

Green park, Sustainable Development

● E.1 Green action

E.1.1 Risk management and adaptation to climate change

■ TCFD risk assessment on sustainable development

Following the increasing threats global climate change, every corporate and organization will be facing physical risks such as floods, hurricanes and earthquakes from extreme weather, as well as transformational risk such as regulations, policies and market demands to overcome climate change.

In order to facilitate corporates in adapting to climate change, Task Force on Climate-Related Financial Disclosure (TCFD) published by Financial Stability Board (FSB) provides a more comprehensive disclosure model to identify risks and opportunities of climate change while linking them to financial impacts. HSPB discloses climate related financial impacts through TCFD to assess the risks and opportunities, in order to enhance the organization's resilience and promote communication with stakeholders.

With reference to TCFD and through risk and opportunity identification meeting, HSPB together with ESG editorial board evaluated based on transformational risks (policy and regulation, technology, market, reputation), physical risks (immediate, long-term) and opportunities (resources efficiency, energy resources, products/services, markets, resilience) as listed in TCFD, and discussed on relevant strategies. The final results were submitted to Director-General for review and approval.

HSPB reference framework of climate-related financial disclosure

Governance

HSPB Environmental Protection and Safety Division, as the management unit of climate-related financial impacts, regularly reviews the potential risks of main operations and revises the potential risk identification table as well as risks distribution, which are then compiled and submitted for verification.

Strategy

After discussion with relevant units and evaluation of impacts of climate-related risks and opportunities on operation/strategy/finance planning, HSPB identified 9 transformational risks and 5 physical risks. The major climate-related transformational risks are legal advocacy and market while disasters and property damage caused by climate change are the main physical risks.

In view of risk of water supply in the park, HSPB carries out several water conservation and control measures, and regularly conducts meetings with water resources-related agencies, in order to gather information and ensure stable water supply. The relevant control measures are as below:

- a) Total water consumption control: Audit manufacturers' water consumption plans based on approved volume by Water Resources Agency (WRA), MOEA, to ensure good control over total usage in park.
- b) Increase water reclamation rate: Conducted counselling on water conservation since year 2022, with potential water saving up to 597,000 metric tons in 2021-2022.
- c) Striving for installation of specialized pipelines for stable water supply.
 - I. Jhunan and Tongluo science parks: Water supply through specialized pipelines from Liyutan Reservoir, expected to be completed in 2024.
 - II. Hsinchu Science Park: Water supply of HSP is supported by Shihmen Dam.
 - A. Fresh water pipe: The 225,000-metric tons water supply pipeline to backup Hsinchu area has been completed and launched on February 1, 2021.
 - B. Raw water pipe: The raw water communication pipe between Baoshan Second Reservoir and Shihmen Dam can supply 300,000 metric tons of water to Hsinchu area per day, in which completion is expected in 2026.
- d) Progressive introduction of reclaimed water
 - I. Tongluo Science Park: Install water reclamation system, with a maximum daily total reclaimed water supply of 3,600 metric tons.
 - II. Hsinchu Science Park (Baoshan Phase II): Baoshan Phase II expansion plans to build its own 30,000 metric-ton reclaimed water plant, and coordinates with Water Resources Agency (WRA), Construction and Planning Agency Ministry of Interior (CPAMI) and county and city governments to import 67,000 metric tons reclaimed water. It is expected to achieve 100% of reclaimed water usage at Baoshan Phase II in 2030.

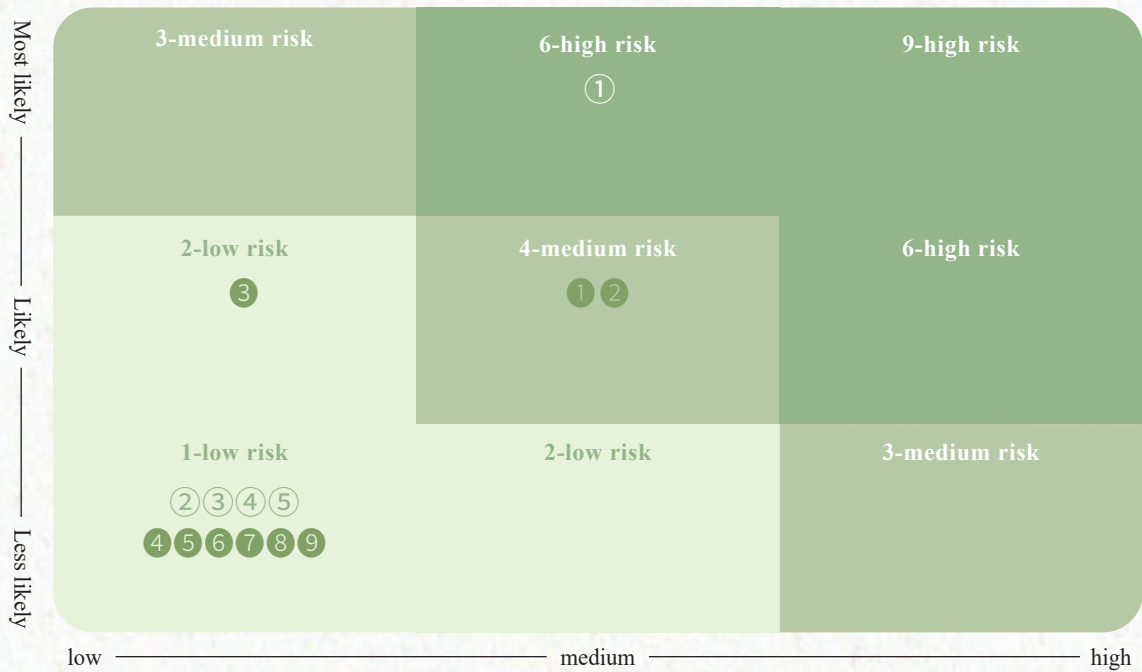
In order to enhance adaptation and mitigation to climate change, the implementation of strategies include:

- a) Integrate smart disaster prevention to increase disaster response capabilities and resilience.
- b) Establish "Emergency Response and Joint Defense Organization" and emergency response workflow to build up the disaster response and joint defense capabilities among manufacturers.
- c) Guide manufacturers in power saving and reducing carbon and GHG emission.
- d) Encourage installation of renewable energy resources.
- e) Promote water reclamation and conservation measures in the park.
- f) Encourage practices of waste reduction and recycling.

