

# The Low-Carbon Indicator System-Sino (LCISS)

An Application-Oriented Tool  
for the Development of the  
Low Carbon City





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# 01. POINT OF DEPARTURE AND TASK

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## Point of Departure

As the biggest carbon contributor worldwide, meanwhile one of the most vulnerable countries, China is tasked with responding to climate change. In 2009, the Chinese leadership made a clear commitment of transition to a low-carbon growth path that could reduce carbon intensity of GDP by 40-45% by 2020 from a 2005 baseline. Chinese cities present an opportunity for such a transition since they are politically, financially, and administratively organized to enact policies quickly to meet the carbon emission reduction goal.

Today, in response to this development transition, numbers of cities are already developing low-carbon city initiatives. As the Chinese Society for Urban Studies reported, until February 2011, 259 cities above prefecture level have declared the intention of becoming an “eco-city” or “low-carbon city”, accounting for over 90% of all prefectural cities (Chinese Society for Urban Studies 2011).

## Task

Given the CO2 intensity reduction goal, low-carbon city development becomes an inevitable target for Chinese cities. However, though numbers of cities have shown considerable interest in developing a low-carbon city, thus far, there is still no consistent definition of the concept “low-carbon city”, and no evaluation method to determine if a city meets the requirements and definition. This makes the low-carbon city development lose its direction and become unmeasurable, which hinders the low-carbon progress in Chinese cities. Therefore, there is an urgent need to define the term “low-carbon city” and to develop a scientific and feasible evaluation framework in order to evaluate a city’s current situation and measure progress toward more low-carbon development.

To bridge this gap, the “Low-Carbon Indicator System – Sino (LCISS)” was developed. It is a method of evaluating new and existing cities, urban districts and areas in China with regard to their potential for carbon reduction and resilience enhancement. The evaluation of LCISS integrates the Chinese urban planning system and six key climate-related urban sectors, i.e. “urban design”, “transport”, “energy”, “building”, “water”, and “municipal solid waste”. These can identify a city’s challenges in different sectors and on different urban planning scales. The method has been tested in the Sino-Singapore Tianjin Eco-City as actual sample planning project and continuously refined based on the results. There are now plans to apply it to the urban development needs of future Chinese megacities.

## 02. POTENTIAL USERS OF THE LCISS

The LCISS is a useful assessment method aiming at municipal planning bureaus, design institutes, professional planning, political commissions, etc. It provides a quantitative, fact-based evaluation to help city managers and decision makers monitoring the performance of cities' low-carbon development and to help urban planners and professionals identifying and prioritizing the potential solution, so as to advance the low-carbon development in a more efficient way.

By applying the LCISS, users will be able to:

-Assess the performance of different sectors on different planning scales, and systematically review the low-carbon development status of a city.

-Obtain a robust indication of where inefficiencies occur as well as where a municipality has to focus on more measures towards "low carbon". Moreover, the history and trend of a city's low-carbon development could be revealed by comparing its evaluations at different periods.

-Define gaps and assess potentials for improvement, and formulate action guideline to orient low-carbon city development in the future.

-Identify the potential solution. Through continuous evaluation and optimization of city planning and construction, LCISS helps city to achieve the goal of low-carbon development.

From the point of view of city development, the LCISS plays an important role in monitoring and directing low-carbon city development. In the planning stage, it could rate the specific plans in terms of adaptability and the ability to reduce climate change in a traceable manner early on, in order to pinpoint errors in planning from a low-carbon standpoint, and correct the plan to resolve those errors. In the construction stage, it could periodically evaluate the city construction status, and then ensure the "low-carbon" direction of city development. For existing cities, the evaluation result of LCISS could be applied as a basis and guide for planning various kinds and various levels of urban redevelopment projects, with the aim of renovation to mitigate and adapt to climate change.

## 03. AN OVERVIEW OF THE LCISS

LCISS is composed of three parts: "indicator list", "evaluation checklist and report", and "development guideline". The main body of LCISS "indicator list" as an evaluation tool is a comprehensive indicator system that is constructed through coupling urban planning and sectors involved in low-carbon actions. "Evaluation checklist and report" is an evaluation result as well as a systematic review of a city's low-carbon development status. "Development guideline" is an action plan that describes which improvement is needed in the future.

Evaluation within LCISS is a circularly ascending process (Figure 1). It follows the sequence of applying "indicator list" to evaluate a city's low carbon development; summarizing status with "evaluation checklist and report"; supporting decision-making with "development guideline"; improving the city's next planning. Through this continuous process, experience could be summarized and lessons could be learned for future development.

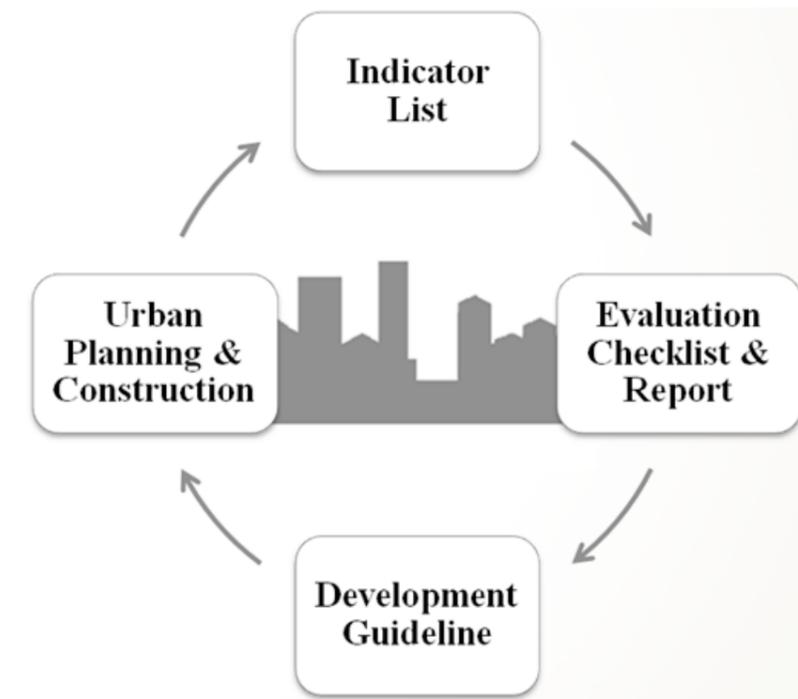


Figure.1 Evaluation process of LCISS

## Evaluation Tool: Indicator List

### Framework

Indicator list is a comprehensive indicator system, constructed through coupling urban planning and key urban sectors. It includes three planning scales, i.e. macro, middle and micro scales, and six sectors: urban design, transport, energy, building, water, and municipal solid waste (MSW) (Figure 2).

