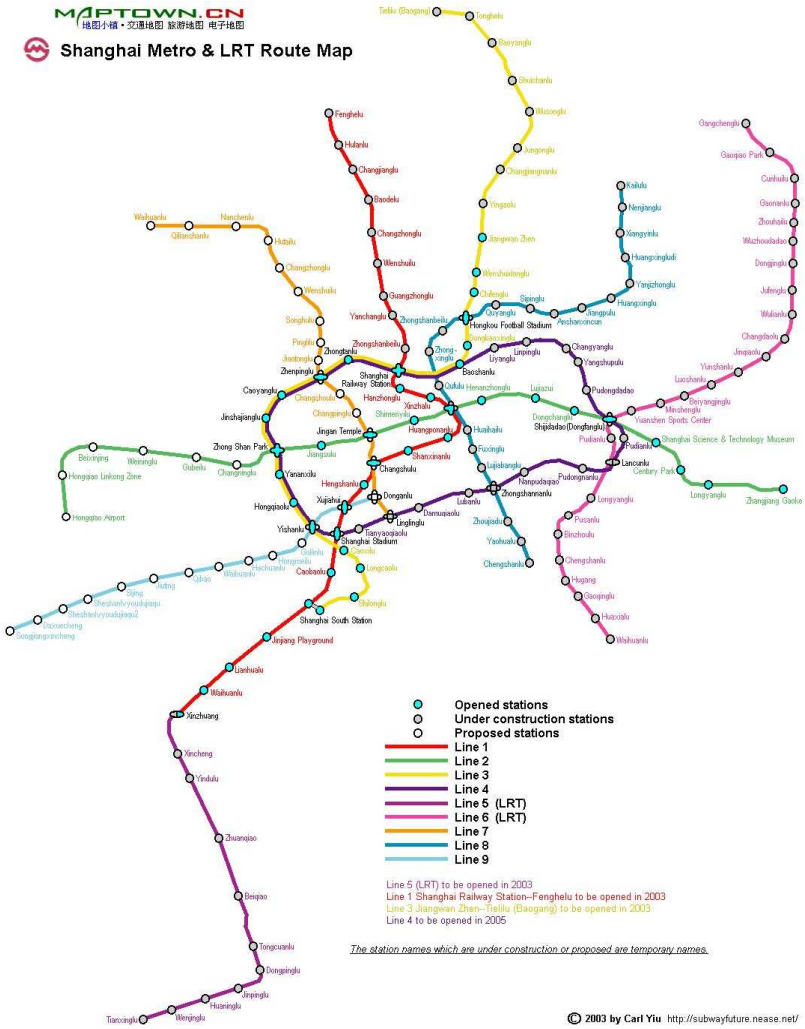


Figure 28 Map of Metro Lines in Shanghai

BRT / LRT definition

Figure 29 Tianjing NRC-line, opened in 2007

In this subchapter we distinguish BRT as a bus system with own tracks, fast and – compared with normal buses - of higher capacity and LRT which we separate into two kinds, namely “premetro” (metro light rail, two rails, capacity comparable with or higher than BRT) and “new railroad car” (only one rail, rubber tired, electric driven, capacity similar to BRT). The difference of the two kinds of LRT lies in capacity, weight of axis, minimum curve radius and maximum gradient.

LRT/premetro

The metro lines 5 and 6 are LRT lines. These lines are already in operation. They use partly own tracks but in other parts of the line network share the road space with other road vehicles.

LRT / NRC

The advantage of electric driven “new railroad car (NRC)” is - compared with normal buses - less pollution and higher capacity. In May 2007, the first modern NRC line went into operation in the Binhai new area in Tianjin. In December 2007, NRC was constructed also in Zhangjiang Pudong.

In Zhangjian, Shanghai, a NRC line is planned to open this year.

Figure 30 Planned NRC-vehicles in Shanghai. Line will open this year 2009

This kind of NRC will carry 167 passengers and reach a maximum speed of 70km/h. The existing traffic light system will be reconstructed with giving signal priority system for the NRC bus. Normally this system will be operated in multi-use roads together with other road vehicles.

Figure 31 Line map and typical cross section for NRC vehicles in Zhangjiang, Shanghai

BRT

Under the influence on BRT system development in many cities in the world[17], many domestic cities began to focus on developing BRT systems of large capacity. This development has been combined with the hope that BRT systems will play an important role in reducing traffic jam problems. Several BRT systems have been implemented in the meantime, i.e. in Beijing, Hangzhou, Kunming and Changzhou.

Many cities in China also are discussing the feasibility of BRT systems, i.e. Shanghai, Guangzhou, Xian, Nanjing, Chengdu, Chongqing and Jinan.

In 2005 Shanghai has promoted the “Conceptive Report on Shanghai BRT Program” which announced that several BRT lines will be constructed until 2010. However, after analyzing the road situation of the Shanghai inner city the decision makers found that a BRT system does not fit in the special situation of Shanghai, especially in the inner parts of the Megacity.

Experts meant that the development of a BRT system needs high efforts in road reconstruction, information systems and platform design. The road and signal priority in favor of BRT will occupy too much of the available road spaces and signaling resources.

[17] See also report no.81 of the China State Council.

Some experts suggested that BRT systems could be better applied in suburbs, which are far away from the inner city (i.e. Jiading). The BRT lines could be constructed between the inner city and the suburbs. The lines would then start and end at connection points with the fast metro lines.

Actually the BRT plans have been stopped due to different reasons: EXPO 2010 needs all available resources; there is no capacity for introducing a new PT system so far; the efforts are bound by the activities in favour for realizing LRT and the first NRC line. It will therefore take additional efforts to plan and develop BRT lines in a different manner as an important part of the bus network and the overall PT system[18].

Responsibilities in public transport

Compared to a common city street, with the planning and realization of a public transport line far more planning authorities and therefore more decision makers are involved. This applies foremost for public transport lines having own lane requirements like e.g. with BRT- and LRT-lines. In this module additional to technical, economical and organizational issues the specific requirements on fuel supply are evaluated, which should be designed in an ecologically compatible way.

The following statements refer to procedures which are common in Germany. The circumstances in Shanghai are on the other hand less clear and less transparent. First and foremost it should be considered that the introduction of a new system (e.g. Maglev) should ideally be conducted by a project team representing all responsible authorities. Such a project team wasn't complied yet. The following statements are therefore a proposal for the approach enclosing experiences in Germany with the implementation of LRT- or similar lines. These should form a basis for further negotiations with the Chinese partners.

Planning of the public infra- and supra-structure

Within the scope of planning a multitude of administrations collaborate making technical, economic and contract agreements and organizing the cooperation with private companies.

Additionally planning requires a multitude of careful consideration with high conflicts of interest of other street users which claim rights of street utilization in emergent structures. Also residents and registered users are to a great extent involved in planning and the corresponding considerations.

The planning and implementation tasks are distributed among different administrative departments: the design, the efficiency verification and the consideration of competing system- and line-concepts are assigned to city planning; the detailed re-modelling of infrastructure (streets, stopping points) is perceived by the Civil Engineering Office. Further administrative departments should be included in case of an electrifying line.

In Shanghai the Urban Planning and Administration Bureau, the Urban Planning and Design Research Institute and the Urban Planning and Traffic Commission play a decisive role in the planning process. Also relevant are environment-relevant departments and administrations

[18] For more information see www.tranbbs.com, www.shmetro.com, www.shanghai-bus.net, www.news.52bus.com, www.zhangjiang.cn, www.chnrail.way, www.shmetro.com

responsible for energy issues. In more complicated cases, especially with the introduction of a new system, the creation of project groups has proved to be beneficial with the collaboration of all responsible administrative offices.

Planning of the private infra- and supra-structure

Commercial buildings (storage facilities, maintenance- and repair halls, office buildings) are planned and constructed by transportation companies. This also applies for the internal Information- and Control System (RBL), which also can be integrated in a central Operational Control System. The vehicle provision is usually the responsibility of the assigned transportation company. The vehicle provision can also be carried out by the administration, so that the vehicles can be rented by companies. Insofar already in the run-up to the planning substantial decisions arise concerning the interface between public and private.

Financing of the public infra- and supra-structure and the subsidies

It can be expected that a BRT- or LRT-line also in a Megacity can't be financed by an investor. The investment and the operation generally require public funds which must flow in addition to the fare income. This financing must be decided on highest city level. In specific cases subsidies can be claimed on central government or district government level.

Implementation of the infrastructure of a BRT- / LRT-Line

The Urban Planning and Traffic Commission and the assigned administration offices are decisive for the implementation of the public infrastructure. If the financing is assured, detailed planning, tender, additional allowances and implementation can be effected.

The city transport management is responsible for the supervision and control of busses/light rails at light-signal systems and must plan and implement the according prioritization facilities. The dynamic information system is assigned to other administration departments.

Determination of the operator, form of contract

The future operator of the line is determined and generally put out to tender by a further department of the city administration. The acceptance goes to the most efficient tender. This company will be in change of the operation for a certain number of years (10 or more, depending on the invested expense).

In this process the contractual arrangements are of high relevance. Dependent on this is the interest that the assigned transportation company has in economic success of the line. The company will invest more in the attractiveness of the line if there is an economic benefit in this investment. Higher attractiveness leads to higher customer satisfaction resulting in a better modal split. This ultimately results in a higher economic and ecologic efficiency of the measure. It is therefore of high importance that in the contractual arrangements with the transportation company incentive mechanisms are included securing a sustainable attractiveness of the line.

