

Southern Taiwan Science Park's Policy for Sustainable Eco-Science Park

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ARSTRACT

To construct Southern Taiwan Science Park into a leading sustainable eco-science park in the world, the Southern Taiwan Science Park Administration(STSIPA) call the park enterprises, such as Delta Electronics Inc. and TSMC 14 FAB (awarded as USGBC. LEED Gold-rating Green Building) to construct a sustainable science park, in accordance with the aforementioned promotion program.

STSIPA is implementing several projects now , such as “The Whole Planning for Sustainable Eco-science Park, “ “Study and Design of the Green Building Indicators for the Southern Taiwan Science Park's Plants, “ and “ Green Building Promotion Program.” . And the workshops and visits will be arranged by April, 2009, a related seminar in June, 2009 and completion of all result in November 2009. It is expected that the Southern Taiwan Science Park will gradually become the model for eco-science parks in the sub-tropical climate. And STSIPA could get the USGBC. LEED-ND.

KEYWORDS :

Ecological science park , sustainable environment , Green Building indicators

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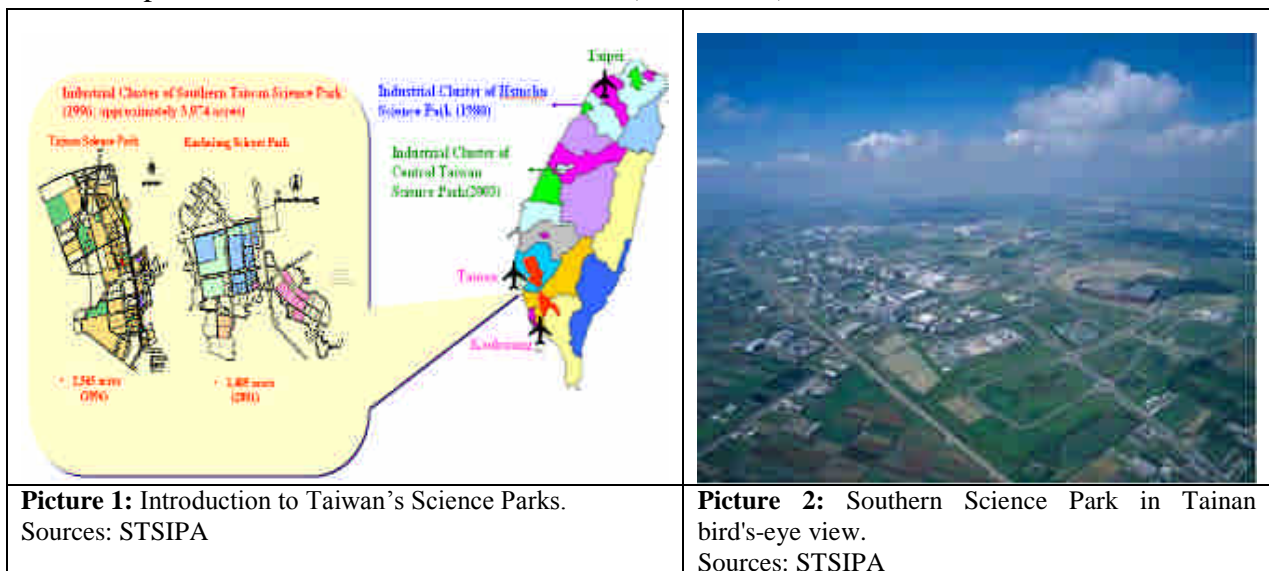
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1. INTRODUCTION

Taiwan's science parks are a drive for economical development and are devoted to the development of high-value added and innovative technologies. Hsinchu and Central Taiwan Science Park, both with the temperate climate, and Southern Taiwan Science Park, with the subtropical climate, comprise the land of about 4,000 hectares and are expected to reach the turnover of 3 trillion dollars by 2011. As a result of the success of Taiwan Science Park in Hsinchu, the Executive Yuan of Taiwan addressed "the installation of Southern Taiwan Science Park" in 1991. National Science Council followed orders from the Executive Yuan to set "Southern Taiwan Science Park" in Feb. 1995, set the "development the preparatory office in Southern Taiwan Science Park" carries on the investment introduction responsibly, handles the Science Park's scheme and the development transport business and so on in 1997. Later, tenant demands spilled into unceasingly, 80% of the land that supply to put up factories had been hired, and to elevate status to establishment "Southern Taiwan Science Park Administrative Bureau" in 25th Jan. 2003.