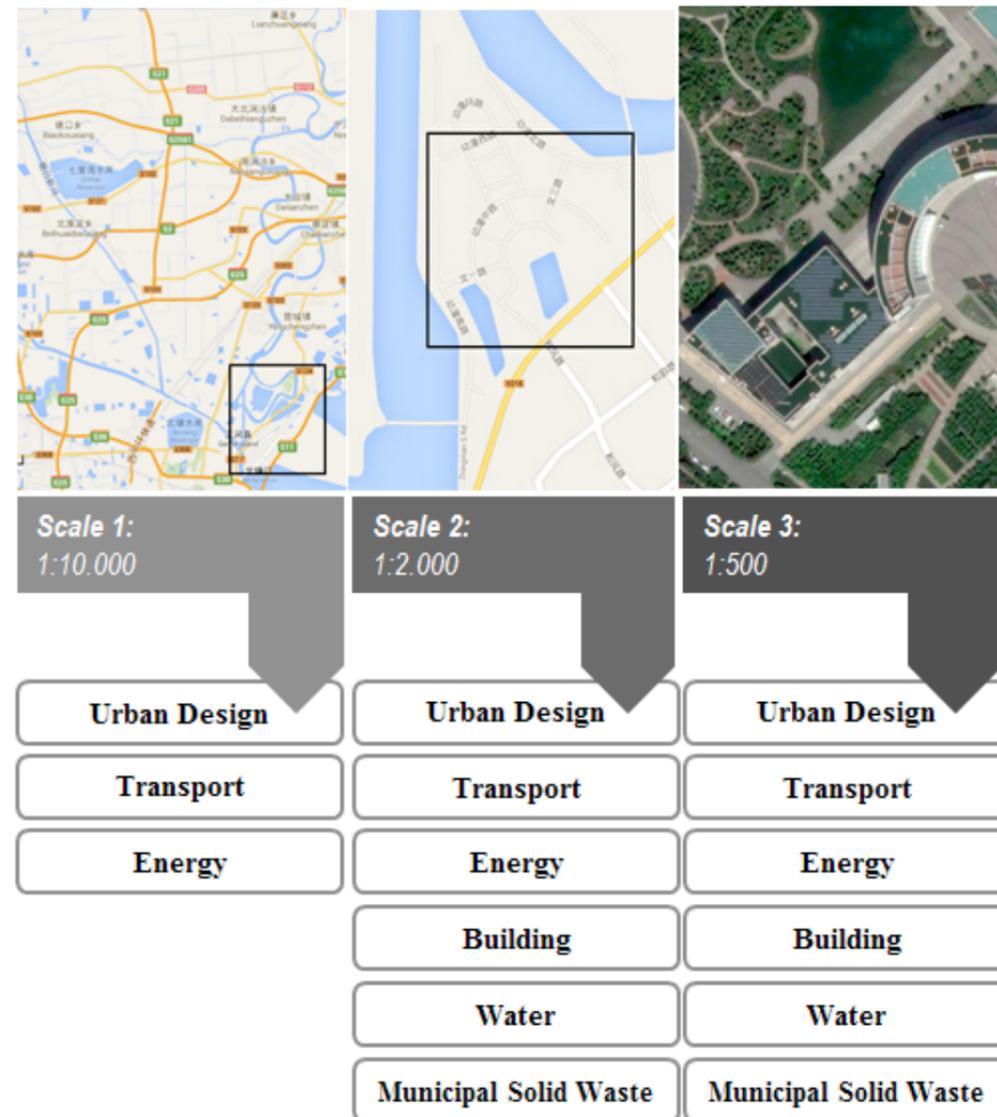


Figure 2. Framework of indicator list

### Structure

The organization of the indicator list includes the following contents:

**Indicator hierarchy** – for simply and accurately illustrating the complex relationship among indicators, the indicator list is built in a three-class hierarchic structure. The first-class indicators are the six key urban sectors above. From first-class to third-class, indicators are from general to specific.

**Indicator selection** – in accordance with relevant, independent, systematic, and measurable principles, indicators of LCISS are selected via two rounds of questionnaire surveys and numbers of interviews with experts.

**Indicator type** – the carbon-reduction potential and climate vulnerability vary from city to city, according to the size, natural environment, economy and social development, etc. For developing an extensively applicable evaluation system, indicators in LCISS are classified into essential type and expanded type.

**Indicator value** – the evaluation scale of the LCISS is performed with normalized scores between -2 and +2, and standard values of indicators are determined in light of the existing research results and successful experience drawn in pilot projects with adjustments based on China's actualities.

Please see the appendix 1 for further information of the indicator list of the LCISS.

### Products: Evaluation Checklist, Report, and Development Guideline

The LCISS evaluation can yield three products: evaluation checklist, evaluation report, and development guideline.

Evaluation checklist is the intuitive result of the overall evaluation of a city with LCISS. Checklists for every key sector and every planning scale can clearly identify potential for optimization.

Evaluation report is a comprehensive review and summary for a city's low-carbon construction grounded on

evaluation checklist. The main contents of the report include: overview of the low-carbon development in a targeted city (incl. comprehensive evaluation value), analysis of performance in all sectors, and challenge of low-carbon development.

Development guideline is developed on the basis of analysis results in evaluation report. The main contents include: recommendation for low-scoring items, involved planning scale, and action responsible department.

## 04. EVALUATION PROCESS OF THE LCISS

The evaluation is done on six key urban sectors in three different planning scales with the following steps:

**Step 1: Specific indicator list development.** As mentioned above, LCISS indicators are classified into essential indicator and expanded indicator. Essential indicators are binding indicators that must be kept in every LCISS evaluation. Expanded indicators are chosen in compliance with the applicable condition of certain indicators and the practical situation of the evaluated cities.

