城市绿色基础设施探讨:
以发展中国家城市为例

Urban Green Infrastructure:
for Cities of Developing Countries

Part of the ELITH Project Report Documents

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前言

发展中国家的城市大多处在炎热的气候带中，并正在迅速发展。他们未来的能源和环境影响是一个主要问题。世界各地的例子表明，城市可以用一个更可持续的方式计划和建设，并且不需要较高的成本。

城市的绿色基础设施包括其开放空间、植被、公园、湖泊和水文要素。这些设施用于提供新鲜空气和休闲场所，并过滤污染物，也是城市通风的关键。如果计划合理，他们有助于建设更少污染、更健康、更凉爽的城市，并大大降低城市的能源需求和成本。

一些最有效的环境规划往往是是简单廉价的。所以，在对已存在的解决方案有更深刻的认识和了解的情况下，更环保、更舒适、更可持续发展的城市是可以实现的。通常观点下，可持续发展方案不是太贵，就是很难被政府强制执行。所以我们更偏向于现实的途径和政策，而不是那种无谓地阻碍开发商或者严重受制约的规划。

Foreword

Developing country cities are mostly in hot climates and are growing very rapidly. Their future energy and environmental impacts are a major concern. Examples worldwide show that cities can be planned and built in a more sustainable way – without significantly higher costs.

The *green infrastructures* of a city are its open spaces, vegetation, parks, lakes and water features. They provide fresh air and recreation, but they can also filter pollutants and are a key to urban ventilation. If well planned they help to make a city less polluted, healthier and also cooler, considerably reducing the city's energy needs and costs.

Some of the most effective environmental planning is simple and inexpensive. In many cases greener, more comfortable and sustainable cities can be achieved – given more awareness and knowledge about solutions that already exist. One hears often that sustainable solutions are either too expensive, or difficult for city authorities to enforce. We prefer realistic approaches and policies which do not needlessly hinder developers or require heavily restrictive planning.

在一个通常注重城市快速发展，城区扩展和采用粗放型增长模式的发展中国家里，“**绿色基础设施**”往往是一个被忽视的部分。

‘**Green Infrastructure**’ is a neglected part of cities of developing countries, where the focus is often on rapid urban growth, urban expansion and extensive development.

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概要/ Executive Summary

绿色基础设施是村庄、城镇和城市之间的物质环境。它代表着用绿色（和蓝色）要素构成的在城市周围的网络，加强并维护环境系统，以支持维系高质量生活。
Green infrastructure is the physical environment within and between our villages, towns and cities. It is the network of green (and blue) elements in and around urban areas, enhancing and maintaining the environmental systems to sustain and maintain quality of life.

这份文件强调了绿色基础设施在城市规划设计中的重要性。四个关键元素'绿色（植被）”，“蓝色（水文），红色（能源）和白色（空气）是本文探索的主要内容，并且提出了实现可持续发展的设计规划方法。最后在四个全球性的例子中，文章讨论了这些城市绿色基础设施的关键要素。
This document highlights the importance of green infrastructure in urban planning and design. Four key elements of ‘Green (Vegetation)’, ‘Blue (Water)’, Red (Energy) and White (Air) are explored as part of this document, suggesting approaches to achieve sustainable design and planning. Four global examples are then presented to discuss these key elements of green infrastructure in cities.

各领域建议 / Implications Across Sectors

篇文章中所示的解决方案给以下领域提供重要思路：

- 决策者和城市领导
- 地产开发商和建筑商
- 规划师和设计师

以上团体协同合作是制定共赢方案的最好的方式。只有这样才能发现更详细的建议和信息。

The solutions illustrated in this short brochure have important implications for:

- policy makers and city leaders
- property developers and builders
- planners and designers

Bringing these groups together is the best way to identify win-win solutions. More detailed advice and information is not hard to find.

