

Exploration and Practice on Implementable Planning of

Low-Carbon New Town

1. Introduction

Energy security and climate changes pose severe challenges during the rapid development of urbanization, industrialization and motorization of China. Abandoning the traditional development pattern in 20th century, the fundamental way to deal with the challenges is by means of technical and policy innovation, the establishment of the low-carbon spatial patterns, industrial structure and life style. City is the major cause of emission of CO₂ and other greenhouse gases. Urban planning has a long-term structural impact on urban development and construction. It plays a leading and overall planning role. Energy conservation is especially a key factor in new town construction and adaptation to climate changes.

"Shenzhen City Development Strategy 2030", approved by Shenzhen Municipal People's Congress in 2006, establishes the slogan "Build a sustainable global pioneer city " as a future developing objective for Shenzhen. It takes a series of actions in legislation, planning, finance, technology, etc. This actively corresponds to the encountered four challenges, that is, land, resources, population, and environment, and leads the city into the track of scientific development. One important action is the planning and construction of Guangming, Longhua, Dayun, Pingshan. These four New Towns planned outside the special economic zone aims to explore different urban transformation models and coordinates the development both inside and outside of the special economic zone.

Guangming New Town, located in north-west of Shenzhen, was established in May 2007 with a total area of 156 square kilometers (figure1). It covers a built-up area of 40 square kilometers with GDP18.6 billion in 2008. The permanent resident population in this area adds up to 400,000. According to the "Shenzhen City Master Plan (2007-2020)", Guangming New Town will be an important sub-center of Shenzhen, an innovative high-tech industry base and ecological demonstration zones, which is consistent with its essence of becoming a low carbon city. Since its establishment, the planning department has organized a series of specific planning and action planning according to the development goals and orientation. Some plans have been approved and put into practice. Guangming has taken the first step of low-carbon development.

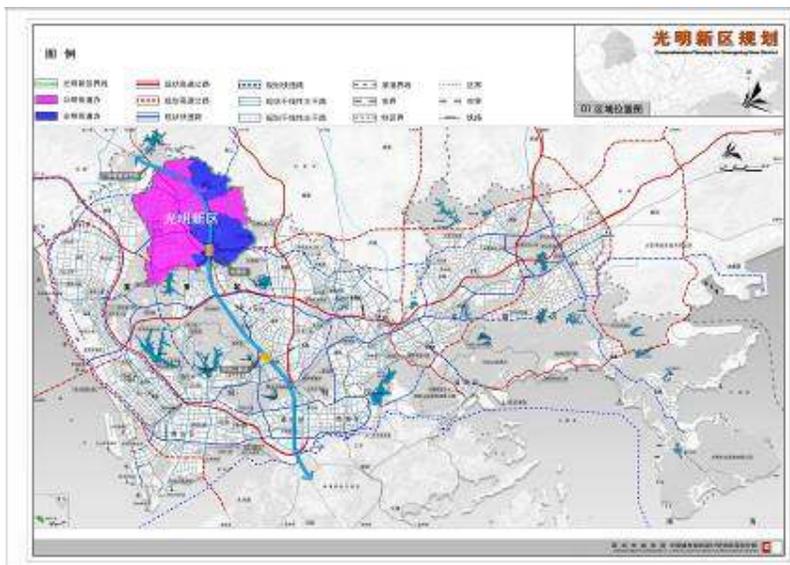


Figure 1: Guangming new town location in Shenzhen

Source: Guangming Branch Bureau of Shenzhen Municipal Planning Bureau. (2009). *Guangming New Town Comprehensive Planning*.

2. Optimize the Structure and Layout of the New Town

2.1 Determine the basic ecological control line to effectively control the development border.

In order to prevent the disordered sprawl of urban construction and maintain the ecological system security, Shenzhen City issued the promulgation and implementation of "Shenzhen Basic Ecological Control Line Management" in November 2005. 974 square kilometers of land in Shenzhen is included within the basic ecological control lines, except for the key transport, municipal utilities, tourist facilities and parks, all other construction activities are prohibited within the control line. Guangming New Town is included within the basic ecological control line, covering an area of 83.44 square kilometers and accounting for 53.45% of total land (Shenzhen municipal government, 2005). During the past three years, the government uses satellite remote sensing to monitor construction activities within the control line, which effectively curbs illegal building activities. At the same time, it has introduced related policies to further protect and stabilize the basic ecological line.

