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Singapore: A High-Rise Utopia?

新加坡：高层建筑乌托邦？



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Peng Beng Khoo and Belinda Huang founded their architectural practice, ARC Studio, in 1998. Their process driven work has earned a reputation for being dynamic and innovative. Peng Beng and Belinda shot to fame in 2002 when they won the International Architectural Design Competition for their Duxton Plain Public Housing project. The "Pinnacle @Duxton", their winning entry, has won many awards including CTBUH's 2010 Best tall building Asia & Australasia region. Peng Beng and Belinda are constantly incubating ideas for high-density environments and how intelligent rural development can inform the sustainability of cities.

Peng Beng Khoo 和 Belinda Huang 于1998年创建了他们的建筑公司-ARC Studio, 他们以过程驱动的工作方式使他们以充满活力和创意而闻名, 他们的成名作是2002年国际建筑设计竞赛得奖作品Duxton Plain 公共住宅设计——达士岭, 这个设计为他们赢得了许多荣誉, 包括CTBUH (世界高层都市建筑学会) 2010年度亚洲/澳洲地区最佳高层建筑奖。Peng Beng 和 Belinda 仍在不断探索高密度环境的设计问题以及智能化乡村开发对可持续城市发展的启发。

Abstract

Singapore has already implemented many urban-scale sustainable strategies that other cities only dream of – true integrated transport networks, 60-storey high green walls, subsidized government-built high-rise housing for all, tower complexes connected in the sky, etc. This presentation takes as its sub-title the evocative notion that "1000 Singapores can house the world's population on 0.5% of the world's land area". It is presented by the architects behind Singapore's seminal 'Pinnacle@Duxton' housing project – which won the CTBUH 'Best Tall Building Asia & Australasia' award in 2010. The Pinnacle project comprises seven 50-storey residential towers connected by urban planes at the ground, 25th and 50th floor levels – creating a significant 'urban habitat' in the sky.

Keywords: Singapore, Pinnacle@Duxton, Superdensity, High-Rise, High-Density, Urbanism

摘要

新加坡已经实施了许多都市尺度的可持续发展战略, 如名副其实的整体交通网络, 60层高的绿化墙、面向所有人的政府补贴建造的高层住宅、在空中连接的高层综合体塔楼等等, 不一而足, 这些在其它许多国家还处于梦想阶段。本讲演有一个令人联想的副标题- '1000个新加坡就能住下全世界的人口, 而只占用0.5%的地球陆地面积', 讲演者就是新加坡富有开创性的 'Pinnacle@Duxton' 住宅项目的建筑师, 该项目赢得了CTBUH 2010年度亚洲/澳洲地区最佳高层建筑奖, 它包括七座五十层住宅塔楼, 塔之间在地面层、第二十五层、第五十层互相立体连接, 造就了一个独特的空中“城市生态环境”。

关键词: 新加坡、达士岭、超密度、高层建筑、高密度、都市化

Singapore – a nation on a small island in the centre of Southeast Asia.

Planned for a population of 6.5 million, Singapore fits into a compact 710 sq km. Multiply that by 1000 times, the entire world's population of 6.5 billion can fit into an area no larger than 0.5% of the world's land area. The entire world could fit into an area equivalent to the size of Texas or two Japans or two Italys.

Absurd yet compelling.

Imagine for a moment a world as compact as this.

More than 99.5% of this world would be natural landscape. A portion would be used to produce food and the remaining left wild.

Human settlements take the form of 1000 cities each with 20 to 30 towns each roughly half the population of cities like Zurich or Copenhagen. The towns will form a large ring around a large water catchment area that doubles up as a reservoir and nature reserve – a wild zone within the city. Train lines would connect the towns that will be further served by smaller light rail transits. Within each town would be community centers, schools and junior colleges, parks, stadiums and sports complexes, hospitals, libraries, water catchment zones and transport interchanges.