Risk management	<p>With risk analysis framework of TCFD as evaluation basis, HSPB identifies potential risks and ranks their intensities according to risk matrix of “significance of impact” and “odds”, thus defining the significant risk source.</p> <p>If new risks are identified in the year, previous risk assessment, summary table and organization’s risk map should be revised as soon as possible and submitted to head of agency for approval.</p>
Targets and goals	<ul style="list-style-type: none"> ➤ Reclaimed water handling system can treat effluents from initial manufacturers; water supply from dual distribution system is applied for non-human contact purposes, including plant cooling, toilet flushing, cleaning and watering. ➤ Assists in GHG inspection and counselling on reducing emission (14 sessions counselling on power and 10 sessions counselling on water conservation) to improve manufacturers’ energy consumption efficiency and reduce GHG emission.

Climate-related risk matrix

low risk
medium risk
high risk



Transformational risks

- ① Higher carbon fee policy advocacy cost.
- ② Instructed to increase proportion of waste resources recycling.
- ③ Total emission of HSP is highly concerned by NGOs, affecting the manufacturers’ intention to station in.
- ④ Increased policy advocacy cost for fuel tax/energy tax charges
- ⑤ Total GHG emission is limited for part of HSP area, affecting corporates to station in.
- ⑥ Most of the manufacturers are mandated to declare GHG emission.
- ⑦ Government sectors are required to achieve certain capacity of renewable energy resources installation.
- ⑧ HSP is required to join Renewable Energy 100 (RE100).
- ⑨ Inbound corporates should meet the inspection on carbon intensity.

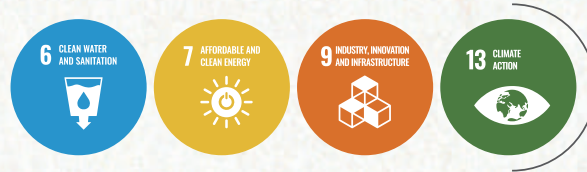
Physical risks

- ① Climate change causes unstable water supply in the park.
- ② Higher hurricane frequency and intensity compared to previous years increase risk of compound disasters, causing damage to park basic amenities.
- ③ Extremely high temperature during summer increases electricity consumption.
- ④ Increasing flood frequency and intensity causes damage to infrastructures and risk of work suspension.
- ⑤ Global warming causes sea level rise for 0.7-1 meter, causing damage to transport and basic amenities in the park.

Remark: ● as transformational risk, ○ as physical risk, number in the symbol as risk ranking.

E.1.2 Sustainable use of energy resources

Corresponding material topic: Net zero program › Energy resources management (including stable energy supply) › Environment quality › Adaptation to climate change



Policy/strategy

As the extreme weather caused by climate change has increased in severity, every industry is facing risk of power and water shortage. HSPB is committed to promoting circular economy and installation of renewable energy resources, while providing continuous guidance on power and water conservation to park manufacturers. HSPB also activates relevant contingency and electricity security inspection mechanisms to prevent interruption to production and improve overall energy efficiency. Besides, HSPB cooperates with other ministries and commissions in driving circular economy through green technology, guiding and encouraging manufacturers to develop power-saving low-carbon measures, together constructing a smart and environment-friendly science park, optimizing entrepreneurial and sustainable environment, as well as leading our industries to accelerate achievement of the goal of net zero carbon emission.

Targets and goals

Short-term goals

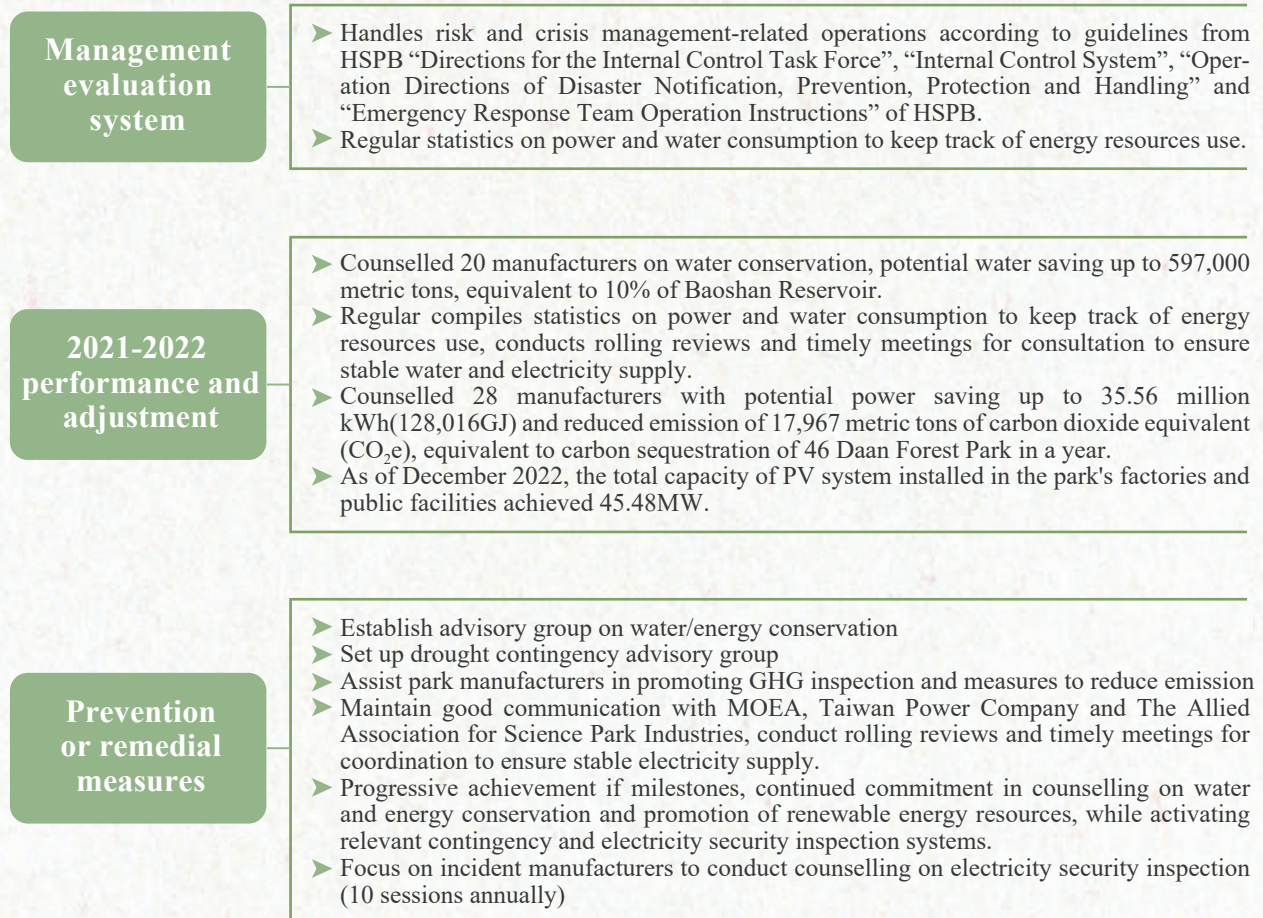
- ▶ Cumulative new PV installations up to 52.9MW in 2022-2023.
- ▶ Continue to guide park manufacturers on water and power conservation. Achieve the target water recycling rate of manufacturing process for each industry (e.g. 85% for semiconductor and optoelectronics)
- ▶ The reclaimed water treatment system can treat sewage from initial manufacturers; water from dual distribution system is used for non-human contact purposes, including plant cooling, toilet flushing, park cleaning and landscape watering.
- ▶ Assisted in GHG inspection and counselling on reducing emission (14 sessions counselling on power and 10 sessions counselling on water conservation) to improve manufacturers' energy consumption efficiency and reduce GHG emission.