In accordance with the "Negative-planning" idea (Yu. Li, 2005), we take the initiative to constrain the spatial development to transfer the quantitative expansion to the "qualitative" improvement (Figure 2). In Guangming New Town Comprehensive Planning (2007-2020), the allocated urban construction area will be 72.54 square kilometers, with the population controlled less than 1 million. The construction land per capita will be 72.5 square meters.

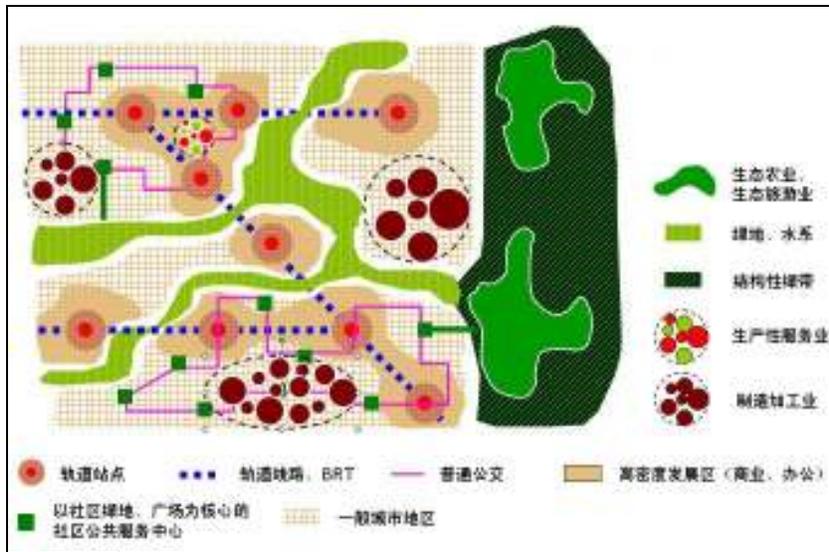


Figure 2: Spatial Model of Guangming New Town

Source: Guangming Branch Bureau of Shenzhen Municipal Planning Bureau. (2009). *Guangming New Town Comprehensive Planning*.

2.2 Establish a complete ecological framework, consecutive ecological corridor, and systematic and networking green space and wetlands system.

The practice of planning and constructing an eco-green center at estuary of Maozhou River is to protect the greenbelt in Gongming - Guangming-Guanlan region and Fenghuang Mountain-Yangtai Mountain-Changling region. Based on comprehensive improvement of the existing rivers, an ecological corridor will be established from the periphery greenbelt to urban construction area (Figure 3). Blue lines of Maozhou River main tributaries will be delineated to protect and make use of the existing fan-shaped water system. 8 wetland parks (with a total area of 156 hectares) will be planned and they will play integrated functions such as flood detention, environmental protection.

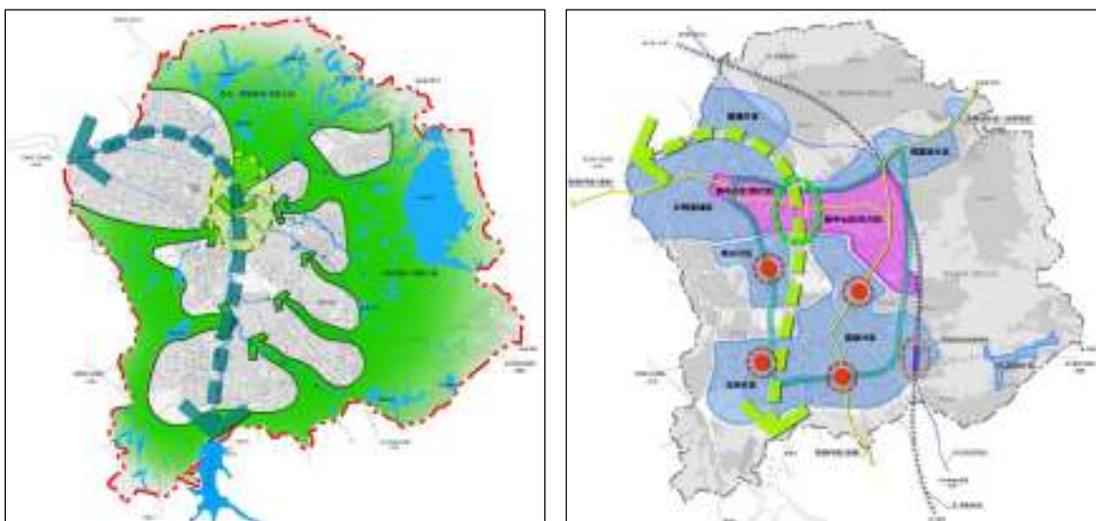


Figure 3: Spatial Structure of Guangming New Town

Source: Guangming Branch Bureau of Shenzhen Municipal Planning Bureau. (2009). *Guangming New Town Comprehensive Planning*.

