Asia-Pacific
Economic Cooperation

Study Report of APEC Low Carbon Model Town Development Index System

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Contents

I. Rationale of the Project

Fully recognizing the importance of environmental and energy issues, the international community has convened several international conferences on reducing the emission of greenhouse gas like CO2, energy saving and development of alternative energy and exploring on the strategy for sustainable development and survival of mankind. As the largest association in the Asia-Pacific region, APEC is endowed with the important mission of improving environment and finding energy solutions.

In June, 2010, at the 9th APEC energy ministers meeting held in Fukui-Ken, Japan, the two ministers of China and Japan jointly initiated the program of APEC low-carbon model town and chose Yujiapu Financial District of Tianjin as the first APEC low-carbon model town. Afterwards, Chinese leaders advocated the program in numerous APEC summit meetings. In a bid to implement the instruction of APEC leaders, promote the development of APEC low-carbon model town program and publicize the achievements China has scored in low-carbon development, under the support of the NDRC, the Ministry of Foreign Affairs, the Ministry of Housing and Urban-Rural Development and China Development Bank, National Energy Administration conducted promotion for APEC low-carbon model town program so as to introduce advanced notions on and technology, capital and modes for low-carbon development and fully facilitate and realize sustainable development of low-carbon town in China.

In 2014, China will host the 22nd APEC Leaders' Meeting. During the meeting, China should make active efforts in publicizing its achievements in low-carbon development and promoting cooperation between China and APEC in the program of low-carbon model town.

The Promotion Planning for APEC Low-Carbon Model Town compiled by the National Energy Administration made it clear that index system for APEC low-carbon should be studied on. This is of significance to low-carbon town development in China. Other APEC economic entities can draw some lessons from the development experience of the program.

II. Concept and connotation of APEC low-carbon town

1. Review of low-carbon town concepts

With the development of low-carbon cities and relevant research, different people have come up with different definitions and explanations on low-carbon town.

1.1 Due consideration to ideal and reality (Chou Baoxin): low-carbon eco cities refer to energy-conserving and environment-friendly cities featuring low energy consumption, low pollution and low emission.

1.2 In the Sustainable Low-carbon Cities in Developing Countries, the World Bank thinks that there lacks a universal definition for low-carbon cities. This is mainly for two reasons. Firstly, difference in energy endowments in different cities. For example, in energy-intensive cities with heavy industries or cities in the chilly North in great need of heating, the absolute carbon intensity should be rather high. On the contrary, in cities with dominant tertiary industries or cities with non-energy-intensive industries or cities in temperate zones in less need of heating or cooling, the absolute carbon intensity should be rather low. Secondly, the ultimate mission of cities is to provide economic opportunities and quality life to its citizen, instead of emission reduction only. Hence, the definition of low-carbon cities should emphasize the change of carbon emission trajectory without influence of the carbon endowment in the first place. In the meanwhile, no adverse effect should be exerted on economic growth and livability.

1.3 Mr. Zhou Shengxian, Minister of Environmental Protection once pointed out that "low-carbon economy refers to a economic mode featuring low energy consumption, low pollution and low emission, marking an important progression for mankind after the primitive civilization, agricultural civilization and the industrial civilization".

1.4 In the report *Low-carbon Economy: Development Path for China under the Background of Climate Change*, CCICED pointed out that "As a economic modality appeared in post-industrialization society, low-carbon economy aims at reducing greenhouse emission to a certain level so as to prevent adverse effects to various countries and their people and ultimately safeguard sustainable livable environment for the mankind."

1.5 Definition on low-carbon cities by the WWF: under the precondition of rapid economic development, low-carbon cities should keep its energy consumption and CO2 emission at a lower level. Low-carbon city should make low-carbon economy as the development mode and direction. Citizen should adopt the notion of low-carbon lifestyle. Low-carbon society should be adopted as the goal and blueprint in government governance.

1.6 In the report Development Strategy for Low-carbon Eco-cities in China, China Society for Urban Studies proposed that through R&D of Zero-carbon and low-carbon technology and its application in cities, low-carbon city should aim at energy saving and intensive utilization so as to reduce carbon emission effectively.

1.7 Concept identification on low-carbon economy and index system for evaluating low-carbon cities by the Institute for Urban and Environmental Studies: Low-carbon economy refers to an economic modality in which carbon productivity and civil development reach a certain level so as to attain the global shared vision of greenhouse emission control. Carbon productivity refers to GDP output per unit CO2 emission. Increase in carbon productivity means more social wealth produced with less

material and energy consumption.

Taking into account of all the above definitions, we think that the following factors should be given due consideration in the research of APEC low-carbon town:

1. Technological transformation by adopting zero-carbon or low-carbon technology;

2. Due consideration to the construction of new cities and the renovation of old cities;

3. Due consideration to different development stages and due consideration to both the development modes in less developed member economies and regions as well as the path of low-carbon construction in developed member economies and regions.

2. Thoughts on APEC low-carbon model town building

2.1 Energy utilization is critical in APEC low-carbon town building

Being the driving force for urban development, energy utilization is critical in the building of low-carbon cities. For this reason, with due consideration to urban construction, economic development and environmental protection, priority should goes to the optimization of energy structure in the development of low-carbon model towns. Importance should be attached to the low-carbon application of new energy and traditional energy in its industrial development, city planning, transportation and construction. Application of energy-saving technology should be emphasized. Spatial structure and city functions should be optimized so as to produce more services and products with the same or even less energy consumption and carbon emission, improve people's living environment and life quality.

2.2 Development should be the first priority in the development of APEC low-carbon town.

With regard to APEC low-carbon town, there has always existed a dispute on the subject of evaluation, being the various goals already obtained or the scientific and operational planning and efforts in obtaining various goals contained in the planning. Promotion of APEC low-carbon model town should aim at introducing these advanced notions into urban development and realize the goal of low energy consumption, low pollution and low emission with the help of quality planning.

2.3 APEC low-carbon town planning should be deemed as a supplement to the overall town development planning.

City is the main consumer of energy. With the increase of aggregate economic output in the process of urbanization, demand of energy should increase inevitably. However, in the current overall planning of various cities, energy application is seldom touched upon. For urban development, energy can be compared with the provisions and fodder for the army. Energy planning plays a critical role in the process of urban development. APEC low-carbon town planning should be deemed as a supplement to the overall town development planning.

3. The connotation of APEC low-carbon model town

The program of APEC low-carbon model town aims at realizing low-energy-consumption and low-carbon-emission development by adopting optimization of energy structure as the main theme, guiding with advanced low-carbon planning, utilizing the platform of international cooperation and creating a energy consumption pattern featuring the close combination of low-carbon economic and social development.

III. Content of APEC Low Carbon Model Town (LCMT) Construction

1. Evaluation Criteria

To what extent carbon emissions are considered low? It is a question for a lot of cities and towns towards low-carbon development. It is believed that the answer should take into account the global consensus on response to climate change, stage of development, historical emissions, per capita emissions of the home country, as well as development positioning.

Absolute low carbon (carbon reduction). From a global perspective, absolute low carbon is required to avoid an overall global temperature rise over 2 ℃. Developed countries bear large responsibilities for historical emissions responsibilities and have high per capita emissions. Given built urban infrastructure, little or negative population growth, and transfer of most carbon-intensive industries to other countries, their carbon emissions mainly come from the consumer field, and their low-carbon development is targeted at absolute carbon reduction. For example, London made the commitment to reduce carbon emissions in 2025 down to 60% of the level in 1990; Sonderborg aims to realize zero carbon emissions by 2029.

Relative low carbon (carbon reduction). In China, the rapid increase in population calls for infrastructure construction (low-carbon construction pose a great opportunity to achieve LCMT). A substantial portion of emissions are from the industrial sector and the consumer sector in cities and towns and the surrounding areas. Although the proportion is growing rapidly, it remains much lower than that of developed member economies. For Chinese cities and towns, low carbon is relative, that is, the carbon emissions per unit of gross domestic production (GDP) should be reduced. Low-carbon, rational consumption is advocated to avoid a high-carbon model of consumption in the whole society. Moreover, consideration should also be given to the differences between cities and towns in stage of development, resource endowments, emission structure, and development orientation. LCMT should not be defined simply by emissions.

In addition, the developed and developing member economies may vary in the efforts towards low carbon. Generally, the emissions in developed member economies are caused by the extensive use of vehicles in the transportation sector, followed by heating and cooling in the building sector. These two often account for 70% to 80% of the entire urban emissions, and waste treatment and industrial production, about 20%. For developed member economies, the focus is put on low-carbon transportation and buildings.

In China, industrial emissions occupy the largest share, and the contribution of construction and transportation, though not high, grow rapidly. Hence, low-carbon industrial development is put in a more important position. In the construction and transportation sectors, the efforts are focused on low-carbon infrastructure in the rapid urbanization process, while low-carbon lifestyle is advocated to avoid paying higher costs in the future

2. How to Build LCMTs

As an increasing number of cities and towns join the ranks of low-carbon development, low carbon becomes the only way for urban economic and social development, and how to develop in a low-carbon manner emerges as the focus of attention. With reference to domestic and international research and practice in low-carbon urban development, it is recommended to take the following steps for LCMT development in the context of China.

2.1 Understand clearly the status quo of carbon emissions of towns

LCMTs have lower carbon emissions or smaller carbon intensity than before or other towns. In any case, a clear picture of the current carbon emissions is the basis, including volume and sources of emissions, and potential in emissions reduction. It is crucial to low-carbon planning and low-carbon action. Moreover, with a clear understanding of emissions over the past several years, it is easier to analyze the relationship between emissions and socio-economic development and the trend.

Preparing a GHG emissions inventory is the primary approach to gaining a scientific understanding. At this stage, it is recommended to focus on CO_2, CH_4, and N_2O and divide the emission sources into stationary sources, mobile sources, industrial processes, and waste disposal. The boundary is limited to the urban areas (including peri-urban areas, excluding the outer suburbs) which corresponds to the Western towns, and it is easy to obtain their data and statistics. Two scales are considered, i.e. all direct emissions and the indirect emissions occurred in electricity and heating buying and redeployment. Emission factors, selected on the basis of research, should accurately reflect local emission characteristics as much as possible.

In addition, it is recommended to carry out a long-series urban GHG research. A long-series GHG inventory is very important t the development of a low-carbon economy as it facilitates an intuitive analysis of the emissions trend, assessment of the emissions reduction and introduction of highly targeted policies and measures. It should be noted that the calculation of carbon sinks also plays a role in promoting the full range of low-carbon urban development.

2.2 Study the medium- and long-term carbon scenarios

With combined consideration to current carbon emissions and future economic and social trends and goals, the scenarios of carbon emissions in the medium and long term should be explored. It lays the foundation for setting carbon reduction targets and formulating low-carbon development planning.

Not a forecast, scenario analysis provides an approach of analyzing problems and the internal causes and impacts, and it is instrumental to for policy evaluation and planning and strategy development. It focuses on the energy system and carbon emissions caused by energy consumption, in the effort to look for ways and means for mitigating emissions and controlling the growth.

First scenario analysis must identify the core factors of urban GHG emissions, including the level of macro-economic development, industrial structure, as well as service volume, energy efficiency and share of non-fossil energy sources in the main industries. Key drivers of various types are then clarified. Generally, at least the business as usual (BAU) scenario and low-carbon scenario (LCS) are developed, and depending on the circumstances, the latter may be divided into weak and strong intervention scenarios.

A "looking back" approach or a "looking forward" approach may be used for quantitative analysis of scenarios, and the results should highlight energy consumption trends, primary energy structure, final energy structure by industry, trends in CO_2 emissions, carbon intensity analysis, contribution analysis of emissions reduction, technical and economic analysis for low-carbon development. Interpretation of the results provides practical guidance for developing low-carbon planning and energy development strategy.

2.3 Set a quantified target for carbon reduction

A comprehensive quantified target for carbon reduction is an indispensible element in the development of low-carbon cities and towns. It should be set with full consideration to the stage of development, resource endowments, emission structure, development orientation, as well as the overall goal of the member economy. Moreover, the target should be forward-looking and demonstrate willingness and image of cities and towns. Currently, the majority cities and towns consider targets for carbon intensity and some, per capita emissions. Given specific demographic change, per capita emissions targets are in fact total emissions targets. Setting emissions targets is the inevitable direction of future development, and earlier attempts and practice will benefit towns and give them advantages in opportunities.

2.4 Establish low-carbon development planning

Low-carbon development planning is the low-carbon action program that decomposes the carbon reduction target to all walks of life and makes arrangements and requirements for a variety of resources and institution building necessary to secure the accomplishment of target.

Low-carbon development planning should cover construction, transportation, industries, and energy, and take into account government guidance, monetary policy, public participation, and corporate participation. It should be kept in line with the existing economic and social development planning and special plans, and ensure in a reasonable way the legal status and operability of related core objectives and measures.

2.5 Implement low-carbon development planning

The competent department of macro-economic management leads the implementation of low-carbon development planning with the collaboration with dedicated departments, and should fully mobilize the enthusiasm of enterprises and the public. Institution building, financial support, technology support, and public advocacy should be combined to push ahead the implementation.

Measures should be carried out in a progressive manner, depending on the rankings by the potential in emissions reduction and "small input, great effect" activities are given priority. Meanwhile, the government should take the lead to perform low carbon in office buildings and public infrastructure, and guide businesses and the whole community in low-carbon actions. And the market mechanism should be given full play in resource allocation to boost research and practice in carbon finance, carbon trading, carbon labeling, and carbon certification.

2.6 Evaluate and monitor emissions reduction effect

Emissions reduction impact is assessed and monitored through the establishment of annual GHG emissions inventory or with the aid of LCMT development index system.

LCMT development indicators include per capita carbon emissions, carbon productivity, carbon emissions elasticity, life-cycle carbon emissions of products, and carbon sinks.

Emissions reduction impact assessment and monitoring is conducive to the timely revision and improvement of low-carbon development planning to ensure the realization of low-carbon objectives. Above-mentioned first four steps are designed to shape a scientific, characteristic, workable low-carbon development planning based on local realities, of which the first and second steps are relatively difficult and important. In reality, many cities and towns set quantitative targets for carbon intensity and formulate and implement plans based on a simple analysis of the current status and future scenarios of emissions, and this also yields positive results.

3. Key Tasks in LCMT Construction

3.1 Framing a low-carbon industrial system

A low-carbon industrial system is critical to low-carbon urban development because economic activities are the core of urban development at the present stage. It calls for a low-carbon industrial structure with low carbon per unit of output (or low emissions) and low consumption of power and resources.

In the current urban industrial structure, industrial sectors exert different impact on low-carbon development. In specific, energy and resources industries, with a higher proportion, put high pressure in industrial emissions. High-tech industries and advanced manufacturing lag behind and hinder efficient low-carbon development, and technological innovation to transform traditional industries and improve the proportion of new industries becomes a major way to reduce carbon emissions. Agriculture, with prominent comparative advantage in low carbon, can realize a transition to efficient organic eco-agriculture by improving efficiency. Besides, the modern service industry is related to the formation of industrial chains and industrial clusters, as well as the urban landscape of dispersed groups, and developed modern services will raise the overall carbon productivity. Tourism and cultural industry is a new aspect to break through for low-carbon urban development.

Industrial chains and industrial clusters based on named industries have a positive role in promoting a low-carbon urban economy: advanced manufacturing, high-tech industries, efficient resource and energy, non-fossil energy, modern service, efficient organic eco-agriculture, low-carbon technologies-centered environmental protection, tourism and cultural industries.

To set up a low-carbon industrial system, industrial organizational innovation is also advocated. A higher proportion of small and medium-sized enterprises (SMEs) and information-based industrial management will be conductive to a low-carbon transition of the urban industrial system.