Mid-term goals (3-5 years)

- ▶ Promote experience sharing and skills improvement, seek after optimization of water and power conservation. Further increase the water reclamation rate for every industry under rationalization of energy consumption efficiency.
- ▶ To work in conjunction with regional water reclamation development plan to promote the use of water resources.
- ▶ Achieve 64.3MW of total PV installation capacity for park manufacturers and public facilities.

Long-term goals (above 5 years)

- ▶ Implement the following measures to continuously increase proportion of PV installation:
 - ⇒ New manufacturers and new factory owners: In the land lease briefing, building permit pre-examination and electricity plan application, it is required to evaluate 50% of the available area of the roof to install PV system.
 - ⇒ Existing manufacturers: Establish "power saving advisory group" to actively guide manufacturers in implementing sustainable development, while focusing on potential manufacturers to enhance counselling, regular tracking and improve their intentions to install solar power system. Meanwhile, PV system advocacy, matchmaking and relevant meetings are also conducted to urge manufacturers with room for installation to actively assess solar power installation.
- ▶ Dedicated to effort in energy conservation and carbon reduction, promoting circular economy, establishing drought contingency plan and electricity security inspection systems, as well as encouraging installation of renewable energy resources.
- ▶ Assists in integrating inspections of water, power, gas supply and demand in the park to prevent imbalances.
- ▶ Semi-annually supply and demand platform meeting



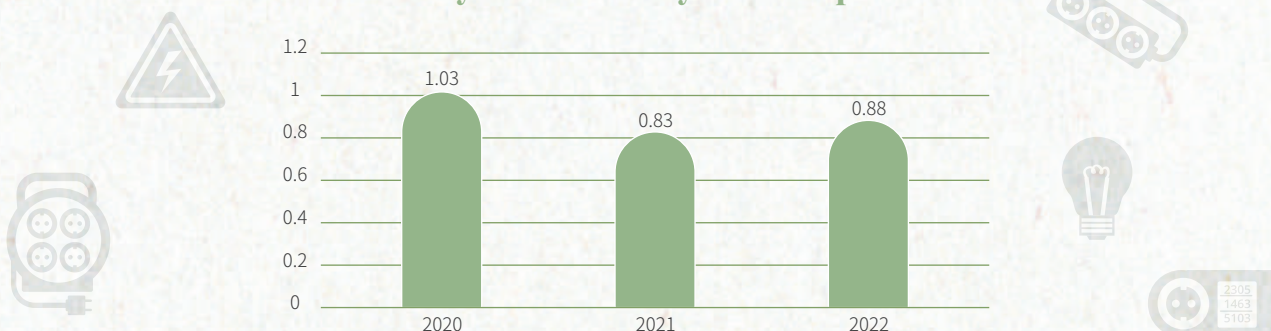
Energy resources consumption

Followed by rapid development of the six science parks and the impacts of industry emplacements as well as sales expansion, together with the improvement of semiconductor process technology, the demand of energy resources is on the rise. The total electricity and water consumption of the six science parks are also increasing. In 2022, electricity consumption increased by 7.43% and the density of power consumption grew by 5.59% compared to 2021. HSPB regularly compiles statistics to keep track of usage to ensure compliance with the approved quantity in EIA, while committed to efforts in energy conservation and carbon reduction.

Electricity consumption of park manufacturers

Park	Electricity consumption (GWh)		Electricity consumption (GJ)		Sum of business (NTD 100 million)		Density of electricity consumption (GJ/NTD 100 million)	
	2021	2022	2021	2022	2021	2022	2021	2022
Hsinchu	10,633.15	11,107.99	38,279,340	39,988,764	14,553.38	14,968.18	2,630.27	2,671.58
Jhunan	1,514.74	1,639.48	5,453,064	5,902,128	599.58	521.19	9,094.81	11,324.33
Longtan	819.62	1,147.73	2,950,632	4,131,828	542.8	433.89	5,435.95	9,522.75
Biomedical	27.77	72.22	99,972	259,992	42.7	29.29	2,341.26	8,876.48
Tongluo	238.74	244.19	859,464	879,084	136.66	174.54	6,289.07	5,036.58
Yilan	0.65	5.97	2,340	21,492	4.61	5.45	507.59	3,943.49
Total	13,234.67	14,217.58	47,644,812	51,183,288	15,879.72	16,132.55	3,000.36	3,172.67

Density of electricity consumption



Remarks: The denominator of density of electricity consumption is the current year revenue of every science park.

Water resources management has always been one of the most important environmental issues. The sources of water supply to all parks in HSP come from water corporations and reservoirs. According to “Aqueduct Water Risk Atlas” from World Resources Institute (WRI), the entire region of Taiwan is considered as Low-Medium (1-2) and water resources are not affected by water withdrawal. HSPB continues to encourage counseling on water conservation and reclamation among park manufacturers. The total water use and density have decreased by 0.49% and 2.07% respectively in 2022 if compared to 2021.