**Step 2: Weight determining.** After the construction of indicator list, the weight of all selected indicators are determined by following the Analytic Hierarchy Process (AHP) and Delphi method by local experts.

**Step 3: Data collection and scoring.** The relevant data and information that is required by the evaluation should be collected in the evaluated city. And then the score (-2 to +2) of all third-class indicators are given based on the collected data.

**Step 4: Evaluation result.** A direct evaluation result – checklist comes out after the scoring in the last step. It visually indicates where improvement is needed in a city.

**Step 5: Result summary and analysis.** Comprehensive evaluation values of indicators in three planning scales are calculated by using the weighted sum method. Based on the comprehensive evaluation values, the pros and cons of every urban sector would be analyzed in the evaluation report.

**Step 6: Solution proposal.** At the last step of the evaluation, development guidelines are formulated for each problem of different sectors on different planning scales, which provide support for government decision-making.

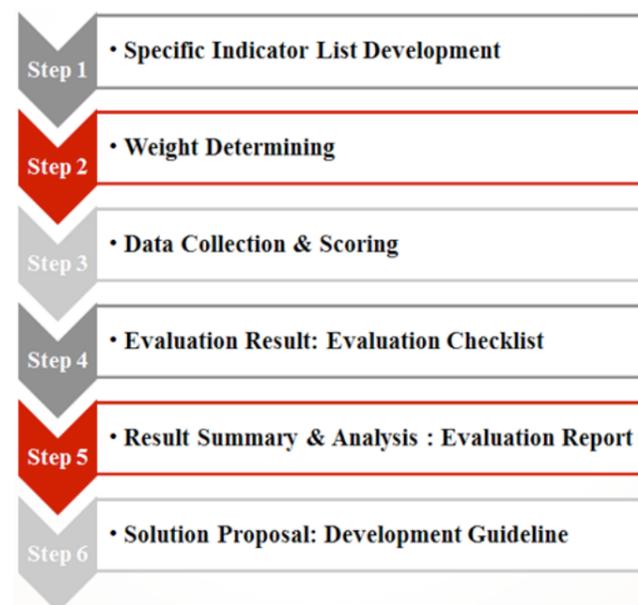


Figure 3. Application steps of the LCISS



# 05. APPLICATION CASE STUDY OF LCISS

In order to visually view the evaluation process of the LCISS, an application case study of Sino-Singapore Tianjin Eco-City (SSTEC) is introduced follow the aforementioned steps.

Step 1: According to SSTEC's practical situation, most of the indicators of the LCISS indicator list are applicable, except the expanded indicator of "qualification ratio of building energy efficiency in existing buildings" since there is no existing building (see appendix 2).

Step 2: The weight of each indicator was assigned by the experts from Sino-Singapore Tianjin Eco-City Administrative Committee in compliance with AHP and Delphi method (see appendix 2).

Step 3: The evaluation required data and information of SSTEC were collected from the following sources: i) publicly available statistical data; ii) government documents; iii) field study results and data obtained from interview with local experts.

Step 4: The value of each indicator is given based on the performance of SSTEC and the evaluation checklist was yielded (see appendix 2).

Step 5: As illustrated in Figure 4, the comprehensive value of three planning scales were calculated in accordance with the formula below.

$$F = \sum_{i=1}^n w_i x_i$$

In the formula, F represents the complex value; n represents the number of evaluation indicators;  $w_i$  represents the composite weight of the i-th evaluation indicator;  $x_i$  represents the normalized evaluation score of the i-th evaluation indicator.

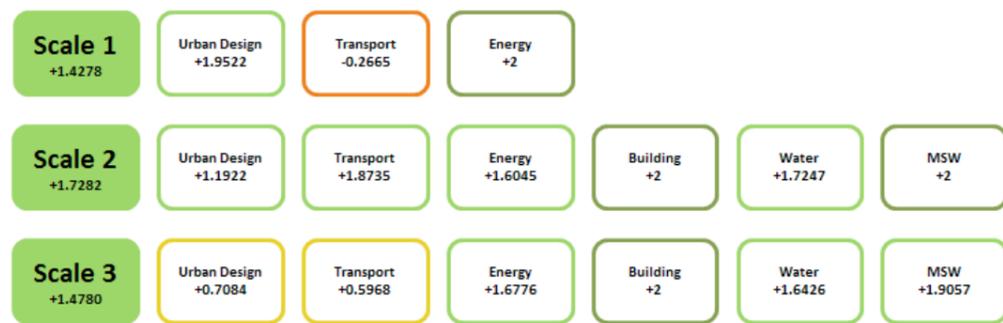


Figure 4. Comprehensive evaluation value of the SSTEC

Based on the comprehensive evaluation values, the evaluation report was organized as requested. The evaluation results showed that SSTEC has advantages in low-carbon development at all three urban planning scales, but there is still room for improvements in several sectors, such as traffic managements, building certification, flood control, waste recycling regulations, etc. According to local expert in-

vestigation and annual development report of SSTEC, this result matches the actual status of the eco-city.

Step 6: At the last step of the LCISS evaluation, a development guideline was formulated. It provided possible solutions for the existing deficiencies of SSTEC's development that were revealed by the evaluation checklist and report.