新加坡——东南亚中心小岛上的国家

新加坡有限的710平方公里的领土上居住者650万人口。如果把新加坡的面积放大1000倍, 一片占地球陆地面积0.5%的土地, 就能盛下全世界65亿人口。也就是说全世界的人口都集中在一块面积相当于美国德克萨斯州的土地上, 或者相当于两个日本或意大利的面积。

非常荒谬但也令人信服。

想象一下, 如果全世界的人口只占这么小的土地, 世界将是什么样子。

超过99.5%的土地都是自然山水, 一部分用以生产粮食外, 其它都是野生环境。

人类聚居地是1000个左右的城市, 每个城市包括20到30个小镇, 每个小镇的人口大约是苏黎世或哥本哈根的一半, 这些小镇环绕一大片集水区而建, 水面既是水库也是自然保护区-都市里的乡野区。火车线连接小镇之间, 小镇之内的交通有更轻型的小火车, 每个小镇都有社区中心、学校和初级学院、公园、体育场和综合体育设施、医院、图书馆、集水区以及交通中转站。每个小镇内部又分成4到5个街坊, 每个街坊内有小型街坊学校和市场。街坊还可以进一步分成不同特色的小区, 小区之间生活质量也不尽相同, 每个小区都有中心花园, 太阳能板提供公共空间的照明用电, 如公共走廊、疏散楼梯、街道和公园

Each town would be made of 4 or 5 neighborhoods with smaller neighborhood schools and markets. Neighborhoods would be broken down further into precincts where communities could form distinct characteristics and quality of life. Every precinct would have its own community garden with solar panels providing energy for the lighting of the public spaces – corridors, escape staircases, streets and parks. Within a 400m radius, a 5 minute walking distance from anywhere within the precincts, one would find a mass rapid transit (MRT) station.

1000 Singapores – A model of the Compact City, as a proposition would be high-density, efficient and green. Only 30% of each city would be built up. A substantial portion of built form would be high-rise. Urban forest reserve and water catchment areas ensure clean water supply and air. High intensity infrastructure and low energy consumption ensure urban sustainability. The urban world from end to end would be no larger than 900km. The world would be connected by high-speed rail. Housing would be diverse, dense, walkable and decked with ample facilities. Schools are within walking distance or a short train ride away. Buildings are connected at multiple levels. Landscape and architecture merge seamlessly. Open space and parks are available just outside every home. Multi-cultural communities become commonplace. Diverse religions co-exist in close proximity.

Utopian? Definitely. Perfect? Of course not.

Meta-visions invite us to think about the world and how we want to live in it. Tony Garnier's *Une Cité Industrielle*, Ebenezer Howard's *Garden City*, Kenzo Tange's *Vision for Tokyo Bay* and Archigram's *Walking Cities* force us to re-think urbanism and architecture. These speculations inspire generations to find urban strategies that would re-define the world we live in. Rather than inventing a new system, by examining Singapore's environment of intricate planning and its meta-project of merging architecture with governance, social, financial and environmental infrastructure, some interesting solutions to rapid urban growth and transformation might be found. In the same spirit of the meta-visions, Singapore's short 50 year history of urban renewal is offered as an agent for a transformative future.

In 1959, Singapore's population was close to 1 million with a GDP of about USD3500 per capita. Today, Singapore's population has reached 5.1 million and the GDP is about USD59,000. From a nation on a tiny sandbar with no natural resources, surrounded by much larger and more powerful neighbors, Singapore has leveraged on the intelligence, discipline and ingenuity of her people to create the city-state as we know it today.

Pinnacle@Duxton

The Pinnacle@Duxton is the tallest public housing project in Singapore at 50 stories (see Figure 1). The result of a worldwide architectural design competition held in 2002 to seek the latest high-rise high-density public housing form in the city, the Pinnacle@Duxton became operational in the year 2009. Comprising 1848 units, the seven interconnected blocks occupy only 2.5 Ha of land, roughly equivalent to the area of three and a half football fields. It is home to almost 7000 residents. At this density, we would need a relatively small plot of 23.8 sq km land to house 6.5 million people. Only 3.5% of the land area of Singapore is needed. This is superdensity – super compact housing.

Consider the alternative form where each unit sits on 150 sqm of land. To house 1,848 units, we would need 277,200 sqm of land excluding roads and land for supporting infrastructure like open fields and substations which typically would need another 30-50% more land.