In order to improve the consumption efficiency of water resources and reduce impact on water bodies, HSPB determines target for rate of water reclamation according to industry category, water consumption and property. Industries with higher water consumption such as semiconductor and optoelectronics, except for older plants, should achieve 85% and above water reclamation rate to conserve water resources.

Water consumption of park manufacturers

Park	Water intake (million liters)		Water disposal (million liters)		Density of water consumption (million liters)		Density of Water intake (million liters/NTD 100 million)	
	2021	2022	2021	2022	2021	2022	2021	2022
Hsinchu	53,523	53,699	37,805	43,418	15,718	10,281	3.68	3.59
Jhunan	8,265	7,963	5,973	6,039	2,292	1,924	13.78	15.28
Longtan	6,330	5,996	5,264	5,242	1,066	754	11.66	13.82
Biomedical	348	412	--	--	--	--	8.15	14.07
Tongluo	648	696	139	172	509	524	4.74	3.99
Yilan	25	33	13	15	12	18	5.42	6.06
Total	69,141	68,799	49,194	54,887	521	542	4.35	4.26

Remarks:

1. Wastewater from Biomedical Science Park flows to Hsinchu Water Recycling Center through sewage system for treatment. Statistics are not included in the reference.
2. The denominator of density of water consumption is the the current year revenue of every science park.

Natural gas use is showing increasing trend over years, with an increment of 6.83% in 2022 if compared to 2021, which is mainly due to participation of new manufacturers and expansion of existing park.

Natural gas consumption of park manufacturers

Park	Natural gas consumption (million cubic meters)		Natural gas consumption(GJ)		Density of natural gas consumption (GJ/NTD100 million)	
	2021	2022	2021	2022	2021	2022
Hsinchu	37.73	42.53	1,262,898.56	1,423,564.16	86.78	95.11
Jhunan	16.14	15.49	540,238.08	518,481.28	901.03	994.80
Longtan	11.15	10.58	373,212.80	354,133.76	687.57	816.18
Biomedical	2.06	2.45	68,952.32	82,006.40	1,614.81	2,799.81
Tongluo	5.10	6.06	170,707.20	202,840.32	1,249.14	1,162.14
Total	72.18	77.11	2,416,008.96	2,581,025.92	152.14	159.99

■ Counselling on water and energy conservation

In order to improve efficiency of power and water consumption among park manufacturers, HSPB collaborates with experts, scholars, The Allied Association for Science Park Industries and technical consulting firms to form advisory groups on water and energy conservation, proposing improvement strategies based on manufacturers' current water and power consumption status, which include:



Water conservation: Replace old-fashioned water installations to improve water production rate, reclaim rainwater and air-conditioner condensate. Counselling 20 manufacturers in total in 2021-2022, with potential water saving reaching 597,000 metric tons, equivalent to 10% of Baoshan Reservoir.



Water saving guidance for manufacturers

Note: According to the basic information of Baoshan Reservoir released by the Water Resources Agency (WRA) of the Ministry of Economic Affairs (MOEA), the effective storage capacity is 5.008 million cubic meters (measured in 2022).



Energy conservation: In 2021-2022, Counselling 28 manufacturers with potential power saving up to 35.56 million kWh (128,016GJ) and reduced emission of 17,967 metric tons of carbon dioxide equivalent (CO₂e), equivalent to carbon sequestration of 46 Daan Forest Park in a year.



Actual electricity savings in 2021 was 9,196 kWh (33,106 GJ) with 4,680 metric tons of CO₂e reduction. Meanwhile, actual electricity savings in 2022 are expected to be completed in 2023.

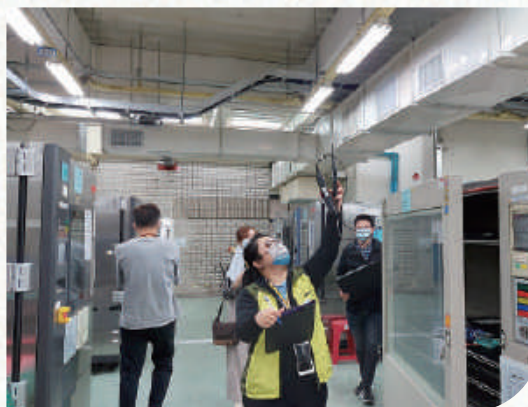


Energy saving guidance for manufacturers

Note: The calorific value of electricity is converted to 1 kWh = 3.6 MJ. The electricity emission factor in 2021 was 0.509 kg CO₂e/kWh. Remark: According to Council of Agriculture (COA), every hectare of forest can absorb 15 metric tons carbon dioxide equivalent (CO₂e) per year. Daan Forest with an area of 25.9 hectares manages to absorb 388.5 metric tons CO₂e per year.



2021 Greenhouse gas reduction



2022 Greenhouse gas reduction

HSPB will conduct educational trainings on water and energy conservation every year to expose manufacturers to new information and understand recent policy plans and global trends through relevant professional courses. In addition, HSPB also holds selection of excellent manufacturers to recognize their outstanding performance and encourage their long-term efforts in water and energy conservation. Visits to benchmark companies in the park are also organized to motivate ongoing improvement in efficiency of water and energy conservation through observational learning, so as to jointly establish an environmental-friendly park.



Hold observation activities

Greenhouse gas management

The main source of GHG emission in HSPB is electricity use. According to electricity and oil consumption of constructions (management buildings and sewage treatment plants) for each science park, the estimated GHG emissions in 2021 and 2022 were 14,504.08 and 15,050.11 metric tons of CO₂e respectively, in which electricity use accounted for 99% of total emissions.

Besides, statistics show that the total GHG emissions of all six science parks in 2020 and 2021 were 8,531,500 and 8,917,000 metric tons of CO₂e respectively. In terms of composition of GHG emissions, Scope 1 (direct emission) took up about 20% whereas Scope 2 (indirect emissions from the generation of purchased energy) occupied approximately 80%.