3.2 Shaping a low-carbon energy supply system

Essential to urban economic and social life, the urban energy system encompasses fossil energy and new energy. Fossil energy sources include thermal power, hydropower, oil, natural gas and coal, while new energy refers to nuclear, wind, solar and biomass power. Hydropower and natural gas are relatively non-fossil, so hydropower and new energy with relative renewability can also be considered as non-fossil energy sources. At present, fossil fuels support more than 70% of China's urban economic and social activities.

A low-carbon energy supply system calls for energy technological innovation, increased investment, and changes in the model of energy development. Energy structure should be optimized by developing new energy and renewable energy so that coal, oil and gas, new energy can progressively gain an equal share in primary energy supply. First, regional cooperation should be strengthened to facilitate a rational distribution of nuclear power production and improve the urban nuclear power supply capacity. Considering the characteristics of urban resources and natural and geographical conditions and climatic conditions, an appropriate planning should be drawn for the development and utilization of wind energy and solar energy, while developing characteristic energy industries. Moreover, efforts should be made to improve the biological level of pollution control, develop industrial biogas industries, and strengthen rural biogas construction. In addition, the primary energy should take a higher share in energy supply to reduce the energy waste in energy supply.

3.3 Establishing a low-carbon infrastructure system

In this regard, the primary task is to build a low-carbon, environment-friendly transportation system. In specific, the transportation within and between cities should rest on railway supplemented by highway. According to statistics, carbon emissions per the unit load of railway transportation are 5%-20% of highway, while energy consumption per ton per kilometer is 118 kcal for train and 696 kcal and 2298 kcal for large trucks and buses and small trucks respectively. Low-carbon-oriented traffic within cities and towns requires retaining and expanding non-motorized vehicle lanes and developing subway, light rail and rapid transit, in which public transportation is given priority. By building such a low-carbon transportation system, carbon productivity can be improved and land for transportation substantially reduced.

Low-carbon buildings and low-carbon public space play a very prominent role in urban carbon reduction and are incorporated as an important task in low-carbon urban planning. Buildings are a major source of GHG emissions. Data shows that buildings account for 30-40% of the total energy consumption in developed member economies and 28% in China, and the share is expected to rise in the future. Large public buildings are given special attention for emissions reduction. New large-scale public buildings are required to meet energy efficiency and low carbon standards in the whole process of construction, inspection, and marketing authorization, and to use a certain percentage of non-fossil energy sources and materials. Existing public buildings are subject to low-carbon renovation.

Urban public space provides contiguous space for cultural activities and also serves as an important carrier of urban carbon cycle. In urban planning, the seepage area should be not less than 50% of the built-up area, while natural ecological elements should be retained as many as possible.

Low-carbon municipal public infrastructure also involves low-energy clean water supply network facilities, water saving facilities, buildings, residential communities, street-grading rainwater harvesting and storage systems, clean and non-fossil energy supply facilities, small-scale decentralized treatment of rural and urban sewage, garbage recycling and biological treatment facilities. For municipal public facilities for water supply, heating, sewage and waste disposal, new technologies for energy saving and emission reduction and economic incentives should be adopted. For example, the sewage treatment fee is returned directly to the sewage treatment plant; rewards instead of subsides are granted for actual emissions reduction and COD reduction, so as to encourage the use of low-carbon energy efficiency technologies.

3.4 Developing a low-carbon urban spatial structure and layout

Low-carbon urban planning requires composite land use to improve land utilization. Land for traffic and industrial purposes should be reduced, and for living and ecological purposes increased. A "low-impact" development model is introduced to maximize the use of natural geographic features, rather than transform the original natural landscape, hydrological and vegetation conditions. Urban spatial layout, on the basis of dispersed groups, should reasonably increase urban compactness and realize convergence of the structural functions of the internal space by way of green ribbon compartment system. In addition, a modest population size should be specified to adapt its layout to efficient low-carbon urban spatial layout and infrastructure.

3.5 Implementing low-carbon public consumption and low-carbon public policy

Government policy guidance and administrative means are combined to push low-carbon urban

development. Preferential policies are formulated for low-carbon industries and infrastructure, and guiding financial investment budget is developed for low-carbon towns and low-carbon transformation projects. Low-carbon energy model is also applicable to government office buildings and vehicles, such as strengthening the capacity building for online office.

Low carbon is vigorously advocated in public consumption, including employment, housing, travel, and lifestyle. Possible measures include increasing the proportion of employment in low-carbon industries, drawing a rational space distance for employment, and giving priority to low-carbon demand in the supply and choice of housing and travel. In public life, low-carbon energy efficiency philosophy and behavior are carried out that facilitates the reduction and reuse of waste and sewage.

3.6 Restoring the high-level virtuous cycle of ecosystem

In ecological protection and construction, non-engineering tools are highlighted to maintain and guide the positive succession of natural woodland and mutualism of artificial and natural ecosystems. Water flow should be realized between rivers and watershed and between surface and underground water, and drying-up should be avoided. Landscape-based green space will be reduced and ecological green space expanded to increase carbon sequestration capacity. Efforts are also needed to keep intact the wildlife habitat and its surrounding environment and migration channels. Efforts are intensified to protect ecologically fragile areas, urban wetlands, and natural water systems, so as to lay a solid foundation for low-carbon eco-towns. Ecological woodlands with economic functions are encouraged to commercialize ecological construction along with eco-friendly economic development.

3.7 Establishing the low-carbon model for environmental protection and governance

In terms of environmental protection and governance, biological means are expected to outnumber chemical and physical means to achieve high utilization of resources and reuse of pollutants (implementation and promotion of waste reduction, sorting, and composting). Advanced techniques for environmental protection and governance are introduced and promoted vigorously, so that enterprises in the pillar industries can meet the standards for pollutant discharge and outperform in carbon emissions per unit of output. Regarding environmental sanitation, an urban- rural integrated public system of sanitation facilities and network operators is designed. Towns also propose a set of environmental targets, including 100% separate collection of garbage, use of recyclable and indigenous materials in the construction, a cap of 110 liters/day/person for indoor water consumption of residents, zero discharge of rainwater runoff in case of once-a-year rainfall, and 90% of the water from non-traditional / recycling channels.

Above-mentioned is the major tasks in low-carbon urban planning. Towns are an open system with close flow of production factors, products and personnel with the outer region, and such mobility leads to mutual replacement of internal and external carbon productivity. Hence, to achieve low-carbon urban development as a whole, it is necessary to strengthen regional and international cooperation, expecting to control the overall carbon emissions of the industrial chain through external collaboration. At the same time, towns whose products serve as energy and raw materials for other regions and towns, shows great external amplification of carbon emissions. It calls for bidirectional accounting to determine the low-carbon development objectives.

IV. Design of APEC low-carbon town index system

1. Design principles

In formulating the framework for the index system, we should mainly focus on the optimization of energy structure and improvement of energy efficiency. We should adopt the notion of sustainable development in the development and construction of low-carbon town. In the meanwhile, the following principles should be followed:

- **Due consideration to both scientific and feasible design**

Index selected should have explicit definition and method for appraisal. In addition, the index should be able to reflect the features and requirements for low-carbon town development. Index included in the scope of government surveillance or easy to obtain should be used to make the design more feasible.

- **Due consideration to both comprehensiveness and particularity**

In designing the index system, we should proceed from features of low-carbon town building and design some universal indexes. In the meanwhile, in order to highlight different features of different cities, some selective indexes should also be designed to encourage various towns in fully taking their advantages and building low-carbon towns in a suitable way.

- **Due consideration to both compulsory and incentive measures**

In low-carbon town development, the minimal requirements of building should be met. Under the precondition of meeting these basic requirements, some higher indexes should be set up gradually so as to encourage the best and long-term development of low-carbon towns.

- **Due consideration to both qualitative and quantitative indexes**

Qualitative indexes should be mainly designed for energy and resources consumption and application of energy technology so as to make scientific evaluations on the development of low-carbon towns. Quantitative indexes should be mainly designed for management policies and industrial policies so as to evaluate the attitude on and measures for low-carbon town development and building.

2. Method

In designing the APEC low-carbon model town index system, the analytic hierarchy process should be adopted to break down the development of low-carbon model towns into different aspects and come up with different indexes for these aspects specifically.

The index system can be roughly divided into two parts, namely the qualitative and quantitative ones. Quantitative evaluation should be adopted for all indexes which can be quantitatively measured so as to reduce any possible errors. In selecting the qualitative indexes, methods such as trend extrapolation, regression analysis and analogy forecast. In determining the value of qualitative indexes, a combination of data collection and questionnaire is applied.

In selecting the quantitative indexes, we should choose these typical ones which can reflect the ultimate goals of low-carbon model towns and establish relevant evaluation process with due consideration to the situation f the low-carbon towns. Qualitative indexes should be mainly used to evaluate the compliance of relevant regulations on the part of the low-carbon towns and the implementation of energy technology in

real work.

In quantitative index system, the benchmark value of various indexes forms the basis to evaluate whether basic requirements for low-carbon towns have been met. The following principle should be followed in determining the benchmark value: should the government or industrial association have explicit value for the index in relevant policies, standards and technical regulations, then such value should be adopted. In the case of absence of such value, medium to high value in daily application of the technology in recent years should be adopted. Benchmark values of the index system should represent the average advanced development of low-carbon towns.

Both the quantitative and qualitative indexes can be further divided into two categories, namely the primary and secondary indexes. Primary indexes include universal and general ones. The secondary indexes include specific, operational and verifiable indexes under the primary indexes.

3. The role of the index system

3.1 It defines the position of APEC low-carbon model town and provides ideas for the planning of low-carbon town;

3.2 It puts forward the basic framework for low-carbon city building and lays the foundation for building planning by various towns;

3.3 It reasonably evaluates and checks the results achieved by the planning.

V. APEC Low-carbon Model Town Index System

1. General description

The APEC low-carbon model town index system consists of basic index and application index. The framework is detailed in the diagram below.

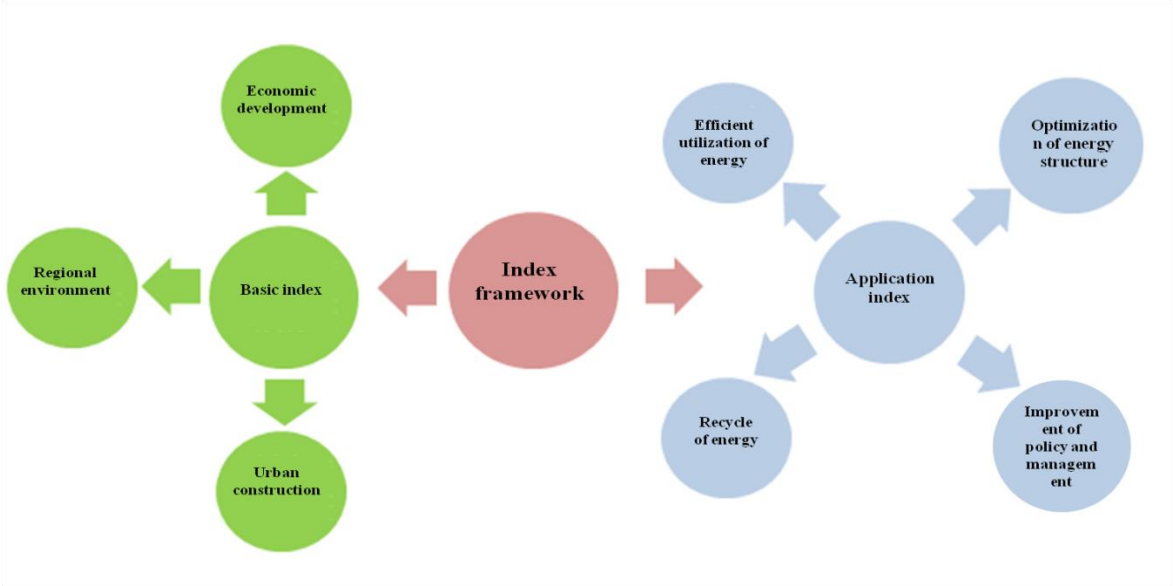


Figure 1：The APEC low-carbon model town index system framework diagram

Basic index is a classification indicator to measure economic development, regional environment and urban construction that are highly valued in the construction of APEC low carbon towns, as well as a reference indicator that must be satisfied in low carbon model town projects.

Application index is classified into control index and selection index. It's designed to guide towns in low carbon development in line with the mode of development suitable for itself by optimizing energy structure, implementing energy-efficient technologies and comprehensively utilizing resources. Among the rest, control index is an overall indicator that must be met; while selection index is selected by towns based on their own features and needs, with each index corresponding to a certain score. The total score of low-carbon model towns must be up to 70.

The index system divides APEC low-carbon model towns into three grades, say, three-star, two-star and one-star towns. The three-star towns are those scoring 90 and above; three-star ones are those scoring 80 ~90, 80 included; and the one-star towns are those scoring 70~80.

The index system is applied for general purposes. We'll put forward a series of targeted index systems in the course of planning and construction of low-carbon towns based on different features of the such major sectors as industry, agriculture, tourism and resources in towns.

2. Contents of APEC low-carbon model town index system

2.1 Basic index

Type of index	Item of index	Description of index	Remarks

1.Economic development index	1) Developing local characteristic industries	Develop diverse characteristic industries suitable for local areas by taking full advantage of native natural resources and social conditions and based on the concept of low carbon	
	2) Carbon emission intensity of per unit GDP	The amount of carbon dioxide generated by economic activities per unit GDP	
	3)Residents' employment index at their localities	The proportion of residents employed in the region to the working population	"Job-housing balance index" can be also selected.
2.Eco-environmental index	4) Carbon emission intensity per capita	It refers to carbon emission intensity of permanent population in urban areas.	
	5)Environmental quality of surface water of the area	Constructing water ecology and water circulation system to protect environmental quality of surface water through measures like sewage treatment and discharge with standard level, river water control, prevention of water and land erosion	
	6) Standard emission ratio of main industrial pollution source in the region	Industrial pollution source refers to production equipment or production sites that have adverse impacts on the environment during industrial production. It generates pollutions to air, water and soil by discharging waste gas, water, residues and heat, and imposes harms to surrounding environment by producing noise, vibration and so on.	
3.Urban construction index	7) Per capita green area of the park in the built-up area	During urban construction, building green belts is vital to enhance urban taste, improve air quality and life comfort of residents, and reduce carbon emission.	"The green coverage of the built-up area" can be also selected.
	8) Comprehensive capacity rate of urban construction land	Comprehensive capacity rate refers to the ratio of total floor area in the built-up urban construction land to the area of the built-up urban construction land.	

