low carbon cities

莱默建筑设计工程咨询（上海）有限公司
BBS INTERNATIONAL CHINA Co. Ltd.
BBS Engineers
BBS INSTITUT

Germany . China

energy saving experts

PAVILION of INNOVATIONS
German Centre Shanghai
88 Keyuan Lu, Pudong
Shanghai 201203 China

Tel: +86 (0) 1891 7998 179

shanghai@BBS-INTERNATIONAL.com
www.BBS-INTERNATIONAL.com

Office address

Am Forst 27
38302 Wolfenbuettel - Germany

Tel: +49 (0)5331-97 17-0
Fax: +49 (0)5331-97 17-17
wf@BBS-INTERNATIONAL.com
www.BBS-INTERNATIONAL.com

莱默建筑设计工程咨询（上海）有限公司
BBS INTERNATIONAL CHINA Co. Ltd.
BBS Engineers
BBS INSTITUT

Germany . China

Motivation	**目的**
Innovations in Energy saving of Buildings and Green Buildings	建筑节能和绿色建筑的新型技术
Innovations of Indoor Climate and the Climate Concepts	室内气候及方案的新理念
Innovations of HVAC System	建筑设备新型技术
Innovation in structure design	结构设计新理念

Priorities	**优先顺序**
Quality and Durability of the Building	建筑物质量和使用寿命
Quality Control	质量控制
Economical Optimisation	经济优化
Ecological Optimisation	生态优化

according to Chinese AND German Standards	**根据中国和德国标准**

energy saving experts

climate concepts	气候方案
HVAC concepts	设备方案
building physics of the building envelope	建筑围护结构的物理学研究
green buildings	绿色建筑
solar architecture	太阳能建筑
certification of building	建筑物认证
software tools for energy efficiency and certification of the building envelope	建筑围护结构能耗优化及认证软件

莱默建筑设计工程咨询（上海）有限公司
BBS INTERNATIONAL CHINA Co. Ltd.
BBS Engineers
BBS INSTITUT

Germany . China

Company for Engineering in Structural Design Building Physics Redevelopment-Techniques	结构设计 建筑物理及 改建技术 工程公司
Institute for Research and Materials Testing in Applied Building Physics and Building Materials	应用建筑物理 /建筑材料研究 与材料检测研究院

The BBS is anxious to realize the current state-of-the-art in practice and consequently to give commands to the implementation.
The BBS INSTITUT supports the BBS INGENIEURBÜRO with laboratory tests while working on projects.
The characteristics of the building materials and their dependence on the accompanying situation are checked to develop an optimal concept regarding an economical point of view.

Complementary, we give advice to the development of new structures and materials. These new structures and materials will be optimized on the basis of preliminary studies which are based on scientific and practice-orientated research; also, we attend to them until launch.
We work on publicly promoted themes of research as well as concrete kind of questions of the industry and economy.

BBS一直致力于将最新的科技运用于实践之中，并对项目的最终完成给予指导。
BBS研究院为BBS工程事务的项目处理工作提供了必要的实验支持。

我们会对建筑材料特性及其适用情况进行检查，并以此为基础，从经济角度出发拟定一个最优方案。

需要补充说明的是，我们还从事新型建筑结构与材料研发的咨询工作，以科学的、面向实践的研究为基础对结构及材料进行初步研究，并在初步研究的基础上将其优化。我们会不断致力于此，直到将产品引入市场。

我们也从事国家资助的研究项目， 比如有关工业和经济的具体课题。

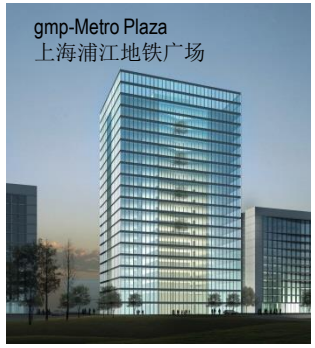
innovations for buildings

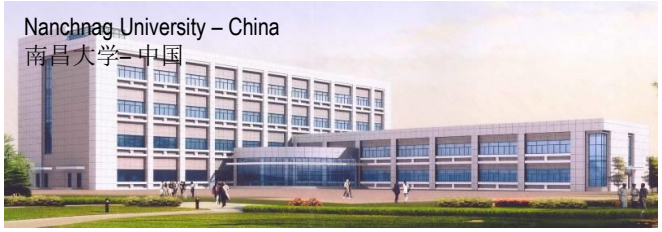
projects

international projects

International projects

BBS INTERNATIONAL.
国际项目
莱默建筑设计工程咨询(上海)有限公司

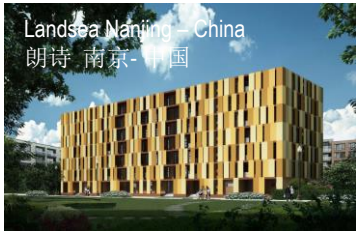




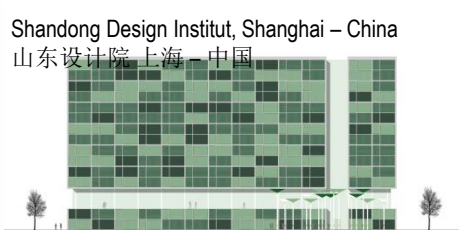
international projects

International projects

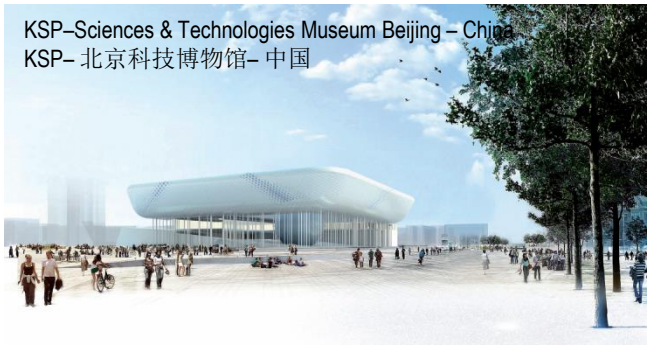
BBS INTERNATIONAL
国际项目
莱默建筑设计工程咨询(上海)有限公司