等。小区400米半径内，即5分钟步行距离内，就有公共交通中转站（MRT）。

1000个新加坡——一个压缩城市的样板，它高密度、高效能且环保。每个城市只有30%的面积是建筑用地，绝大多数建筑都是高层建筑，城市里的森林保护区和集水区保证了城市水源和空气的清洁，高密度的城市基础设施和低能耗保证了城市的可持续性发展，城市一端到另一端不超过900公里，世界以高速铁轨相连，住宅品种多样，密集，利于步行，还配有众多生活设施，学校都在步行或短途火车距离之内，建筑在多个高度上相互连接，自然与建筑水乳交融，每家门口就是开放的空间和公园，各种文化、宗教共生共荣。

乌托邦？肯定是。完美世界？肯定不是。

我们可以用超越现实的想象来思考这个世界，思考我们想如何在城市中生活。Tony Garnier的《工业城市（*Une cité industrielle*）》、Ebenezer Howard的《花园城市（*Garden City*）》、丹下健三的《东京湾的愿景（*Vision for Tokyo Bay*）》及Archigram的《行走中的城市（*Walking Cities*）》都强迫我们重新思考都市化和建筑问题，他们的观点启发了几代人寻求都市化策略，以求彻底改变我们生活的世界。其实不用发明一个全新的体系，通过研究眼前的新加坡，研究新加坡精细的环境设计、建筑与政府、社会、金融及环境设施的多元融合，我们也许能发现一些应对都市快速发展、演变的有趣方法。就像我们上面所提及的超越现实的想象一样，新加坡50年来城市更新的历史能为未来城市演变提供一个线索。

1959年，新加坡的人口接近100万，人均GDP约为3500美元，今天，新加坡的人口达到510万，人均GDP约为59000美元。坐落在小沙洲上、没有自然资源、周边环境环绕的都是比她更大、更强的国家，新加坡的崛起靠的是其人民的知识、纪律和智慧，建造起今天我们看到的城市国家。

达士岭项目

达士岭是新加坡最高的公共住宅项目，高度为50层（见图1）。最终方案是2002年国际建筑设计竞赛的结果，目的是寻求最新的高层高密度城市公共住宅形式，达士岭2009年投入运营，共有1848个住宅单元，由七个相互连接的区块组成，共占地2.5公顷，大致相当于2.5个足球场的面积。总居民人数将近7000人，如果全新加坡住宅都是这个密度，我们只需要23.8平方公里的土地（占国土面积的3.5%）就可以住得下全国650万人口。可见，达士岭是超高密度、超级紧凑的住宅项目。



Figure 1. Pinnacle@Duxton: the tallest public housing project in Singapore. (Source: ARC Studio Architecture + Urbanism)

图1. 达士岭：新加坡最高的公共住宅项目。（出自：ARC Studio Architecture + Urbanism）

A precinct like this would require about 400,000 sqm of land – 16 times more land than the Pinnacle@Duxton. If each plot is 1000 sqm or about a quarter of an acre, 1,848,000 sqm would be needed for the units and a total of about 4,000,000 sqm of land for the entire project; 160 times more than the Pinnacle@Duxton. Kilometers of roads, drains, street lighting, power lines, fiber optics and communication lines, water and sewer systems will be needed to support the same number of units.

A sprawling urbanism like this implies an environment reliant on cars and roads for transportation as any mass rapid transit system such as trains and buses would be inefficient. Every station or bus stop would serve a small catchment of people and the distance between urban centers and the edges are great. Walking from edge to center will be impractical. Transportation networks and other infrastructure will not be economically sustainable. Such systems will require constant fiscal injections to sustain their operations and maintenance.

Is a sprawling model like this sustainable for the cities of tomorrow or a land limited city-state like Singapore?

Superdensity

As cities continue to expand at a staggering rate, land would not be the limiting factor. It would be low performance infrastructure that would be unsustainable both in fiscal and environmental terms. In superdensity urbanism such as the Pinnacle@Duxton, the infrastructure serves more people and is therefore shared by more people. The energy consumption per capita is much lower and therefore more sustainable.

What is it like living at superdensity?

The Pinnacle@Duxton is located on the edge of the Central Business District of Singapore. Hundreds of cafes, restaurants, shops are within a 10 minute walking distance. Residents walk to the two MRT stations only 300 meters away. Hotels and offices are no further. And a linear park connects the project to an island wide network of parks. It will eventually be possible to walk from one park to another around the island in a pedestrianized environment. Within the project itself there are three levels of public parks. One on the ground and two sky gardens on the 26th storey and the 50th storey respectively (see Figure 2). These public spaces become extensions of the units.