2.2 Application index

Type of index	Item of primary index	Item of secondary index	Property of index	Score
1. Efficient utilization of energy (30 scores in total)	Comprehensive index	1) Energy consumption of per unit GDP (tce/ten thousand yuan)	Controlling	
		2) Efficiency of energy utilization	Selective	5
	Energy saving of buildings	3) Proportion of green and energy-saving buildings in new buildings	Controlling	
		4) Proportion of floor area of g two-star and three-star green buildings and total area of green buildings	Selective	5
		5) Energy saving and renovation plan of existing buildings and its implementation	Selective	3
	Energy saving of transportation	6) Construction of slow-traffic system of towns	Controlling	
		7) Bearing rate of public transportation (%)	Selective	5
	Industrial energy saving	8)Energy consumption of per unit industrial value-added (tce/ten thousand yuan)	Selective	4
		9) Per unit energy consumption of major products of key industries (tce)	Selective	4

Type of index	Item of primary index	Item of secondary index	Property of index	Score
		10) Recycling measures of industrial surplus energy	Selective	4
2.Optimization of energy structure(totally 35 scores)	Comprehensive index	11) Ratio of clean energy consumption to the total energy consumption (%)	Controlling	
		12) Application of innovative technology of renewable energy	Selective	5
	Utilization of new energy -buildings	13) Proportion of use of renewable energy in buildings in total energy consumption in buildings (%)	Selective	6
	Utilization of clean energy-transportation	14) Ratio of clean energy applied in public transportation (%)	Selective	4
	Application of new energy	15) New energy application plan. Analyzing application potential and formulating new energy application plan based on new energy and resources.	Selective	20
3. Recycling of resources (totally 20 scores)	Recycle of water resources	16) Utilization rate of reclaimed water in towns (%)	Controlling	
		17) Reuse rate of industrial water (%)	Selective	5

Type of index	Item of primary index	Item of secondary index	Property of index	Score
	Recycle of domestic waste	18) Resource utilization rate of domestic waste (%)	Selective	5
	Recycle of industrial waste	19) Comprehensive utilization rate of industrial solid waste (%)	Selective	5
	Disposal and recycle of construction waste	20) Disposal and recycle of construction waste	Selective	5
4.Improvement of policy and management (15 scores in total)	Low-carbon development plan	21) Preparing urban low-carbon development plan	Controlling	
	Energy management	22) Establishing a system of monitoring and statistics related to carbon emission and energy consumption	Selective	3
	Construction of smart city	23) Constructing of digital and information platforms	Selective	3
	Classification management of garbage	24) Institutionalizing classification management of domestic garbage	Selective	3
	New energy and energy-saving technologies	25) Financial and policy support	Selective	2
		26) Construction of public service platform	Selective	2
	Low-carbon publicity	27) Publicity and popularization of low-carbon life style	Selective	2

Note：The unit in charge of such index preparation will be responsible for the interpretation of specific definitions and methods for calculation and assessment above mentioned.

3. Interpretation on APEC low-carbon model town index system

3.1 Interpretation on items of basic index

- Economic development index

1) Developing local characteristic industries

Interpretation on the index:

Develop diverse characteristic industries suitable for local areas by taking full advantage of native natural resources and social conditions as well as based on the concept of low carbon, so as to form more competitive enterprise clusters.

Local characteristic industries refer to large-scale, intensive, chained and market-oriented production and operation groups that are formed based on regional and resource superiorities and are engaged in production, sales and services of featured products.

Requirements for the index:

The qualitative index is that cities and towns should be fully aware of their advantages in resources, locations and transportation, and try to develop characteristic industry in line with their local features in combination with the established industrial agglomeration degree and the low-carbon elements.

2) Carbon emission intensity per GDP

Indicator interpretation:

The amount of carbon dioxide generated by economic activities per GDP

Calculation method:

$$carbon\ emission\ intensity\ per\ DGP = \frac{CO2\ discharge\ amount\ (tons)}{\text{GDP (thousand yuan, at constant price)}}$$

In this system, the discharge amount of carbon dioxide is generated from the burning of fossil fuels and the production of cement. GDP is the gross regional product at constant price.

Indicator requirement:

Carbon emission should meet the objective of urban low-carbon development.

3) Resident local employment indicator

Indicator interpretation:

It refers to the proportion of local employment in the total employment of the resident

Calculation method:

$$resident\ local\ employment\ indicator = \frac{\text{resident number of local employment}}{\text{resident number of total employment}}$$

Indicator requirement:

The proportion should be higher than 50%.

The indicator requires that urban development should take into account the integration of city and production, and avoid the building of an empty city.

- Regional Environmental Indicator

4) Carbon emission per capita

Indicator interpretation:

The carbon emission intensity of permanent resident population in urban areas

Calculation method:

$$per\ capita\ carbon\ emission = \frac{\text{CO2 dischage amount (tons)}}{\text{permanent resident population (people)}}$$

Indicator requirement:

If per capita GDP is lower than the national average level, the per capita carbon emission should also be lower than the national average level; if per capita GDP is higher than national average level, the per capita carbon emission should not be higher than 50% more of the national average level of per capita GDP.

The indicator requires that urban carbon emission should reach the national advanced level.

5) Regional surface water environment quality

Indicator interpretation:

The protection and restoration of aquatic ecological environment are the important measures of natural and ecological environment protection. Measures like river water treatment, treatment and standard discharge of sewage, reclaimed water reuse, and the prevention of water loss and soil erosion should be adopted to build the system of water ecology and water recycling, and protect the quality of surface water environment.

Indicator requirement:

It is the quantitative index, and requires that the quality of regional surface water environment should completely meet the standard of current requirements for IV water quality setting in *Surface Water Environment Quality Standard*.

6) Standard discharge rate of regional key industrial pollution sources

Indicator interpretation:

Industrial pollution sources are the production equipment and production places that have harmful effects on the environment in industrial production. It contaminates the air, water and land by discharging waste gas, waste water, waste residue and waste heat, and does harm to the surroundings by generating noises and vibrations, etc..

Calculation method:

$$standard\ discharge\ rate\ of\ urban\ key\ industrial\ pollution\ sources = \frac{\text{standard discharge amount of } urban\ key\ industrial\ pollution\ sources\ (tons)}{\text{total discharge amount of } urban\ key\ industrial\ pollution\ sources\ (tons)}$$

Indicator requirement:

It requires that the discharge of pollutants by all key industrial pollution sources in the urban areas should completely meet the relevant national and regional standard.

- Urban Construction Indicator

7) Per capita park green area in built-up areas

Indicator interpretation:

"Park green land" is the green land that opens to the public with the main function of recreation as well as other functions like ecological improvement, beautification and disaster prevention, etc. It is an important element in urban development land, urban green land system and urban public utility. The indicator is a significant one for showing the overall environment level of the city and the life quality of its residents.

In the construction of cities and towns, green land development plays an important role in elevating the taste of the city, improving the air quality, raising the comfort level for the citizens and lowering carbon emission, etc.

Calculation method:

$$per\ capita\ park\ green\ land\ area = \frac{park\ green\ land\ area(m2)}{\text{urban population (people)}}$$

The calculation method of park green land area takes reference from *Urban Green Land Classification Standard* (CJJ/T85-2002).

The urban population is made up by registered population and permanent population.

Indicator requirement:

Per capita park green land area ≥12 square meter/person

8) Comprehensive plot ratio of urban construction land

Indicator interpretation:

The comprehensive plot ratio is the ratio between the total floorage in urban construction built-up land and the area of urban construction built-up land. It reflects the overall intensity of use of urban construction built-up land. In a certain range, the bigger the comprehensive plot ratio is, the higher the level of

intensive use will be.

Calculation method:

$$\text{comprehensive plot ratio of urban construction land} = \frac{\text{gross floorage ofplot ratio(m2)}}{urban\ construction\ land\ area\ (m2)}$$

Indicator requirement:

Comprehensive plot ratio of construction land ≥1.2

It requires the intensification of land use.

3.2 Application Indicator Interpretation

- Efficient Utilization of Energy

1) Per capita GDP energy consumption (tce/ten thousand yuan)

Indicator interpretation:

The energy consumption of every ten thousand GDP

Calculation method:

$$per\ capita\ GDP\ energy\ consumption = \frac{gross\ energy\ consumption\ (tce)}{\text{GDP (ten thousand yuan, at constant price)}}$$

Indicator requirement:

Controlling indicator

Low-carbon cities and town should fulfill the task of lowering per capita GDP energy consumption set by the provinces.

2) Efficiency of energy utilization

Indicator interpretation:

At the macro level, efficiency of energy utilization means the GDP generated from per capita energy consumption (ten thousand yuan/tce), and it is the ratio of energy input and output.

Calculation method:

$$efficiency\ of\ energy\ utilization = \frac{\text{gross domestic (regional)}production\ (ten\ thsounsand\ yuan, constant\ price)}{gross\ energy\ consumption\ (tce)}$$

Indicator requirement:

Selection index

5 scores for improvement by 20% of low-carbon pilot cities and towns compared with base period value.

3) Ratio of green buildings and energy-saving buildings in new buildings (%)

Indicator interpretation:

The coverage area of buildings that meet the standards of green building and energy-saving building in new buildings of town planning

Calculation method:

$$ratio\ of\ green\ buildings(energy-saving\ builidngs)in\ new\ buildings\ (\%) = \frac{\text{new green building (energy} - \text{saving building)area(m2)}}{\text{new buildings area (m2)}}$$

Indicator requirement:

Controlling indicator

Reaching 100% of the standard

4) Ratio of two star and above buildings areas in total green buildings areas (%)

Indicator interpretation:

The proportion of two star and above buildings in the total green buildings

Calculation method:

$$\text{proportion of two star and above buildings in the total green buildings} = \frac{\text{two star and above green buildings (m2)}}{\text{total green buildings (m2)}}$$

Indicator requirement:

Selection indicator

5 scores for reaching 30% of the standard

5) Planning and implementation of energy conservation reconstruction of existing buildings

Indicator interpretation:

Qualitative index

Planning for energy conservation reconstruction of existing non-energy saving buildings, and the implementation of the planning.

Indicator requirement:

Selection indicator

3 scores for the planning of energy conservation reconstruction and the gradual implementation

6) Construction of urban slow transportation system

Indicator interpretation:

Qualitative index

Urban slow transportation system is the road system for walking and noon-motor vehicle. It requires the slow transportation system to be convenient and popular, and be seamless connected with public transportation and the subway system so as to promote green transportation.

Indicator requirement:

Controlling indicator

Improve the system of walking and bicycle. Low-carbon cities and towns should build reasonable and complete slow transportation system.

7) Assumed rate of transit trip (%)

Indicator interpretation:

Rate of chances for urban residents to choose public transportation (conventional public traffic and underground transportation) among all other ways of transportation

Calculation method:

$$assumed\ rate\ of\ public\ transportation = \frac{\text{total population taking public transportation}}{total\ population\ on\ transportation}$$

Indicator requirement:

Selection indicator

3 scores for reaching 25% of the standard; 5 scores for 30%

8) Energy consumption per unit industrial added value (tce/ten thousand yuan)

Indicator interpretation:

The ratio of urban comprehensive gross energy consumption and urban industrial added value

Calculation method:

$$energy\ consumption\ per\ unit\ of\ industrial\ added\ value = \frac{urban\ gross\ industrial\ energy\ consumption\ (tce)}{\text{urban industrial added value (ten thousand yuan, constant balue)}}$$

Indicator requirement:

Selection indicator

4 scores can be obtained if the energy consumption per unit of industrial added value is equal to or less than 0.5 tce/ten thousand yuan.

9) Per unit comprehensive energy consumption of major products in key industries

Indicator interpretation:

It indicates the comprehensive energy consumption generated by major products (steel, copper, aluminum, cement, chemical fertilizer and paper, etc.) in key industries in cities and towns.

Calculation method:

$$comprehensive\ energy\ consumption\ of\ major\ products\ in\ key\ indstries = \frac{\text{energy consumption of major products(tce)}}{\text{output of major products (tons)}}$$

Indicator requirement:

Selection indicator

4 scores for the advanced standard of energy consumption in the same industry

10) Recycling measures for industrial complementary energy

Indicator interpretation:

Qualitative index

Industrial complementary energy is the energy generated from industrial processes that can be recycled, including high temperature waste heat from exhausted gases, cooling medium waste heat, waste heat from spent steam and waste water, high temperature product and cinder waste heat, waste heat from chemical reaction, combustible waste gas and spent liquor waste heat, and waste pressure of high pressure fluid, etc. According to the different carriers of waste energy, industrial waste energy can be divided into heat-carrying waste energy (like cement kiln waste heat, boiler smoke waste heat, circulating cooling water waste heat, etc.), combustible waste energy (gas of coal mine, coke oven gas) and pressure-carrying waste energy (like blast furnace gas waste pressure, excess pressure of high temperature oil in hydrocracker).

Indicator requirement:

Selection indicator

In low-carbon cities and towns, reasonable utilization plans should be made and implemented for industrial waste energy in established industries and planned industries, and the utilization ratio should meet the relevant industry standards. Fulfilling the requirements gains 4 scores.

- Energy Structure Optimization

11) Ratio of clean energy in energy consumption (%)

Indicator interpretation:

Clean energy can be divided into the narrow sense and the broad sense. Narrowly, it refers to renewable energy, such as, water energy, bioenergy, solar energy, wind energy, geothermal energy and ocean energy. Broadly, it includes the energies that have low pollution or no pollution to the ecological environment in the production and consumption process, such as, natural gas, clean coal (coal is transformed into gas or coal oil through chemical reaction, and into electricity through burning strictly controlled by high and new technology) and nuclear energy, etc. This indicator pays high attention to law-carbon energy, and thus belongs to clean energy in the broad sense.

Calculation method:

$$ratio\ of\ clean\ energy\ in\ energy\ consumption\ (\%) = \frac{\text{clean energy consumption (tce)}}{\text{total energy consumption (tce)}}$$

Note: renewable energy in electricity consumption and generating capacity of industrial waste energy are included in clean energy consumption, and fire coal electricity and outsourcing electricity are not included in clean energy consumption. The nigger head coefficient of electricity is evaluated by net coal consumption rate of fire coal in the previous year.

Indicator requirement:

Controlling indicator

The requirement is more than or equal to 45%.

12) Innovative technology application of renewable energy

Indicator interpretation:

Qualitative index

It refers to the innovative technologies applied in new energy. The application of renewable energy and new energy needs innovation, and low-carbon cities and towns should take the lead.

Indicator requirement:

3 scores for one innovation technology; 5 scores for 2 and more

13) Ratio of renewable energy sources application in total energy consumption of buildings (%)

Indicator interpretation:

The ratio of renewable energy application in energy utilization in buildings of civil use

Calculation method:

$$\text{ratio of renewable energy application in energy utilization in buildings of civil use} = \frac{\text{application of renewable energy in buildings (tce)}}{\text{total energy consumption in buildings (tce)}}$$

Indicator requirement:

Selection indicator

3 scores for the requirement more than 4%; 6 scores for that more than 6%

14) Clean energy application ratio in public transportations (%)

Indicator interpretation:

The utilization ratio of electricity, natural gas and other clean energy in public transportation (buses and taxis) in the total energy consumption of public transportations

Calculation method:

$$ratio\ of\ clean\ energy\ in\ public\ transportation = \frac{\text{utilization of clean energy in public transportation (tce)}}{\text{gross energy consumption of public transportation (tce)}}$$

Indicator requirement:

Selection indicator

4 scores can be obtained if the requirement is more than or equal to 80%.

15) New energy application plan

Analyze the application potential based on renewable energy resources, carry out the application plan of new energy, and put forward the ratio of renewable energy utilization in gross energy consumption at the final stage of planning.

Indicator interpretation:

Quantitative index

Accurately analyze the potential of renewable energy in the region; reasonable scale of development and application; feasible technical program; application of one or more renewable energy resources.

Calculation method:

$$application\ ratio\ of\ renewable\ energy = \frac{\text{application amount of renewable energy (tce)}}{\text{regional gross energy consumption (tce)}}$$

Indicator requirement:

Selection indicator

Accurately analyze the potential of renewable energy in the region; reasonable scale of development and application; feasible technical program; 10 scores if the application rate of renewable energy accounts for 6% of the gross energy consumption, 1 score more for 1% increase of the rate, the highest score is 20.

- Resources Recycling

16) Urban reclaimed water utilization ratio (%)

Indicator interpretation:

The ratio of reclaimed water utilization and urban gross sewage treatment

Calculation method:

$$urban\ \text{reclaimed water utilization ratio} = \frac{\text{urban reclaimed water utilization amount}}{\text{urban sewage treatment amount}} \times 100\%$$

Indicator requirement:

Controlling indicator

The requirement should be over 25%.

17) Repeating utilization factor of industrial water (%)

Indicator interpretation:

The ratio of industrial water repeating use in gross industrial water utilization

Calculation method:

$$\text{repeating utilization factor of industrial water (\%)} = \frac{industrial\ water\ repeating\ utlitzation\ (t)}{\text{total amount of industrial water utilization (t)}}$$

Amount of industrial water repeating utilization: the amount of water that is repeatedly utilized in industrial production.