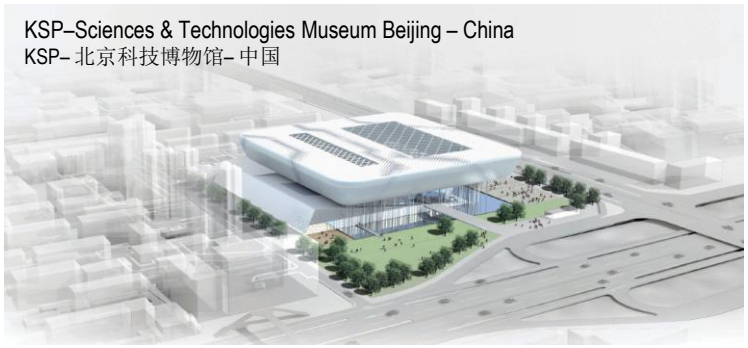

Landsea Nanjing – China
朗诗 南京- 中国

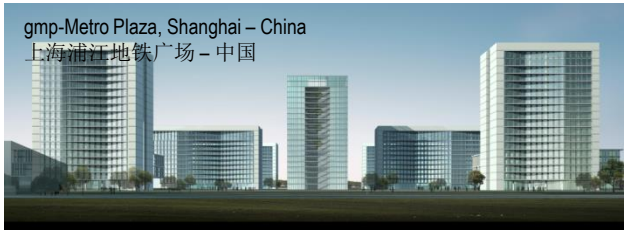

Landsea Nanjing – China
朗诗 南京- 中国

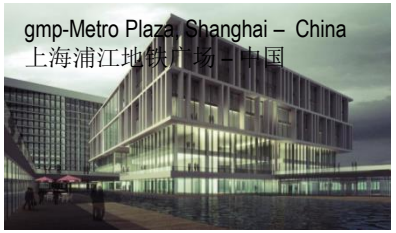

Shandong Design Institut, Shanghai – China
山东设计院 上海 – 中国


KSP – SIPO Beijing – China
KSP –SIPO 北京- 中国


KSP–Sciences & Technologies Museum Beijing – China
KSP– 北京科技博物馆– 中国


KSP–Sciences & Technologies Museum Beijing – China
KSP– 北京科技博物馆– 中国


gmp-Metro Plaza, Shanghai – China
上海浦江地铁广场 – 中国

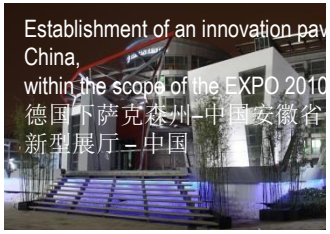

gmp-Metro Plaza, Shanghai – China
上海浦江地铁广场 – 中国

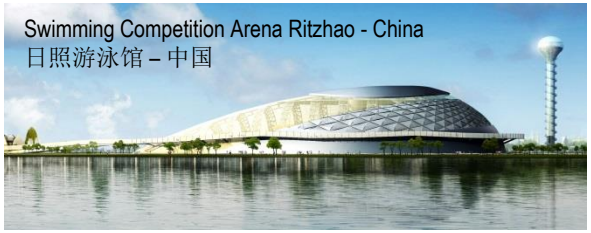

gmp-Metro Plaza, Shanghai – China
上海浦江地铁广场 – 中国

international projects

International projects

BBS INTERNATIONAL
国际项目
莱默建筑设计工程咨询(上海)有限公司





Chapel of Our Lady of Guia – Macao
澳门特别行政区圣母雪地教堂

low carbon project

Low Carbon Economy in Cities of China
中国城市的低碳经济

BEE (Building Energy Efficiency) Simulations
- Possibilities to estimate the national potential of CO2-Emissions
建筑节能模拟 - 对国内碳排放估算的可能性

Preamble 序言

The Chinese government decided the domestic emission reduction goals in the 12th Five Year Plan (2011-2015) according the international emission reduction goals the reduction of carbon intensity per unit of GDP in China by

40-45% in 2020

against 2005 levels.

中国政府决定在第12个五年计划期间（2011-2015）国内温室气体减排目标依据国际减排标准-每单位GDP中碳含量到2020年实现相对于2005年减少

40%到45%。

In order to detect and to investigate the CO2 savings potential, the following steps of work need to be done:

Numeric simulation of the range of the Energy Demand from the selected building types for *heating, cooling and dehumidification*
Setting of a base-line for each building type
Calculation of the Energy Saving - / CO2 Emissions Saving Potential of each building type
Forecast of the CO2 Emissions Saving Potential for a whole pilot-region

为了监查和监测二氧化碳减排潜能，须完成以下工作步骤。

对所选建筑类型在采暖、制冷、以及除湿方面的能源需求进行数值建模
对每一项建筑类型设立基准线
计算每一项建筑类型的节约能源以及二氧化碳减排潜能
预测整个试点地区的二氧化碳减排潜能进行

Base-Lines 基准线

The detection of the CO2 savings potential is based on the so called baselines, which are set by the

二氧化碳减排潜能的监测基于一定的基准线，而此基准线由

Energy Standard of National Standards and/or regulations by each country

各个国家各自的节能标准及规范来确定。

Examples:
For China the Standards
- GB50189-2005 public buildings
- GB/T 50378-2006 Green Building Standard
- GB 50189-2005 non-residential buildings
- GB 50176-93 residential buildings
- Added by regional regulations such as standard 50% or 65%

For Germany regulation EnEV2009-DIN 18599

例如：
中国标准规范
- GB50189-2005 公共建筑
- GB/T 50378-2006 绿色建筑评价标准
- GB50189-2005 非民用建筑
- GB50176-93 民用建筑
- 加上地区规范 如标准 50% 或65%

德国标准规范- EnEV 2009-DIN18599

Calculation of the Primary Energy Demand (PED)
初级能源需求PED 计算

ED_CDM – Baseline

=

EDsim.50 e.g. EDcalc.50 – ED Planning – ED Realization – ED Users behavior

Work Steps
Calculation of the Energy Demand (ED)
- Heating
- Cooling
- Dehumidification

Calculation of the Energy losses by the HVAC Systems (ED_HVAC)

Definition of the Transform Factor of the power grid of the region (ED_Factor)

工作步骤
计算能源需求（ED）
- 采暖
- 制冷
- 除湿

计算由室内设备系统产生的能源损失（ED-HVAC）

定义地区能源转换系数（ED-Factor）

Thermal Energetic Building Simulations TES
热力学节能建筑模拟 TES

The simulation model considers
external climate conditions of the region by hour data
Boundary conditions according the calculations in use
- General information
- Building related information / data
- User based information / data

According the Chinese Guidelines
and / (or if not defined)
German Guidelines DIN 18599

Variables
Building shape
- Building size

Building Volume
Building High
Building Orientation
Building ground Floor area
Building (Use) Floor – Area
Building Window to Wall area ratio
Building construction elements / layers of the building element
- Building envelope
- Building windows