The park on the ground is actually built on an architectural surface that is a topological manipulation to conceal the three levels of



Figure 2. Three public parks are located on the raised new ground, 26th and 50th stories respectively. (Source: ARC Studio Architecture + Urbanism)
图2. 三座公园分别位于抬高的新地面层、第二十六层和第五十层。(出自: ARC Studio Architecture + Urbanism)

请考虑另一种方案, 假如每个住宅单元坐在150平方米的土地上, 1848个单元总用地是277200平方米, 不包括道路和辅助设施用地, 如空地和变电站等, 这些会使占地增加30-50%, 因此, 这样一个小区的用地应该是400, 000平方米, 也就是达士岭用地的16倍。再假如每个住宅单元坐在1000平方米的地块上(大约1/4英亩), 所有单元的总占地就是1,848,000平方米, 整个项目的总用地将是4,000,000平方米, 是达士岭实际用地的160倍。除此之外, 支持这些住宅单元还需要上公里的道路、排水管道、路灯、供电线路、光纤和通讯线路、供水和排污系统等等。

这种分散扩张的都市设计意味着依赖汽车和道路的环境, 应为在这种情况下, 公交车和火车这些公共交通系统效率非常低, 每个火车站和公交车站只能服务周边很少一些人, 城市中心之间以及城市边缘到城市中心的距离很大, 从城市边缘步行到城市中心变得很不实际。公共交通网络和其它设施在经济上都难以自负盈亏, 其运营和维护都需要不断注入资金支持。

未来城市的可持续发展是按照这种分散扩张的模式还是像新加坡这样土地有限的城市国家?

超高密度

当城市以惊人的速度扩张时, 限制因素并不是土地, 而是城市设施在经济和环境意义上的低效使城市扩张不可持续。在超高密度都市中, 如达士岭, 城市设计服务更多的人, 因此为更多人所分享, 人均能源消耗也就低得多, 城市更具可持续发展性。

那么, 超高密度都市里的生活是什么样的呢?

达士岭坐落在新加坡中心商业区(CBD)的边缘, 10分钟步行距离内有上百家咖啡店、餐馆和商店, 居民步行到两个交通中转站也只有300米远, 酒店和办公室只稍远一点。此外还有一个带形公园把小区和贯通全岛的公园系统连在一起, 今后的目标是连接全岛公园的全步行系统。在小区内部有三个不同高度的公园系统, 最低的在地面层, 其余两层天桥分别在第二十六层和低五十层(见图2), 这些公共空间成为居住单元的延伸。

地面层的公园实际是建在人工平面上, 其下面是三层地下停车和服务设施。地面层平面要容纳很多内容, 因此需要有效地组织各种服务设施以及地段内外的交通流线, 同时保证居民在公共空间里的安全, 抬高的新地面层与城市地面完美衔接, 同时在公共空间和私人空间之间有明显的过度。(见图3)

儿童游戏场、幼儿园、托儿所和放学后托儿设施、美食广场、便利店和牙科诊所都为居民家庭提供了必要的支持, 社区中心还有一个很大的运动馆, 频繁组织社交、运动和教育活动, 社区中心



Figure 3. Raised new ground: stitching seamlessly to the city ground plane while providing a distinct threshold for a transition from the public to private realm. (Source: ARC Studio Architecture + Urbanism)
图3. 抬高的新地面层: 与城市地面完美衔接同时在公共空间和私人空间之间有明显的过度。(出自: ARC Studio Architecture + Urbanism)

carpark and building services in a new architectural hill. The ground is a highly contested surface. It needs to efficiently organize services and the traffic flow in and around the site while allowing a safe and defensible public space for the residents. The raised new ground stitches seamlessly to the city ground plane while providing a distinct threshold for a transition from the public to the private realm (see Figure 3).

Playgrounds, pre-schools, childcare and after school care, a food court, a convenience store and a dentist provide support for the families living there. A community center with a large sports hall and a full calendar of social, recreational and educational programs is connected to the raised new ground via a short bridge. A new primary school lies across the road. Every facility is literally at your feet. At superdensity, residents rely on the community at its doorstep. Within a 10 minute walk, there are hundreds of cafes, restaurants, markets, school, temples, churches, parks, cinemas, malls. Within a fraction of an hour, one is able to reach the airport by mass rapid transit and be connected to the rest of the world.