Amount of industrial water utilization: the amount of water that is used in production and living in enterprises and factories, which is the sum of industrial fresh water and industrial repeating water.

Indicator requirement:

Selection indicator

5 scores for reaching the 90% of the requirement

18) Reclamation use ratio of household refuse

Indicator interpretation:

The percentage of recycling refuses in total amount of refuse; the recycling use of refuse is the sum of the recycling amount of matters and energies. Matter and energy recycling includes three parts: reuse, recycling and energy recovery.

Calculation method:

$$urban\ household\ refuse\ reclamation\ ratio\ (\%) = \frac{\text{amount of urban household refuse reclamation}}{\text{amount of urban household refuse clean} - \text{up}} \times 100\%$$

Indicator requirement:

Selection indicator

5 scores for reaching 60% of the requirement

19) Comprehensive utilization rate of industrial solid waste (%)

Indicator interpretation:

The percentages of comprehensive utilization of industrial solid waste in industrial solid waste output (including comprehensive utilization storage in previous years).

Rate of comprehensive utilization of industrial solid waste: the amount of solid waste (including industrial solid waste storage in previous years) that can be extracted or transformed into utilizable resources,

energies and other materials through recycling, procession, circulation and exchange by enterprises in the reporting period, which can be used as agricultural fertilizer, production and building materials or paving roads, etc.

Calculation method:

$$\text{Comprehensive utilization rate of industrial solid waste (\%)} = \frac{\text{comprehensive utilization amount of industrial sollid waste (t)}}{\text{industrial solid waste output (t)}}$$

Indicator requirement:

Selection indicator

5 scores for reaching 90% of the requirement

20) Treatment and recycling of construction waste

Indicator interpretation:

There should be reasonable classification, collection, treatment and recycling utilization of construction waste.

Indicator requirement:

Selection indicator

5 scores can be obtained if the utilization program is reasonable and well-implemented.

- Policy and Management Improvement

21) Compiling of urban low-carbon development program

Indicator interpretation:

It indicates that low-carbon cities and towns should establish low-carbon development programs.

Indicator requirement:

Controlling indicator

The compiling of low-carbon development program should be completed.

22) Establishment of monitoring and statistical system of carbon emission and energy consumption

Indicator interpretation:

The system is an important measure for the realization of urban low-carbon development. It can provide reliable data for energy consumption, new energy utilization and carbon emission, and lay a good foundation for future carbon trading.

Indicator requirement:

Selection indicator

The system of energy statistics and monitoring including new energy should be established, which can

provide various data of energy production and consumption. 3 scores can be obtained if the project is feasible and well-implemented.

23) Construction of digitization and informationization platform

Indicator interpretation:

It refers to the establishment of information platform that can provide unified management and exchange of the public information, and meet the needs of urban businesses and industry development to public information exchange and service.

This indicator reflects the requirement of wise city.

Indicator requirement:

3 scores for meeting the requirement of informationization system of wise city

24) Institutionalization of household refuse classification and management

Indicator interpretation:

Household refuse classification is an important measure for the reduction and reclamation of refuse in the collection stage. The establishment of refuse classification and management system is the significant content of the system of refuse collection, transportation and treatment. It plays a positive leading role in adopting economic and technical policies and measures in favor of the comprehensive utilization of urban refuse, enhancing the scientific and technical level of urban refuse treatment, and encouraging the complete recycling and reasonable utilization of urban household refuse.

Indicator requirement:

Selection indicator

3 scores for establishing and implementing household refuse classification and management system

25) Fiscal policy support

Indicator interpretation:

Positive fiscal policy is the effective guarantee for the promotion of energy conservation technologies and new energy technologies.

Indicator requirement:

Selection indicator

The special fund of energy conservation technology and new energy technology pilot and promotion should be established, as well as other supportive measures. 2 scores can be obtained if the program is reasonable and well-implemented.

26) Establishment of public service platform for energy conservation technology and new energy technology

Indicator interpretation:

A complete public service platform is necessary for the further development of energy conservation and

new energy technology.

Indicator requirement:

Selection indicator

Establish and improve energy service system with market operation, and form the service network of energy technologies (including information service platform, professional service companies, and technical personnel training, etc.). 2 scores if the system is valid.

27) Promotion and popularization of low-carbon lifestyle

Indicator interpretation:

Low-carbon development needs public engagement, and low-carbon cities and towns should take up the responsibility of publicizing and popularizing low-carbon knowledge so that the whole society can have a deep understanding towards low-carbon lifestyle.

Indicator requirement:

Selection requirement

Publicize the knowledge of low-carbon lifestyle, and enhance the understanding of the society towards low-carbon lifestyle; actively promote the lifestyle and mode of consumption of green development, circular development and low-carbon development. 2 scores for the program and its implementation

VI. Applications for APEC LCMT Development Index System

1. Low-carbon Development Demonstration Area

(1)Shenzhen International Low-carbon City

1. Project Profile

Located in Pingdi Street, Longgang District, Shenzhen International Low-carbon City covers a planning area of 53.4 square kilometers and embraces rich forests, gardens and waters, such as Dingshan River and Longgang River. On the periphery, there are Qinglingjing Country Park, Huangzhukong Reservoir, Longjing Mountain System. Shenzhen International Low-carbon City enjoys abundant carbon sequestration and favorable geographical conditions, with half of the land in the scope of basic ecological control.

Figure 2 Geographic location and range of Shenzhen International Low-carbon City

Social, economic and industrial overview

Pingdi Street, home to Shenzhen International Low-carbon City, had a total population of about 226.400 in 2013. Prior to 2012, traditional manufacturing and processing industry was dominant, supplemented by the modern manufacturing industry, while emerging industries were in the inception. Land for industrial purpose is massive, but the plot ratio is low. Most communities lack contiguous reserve land, and the majority industrial areas are small-scale and dispersed with high energy consumption, heavy pollution and low output, and lack economic growth potential. In 2011, its GDP registered 4.281 billion yuan, and the industrial output value reached 11.5 billion yuan, of which above-scale industrial added value attained 2.5 billion yuan. Totally, the investment in fixed assets numbered 1.91 billion yuan, and the tax revenue and financial revenue registered 650 million yuan and 490 million yuan respectively.

Ever since the project implementation in 2012, GDP rose by 27.62% to 6.972 billion yuan in 2013, significantly higher than the annual growth rate of 10% prior to 2011. Industrial output value reached 18.2

billion yuan with an average annual growth of 25.8%, and the numbers read 4 billion yuan and 26.5%for above-scale industrial added value. In terms of the growth rate of investment in fixed asset and retail sales of consumer goods, Pingdi Street ranked first and third respectively in Longgang District, which effectively boosts economic growth.

Energy supply and consumption

In the past, the pace of economic development in Pingdi Street was slow, relative to the average levels of Longgang District and the downtown of Shenzhen. Its output per unit area was only equivalent to 14% and 31% of the latter two respectively in 2010, down from 16% and 36% in 2005. In addition, the power consumption per unit of GDP was on the rise in Pingdi Street, but decreased in Longgang District and the downtown of Shenzhen. Its rates increased from 2.2 times and 2.9 times in 2005 to 3.4 times and 3.6 times respectively in 2010.

New energy use

From 2011 to 2013, Shenzhen International Low-carbon City combined low-speed wind, solar and geothermal energy on the basis of combined cooling, heat and power (CCHP), supplemented by clean energy generated from garbage, sludge, and sewage treatment. It has developed new integrated energy supply industry based on the adjustment of energy storage power stations and connection of regional smart grids, while green plants played the role in carbon elimination and reduction. It put emphasis on technical innovation, industrial cultivation, and demonstration effect. It accelerated the introduction and industrialization of advanced incineration-based power generation and flue gas treatment equipment by encouraging enterprises to adopt advanced technologies of incineration-based power generation, so as to build up the capacity in the design and operation of power generation systems and in the resource utilization and further improve energy efficiency. It also speeded up the research and development, production and application of bio-environmental products, and actively pushed ahead technological development and commercialization for the comprehensive utilization of renewable resources. It beefed up work in landfill gas recovery and utilization and provided support to projects for landfill gas power generation and bio-fuel purification, in an effort to achieve carbon reduction and comprehensive resource utilization.

Infrastructure

In 2013, a total of 1.96 billion yuan was pooled to Pingdi Street for infrastructure construction, of which 1.2 billion yuan was used to build or renovate 11 roads including Jiaoqiao Road and complete sewage pipe network transformation in Huayuan Community and Jixiang Community. A total of 760 million yuan was allocated for the Promoter Region to carry out 7 projects for convention and exhibition centers, Dingshan River ecological remediation, and urban appearance and environmental upgrading. Goaqiao Section of Dingshan River has become a beautiful business card showcasing low-carbon development. According to the integration planning, a number of infrastructure and urban facilities projects will start within the next two years, including the Eastern Extension of Metro Line, urban appearance transformation in Hengping Road, Pingzi Road Extension, Outer Ring Road, Tunzi River Ecological Park, and Phase II Governance of Dingshan River. A group of urban renovation projects, such as Taihe, Changmeiling, and Fulongshan Garden, will be completed. It is expected that public infrastructure and urban support functions will be significantly upgraded, and late-development advantages in land, ecology and cost, accumulated over the years will fully stand out. Pingdi will become greatly attractive to innovative enterprises, strategic new

industries, high-end talents, and high-end resources.

2. Low-carbon Development Goals

Shenzhen International Low-carbon City serves as a pathfinder for national low-carbon development and an important strategic pivot in China's international negotiations to address climate change. It is instrumental to implement the *Outline of Reform and Development Planning for the Pearl River Delta Region (2008-2020)* and meets the strategic need to practice the Scientific Outlook for Development and explore the model for upgrading over the next three years. It is built as a demonstration project for steady quality growth and sustainable comprehensive development.

Shenzhen International Low-carbon City adheres to the convergence of international features and local specialties, fusion of urban development and industrial development, and combination of resources development and ecological civilization. It encompasses "One High Ground and Four Zones", namely state-level test zone for low-carbon development, pioneering zone for national response to climate change, state-level demonstration zone for low-carbon industries, leading zone for international low carbon cooperation, and strategic high ground for low-carbon development.

Immediate goal: To 2015, its GDP will exceed 10 billion yuan with an annual growth rate of 23%. Remarkable achievements will be achieved in the 1 km^2 Promoter Region and progress made in the 5 km^2 Expanding Area construction, while the renovation of the whole region will start. Urban infrastructure projects will be completed; key industries will develop steadily; low-carbon innovation and application capabilities will be built. Marked improvement will also be seen in quality and efficiency of low-carbon development, such as efficiency of intensive use of resources and ecological environment, and low-carbon industrial parks will take the initial shape.

Medium and long-term goal: By 2020, its GDP will attain 40 billion yuan and GDP per capita will surpass half of the average level of Shenzhen. Its carbon intensity per 10,000 of GDP will fall below 0.32 tons and per capita carbon intensity 5 tons. It will be the first to reach the peak of carbon emissions and make into the international advanced ranks of low-carbon development.

By 2030, its GDP will attain 100 billion yuan, and GDP per capita and added values per unit of land area will be higher than the average level of Shenzhen. With leapfrog development, it will become a global pioneer in low-carbon development.

Index System for the Low-carbon City:

(1) Consolidated results indicators

Level-1 Indicator	**Level-2 Indicator**	**No.**	**Indicator**	**Unit**	**Value**	
					Promoter Region	**Low-carbon City**
					2015	**2020**
Complex indicators	Carbon emissions	1	carbon emissions /10,000 yuan of GDP	ton/10,000 yuan	<0.56	<0.32
		2	GDP per capita	ton/person/year	——	≤5

Level-1 Indicator	Level-2 Indicator	No.	Indicator	Unit	Value	
					Promoter Region	Low-carbon City
					2015	2020
	Ecological environment	3	Proportion of environmental security (soil, water, air)	%	≥95	100
		4	Physical environment compliance rate (including sound, light and thermal environment)	%	100	100
	Public satisfaction	5	Rate of public satisfaction with social services and environment	%	——	≥90

(2) Process indicators

Goal	Level-1 Indicator	No.	Level-2 Indicator	Unit	Value	
					Promoter Region	Low-carbon City
					2015	2020
Low-carbon industries	Industrial level	1	Carbon dioxide emissions per unit of industrial added value	Ton/10,000 yuan	＜0.28	＜0.28
	Industrial gathering	2	Proportion of output value of key industries	%	——	≥80
		3	Development of local special industries	-	——	——
	Industrial innovation	4	Ratio of R&D expenditure to GDP	%	——	≥4.5
		5	Ratio of risk investment to GDP	%	——	≥0.3

		6	International low-carbon innovation carriers	Number	——	≥10
Low-carbon environment	Spatial optimization	7	Proportion of employment and housing	-	——	0.8~1.2
		8	Integrated plot rate of urban construction land	-	——	≥1.2
	Ecological environment	9	Green ecological capacity rate	-	≥1.0	≥1.0
		10	Urban heat island intensity	℃	——	≤1.0
		11	Per capita green area	㎡ per capita	≥15	≥25
	Green energy	12	Rate of renewable energy utilization	%	≥20	≥30
		13	Penetration rate of District Heating and Cooling (DHC)	%	——	≥30
		14	Proportion of non-fossil fuels in primary energy	%		30
		15	Innovative renewable energy technologies for demonstration and application	-	——	——
	Green transportation	16	Split travel rate	%	≥85	≥90
		17	Proportion of clean energy in public transportation	%	100	100
		18	Transit-oriented development (TOD)	--	——	——
	Green building	19	New green building proportion	%	100	100
		20	Green building proportion (two-star and above)	%	30	50
	Resource intensive	21	Wastewater treatment rate	%	——	100

	utilization	22	Utilization rate of non-conventional water resources	%	≥30	≥50
		23	Coverage of sewage collection pipe network	%	100	100
		24	Piped gas coverage	%	100	100
		25	Utilization rate of construction waste resource	Ton/10,000 sqm	——	<350
Low-carbon life	Guidance for low-carbon behavior	26	Coverage of carbon trading in the community	%	——	30
	low-carbon living conditions	27	Coverage of five kinds of service facilities (within 15-minute living area)	%	≥80	≥95
		28	Self-sufficiency rate of fruits and vegetables	%	≥5	20
		29	Wireless coverage	%	100	100
Low-carbon operations	Classified garbage collection	30	Classified garbage collection rate	%	100	100
		31	Garbage collection, sorting recycling, and pretreatment systems	-	——	——
	Intelligence operations	32	Electronic intelligence platform coverage for life information	%	60	100
		33	Intelligent monitoring system	-	——	——
Low-carbon management	Service platform	34	Mechanisms conducive to service platforms	-	——	——
	Financial support	35	Special funds	-	——	——
	Low-carbon dissemination	36	Low-carbon lifestyle promotion	%	——	80

			and penetration			

Consolidated results indicators describe the expected results of planning and construction according to the process indicators.

Process indicators are applied in LCMT planning and construction and designed to achieve new urbanization with a shorter time and ensure quality growth with lower carbon intensity by driving low-carbon industries, providing a low-carbon environment, and creating low-carbon culture.

3. Implementation Program and Major Projects

(1) Energy restructuring and development

In line with principles of innovation-driven, high-end development, key breakthroughs, and leading demonstration, and its strategic positioning, Shenzhen International Low-carbon City is designed to greatly enhance the capability of low-carbon technological application and actively explore new model of LCMT construction. It is expected to build a sustainable modern industrial system featuring small input, high output, and low consumption and emissions, foster internationally competitive industrial clusters, optimize in depth and upgrade the industrial structure, and underpin the integration of industry and city and low-carbon economic development. Priority support will be given to CCHP in the Promoter Region, energy supply and resources utilization projects.