Mistakes during
- Planning Phase
- Realisation Phase on side
- Users behavior

Regional climate in the Region

Constants
Standard Building Elements according the Chinese Requirements

模拟模型采用了以下考虑
按小时统计的地区外部气候条件
由计算确定的边界条件
- 一般信息
- 建筑物相关信息/数据
- 基于用户的信息/数据

依据中国规范
以及（如果未定义）
德国规范 DIN 18599

参数变量
建筑物形状
- 建筑物尺寸

建筑物体积
建筑物高度
建筑物朝向
建筑物底面积
建筑物楼层面积
建筑物窗墙比
建筑物建筑构件/建筑单元层次
- 建筑物围护结构
- 建筑物窗体

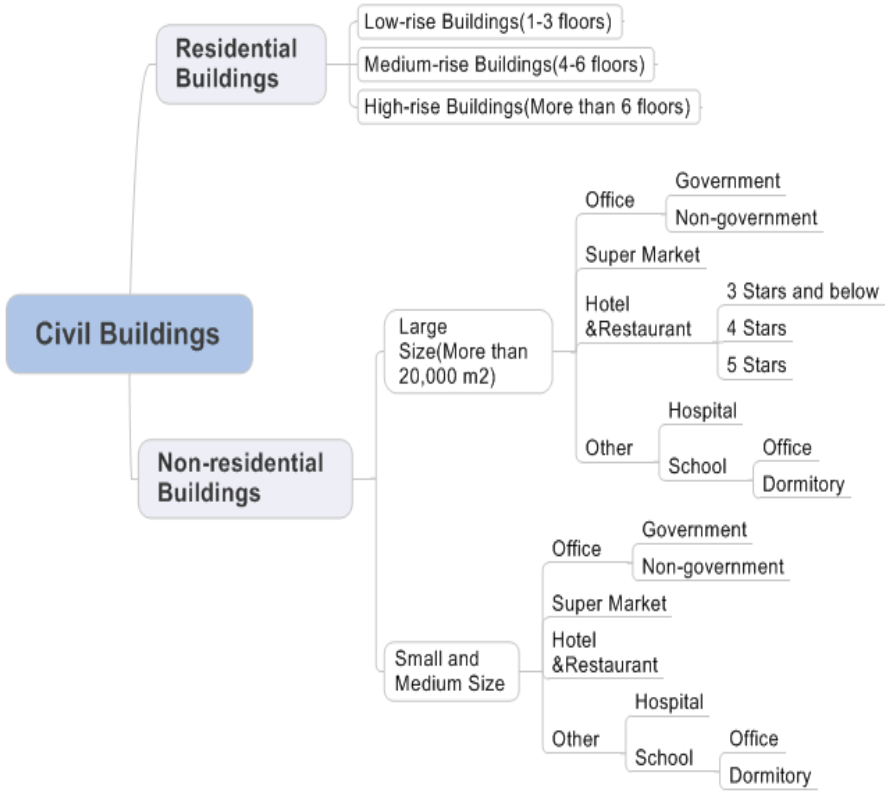
在以下阶段中出现的误差
- 设计阶段
- 施工阶段
- 使用者行为因素

地区气候

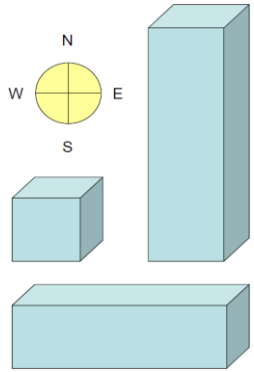
常量
依据中国规范的标准建筑单元

Selection of building types
建筑物类型选择

Single family houses	别墅
Multi-storage houses	多层公寓
Office buildings	办公楼
Shopping centres	购物中心
hotels	旅馆
Congress / Fair	会议楼/游乐场
Schools	学校
Other buildings	
for example:	其他类型建筑 如：
Restaurants Theatre	饭店，
Cinema Library	剧院，
Sports facility	影院，图书馆，运动场所



Selection of building types
建筑物类型选择

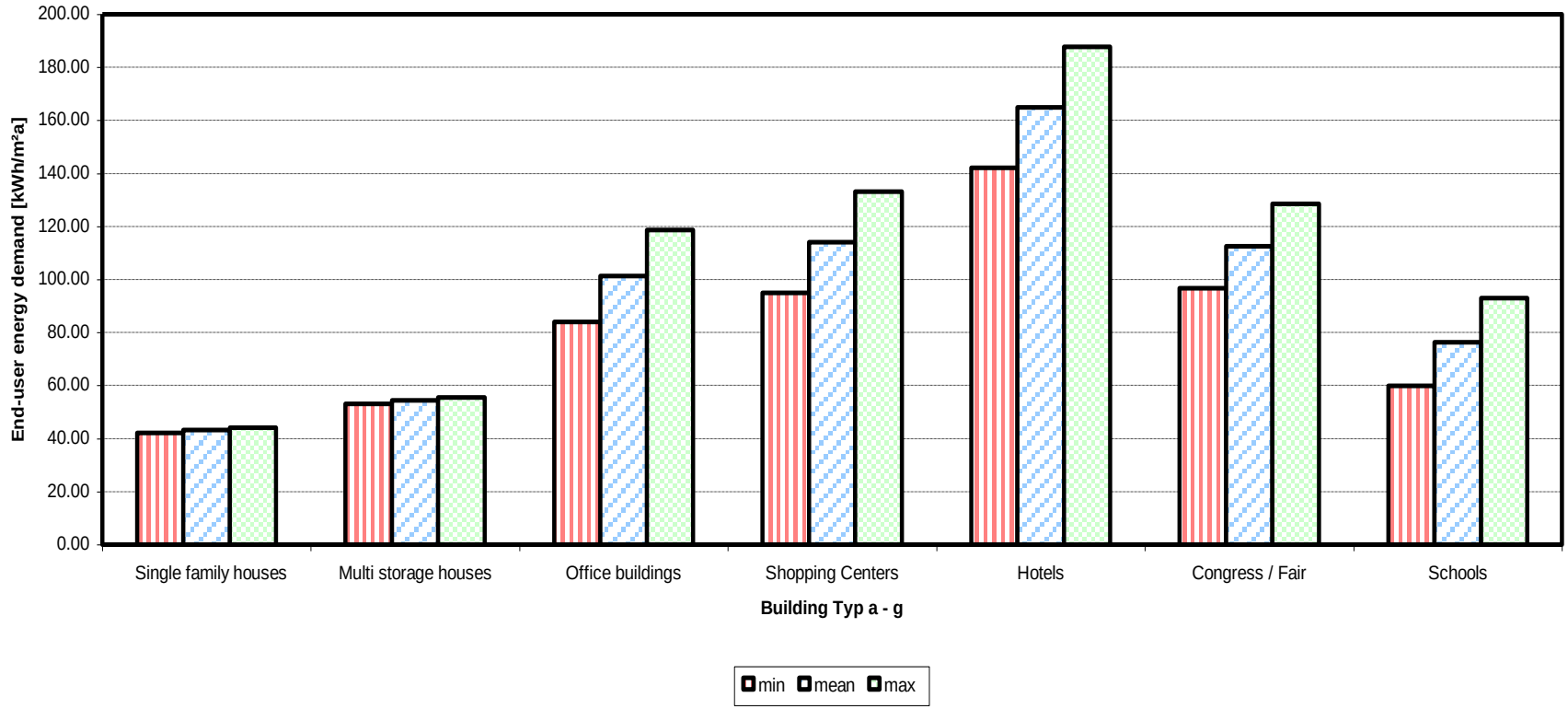
	Building Typ a 建筑类型a	Building Typ b 建筑类型b	Building Typ c 建筑类型c	Building Typ d 建筑类型d	Building Typ e 建筑类型e	Building Typ f 建筑类型f	Building Typ g 建筑类型g	Building Typ h 建筑类型h
	Single family houses 别墅	Multi-storage houses 多层公寓	Office buildings 办公楼	Shopping centres 购物中心	Hotels 旅馆	Congress / Fair 会议楼/游乐场	Schools 学校	Other buildings for example: Restaurants Theatre / Cinema Library Sports facility 其他类型建筑如：饭店， 剧院，影院，图书馆，运动场所
Type	a1 – a2	b1 – b7	c1-c8	d1-d4	e1-e8	f1-f4	g1-g4	
Number of floors 楼层数	2, 3	10, 20, 30	10, 20, 40, 80	5, 10	10, 20, 40, 80	5, 10, 20	3,4, 5	
Floor area - total 楼层总面积	450	3000 .. 36000	25000 .. 450000	28000 .. 100000	56000 .. 800000	25000 .. 450000	3000 .. 36000	
A/V – ratio 面积与体积比	> 0,33	0,23 .. 0,16	0,08 .. 0,05	0,05 .. 0,04	0,05 .. 0,04	0,08 .. 0,05	0,08 .. 0,02	