城市规划和
绿色基础设施

一些城市社区和地区已经设法减少了超过75%的排放和能耗。部分区域已经不再使用化石燃料。一个城市的总体布局与代表色为绿色和蓝色的基础设施正是这些成果的重要基础因素。问题是又为什么很少去这样做呢？因为有地方政策到土地价格及缺乏知识等许多障碍。许多国家中，都只有计划过的法律，缺失的有经验的规划者和少量控制城市发展的手段。如果没有一个协调的城市计划，只有持续低效的建造方式，避免能源和气候影响，减少当局以及公民后代生活成本的黄金机会将会被错过。

City Planning and

Green Infrastructure

Some urban districts and communities have already managed to reduce their climate emissions and energy use by over 75%. A few have managed to cut out the use of fossil fuels entirely. A city's overall layout and its green and blue infrastructures are the foundation for this. Why is it seldom done? There are many barriers, from local politics to land prices or lack of knowledge. In many countries there are few if any planning laws, few skilled planners, and few means of controlling the urban development. Without a coordinated city plan, and with continuing inefficient building practices, golden opportunities are missed to avoid energy and climatic impacts and rising future costs for the authorities as well as citizens of future generations.

下面的章节简要讨论可持续解决方案的四个主要基础设施领域并对其举例说明：

绿色 - 土壤—植被、土壤、绿荫、氧化作用、生物多样性、噪声治理、污染物过滤；

蓝色 - 水文—水池，溪流，喷泉—渗透，蒸发，净化，回收，冷却；

红色 - 能源–生物气象学城市设计–降低热负荷和提供可再生能源；

白色 - 空气—城市通风，冷却，新鲜空气，除污染，减少热岛效应。

The following sections briefly discuss and give examples of sustainable solutions in the four main infrastructure areas of:

GREEN – earth – vegetation, soil – shade, oxygenation, biodiversity, noise abatement, pollutant filtration;

BLUE – water – pools, streams, fountains – infiltration, evaporation, purification, recycling, cooling;

RED – energy – bioclimatic urban design – reducing the heat load and supplying renewable energy;

WHITE – air – urban ventilation – cooling, fresh air, removing pollution, reducing heat island effect.

发展中国家城市的普遍问题

General Issues for Cities of Developing Countries

-ve

消极趋势
Negative Trends

- 城市地区气温显著升高;
  Significant Raise in temperature in urban areas;
- 快速小规模城市开发;
  Rapid pace of inconsiderable urban development;
- 大规模、低质量规划项目;
  Large scale and low quality masterplanning projects;
- 增加制冷能源消耗;
  Increase in energy consumption for cooling demands;
- 在建筑环境中的绿化缺乏和生活质量低下;
  Lack of greenery and quality of life in the Built Environment;
- 低质量的城市环境引起的健康风险和危害;
  Significant health risks and hazards from low quality urban environments;
- 在城市环境中减少自然资源，绿色和蓝色。
  Reduction of natural resources, green and blue from the city environments.

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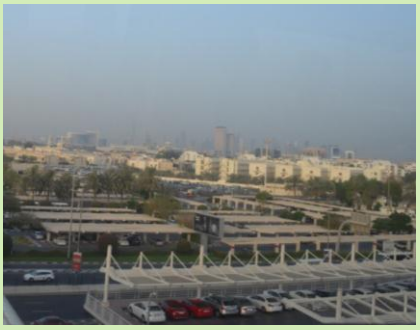
1. 城市住房和硬表面的景观（设拉子，伊朗）
Urban housing and hard surface landscape (Shiraz, Iran)
2. 城市形态和生活环境的变化（海南，中国）
Change in urban patterns and living environments (Hainan, China)
3. 中心城区缺乏绿色空间（坎帕拉、乌干达）
Lack of green spaces in central urban areas (Kampala, Uganda)
4. 城市内绿化消失（金边，柬埔寨）
Disappearance of greenery from the city (Phnom Penh, Cambodia)
5. 大规模基础设施建设（马尼拉，菲律宾）
Mass infrastructure expansion (Manila, the Philippines)
6. 大型停车场和道路（迪拜，阿联酋）
Large scale areas of car parking and roads (Dubai, UAE)
7. 逐步被灰色元素替换的绿色元素（曼谷，泰国）
The gradual replacement of green by grey (Bangkok, Thailand)