Southern Taiwan Science Park is including Tainan Park and Kaohsiung Park, the development period regulation is from 1996 to 2010, the total funds are 8.3517 billion dollars, comprise the land of about 1,608 hectares, including the land about 1,038 hectares in Tainan Science Park that provided 527 hectares Industrial land, the land about 570 hectares in Kaohsiung Science Park that provided 207 hectares Industrial land (Picture 1,2)



In 2008, manufacturers introduction present situation are 243 (Picture 3), Foreign Tenant Companies at the Park: 15 Japanese Companies, 6 American Companies, and 1 German Company ; Major foreign companies include Corning, 3M, APPLIED MATERIALS, SAFC Hitech Taiwan, SUMIKA, Finex, International Nitto, NEC Lighting, Intelligent Research (Chisso), ULVAC, Yaskawa, and Busch in the park.

Working population are more than 55 thousand workers. (Picture 4) , More job

opportunities are created upon the establishment of the Southern Taiwan Science Park. Approximately 70% of the employees are from the Southern Taiwan. Based on Taiwan's experiences to develop science parks, a full-time job opportunity provided in the science park brings three more jobs in the nearby area. Annual production value is more than 550 billion dollars. (Picture 5) ◦

<p>Picture 3: Cumulative Number of Approved Companies by Year Sources: STSIPA</p>	<p>Picture 4: Growth Trend of Workforce Sources: STSIPA</p>	<p>Picture 5: Growth Trend of Turnover Sources: STSIPA</p>

And Green Energy Technology and Energy Saving Industry, Make the best use of the advantages of the STSP's optoelectronics, IC and precision processing equipment industries. Develop solar cells, fuel cells, and LED lighting. 5 new tenant enterprises were approved in 2007, investing US\$270.4 million (71.5% of total investments), (Picture 6, 7) ◦

	<table border="1"> <tr> <th colspan="3">Green Energy Technology and Energy Saving Industry</th> </tr> <tr> <th colspan="3">Solar Cells</th> </tr> <tr> <td colspan="3">MOTEC, Kenroc Photovoltaic Co., Ltd., Tao-photovoltaic Technology, Gloria Solar, Ausia Solar Co., Ltd., ArmaTek, Solar Energy Co., Ltd. Chi Mei Energy Corporation</td> </tr> <tr> <th>Solar Systems and Relevant Materials and Key Components</th> <th>LED</th> <th>Fuel Cell</th> </tr> <tr> <td>King Euratech System Corp., MPI Probe Inc., Tainan Polysilicon, Delta</td> <td>EPICSTAR, Formosa Epitaxy, Genesis Photonics, Epilux Corp., EPLEDs</td> <td>Boyan</td> </tr> </table>	Green Energy Technology and Energy Saving Industry			Solar Cells			MOTEC, Kenroc Photovoltaic Co., Ltd., Tao-photovoltaic Technology, Gloria Solar, Ausia Solar Co., Ltd., ArmaTek, Solar Energy Co., Ltd. Chi Mei Energy Corporation			Solar Systems and Relevant Materials and Key Components	LED	Fuel Cell	King Euratech System Corp., MPI Probe Inc., Tainan Polysilicon, Delta	EPICSTAR, Formosa Epitaxy, Genesis Photonics, Epilux Corp., EPLEDs	Boyan
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<p>Picture 6: Green Energy Technology and Energy Saving Industry Sources: STSIPA</p>	<p>Picture 7: Industrial Clusters Sources: STSIPA</p>															