## Appendix 1 Indicator List of the LCISS

First-class indicators	Second-class indicators	Third-class indicators	Value					Scale	Type
			-2	-1	0	+1	+2		
Urban design	Site planning	1 Original land use type	Arable land / woodland / grassland		Unused land		Brownfield	123	essential
		2 Disaster risk	There are constructions in high risk areas that threatened by disasters, such as flood, geologic hazard, and secondary disaster				There is no construction in high risk areas that threatened by disasters, geologic hazard, or secondary disaster.	12	essential
	Land use	3 Mixture of functions	D<0.980	0.980≤D≤0.988	D=0.990	0.992≤D≤0.994	0.995≤D	123	essential
		4 Urban development land area per capita	Higher than the standard stated in the PRC's National Standard GB 50137-2011		Compliance with the standard stated in the PRC's National Standard GB 50137-2011		Lower than the standard stated in the PRC's National Standard GB 50137-2011	23	essential
		5 Small-scale block	R<40%	40%≤R<50%	50%≤R<70%	70%≤R<80%	80%≤R	23	essential
	Accessibility	6 Regional traffic connection	No regional traffic connection	Partial regional traffic connection	Area wide regional traffic connection only by individual transport	Area wide regional traffic connection by individual transport and one kind of public transport	Area wide regional traffic connection by individual transport and various public transport	123	essential
		7 Transit-oriented employment density	Lowest density of the area at public transport hubs	Density slightly below average	Average density of the area	Density slightly above average	Highest density of the area at public transport hubs	23	essential
		8 Transit-oriented residential density	Lowest density of the area at public transport hubs	Density slightly below average	Average density of the area	Density slightly above average	Highest density of the area at public transport hubs	23	essential
	Green open space	9 Green space rate	>20% below the average level	≤20% below the average level	Similar like the average level	≤20% above the average level	>20% above the average level	23	essential
		10 Coverage ratio of green space service radius	R<60%	60%≤R<70%	70%≤R<80%	80%≤R<90%	90%≤R	23	essential
		11 Quality of green open space: 1. Equipped with various public facilities (e.g. furniture, sculpture, landscape decoration, fountain) 2. Plant low water consumption native plants 3. Well functional organized space with different uses 4. Good accessibility 5. Bright lights at key locations 6. Clear signage 7. Well shadowed 8. Applied devices by renewable energy 9. Applied light colored, durable, environmental friendly pavement material	No one criterion fulfilled	1-2 criterion fulfilled	3-4 criteria fulfilled	5-6 criteria fulfilled	All criteria fulfilled	3	expanded
		12 Position in highway network	Long distance (≥ 5km) to the next highway	Next highway <5km away from the border	Next highway < 2km away from the border	Next highway < 1km away from the border	Highway inside of the area, or along of a border	1	essential
	Transport Motorized individual transport	13 Road network density	Below the standard, and branch roads account lower proportion of total length of network	Below the standard	Complies with the standard	Above the Standard	Above the standard, and branch roads account higher proportion of total length of network	2	essential
		14 Car park management	No local law, regulation and policy of car park management		Local laws, regulations and policies of car park management are being developed		Local laws, regulations and policies of car park management have been implemented	3	essential
		15 Recharging devices of E-mobility	No recharging device	Some parking with recharging devices, access only for employee of some companies, private garage owners, or parking pass holders	Some parking with recharging devices, access for all	Adequate number of parking with recharging devices, access for all	Adequate number of parking with recharging devices, access for all; and combined with transport connection point, easy payment	3	expanded
		16 Car sharing: 1. Cars available in the whole area- not station-bounded 2. Easy registration and payment 3. Online reservation 4. Discount on public transport tickets 5. Various types of vehicles (cars and trucks)	No car sharing concept	Car sharing available but no one criterion fulfilled	1 criteria fulfilled	2-3 criteria fulfilled	4 or more criteria fulfilled	3	expanded



Urban Design- Bird's Eye View



Transport-Electric Vehicles Charging Station

First-class indicators	Second-class indicators	Third-class indicators	Value					Scale	Type
			-2	-1	0	+1	+2		
		17 Prioritization for low emission vehicles: 1.Subsidies and tax concessions to encourage the purchase and use of low emission vehicles 2.Permission to enter auto restricted zones 3.No traffic restriction (odd-and-even number limit lines) 4.Parking charge discount	No one criterion fulfilled	1 criteria fulfilled	2 criteria fulfilled	3 criteria fulfilled	All criteria fulfilled	3	expanded
		18 Main form of Mass Rapid Transport	No public transport connection	No MRT, only bus connection	LRT/BRT	Metro + LRT/BRT	Metro + LRT/BRT	1	expanded
		19 Connection to the major origins and destinations	No connection, or only bus connection to some of the major origins and destinations	Bus connection to the most of major origins and destinations	Bus connection to all major origins and destinations	MRT connection to the most of major origins and destinations, bus connection to the remaining origins and destinations	MRT connection to all major origins and destinations	2	expanded
		20 Transit station coverage	R<65%	65%≤R<70%	70%≤R<75%	75%≤R<80%	80%≤R	2	essential
		21 Velocity of public transport	2.5<R	2<R≤2.5	1.5<R≤2	1<R≤1.5	R≤1	3	essential
		22 Average wait-time in the highest peak hour	>20mins	11-20mins	6-10mins	3-5mins	<3mins	3	essential
		23 Emission level of buses	Most vehicles meet the National Discharge Standard of Vehicle Pollutant ( I Stage)	Most vehicles meet the National Discharge Standard of Vehicle Pollutant ( II Stage)	Most vehicles meet the National Discharge Standard of Vehicle Pollutant ( III Stage)	Most vehicles meet the National Discharge Standard of Vehicle Pollutant ( IV Stage)	Most vehicles meet the National Discharge Standard of Vehicle Pollutant ( V Stage)	3	essential
	Public transport	24 Quality of vehicles of public transport: 1. Air-conditions 2. Wide doors 3. Passenger travel information 4. Entertainments (e.g. TV, internet service)	Most of vehicles do not fulfill any criterion	1 criterion fulfilled by most vehicles	2 criteria fulfilled by the most of vehicles	3 criteria fulfilled by the most of vehicles	All criteria fulfilled by the most of vehicles	3	expanded
		25 Quality of public transport stations: 1. Canopy 2. Ticket machine 3. Passenger travel information 4. Lighting 5. Barrier-free access 6. Bicycle parking infrastructure 7. Small scale shopping possibility nearby	Most of stations don't fulfill any criterion	1-2 criteria fulfilled for the most of stations	3-4 criteria fulfilled for the most of stations	5-6 criteria fulfilled for the most of stations	All criteria fulfilled for the most of stations	3	expanded
		26 Connectivity of footpaths	Area is not complete equipped with foot paths along the streets	Area is nearly complete equipped with foot paths along the streets	Area has footpaths separated from the streets	Short & direct footpaths connect to major facilities	Footpaths link to various grades of highway in surrounding areas	2	essential
		27 Quality of footpaths	Footpaths are too narrow (<2m), barely usable	Footpaths have usable width (≥ 2m)	Footpaths have usable width (≥ 2m); and separated from motorways	Footpaths have sufficient width (large city ≥6m; small and medium-sized cities ≥4m) and separated from motorways	Footpaths have sufficient width (large city ≥6m; small and medium-sized cities ≥4m) and separated from motorways; most footpaths are well-paved, well-lighted, furnished, greened	3	essential
		28 Connectivity of cycle tracks	Area is not complete equipped with cycle tracks	Area is nearly complete equipped with cycle tracks along the roads	Area has cycle tracks separated from the roads	Short & direct cycle tracks connect to major facilities	Cycle tracks link to various grades of highway in surrounding areas	2	essential
	Non-motorized transport	29 Quality of cycle tracks	Tracks are too narrow (one-way W<2m; two-way W<2.4m), barely usable	Tracks have usable width (one-way 2m≤W<4m; two-way 2.4m≤W<6m)	Tracks have usable width (one-way 2m≤W<4m; two-way 2.4m≤W<6m); and separated from motorways	Tracks have sufficient width (one-way 4m≤W; two-way 6m≤W) and separated from motorways	Tracks have sufficient width (one-way 4m≤W; two-way 6m≤W) and separated from motorways; most tracks are well-paved, well-lighted, furnished, greened	3	essential
		30 Non-motorized vehicle parking: 1.Sufficient parking space at important public service facilities and PT stops 2.Well-equipped bicycle racks 3.Lighting 4.Good security 5.Canopy	Most of parks do not fulfill any criteria	1 or more criteria fulfilled by several parks	2 criteria fulfilled by the most of parks	3 criteria fulfilled by the most of parks	All criteria fulfilled by the most of parks	3	essential
	Freight transport	31 Main freight transport modes	Road transportation is the only mode		Rail-road or port-road is the main mode		Port-road-rail is the main mode	1	essential