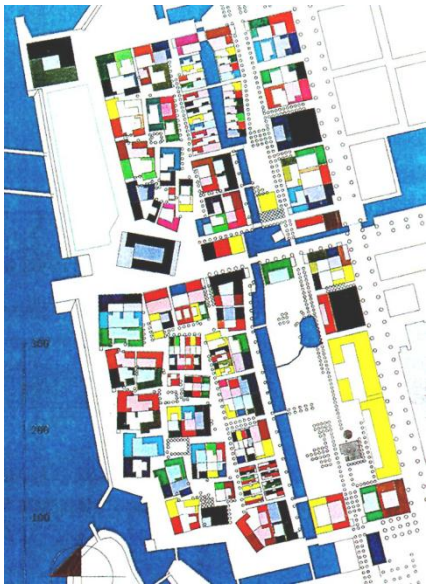
马尔默/瑞典

西部海港区

The Western Harbour District

瑞典的马尔默是一个世界领先的可持续发展城市。这个城市的气候排放量已经减半，其目标是到2020为止的污染气体中和。西部海港区已经成为一个可持续解决方案的国际试验床，不仅在于环境解决，而且同样是一个社会愿景。这是一个占地160公顷，居住着约10000居民，包括商业区，学校和服务区的试验田。一个关键目标是实现文化和环境的多样性，包括各类的建筑，空间和功能。它是欧洲第一个完全使用可再生能源的城市地区。

Malmo in Sweden is a world leader in sustainable urban development. The city's climate emissions have been halved already, and the aim is to be climate neutral by 2020. The Western Harbour district became an international test bed for sustainable solutions, not only environmental but equally a social vision. It is an area of 160 hectares for about 10,000 residents and includes commerce, schools and services. A key goal was cultural and environmental diversity, with a wide variety of architecture, spaces and functions. It is the first urban district in Europe with 100% renewable energy.



以下是一套完整的绿色基础设施：
There is a complete set of green infrastructures:

- 新公园，当地生态群落，植物园的产业/New public parks, indigenous biotopes, vegetable garden allotments;
- 广泛覆盖的植被，绿色的屋顶和墙壁，鸟类/动物收容所/Extensive vegetation, green roofs and walls, bird/animal shelters;
- 池塘，游泳池，水源涵养，透水表面，雨水收集/Ponds, pools, water conservation, permeable surfaces, rainwater harvesting;
- 废物分离，真空垃圾回收系统，材料回收/Waste separation, vacuum based garbage collection system, materials recycling;
- 可持续交通系统，无车区，自行车和步行网络/Sustainable mobility systems, car free areas, bicycle and footpath network;
- 100%可再生能源-风能为主，包括太阳能光伏发电，太阳能热和沼气/100% renewable energy - mostly wind, also solar PV, solar thermal and biogas.

Malmo/ Sweden

新的进展-质量计划 / A NEW PROCESS - THE QUALITY PROGRAM

一个非常重要并成功的创新是一个叫做“质量计划”的规划方法。在质量计划中，生态，经济和社会目标相结合，并被明确划分。这份计划文件随后成为了与开发商签订的法律合同的一部分，而那些有野心的开发商也将被准许开发项目。质量计划是在整个设计和施工中控制质量的基础，它确保了在过程中追求最初的愿景和目标。类似的方法现在也用于其他城市。

A very important and successful innovation was a new planning method, the “Quality Program”. In the QP the ecological, economic and social goals are combined and clearly specified. This document then formed part of the legal contracts signed with developers, who were awarded projects if they guaranteed high ambitions. The QP is then the basis for quality control throughout the design and construction – ensuring that the initial visions and goals are followed. Similar methods are now used in other cities.

生态的可持续性离不开健康发展的社会，由此该方案涵盖了研究，信息和教育领域。可持续性消费和发展的健康性得到了大力推动，包括绿色生态的建造，在2020年实现100%生态食品的目标，以及实现城市，当地协会，居民和企业之间的密切合作。

Recognising that e*cological* sustainability cannot be achieved without healthy *community*, the programs include research, information and education. Sustainable consumption as well as health are strongly promoted, including green procurement, a goal of 100% ecological food by 2020, and close cooperation between city, local associations, residents and business.