Next steps: rapid transit planning / bus systems optimization

During the numerous business trips undertaken by the project team, extensive canvass talks were conducted and contacts in Shanghai's political, administrative and research institutions were established. Currently, a thorough stakeholder analysis based on the insight gained so

far is being drawn up that identifies all affected interest groups ("stakeholders") in the project field of public transportation. Thus, in the future, it will be possible for many interest groups to participate in the analysis work of Module 4 and to support the results on a wide basis.

So the Module can be easily integrated into the total project, a long-range traffic line should be selected for connecting a fast-growing satellite city with Shanghai's city center. The good public transportation connection to the satellite cities is especially important. After all, experiences gained so far in the Shanghai region – namely that newly planned model cities are almost deserted if there is no public transportation link to the city center. A good connection to the regional road system is insufficient to compensate for this "disadvantageous location".

One investment surge coupled with the financial crisis for expanding the subway system can only be welcomed by the project team. A limitation of this Module to the BRT associated with low investment costs seems no longer needed due to the latest developments. Possibly, a subway or LRT line can be chosen as exemplary object for the analysis and optimization of public transportation.

Due to the modified project definition the partner Hamburg Consult will leave the project because the new focus does not correspond with the company's objectives and tasks. Nevertheless the Module 4 can continue to be executed within the project. A discontinuation of this module is not reasonable for the overall project, because the mobility component is a crucial aspect in terms of a sustainable and energy-efficient urban development. If no substitute partner can be found for Hamburg Consult, the University can if necessary could be assigned with this module by awarding small contracts to experts.

6.5 General Remarks

Work Status

Trips/Dialogues/Contacts

Especially in the first months it was of particular importance to be present in Shanghai to continue the cooperation process from the pre-phase. For these reasons many trips with different people took place in 2008 and 2009. During these trips, already existing and supportive contacts were strengthened and refreshed. In addition, however, many new contacts were made that will be helpful as project work continues.

Furthermore, the structures within the German project team were organized and clarified in detail. Therefore, a series of meetings and conversations with the interlinked transit system partners, within the Modules and with the entire team were necessary. These meetings will take place on a regular basis. To keep the partners up-to-date on a regular basis, newsletters will be sent by project management informing about the most important activities and developments.

Cooperation/Networks/Workshops

A series of workshops and dialogues have also already taken place in Germany – for example with representatives of other megacity projects (see Chapter 4.2). Different subject areas were mentioned and discussed and jointly evaluated by the different project teams. The dialogues and

discussions were of benefit for the project work; suggestions were given, experiences were exchanged, and the work was assessed from different points of view. These meetings are expected to continue in regular intervals in the future.

Public relations

Especially in the early stages of the project public relations were of high importance for the project team in order to promote the project – which was also an important aspect for the local persons in charge. Thus, the project website was established as required and continuously updated and expanded. On this website the current research results and events are regularly added and explained. The address of the website is: www.megacity-energy.de.

Apart from the website, several flyers and information brochures were designed in three different languages (German, English and Chinese) which, on the one hand, are not only useful but also provide summarized information for the interested parties and, on the other hand, make the project known to a wider public through distribution of these information flyers.

Language course

Some project team members attended a Chinese class for mastering the basics of understanding on-site and for a better understanding of Chinese culture and customs. The knowledge gained has already been applied on trips to Shanghai and it has proven to be very useful not only for work purposes but also for the stay on location.

Next steps: overall project

For the overall project the establishment of new contacts and further public relations is still a priority.

Academic Activities

Already in the pre-phase the Megacity project initiated different academic activities which now continue. At present the following topic is being evaluated:

_Waste utilization in residential houses for the decentralized energy generation. Waste-economical and urban evaluation of a residential area in Shanghai. Current work state: inventory/assessment/interviews of residents on location. Author: Han Fei. Interdisciplinary Master Project, M.Sc. Department of Building Sciences, Faculty of Engineering Sciences, University of Duisburg-Essen

_Resource Flows in Cities: How can resource flows within cities be optimized in terms of energy and waste. This topic will be evaluated regarding the question of how the ecological footprint can be reduced in a city. Current work state: research and general preliminary work; Author: Dipl.-Ing. Hannah Baltes. Dissertation. Department of Building Sciences, Faculty of Engineering Sciences, University of Duisburg-Essen

_Energetic Evaluation of planned cities in Germany in comparison to new Eco Towns. Current work state: research and general preliminary work; Author: Dipl.-Ing. Sabine Drobek. Dissertation. Department of Building Sciences, Faculty of Engineering Sciences, University of Duisburg-Essen

_Sustainable urban Mobility – Feasibility of a complete renunciation of fossil energy sources: basic principles, challenges and solution concepts.

Within the DAAD Megacity-Program the Admission Committee already held a meeting and evaluated. With overall ten concrete applications and four letters of inquiry and due to the extremely good evaluations, three scholarships are expected. Beginning in fall 2009, presumably the following research work will be developed and evaluated within the project:

_Tourism and Urban Planning: Smart Growth principles for the touristic and urban planning development of the Haiwan area in the Fengxian District /Shanghai. Planned Master Thesis at the University of Duisburg-Essen

_Contribution to dynamic methods of calculating the energy demand of mobility in Megacities. Planned Ph.D at the University of Duisburg-Essen

_The landfill-free City: A strategy for the future urban waste disposal and its´ integration in the urban development strategy for Shanghai. Planned Ph.D at the University of Duisburg-Essen.

Contacts

The last trip was taken not only to Shanghai but also to Beijing. Dialogues were held with representatives of the German Embassy resp. the CAUPD (China Academy of Urban Planning and Design), a Research Institute assigned to the MHUHRD (Ministry of Housing, Urban and Regional Development). Especially it has been discussed how the project team can gain further support on Ministry level and how a financial support of the Tongji University can be achieved on the Chinese part. In the dialogues the political dimension of the project and the research topic was communicated and explained to the Chinese contact partners and brisk interest could be aroused so that further support can be expected. It also showed that an intervention by the BMBF or by the project executing organization would be beneficial for a support by the Chinese Ministries. Here further dialogues and discussions about the further approach will take place within the next weeks.

Additionally several dialogues took place with partners on location. It has been agreed upon the signing of different binding cooperation contracts (Friendly Cooperative Memorandum) presumably in May 2009. These contracts will comprise et al. agreements about the provision of different data which are necessary especially for the traffic modeling and the energy calculations. Cooperation agreements will presumably be signed with:

_Chengtou Investment Corporation Shanghai (Mr. Hu)
_Town Planning and Traffic Commission: data provision for the traffic situation in the inner-city area of Shanghai (Herr Cheng)
_Urban Planning and Administration Bureau Shanghai (Herr Xu).

Public relations

The project will be represented in different conferences to be held in the coming weeks. On the one hand, there will be participation in the European Climate Teach-in Day, a trans-European online event for students about the topic of climate change. The subject of the contribution will be “Innovative Structures for a Post-fossil Future of the City“. In addition, a lecture about the subject of the sustainable development of

megacities will be delivered at the Real CORP Conference in Sitges in April 2009: “Energy Efficient Structures for the Shanghai Region using Fengxian Districts as Example”. Participation in additional conferences (Cities for Mobility in Stuttgart, for example) is being planned.

Workshops

As already mentioned in Chapter 4.2, other workshops are planned with other megacity projects for late October and with Tongji University for September. More workshops or talks will take place on a short term basis depending on need.

7 Challenges

The process of the project showed that working in china always goes along with different challenges for the project team. Not only global trends and happenings like the economic crisis but also developments inside of china influence the investments, the accomplishment of planning and construction projects and political decisions. This makes it necessary that the project team often changes its approach or breaks new ground unlike as planed before to come to the actual result.

7.1 Thematic challenges

A very distinguished challenge in is the complexity of the treated topic. The project deals with a lot of different topics regarding sustainable urban development and the project team works on them in an interdisciplinary way. This is why the topic appears so complex. Therefore the division of the project in four Modules is - especially for the work in Shanghai – a big advantage. In China there are excellent experts for every special field. But we often see that the Chinese operation method and the way of thinking is very different from the German one where we try to find innovative solutions by holistic planning approaches and interdisciplinary cooperation. The Chinese project partners only deal with small and concrete problems in their special workspace. Statements regarding similar or foreign topics are truly rare. This is why the German team first has to break the whole topic down to the different special fields and afterwards to join them together.

7.2 Organizational challenges

Data collection

Data collection in China often turns out to be elaborate and long-winded. Reasons for that are amongst others that there is a lack on data collection, datasets are absent or incomplete or the data are very sensitive and so the institutions are not allowed to pass the data over to foreign people. Generally data collection is only possible in cooperation with the Chinese partners which are involved in the project, know the objectives very well and are able to pass them over to the persons in charge. Their main business is to make and attend contacts in Shanghai and legislate faith as a basis.

Implementation/ Realization of the project/ Changes on the political level

The realization of the project depends on decisions on the political level and so it is also reliant on its specific cycles. The rapid urban growth in china leads to a numerous reorganization of the responsibilities on the political level and also on the planning level.

During the process of the project this took place on the level of the district Fengxian as well as on the level of the region Shanghai.