Southern Taiwan Science Park in Tainan has finished the main roads system and public facilities. The factory owners have built and carried on business the factories. The buildings in STSP are gathered in Nanke North Road to Nanke South Road 50 meters, the position is by the side of a boulevard. In construction, at first the factories and the officers had been built, they were transferred to promote to build the way of quality life. To go through of the earlier days of the dormitories and the building built, to near future of the Southern Taiwan Science Park in Tainan started using the centers of the communities, healthy centers, commercial service buildings and restaurants. Southern Taiwan Science Park in Kaohsiung is followed by the model in Tainan, continued to drive public constructions and attract commercial dealings.

The park appeals ecology, landscape that is emphasized by the quality of living. Not only function ecology recovery and to emphasize environmental protection, but also expected to

combine the shape of the communities. According to the way the city design to purchase production, ecology and life three purpose in the perfect environment.

2. Taiwan and STSIPA Green Building policy

2.1 Eco-City and Green Building impetus plan

Taiwan is the 4th country to enforce the evaluated certification of Green Building, and the 1st country in 3 parts: bring Green Building into public buildings, rebuild the old official buildings by government, regulate Green Building rules in construction legislation in the world. The Executive Yuan of Taiwan approved “Eco-City and Green Building impetus plan” in 12th Jan. 2008 and the general objective is to response the the global warming and urban heat island effects, impels the ecology city and Green Building positively to reduce urban heat island effects and to reach the goal of the national territory continues forever to construct. Inferior goals are included (1) handles can the area or the traditional block continues forever the environment transformation and lower urban heat island effects (2) promote and publicize the ecology cities, blocks and the concept of Green Building, and offer the prize and the subsidy to help those in need (3) to heave the skills of interior environment and establish the establishment mechanism that creates comfortable healthy and the high quality habitable area (4) Strengthens the construction to save the energy, carries out the greenhouse gas decrement (5) reward groundbreaking Green Building design and also has the building Green Building improvement in order to broaden ecological environment benefits.

The expectation carries out by the surface level to an level from city, community, building body, indoor quality combine” continues forever to develop the circulation system” and correspond with the Executive Yuan prompts “the impetus ecology community city to continue forever” the direction, complies with “the international tendency” and “acts as circumstances permit” the demands ; estimated that in 2011 this plan handles completes , every year may reduce the CO2 withdrawal 270,000 tons.

2.2 STSIPA’s goal

STSIPA in order to construct the Southern Taiwan Science Park to become the leading world to continue forever the healthy ecology science and technical park, coordination the Executive Yuan’s policy of “ecology city Green Building impetus plan” above, handles “the green Building impetus plan, “continues forever the healthy ecological science park corporate planning” and “the workshop green building appraisal target draws up in Southern Taiwan Science Park” in 2009. The statements as follow:

2.1.1 Green Building impetus plan

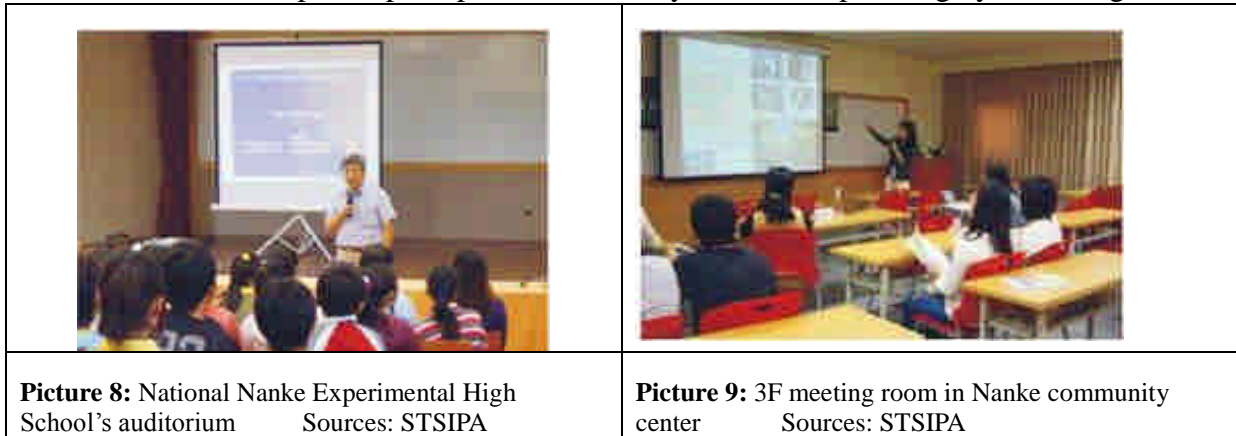
In coordination with Ministry of Interior” strengthens the green construction impetus plan” , entrusts Republic of China Construction Academic society , holds the Green building guidance conference , the subject subscribes is “continues forever LOHAS Green Science Park” , Southern Taiwan Science Park in Tainan in Mar. , aims at the International Experiment Middle School teachers and students, the community residents and the campus manufacturer separately and is related the entrepreneur to hold three Green Building guidance meeting , Southern Taiwan Science Park in Kaohsiung in Apr. The standard workshop conducts the Green Building guidance to meet and to handle the campus and the domestic fine green Building case visit, Summarizes as follows:

2.1.1.1 16th Mar. the lecture of the continues forever of the campus (Picture 8)

In view of National Nanke International Experimental High School teachers and students that invited Chia Nan University of Pharmacy & Science Department of Environmental Engineering and Science Professor Shu Jen Ching , continues sustainable campus idea to discuss the issue of” The 21st century high quality campus new viewpoint - Sustainable Health LOHAS “ , and to realize that although understands the school building is the teachers and students moves the time long place , the important attribute which in the school building the ideal campus is actually for moves the teachers and students who felt comfortably. Including vision, sense of hearing, sense of smell, sense of touch and so on. The proper green space may give the student the health the visual environment : the careful generatrix plan and hedgerow sound-insulated design can reduces the student from the noise disturbance. If the campus base can be helpful each kind to the teachers and students in the school life project, with plans attentively carefully in the limited space, then the campus then can be long-time , that is the goal of the continues forever the campus.

2.1.1.2 17th Mar. the conference of” continues forever the community to build” (Picture 9)



To the community residents in Nanke community center that invited National Pingtung Institute of Commerce Professor Kuei Feng Chang to discuss in “the sustainable community” concept and Eco-village: the case of ecology in the suburbs, and “the construction evolves again, community reactivation ”and take the Da Kuang community and Shui Chung community in Heng Chun country for example. May take Taiwan in the future the rural area development perhaps the community restoration profiting by observing others



2.1.1.3“Sustainable LOHAS . Green Science Park” Southern Taiwan Science Park in Tainan, Green Building guidance meeting on 24th Mar. (Picture10 、 11) .

In view of the scientific and technical park manufacturers and the related jobholders, the administrative bureau guidance “Sustainable LOHAS ,Green Science Park” Green Building idea in STSIPA. Administrative bureau chief Chun Wei Chen declared to the world that Southern Taiwan Science Park is Carrying out Green Science Park’s determination and estimate that to get USGBC LEED-ND (LEED for Neighborhood Development Rating System) Authentication in two years.

This time we invited Professor Hsien Te Lin, Department of Architecture, NCKU, Professor Fang Ming Lin, Department of Wood Science and Design, NPUST and TSMC LEED Team Chiang Tse Chen and the exterior team that provide the campus manufacturer to understand that current continues forever the health Green Building tendency, forecast of the green construction of operation practice and the Green Science Park. And branch factory F14P3 (obtains American LEED gold level Green Building authentication and Taiwan EEWH on this company diamond level green construction marker) to share the green construction management and the managerial experience.