Sky Gardens

The scale of the project and the large number of units allow residents to share the ownership of new and unusual facilities and amenities. Every resident in the Pinnacle@Duxton has access to an 800m running track on the 26th storey sky garden dotted with pocket gardens and playgrounds (see Figure 4). And when they yearn for the feeling of space, a walk on the 50th storey sky garden is like a stroll on a mountain path with distant views of city lights and the sea and on clear days the Indonesian Riau Islands (see Figure 5). As the buildings became taller and more vertical, the sky garden provides horizontal connections that are strips of land reclaimed from the air (see Figure 6).

These sky bridges that connect the seven blocks create a distinct silhouette for the project, forming urban windows that allow the city to be viewed from different perspectives. Functionally, the sky bridges allow for more efficient sharing of services like water tanks and the façade maintenance unit. It is also an area of refuge in emergencies allowing greater possibilities of escape paths and safe zones.

The sky gardens of the Pinnacle@Duxton open the window to a new future for high-rise buildings. As buildings become more vertical they will also possibly be more connected horizontally. The sky gardens suggest the possibility of networks at multiple levels with sky streets and new programs. Instead of free standing monoliths, the skyscrapers of the future could possibly form three-dimensional networks where private and public programs inter-act and inter-twine. Superdensity urbanism becomes a layered and complex matrix of connections.

Human Spaces

Superdensity's challenge lies in addressing density and congestion. Its compact nature allows for highly integrated and efficient infrastructure and yet this very quality creates the greatest challenge for the living environment. While residents want speed and efficiency, they also value slowness and aimlessness. While they want to be connected, they also cherish privacy, isolation and tranquility. The critical factor in the sustainability of superdensity urbanism lies in how the social and environmental factors are addressed in relation to human habitation. The design of the built environment at this density needs to resolve such issues while inspiring new imaginative alternatives to the space and individuality of sprawling urbanism.

At the Pinnacle@Duxton, the blocks are oriented to achieve maximum distant views from every unit while minimizing solar heat exposure.

通过一个短桥与抬高的地面层连接，马路对面就是一所新建的小学，所有服务设计都近在咫尺。超过密度情况下，居民生活依赖的就是这些近在门前的社区服务，10分钟步行距离之内有上百家咖啡店、饭馆、市场、学校、寺庙、教堂、公园、电影院和购物中心，乘坐捷运交通1小时内就能到达机场，再转道世界各地。

空中花园

达士岭庞大的规模和住户数量使居民有可能分享全新而独特的服务与娱乐设施的所有权，每个居民都能使用位于二十六层的800米跑道，跑道两侧的小花园和儿童游戏场（见图4）。如果你向往更广阔的空间，走在第五十层空中花园中，就仿佛行走在大道上，远处城市的灯火和海景尽收眼底，天气晴朗时能一直看到印度尼西亚的Riau岛（见图5）。建筑越高越给人壁立的感觉，空中花园提供了横向的联系，也是从空中争取来的一片土地（见图6）。

连接七个体块的天桥给予达士岭独特的轮廓线，为从不同的视角体验城市提供了独特的窗口，在功能上，天桥为建筑水箱和外墙维护提供了方便，同时也是建筑的紧急出口的避难区和逃生通道。

达士岭的空中花园为高层建筑开启了一扇通向未来的窗口，随着建筑纵向高度的不断提升，建筑的也需要更多的横向联系，空中花园启示着未来建筑可以在多个不同高度上通过空中街道和其它内容连成网络，未来的建筑不再是一个个独立的巨柱，未来的摩天楼是一个空中的三维网络，私人 and 公共部分交织互动。超高密度的都市就是这种多层次复杂排列的连接体。



Figure 4. 26th Storey Sky Garden: Running track dotted with pocket gardens and playgrounds. (Source: ARC Studio Architecture + Urbanism)

图4. 26层空中花园：小花园和游戏场点缀的跑道。（出自：ARC Studio Architecture + Urbanism）



Figure 5. 50th Storey Sky Garden: a vast, continuous space where people encounter views of the city and the distant horizon. (Source: ARC Studio Architecture + Urbanism)