Composition of GHG emission in HSP

Category	2020	Percentage of total emissions in park	2021	Percentage of total emissions in park
Scope 1 (metric tons of CO ₂ e)	1,917,083	22.47%	1,967,914	22.07%
Scope 2 (metric tons of CO ₂ e)	6,614,461	77.53%	6,949,125	77.93%
Total (metric tons of CO ₂ e)	8,531,544	100.00%	8,917,039	100.00%

Remark:

1. The GHG emission factors are referred to GHG Emission Factor Management Table Version 6.0.4 published by EPA, whereas Global Warming Potential (GWP) values are referred to Fourth GWP value from Intergovernmental Panel on Climate Change (IPCC). GHG inspections are independent and have no baseline years. The major GHG emitted include CO₂、CH₄、N₂O、HFCs、PFCs、SF₆、NF₃.
2. The results of 2022 GHG inventory will be completed by the end of November 2023 and disclosed in the next report.

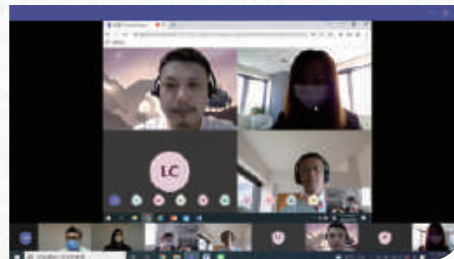
In 2020-2021, there were 45 manufacturers that meet EPA’s inspection requirements for registration. Their total emissions occupied nearly 80% of total GHG emissions in the park, with IC and optoelectronics as main industries.

Year	2020		2021	
	Number of manufacturers	Composition of GHG emission	Number of manufacturers	Composition of GHG emission
IC industry	36	66.2%	36	65.6%
Optoelectronics	9	11.2%	9	10.9%
Percentage of total park	8.5%	77.4%	8.2%	76.5%

Committed to exposing park manufacturers to the importance of reduced GHG and carbon emissions, HSPB conducts annual GHG management seminar and courses related to internal carbon pricing and corporate sustainability, in order to understand global trend of net zero and internal carbon pricing system. Meanwhile in 2021-2022, HSPB assisted one manufacturer and Yilan Science Park in building ability to inspect GHG , as well as one manufacturer in preparation of carbon offset plans. In 2022, HSPB guided one manufacturer in setting SBT to assist in adaptation to future impacts of reduced GHG emission. Moreover, HSPB conducted two courses on TCFD in 2022 to provide guidance in more precise assessment of climate-related risks and opportunities, leading industries in low-carbon transformation and thus towards a sustainable development. As a reference for GHG reduction, HSPB continues to improve its sustainability actions through the above-mentioned educational trainings.



2021 Greenhouse gas inspection counselling-educational training



2022 Greenhouse gas inspection counselling-kick-off meeting



2021 Carbon offset project counselling



2022 Carbon offset project counselling

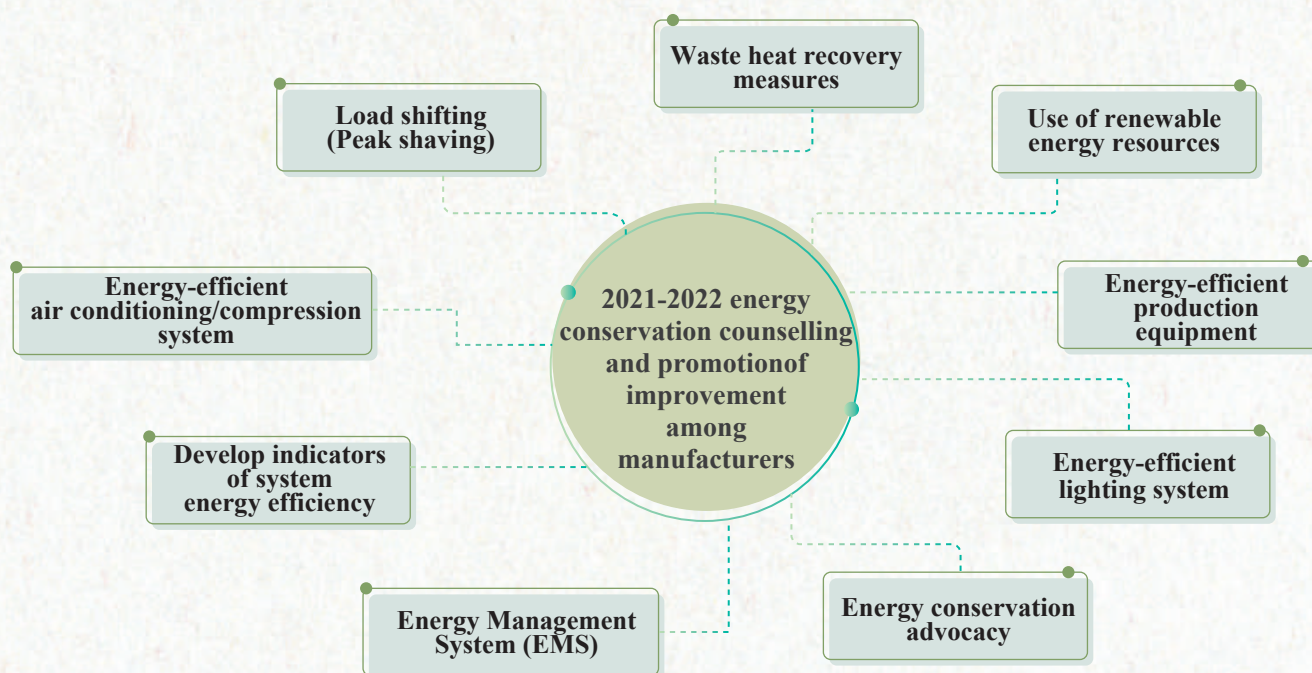


Science-based emission reduction target (SBT) educational training



Task Force on Climate-Related Financial Disclosures (TCFD) course

Furthermore, according to annual survey data, GHG reduction measures mainly focus on energy conservation of infrastructures, low-emission process and utilization of renewable energy resources, etc. The measures are as below:



Stable water, electricity, and gas supply

HSPB attaches great importance to management of water, electricity, and gas resources conservation. In 1995, HSPB collaborated with ASIP to establish “Water, Power and Gas Supply Committee”, which is responsible for compilation of information related to water, power and gas consumption as well as drafting of power-saving measures, including:

- ★ Coordinating with Taipower, Taiwan Water Corporation and gas suppliers to plan water, electricity and gas supply to the park.
- ★ Organizing courses related to power security, water resources recycling and gas safety.
- ★ Drafting design and operation specifications for water, electricity and gas equipment to be used as guidance for new or operating equipment.
- ★ Assists in integrating inspections of water, power, gas supply and demand in the park to prevent imbalances.
- ★ Promote emergency support system between Taipower, Taiwan Water Corporation and park consumers as well as gas suppliers, while improving the stability and quality of gas supply.