	
<p>Picture 10: South Science Park Administrative Bureau chief Jun Wei Chen delivered a speech Sources: STSIPA</p>	<p>Picture 11: attending distinguished guests all group photo Sources: STSIPA</p>

2.1.1.4 " Sustainable LOHAS . Green Park" the promotion of Green Building in Kaohsiung Science Park, Southern Taiwan, 3 April.







To further discuss the issue of Sustainable LOHAS: Green Park, we invited professor Shian De, Lin from Department of Architecture of National Cheng Kung University and Green Building investigator s from Taiwan Architecture Building Center to introduce the prospection of green factories in Taiwan, model cases of Green Building in the world, an introduction to and application procedures for Taiwan's EEWH and the issues of BIPV' s development t and application. The meeting was expected to provide the companies in Parks with the understanding of present Sustainable Green Building tendency and policy.

2.1.1.5 visits to Parks' and domestic model green buildings

Except for the briefing in writing at the promotional meeting, companies were able to visit model green buildings in the Park to understand the design of green buildings. Location in the morning: TSMC 14 FAB Building P3 (awarded as U.S.A. LEED Gold-rating Green Building, Taiwan Diamond-rating Green Building) (as in picture 11, 12) and Delta Electronics Inc. (awarded as Taiwan Gold-rating Green Building) (as in picture 13). Due to the completion of the bicycle lane at Tainan Science Park, Southern Taiwan, bicycles were used as shuttle buses to get to green buildings.

Take shuttle buses to the Main Stadium for The World Games 2009 in Kaohsiung (awarded



as Taiwan Gold-rating Green Building). The main stadium is to be inaugurated in May for the purpose of World University Games and to become a very important visit site for Green Building in Taiwan.

	
<p>Picture 11: TSMC 14 FAB Building P3 Sources: STSIPA</p>	<p>Picture 12: visiting TSMC 14 FAB Building P3 Sources: TSMC</p>
	
<p>Picture 13: Delta Electronics Inc factories Sources: STSIPA</p>	<p>Picture14: visiting bicycle route Sources: STSIPA</p>
	
<p>Picture 15: green buildings in the Park to be visited Sources: STSIPA</p>	<p>Picture 16: the Main Stadium for The World Games 2009 in Kaohsiung Sources: STSIPA</p>

2.1.1.6 The Park Guide Map of Green Buildings and Construction of Official Site for the Plan

The Executive Yuan of Taiwan stipulates that if the capital of a public construction is more than fifty million dollars, the company should obtain the certificate of Green Building before the construction begins and acquire Green Building Logo after the completion of the construction. In then Southern Taiwan Science Park, TSMC has obtained Taiwan Diamond-rating Green Building Logo (awarded as U.S.A. LEED Gold-rating Green Building), Delta Electronics has obtained Gold-rating Green Building Logo and Kaiser Pharmaceutical

CO., LTD. has obtained Silver-rating Green Building Logo. Hence the Park will make the Park guide map of green buildings and try to connect every model case of the green building with green transportation- bicycle lane.

	
<p>Picture 17: the Park guide map of green buildings Sources: STSIPA</p>	<p>Picture18: Bicycle lane in the Park Sources: STSIPA</p>

2.2 The Whole Planning for Sustainable Eco-science Park, Study and Design of the Green Building Indicators for the Southern Taiwan Science Park's Plants and so on

The STSIPA's routine promotion of Green Building is to examine whether the company follows the green-building-related regulations. In 2007 the sixth floor of the administration building became the model center for IAQ in Southern Taiwan. The building is able to oversee the concentration of CO₂ and provide fresh air properly to maintain the quality of indoor air. Also, in 2009 STSIPA administration received a 3,500,000-dollar grant from Architecture and Building Research Institute, Ministry of the Interior. The grant-in-aid is to improve related air-conditioners and facilities.