- **CCHP in the Promoter Region:** Emissions will be cut from the source. Energy efficiency can be increased to 70% through cascade utilization of primary energy. Clean energy utilization rate will reach 100% and renewable energy, not less than 20%. Emission reduction rate will reach over 40%, and emissions will be cut by 160,000 tons.
- **Energy supply and resource utilization center:** It is conducive to the comprehensive utilization of resources and energy and can generate significant social, economic and environmental benefits. It will be able to process annually 1.665 million tons of waste (about 30% of the total in Shenzhen), 21.9 million tons of waste water, and 292,000 tons of sludge. It is expect to gain an annual generating capacity of 430-560 million kWh (supporting 233,000 households), and realize emission reductions of 792,000 tons per year.

(2) Comprehensive and efficient use of water resources

- **Rainwater utilization project:** It covers: 1) infiltration facilities for motor vehicle lanes: 8.16 km drainage lanes and 0.32 km completely permeable lanes; 2) infiltration facilities for slow-traffic system: 9.95 km completely permeable bicycle lanes and 8.8 km pervious sidewalk; 3) infiltration and detention systems for green belts, including rainwater collection, processing, and infiltration systems, rainwater tank, sunken ditches in green space, and integrated early rain clarifier.
- **Recycled water utilization project:** Recycled water supply network with a total length of 8,960m will be established, including 6,860m DN200, 2100m DN300, vertical gates and 56 DN200 concrete wells, vertical gates and 7 DN300 concrete wells.

(3) Intensive development of land resources

It encompasses the construction of water supply pipes, recycled water pipes, cooling pipes, heating pipes,

power cables, communication pipes, and reserve pipelines that have a total length 1321.34 meters. It involves 408m ditches with a section of 5.1×2.85m, 142m of A (4.1+2.1)×2.85m, 412m of A3.3×2.85m, and 360m of 2A2.4×2.85m. It is conducive to the intensive use of land resources and save more than 80% of underground space. It avoids the impact and interference in the transportation and travel of residents caused by laying and maintaining roads and underground pipelines, and maintains urban integrity and beauty.

(4) Green building renovation and demonstration

- **Comprehensive demonstration project:** a variety of energy-saving technical measures are implemented to achieve an overall saving rate of 60% and annual power savings of 1,068,000 kWh. A number of water-saving technical measures are carried out to achieve an 8% water reduction in indoor appliances and annual savings of 1,000 tons of traditional water sources. It is expected that the use rate of non-traditional water will reach 20%, and annual consumption, approximately 3900 tons. Annually, waste water discharge will be reduced by about 4,900 tons; CO_2 emissions to the atmosphere will be cut by 1049.5 tons, SO_2 8.5 tons, NO_x 7.3 tons, and soot 3.6 tons. The project will significantly mitigate the GHG effect.
- **Industrial building green transformation:** Large-scale demolition and construction is prohibited. In accordance with the idea of overall retention and function optimization, economic and efficient low-carbon energy technologies will be introduced to renovate 9000m^2 existing industrial plant and 19,280m^2 complex building in the industrial park to meet two-star and higher standards, so as to achieve comprehensive energy conservation in the whole process of construction, production, operation and management.

(5) Emissions trading pilot

- **Real-time carbon monitoring platform:** A public information platform is set up in the Promoter Region for carbon monitoring in the whole process of construction, production, operation and management. It breaks down the carbon indicators for implementation to realize the centralized monitoring, real-time display and management of emissions reduction in production and life.
- **Carbon certification service center:** It is public service platform for carbon testing, evaluation and certification, and will include a mobile testing laboratory for carbon emissions and at least 3 testing and evaluation laboratories, targeted at emissions from building materials, parts and equipment, full life-cycle emissions of buildings, and industrial corporate emissions.

(6) Dingshan River landscape restoration and low-impact development

A comprehensive renovation will be made to the Dingshan River watershed. It encompasses water quality improvement in the upstream and Shenzhen section, river landscape engineering, and river breakwater engineering, trying to achieve "clear water and low-carbon, ecological" upstream sections. It is conducive to the surrounding water environment of the Promoter Region, and will create a favorable external environment for Shenzhen International Low-carbon City and the Forum, but also offer a great place for leisure, entertainment, and fitness for residents. It is a perfect embodiment of low-carbon ecology and life.

(7) Green transportation and efficient travel

Shenzhen International Low-carbon City implements the bus priority strategy and provides convenient

access to public transportation transfer. Waterfront landscape belts are set along the greenway and slow-traffic systems between the various functional zones as a component of Pingdi slow-traffic system along the Dingshan River. In the form of greenway, sotto portico, and arcade, they create an agreeable slow-pace space environment. According to the concept of green and low-carbon transportation, bike-dedicated lanes are designed in the municipal roads and effectively connected with public transportation and linked to the bicycle transportation within the low-carbon city.

(8) Low-carbon service industries

- **China-US Innovation Experiment Center for Low-carbon Building and Community:** It includes China-US Flexlab, counseling center for water-saving facilities and rainwater utilization, geological and ecological diagnostic center, structure and material testing center, outdoor environmental pollution monitoring center, indoor environmental quality testing center, and testing center for industrialized parts of buildings. It mainly carries out research in such aspects: mobile building development, low-impact development, ecological restoration, low-carbon building energy system, indoor environmental monitoring, integration of building and urban agriculture, as well as application of low-carbon technologies in different climate and environmental conditions.

- **Low-impact development demonstration and experimental development platform:** It encompasses: 1) comprehensive experimental projects (10 categories, including 8 groups of green roofs, 10 groups of sunken green space, 20 groups of rainwater gardens, 20 groups of new permeable paving materials, 10 groups of grass ditches, 10 groups of ecological tree pools, 20 groups of ecological parking lots, 10 groups of infiltration facilities, 20 kinds of new integrated decontamination equipment, and 4 groups of rainwater collection and reuse facilities); 2) supporting monitoring facilities; and 3) laboratories and R & D centers.

(2)Yunhu Core Area of Xuwei New District

1. Project Profile

Yunhu Core Area, the Promoter Region of Xuwei New District, "provides an interactive platform for east-west cooperation, development and intermediate experiment services for dominate industries, and public services and business platform for the development of Xuwei New District". It covers a land area of approximately 22.91 square kilometers, surrounded by the seawall, Xuxin Road, branch of Shaoxiang River, North Channel of Xuwei Port.

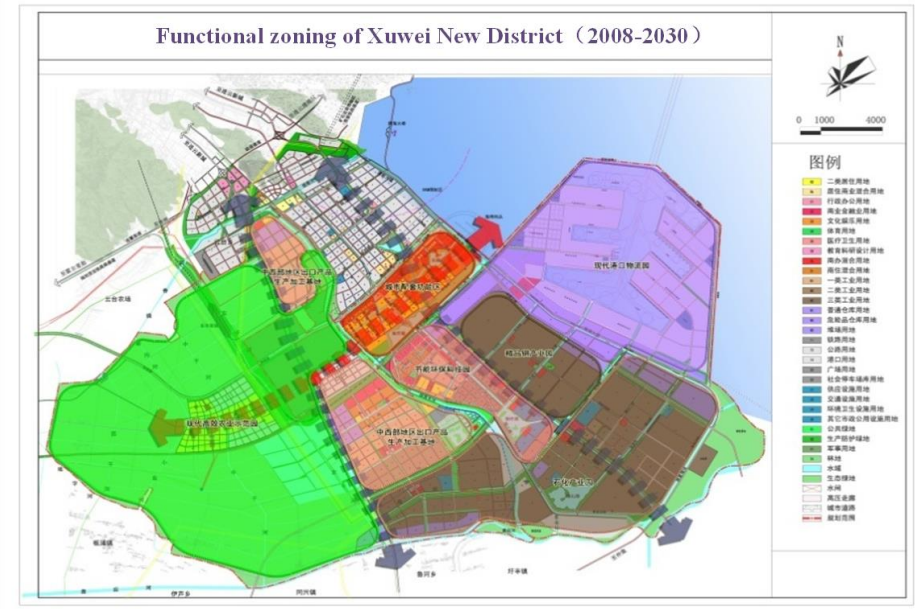


Figure 3 Location of Yunhu Core Area of Xuwei New District

In 2013, the GDP of the Development Zone / Xuwei New District reached 31.5 billion yuan and per capita GDP 39,367.91 dollars, much higher than the average level of 12,062 dollars in Jiangsu Province. Xuwei New District focuses S&T research and development, business and leisure, financial services, and tourism. Yunhu Core Area, among "One Area and Six Parks" of Xuwei New District, is driven by the financial services and business and leisure of fine steel industrial park, petrochemical industrial park, and modern port logistics park. It can develop financial services, headquarters economy, and tertiary industries such as business and leisure services, to achieve the target of environment-friendly and sustainable industrial development.

2. Low-carbon Development Goals

For Yunhu Core Area, the goal can be summarized as low-carbon, ecological, and harmonious. More specifically, the LCMT construction should be low carbon oriented within the framework of sustainable development, with consideration to the development of the area. Yunhu Core Area will be built into a three-star APEC LCMT, pioneering area for regional cooperation on low carbon, clean energy demonstration area, and extended at home and abroad.

CO_2 reduction targets are set for Yunhu Core Area based on energy simulation and emission estimation.

More specifically, the mid-and long-term goals are set as follows.

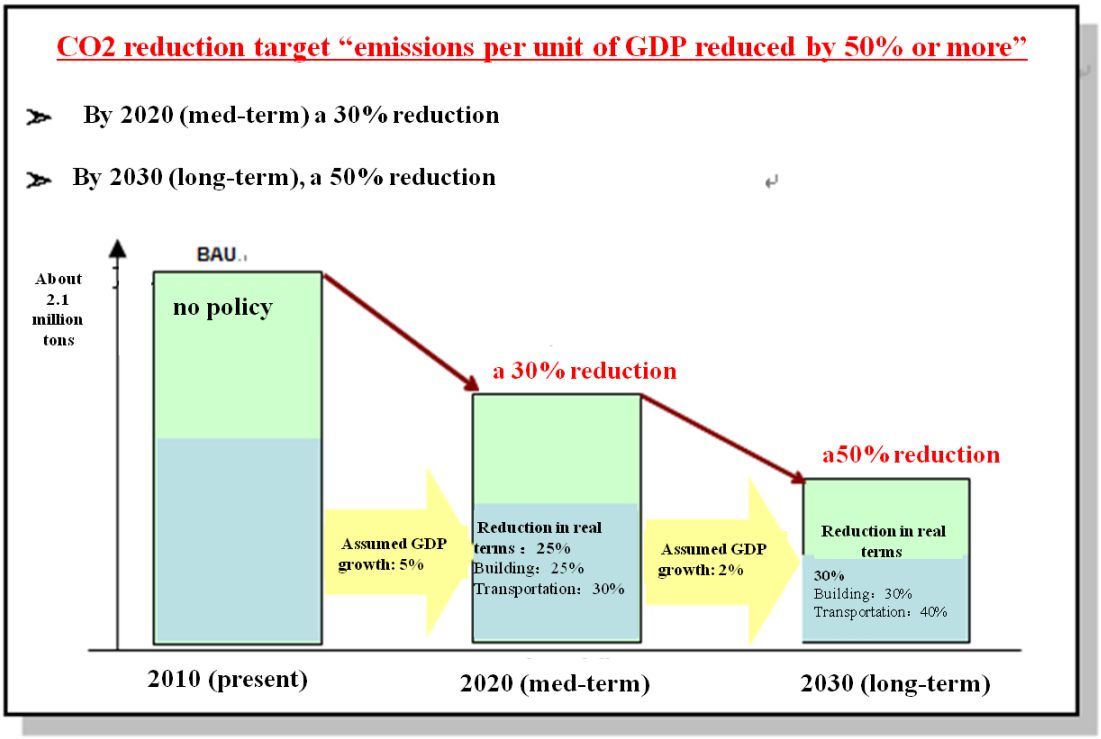


Figure 4 Emissions reductions by phase in Yunhu Core Area

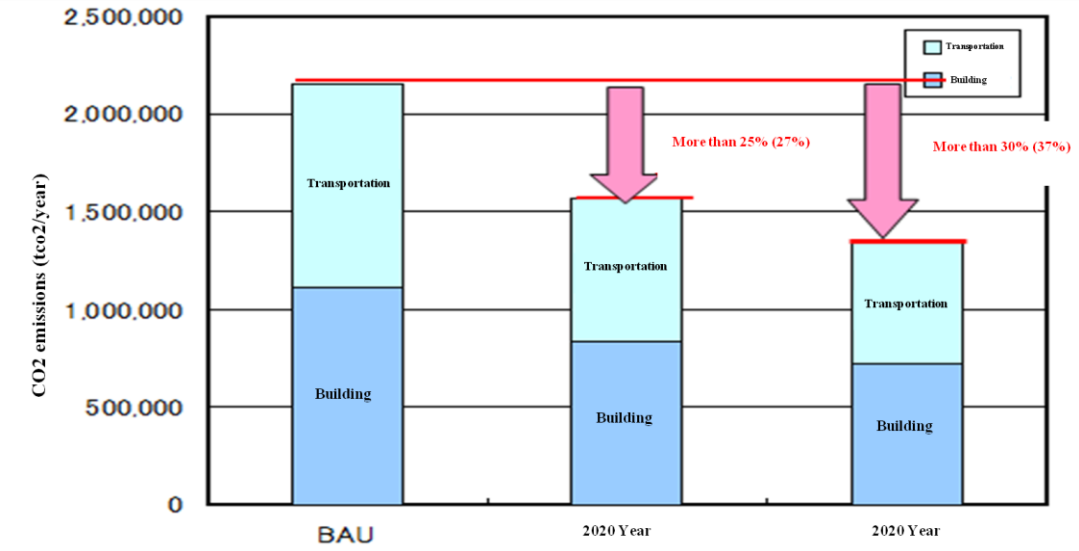


Figure 5 Emissions reduction in real terms of Yunhu Core Area of Xuwei New District

Low Carbon Index System:

Index System for Yunhu Core Area of Xuwei New District			
Classification	**No.**	**Indicator**	**Value**

Low-carbon environmental protection	1	Per capita carbon intensity	≤6 ton / person (2020)
	2	Surface water quality	Grade II Standards
	3	Green coverage in built area	≥40%
	4	Integrated plot rate of construction land	≥1.2
Low-carbon energy use	5	Energy consumption per unit of GDP .	3.6% reduction in energy consumption per unit of GDP of Jiangsu Province in 2014
	6	Clean energy utilization rate	≥50%
	7	Intensive energy supply coverage	≥80%
	8	Rate of renewable energy in building energy consumption	≥6%
	9	Building-integrated solar thermal utilization	≥62%
	10	Energy efficiency	Up by more than 20% over the level of 2010
	11	Seawater-source heat pump efficiency	22%
	12	Innovative renewable energy technologies	Based on local resource endowments, appropriate renewable energy technologies are introduced, and integrated with technologies in shallow water-source heat pump, energy tower heat pump, ground source heat pump, biomass boilers thermal power, energy storage, and alliant energy/energy island for innovation, so as to

			improve the applicability of technologies to generate economic benefits.
	13	New energy use	By intensive energy supply, these new energy are put into utilization, accounting for 20% of the total energy consumption.
	14	Water recycling and reuse	≥30%
	15	Utilization of water-saving appliances	100%
	16	Garbage resource utilization	≥60%
	17	Construction waste utilization	≥40%
	18	Proportion of separated garbage collection	100%
Low-carbon travel	19	Proportion of low-carbon transportation	≥80%
	20	Proportion of public transportation	≥70%
	21	Cycling dominated range	≥20 min or 4 km。
	22	Distance between bus stations	0.8-1.6 km
	23	Bus station service area with a radius of 500m	Bus coverage ≥ 90%
	24	Bus line network density	≥3 km/km^2

	25	Transfer distance in the public transport system	≤200m
	26	Proportion of new energy bus	100%
	27	Non-linear coefficient of bus lines	≤1.4
	28	Average passenger transfer coefficient	≤1.3
	29	Maximum one-way travel time for 95% of the residents consumption is the ratio set point	≤40min
	30	Rate of bicycle rental sites in rail transport stations	100%
	31	Shade rate of slow-traffic roads	≥80%
	32	Network density of the slow traffic system	≥2.5km/km^2
	33	Permeable pavement coverage	≥70%
	34	Urban slow-traffic system construction	Metro, BRT, cycling bikes, cycling buses, electric vehicle (EV) charging facilities, bicycle path are designed for slow traffic. Meanwhile, low-carbon bus travel is encouraged, and education and publicity is strengthened to enhance public awareness of low-carbon environmental protection.