That is why recently the province Shanghai reestablished or joined the Shanghai Urban and countryside Construction & Communications Committee (formerly: Shanghai construction & communications committee and a part of Shanghai Municipal Agriculture Commission and a part of Municipal Engineering Administration), the Shanghai Municipal Transport and Port Authority (formerly: Shanghai Metropolitan Transportation Authority, Shanghai Port Authority and a part of Shanghai Airport Group Co., Ltd. and a part of Municipal Engineering Administration), the Shanghai housing security and the Housing Authority (formerly a part of Shanghai Municipal Housing, Land and Resources Administration and a part of shanghai construction & communications committee) and the Shanghai Municipal City Planning and Land Resources Administration (formerly a part of Shanghai Municipal City Planning Administration and a part of Shanghai Municipal Housing, Land and Resources Administration).

These reorganizations have long-term influences on the project because the responsibilities change and in the cause of this also the contact persons. In particular this is adverse if one partner got to know to the complex issues of the project and a trustworthy basis for cooperation was created. This applies only the political level, the contact persons of the economic partners are continuous the same since the beginning of the project.

8 Time- and work-schedule

Time- and work-schedules of the project remain in comparison to the application almost unchanged. There is only a small temporal delay based on a different project start.

8.1 Cooperative project

The time-schedule of the whole project needs no adaption in comparison to the interim report in February.

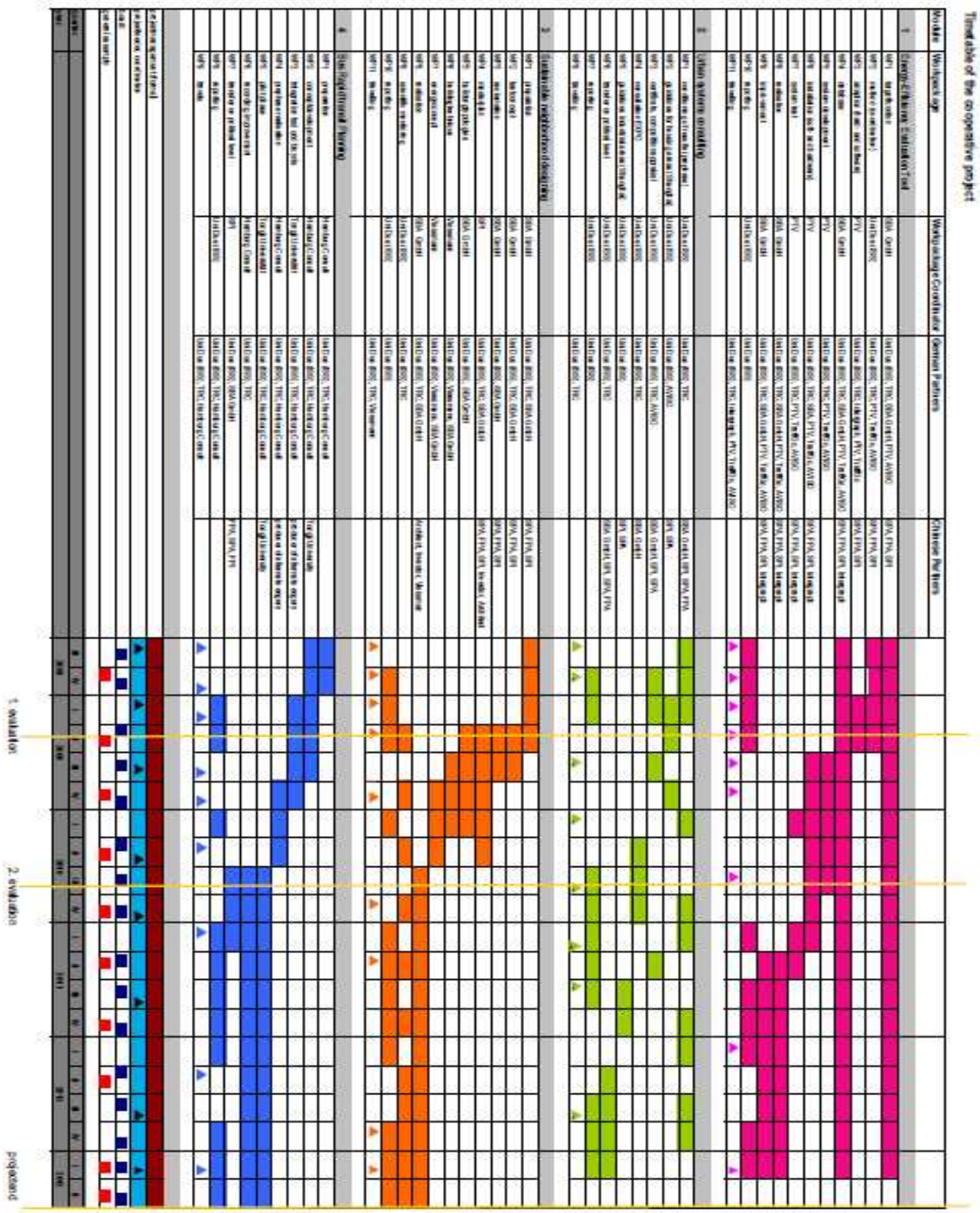


Figure 32 Time-schedule of the entire project

Below the time- and work-schedule of all Modules are explained in detail.

8.2 Module 1: assessment / controlling of energy-efficiency

Time-schedule of Module 1

In the time-schedule of Module 1 no changes are necessary.

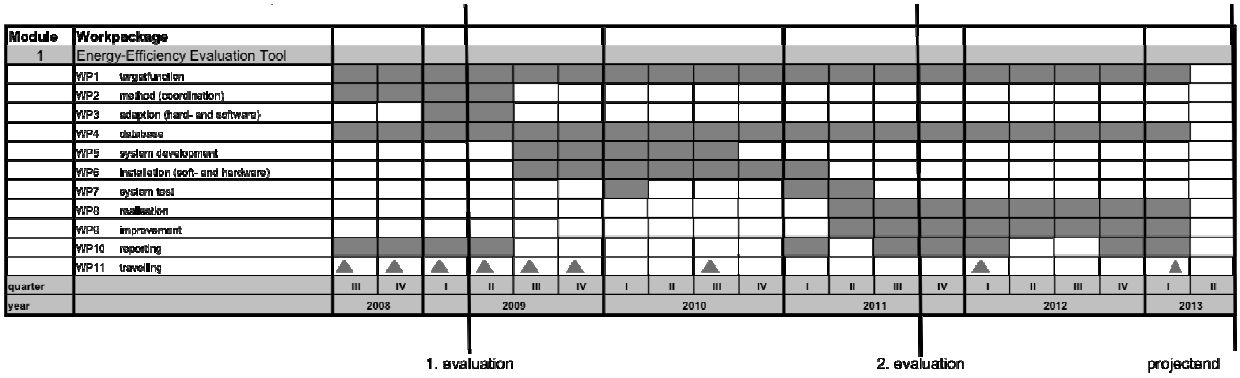


Figure 33 Time-schedule of Module 1

Work Schedule

I. Target Function	University of Duisburg-Essen, Shanghai Urban Planning and Administration Bureau (SPA), Fengxian Urban Planning and Administration Bureau (FPA), Shanghai Urban Planning and Design Research Institute (SPI), SBA Shanghai.
II. Adjustment of Methods	University of Duisburg-Essen, Intergraph, AVISO, PTV, TraffGo, SPA, FPA, SPI.
III. Adjustment of Hardware-/ Software Concept	University of Duisburg-Essen, SPA, FPA, SPI, Intergraph Germany, AVISO, PTV, TraffGo.
IV. Database	SPA, FPA, SPI, Intergraph Shanghai, SBA Shanghai.
V. System Development	University of Duisburg-Essen, Intergraph, PTV, TraffGo, AVISO
VI. Soft- and Hardware Installation	SPA, FPA, SPI, SBA Shanghai, Intergraph Shanghai, PTV.
VII. System Test	University of Duisburg-Essen, Intergraph Shanghai, SPA, FPA, SPI, PTV, TraffGo, AVISO, Intergraph, AVISO
VIII. Realization/ Implementation	University of Duisburg-Essen, Intergraph Shanghai, SBA Shanghai, SPA, FPA, SPI, PTV, TraffGo, AVISO
IX. Optimization, spatial extension	University of Duisburg-Essen, SPA, FPA, SPI, Intergraph Shanghai, SBA Shanghai, PTV, TraffGo, AVISO

X. Quality Control and Scientific Monitoring
(University of Duisburg-Essen, TRC)

Figure 34 Work-schedule of Module 1

8.3 Module 2: urban systems consulting

The existing time-schedule of Module 2 is not detailed because a lot of the work in Module 2 is based on appointments of Chinese partners. Now the next work is clearer and so it is possible to adjust the time-schedule.