Simulated End-user Energy Demand最终用户能源需求模拟
Simulated CO2 - Emissions 二氧化碳排放量模拟

No.	Building type	**Simulated energy demand (mean value)** for cooling, heating, dehumidification current. Energy Standard China	
		kWh/m²a	kg CO_2/m²a Xiamen
a.	Single family houses	43,10	37,03
b.	Multi-storage houses/multiple families	54.28	46.64
c.	Office buildings	101.29	87.03
d.	Shopping centres	114.02	97.97
e.	Hotels	164.93	141.71
f.	Congress/Fair buildings	112.60	96.74
g.	Schools	76.37	65.61

Simulated End-user Energy Demand 最终用户能源需求模拟
Range for heating, cooling and dehumidification (HVAC -normal standard)
在采暖、制冷以及除湿范围内 （室内设备-普通标准）

Simulated end-user energy demand for heating, cooling and dehumidification
(normal standard - windows-wall area ratio 30-40%)



Low Carbon Economy in XIAMEN-Jimei
厦门集美-低碳经济

BEE (Building Energy Efficiency) Simulations
- Possibilities to estimate the national potential of CO2-Emissions
建筑节能模拟-对全国碳减排潜能估计的可能性

The aim of this part of the research
此部分研究的目标

Implementing a building energy efficiency simulation in the calculation of the energy consumption and the CO2 emissions of the 7 characteristic building types for new buildings in China under the climate conditions according to GB50189 for the region “hot summers and warm winters”

依据GB50189针对夏热冬暖地区的气候条件，对七种典型建筑物类型，将建筑节能模拟应用到新建建筑物的能耗计算以及二氧化碳排放计算。

Possible variables of the building type are
Size
Height
Orientation according to azimuth of the buildings
Different ratios of the wall-/window areas of the facades
Different users behavior in the building
Different quality standards of the building technical systems, installations for energy distribution and energy production
and
range of influence on planning- / arithmetic errors
Range of realizations mistakes on site.

建筑物类型参数
尺寸
高度
建筑物的朝向
不同的窗墙比
建筑物内不同的用户行为
建筑物技术设备系统不同的质量标准， 能源分配以及能源解决系统
对设计与计算上误差的估算
对施工误差的估算

CO2 Saving Potential 二氧化碳减排潜能
Bottom-up calculation process for Jimei – Pilot Project
集美-试点项目的逆向计算过程

A - pilot region
B - building side area
C – building type [a.- f.]