(Source: www.Malmö.se/sustainablecity)

Kengeri / 印度

Malhar生态村/Eco-Village

Malhar生态村位于印度的班加罗尔市郊区的Kengeri，它是由Goodearth组织基于建设可持续社区的整体概念发展的。

通过理解和规划生态友好型的布局，Malhar生态村成为了一个低层住宅模式和各种环境特点相结合的著名例子，包括与绿色开放空间，公园，透水地坪，无车区，水收集系统等等。

Located in Kengeri, one of the outskirts of the City of Bangalore in India, Malhar Eco-Village is developed by GoodEarth Organisation, with an overall concept of building sustainable communities.
Through understanding and designing suitable and ecologically-friendly layouts, Malhar Eco-Village is a remarkable example of low-rise housing pattern with various environmental features of green and open spaces, green parks, permeable flooring, no-car zones, water collection system and etc.

Kengeri/ India

关键设计与规划特点

社区的形态和布局是一个计划组合的住房，设施和开放/绿地的丰富组合。该建筑布局提供了多多样化的无车区，共享生活空间/社区生活环境和公园。

景观与遮荫

新造林和现有树木是整体规划和空间设计的一部分。阴影遮盖降温生活区也成为一个社区的重要景观特征。

水文景观

该社区包括了一些水文特征和小水池。这些都是集成在庭院的绿化区域里；同时具有雨水收集功能；并冷却公用生活环境。

绿化景观与地形

阶梯式绿地的采用，避免了水过剩和水灾并支撑了一个渐进的水收集系统。

KEY DESIGN AND PLANNING FEATURES

The form and layout of the community is a generously planned mix of housing units, facilities and open/green spaces. The building layout offers a variety of no-car zone, shared living spaces/ community living environments and parks.

Landscape and Shading

New plantation and existing trees are part of the overall masterplan and spatial design. Provision of shading to cool down the living environments is a major landscape feature of the community.

Water Landscape

The community includes several water features and small pools. These are integrated within the courtyards/landscaping of the area; used as rainwater collection; and are for cooling the shared living environments.

Green Landscape and Topography

The stepped green spaces are used to avoid flooding or overflow of water and support a gradual water collection system.

松岛/韩国

松岛国际商务区

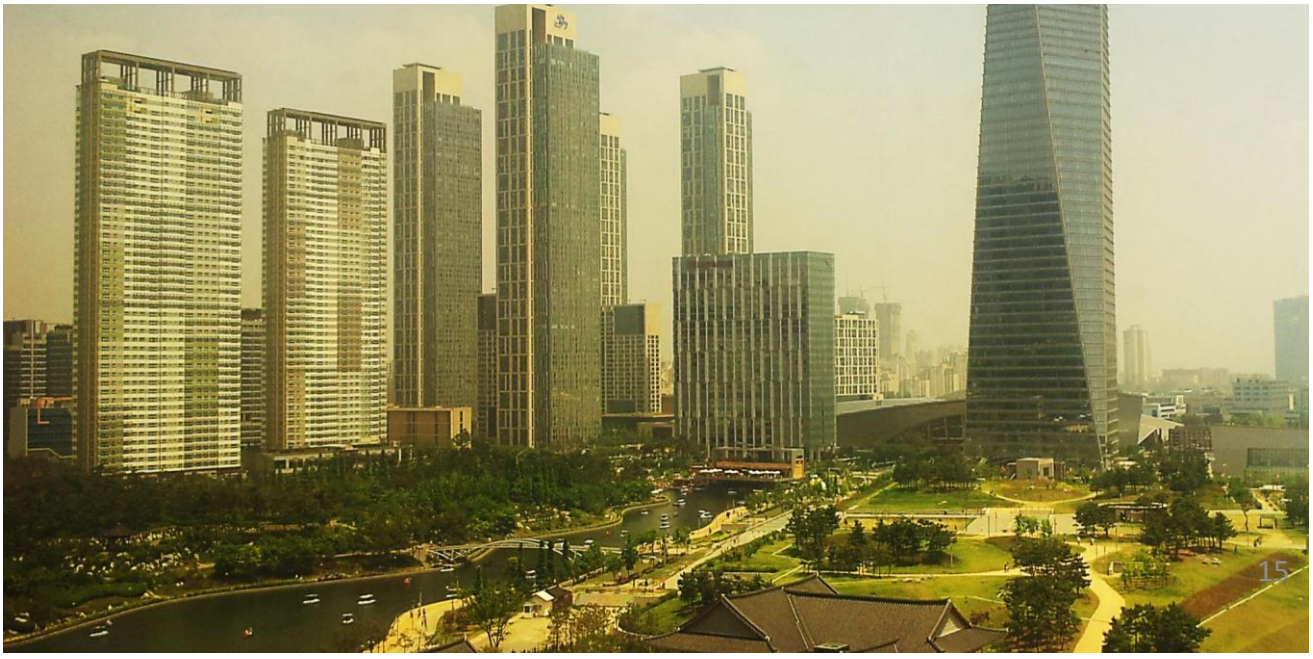
随着一个面积达1500亩（约600公顷）的地块的开发，松岛国际商务区（SIBD）成为了一个建立在填海造田土地上的韩国仁川海岸的主要开发地区。其部分新业务区仍处在建设中。自上而下的规划和城市设计的发展方法是一个伟大的关键表现指标（KPI），节能奖励和绿色基础设施发展的使用例子。松岛常被视为一个新的'智慧城市'或'无处不在的城市，也被经常强调为一个“未来城市”。