Except for the above-mentioned programs, in order to achieve the goal of becoming the best green science park in the world, in 2009 STSIPA asked experts to make two plans; the Whole Planning for Sustainable Eco-science Park and Study and Design of the Green Building Indicators for the Southern Taiwan Science Park's Plants.

The Whole Planning for Sustainable Eco-science Park, the criteria for park planning and the comprehensive survey in the future, is to plan parks and cities in accordance with the requirements of the evaluation for Eco-city, such as the whole transportation in the Park, renewable energy and the use of land. And Study and Design of the Green Building Indicators for the Southern Taiwan Science Park's Plants is in relation to the detailed design for the construction of plants and construction levels. The construction of plants should meet the requirements of the evaluation, such as energy saving (including water and electricity) and indoor environment quality. And the Study and Design of the Green Building Indicators for Science Park's Plants are to be made according to Taiwan's subtropical climate to be the basis for the design of future cities and the building evaluation. STSIPA will combine Park

companies that have obtained the certificate of Green Building to construct a sustainable science park, in accordance with the aforementioned promotion program.


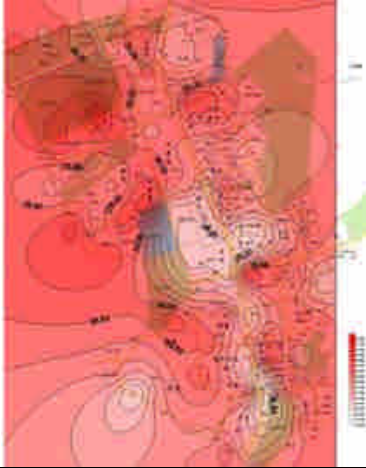

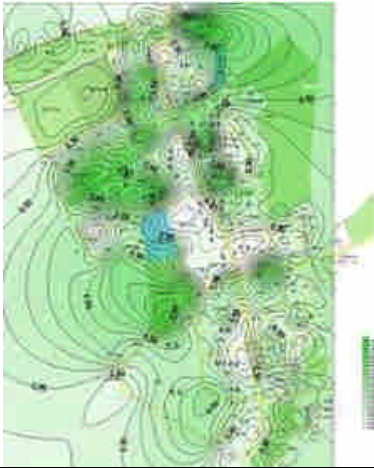
April's progress: the project referred to information from the weather station in the Southern Taiwan and surveyed the Park's physical environment. The buildings in the Park spread from the North to the South, with the spread of land and farms in the East and the West. The area has a low density of buildings. With proper planning, it's likely to effectively control the climate in this area and reduce the effect on nearby area. Heat-absorbing plants built because of the requirement cause this effect. The test result is analyzed below:

Analysis of the test result of the Park, daytime:

Daytime temperature: Chi Mei (plant land 4), HannStar, EPiSTAR(plant land 7), CTimes (plant land 10), Kenmos (plant land 24), the Taiwan Power substation and so on with high temperature; the plants in plant land 12 and 9 with lower temperature. It's speculated that the two plants' low temperature is due to the two wide wooded area in the West. And the relatively high temperature in those areas is caused by the developing parks' lack of vegetation. (As in picture 20)

Daytime humidity: It's about 40~55 %, which is generally low. The outdoor staff feels comfortable. Plant land 1 with water a treatment pool and plant land 12 with a park in the West are in the higher-humidity area. Humidity in areas with plants is within average range and that of areas with roads is higher. It's thus clear that the distribution of water areas has a clear influence on nearby environment. The Park has sufficient sunshine; hence the highest of outdoor humidity in the daytime is around 60%, within the range that human body can feel comfortable. (As in picture 21)