Jimei – Pilot Project 集美-试点项目

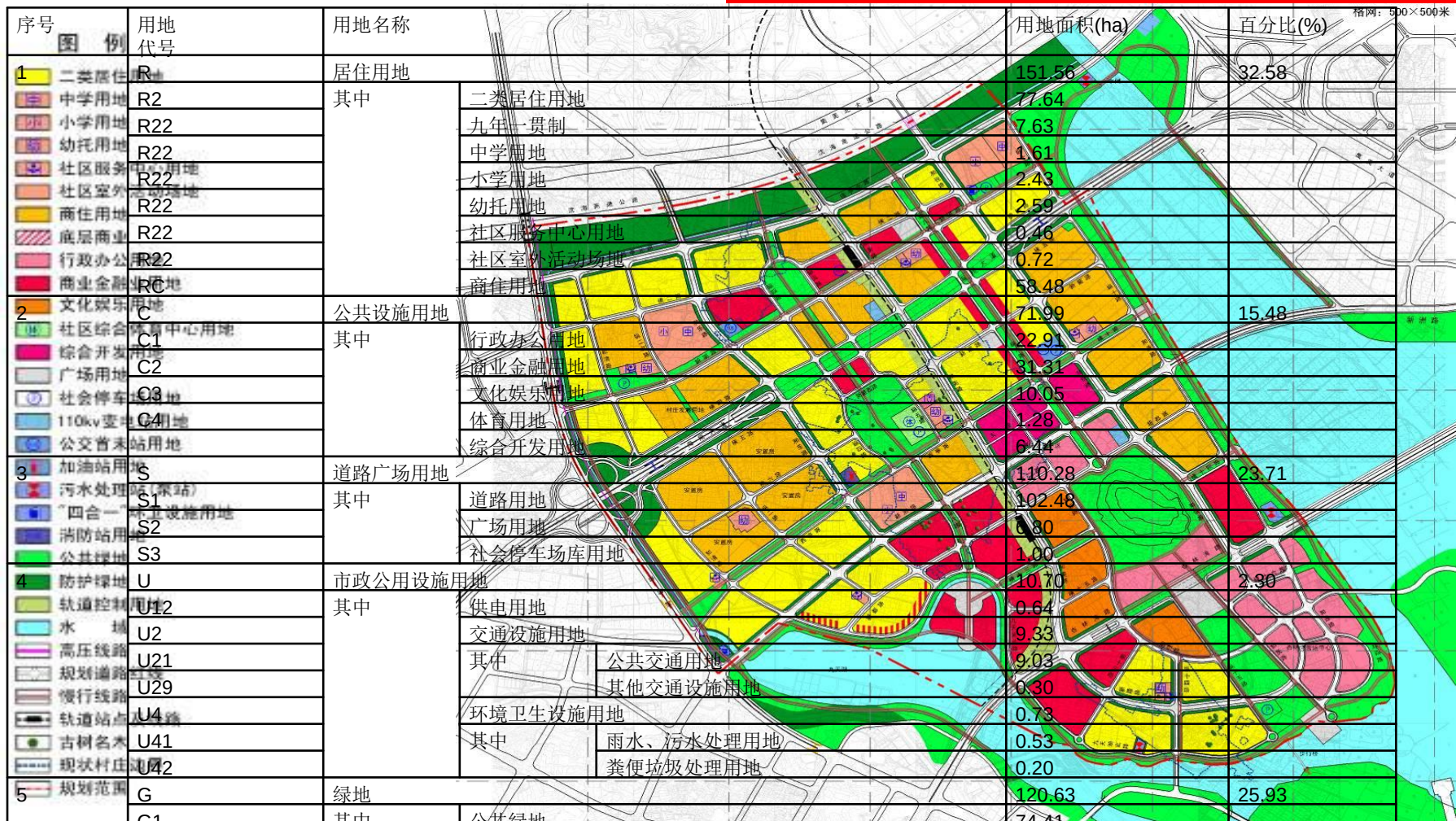
Works Steps

Analysis of the property
- sqm each section / single area
- Description of the section/area
  - Ground, orientation, etc.
- Definition to the use of the section
  - Counted number of Buildings according to the building-Types in each section/area
    - Size of the building types in each section/area
    - Number of floors
    - Floor area - total
    - A/V – ratio
  - Numbers of each Building type in each section/area

工作步骤

对用地性质分析
- 每块用地/地区面积
- 用地性质描述
  - 不同用途的的面积，以及性质等
- 地块建筑物使用定义
  - 依据建筑物类型，统计每块用地上的建筑物的
    - 相应的建筑物的尺寸
    - 楼层数
    - 总楼层面积
    - 形体比
  - 用地上相应建筑物的数量

Jimei – Pilot Project 集美-试点项目



序号	用地代号	用地名称			用地面积(ha)	百分比(%)
1	R	居住用地			151.56	32.58
	R2	其中	二类居住用地		77.64	
	R22		九年一贯制		7.63	
	R22		中学用地		1.61	
	R22		小学用地		2.43	
	R22		幼托用地		2.59	
	R22		社区服务中心用地		0.46	
	R22		社区室外活动场地		0.72	
	RC		商住用地		58.48	
2	C	公共设施用地			71.99	15.48
	C1	其中	行政办公用地		22.91	
	C2		商业金融用地		31.31	
	C3		文化娱乐用地		10.05	
	C4		体育用地		1.28	
			综合开发用地		6.44	
3	S	道路广场用地			110.28	23.71
	S1	其中	道路用地		102.48	
	S2		广场用地		0.80	
	S3		社会停车场库用地		1.00	
4	U	市政公用设施用地			10.70	2.30
	U12	其中	供电用地		0.64	
	U2		交通设施用地		9.33	
	U21		其中	公共交通用地	9.03	
	U29			其他交通设施用地	0.30	
	U4		环境卫生设施用地		0.73	
	U41		其中	雨水、污水处理用地	0.53	
	U42			粪便垃圾处理用地	0.20	
5	G	绿地			120.63	25.93
	G1	其中	公共绿地		74.41	

Site area – Information 地块面积信息

Nummer	Eigenschaft	Grundstückfläche(m2)	Baufläche(m2)	Volume Fraction	Bebauungsdichte(%)	Begrünungsrate(%)	Gebäudehöhe(m)	Wohnbevölkerung(P)
编号	用地性质	用地面积（m^2）	建筑面积(m^2)	容积率	建筑密度(%)	绿地率(%)	建筑限高(m)	居住人口（人）
11-11A01	R_{21}	14560.23	29120	2	22	38	60	728
11-11A02	R_{21}	26640.85	47954	1.8	22	38	60	1199
11-11A03	R_{21}	29321.21	52778	1.8	22	38	60	1319
11-11A04	R_{22}	41906.4	21200	0.51	30	40	24	--
11-11A05	G_1	6509.89	65	0.01	5	80	12	--
11-11A06	G_1	12463.19	125	0.01	5	80	12	--
11-11A07	R_{22}	4313.73	3900	0.9	30	40	12	--
11-11A10	RC	29310.77	46897	1.6	30	30	100	938

$$red\_CO2 = (n\_Build * A\_Build * (PED\_Baseline\ Build - PED\_Build\ Type)) * f\_CO2$$

Steps to do
Calculation of LOW-Carbon potential each section/area

计算步骤
计算每块用地的碳减排潜能

red_CO2	Reduction of CO2 – emissions of each section/area
n_Build	Number of building types
A_Build	Size of the building
PED_Baseline Build	Primary Energy demand of the referent building type 2**
PED_Build Type	Primary Energy demand for the building type > 3***
f_CO2	Factor to transform kW/m² to kg CO2

red_CO2：	每一地块碳减排量
n_Build：	建筑物类型的楼房数量
A_Build：	建筑物的尺寸
PED_Baseline Build：	参考建筑物2**的初级能源消耗
PED_Build Type:	建筑物类型的初级能源消耗（对于节能标准高于 3***）
f_CO2：	能源转CO2的转换系数 kW/m² 到kg ）

Increase the energy demand / CO2 emissions
能源需求以及碳排放的增加

Increase Standard of the Building envelope acc. LEC

LEC-Standard	Explanation
★	The building does not correlate with any permitted standard
★★	corresponds to the minimum requirements according to GB 50189
★★★	corresponds to the increased requirements according to GB/T 50378 500050378
★★★★	comparable to the European building standard EnEV 2001
★★★★★	comparable to an increased European building standard EnEV 2009