配合使用该地区的信息技术网络，一个管理所有建筑，水资源节约，废物管理系统和智能交通和基础设施网络的系统也被采用。通过聚焦于商业和休闲中心，松岛提供了超过总面积的40%的绿色空间。它们包括松岛著名的中央公园， 滨水地区，为候鸟和濒危水鸟栖息的阶梯地块，[城市]农业区，集成型的住宅和商业区和绿色（蓝）休闲环境。

Songdo International Business District

With an overall development area of 1,500 acres (or about 600 hectares), Songdo International Business District (SIBD) is a major new development built over a reclaimed land from Yellow Sea off the City of Incheon, South Korea. Parts of this new business zone is still under construction. The top-down masterplanning and urban design approach to this development is a remarkable example of the use of Key Performative Indicators (KPIs), energy saving incentives, and green infrastructure development. Songdo is often regarded as a new ‘smart city’ or ‘ubiquitous city’ and is often highlighted as a ‘City of the Future’.

With the area’s information technology network, there is a management system in place for energy use of every building, water conservation, waste management system and a smart network of transportation and infrastructure. With focus on both business and leisure, Songdo offers a variety of green spaces that account for more than 40% of the whole area. These include Songdo’s well-known central park, waterfront areas, staging ground for migrating birds and threatened waterbird species, [urban] agricultural areas, integrated green spaces for housing and business districts and green (and blue) environments for leisure.



Songdo/ South Korea

作为总体规划的一部分，绿色基础在朝向整体化社区建设的绿色道路上起到了主要作用。从实施智能垃圾管理系统到生态保护，松岛可以被视作是蓝色（水文）和绿色（植被）基础设施的成功模版。

中央公园和水系统

中央公园位于近松岛中部，它和周围的水文连接是该区域的重点休闲中心。

连通性，可走性和可骑行性

有了更多的建造绿色基础设施的可能性，创造更具包容和连通性的生活环境也有了更高的机会。这包括了整个地区的步行和骑行的主要路线，保障了更好的无障碍设施，更好接触到的步行的流域，休闲和商业区。

融合蓝绿

该杰出的设计以绿色和蓝色区域集成到建筑环境，如教育区，住宅之间宜居空间，吸引人的野餐区和休闲活动，和松岛商业贸易区。

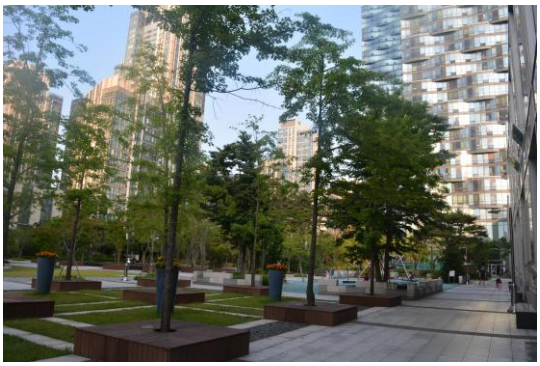
As part of the overall masterplan, the green infrastructure plays a major role in creating a green path towards a holistic community development. From implementation of smart waste management system to preservation of ecology, Songdo can be regarded as a successful model for green and blue infrastructure.