2.3 Develop a reasonable sequence of the development and construction, optimize the environment for innovation and entrepreneurship.

Oriented by optimizing the innovation environment, the construction of municipal infrastructure, public facilities, equalization and optimization of public services will be the focus in Guangming recently,. The investment fund is up to 39.2 billion Yuan during 2007-2010. A reasonable development and construction sequence will be determined to keep the pace of industry and real estate development, strengthen the housing security so that it can be guaranteed that the new city is being developed in a balanced way of working and living, function improvement and industry upgrading gradually.

3. Put emphases on industrial restructuring and upgrading as well as comprehensive utilization of resources, and focus on the development of low-carbon economy

3.1 Constantly optimize the energy structure, and improve energy efficiency

Among the primary energy consumption in Shenzhen in 2006, petroleum accounts for 66%, coal 11%, external electricity 21.2%, natural gas accounts for 1.8% (Table 1). Among the terminal energy consumption, petroleum accounts for 49.9%, electricity accounts for 41.8 %, liquefied petroleum gas and natural gas accounts for 7.8%, coal accounts for only 0.55%. At present, Shenzhen is accelerating the second West-East Gas Pipeline Route Project and promoting the construction of urban high-pressure natural gas transmission and distribution pipeline network to improve the natural gas proportion in primary energy structure.

Table 1 Primary energy structure of China, Guangdong Province, and Shenzhen City (%)

Energy Type	Coal	Petroleum	Electricity	Natural Gas	Renewable Energy
The International Average (2004)	27.2	36.8	12.3	23.7	
China (2005)	69 . 1	21	7 . 0	2 . 8	0 . 1
Guangdong Province (2005)	42 . 8	33 . 8	17 . 2	5 . 8	0 . 4
Shenzhen City (2006)	11 . 0	66 . 0	21 . 2	1 . 8	

Source: Shenzhen Municipal Planning Bureau. (2008). Shenzhen Branch. Shenzhen master planning(2007-2020).

In 2007, Shenzhen unit GDP energy consumption was 0.56 tons of standard coal per ten thousand Yuan (price at that moment), which is 48% of the national average (Table 2, Figure 4). The energy structure of Guangming is almost the same as that of the whole city. In 2008, the energy consumption per ten thousand Yuan is 0.5 tons of standard coal, which dropped 2.8%.

Table 2 Unit GDP energy consumption comparison of major cities and regions in China in 2007

	Energy Consumption of Unit GDP		Energy Consumption Of Unit Industrial Added Value		Power Consumption of Unit GDP	
	Index value (coal equivalent/ ten thousand Yuan)	Increased or decreased	Index value (coal equivalent/ ten thousand Yuan)	Increased or decreased	Index value (kWh / ten thousand Yuan)	Increased or decreased
Shenzhen	0.56	-2.76	0.56	-3.76	848.8	0.54
Guangzhou	0.713	-4.44	1.12	-8.33	775	-2.3
Zhuhai	0.623	-2.6	1.01	18.53	968.3	-0.4
Dongguan	0.778	-5.36	0.92	-10.07	1657.7	-7.6
Guangdong Province	0.747	-3.15	0.98	-5.28	1156.9	-1.3
Beijing	0.714	-6.04	1.188	-10.81	758.28	-3.7
Shanghai	0.833	-4.66	1.006	-8.49	914.19	-5.2
Chongqing	1.333	-4.46	2.41	-7.19	1148	-4.1
Tianjin	1.016	-4.9	1.222	-8.33	1017.2	-0.7

Sources: National Bureau of Statistics of China, "2007 Unit GDP Energy Consumption Indicators Gazette for Prefecture-Cities in Guangdong Province ", "2007 Unit GDP Energy Consumption Indicators Gazette for Provinces, Autonomous Regions and Municipalities ", on July 14, 2008.