Drought contingency system

Due to worsening climate extremities plus difficult water storage in Taiwan’s terrain, the park will encounter critical water conditions during winter and spring seasons. In 2020, for the first time since 1964, the water condition started to worsen in the fall with no hurricane attack. Overall rainfall in the west region was persistent but relatively minimal.

In response to upcoming alterations in water condition, HSPB has implemented various back-up measures through interdepartmental cooperation, which include improving rates of water conservation and reclamation, use of reclaimed and fresh water, etc., to ensure that manufacturers have no issue with water usage. The drought contingency plans are as below:

- ◆ Through circulars, inform park manufacturers under charge (Hsinchu, Biomedical, Longtan, Jhunan and Tongluo science parks) to reinforce water conservation and early adaptation. They need to practice autonomous water saving and withhold or reduce non-production related water consumption (such as landscape, watering, wall/drapery cleaning, fire safety training and swimming pool), provided the production and epidemic prevention are not compromised, while making adjustments to relevant factory equipment to extend the period of water supply from reservoirs.
- ◆ Establish Emergency Response Team with Director and Deputy Director as convener and vice convener respectively, and relevant operational personnel as members of the team. Their main tasks include gathering information on water conditions, hosting contingency meetings, coordinating relevant authorities and releasing news, etc. Besides, the team invites park manufacturers, Central Weather Bureau (CWB), Ministry of Transportation and Communications (MOTC), Water Resources Agency (WRA), MOEA, Taiwan Water Corporation, county governments of science parks under HSPB, ASIP and other relevant departments to discuss on adaptation policies, advocate for water conservation among manufacturers and to cooperate with WRA, MOEA to implement water restriction measures at various phases.
- ◆ Set up drought zone in park's website to immediately reveal information on water conditions and counter-measures, including announcement of water loading points, central and local government sources of drought relief such as wells, ponds, and portable water purifier, etc., and therefore manufacturers can be informed in advance and be prepared to respond.
- ◆ Manufacturers with water consumption of more than 1,000 metric tons have to record daily meter reading and report weekly to control the effectiveness of water conservation. In addition, inspections are conducted on the effectiveness of water saving report from large water users, and effectiveness of water conservation is reviewed through meetings, circulars, call tracking, site visits and counselling in order to achieve water saving targets.
- ◆ Rolling review of response with WRA, Taiwan Water Corporation to reduce impact of water shortage.
- ◆ Prepare public reservoirs and manufacturers' own reservoirs for backup during water supply by districts. Water truck is activated if water situation becomes critical.

■ Stable power supply system

Regarding power consumption in the park, "Power Information Today" is set up on HSPB's website home page for manufacturers to acquire information on power supply condition in real time. This section immediately provides power information as well as forecast of power supply and demand in the coming week, and therefore manufacturers can keep track with latest power supply information and take relevant contingency actions sooner. Moreover, HSPB pays close attention to power supply condition from Taipower, maintains a smooth communication channel with MOEA, Taipower and ASIP to conduct rolling review and timely meeting to ensure stable electricity supply.

HSPB invites relevant departments (associations, Taipower, manufacturers) to conduct quarterly meetings to review power incidents. The units that have had incidents will present the causes and improvement measures, to discuss preventive measures to avoid recurrence, stabilize power supply and to preserve quality of power supply. The manufacturers involved in accidents are counseled on electricity safety inspection (10 sessions per annum). Through electricity safety inspection counseling group, HSPB will conduct on-site safety inspection of electrical equipment with manufacturers, providing professional advices and sharing experiences by having face-to-face discussion and interaction between experts and electrical technicians, in order to preserve the electric equipment at all times.

In order to enhance power quality in the park, Taipower launched new construction of "Baoshan Extra-High Voltage Substation (E/S)" in 2022 corresponding to power demand of Baoshan Phase II plan of expansion. This will increase the power supply capacity, quality and reliability, effectively improving resilience of HSP power grids, stabilizing power supply while meeting the future growing power demands.

■ Promotes renewable energy resources

In response to green energy policy in our country to promote development of diversified energy resources and to gradually achieve target of 20% of energy generation from renewable resources by 2025, HSPB fully supports and continues to encourage PV system installation. HSPB has organized a series of observational activities on renewable energy resources to increase manufacturers' willingness to install PV and energy storage devices through on-site visits, discussion on regulations, sharing of performances and experiences, as well as provide technical exchange on construction and maintenance.



Meeting Discussion Exchange



On-site observation and experience sharing

HSPB actively counsels manufacturers on space utilization to install PV system. Part of them has gradually completed the installation, for instance AU Optronics Corporation in Longtan Science Park (installation capacity of 9.87MW) and Innolux Corporation in Jhunan Science Park (installation capacity of 4.88MW). Besides, HSPB has also taken initiatives to restore public space to support renewable energy sources, for example parking tower at Si-Soft Research Center in Hsinchu Science Park (installation capacity of 1.2 MW), wastewater treatment plant in Jhunan Science Park (installation capacity of 0.96MW). It is anticipated to motivate the manufacturers to follow and together build a low-carbon yet energy-saving green park.

In order to increase percentage of PV installation, HSPB established "Photovoltaic Promotion Team" to actively guide manufacturers in utilizing available space for PV installation, and to enhance guidance and track on regular basis for potential manufacturers to increase their willingness to do so. New manufacturers and plant owners are required to evaluate 50% of the available roof area to install PV to be inspected in land lease briefing, electricity plan and building permit application. As of statistics until December 2022, the total capacity of photovoltaic (PV) system installed in the park's factories and public facilities achieved 45.48MW.