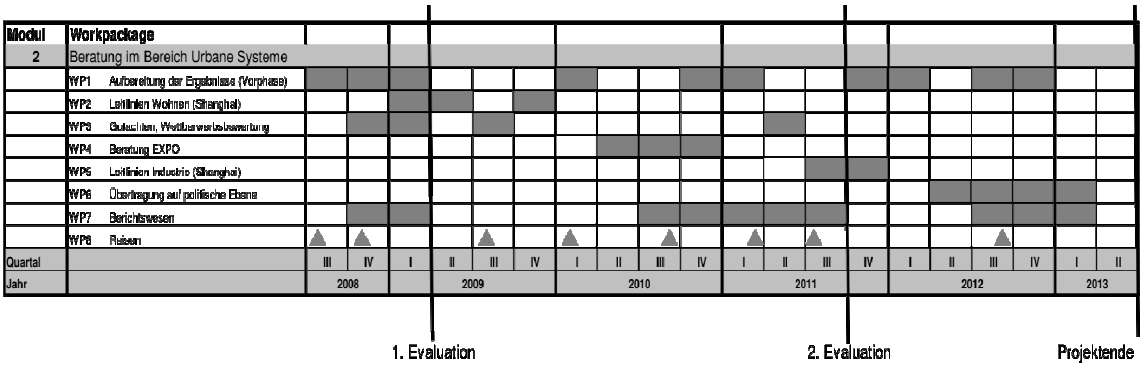


Figure 35 Existing time-schedule Module 2

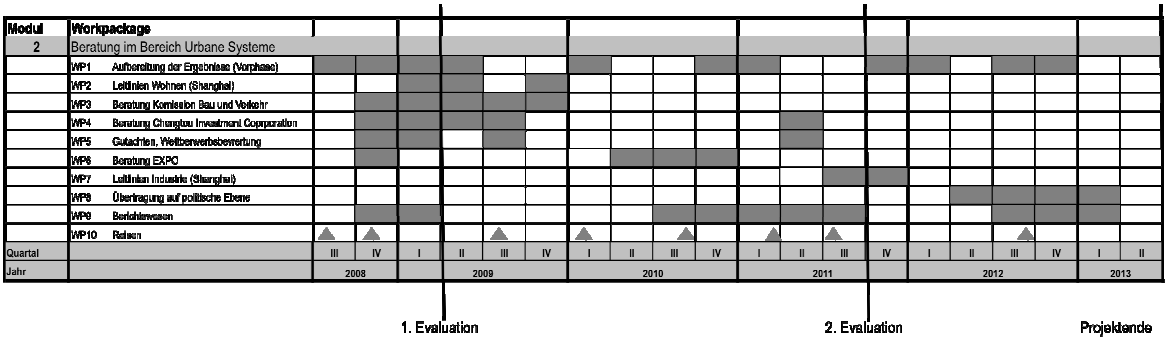


Figure 36 New time-schedule of Module 2

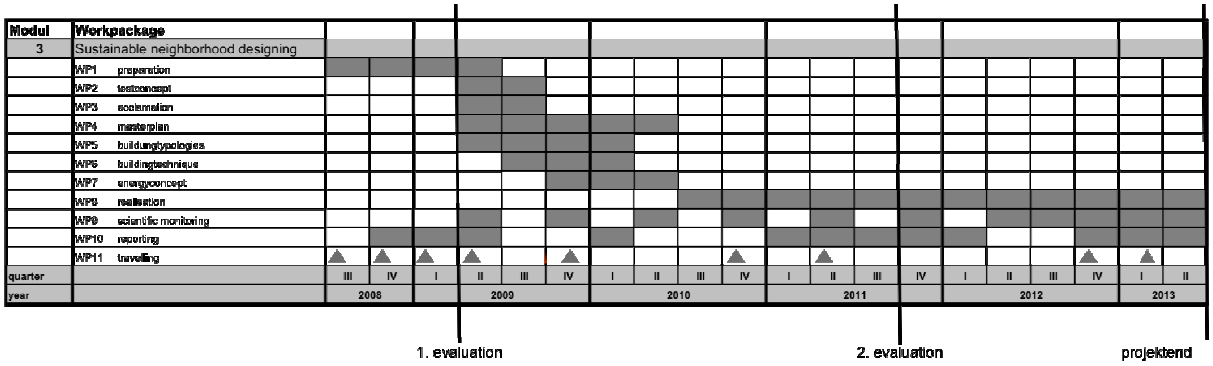
The work packages 3 and 4 are new. The activities – consulting of the Committee of Building and Transport and consulting of Chengtou Investment Corporation – already begun but are not completely finished. Therefore it is possible that this cooperation will go on in the future.

The work package 1 has been extended because it was not possible to conclude the required activities. In return the project team worked on work package 8, consulting for the EXPO.

The development of a work-schedule for Module 2 is not helpful at the moment. The whole Module will be worked by the University of Duisburg-Essen because the university is the project manager of this Module. If it is necessary other partners or experts - also from Shanghai - will be involved in this Module.

8.4 Module 3: sustainable neighborhood designing

Schedule of Module 3



Work Schedule

Below the work packages of the Module and the editors will be described in detail.

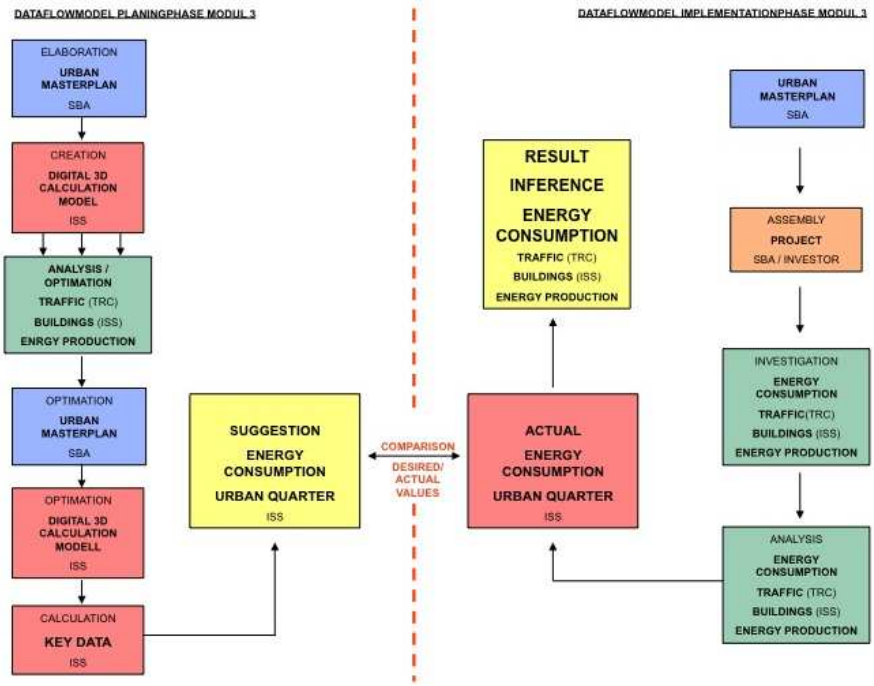


Figure 37 Data-Flow Model of Module 3

WP 1: Preparation of the project
First discussions with the persons in charge in China, choice of the planning area, formulation of concrete project objectives
WP 2: test drafts/ evaluation (energy efficiency)
Creation of the first drafts of the planning area, calculation and evaluation of their energy demand
WP 3: Adjustment phase
Adjustment of all partners concerning the test drafts, agreement for one draft which will be realized
WP 4: Masterplan
Creation of the masterplan for the planning area in consideration of the agreement of WP3
WP 5: Building Typologies
Development of a concept for energy-efficient building typologies for a realization in the planning area

WP 6: Building Technology
Development of a concept for energy-saving building technologies, which will be realized in the buildings of the planning area
WP 7: Energy concept
Development of a decentralized energy concept under comprehension renewable energies
WP 8: Realization
Realization of the masterplan; this includes for example: Creation of the local plan, preparation of a financing program, consulting and evaluation of the realization
WP 9: Scientific Monitoring
Scientific consulting and monitoring during the whole project especially concerning the energy-saving and energy-efficiency

8.5 Module 4: optimized public transport system

In Module 4 the existing schedule must be adjusted to the modified project task. The schedule shows that the work package 1 (WP1) in the year 2008 – developed against the background of the old objective – is still valid. WP 2 comprises the analysis and the assessment of the three pilot areas considering all means of transportation. This work step will last during the second and third quarter 2009. There the Tongji-University partner will take over a task also supported by SBA. WP3 comprises the development of alternative proposals and the assessment of these proposals between the third quarter of 2009 and the second quarter of 2010. Parallel reconciliations with the advisory boards and the "project authority" (WP4) take place on a regular basis.

The following implementation- and pilot phase starts in the third quarter 2010, followed by WP 6 with the accompanying researches.