The Central Park and Water System

Located in almost the central part of Songdo, the central park and surrounding water connections are key leisure hubs of the area.

Connectivity, Walkability and Cycleability

With more possibility for green infrastructure, there is a higher chance of creating more inclusive and connected living environments. This includes major routes for walkable and cycleable areas across the whole area, allowing a better walkable catchment for better accessibility to amenities, work, leisure and businesses.



Integrating Blue and Green

The masterplan takes on board integration of green and blue in to the built environment, such as the education zone, liveable spaces in between the residential blocks, attractive picnic areas and leisure activities, and across commercial/business zones of Songdo.

天津生态城/中国

Tianjin Eco-City, China

天津生态城是一个位于中国东北天津市东部的中新项目。这一新的生态城市发展规划是中国首批八个生态城市项目之一。该项目覆盖了30平方公里的面积，处在半业务半建设阶段。

天津生态城采用的关键绩效指标（KPI）框架包括22个定量和4个定性指标。该项目的实践包括解决主要环境问题，涵盖了能源，水资源，废物，土地使用和场地保护。

Tianjin Eco-City is a Sino-Singaporean project located towards the East of Tianjin City, North China. This new eco-city development is one of the first eight eco-city projects of China. This project stretches over a total area of 30 sq km and is partly operational with remaining phases under construction.

The Key Performance Indicator (KPI) framework of Tianjin Eco-City includes 22 quantitative and 4 qualitative indicators. The common practice of the project embraces the main environmental issues, ranging from energy, water, wastes, land use and site preservation.