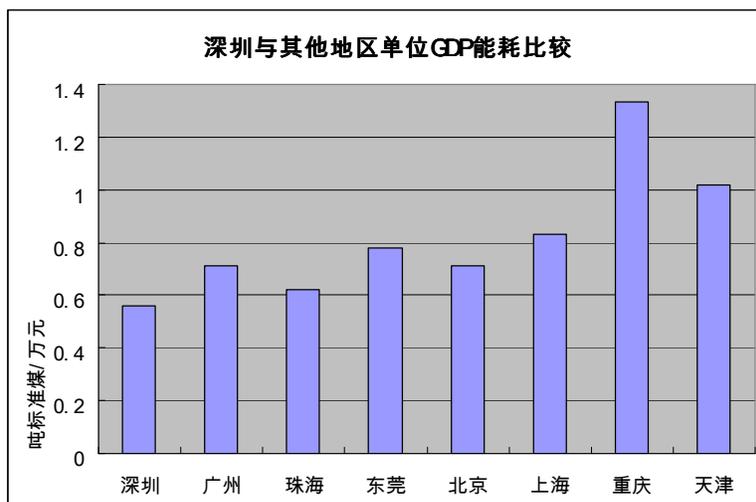


Figure 4: 2007 Unit GDP energy consumption comparisons of Shenzhen and that of other major cities in China

Sources: National Bureau of Statistics of China. (2008). "2007 Unit GDP Energy Consumption Indicators Gazette for Prefecture-Cities in Guangdong Province ", "2007 Unit GDP Energy Consumption Indicators Gazette for Provinces, Autonomous Regions and Municipalities ".

3.2 Environment friendly water-usage and disposal of solid waste

Water recycling is encouraged. Three sewage treatment plants are planned in Guangming New Town, with a total disposal capacity of 450,000 cubic meters/ day (Guangming Branch Bureau of Shenzhen Municipal Planning Bureau , 2008). Recycled water is mainly used as industrial water, urban water and ecological water supply for Maozhou River. The planned aim is to increase renewable water rate up to 50 % in 2020. This can save quality drinking water resources of 100,000 cubic meters / day, saving the cost of the raw water system up to 300 million RMB/ year. 350,000 cubic meters of river water for ecological is provided every day. Carbon source flowing into Maozhou River is reduced through the integration of artificial deep processing and artificial wetlands to protect the ecological environment. Rainwater resources are utilized to increase the evaporation, infiltration capacity and rainwater utilization so that flood peak flow can be decreased. In addition, the pressure if flood prevention is lessened and the pollution source is controlled. Also the urban heat island effects can be reduced.

The policy of garbage collecting and classifying is gradually implemented. 32 small scale garbage compressing stations are planned in this area. A pilot pneumatic transport system to improve the garbage collection and treatment facilities is constructed, which aims to achieve non-polluting disposal of municipal solid waste, and increase the utilization rate of disposed industrial solid waste and hazardous waste up to 100%.

3.3 Guide the industries to develop in a low-carbon way.

The industry-oriented directory and land use principles for logistics and industrial construction will be improved. Scientific and reasonable evaluation indicator system and procedures need to be established to strictly control the newly-started projects. That is, the introduced enterprises should be in accordance with the "two-low and three-high" (low energy needed, low power consumption, high-tech, high value-added, and high-tax contribution rate) standards. In 2008, 200 industrial projects have applied to settle in Guangming New Town. After a rigorous assessment, of which 80 projects are selected in the Reserve Pool (waiting list) and 15 projects have been granted the land for market development. At present, the initial structure is leading by high-tech industries such as optoelectronics, flat panel display, and biomedicine, and other traditional manufacturing-oriented industries such as mold, underwear, watches, and the tertiary industry is at a steady growth at the same time. The high-tech industrial output value is 25.65 billion Yuan, accounting for 48.5% of industrial production value in 2008.

Based on its own conditions, new town seizes the opportunity to actively develop the low-carbon industries such as LED, solar power. Production service industry is fostered to support transformation and upgrading of manufacturing and trading enterprises to comprehensively promote industrial restructuring and upgrading. The Management Committee and Hong Kong Productivity Council signed a framework agreement on clean production plans to make use of the technical advantages and service platform of Hong Kong Productivity Council. Some measures such as training, technical support, and demonstration projects will be taken to help enterprises in the new town to adopt cleaner production technologies.