Daytime wind velocity: commercial land 2, plant land 4, plant land 7, plant land 34, plant land 33, South part of public utility land 15, public utility land 20 and so on with higher wind velocity of 0.8~1.1m/s and the daytime average wind velocity in other areas in the Park is 0.5m/s. It's speculated that the Park's surroundings are gradual and has wide distribution of farms and water pools. Consequently, in the seasons with less effect of the monsoon, the temperature gradient in this area is not obvious; hence higher wind velocity won't happen. In terms of outdoor environment, the wind velocity in the Park won't have too much influence on the outdoor staff. (As in picture 22)





	
<p>Picture 19: aerial photos of the Park and the numbers of measure points Sources: STSIPA</p>	<p>Picture 20: the contour line for daytime temperature Sources: STSIPA</p>
	
<p>Picture 21: the contour line for daytime humidity Sources: STSIPA</p>	<p>Picture 22: the contour line for daytime wind velocity Sources: STSIPA</p>

Analysis of the test result of the nighttime Park:

Nighttime temperature: Picture 23 shows that nighttime temperature is between 15°C~24°C. In this area, the temperature difference between daytime and nighttime is up to 8°C. The possible reason is that the Southern Taiwan Science Park is mainly surrounded by farms and water pools. As a result, nighttime temperature drops faster. TSMC, plant land 33, plant land 34, ChopMOS, Chi Mei, plant land 9、plant land 12、environmental protection facility land2、public utility land 5、public utility land 15、水6、public utility land 29 are surrounded by water pools and wooded land and the temperature drop obviously. In public utility land 13、plant land 25、plant land 24、institution land 2、plant land 23、plant land 21、plant land 20、plant land 26, the temperature is obvious lower as a result of the connection of wooded area. Temperature in plant land 2、plant land 1、plant land 4、plant land 5、environmental protection facility land 1、transformer substation land 1 is clearly higher as a result of urban heat island effect. (As in Picture 23)

Nighttime humidity: This picture shows that nighttime humidity is between 65%~95%. The actual daytime and nighttime test shows that nighttime humidity is clearly higher. Nighttime humidity in the whole area is over 80%, which means that the number of surrounding water pools and farms affects the change of humidity in the Southern Taiwan Science Park. Humidity in plant land 3、plant land 34、public utility land 6 is relatively higher because of water pools. Humidity in green land 26 is relatively lower and humidity in the Park is obviously high in the nighttime without sunshine.

This picture indicates the wind velocity range is between 0m/s~0.5m/s. Obviously, the wind velocity in the nighttime is slower and weaker than in the daytime. The possible reason is that the stronger daytime convection causes higher wind velocity. On the other hand, the weaker nighttime convection weakens wind velocity. All in all, in the nighttime the Park hardly has wind velocity, except in , plant land 35 which is resulted from temperature gradient. (As in Picture 25)

	
<p>Picture 23: the contour line for nighttime temperature Sources: STSIPA</p>	<p>Picture 24: the contour line for nighttime humidity Sources: STSIPA</p>
	
<p>Picture 25: the contour line for nighttime wind velocity Sources: STSIPA</p>	<p>Picture 26: the Park guide map of the linking system between small scale service roads and bicycles Sources: STSIPA</p>

Study and Design of bicycle lanes and mass transportation system: the principles of the Ministry of Transportation and Communications are energy saving and the increase in safety efficiency, short-distance transportation and human and eco-system-oriented transportation. (As in Picture 26)

Future goal: the plan is in progress, the Southern Taiwan Science Park is now aimed at sustainable health and energy saving and carbon reduction. The short-term goal is to finish the Whole Planning for Sustainable Eco-science Park and Study and Design of the Green Building Indicators for the Southern Taiwan Science Park's Plants as the planning criteria for future parks, the comprehensive survey, city design and the building evaluation. The medium-range goal is to obtain Green Park Logo in Taiwan and to learn from TSMC's experience of acquiring USGBC LEED for Neighborhood Development Rating System. The final goal is to improve every aspect of the Southern Taiwan Science Park, making it the model eco-city and the sustainable leading science park in the world