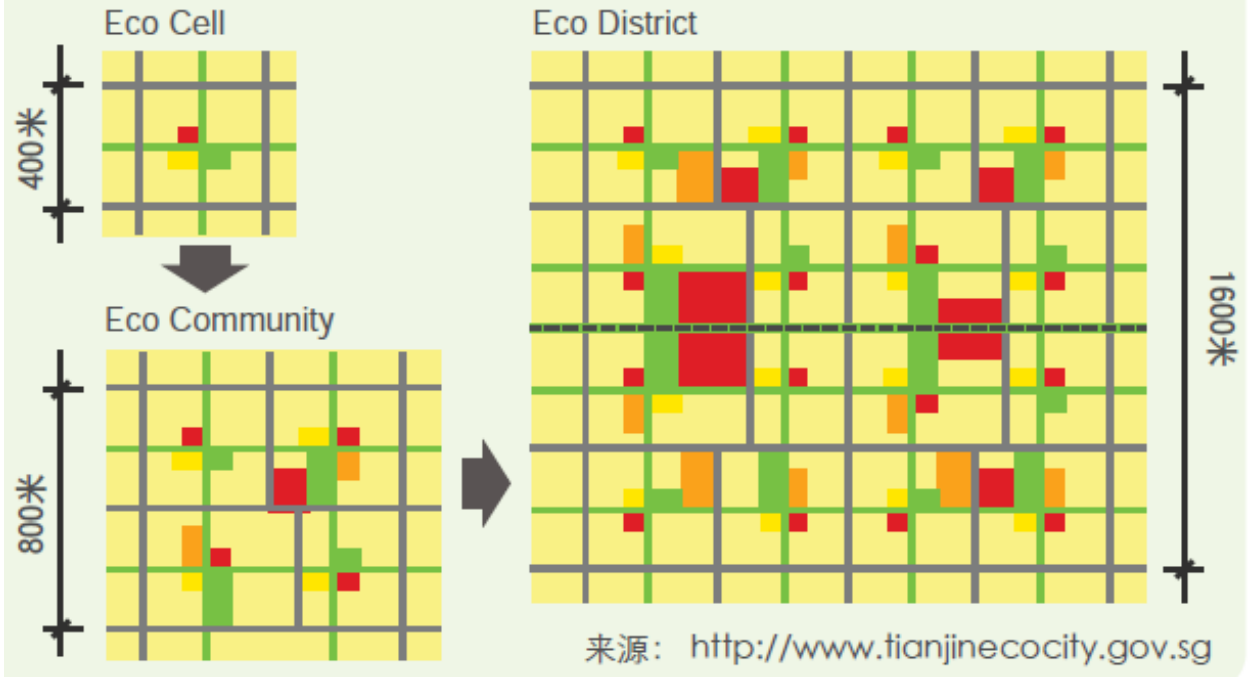
Tianjin Eco-City/ China

主要设计和规划特点

这一项目的主要特点之一是“生态区”和“生态社区”（宏观规模），“生态小区”（中等规模）和“生态建筑/块”（微型规模）的发展。在生态小区内的绿色通道和绿色开放空间的提供是这个生态城市的一个主要的功能特点。这种方法已经促进了一个更为综合的规划，使绿地相互连接，绿色走廊有效地引入了城市通道网络系统，城市块被分割成了更小但具有更好渗透性和功能的区域。

MAIN DESIGN AND PLANNING FEATURES

One of the key features of this project is the approach to development of ‘Eco District’ and ‘Eco Community’ (at macro scale), ‘Eco Cell’ (at meso scale) and ‘Eco Buildings/Blocks’ (at micro scale). The provision of green corridors and green open spaces within each eco cell is a major planning feature of this eco-city. This approach has promoted a more integrated planning whereby green spaces are connected with each other, green corridors are effectively introduced in the urban grid system and urban blocks are broken to a smaller scale with better permeability and performance.



指引：前进的道路
Guidelines: The way Forward

绿色基础设施与城市农业
城市可以提供土地给农业，通过提供食物生产，保障食品安全，用食物再生来循环丰富当地小微商业来支持当地社区。

绿色基础设施和制冷效果
城市可包括那些用来消散建筑环境所产生的热量的地区，以及在设计中考虑作为城市通风的地区。

绿色基础设施与可持续生活
城市可以提供存在社区感，安全性和适宜居住性的社交场所，也是一个人们能有户外活动工作，生活和娱乐的地方

绿色基础设施和微气候
城市可以包括微型气候的应对措施，在那里更凉爽的生活环境可以提供一个更好的自然/被动通风。

Green Infrastructure and Urban Farming
Cities can offer places for agriculture, supporting the local community by food production, food security and enriching the small local businesses through regeneration.

Green Infrastructure and Cooling Effect
Cities can include places for cooling the heat produced by the built environment and places where urban ventilation is considered in design.

Green Infrastructure and Sustainable Living
Cities can offer socialising places, where there is a sense of community, security and liveability; places where people can have their outdoor activities for work, living and joy.

Green Infrastructure and Micro Climate
Cities can include micro climate solutions, where cooler living environments can provide a better natural/passive ventilation.

一个用来工作的地方 / 一个用来生活的地方 / 一个用来享受的地方
A Place to Work / A Place to Live / A Place to Enjoy