Renewable Energy



Green Building- Middle School

First-class indicators	Second-class indicators	Third-class indicators	Value					Scale	Type
			-2	-1	0	+1	+2		
		32 Prioritization for low emission trucks: 1. Subsidies and tax concessions to encourage the purchase and use of low emission vehicles 2. Permission to enter auto restricted zones 3. No restriction for delivering time periods 4. Recharging devices in delivering zones 5. Special delivering zones only for low emission trucks	No one criterion fulfilled	1 criteria fulfilled	2 criteria fulfilled	3 criteria fulfilled	All criteria fulfilled	3	expanded
Energy	Supply-side	33 Main sources of energy supply	Conventional energy supply (power grid, gas network, heating network)		One auxiliary energy source (e.g. waste heat, renewable energy, co-generation, etc.) besides conventional energy system		More than one auxiliary energy sources (e.g. waste heat, renewable energy, co-generation, etc.) besides conventional energy system	123	essential
		34 Renewable energy production	R<5%	5%≤R<10%	10%≤R<15%	15%≤R<20%	20%≤R	23	essential
		35 Electricity production by co-generation	R=0		0<R<5%		5%≤R	23	essential
	Demand-side	36 Green electricity contract	No green electricity contract				Green electricity contract available	3	expanded
		37 Incentive policy of renewable energy utilization	No clear incentive policy and plan		Incentive policies and plans are being developed		Incentive policies and plans have been implemented	3	essential
		38 Metered heating rate	R<10% (residential building); R<20% (public building)	10%≤R<15% (residential building); 20%≤R<30% (public building)	15%≤R<20% (residential building); 30%≤R<40% (public building)	20%≤R<25% (residential building); 40%≤R<50% (public building)	25%≤R (residential building); 50%≤R (public building)	3	essential
Building	New buildings	39 Qualification ratio of building energy efficiency in new buildings	R<95%		95%≤R<100%		R=100%	23	essential
		40 Proportion of green buildings in new buildings	R<5%	5%≤R<20%	20%≤R<35%	35%≤R<50%	50%≤R	23	essential
	Existing building	41 Qualification ratio of building energy efficiency in existing buildings	R<10%	10%≤R<20%	20%≤R<30%	30%≤R<40%	40%≤R	23	expanded
Water	Water supply	42 Water supply from non-traditional sources	R<5%	5%≤R<10%	10%≤R<15%	15%≤R<20%	20%≤R	23	essential
		43 Water tariff	Increasing block water tariff system not established, water price is lower than the cost	Increasing block water tariff system not established, water price is higher than the cost	Increasing block water tariff system established, water price is lower than the cost	Increasing block water tariff system established, water price is higher than the cost, charge rate cannot balance the payment	Increasing block water tariff system established, water price is higher than the cost, charge rate achieve low profit breakeven	3	essential
		44 Leakage rate	14%≤R	12%≤R<14%	R=12%	10%≤R<12%	R≤10%	3	essential
		45 Coverage of water-saving appliances	R<76%	76%≤R<84%	84%≤R<92%	92%≤R<100%	R=100%	3	expanded
	Wastewater treatment	46 Treatment rate of wastewater	>10% than the average level	≤10% below the average level	Similar like the average level	≤10% above the average level	>10% above the average level	23	essential
	Stormwater management	47 Stormwater and wastewater diversion	R<100%				R=100%	23	essential
		48 Drainage system	Not meet the "Code for Design of Outdoor Wastewater"		Meet the "Code for Design of Outdoor Wastewater"		Above the "Code for Design of Outdoor Wastewater"	23	essential
		49 Flood prevention	Not meet the "Code for Design of Urban Flood Control Project"		Meet the "Code for Design of Urban Flood Control Project"		Above the "Code for Design of Urban Flood Control Project"	23	essential
Municipal Solid Waste	MSW collection & transfer	50 Waste collection rate	R<70%	70%≤R<80	80%≤R<90%	90%≤R<100%	R=100%	23	essential
		51 Proportion of communities with separate waste collection facilities	R=0		0<R<15%		15%≤R	3	essential
		52 Emission level of waste transport vehicles	Most vehicles meet the national discharge standard of vehicle pollutant (I Stage)	Most vehicles meet the national discharge standard of vehicle pollutant (II Stage)	Most vehicles meet the national discharge standard of vehicle pollutant (III Stage)	Most vehicles meet the national discharge standard of vehicle pollutant (IV Stage)	Most vehicles meet the national discharge standard of vehicle pollutant (V Stage)	3	expanded
	MSW disposal	53 Landfilling rate	>10% above the average level	≤10% above the average level	Similar like the average level	≤10% below the average level	>10% below the average level	23	essential
54 Harmless treatment rate		>5% below the average level	≤5% below the average level	Similar like the average level	≤5% above the average level	>5% above the average level	23	essential	