4. Implement TOD development model, and establish green transport-oriented transport system.

4.1 Accelerate the construction of public transportation-oriented infrastructure

Currently, the transport energy consumption accounts for 20% of all the energy consumption in China. In 2008, the number of motor vehicles in Shenzhen reached 1.4 million and this keeps increasing with an average annual rate of 20%. How to avoid the old traffic developing mode of the special economic zone? Before industries and the population flood into the new town in large scale, we need to speed up the establishment of public transport system as the backbone and coordinate development of various transport modes. This is an important way for low-carbon development. According to residents travel survey in 2005, public transport accounted for 50 % and car travel accounted for 27%. To further reduce transportation energy consumption, the new town will develop green transport system based on public transport. In the planning, the internal transportation balance rate would be 50%, with bus accounting for 70%, and rail transit accounting for 49% (Figure 5). In addition to the Guangzhou-Shenzhen-Hong Kong passenger lines and Shenzhen- Dongguan R1 line, the total length of subway line 6, 13, 15 will be 43 kilometers. The light rail line takes 13 km, BRT Loop Line takes 26 kilometers in the range of new town. By 2020, the total coverage of area 500 meters within bus stations will account for 90% of the built-up area.

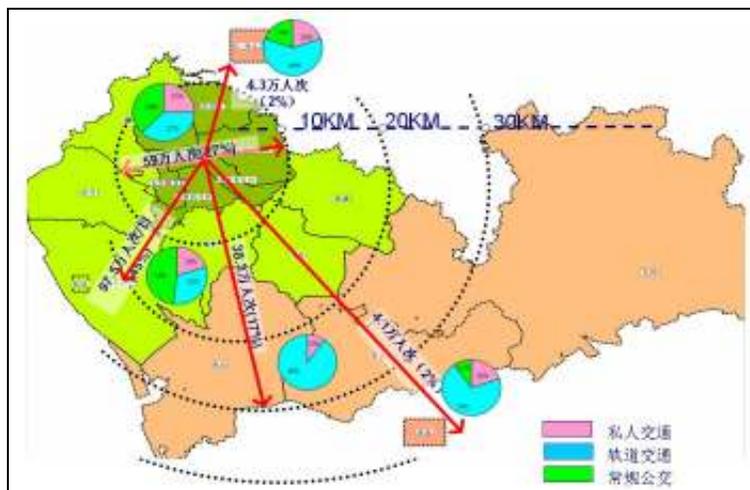


Figure 5: Analysis of Traffic Demand Forecasting in Guangming New Town

Source: Shenzhen Municipal Planning Bureau. (2009). *Comprehensive Transportation Planning of Guangming New Area*.

4.2 Guide the construction of compact city by TOD model.

A density plan should be made to appropriately allocate the construction. Highly intensive developments around the railway stations and rapid transit hubs will be conducted to create compact and orderly urban form (Figure 6). In the district center where the 6th MTR station sited, three vertical city buildings are planned. They cover an area of 103,000 square meters with a total construction area of 1,360,000 square meters. The floor area ratio in central area is 1.5-2.5. Generally, height is controlled within 24 meters. All these help to form a view of urban carpet from as a whole.