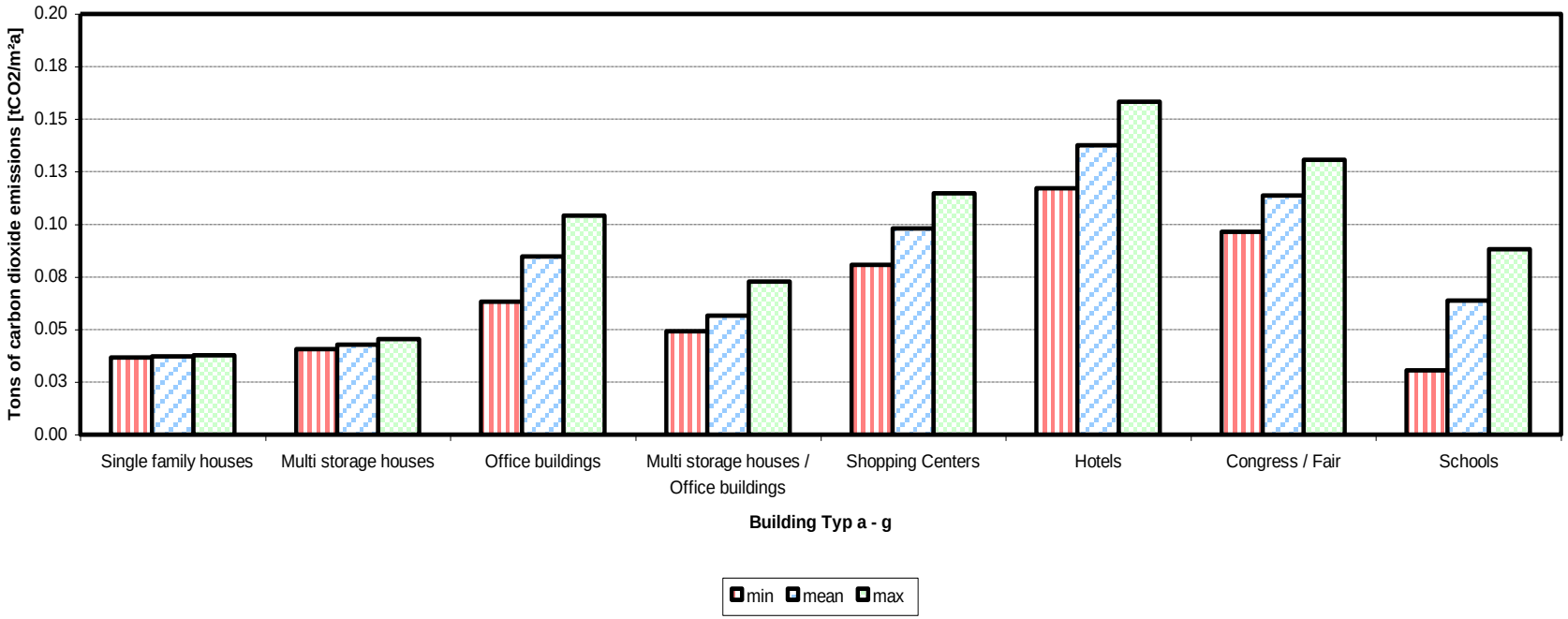
Increase Standard of the Quality of the technical Systems/HVAC

NORMAL Standard (≤.2**)	Actual Standard in use to for fill the Chinese Requirements 普通 标准
(≤.2**）	中国现行标准
HIGH Standard .. (≥ 3***)	Standard above; optimised HYAC Systems incl. Systems for renewable energy
高标准(≥ 3***)	提高的标准，包含了再生能源系统的优化后的室内设备

CO2- Emmisons Xiamen – Jimei 厦门集美 的碳排放

selection Building Type – Chinese building standard – 2** LEC
建筑物类型的选择- 中国建筑标准- LEC 2** 标准

Simulated tons of carbon dioxide emissions for heating, cooling and dehumidification for the LOW Carbon Building City Xiamen/Jimei (normal standard)



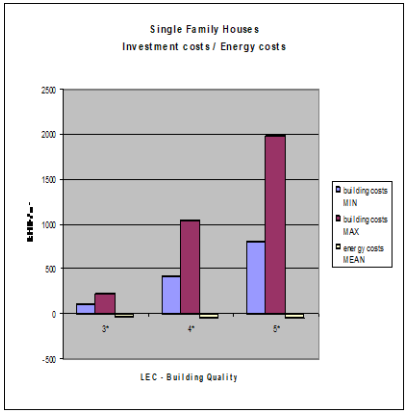
CO2-Emmissions Potential Xiamen – Jimei in total 碳排放潜能
Simulated tons of carbon dioxide emissions for heating, cooling and dehumidification 厦门集美项目 总量
MIN values模拟计算得到的由采暖、制冷以及除湿所产生的碳排放顿数（最小值）
,
Building Standard according LEC建筑标准 依据LEC
HVAC-Standard 2** - Normal / ≥ 3*** 室内设备普通标准 2**, 高标准>= 3***

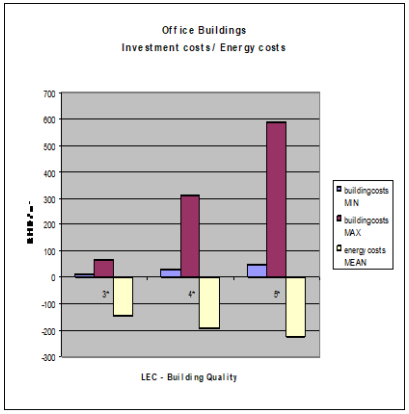
		(t CO_2/a)			
Building type	Floor area (m²)	Baseline	3 *	4 *	5 *
Single family houses	125969	4624	3081	2977	2664
Multi storage houses	1142439	47464	29545	27139	25180
Office buildings	946974	68184	61800	54332	46194
Multi storage houses / Office buildings (mix)	1247028	64288	43795	39312	36264
Shopping Centers	647986	52158	43418	40041	37955
Hotels	142016	16831	8503	7854	7083
Congress / Fair	11192	1078	834	772	733
Schools	68966	3493	1476	1249	1187
Other buildings	535384	40473	35351	31715	28292
TOTAL	**4867954**	**298594**	**227805**	**205390**	**191837**

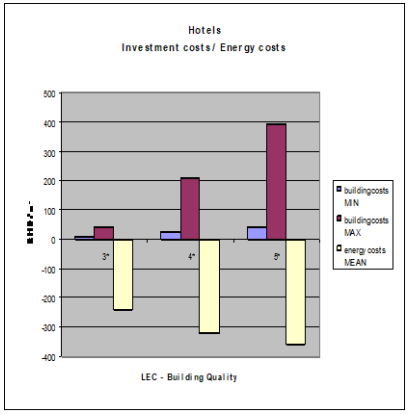
Calculation of the INvestment costs and the REinvestment costs of energy of the building envelope
对围护结构投资成本的计算 - 对能源再投资成本的计算