Parking tower at Si-Soft Research Center

■ Reclaimed water related information or commitment

In order to reduce water consumption of the park and provide water resources for recycling, HSPB plans to progressively introduce reclaimed water. Relevant plans are as following:

1. Tongluo Science Park: Deploy water reclamation system with the total maximum amount of water supply of approximately 3,600 metric tons per day.
2. Hsinchu Science Park (Baoshan Phase II): Baoshan Phase II expansion plans to build its own 30,000 metric-ton reclaimed water plant, and coordinates with WRA, CPAMI and county and city governments to import 67,000 metric tons reclaimed water. It is expected to achieve 100% of reclaimed water usage at Baoshan Phase II in 2030.

E.1.3 Circular Economy

Corresponding material topic: Water and effluent \ Circular economy (including waste) \ Environment quality



Policy/strategy

Focusing on vision of sustainable development and implementation of environmental protection, HSPB exerts tight control over total emission, flow of waste disposal and continues to strive for development with minimal environmental impact to co-benefit with local community, Environmental Protection and Safety Division is responsible for various environmental permits, conducting on-site audits, tracking and guidance, as well as environmental quality monitoring.

Targets and goals

- Short-term goals**
- Overall rate of wastewater disposal of 100%
 - Reclaimed water in 2023 of approximately 700 metric tons per day
 - Drainage water meets and even beyond EIA standards
 - Improvement in function of electricity conductivity equipment of Tongluo Science Park sewage treatment plant
 - Implement honest declaration system, install pollution control equipment according to regulations and perform proper operation and maintenance.
- Mid-term goals**
- Installation of renewable energy resources achieves 25%
 - Rate of waste reuse reaches above 92% by 2030
 - Generate 3,600 metric tons of reclaimed water per day for park use by 2025
- Long-term goals**
- 100% recycled water by 2050 for advanced semiconductor process.
 - 45% of renewable energy by 2040 and 100% by 2050.

Management evaluation system

- Audit environmental permit according to “Air Pollution Control Act”, “Water Pollution Control Act”, “Waste Disposal Act” and relevant regulations, while irregularly conducting on-site inspection.
- Prior to development, submit various environmental assessment report according to Standard Operating Procedures of EIA.

2021-2022 performance and adjustment

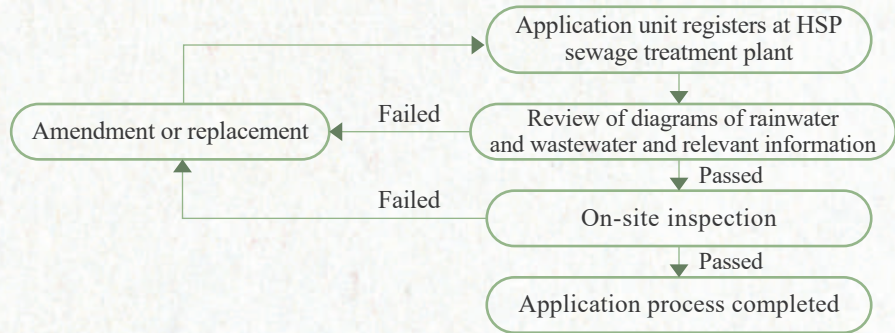
- Air pollution, wastewater and waste generation are in line with EIA commitment values.
- 100% of treated water concentration of sewage treatment plants in each park is less than national effluent standards and EIA commitment values.
- Sewage treatment plants in Hsinchu Science Park installed additional plate-frame filter press and reclaimed water pipelines in 2021, which will save about 51,658m³ freshwater consumption with a reduction rate of 46%.
- The rate of waste resources recycling in the park has reached 89.93%, exceeding Taiwan’s sustainable development target of 86.4%.
- Counseled 4 park manufacturers in 2021 to channel highly aqueous solvent waste into resource treatment facility for collection, which increased the initial resource recovery rate of the company from 56% to above 90%.
- Counseled 5 park manufacturers in 2022 to introduce carbon dust into heat treatment facility as supplementary fuel.
- Waste reductions in the park are 43,093 and 58,982 metric tons respectively.

Prevention or remedial measures

- Environmental protection supervisory group of each park in Hsinchu Science Park continues to carry out supervision tasks.
- Ongoing promotion of source reduction and improvement of resource recovery measures.
- Organizes annual "Waste Reduction and Circular Economy Outstanding Enterprise Evaluation" to acknowledge remarkable enterprises as role model.
- Sewage treatment plants piping regulations:

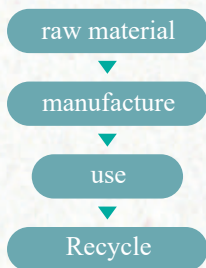
Prior to discharging the wastewater into the sewage system, the manufacturers in the Park shall submit application to the Science Park Bureau for approval (including the average daily, maximum daily and peak hourly flowrate of discharged wastewater, quality of discharged wastewater and location where the wastewater will be discharged and related illustrations of facilities). After approval, the wastewater from park manufacturers shall conform to the water quality standard for the accommodation capacity of drainage before discharging into the sewage drainage and shall pay seasonally to the HSPB the expenses for using the sewage drainage in accordance with the discharge flow rate and the quality of wastewater the former has used. If found incompliant with sewer-connected regulations, the user shall be charged accordingly and required to explain the reason for abnormality, with continuous reviews, sample collection and tracking until the manufacturer improves.

Flowchart for the application process

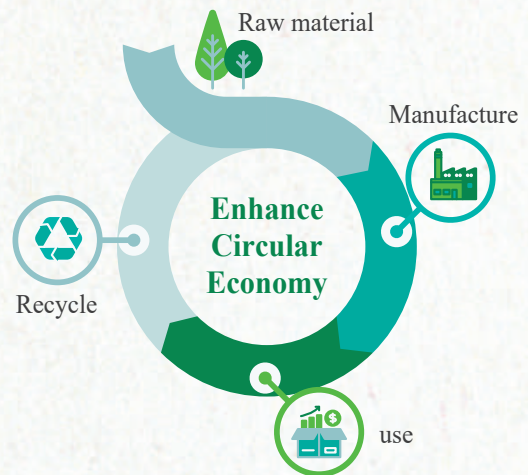
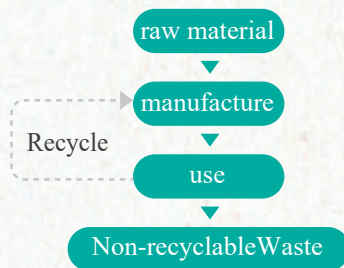


Hsinchu Science Park is the key cluster of advanced technology worldwide. HSPB proactively promotes circular economy which is in correspondence to government policies. Besides regularly guiding manufacturers to reduce waste at source, recycle and reuse resources, introduce circular economy and guide manufacturers to achieve circular economy inspection declaration or standard, HSPB also recognizes outstanding enterprises through conducting evaluation for “Waste Reduction and Circular Economy Outstanding Enterprise Award”. Meanwhile, HSPB continues to cooperate with Executive Yuan’s governance axis of “promoting recycling and reusing of resources” and “developing circular economy”, gradually achieving a win-win situation of resource recycling and industrial mutualism.