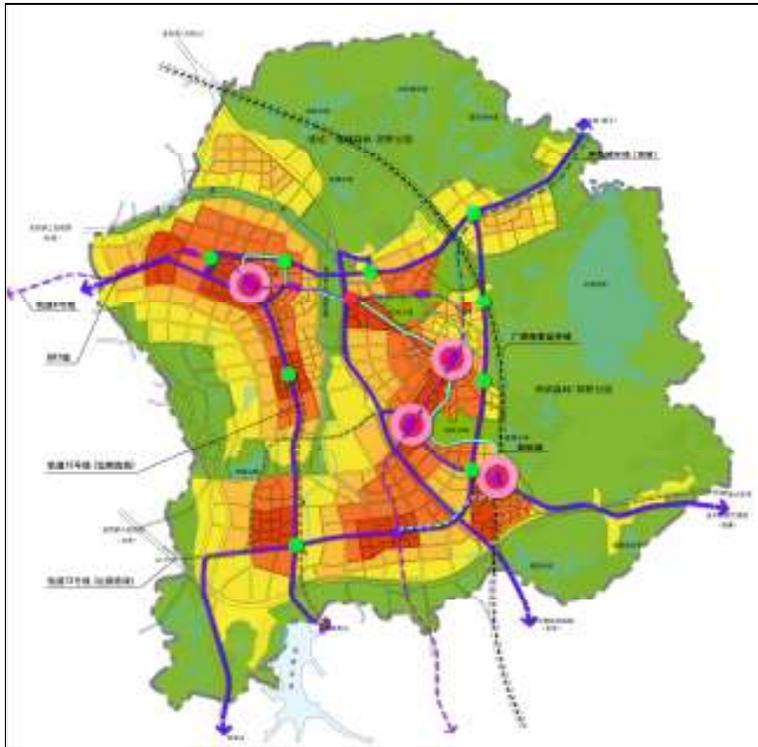


Figure 6: Density Zoning Plans for Guangming New Town

Source: *Guangming Branch Bureau of Shenzhen Municipal Planning Bureau. (2009). Guangming New Town Comprehensive Planning.*

Appropriate mixed land functions are encouraged. Learning from the experiences of Singapore, a certain proportion of spare land, integrated development land, class 2.5 industrial land are allocated in the planning. A variety of urban functions according to the development characteristics of different patches are taken into account when deciding their respective major functions. The proportion of non-productive land-use such as high-tech zones, mould, watches, and underwear industries is increased to appropriately loosen the policy restrictions of mixed industrial construction projects. Integrated park environment for work, study, living and leisure is created.

4.3 To build a comfortable and pleasant slow transportation system and strengthen the connection between slow traffic and public transport.

Combined with urban renewal, road network density between rail transit stations and internal bus stations is increased. The block-size is controlled under the level of 150 meters. Multiple possibility transportation forms are created to enhance the permeability of local area traffic. Veranda is utilized to construct sheltered corridor and a continuous pedestrian system. Shopping area is deployed along the ground floor of the buildings, which creates a vibrant street life style. It is safe, convenient, and quick for people to access all buildings, city squares, parks, bus stations and MTR stations (Figure 7). In addition, the bicycle system is also improved.

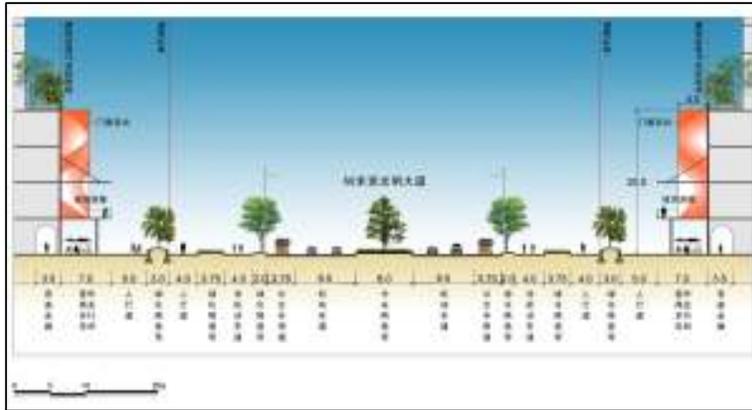


Figure 7: Cross-section Schematic of Guangming Boulevard

Source: Shenzhen Municipal Planning Bureau. (2009). *Development Guide Plan of Shenzhen Guangming Central Area*.

5. Develop Green Building

5.1 Setting Criteria First.

The energy consumption of buildings accounts for 30% of the total energy consumption in Shenzhen. Electricity consumption of buildings accounts for 43% of the city's total electricity load. Many surveys and measurement in Shenzhen showed that above 80% "green" contribution are from the planning and design. The energy consumption of building will increase 8-10% when the ambient temperature increases by 1 centigrade degree. Sound natural ventilation system can contribute to an additional energy-saving rate of 10%. It clearly showed that planning and design plays an important role in developing green buildings.