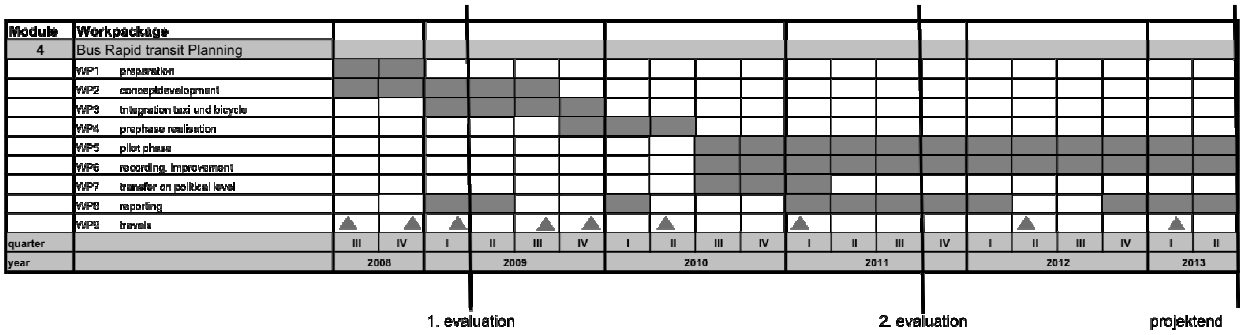


Figure 38 Previous time schedule of Module 4

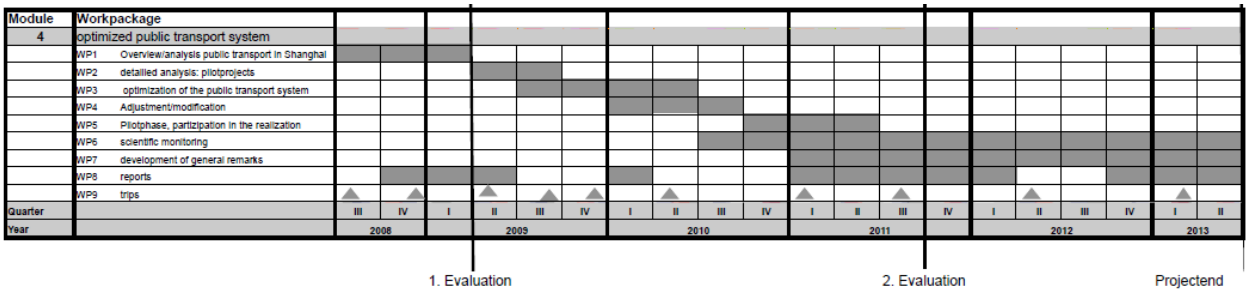


Figure 39 New time schedule of Module 4

Work Schedule

WP1: Overview and analysis Public Transport in the Shanghai Region

WP2: Detailed analysis and assessment of the three pilot areas (C) with regard to Public Transport and the connections with other means of transportation

WP3: Development of alternative proposals for the optimization of the Public Transport System, assessment of proposals

WP4: Coordination of proposals with the responsible decision makers, modifications of the proposals if necessary

WP5: Involvement in the implementation phase: pilot phase

WP6: Accompanying research

WP7: Development of general recommendations.

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10 ANNEX

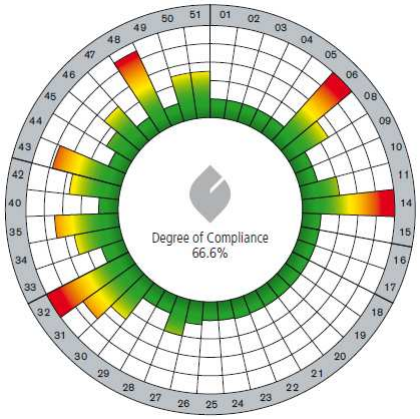
Annex Chapter 5: Approaches for an Energetic Certification

DGNB

The DGNB (*German Sustainable Building Council*) awards a certificate for outstanding buildings as an objective pass for building quality and as an instrument to promote sustainable construction[19]. The German Sustainable Building Certificate was developed together with the Federal Ministry of Transport, Building, and Urban Affairs (BMVBS) and represents a further development of the "Guideline for Sustainable Construction".

Topics of the DGNB-Certificate; Source: DGNB

The DGNB-System can be awarded for new office- and administration buildings and soon also for existing buildings and other building types and uses and is based on the life cycle of a building. For the evaluation of building quality 6 topics (ecological, economical, socio-cultural and functional, technical and process quality) are analyzed; the location quality is analyzed separately so that every project can be assessed location-independently.



Rating-System graphic DGNB; Source: DGNB

Each topic is divided into several criteria (43 criteria for building quality, 6 criteria for location quality). For each criteria measurable target values and weightings (all subjects have the same weighting (22.5%) except for the process quality (10%)) are defined. Grades are for the total performance of the building as well as for the individual topic. Energy-efficiency-relevant criteria or measures for the reduction of the energy consumption can be found under the following topics:

Within the topic „*Ecological Quality*" the total primary energy demand (PED), the non-renewable PED and the renewable PED are evaluated and assessed for the construction and operating phase. For the non-renewable PED also the energy demand in the upstream chains and in the life cycle of a building in kWh/m²NGF*a are evaluated. The total and renewable PED is assessed over the period of 50 years. Notwithstanding the German EnEV 2007 a coverage ratio of 15 % of the thermal energy demand will be covered by solar heat systems. For the assessment of construction including the HVAC-systems appropriate reference values on the basis of a average office building are defined.

Within the topic „*Socio-cultural and Functional Quality*" the thermal comfort in winter/summer is evaluated and it will be analysed, if alternative solutions should be developed within planning competitions that meet the demands concerning energy conservation and environment protection. The mobility topic is only represented by the criteria of „ Bicycle Comfort ".

Within the topic „*Technical Quality*" the energetic quality of the building's shell (average heat transmission coefficient, consideration for thermal bridges, permeability of joints, air exchange rate) based on the German EnEV 2007, the DIN 4108 and the DIN EN 12207 is evaluated in order to minimize the energy demand for space conditioning and to assure a high thermal comfort.

[19] Source: DGNB - Deutsche Gesellschaft für Nachhaltiges Bauen e.V.: Das deutsche Gütesiegel nachhaltige Bauen, Aufbau – Anwendung – Kriterien; 1. Auflage 01/2009, Stuttgart 2009, s. http://www.gesbc.org/

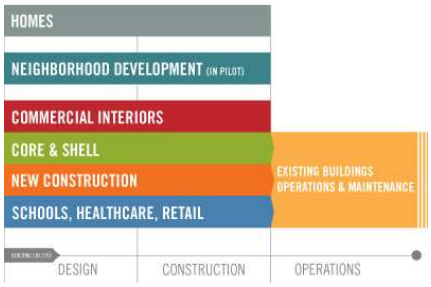
Within the topic „*Quality of the Location*“ the circumstances at the micro-locations are characterized and assessed. Also the environment of a building is assessed according to the surrounding buildings, their height and orientation which are influencing the energetic quality of a building. Additionally the connect ability of pipeline-bound energy (district heating, local heat, natural gas), as well as the solar radiance supply (shading, urban land-use planning) are described and analysed. Unfortunately there is no overall energetic assessment of the location according to the climatic conditions. The analysis of the mobility topic comprises the evaluation of the connection to transportation, the vicinity to usage-specific objects and facilities, the availability via various means of transportation and the traffic connection.

The German Sustainable Building Certificate can be adapted to the individual *requirements* of different building types. Similarly, it can be adapted to regional requirements or social developments, for example to the increasing importance of individual criteria like CO2-emissions of a building.

LEED

LEED („*Leadership in Energy and Environmental Design*“) is a Green Building Rating System, developed by the U.S. Green Building Council (Source: http://www.usgbc.org/) in 1998. It defines a set of standards for ecological, resource-conserving and sustainable construction. The certificate has already been registered in 50 US-States and in 91 countries including China for about 18.500 projects, awarded for about 2.400 projects adapted in countries like Mexico, India, Israel, Canada, Brazil and soon in China[20].

LEED was developed to define a „green building“ a common standard of measurement and is a pre-condition in many American cities in order to get a construction permit in special areas and enables tax- and other benefits. For new constructions and bigger renovations buildings can qualify for 4 levels of certification (Certified, Silver, Gold and Platinum). There are different LEED certificates[21]:



The LEED-Green Building Rating System Source: USGBC

_LEED-NC (New Construction)
_LEED-EB (Existing Buildings)
_LEED-CI (Commercial Interiors)
_LEED-CS (Core & Shell)
_LEED-H (Homes)
_LEED-ND (Neighborhood Development)
_LEED-S (Schools)
_LEED-R (Retail)

LEED as a nationally accepted benchmark for the design, the construction and the operation of high performance green buildings evaluates the buildings performance in 6 key areas with different weightings: sustainable site (20%), water efficiency (7%), energy & atmosphere (25 %), materials & resources (19%), indoor environmental quality (22%) and innovation & design process (7%).

[20] Source: USGBC: Green Buildings by Numbers, March 2009; http://www.usgbc.org/ShowFile.aspx?DocumentID=3340

[21] Source: U.S. Green Building Council, LEED, Green Building Rating System for Core and Shell Development, September 2003; http://www.usgreenbuildingcouncil.com/Docs/LEEDdocs/LEED-CS%20Pilot%20Rating%20System.pdf

Within the category "*sustainable site*" subjects like urban density and development quality, Brownfield redevelopment, access to alternative transport, development-footprint etc. are assessed. Within the category "*energy & atmosphere*" subjects like fundamental commissioning of HVEC-system, minimum (code) energy performance, refrigerant management, optimization of energy performance in buildings by 14% (new) or 7% (existing), on-site renewable energy and "green" power are analysed. Within the category "*indoor environmental quality*" the indoor air quality (minimum), the ventilation, the thermal comfort and the daylight quality are evaluated.

The *LEED for Neighborhood Development* (LEED-ND[22]) as the first national system for the design of neighborhoods integrates the principles "smart growth", "new urbanism" and "green building". LEED-ND is currently a pilot program and should be completed in summer 2009. LEED-ND aims at the development of compact, walkable, vibrant, mixed-use neighborhoods with good connections to nearby communities. As LEED-ND communities, locations close to existing town and city centers, areas with good transit access, infill sites, Brownfield sites and sites adjacent to existing development are preferred to reduce the impacts of urban sprawl or unplanned, uncontrolled spreading of urban development into areas outside of the metropolitan region. LEED-ND also issues the mobility and aims at a higher choice of modes of transport (bus, train, car pooling, walking- and bicycle network) and a reduced automobile dependence.