冷却和净化
Cooling and purification

城市通风
Urban Ventilation

房屋与景观
Housing and Landscape

城市空间与社区
Urban Space and Community

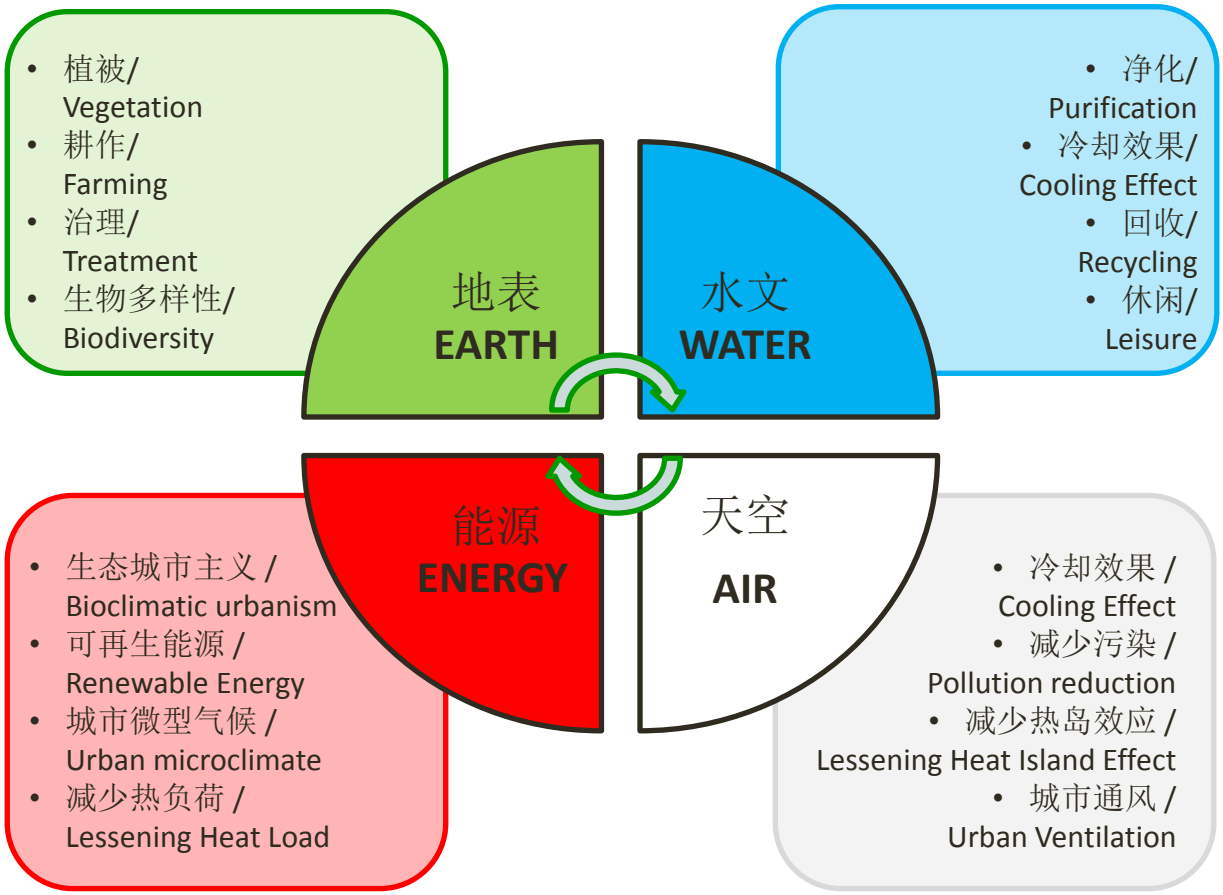
都市农业
Urban Farming

休闲与工作
Leisure and work

引言：前进的道路
Guidelines: The way Forward

这个城市是由建筑和自然环境组成的。通过联结的两个者到一个集成的方法里，我们可以使城市冷却和城市通风（可减少能耗），减少城市热岛效应（更好的温度舒适性并减少污染），以及城市走廊发展，城市峡谷和城市降温岛屿。当代发展中国家的城市规划应考虑通过开发可吸引投资，生活和工作的地块来达到建筑与自然合作，来提高生活质量，并对可持续发展的排水，废物管理和基础设施提供切实的支持。

The city consists of the built and natural environments. By coupling the two in an integrated approach, we can create possibilities for urban cooling effect and urban ventilation (resulting in less energy consumption), reduction of urban heat island effect (resulting in a better thermal comfort and reduction of pollution) as well as development of urban corridors, urban canyons and urban cool islands. The contemporary planning of cities of developing countries should consider building and working with nature to enhance quality of life by developing places of attraction for investment, living and work and to provide tangible support towards sustainable development of drainage, waste management and infrastructure.



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本文件特别作为城市规划部门，决策者和城市开发商的指导意见。

This document is particularly produced as a guidance for city planning authorities, urban planning sector, policy makers and city developers.

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