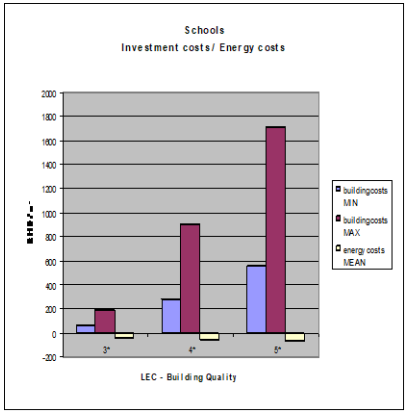
Building Type	building quality	RM building costs MIN	Building Type	building quality	RMB/m² energy costs MEAN
Single family houses	3*	96	Single family houses	3*	-36
	4*	419		4*	-47
	5*	805		5*	-53
Multi-storage houses/multiple families	3*	44	Multi-storage houses/multiple families	3*	-52
	4*	202		4*	-69
	5*	393		5*	-78
Office buildings	3*	14	Office buildings	3*	-147
	4*	31		4*	-196
	5*	52		5*	-221
Shopping centers	3*	13	Shopping centers	3*	-166
	4*	30		4*	-221
	5*	50		5*	-249
Hotels	3*	10	Hotels	3*	-240
	4*	23		4*	-320
	5*	39		5*	-360
Congress/Fair buildings	3*	26	Congress/Fair buildings	3*	-63
	4*	59		4*	-84
	5*	96		5*	-94
Schools	3*	65	Schools	3*	-43
	4*	286		4*	-57
	5*	550		5*	-64

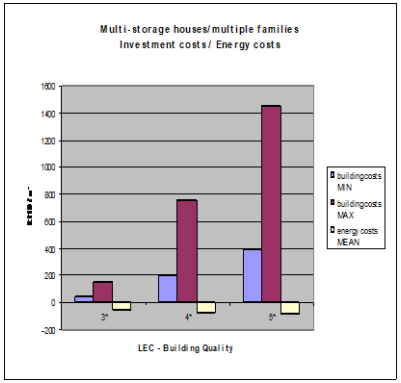
Investment costs / Energy costs
投资成本/能源成本

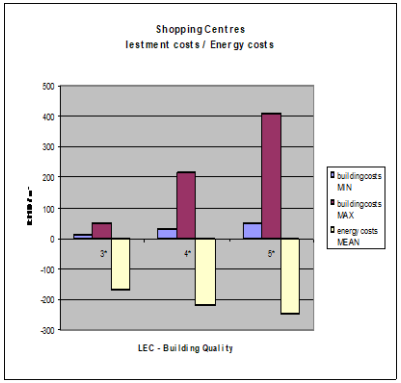


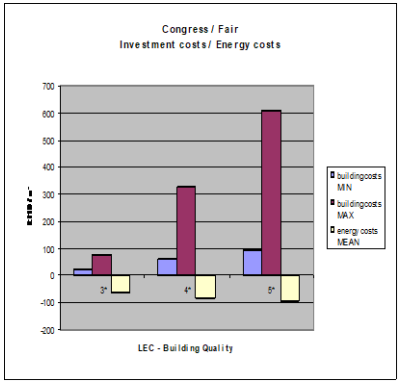






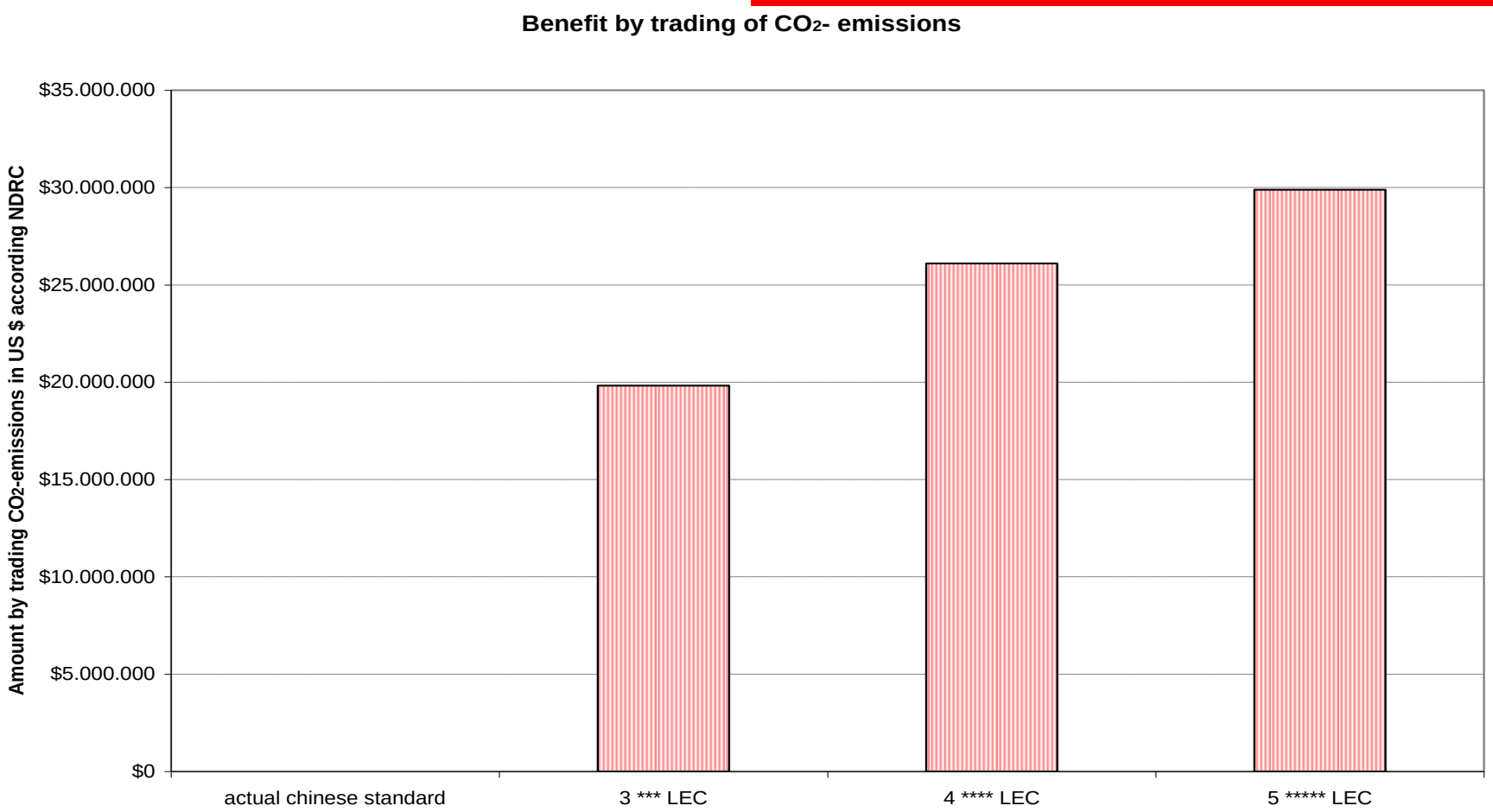






10 US-$ / 1 t CO2 per year

possible trade volume of CO2-Emissionen Xiamen-Jimei depending on the building standard in US-$
依据建筑标准所决定的厦门集美项目可交易的碳排放量（US-$）