Waste Water Treatment



Waste System

Appendix 2 LCISS Evaluation of SSTE

LCISS Evaluation of SSTE in Scale 1

First-class indicator	Second-class indicator	Third-class indicator	Weight	Value					
				-2	-1	0	+1	+2	
Urban design	Site planning	1	Original land use type	0.0131	Arable land / woodland / grassland		Unused land		Brownfield
		2	Disaster risk	0.0653	There are constructions in high risk areas that threatened by disasters, such as flood, geologic hazard, and secondary disaster				There is no construction in high risk areas that threatened by disasters, geologic hazard, or secondary disaster.
	Land use	3	Mixture of functions	0.1567	D<0.980	0.980≤D≤0.988	D=0.990	0.992≤D≤0.994	0.995≤D
	Accessibility	4	Regional traffic connection	0.3134	No regional traffic connection	Partial regional traffic connection	Area wide regional traffic connection only by individual transport	Area wide regional traffic connection by individual transport and one kind of public transport	Area wide regional traffic connection by individual transport and various public transport
Transport	Motorized individual transport	5	Position in highway network	0.0395	Long distance (≥ 5km) to the next highway	Next highway < 5km away from the border	Next highway < 2km away from the border	Next highway < 1km away from the border	Highway inside of the area, or along of a border
	Public transport	6	Main form of Mass Rapid Transport	0.1298	No public transport connection	No MRT, only bus connection	LRT/BRT	Metro + LRT/BRT	Metro + LRT/BRT + commuter rail
	Freight transport	7	Main freight transport modes	0.0716	Road transportation is the only mode		Rail-road or port-road is the main mode		Port-road-rail is the main mode
Energy	Supply-side	8	Main sources of energy supply	0.2106	Conventional energy supply (power grid, gas network, heating network)		One auxiliary energy source (e.g. waste heat, renewable energy, co-generation, etc.) besides conventional energy system		More than one auxiliary energy sources (e.g. waste heat, renewable energy, co-generation, etc.) besides conventional energy system

LCISS Evaluation of SSTE in Scale 2

First-class indicators	Second-class indicators	Third-class indicators	Weight	Value					
				-2	-1	0	+1	+2	
Urban design	Site planning	1	Original land use type	0.0025	Arable land / woodland / grassland		Unused land		Brownfield
		2	Disaster risk	0.0125	There are constructions in high risk area that threatened by disasters, such as flood, geologic hazard, and secondary disaster				There is no construction in high risk areas that threatened by disasters, geologic hazard, or secondary disaster.
	Land use	3	Mixture of functions	0.0082	D<0.980	0.980≤R≤0.988	D=0.990	0.992≤D≤0.994	0.995≤D
		4	Urban development land area per capita	0.0130	Higher than the standard stated in the PRC's National Standard GB 50137-2011		Compliance with the standard stated in the PRC's National Standard GB 50137-2011		Lower than the standard stated in the PRC's National Standard GB 50137-2011
		5	Small-scale block	0.0205	R<40%	40%≤R<50%	50%≤R<70%	70%≤R<80%	80%≤R
Accessibility	Regional traffic connection	6	Regional traffic connection	0.0059	No regional traffic connection	Partial regional traffic connection	Area wide regional traffic connection only by individual transport	Area wide regional traffic connection by individual transport and one kind of public transport	Area wide regional traffic connection by individual transport and various public transport
		7	Transit-oriented employment density	0.0145	Lowest density of the area at public transport hubs	Density slightly below average	Average density of the area	Density slightly above average	Highest density of the area at public transport hubs
		8	Transit-oriented residential density	0.0092	Lowest density of the area at public transport hubs	Density slightly below average	Average density of the area	Density slightly above average	Highest density of the area at public transport hubs
	Green open space	9	Green space rate	0.0107	>20% than the average level	≤20% below the average level	Similar like the average level	≤20% above the average level	>20% above the average level
	10	Coverage ratio of green space service radius	0.0107	R<60%	60%≤R<70%	70%≤R<80%	80%≤R<90%	90%≤R	

Transport	Motorized individual transport	11	Road network density	0.0404	Below the standard, and branch roads account lower proportion of total length of network	Below the standard	Complies with Standard	Above the standard	Above the standard, and branch roads account higher proportion of total length of network
		12	Connection to the major origins and destinations	0.0292	No connection, or only bus connection to some of the major origins and destinations	Bus connection to the most of major origins and destinations	Bus connection to all major origins and destinations	MRT connection to the most of major origins and destinations, bus connection to the remaining origins and destinations	MRT connection to all major origins and destinations
	13	Transit station coverage	0.1169	R<65%	65%≤R<70%	70%≤R<75%	75%≤R<80%	80%≤R	
	Non-motorized transport	14	Connectivity of footpaths	0.0148	Area is not complete equipped with foot paths along the streets	Area is nearly complete equipped with foot paths along the streets	Area has cycle tracks separated from the streets	Short & direct footpaths connect to major facilities	Footpaths link to various grades of highway in surrounding areas
		15	Connectivity of cycle tracks	0.0296	Area is not complete equipped with cycle tracks	Area is nearly complete equipped with cycle tracks along the roads	Area has cycle tracks separated from the roads	Short & direct cycle tracks connect to major facilities	Cycle tracks link to various grades of highway in surrounding areas
Energy	Supply-side	16	Main sources of energy supply	0.1272	Conventional energy supply (power grid, gas network, heating network)		One auxiliary energy source (e.g. waste heat, renewable energy, co-generation, etc.) besides conventional energy system		More than one auxiliary energy sources (e.g. waste heat, renewable energy, co-generation, etc.) besides conventional energy system
		17	Renewable energy production	0.0809	R<5%	5%≤R<10%	10%≤R<15%	15%≤R<20%	20%≤R
	18	Electricity production by co-generation	0.0513	R=0		0<R<5%		5%≤R	
Building	New buildings	19	Qualification ratio of building energy efficiency in new buildings	0.0536	R<95%		95%≤R<100%		R=100%
		20	Proportion of green buildings in new buildings	0.0536	R<5%	5%≤R<20%	20%≤R<35%	35%≤R<50%	50%≤R
Water	Water supply	21	Water supply from non-traditional sources	0.0770	R<5%	5%≤R<10%	10%≤R<15%	15%≤R<20%	20%≤R
	Wastewater treatment	22	Treatment rate of wastewater	0.0770	>10% than the average level	≤10% below the average level	Similar like the average level	≤10% above the average level	>10% above the average level
	Stormwater management	23	Stormwater and wastewater diversion	0.0120	R<100%				R=100%
24		Drainage system	0.0076	Not meet the "Code for Design of Outdoor Wastewater"		Meet the "Code for Design of Outdoor Wastewater"		Above the "Code for Design of Outdoor Wastewater"	
	25	Flood prevention	0.0189	Not meet the "Code for Design of Urban Flood Control Project"		Meet the "Code for Design of Urban Flood Control Project"		Above the "Code for Design of Urban Flood Control Project"	
MSW	MSW collection & transfer	26	Waste collection rate	0.0682	R<70%	70%≤R<80	80%≤R<90%	90%≤R<100%	R=100%
		MSW disposal	27	Landfilling rate	0.0085	>10% above the average level	≤10% above the average level	Similar like the average level	≤10% below the average level
	28	Harmless treatment rate	0.0256	>5% below the average level	≤5% below the average level	Similar like the average level	≤5% above the average level	>5% above the average level	