In July 2007, Shenzhen Municipal Planning Bureau took the lead in China by organizing the "The Guidelines of Shenzhen Green Building Design", which aims to learn from relevant international standards, reflect the Shenzhen characteristics, link with the national "Green Building Evaluation Criterion", and adapt to the current economic and social development. In March 2008, the Ministry of Housing and Urban-Rural Development and Shenzhen Municipal Government co-signed "Framework Agreement on Construction of Guangming New Town Green Building Demonstration Area". In March 2009, to promote the construction of the demonstration zone, after detailed consultation with various government departments, investors, building design and construction reviewing agencies, the Planning Bureau and Guangming New Town Administration Committee introduced a complementary approach together. It further elaborates the applicable scope of the "Guidelines". Specific requirements listed in the guidelines such as ground, sunlight, natural ventilation and lighting, ecological greening, ground water, green transportation, building materials, insulation, external shading, use of rainwater, water use, classification and measurement of energy consumption, energy-efficient lighting, efficient energy systems and equipment are defined as basic requirements. Basic requirements and higher requirements are differentiated. Various criteria corresponding to different categories are also provided.

At the same time, quantitative criteria for technique key-points review and contents are defined. In addition, administrative regulatory functions of planning, land, construction,

environmental protection, the reform and financial and other related departments are combined to set detailed regulations on project approval, program bidding, planning permission of construction, planning acceptance as well as green building-related management activities. After the enact of the "Guidelines", government-funded construction projects, the road construction, reconstruction and extension in central area, high-tech area (an area of 32 square kilometers) and other important sections, the habitation, office, shopping malls and hotel construction within the scope of Guangming New Town will fully achieve the national "Green Building Evaluation Criterion" four star level. The energy-saving will also achieve the level of 50%.

5.2 Demonstration and guiding effects.

High-tech Enterprise Accelerator is the first green building project in the planning and design of Guangming New Town. It emphasizes the planning and design of green buildings in the hope of creating a green-featured, environmental protecting and energy saving in its life cycle, comfortable and efficient modern enterprise park through the design and appropriate use of green technologies. At the macro level, the wind path is taken into account in this project to form several major "Wind Corridors", which can ensure the ventilation along the dominant wind direction in the whole Park (Figure 8). It also emphasize on three-dimensional design of the Green Space System. At the micro-level, some green design techniques such as natural ventilation design in the underground garage, shading systems, artificial wetland, elevated roofing system, solar energy and air-source heat pump system are applied. (Figure 9).



Figure 8: "Wind Path Corridor" in High-tech Enterprise Accelerator Park

Source: Zhaoshang estate Co. Ltd. (2008). "Design Proposal of Guangming High-tech Enterprise Accelerator"

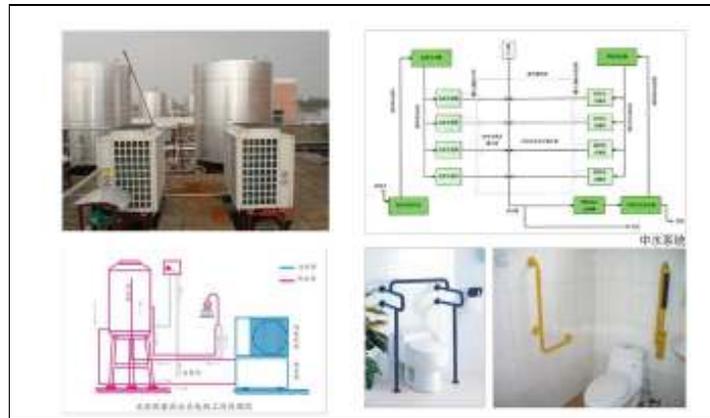


Figure 9: Heat Pump System in High-tech Enterprise Accelerator Park

Source: Zhaoshang estate Co. Ltd. (2008). "Design Proposal of Guangming High-tech Enterprise Accelerator"

Topraysolar Industrial Park in Guangming New Town is one of the first national renewable energy demonstration projects. It focuses on producing a variety of optoelectrical and optothermal components that can be directly integrated with the buildings. Amorphous silicon photovoltaic cells wall, monocrystalline silicon photovoltaic power plant, new flat-plate solar water heater, new wind power generation system and various solar energy road lamps and lawn lamps are installed in this park. (Figure 10) This make this park the most comprehensive demonstration base of making use of solar energy and renewable energy. It is estimated that photovoltaic and optothermal application in Topraysolar Industrial Park can produce 496,400 kWh, 1,839,600 MJ of heat power per year, saving 231 tons of standard coal and reducing 689 tons of greenhouse gases emission.



Figure 10: Combination of Optoelectrical and Optothermal Components in Topraysolar Industrial Park

Source: Shenzhen Topray Solar Co. Ltd

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