Results for Xiamen-Jimei 厦门-集美项目的结果

Even considering regional characteristics, it is shown that there is a possibility to determine the CO2 potential for „Low Carbon Cities" of China.

The results will deliver the base to make decisions by
implementing a new CDM-Baslines
to limit the Energy Demand in a special „Low Carbon Standard", a
standard quite above the actual energy standard
of China.

即使考虑到地区性特点，项目结果也显示，为中国"低碳城市"制定二氧化碳减排潜能是可行的。

计算的结果为作出以下决定提供了基础，通过应用
新的CDM基准线
将能源需求限制在"低碳标准"之内，而
这项标准远高于中国现行标准。

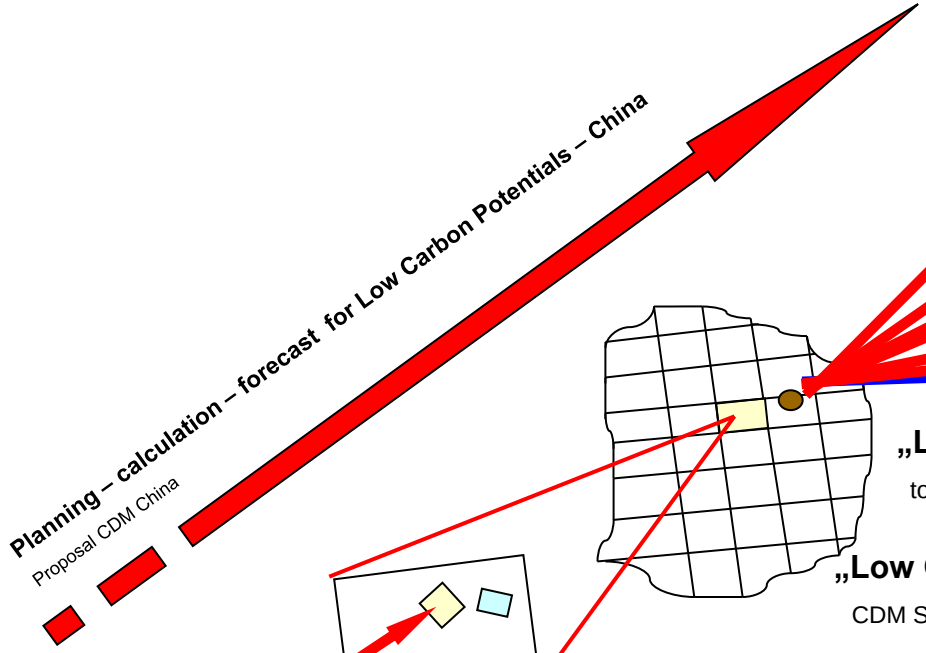
The CO2-savings potential of the currently planned Low Carbon Cities in China shows that an economic and ecological building process in China is realizable once the requirements of the energy quality of the buildings are reasonable increased, along with an increase of the requirements for efficient energy distribution and energy production systems. This building process may lead the way to accomplish the global restriction of CO2-emissions in the construction sector.

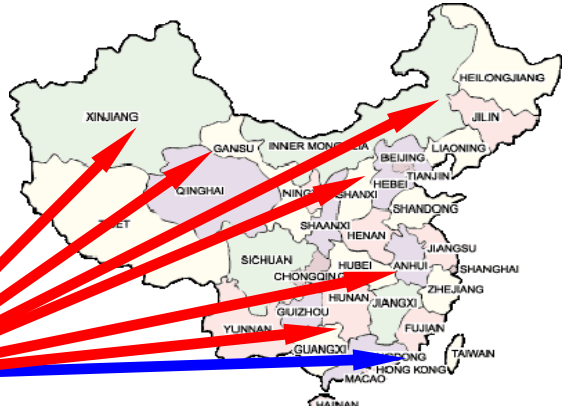
To establish China as a pioneer for CDM in the building sector, measures have to be done by the Chinese government in a short term.

中国现已规划的低碳城市的二氧化碳减排潜能显示，在中国一个既具有经济性又具有生态意义的建筑进程是可以实现的。前提是对建筑物的节能质量的要求合理得提高，同时对能源有效分配以及能源生产体系要求的提高。 这样的建筑过程可以引导在建筑领域实现全球的二氧化碳减排。

为将中国在建筑领域建立成为一个CDM方面的先锋，中国政府须在近期内采取相应的措施。

Forecast of the
CDM - Low Carbon potential for China
对中国CDM -低碳潜能的预测





„Low Carbon - Building Cities China“低碳城市

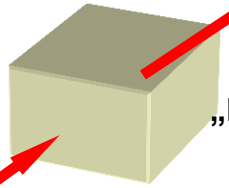
total Low Carbon Potential in China

„Low Carbon - Building City“ 低碳建筑城市

CDM Sites in Low Carbon Cities

„Low Carbon - Building Site“ 低碳建筑区

CDM Building Sites in a town area



„Low Carbon - Building“ 低碳建筑物

CDM Building Types (a-g), buildings less than the CDM Standard baseline

„Low Carbon - Building Elements“ 低碳建筑单元

CDM Building Elements (Proposal for wall, windows etc.)

PAVILION of INNOVATIONS
German Centre Shanghai
88 Keyuan Lu, Pudong
Shanghai 201203 - China
Tel: +86 (0) 1891 7998 179

shanghai@BBS-INTERNATIONAL.com
www.BBS-INTERNATIONAL.com

BBS INTERNATIONAL

Am Forst 27
38302 Wolfenbüttel - Germany
Tel: +49 (0)5331-97 17-0
Fax: +49 (0)5331-97 17-17
info@BBS-INTERNATIONAL.com
www.BBS-INTERNATIONAL.com