Low-carbon spatial organizations	35	Proportion of green buildings in the built-up area	100%
	36	Proportion of two-star green buildings or above	≥30%
	37	Proportion of green building construction	100%
	38	Rate of construction sites in compliance with provincial standards	≥18%
	39	Construction waste disposal and reuse	Reuse of old wood and sawdust, old brick and tile, old asphalt and concrete, construction waste landfill
	40	Energy-saving trans formation and implementation for existing buildings	Buildings in Yunhu Core Area are all newly built.
	41	Proportion of fully decorated new residential buildings	≥45%
	42	Proportion of fully decorated affordable new residential buildings	100%
	43	Length of corridors	≥28km
	44	Penetration of energy-saving lighting fixtures	100%
	45	Intelligent lighting	100%

		rate	
Low-carbon economic development	46	Local employment index	≥70%
	47	Carbon intensity per unit of GDP	<240 t /million dollars
	48	Green procurement coverage in public utilities	100%
	49	Carbon inventory rate of large public buildings	≥80%
	50	Proportion of large public buildings involved in carbon trading	≥80%
	51	Development of local specialties industries	In line with the functional positioning, technological research and development, business and leisure, financial services, and tourism are developed
Low-carbon operations	52	Proportion of intelligent buildings	100%
	53	Sensor network coverage up to 65%	≥65%
	54	3G network coverage	≥98%
	55	Intelligent applications of enterprises of designated scale or above	≤50%
	56	Digital and information	Cloud service platforms are built for business, technology and talent, ecology,

		platforms	modern logistics and industrial collaboration.
	57	Monitoring and statistical system for carbon emissions and energy consumption	System are established for carbon certification, low-carbon construction supervision, and regional energy management, in addition to the nergy management monitoring platform
	58	Low-carbon policy sophistication	100%
	59	Low-carbon urban development plan	Low-carbon spatial distribution and land use planning, low-carbon energy planning, low-carbon transportation planning, low-carbon construction planning, low-carbon urban management planning are worked out, to carry out full range of low-carbon construction.
	60	Institutionalized waste classification management	Systems are established for separate collection of kitchen waste and paper waste, as well as classified delivery, closed collection, compressed transport of waste. Publicity and education on garbage separation and collection is carried out.
	61	Fiscal policy	Differentiated subsides are specified: 10 yuan/m^2 for use of solar thermal power, 50 yuan/m^2 seawater source heat pump, 40 yuan/m^2 ground source heat pump, 30 yuan/m^2 surface water-source heat pump, 50 yuan/m^2 regional energy supply, and 60 yuan/m^2 buildings integrated solar thermal and ground source heat pump. In addition, 10 yuan/m^2 is subsidized for certified one-star green buildings, 18 yuan/m^2 two-star buildings, and 25 yuan/m^2 three-star buildings.
	62	Public service platform	A leading group-centered public service platform is set up, composed of the departments for public security, urban management, social utilities, planning and

			construction, and Fangyang Group
	63	Low-carbon lifestyle outreach	Low-carbon life guide is issued to provide guidance in low-carbon diet, travel, and consumption. Responsible departments improve the public awareness of garbage classification and minimization through pilots and various promotional methods. Residents are encouraged to choose green travel with low energy consumption and pollution and minimize carbon footprint and carbon emissions in the travel. It covers the low carbon government policies, low carbon tours introduced by travel agencies, eco-friendly luggage and hotels, low-carbon transportation, and even bicycle and hiking.

3. Implementation Program and Major Projects

Low-carbon construction priority in Yunhun Core Area

(1) low-carbon energy

Clean energy should take up more than 50% of the total energy consumption. In Yunhun Core Area, renewable energy includes surface water resources, waste water resource, ground source and air source heat pumps. Based on energy stations supplemented by self-built cooling and heating rooms, heating and cooling stations are deployed according to plot forms and development timing, with consideration to public green space and underground space. United energy as a typical innovative model of the circular economy removes the professional and technical barriers and integrates many cutting-edge energy technologies, such as soil heat, gas, steam, cogeneration and ice storage. With reasonable and complementary application, this model facilitates classified utilization and reuse of energy by grade while improving efficiency of a single system.

(2) Low-carbon transportation

The Project restricts private cars, encourages non-motorized travel, and advocates "bus + slow traffic" and TOD. It is intended to increase the rate of public transportation to 80% through a group of plans, covering metro, BRT (7 BRT line access points outside and inside the low-carbon city), bus (three small loop line and a large loop line), bike rental, EV rental and charge piles, bicycle fast track. It also promotes the use of new energy buses and the full coverage in Yunhu Core Area. A comprehensive parking management system and charging system will be designed to complement the low-carbon transportation system for Yunhu Core Area.

(3) Low-carbon buildings

Energy waste is prevented in many ways, such as reducing building heat load, making full use of natural lighting and ventilation, solar PV and hot water, green roofs, improving equipment energy efficiency, choosing high-efficiency cooling and heating sources, cutting new wind load and fresh air conditioners,

adopting energy-efficient lighting, as well as initial illumination correction and daylight link. Building carbon emissions are cut by reducing transportation power. All buildings in Yunhu Core Area should be green and energy-efficient. Research finds that the carbon intensity of three-star buildings 45.7 kg/m^2 per year, far below the average level of 81.16 kg/m^2 per year of ordinary buildings designed or constructed during the same period. Moreover, the carbon reduction rate is up to 43.69%, demonstrating great environmental and social benefits.

(4) Low-carbon life

Aiming to meet public needs, the Project creates a comfortable, low-carbon living space and livable environment and builds a wide-coverage, easy-to-use information service platform. It promotes low-carbon culture, advocates low-carbon lifestyle, implements the concept of green consumption, carries out the universal action for energy conservation and carbon reduction to push ahead a low-carbon transition in clothing, food, housing, transportation, and tools. Activities for low carbon promotion are also designed, including LCMT images, low-carbon planning commercials, and promotional films, to enhance the LCMT influence. All kinds of activities to promote the low carbon concept are mobilized, such as low-carbon economy exhibition and low-carbon publicity and education base. In view of the features of smart cities, the Internet, e-commerce, and means alike are used to further enhance low-carbon culture promotion. A household survey on carbon emissions is conducted and an energy information collection platform and a GHG emissions information system are established. Mechanisms for supervision and management of carbon reduction and reward and punishment are improved, to encourage residents, social organizations to participate in the construction and management of low-carbon communities.

Major projects

(1) Intensive energy supply project and solar energy planning project in Yunhu Core Area

The Project follows and complies with the official documents of Jiangsu Province and the policies of Lianyungang on natural gas, water, coal, and electricity prices, including *Technical Specifications for Ground Source Heat Pump Systems 091016*, *Technical Specifications for Heat-Source-Tower Heat Pump Systems*, *Energy Efficiency Standards for Public Buildings*, the *12th Five-Year Plan for Energy Development in Jiangsu Province*, *Measures for Building Energy Efficiency Management in Jiangsu Province*, *Regulations of Jiangsu Province for Energy Conservation*, *Outline of the 12th Five-Year Plan for Economic and Social Development in Jiangsu Province* and *Opinions of the Provincial Government on Further Strengthening the Work on Energy Conservation*. Surface water resources, waste water resource, ground source and air source heat pumps are all integrated for intensive energy supply. Given that traditional energy is the largest source of urban carbon emissions, low-carbon energy as an alternative to high-carbon traditional energy plays a pivotal role in energy conservation in Yunhu Core Area. It will contribute more than 50% in the compliance with emissions reduction indicators for LCMT. All building heating and cooling in Yunhu Core Area will rely on renewable energy. It will generate annual savings of 165,974.86 tce and reduce annual CO_2 emissions by 434,333.68 tons, SO_2 1409.13 tons, NO_x emissions 1226.80 tons, and soot 2486.45 tons.

Payback period of renewable energy investment:

Type of renewable energy	Investment model	Payback period
Ground source heat pump	Energy performance contracting (EPC)/BOT	10 years

Shallow water source heat pump	EPC/BOT	6~8 years
Air source heat pump	EPC/BOT	6~8 years

Fangyang Group is responsible for project implementation. To reduce maintenance and management costs, a dynamic pricing system and the AEMS system (5%-10% energy savings expected) are imported.

Given the construction area of Yunhu Core Area, the estimated roof area available for solar thermal and PV application is 2,139,200 m^2. The utilization of solar resources follows the principle of thermal power first and then PV rooftop under the premise of meeting hot water needs. Available solar PV power totals 266,407,700 kWh. With the use of solar thermal power, CO_2 emissions will be reduced by 82,564.7 tons per year, and solar PV power, 160,910.25 tons per year. Wind and solar LED lights are deployed along the primary and secondary roads in Yunhu Core Area, which saves an investment of up to 2,552,500 yuan in power generation.

(2) Low-carbon public transportation planning project

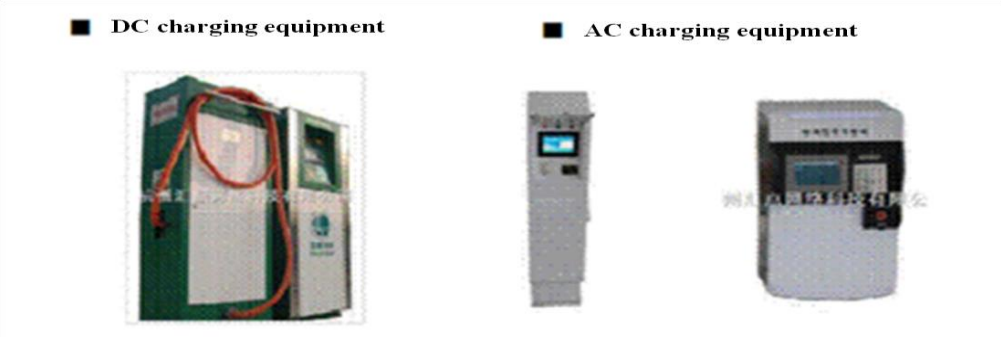
By building a comprehensive low-carbon transportation system, the Project is intended to reduce overly dependence on cars and increase bus share ratio, and the measures are specified as follows. Fangyang Group is responsible for project implementation.

Measures for low-carbon transportation:

Measure		Scope
①Loop bus	Surrounding areas Loop bus	Surrounding areas, Yunhu Core Area
	Yunhu Core Area Loop bus	Within the area only
②Electric vehicles (including rental and sharing services)	Basically within the area	
③Community bikes		Surrounding areas, Yunhu Core Area

To encourage people to travel by bike, a high-speed bike road is planned in Yunhu Core Area to avoid bikes mixing up with motor vehicles that undermines traffic fluency. It will allow convenient, safe, and high-speed cycling and promote cycling leisure.

To reduce CO_2 emissions from vehicle traffic in surrounding areas, the EV penetration should be improved. It is necessary to deploy in advance adequate charging equipment in the public space or private facilities. Below is a cost analysis of the charging equipment.



Item	DC charging equipment	AC charging equipment
Time	About 15 min	7-8h
Proportion	80%	100%
Fees	Less than 40 yuan	Less than 40 yuan
Installation expenses	250,000 yuan	20,000 yuan

(3) Yunhu building energy efficiency and green building project

To maximize and mobilize the enthusiasm and promote comprehensive and rapid development of green building in Yunhu Core Area, a set of index systems are designed, covering construction management, environmental protection, building materials, water, energy efficiency, and land use. Efforts are strengthened in energy efficiency examination in construction and inspection, and also in green building rating. All new buildings in Yunhu Core Area should be green. Residential buildings should meet the one-star standards or higher, and at least 40% of the public buildings meet the two-star standards.

The Project, with a construction area of 1,122,800 m^2, encompasses 13 sub-projects and incorporates the following innovative technologies: centralized building integrated solar thermal applications, solar heating and air conditioning, ground source heat pump, surface water source heat pump, seawater source heat pump, sewage source heat pump, solar thermal and ground source heat pump combined system, and green building.

By developing solar PV and solar thermal technologies, Yunhu Core Area of Xuwei New District promotes the comprehensive utilization of solar energy and buildings integrated ground source and water source heat pumps. Measures are introduced to strengthen the technical and service systems for renewable energy application in buildings. New buildings in the area required to 100% use renewable energy, and 100% follow green construction. Affordable housing projects should be decorated once and demonstration construction projects 100% fully decorated. For non-affordable housing projects, the proportion of fully decorated residential housing should be gradually increased. In Yunhu Core Area as a whole, not less than 45% of newly built residential buildings should be decorated.

(4) Water use system plan

Yunhu Core Area has a resident population of 300,000 and a water demand for 36,000 m^3/day or 13.14 million m^3/year. It produces sewage estimated to be 28,800 m^3/day or 10,512,000 m^3/year.

The water reuse system with a daily production capacity of 14,400 m^3 provides reclaimed water for landscaping, toilet flushing, and road washing, opening a new path for the utilization of sewage in Yunhu Core Area. In total, up to 5,256,000 m^3 of reclaimed water can be achieved annually, which helps

treatment plants to recover 4,204,800 yuan each year. The social benefits are obvious that reclaimed water can be used for miscellaneous purposes. It not only reduces the burden on water companies, but also serves as a second water source that provides a favorable guarantee for the sustainable economic development of Yunhu Core Area.

Yunhu Core Area also adopts the rainwater harvesting system which encompasses regional collection, roof gutters, downspouts, rainwater diversion, filters, storage facilities, and watering. Given an estimated catchment area of about 2,139,200 m^2 and an annual precipitation of 920 mm according to meteorological data, a total of 944,700 m^3 of rainwater can be collected annually in Yunhu Core Area.

In Yunhu Core Area, the annual reclaimed water and rainwater can amount to 6,200,700 m^3.

(5) Low-carbon community project

In line with capabilities and realities, results-oriented efforts are made to build characteristic low-carbon communities, focusing on the following six aspects:

Low carbon concept guides the whole process of community building. Perfect plans are developed for pilot communities in accordance with green low-carbon requirements. Mixed land use and compact spatial distribution are favored, so as to optimize land use, functional layout and living area, and form an efficient low-carbon model for spatial development.

Low carbon culture and low-carbon lifestyle are fostered. Residents are encouraged to use low-carbon energy-efficient appliances and simple- packaged products, and to travel by walk, bike, public transportation, carpool, and ride.

Low-carbon operations and management is explored. Efforts are strengthened in building intelligence communities that make full use of modern information tools to achieve efficient operation and management.

Energy-efficient buildings and green buildings are promoted. New affordable housing within the pilot community should meet one-star green building standards, and new commercial housing two-star green building standards and above.

Efficient and low-carbon infrastructure is built. Public transportation and slow-traffic facilities within the scientific community are incorporated into the scientific planning to develop low-carbon transportation means. Meanwhile, systems are in place for waste collection, sorting and recycling, and pre-disposal and disposal, and solar public lighting systems are preferred.

A beautiful and livable environment is created within communities. Efforts should be upgraded in eco-environment planning that make full use of the green belt to reduce noise, and includes public green space and pedestrian greenway to meet residents' leisure needs. Water for ecological and environmental purposes should be used in a conservative, intensive and recycling way, while rainwater, recycled water and other non-traditional sources can be put into maximum application.