According to a white paper by the Leonardo Academy LEED-certified buildings achieved superior operating cost savings with an average valuation of 6.68 $ per m². The overall cost of implementation and certification of LEED-EB-projects amounts 2.43 $ per m²[23] on average.

This demonstrates that the implementation of green buildings is not expensive, especially in comparison to cost savings. Additionally LEED-certified buildings are on average 25 – 30% more energy-efficient and Gold- and Platinum-certified buildings can achieve energy-savings by almost 50%[24].

It is expected that LEED-NC 3.0 will include a requirement for a carbon footprint (carbon building print) and a significant reduction of GHG (green-house gases) beyond a baseline level. These include emissions related to the consumption of grid delivered electricity, on-site combustion of fossil fuels, and fugitive refrigerant emissions. Thereby the effects of climate change could be monetized in the same way that the *Kyoto Clean Development Mechanism Project* (CDM, Source: http://cdm.unfccc.int/index.html) describes (Example: SGS and Gujarat Fluorochemicals Ltd/GmbH in India[25]).

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[22] Source: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=148

[23] Source: The Economics of LEED For Existing Buildings For Individual Buildings, White Paper by Leonardo Academy Inc., April 21, 2008; http://www.leonardoacademy.org/download/Revised%20Economics%20of%20LEED-EB%2020081014.pdf

[24] Source: Going Green - Is it the Elephant in the Room?; http://mybuildingsuccess.com/index.php?option=com_content&task=view&id=46&Itemid=76

[25] SGS: Weltweit größtes CDM-Projekt registriert; http://www.de.sgs.com/de/the_worlds_largest_cdm_clean_development_mechanism_project_registered_on_25th_february_2005 _de?viewId=5784

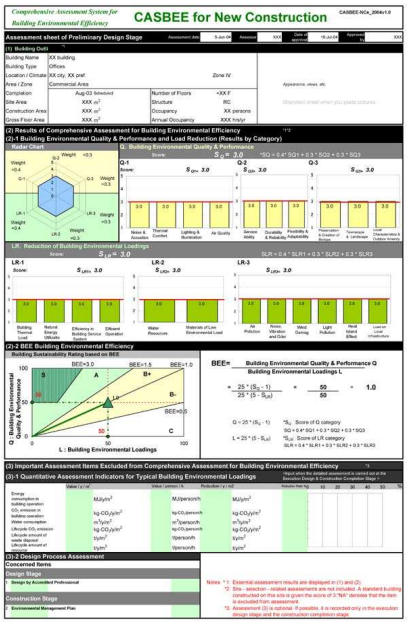
BREEAM

The BREEAM (*Building Research Establishment Environmental Assessment Method*, http://www.breeam.org/) provides an extensive assessment of ecologic, economic and socio-cultural aspects of sustainability of buildings, which already has been developed in 1990 in Great Britain and therefore is the first certificate for green buildings and for the environmental performance of buildings. The certificate has been issued for about 110.000 buildings worldwide.

BREEAM uses 9 categories which are weighted individually: Management 12 %, Health and Wellbeing 15 %, Energy 19 %, Transport 8 %, Water 6 %, Materials 12.5 %, Waste 7.5 %, Land Use and Ecology 10 % and Pollution 10 %. BREEAM can be awarded to nearly all new and existing buildings types – Bespoke (leisure complexes, laboratories, educational facilities, hotels), Courts, Homes, Multi-Residential, Healthcare, Industrial Buildings, Prisons, Offices, Retail – and can be certified for Design and the Operation of a building. BREEAM International can assess a single development or can assist in creating a BREEAM version for a country or region outside of the UK.

The *BREEAM Communities* will soon be launched to help planners and developers to improve, measure and independently certify the sustainability of development proposals at the planning stage[26]. The rating basis are "Regional Sustainability Checklists" comprising criteria which can be summarized to 8 categories: climate change and energy (u.a. energy-efficient design and management; ratio of renewable energy between 10 – 60 % of the total energy demand), community, place making, buildings, transport and movement, ecology, resources and business[27].

BREEAM also provides different instruments like e.g. the *LCA – environmental profiles* (providing information about the environmental impacts of construction materials measured over the whole life cycle of the product), *Specification – The Green Guide* (publication outlining the relative environmental impacts of over 250 elemental specifications for roofs, walls, floors etc.) and *Envest – whole building LCA software* (web-based tool that simplifies the complex process of designing buildings with low environmental impact and whole life costs).



Results Assessment Sheet CASBEE; Source: IBEC

CASBEE

CASBEE (*Comprehensive Assessment System for Building Environmental Efficiency*, http://www.ibec.or.jp/CASBEE/english/overviewE.htm) is a certificate for green buildings which is commonly used in Japan for new and existing buildings, renovations as well as urban development, urban area + buildings and homes.

The certificate uses 4 assessment categories: energy efficiency, resource efficiency, local environment and indoor environment. The 4 categories are divided into the numerator Q (building environmental quality and performance) and the denominator L (building environmental loadings, e.g. resource consumption, CO2, noise etc.) generating the Building Environmental Efficiency (BEE) for the classification of a building or a district which enables the comparison of buildings. Q is broken down into 3 categories: Q-1 Indoor Environment, Q-2 Quality of Service and Q-3

[26] Website BREEAM: BREEAM Communities; http://www.breeam.org/page.jsp?id=117

[27] BREEAM Communities: Draft Technical Guidance Manual; 2008; http://www.breeam.org/filelibrary/BREEAM_Communities_Pilot_Program_Draft_Issue_1_0.pdf

Outdoor Environment on Site. L is sub-grouped into L-1 Energy, L-2 Resources& Materials and L-3 off-site Environment. Overall 6 aspects with 22 main categories and 90 sub-categories are evaluated.

Green Star

In Australia and New Zealand there is a system known as *First Rate* aiming at the improvement of the energy efficiency in residential buildings. The *Green Building Council of Australia* (GBCA, http://www.gbca.org.au/[28]) established a Green-Building-Standard which is known as the *Green Star* and is similar to LEED and BREEAM in structure and rating process. The 8 performance categories are weighted differently due to different local conditions: Management (10%), Indoor Environment Quality (12%: ventilation rates, air exchange effectiveness, thermal comfort), Energy (24 %: GHG emissions, energy sub-metering, peak energy demand reduction, car park ventilation), Transport (8 %: provision of car parking, fuel efficient transport, cyclist facilities, Public Transport, trip reduction – mixed use), Water (19%), Materials (10%, no evaluation of different Materials and Insulation), Land Use & Ecology (9%) and Emissions (8%). It is used for Retail Centre, Education, Offices (new, interiors); the Green Star for Industrial, Multi Unit Residential, Mixed Use, Healthcare and Office Existing Buildings is still in pilot phase[29]. To qualify for a Green Star assessment projects must meet all 4 requirements (space use, spatial differentiation, conditional requirements, certification timing).

Energy Star

The *Energy Star*-Program of the *US Environmental Protection Agency* and the *U.S. Department of Energy* analyses commercial and residential buildings according to their energy efficiency and provides Energy Star-qualifications for objects meeting the standard for energy-efficient construction. The Energy Star also refers to household appliances and to the energy management (measuring the current energy performance, target development, implementation of economy measures) and provides an innovative Energy Performance Rating System. Residential buildings must be 15 % more energy-efficient than the *2004 International Residential Code* (IRC) requires and must contain additional energy-saving components featuring a 20 – 30% higher energy efficiency than standard buildings. Energy Star-qualified buildings can contain a wide scope of energy-efficient components: an effective insulation, thermally insulated windows, an airtight building envelope, efficient heating- and ventilation systems and efficient household appliances[30].

HQE²R

The Research- and Demonstration Project „Sustainable Renovation of Buildings for Sustainable Neighborhoods – HQE²R“ (*Haute Qualité Environnementale et Economique Réhabilitation*, Source: http://hqe2r.cstb.fr*)* was funded from July 2001 till March 2004 by the

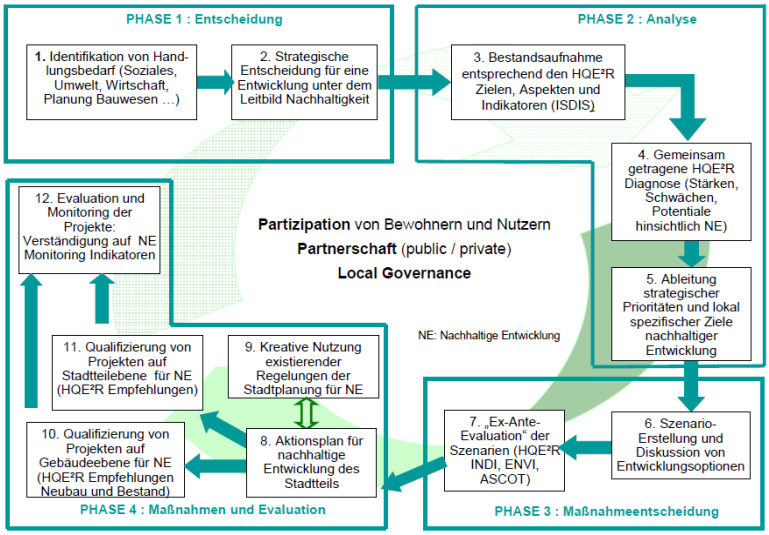
[28] Website GBCA; http://www.gbca.org.au/ und http://www.gbca.org.au/green-star/rating-tools

[29] Rating tool factsheet: Green star - Retail centre; Status: Version 1 (v1) released August 2008; http://www.gbca.org.au/uploads/221/1757/Retail%20Centre%20Fact%20Sheet_260808.pdf

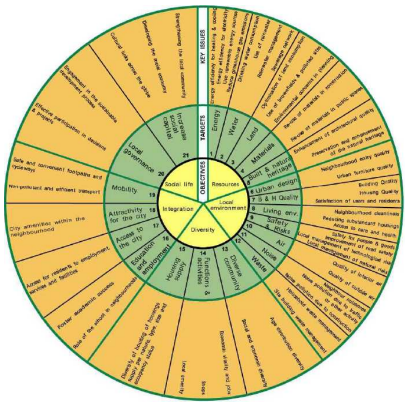
[30] Website EnergyStar; http://www.energystar.gov/index.cfm?c=home.index und http://www.energystar.gov/index.cfm?c=new_homes.nh_features

European Commission under the Fifth Framework R&D Programme and coordinated by the biggest French Building Research Center CSTB[31] .