LCISS Evaluation of SSTE in Scale 3

First-class indicators	Second-class indicators	Third-class indicators	Weight	Value					
				-2	-1	0	+1	+2	
Urban design	Site planning	1	Original land use type	0.0098	Arable land / woodland		Unused land		Brownfield
		2	Mixture of functions	0.0071	D<0.980	0.980≤D<0.988	D=0.990	0.992≤D<0.994	0.995≤D
	Land use	3	Urban development land area per capita	0.0062	Higher than the standard stated in the PRC's National Standard GB 50137-2011		Compliance with the standard stated in the PRC's National Standard GB 50137-2011		Lower than the standard stated in the PRC's National Standard GB 50137-2011
		4	Small-scale block	0.0162	R<40%	40%≤R<50%	50%≤R<70%	70%≤R<80%	80%≤R
		5	Regional traffic connection	0.0031	No regional traffic connection	Partial regional traffic connection	Area wide regional traffic connection only by individual transport	Area wide regional traffic connection by individual transport and one kind of public transport	Area wide regional traffic connection by individual transport and various public transport
	Accessibility	6	Transit-oriented employment density	0.0100	Lowest density of the area at public transport hubs	Density slightly below average	Average density of the area	Density slightly above average	Highest density of the area at public transport hubs
		7	Transit-oriented residential density	0.0055	Lowest density of the area at public transport hubs	Density slightly below average	Average density of the area	Density slightly above average	Highest density of the area at public transport hubs
		8	Green space rate	0.0041	>20% below the average level	≤20% below the average level	Similar like the average level	≤20% above the average level	>20% above the average level
	Green open space	9	Coverage ratio of green space service radius	0.0051	R<60%	60%≤R<70%	70%≤R<80%	80%≤R<90%	90%≤R
		10	Quality of green open space: 1. Equipped with various public facilities (e.g. furniture, sculpture, landscape decoration, fountain) 2.Plant low water consumption native plants 3.Well functional organized space with different uses 4.Good accessibility 5.Bright lights at key locations 6.Clear signage 7.Well shadowed 8. Applied devices by renewable energy 9. Applied light colored, durable, environmental friendly pavement material	0.0032	No one criterion fulfilled	1-2 criterion fulfilled	3-4 criteria fulfilled	5-6 criteria fulfilled	All criteria fulfilled
Transport	Motorized individual transport	11	Car park management	0.0073	No local law, regulation and policy of car park management		Local laws, regulations and policies of car park management are being developed		Local laws, regulations and policies of car park management have been implemented
		12	Recharging devices of E-mobility	0.0050	No recharging device	Some parking with recharging only for employee of some companies, private garage owners, or parking pass holders	Some parking with recharging devices, access for all	Adequate number of parking with recharging devices, access for all	Adequate number of parking with recharging devices, access for all; and combined with transport connection point,
		13	Car sharing: 1. Cars available in the whole area - not station-bounded 2.Easy registration and payment 3.Online reservation 4. Discount on public transport tickets 5. Various types of vehicles (cars and trucks)	0.0050	No car sharing concept	Car sharing available but no one criterion fulfilled	1 criteria fulfilled	2-3 criteria fulfilled	4 or more criteria fulfilled
		14	Prioritization for low emission vehicles: 1.Subsidies and tax concessions to encourage the purchase and use of low emission vehicles 2.Permission to enter auto restricted zones 3.No traffic restriction (odd-and-even number limit lines) 4.Parking charge discount	0.0072	No one criterion fulfilled	1 criteria fulfilled	2 criteria fulfilled	3 criteria fulfilled	All criteria fulfilled
	Public transport	15	Velocity of public transport	0.0428	2.5<R	2<R≤2.5	1.5<R≤2	1<R≤1.5	R≤1
		16	Average wait-time in the highest peak hour	0.0173	>20mins	11-20mins	6-10mins	3-5mins	<3mins
		17	Emission level of buses	0.0102	Most vehicles meet the National Discharge Standard of Vehicle Pollutant (I Stage)	Most vehicles meet the National Discharge Standard of Vehicle Pollutant (II Stage)	Most vehicles meet the National Discharge Standard of Vehicle Pollutant (III Stage)	Most vehicles meet the National Discharge Standard of Vehicle Pollutant (IV Stage)	Most vehicles meet the National Discharge Standard of Vehicle Pollutant (V Stage)