2. Low-carbon Industrial Demonstration Area

(1) Low-carbon Industrial Park in Dongxiang County, Jiangxi Province

1. Project Profile

Dongxiang Economic Development Zone is a provincial-level economic development zone announced by National Development and Reform Commission (NDRC) in 2005. Its pattern can be described as "One Zone, Three Parks, and Six plates". In specific, "One Zone" refers to the economic development zone; "Three Parks" refers to Dongsheng Industrial Park, Industrial Park, Donghui Industrial Park, and Dongteng Industrial Park, which are subdivided into six industrial plates. The demonstration covers Dongfu Industrial Development Area and Dongteng Industrial Park, with a total area of about 9.75 square kilometers. Underpinning the future industrial development in Dongxiang County, the demonstration follows the idea of "rural-urban integration and ecological vitality" and "production-city integration, efficiency, and low carbon", to attract high-tech industries and industrial transfer from Nanchang and the eastern region.

2. Low-carbon Development Goals

While strengthening ecological protection and construction, efforts are made to fully release the power and potential of industrial development and boost the great economic growth in Dongxiang County, such as integrating existing advantages of resources, optimizing the industrial structure, eliminating backward production capacity, and introducing strategic emerging industries. By 2020, low-carbon production and low-carbon consumption will be basically established; carbon emissions per unit of industrial added value will be substantially cut; low-carbon transformation of traditional industries will be underway, while new low-carbon industries witness development.

Immediate objective: The structure of production is optimized through the low-carbon transformation of traditional industries and rational distribution of new low-carbon industries. Infrastructure construction starts and low-carbon industrial projects are given priority. The industrial pattern of "Two Zones in One Park" takes initial shape, namely low-carbon production zone and low-carbon industrial incubation zone in the low-carbon industrial park (Dongteng Industrial Park).

Medium-term objective: Low-carbon industries consolidate the advantages based on optimized industrial structure and improved industrial quality. The industrial chain from upstream to downstream turns perfect, where links of low emission, pollution and power consumption and high added value and return continue to strengthen. Demonstration industrial projects generate results.

Long-term objective: Key areas and key projects in the low-carbon industrial park are completed. Driven by low-carbon industries, Dongxiang County receives coordinated social, economic, and environmental development, and fosters unique model for industrialization and urbanization.

Low-carbon Industrial Park Development Index System:

Target	**Level-1 Indicator**	**No.**	**Level-2 Indicator**	**Unit**	**Value**
Comprehensive indicator		1	Reduction of comprehensive energy consumption per unit of industrial added value of enterprises of designated scale or above	%	16

	2	Emissions per unit of industrial added value of enterprises of designated scale or above	%	17
Intensive use of land	3	Industrial output of construction land	100 million yuan/ km^2	20
Industrial energy efficiency	4	Energy consumption per unit of major products in key industries	tce	Advanced level of the industry
Low-carbon industrial level	5	Proportion of strategically emerging industries in the county by industrial added value	%	≥50
	6	Proportion of renewable resources industries in the county by industrial added value	%	≥50
Low-carbon energy		Clean energy utilization	%	≥45
	7	Renewable energy utilization	%	≥13
Resources utilization	8	Utilization of industrial waste heat /voltage / energy	%	≥60
	9	Utilization of industrial solid waste	%	≥85
	10	Reuse rate of reclaimed water	%	≥30
	11	Repetition rate of industrial water	%	≥90
Low-carbon management	12	Leadership and working bodies		
	13	Low-carbon management information system		

	14	Incentives to encourage the development of low-carbon industries, new energy utilization, and public participation
	15	Low-carbon production and park admission standards to eliminate high-carbon backward production capacity and enterprises and implement low-carbon management of enterprises and new projects in the park

3. Implementation Program and Major Projects

(1) Water recycling project

With reference to the "by-product collaboration" model in the eco-industrial park, a new model for water use is created based on recycling waste water, and fusing with natural water bodies, as illustrated below.

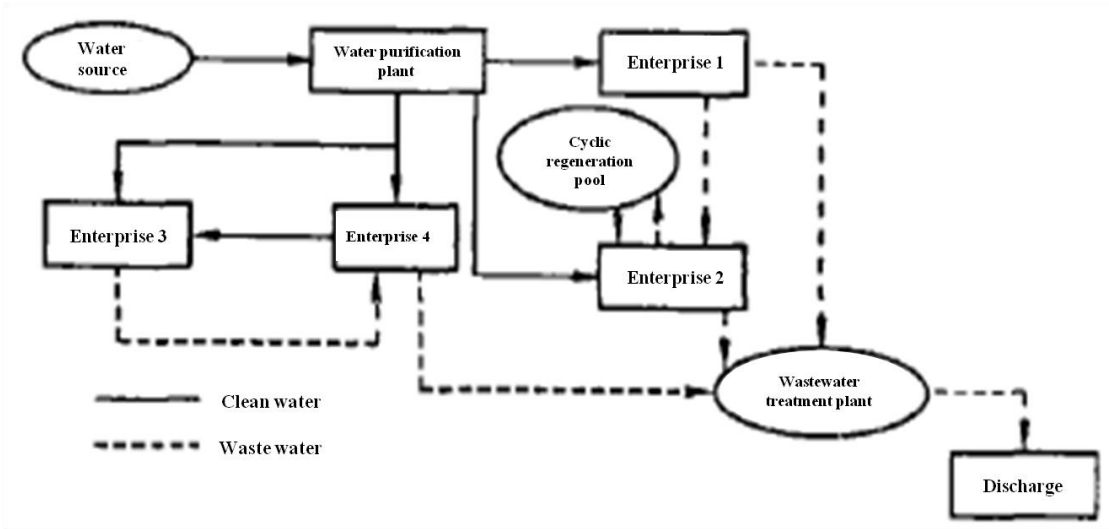


Figure 6 Water circulation in the low-carbon industrial park

In Dongteng Industrial Park, the primary and secondary treatment works and supporting pipe network, with a daily processing capacity of 20,000 m^3, is established for water reuse. More specifically, the primary treatment, with a daily processing of 10,000 m^3, ensures quality water for landscape, green space, urban miscellaneous purposes, and the secondary treatment, with a daily processing of 10,000 m^3, ensures quality water for corporate industrial boilers and water recycling.

Landscape water bodies are long and narrow and serve for multiple functions, such as regulation pool for water regeneration stations, landscaping, flood regulation, and fire prevention. Levels are set respectively for landscape formation and food control, where the former is low to shape landscape and needs less water and the latter is high. Between the two levels, the space is reserved for water detention in flood season.

Meanwhile, a variety of measures are taken to control and utilize rainwater, such as concave-down green space, gutters, rainwater gardens, permeable paving, infiltration wells, and storage tanks.

(2) PV power generation project

Jiangxi Red Star Pig Co. Ltd plans to build a 3MWp rooftop solar project which installs 12,000 SU-250P

solar panels on the roof of pig house. Given the roof area of 38,400 square meters, the PV power plant will gain a capacity of 3MWp. The project involves a total investment of 25.5 million yuan and annual on-grid power capacity is expected to reach 3,250,000 kWh after the power plant is put into operation.

(3) Integrated energy optimization project in Yuanshangang Industrial Park

Power supply network is laid with center on Zhengda Jiaodian Co., Ltd, to shape steam and gas supply system serving the surrounding ceramic enterprises and textile companies, to reduce coal use and improve energy efficiency in the park.

(4) Industrial solid waste recycling project

By recycling, processing, circulation, and exchange, industrial waste will be utilized comprehensively. It is planned to build a unified industrial waste processing center in Dongteng Industrial Park. Information centers for solid waste sorting, recycling and exchange will also be established to recycle waste and scrap metal and facilitate exchange of information and materials. Expected investment attains 15 million yuan, 2/3 of which serves for solid waste separation and 1/3 for solid waste exchange. After the project is completed, unified recovery and recycling of solid waste will be realized in the park.

5) Organic waste utilization project

Farm waste, straw, cassava residue, and other organic waste materials will be used to produce biogas and organic fertilizer. It is important content of the circular economy of Dongxiang County.

An organic waste utilization project is proposed which uses CSTR process and equipment to process 100,000 tons of straw and 20,000 tons of livestock manure annually. Biogas produced by the project is purified, pressurized, and sold as compressed natural gas for vehicles; biogas residue generated by the project, is added with beneficial microbial fungus to produce organic fertilizer.

(6) Distributed energy project for Dongteng Industrial Park

It is planned to build a CCHP-based, intelligent scheduling-centered energy supply system, with the supplement of renewable energy. This green, low-carbon, energy-efficient, intelligent energy system realizes disposal and recycling of sewage, wastewater, and garbage while meeting power, heating and cooling needs.

It involves sewage and garbage disposal, distributed energy, and smart grid.

① Sewage and garbage disposal. 40000 m^3/day wastewater treatment (ie, Key Project 1) and anaerobic reaction center and magnetization pyrolysis equipment with a daily processing 20 tons of garbage will be deployed. It can produce 6000 biogas m^3 daily and provide 30,000 kWh of distributed energy.

② Distributed energy. A 54MW gas engine system (two 3.3MW engines and five 9.5MW engines), a 14MW renewable energy system (5MW solar power and 9MW wind power) and 0.5MW energy storage batteries will be established.

③ Smart grid. A client-end intelligent energy management platform will be founded for integrated management of power, heating, cooling needs. Energy storage devices are rationally deployed, supplemented by wind power, solar energy and other renewable energy sources, to achieve smart, efficient energy management.

(7) Garbage treatment system project

It is planned to build a garbage treatment system in Dongteng Industrial Park that separates, processes, and disposes a variety of waste for optimization, combination and integration. Considering the characteristics of Dongxiang County, the landfill-centered integrated treatment model is preferred, supplemented by sorting and biological treatment.

A separate collection and seal transit system is adopted to classify garbage to combustible waste, dust waste, and discarded products (glass and metal). Each garbage collection station ships garbage directly to the landfill. Garbage is further separated so that the recyclable waste is reused as a resource; non-combustible dust waste is buried; the remaining garbage is buried in the sanitary landfill. Landfill leachate flows through pipeline to the wastewater treatment plant.

(2) Maotai Eco-industrial Park for Circular Economy, Guizhou Province

1. Project Profile

Maotai Eco-industrial Park Project is located in the eastern part of Yaxi Town, and covers a planning area of 748 hectares, including 267 hectares for industrial purpose, 343 hectares for ecological control, and 138 hectares for commercial and residential industrial purpose.

A circular economy is an economic form characterized by resource conservation and recycling. In this model of economic production, resources input for production are recovered and reused through recycling to reduce waste emissions in whole process from allocation of resources, production, consumption, and waste disposal. Maotai industrial park has three functional components: Fansha wine and Suisha wine brewing, biogas and organic fertilizer production, and ecological agriculture.

For wine waste disposal industries, the resource recycling project focuses on distiller's grains in the production process and converts them into organic fertilizer and biogas. Organic fertilizer can be used for surrounding ecological agriculture, and the products of ecological agriculture serve as food for residents and materials for the wine industry, but also can be introduced as specialty products in eco-tourism and health resorts. Biogas can be an alternative energy for wine production or residents' daily life. It reflects the coupling between industrial development and ecological agriculture and achieves industrial ecology and eco-industrialization.

With lees as the carrier, the streamline of the functional blocks in a circular industry is described as follows:

(1) Distiller's grains and food from Renhuai enter the liquor-making factory through long-distance transportation (along the north freight track on the highway);

(2) Liquor is made (liquid products from the closed loop: finished wine for storage, packaging and shipping);

(3) Distiller's grains are sent through short-distance transportation to biogas plant (gaseous products from the closed loop: biogas);

(4) Distiller's grains are used for organic fertilizer production;

(5) Organic fertilizers are used in the production of organic food (solid product from the closed loop: protein and fungi);

(6) Organic fertilizers are applied in Langtouba Ecological Agriculture Demonstration Area;

(7) Agricultural production and output;

(8) Food, after short-distance transportation, re-enter the liquor-making factory to complete the closed loop of the circular industry.

2. Low-carbon Development Goals

Making use of the distillers' grains of Maotai, a circular economic chain will be shaped, covering liquor making, distillers' grains, complex wine production, biogas production, organic fertilizer production, ecological agriculture, and wine crop growing. With the implementation of the Project, Guizhou Maotai Group can completely solve the pollution caused by organic waste (lees and water in pots and pits), adjust the energy structure, improve the application of clean energy and renewable energy, but also optimize the industrial structure. Moreover, the new model guarantees organic fertilizer that improves the soil environment of Maotai's organic raw materials base.

Index System for Maotai Industrial Park:

Category	**Level-1 Indicator**	**No.**	**Level-2 Indicator**	**Requirement**
Integrated indicators		1	Carbon intensity per unit of GDP	≤2.33 tons of CO_2/ 10,000 yuan
		2	Carbon intensity per capita	≤ 50% of the level of national average
		3	Proportion of clean energy in total energy consumption	≥50%
	Economic development	4	Development Specialty industries	Development of industries with local characteristics
		5	Local employment index / living and employment balance index	≥50%
Low-carbon economy	Low-carbon industries	6	Energy consumption per unit of GDP	≤1.4 tce /10,000 yuan
		7	Energy consumption per unit of industrial added value	≤0.8 tce /10,000 yuan

		8	Measures for industrial waste heat recycling	≥60%
		9	Industrial solid waste utilization	≥95%
		10	Industrial water recycling	≥90%
	Low-carbon agriculture	11	Proportion of organic products in agricultural products	≥80%
		12	Growth rate of organic carbon content in soil	Up by 10% by 2020
	Industrial innovation	13	Innovative renewable energy technologies	At least one innovative technology
	Ecological indicators	14	Preservation rate of original ecological assets	≥1
		15	Surface water quality	Not worse than the Class III standards
	Planning and land use	16	Per capita green space in the built-up area	≥12 ㎡
		17	Volume rate	Compliance with planning requirements
Low-carbon environment	Green building	18	Proportion of green buildings in new buildings	100%
		19	Construction waste and reuse	≥75%
	Green transportation	20	Proportion of green transportation	≥75%
		21	Energy consumption	Down by 5% or more

			reduction per unit of transportation for trucks	from the 2013 level
	Green living	22	Per capita water consumption per day	≤120L /person·day
		23	Per capita garbage production per day	≤0.8K / person·day
		24	Garbage recycling rate	≥75%
Low-carbon management	Organizational construction	25	Leadership and working bodies for the low-carbon park	Established governing bodies
	Energy management	26	Monitoring and statistical system for carbon emissions and energy efficiency	Established energy efficiency monitoring system
	Financial support	27	Low-carbon development funds	≥3% of tax revenue

3. Implementation Program and Major Projects

(1) Low-carbon industries.

Making full use of local resources and energy advantages, the circular economy industrial chain, centering on Maotai liquor-making industry, is created, and a series of recycling projects organized to convert waste into biogas and organic fertilizer. It includes low-carbon industry, low-carbon agriculture, low-carbon services, and circular economy industries.

(2) Low carbon layout.

The industrial park is closely and interactively related to the city. It is the spatial concentration of urban economic functions, and its level of development directly affects the level of economic development of city as a whole. With effective support in other comprehensive services, the industrial park can continue to improve itself and expand the radiation influence.

(3) Low-carbon energy system

The construction of low-carbon energy system complies with the overall plan and takes short-term and long-term considerations. The project site, Langtouba, is three kilometers away from Yaxi Power Plant and within the heating range of the cogeneration economy. In the early phase, the nationally advocated cogeneration will be realized through cooperation with Yaxi Power Plant to make full use of its resources. Renovation in renewable energy technologies is also favored and vigorously extended in the park. Biogas production and utilization can meet part of the energy needs, increase the proportion of renewable energy

consumption, and reduce carbon emissions from the energy supply side.