10 Research Institutes and 13 municipal case studies from 7 European countries (Germany, Great Britain, France, Denmark, Netherlands, Italy and Spain) cooperate within this project. German partners are the IOER (Institute of Ecological and Regional Development in Dresden, http://www.ioer.de/index.php?id=524) and the Municipal Planning Administration Dresden.



The HQE²R approach towards sustainable neighborhood development, Source: IOR



5 HQE²R objectives, 21 targets and 51 key issues (ISDIS for the sustainable development of city districts [Source: IOR]

With the HQE²R-approach systematic framework has been developed, which can be generally applied in European cities. The HQE²R-project provides decision aid tools for municipalities and their local partners promoting sustainable development and the quality of life at the level of urban neighborhoods and derives concrete operational methods and tools (Action Plan) for the municipalities.

The HQE²R contains 6 leading principles: participation/governance, global embedding, long-term consideration, social acceptability, compatibility of environment and economical efficiency. Based on these principles HQE²R defines 5 main global sustainable development objectives: diversity, integration, natural and cultural heritage, quality of life and social cohesion.

The analysis framework is supported by a aspects- and indicator-system which enables the sustainability assessment of city districts using 5 main global objectives, 21 targets with 51 key issues and overall 61 indicators (ISDIS: „Issues and Sustainable Development Indicators System).

ISDIS defines on-site the common content nucleus of the instruments and the empiric work like e.g. inventory methods, analyses and later scenario development on Neighborhood level. For every indicator there is a description with background information, recommendations for the acquisition and reference values. For the „Ex-ante-Evaluation" 3 assessment tools are offered: *INDI* („Indicator Impact") based on the ISDIS and enabling the sustainability assessment of neighborhoods, *ENVI* („Environmental Impact") assessing the environmental impacts of projects in the fields of energy, water, area, waste and CO2 on neighborhood level,

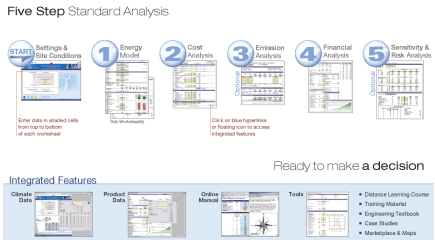
[31] http://www.cstb.fr

and *ASCOT* calculating and optimizing the global costs of a construction project (buildings level). For a more detailed evaluation an additional overview over existing assessment approaches for buildings and districts resp. has been developed[32].

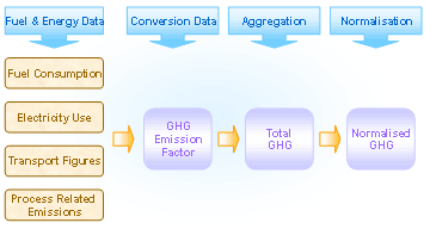
Green Building Tool /Sustainable Building Tool (INT)

The GB-Tool or the SB-Tool was developed by the iiSBE (*International Initiative for a Sustainable Built Environment*, Website http://www.iisbe.org/iisbe/start/iisbe.htm) with the collaboration of 20 countries and serves as a rating framework for new constructions and existing buildings. It requires the adaption to the respective regional situation by setting weighting factors, benchmarks and comparison standards. There are 2 input masks: Module A for the Benchmarking, the weighting and the fuel emissions and Module B for the location, the buildings data and the energy assessment.

Furthermore iiSBE provides the SBIS (*Sustainable Building Information System*), a web-based database for an independent and objective information representation. There are 8 assessment criteria: choice of location (et al. Urban development), energy- and resource consumption (consumption of fossil energy in the life cycle, forecast of energy peak consumption, renewable energy, coordination of HVAC-system, materials- and water consumption), environmental impacts (et al. CO2-emissions), internal building quality (air quality, -circulation, -temperature, relative humidity, daylight influence and lighting), functionality and controllability of building systems, long-term availability, social and economic aspects as well as cultural and perception aspects. The point rating system is carried out in these 8 categories with weighted main- and sub criteria.



Structure of the RETScreen; Source: UNEP



Structure of the GHG Indicator; Source : UNEP

RET Screen

RET Screen (*Renewable Energy Technology Screen*, Source: http://www.retscreen.net/de/home.php) developed by Natural Resources Canada (NRCan) is a pre-feasibility analysis software for renewable energy projects. The software, available free of charge, can be used to evaluate the annual energy production, costs and financial viability of the following renewable energy technologies (RETs): Wind energy, Small hydro, photovoltaics, solar air/water heating, biomass heating, passive solar heating und ground source heat pumps. An energy model with an integrated climate database and the emission analysis are part of the RET Screen.

Additionally the **GHG Indicator**[33] has been developed in cooperation with the *United Nations Environment Programme* (UNEP, http://uneprisoe.org/) and CANMET *Energy Diversification Research Laboratory* (CEDRL, http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/eng/index.html) as a greenhouse gas emissions (GHG) mitigation model for the calculation and minimization of GHG emissions of industrial buildings and non-commercial organizations. Parallel to this effort, the U.S. National Aeronautics & Space Administration (NASA[34]) worked with NRCan to facilitate the use of NASA's global satellite data with RETScreen.

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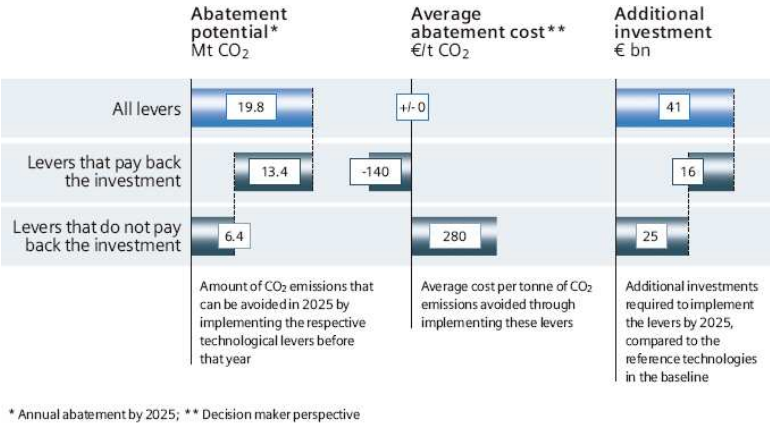
[32] Blum, Andreas: Entwicklung nachhaltiger Nachbarschaften – Das Europäische Instrumentarium HQE²R; Leibniz-Institut für ökologische Raumentwicklung (IÖR), 2005

[33] http://www.uneptie.org/energy/information/tools/ghg/software.htm

[34] Website NASA: NASA Surface meteorology and Solar Energy; http://eosweb.larc.nasa.gov/cgi-bin/sse/retscreen.cgi?uid=0

Approaches for an economic assessment in the fields of mobility and buildings – the London example

In this digression the results of a research study by McKinsey & Company[35] about Sustainable Urban Infrastructure with London as a case study are presented. This research aims at evaluating the environmental protection effects of technological levers until 2025 without compromising the current lifestyle. This study therefore is not focusing on the social or economical aspects of sustainability or the shift in users´ behavior.



Overview of identified potential, costs and investments for greenhouse gas reduction in London

One of the key findings of the study is that London can meet international greenhouse gas targets without a massive shift in its citizens' life style by exploiting existing technology. The identified technological levers, if fully adopted, would lead to a cut of almost 44% from 1990 levels by 2025 with C02-emissions of less than 26 megatonnes (Mt) exceeding the targets stipulated at Kyoto (12,5 % by 2015), by the EU (20% by 2020) und the British Government (30% by 2025). In order to meet the target aspired in the *London Climate Change Action Plan* of 60% by 2025, a combination of regulatory change, lifestyle change and future technological innovation is necessary.

About two-thirds of these solutions will pay for themselves. Some of these technological shifts would cost more than remaining in the status quo, but the majority would save money for those who invest in them, largely by reducing energy costs. Adopting all of the levers identified to eliminate 19.8 Mt annually from London's emissions by 2025 would take an total investment of about 41bn Euros over a 20-year period – or less than 1% of London's total economic output, which is less than 300 Euros per inhabitant per year or around half of the average Londoner's annual bill for gas and electricity. In the year 2025, the resulting average net cost of reducing 1 tonne of CO2 through these technologies would be around zero.