Urban design	Site planning	18	Quality of vehicles of public transport: 1. Air-conditions Wide doors Passenger travel information 4. Entertainments (e.g. TV, internet service)	0.0099	Most of vehicles do not fulfill any criterion	1 criterion fulfilled by most vehicles	2 criteria fulfilled by the most of vehicles	3 criteria fulfilled by the most of vehicles	All criteria fulfilled by the most of vehicles	
		19	Quality of public transport stations: 1.Canopy 2.Ticket machine 3.Passenger travel information 4.Lighting 5.Barrier-free access 6.Bicycle parking infrastructure 7.Small scale shopping possibility nearby	0.0112	Most of stations don't fulfill any criterion	1-2 criteria fulfilled for the most of stations	3-4 criteria fulfilled for the most of stations	5-6 criteria fulfilled for the most of stations	All criteria fulfilled for the most of stations	
	Non-motorized transport	20	Quality of footpaths	0.0207	Footpaths are too narrow (<2m), barely usable	Footpaths have usable width (≥ 2m)	Footpaths have usable width (≥ 2m); and separated from motorways	Footpaths have sufficient width (large city ≥6m; small and medium-sized cities ≥4m) and separated from motorways	Footpaths have sufficient width (large city ≥6m; small and medium-sized cities ≥4m) and separated from motorways; most footpaths are well-paved, furnished, greened	
		21	Quality of cycle tracks	0.0132	Tracks are too narrow (one-way W<2m; two-way W<2.4m), barely usable	Tracks have usable width (one-way 2m≤W<4m; two-way 2.4m≤W<6m)	Tracks have usable width (one-way 2m≤W<4m; two-way 2.4m≤W<6m); and separated from motorways	Tracks have sufficient width (one-way 4m≤W; two-way 6m≤W) and separated from motorways	Tracks have sufficient width (one-way 4m≤W; two-way 6m≤W) and separated from motorways; most tracks are well-paved, well-lighted, furnished, greened	
		22	Non-motorized vehicle parking: 1.Sufficient parking space at important public service facilities and PT stops 2.Well-equipped bicycle racks 3.Lighting 4.Good security 5.Canopy	0.0083	Most of parks do not fulfill any criteria	1 or more criteria fulfilled by several parks	2 criteria fulfilled by the most of parks	3 criteria fulfilled by the most of parks	All criteria fulfilled by the most of parks	
	Freight transport	23	Prioritization for low emission trucks: 1.Subsidies and tax concessions to encourage the purchase and use of low emission vehicles 2.Permission to enter auto restricted zones 3.No restriction for delivering time periods 4.Recharging devices in delivering zones 5.Special delivering zones only for low emission trucks	0.0304	No one criterion fulfilled	1 criterion fulfilled	2 criteria fulfilled	3 criteria fulfilled	4 or more criteria fulfilled	
		24	Main sources of energy supply	0.1235	Conventional energy supply (power grid, gas network, heating network)		One auxiliary energy source (e.g. waste heat, renewable energy, co-generation, etc.) besides conventional energy system		More than one auxiliary energy sources (e.g. waste heat, renewable energy, co-generation, etc.) besides conventional energy system	
	Energy	Supply-side	25	Renewable energy production	0.0553	R<5%	5%≤R<10%	10%≤R<15%	15%≤R<20%	20%≤R
			26	Electricity production by co-generation	0.0243	R=0		0<R<5%		5%≤R
			27	Green electricity contract	0.0124	No green electricity contract				Green electricity contract available
Demand-side		28	Incentive policy of renewable energy utilization	0.0233	No clear incentive policy and plan		Incentive policies and plans are being developed		Incentive policies and plans have been implemented	
		29	Metered heating rate	0.0658	R<10% (residential building); R<20% (public building)	10%≤R<15% (residential building); 20%≤R<30% (public building)	15%≤R<20% (residential building); 30%≤R<40% (public building)	20%≤R<25% (residential building); 40%≤R<50% (public building)	25%≤R (residential building); 50%≤R (public building)	
Building	New buildings	30	Qualification ratio of building energy efficiency in new buildings	0.0776	R<95%		95%≤R<100%		R=100%	
		31	Proportion of green buildings in new buildings	0.0776	R<5%	5%≤R<20%	20%≤R<35%	35%≤R<50%	50%≤R	
Water	Water supply	32	Water supply from non-traditional sources	0.0142	R<5%	5%≤R<10%	10%≤R<15%	15%≤R<20%	20%≤R	
		33	Water tariff	0.0061	Increasing block water tariff system not established, water price is lower than the cost	Increasing block water tariff system established, water price is higher than the cost	Increasing block water tariff system established, water price is lower than the cost	Increasing block water tariff system established, water price is higher than the cost, charge rate cannot balance the payment	Increasing block water tariff system established, water price is higher than the cost, charge rate achieve low profit breakeven	

		34	Leakage rate	0.0067	14%≤R	12%<R<14%	R=12%	10%<R<12%	R≤10%
		35	Coverage of water-saving appliances	0.0348	R<76%	76%≤R<84%	84%≤R<92%	92%≤R<100%	R=100%
	Wastewater treatment	36	Treatment rate of wastewater	0.0706	>10% than the average level	≤10% below the average level	Similar like the average level	≤10% above the average level	>10% above the average level
	Stormwater management	37	Stormwater and wastewater diversion	0.0108	R<100%				R=100%
		38	Drainage system	0.0055	Not meet the "Code for Design of Outdoor Wastewater"		Meet the "Code for Design of Outdoor Wastewater"		Above the "Code for Design of Outdoor Wastewater"
		39	Flood prevention	0.0108	Not meet the "Code for Design of Urban Flood Control Project"		Meet the "Code for Design of Urban Flood Control Project"		Above the "Code for Design of Urban Flood Control Project"
MSW	MSW collection & transfer	40	Waste collection rate	0.0271	R<70%	70%≤R<80	80%≤R<90%	90%≤R<100%	R=100%
		41	Proportion of communities with separate waste collection facilities	0.0426	R=0		0<R<15%		15%≤R
		42	Emission level of waste transport vehicles	0.0115	Most vehicles meet the national discharge standard of vehicle pollutant	Most vehicles meet the national discharge standard of vehicle pollutant	Most vehicles meet the national discharge standard of vehicle pollutant (III Stage)	Most vehicles meet the national discharge standard of vehicle pollutant	Most vehicles meet the national discharge standard of vehicle pollutant
	MSW disposal	43	Landfilling rate	0.0102	>10% above the average level	≤10% above the average level	Similar like the average level	≤10% below the average level	>10% below the average level
		44	Harmless treatment rate	0.0305	>5% below the average level	≤5% below the average level	Similar like the average level	≤5% above the average level	>5% above the average level

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