(4) Water recycling and reuse

A rainwater harvesting and water reuse system is deployed that collects rainwater for irrigation. Meanwhile, a purifying "ecological garden" is incorporated in the landscape sketch design, reflecting biodiversity and natural process of water purification, while replenishing groundwater resources.

(5) Low-carbon buildings

New buildings should strictly follow the energy efficiency standards for 50% energy consumption reduction. The architectural design highlights roof and wall insulation, and requires appropriate energy-saving materials, steel windows with excellent tightness performance, insulation materials for joints of doors and windows, in order to achieve energy savings and reduce emissions in the construction and use of buildings.

(6) Low-carbon transportation

Public transit-oriented transportation development is advocated and promoted, by strengthening the intelligent transportation system, improving the traffic organization and management, and promoting the use and development of energy-saving environment-friendly vehicles. New energy vehicles and clean energy-based means are encouraged in the public transportation system and trucking system, to reduce emissions and gaseous pollutants generated in this sector.

A slow traffic network system, including bicycle paths and pedestrian walkways, is also considered. Paths for leisure walk and fitness will be opened in green space to improve the pedestrian network, with focus put on the user's comfort and safety.

3. Low-carbon Life Demonstration Area

(1) Low-carbon Demonstration Area in Dongxiang County, Jiangxi Province

1. Project Profile

This Low-carbon Demonstration Area is sited in Zhanqian New District in Dongxiang County. Zhanqian New District is located in the north of the central zone and neighbors the Xingzheng New District in the west and the old central zone in the south. In specific, it extends to North Ring Road, Xionglan Road, Xingzheng Road, and East Golden Road, and covers a planning area to of 356.02 hectares (including 74.93 hectares of built-up area, 265.01 hectares of land suitable for construction, and 16.08 hectares of waters). Zhanqian New District is close to Fuzhou East Railway Station and the core zone for northward urban expansion. By virtue of location and transportation advantages and convenient contact and access, the development and construction of Zhanqian New District will help drive the rapid development of the surrounding area.

According to the Dongxiang County Master Plan, Zhanqian New District is identified as a key area for urban construction and built as a new portal to Dongxiang County, efficient transportation hub, well-equipped business district, quality residential community, and embodiment of urban image and features.

With consideration to the master plan, Zhanqian New District is defined as a livable urban new district that integrates transportation hub and business services. It is built to be an important transport gateway, an

integrated area for high-speed rail service, and a livable demonstration area.

In specific, the master plan identifies the elements below:

① Residence: Northern and southern residential areas, Longyi residential cluster, and Zishan residential cluster.

② Administrative office: Xiaogang Government and Court.

③ Culture and entertainment: Chengbei Cultural Center.

④ Education and research: Chengbei High School, Zhanqian Primary School, JinGong Primary School, Dezheng Primary School, Dongxiang County Kindergarten, and special education schools.

⑤ Sports: Chengbei Stadium.

⑥ Health: Chengbei Hospital.

⑦ Business services: district-level business centers, Yongshan business cluster center, and two town-level commercial streets.

⑧ Park: Zhanqian Park, Zishan Park, Xiaogang Park, and square in the front of Fuzhou East Railway Station.

Scale of development

① Population size

Zhanqian New District has a total population of 4.45 million.

② Land size

Zhanqian New District has a total land area of 356.02 hectares.

Utilization of resources

Water consumption: 22 000 m^3/day;

Annual power consumption: 100 million kWh;

Annual gas consumption: 4 million m^3 / year.

2. Low-carbon Development Goals

General target

Zhanqian New District, the planned low-carbon demonstration area, centers on Fuzhou East Railway Station, and covers a total area of 356.02 hectares, approximately 3.56 square kilometers. It is designed as an integrated project of low-carbon residential and commercial facilities, and highlights harmony, intelligence, and low-carbon communities. Making full use of local natural resources, combined with local realities, the focus is put on efficient use of energy, energy structure optimization, and resource recycling. With consideration to industries and infrastructure in other areas of Dongxiang County, a group of implementation strategies and key projects are introduced, covering low carbon buildings, transportation, industries, life, and layout. It is planned to build Zhanqian New District into a two-star LCMT demonstration area of the region across the Taiwan Strait and APEC.

Specific targets

① Proportion of clean energy in energy consumption: greater than or equal to 45%;

② Proportion of new energy in total energy consumption: greater than 20%;

③ Proportion of public transportation in the community: greater than equal to 60%;

④ Non-traditional water resources utilization rate: greater than 40%;

⑤ Garbage collection rate: greater than or equal to 40%; solid waste utilization rate: greater than or equal to 60%;

⑥ New buildings 100% compliance with green building standards; two-star construction area and above: more than 30% of the total area of green building.

⑦ Existing buildings: corresponding energy-saving plan implemented.

⑧ A sound slow traffic system established.

3. Implementation Program and Major Projects

(1) Harmonious low-carbon demonstration community

Low-carbon communities refer to urban rural communities with low carbon emissions and energy and resource consumption achieved through climate-friendly natural environment, housing construction, infrastructure, lifestyle and management. Harmonious communities are modern civilized communities characterized by sound facilities, beautiful environment, standard management, considerate service, dense cultural atmosphere, interpersonal harmony, and morality.

(2) Low-carbon energy project

It encompasses the solar thermal utilization and solar photovoltaic utilization in Zhanqian Area District. In the absence of geological survey and analysis report for the district, it is currently hard to estimate the potential in the utilization of shallow geothermal energy, but under the right circumstances, shallow geothermal energy utilization is advocated to improve efficiency of heating and cooling equipment and increase low-carbon energy utilization.

In terms of solar energy resources, Dongxiang County is classified into Class IV. Given 2.0 m^2 solar collectors for each 100L hot water, a total 31,150 m^2 of solar collectors are needed, or equivalently 3115tce, which accounts for 18% of the total energy consumption of Zhanqian Area District. It will generate emission reductions of 15,309 tons of CO_2.

Available solar PV energy totals 35,687,500 kWh, accounting for 26% of total energy consumption of Zhanqian Area District. It will generate emission reductions of 21,555.25 tons of CO_2.

(3) Low-carbon eco-technology research and development center - three-star green building project

A low-carbon eco-technology research and development center is created in the Zhanqian Area District, to strengthen inter-regional technical exchanges and cooperation, promote the transfer of low-carbon technologies, enhance the commercialization of low-carbon technologies; to encourage companies to develop low-carbon technologies and products, improve the level of technological innovation and promotion, and achieve continued development of low-carbon eco-industrial park, so that enterprises

become more competitive in the international arena; and to attract cross-strait and international research institutes. It will build three-star green buildings that save land, water, energy, and materials, and protect the environment.

(4) New energy utilization project

It covers the following aspects:

- Wind and solar LED lights
- Light guide illumination system
- Green ecological toilets

- Green bus station
- Biomass use

(5) Electric public transportation

Great efforts are made to develop electric bus-based public transportation system in the urban areas of Dongxiang County, especially Zhanqian New District, and infrastructure should be put in place, including charging stations, power plants, charging piles, and line requirements.

(6) Rainwater recycling project

To optimize the use of water resources in the demonstration area, water-saving products and pipeline facilities are advocated, while active efforts are made to utilize renewable water sources. Dongxiang County has plenty of rainfall with an average annual precipitation of 1768mm. Given a planning area of 356.02 hectares and a 30% rainwater utilization rate, a total of 1.88 million m^3 can be collected annually, accounting for 24% of annual water consumption.

Available water resources become increasingly tense due to the massive social needs, while the virtuous ecological cycle of water resources is prone to destruction as the capability of water replenishment continues to decrease. Rainwater, with its advantages of low cost and simple processing methods, become a new available water resource.

(2) Low-carbon Demonstration Area in Shagangwang, Zhongmu County, Henan Province

1. Project Profile

Zhongmou County is subordinated to Zhengzhou, Henan Province and neighbors the ancient city Kaifeng in the east and Zhengzhou in the west. It has a total land area of 1,416.6 square kilometers and a total population of 700,000.

Shagangwang District is a "village to city" demonstration of Zhengzhou, where villages are integrated and communities are resettled to push ahead the new urbanization process. It accelerates the construction of distinctive modern urban system in line with realities of Zhongmou. Generally it is aimed to create a green low-carbon living environment and build smart communities. By virtue of no pollution and high air quality, new technologies, new energy, and environmentally friendly materials are advocated for widespread application to realize reasonable layout with low carbon buildings and transportation, as well as low-carbon energy and resources recycling.

It covers an area of about 1,500 mu, with a total construction area of about 2,000,000 square meters, and involves a total investment of 7.5 billion yuan.

Figure 7 Land use plan for Dameng Town, Zhongmou County (2013-2030)

Proceeding from emissions reduction, high-quality settlements are built in the Community and diverse urban facilities are put in place, including modern community management center, business services, community hospitals, kindergartens, schools, and parks, so that the community become an ideal, sustainable place that integrates natural environment and artificial environment.

2. Low-carbon Development Goals

The Project is launched to build a green, low-carbon, eco-suitable living environment featured by ecological layout, low-carbon energy, low-carbon buildings, smart community, low-carbon transportation, renewable resources, and the ultimate target is a favorable environment, convenient and comfortable transportation system, green livable buildings, and healthy and rational low-carbon lifestyle.

According to the APEC LCMT development index system, the project can achieve 83 points and reach the two-star level.

3. Implementing Measures

Ecological layout: Shagangwan community is built into a sustainable place integrating natural environment and artificial environment through ecological environmental protection, intensive use of land, and optimal spatial design.

Low-carbon energy: Renewable energy use is strengthened and energy efficiency improved, to achieve energy saving and improvement of living standards.

Low-carbon buildings: The key is energy efficiency and the fundamental principle is to cater design methods and technical measures to local conditions with consideration to climate conditions.

Low-carbon transportation: It follows the principle of transportation in harmony with land in the planning and layout and the focus is put on the low-carbon model of "bus + slow traffic".

Renewable resources: With attention to environmental protection, a scientific and rational water system is designed, supplemented by reuse of solid waste, to give full play to the guiding role of the demonstration area in guiding the industrial development of renewable resources in Zhongmou County.

Smart community: With the aid of information technology tools, efforts are made to build an integrated intelligent platform for information service management, covering community management, community service, and community building.

VII. Safeguards for LCMT Construction

(1) Strengthening Organizational System Construction

Given that LCMT involves a broader range of issues, including social, economic, environmental issues, it is necessary to set the corresponding organ to ensure policy implementation.

A long-term working mechanism for low-carbon economic development should be established, which identifies the "unified leadership of the government, responsibilities of departments, and implementation of companies", and specifies "tasks and targets". Tasks and objectives in LCMT construction should be decomposed for implementation and the responsible departments should develop programs that assign objectives and tasks down to person. "Top leaders" of the party and the government should personally take overall responsibility to ensure that responsibilities, measures and input are "in place".

(2) Implementing the Target Responsibility System

Leading Group and Implementation Group for LCMT Construction are created, and on this basis, target assessment and accountability systems are established which link targets at all stages and at all levels with the relevant leaders to implement management by targets. Assessment measures will be introduced to strengthen the tracking and inspection of responsibilities and progress. LCMT construction will be incorporated into the assessment of leadership of administrative departments.

(3) Formulating out Sound Policies to Support the Development of Low-carbon Industries

Research should be made to formulate policies favorable for low-carbon development in industrial, fiscal, monetary and consumer aspects. Industrial policy should be introduced for low-carbon industries that low-carbon projects are highlighted in investment and given priority in land for construction. Fiscal policy should provide support to major low-carbon projects and technological and industrialization demonstration projects by means of priority loans or tax exemptions, as well as important low-carbon technologies and products and related R&D and technological promotion. EPC is also advocated and measures will be worked out to encourage EPC projects and boost the energy conservation service industry. Meanwhile, the policy mechanism for renewable energy development will also be strengthened.

Special funds should be set up for demonstrating and promoting energy-saving technologies or new energy technologies, supplemented by supporting measures. A sound market-oriented energy service system should be established to shape a service network that covers information service platform, professional services companies, and personnel training.

(4) Increasing Capital Investment and Expanding Financing Channels for Low-carbon Finance

A special fund for low-carbon development should be created, mainly for GHG inventory preparation and the statistical and index system, carbon trading pilot, and carbon certification capacity building, as well as the promotion of low-carbon technologies and applications, pilot and demonstration projects, and low-carbon community and life.

In addition to direct financial support from the government, low-carbon financing policy should be developed as soon as possible to raise funds in many ways based on innovative idea and market approaches. It should give full play to the role of market mechanism in allocating resources by attracting domestic and foreign capital to development of key low-carbon projects. While the threshold should be lowered, we should boldly learn from the successful experience and carry out market-based environmental

investment pilots. Financing channels should be expanded with innovative financial institutions and financial tools to support low-carbon development projects and industries in lease financing, issuance of corporate bonds, and public financing. Investors regardless of economic attribute and categories are encouraged to participate in the investment, construction and operation of low-carbon development projects, and robust market and industrialization mechanisms should be set up to facilitate the transfer of capital and technology to low-carbon projects. Active efforts should be made to seek bilateral and multilateral funds from foreign governments and international organizations, which can be used for capacity building and technological development and promotion in the low-carbon sector. In specific, financial security is reflected in the following five aspects:

1) Opening up channels to attract funds with projects

2) Expanding internal and external communication to seek domestic and foreign fund

3) Establishing a special fund for low-carbon economy

4) Seeking financial capital

5) Establishing market-oriented financing channels

(5) Deepening Reform to Green Rise based on Low-carbon Innovation

The S&T system reform should be deepened to consolidate market-oriented scientific research and technological development and policy guidance mechanisms. Enterprises occupy a dominant position in the technological progress and should be strategically motivated in the reliance on S&T progress. A robust joint research mechanism should be set up that encourages enterprises to carry out various forms of cooperation with institutes and universities. Efforts should be exerted to strengthen S&T innovation service system and promote the popularization and application of S&T achievements. Efficiency agriculture is advocated with the implementation of standardized agricultural production technologies to improve technology content. The S&T market with sound market functions should be developed and nurtured, while an efficient S&T information network should be framed. Also, computer tech information centers and action centers are created to train S&T personnel for modernization.

By way of "pioneering implementation and pilot", institutional reform and mechanism innovation in favor of changing models of development and LCMT construction should be accelerated, with the focus on administrative, social, technological, talent and investment management. An integrated institutional mechanism for low-carbon development should be set up that gives full play the guiding role of administrative regulation and the basic role of market regulation.

Industrial structure and product structure should be adjusted and optimized to achieve intensive economic growth. Active efforts should be exerted to promote clean production processes, develop high value-added, less-polluting or non-polluting products, and phase out backward processes, products, equipment and technologies. It is prohibited to produce energy-consuming, polluting products with raw material waste, while high-tech and resource-saving industries and products are encouraged, which safeguards healthy and rapid economic, social and environmental development.

(6) Intensifying Dissemination to Create a Favorable Social Environment for Low-carbon Development

On the one hand, public participation is encouraged to strengthen the public oversight mechanism. A

mechanism-based public participation system should be established with the support of favorable policies. A monitoring system should be established to strengthen social supervision, enhance public opinion, and achieve two-way exchange of information.

On the other hand, publicity, education and communication should be strengthened. A variety of publicity activities can be carried out to strengthen education on low-carbon development and climate change and further enhance the low carbon awareness of leaders at all levels, enterprises and the masses.

(7) Acting Actively in International Exchange and Cooperation

Multi-channel, multi-level domestic and international cooperation in different forms should be established and strengthened, with the focus on technology and capital introduction and capacity building. By transferring low-carbon technologies and developing CDM projects through joint research and development, the level of low-carbon technologies and innovation can be improved to narrow the gap with leaders as soon as possible.

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APPENDIX

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