[35] Source: Denig, Stefan: Sustainable Urban Infrastructure, London Edition – a view to 2025; Forschungsprojekt von McKinsey & Company gefördert durch die Siemens AG; München 2008

The CO2 saving potentials and measures have been evaluated and assessed in detail in the building, transport, energy supply, water and waste sectors.

In the building sector the single biggest possible lever for CO2 is better insulation, which on its own could reduce 4.5 Mt, or 10%, out of the city's annual carbon output by 2025 or could save the investors about 150 Million Euros per year in energy costs net of investment. Measures relating to more efficient heating of buildings and an optimization of controls could add another 2.7 Mt of reductions, saving almost 400 Million Euros, and energy-efficient lighting could eliminate 1.4 Mt per year and save around 170 Million Euros annually. Replacing old appliances with more energy-efficient ones in homes and offices could cut a further 1.3 Mt of CO2 emissions.

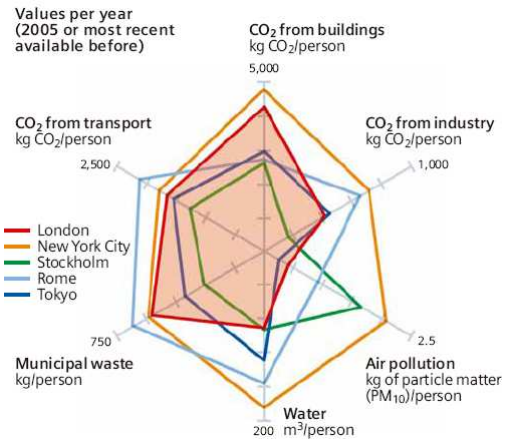
In the transport sector with over half of London's transport- related greenhouse gas emissions coming from cars, cost-efficient measures to improve automobile fuel efficiency are the cheapest and most promising technological innovations, with a potential of abating 1.2 Mt of CO2 and savings of 400 Million Euros. City government can also make a difference by investing in hybrid buses which would reduce an additional 0.2 Mt, and save around 50 Million Euros.

	Levers	Abatement potential[1] Mt CO_2	Average abatement cost[2] €/t CO_2	Additional investment € bn	Abatement/ investment ratio kg CO_2/€	Decision maker
Buildings	Insulation	4.5	-30	10.4	0.4	• Individuals (70% of potential) • Businesses/city (30% of potential)
	Heating efficiency	2.7	-150	1.0	1.9	
	Lighting	1.4	-120	0.9	1.5	
	Appliances	1.3	-190	0.8	1.6	
	Other	0.7	460	7.3	0.1	
Transport	Higher car efficiency[3]	1.2	-320	2.4	0.5	Individuals[4]
	Biofuels	0.5	140	–	n/a	National level
	Hybrid passenger cars	0.3	1,700	5.3	0.1	Individuals
	Hybrid bus	0.2	-240	0.5	0.4	City
	Other	0.8	230	4.3	0.2	Various
Energy	Grid mix	3.7	40	1.1[5]	3.4	National level
	CHP	2.1	-90	4.0	0.5	Businesses
	Other	0.4	570	3.5	0.1	Individuals/businesses

1) Abatement by 2025; 2) Decision maker perspective; 3) Economical levers only; 4) Assuming car manufacturers follow individuals' demand; 5) Pro rata share of total investment at national level

Overview of identified greenhouse gas abatement levers in London 2025

The Figure above gives a general overview over the saving potentials and costs. Also interesting is the comparison of cities' environmental footprint (see Figure below).



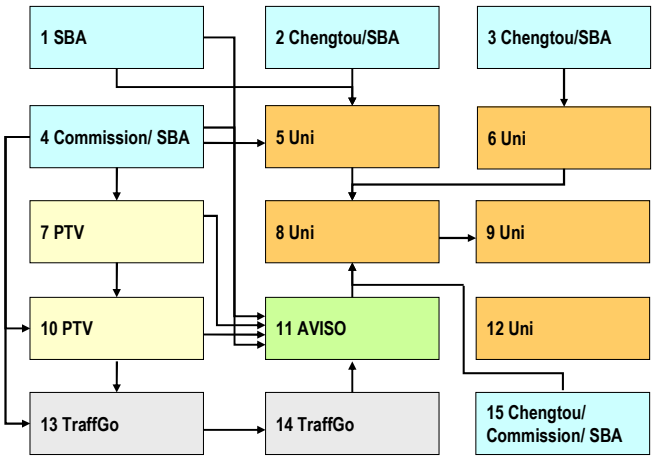
Comparison of cities' environmental footprint

Annex Chapter 6.1: Energy Monitor

The project participants have met several times for working out the Module. So far, the following meetings have taken place:

Date	City	Participants
25 June 2008	Essen	Interlinked transit system partners
22 July 2008	Essen	Module 1 participants
15 October 2008	Essen	Management group
17/18 December 2008	Essen	Intergraph, ISS, TRC, Abstracture
14 January 2009	Essen	Module 1 participants, interlinked transit system partners, management group

The individual interface data are:



Task concept, Source: own exposure

1 SBA weather data: SBA provides the statistical weather data for 2008 (differentiated according to h, d, m, a) for the planning region; access to online weather stations is created (Plan A); Plan B is the forwarding of the evaluations with statistical data.

2 SBA building data: The buildings for the planning region are typified and handed over in digitalized form with the data needed for calculating energy consumption; SBA also takes over the updating service (vrs. biannual cycle).

3 SBA renewable energy production: Plan A consists of recording the current installations in the planning region and determine their production dynamically (h, d); Plan B envisages a modeling of production. SBA also takes over the updating service (vrs. biannual cycle).

4 SBA network, structure and traffic data: The data mentioned are compiled and collected according to the basis of the “7 PTV, 10 PTV, 11 AVISO and 13 TraffGo” guidelines. SBA is also in charge of setting up dynamic measuring points according to the “10 PTV and 13 TraffGo” guidelines. Furthermore, SBA takes over the updating service of the network and structural data (vrs. biannual cycle).

5 University building model, energy consumption: From weather data, known values of buildings and structural data, the University of Duisburg-

Essen determines the building- and resident-related daily energy consumption. These data are then passed on to the energy controller ("8 Uni"). The University of Duisburg-Essen takes over the archiving task for this point.

6 University renewable energy production: From the "4 SBA" data, the University of Duisburg-Essen determines the daily energy production of the renewable energy sources recorded in the planning region. If energy production can be directly recorded, this procedure does not take place. The University of Duisburg-Essen takes over the task of archiving for this point.

Calculate 7 PTV traffic model and 10 PTV traffic situation IV: As part of the preliminary phase for the development of the Nanqiao planning region traffic model for motor vehicle street traffic, it had been foreseen for public transportation to take over and make it more dynamic within the scope of the hourly-based EEC development.

The hourly link-related mileages, the trip paths and the persons moved in the traffic result from this dynamic traffic model that differentiates according to means of transportation. These data represent – in coordination with "11 AVISO" requirements, the source data for the energy consumption estimate in street traffic, public transportation as well as for inland waterway and rail cargo transportation. The latter transportation carriers are calculated on a per diem basis. PTV takes over the archiving task for this point.

8 Maintain university desired values, calculate desired/actual comparison: Taking the objective value functions ("15 SBA") as basis, the energy consumption results and energy production estimates are combined to daily values from which monthly and yearly forecasting values are derived, compared with the objective values and processed in monthly and annual reporting.

9 University Internet Edition: The results from "8 Uni" are made available in staggered form to the administrative authorities, the politicians and the public at large. The published data are filed away.

11 AVISO energy consumption traffic: The hourly/daily energy consumption of traffic is determined by AVISO and fed into the energy controller ("8 Uni"). When doing this, AVISO takes into account the required differentiation of fuel types in street traffic. Data for the trip paths of the vehicle collective are used from "14 TraffGo" for improving the consumption estimate IV. AVISO takes over the archiving task for this point.

12 University central archive: The University of Duisburg-Essen develops the database structures and maintains all data in a central archive. The respective partial projects have reading access to it.

13 and 14 TraffGo traffic situation and energy consumption estimate, microscopic: For a pre-selected street or partial areas, TraffGo applies a microscopic simulation model that uses dynamic traffic data. The model delivers vehicular data for the trip sequence (accelerations, delays) and is suitable for providing reference values for the consumption algorithms used by "11 AVISO". TraffGo uses the simulation model for a traffic situation estimate that supplements the calculation of "7 PTV" in the planned partial area. TraffGo takes over the archiving task for this point.

15 SBA objective functions: SBA takes over the coordination of the objective values to be defined by the political region for reducing the increase in consumption. The objective values flow into “8 Uni” for the desired/actual comparison. Different objective value functions are planned, differentiated per subject field and according to energy carriers. In Plan B, objective value functions from own estimates of the savings and production potentials are derived.

The individual tasks are connected by the information and data flows shown. These connecting lines represent interfaces that were also put into concrete terms in the total concept. Every interface was exactly defined with regard to the exchanged data by the partners involved. Specifically, type of data, contents, dimension, spatial and temporal reference as well as information (whether the data are static or dynamic) are recorded.