图5. 50层空中花园：一个巨大的连续空间，在这里人们可以观赏城市景观和登高远眺。（出自：ARC Studio Architecture + Urbanism）



Figure 6. Reclaimed land: the sky bridges are strips of land in the air that provide connections, a refuge area for fire safety and a powerful architectural identity. (Source: ARC Studio Architecture + Urbanism)

图6. 重新得到的土地：天桥是一条架在空中的土地，它是建筑间的连接，是防火逃生的避难区，还是强有力的建筑特征。（出自：ARC Studio Architecture + Urbanism）

All units maximize daylight penetration and natural ventilation. The borrowed space of distant views expands the interior spaces and give a sense of vastness within the units. It is important that while the density is extremely high, residents should feel that their living spaces are spacious and uncluttered. Each lift core serves six units per floor, small enough for the formation of a small cluster and for friendship to blossom. The massing and façade is intentionally designed to reduce the perceived mass of the building by emphasizing its verticality. Leveraging on the high degree of repetition, the façade system produces a highly differentiated building envelope from the undifferentiated pre-fabricated concrete construction from a small number of modules (see Figure 7).

The Pinnacle@Duxton has been in operation for a little more than 2 years. A deeper observation over a longer period would shed light on how people respond to living up in the air at this density. How compact can our urban habitation be? How much more compact can we live while maintaining a sense of individuality and privacy? What are the energy consumption and energy input for the life cycle maintenance? How does superdensity affect social development?

1000 Singapores – a model of the compact city houses the world's population in 0.5% of its land area. This would include reservoirs, military facilities, airports, roads and industry. At a similar density as Singapore, the housing component would occupy 0.15% of the world's land area. At superdensity, similar to the Pinnacle@Duxton, all of the world's population can be housed in only 23,800 sq km – 0.017% of the world's land area. This is almost negligible.

Human footprint on Earth therefore becomes negligible.

How sustainable is that?



Figure 7. Pre-fabricated facade: the pattern structure reduces the perceived mass of the building. (Source: ARC Studio Architecture + Urbanism)

图7. 预制外墙，带图案的结构减小了建筑的视觉体量。（出自：ARC Studio Architecture + Urbanism）

人的空间

超高密度都市的挑战在于解决密度和堵塞的问题。高密度使城市设施高度交叉而有效率，但同时也对生活环境的质量提出挑战，居民追求快速和高效的同时，也希望享受慢速和悠闲，在追求互相联络的同时也希望能有私密、独处和安静的时刻。超高密度都市的理念能持续发展的关键因素在于解决人类聚居生活与社会和环境因素的关系，这种高密度的人工环境设计不仅要解决上述问题，同时也是对于分散扩张的都市设计在空间和人的个性和发面提出全新的、完全不同的理念。

在达士岭的设计中，每栋楼的角度都考虑到使每个单元的得到最小的视线遮挡和最大的遮荫，减少太阳的热辐射，所有单元都做到最大程度利于自然日光和自然通风，窗外景色‘借景’到室内，扩展了室内空间的视觉尺度，这种视觉上的宽阔感和通畅感对于高密度的住宅区尤为重要。每部电梯每层服务六个单元，形成一个小便于社交的邻里组合，在建筑体量和外墙设计上强调了垂直感使建筑不显得太厚重，虽然外墙使用的是样子千篇一律的预制混凝土结构，而且用的模数也很少，通过重复和组合，还是使七栋建筑的外墙系统个性鲜明（见图7）。

达士岭已经投入运行两年多了，更长时间、更深入的观察会揭示出人们对这种密度下在高空中生活的反应，我们的城市生活可以被压缩到什么程度？什么样的城市密度就会突破维持人的个性和隐私的底线？什么是维持生命循环的能量消耗和输入？超级密度的都市对社会发展有什么样的影响？

1000个新加坡——仅用地球面积的0.5%就能解决全球人口的住房问题的高密度都市模式，这里还包括了水库、军事设施、机场、道路及工业建筑。按新加坡的密度，住宅部分将占0.15%的地球土地面积，按达士岭的密度，容纳全世界人口的住宅只需23800平方公里，即0.017%的地球土地面积，这基本上就小到可以忽略不计了。

人类在地球上的足迹就可以忽略不计了。

还有比这个更具可持续发展性吗？