Linear economy



Reuse economy



Outcomes of circular economy promotion

HSPB continues to actively promote waste recycling. The percentage of waste recycling in the park progressively increased from 87.61% in 2019 to 89.93% in 2022, exceeding Taiwan's sustainable development target of 88% which shows that HSPB's counselling is effective. Based on questionnaire survey, the volumes of waste reduction were 43,093 and 58,982 metric tons respectively in 2021-2022. Some of the implementing measures include reusing leftovers of wafer dicing, replacing steel wire with diamond dicing blades to reduce silicon carbide sludge, filtering and reusing cutting fluid, diverting waste sulfuric acid into sewage treatment to minimize production, recycling waste copper sulfate into liquid form for reuse in the production process to limit its production and reclaiming waste photoresistor for use in manufacturing, etc.

Moreover, to understand the current utilization rate of resources in each industry, HSPB further compiles the resource recycling rate of six industries in the park and encourages improvement of manufacturers with lower recycling rates through regular supervision and professional guidance.

During counselling on production sources, focusing on wastes that are hardly recycled such as scrapped plastic mixture and highly aqueous solvent waste, the targets are selected through screening mechanism and on-site counselling is conducted with counselling committee which is composed of experts and scholars. HSPB counselled 4 park manufacturers in 2021 and successfully channeled highly aqueous solvent waste of certain company into resource treatment facility for collection, which increased the initial resource recovery rate of the company from 56% to above 90%. HSPB counselled 5 park manufacturers in 2022 and has introduced carbon dust into heat treatment facility as supplementary fuel.

In addition to that, HSPB constantly promotes source reduction and improves resource recovery measures, including development of feasible yet low-risk resources recycling technologies, combined with initial trial results from manufacturers, and encourages manufacturers to apply for recycling permit for individual case or bridge with treatment facilities, eventually informing park manufacturers through technical promotional conferences to achieve the target of improving waste resources recycling rate.



2021 circular economy promotional conference



2022 circular economy promotional conference



2021 outstanding enterprise evaluation



2022 outstanding enterprise evaluation

HSP sewage treatment plants treat the ammonia nitrogen concentration using “Anoxic/Oxic Membrane Bio-Reactor (AO-MBR)”. Due to the good quality of treated water, all water in this unit (flushing water for fine screen, cooling water for blower and cleaning water for the membrane, etc.) is partially recycled to achieve the purpose of fully recycling of this system. Besides, effluent from sewage treatment plants is partially recycled for toilet flushing, cleaning and defoaming in treatment units of the park, implementing the concept of “resource conservation” in practice.

Furthermore, the sewage treatment plants produce sludge cake of approximately 45 metric tons daily (water content 62-65%) and it belongs to non-hazardous industrial waste. With the uphold of the principle of “resource conservation”, the sludge cake generated from sewage treatment plant is handed over to qualified companies for proper treatment and can be used as a secondary raw material for brick manufacturing factories or building materials and cement, with the goals of reducing sludge production, conserving resources and minimizing environmental impacts.

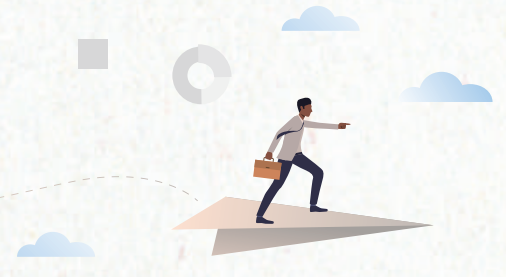
In order to encourage the park manufacturers to implement circular economy and in line with international standards, HSPB provided guidance to 4 manufacturers to introduce circular economy standards and all of them achieved the Optimizing level in Circular Economy Business Model. In 2021-2022, there was a total of 12 enterprises awarded for their excellent performances in waste reduction and circular economy evaluation and commended as role model.



2021 on-site counselling project



2022 on-site counselling project



2022 circular economy outstanding enterprises evaluation



2022 circular economy outstanding enterprises evaluation

E.1.4 Total pollutant control

Due to global climate change, in order to protect the environment and conserve energy resources, HSPB is committed to promoting green energy and circular economy in accordance with government policies, actively providing guidance to manufacturers, improving production process, saving energy and reducing carbon emission, recycling energy resources and conserving ecosystem. HSPB also exerts strict control over total waste, precisely monitors the flow of waste disposal and sewage treatment for each plant, in order to prevent environmental burden, implement honest declaration system among park manufacturers, install pollution prevention equipment and refine operation, maintaining overall park's environmental quality standards.

■ Environmental permit management

Every park has set up its total pollutant emission. Manufacturers who just move in or expand production capacity need to submit an estimate of total pollutant and can only operate after passing various environmental permit audits.

In 2021-2022, HSPB audited 1,611 applications on stationary air pollutant permits, water pollution prevention and control measures, operational waste disposal plans, resources recycling and reuse (including waste recycling) as well as total emission control. In addition, HSPB also handled 959 daytime audits, counselling and inspections to understand the current implementation status of pollution prevention and control and provide guidance.

Number of environmental permit audits

Number of audits	Years		
	2021	2022	Total
Permitted items			
Stationary air pollution source	197	176	373
Water pollution prevention and control measures	138	159	297
Operational waste disposal plan	321	383	704
Industrial waste recycling	25	19	44
Total pollution	106	87	193
Total	787	824	1,611

■ Air pollutant emissions control

HSPB has divided air pollution control into two stages, namely "investment application" and "operation management". EIA results are implemented as basis for upper limit of total emission control and the amount of emission is allocated for each park manufacturer with total allocation not exceeding the approved volume by EIA.

The air pollutant control varies slightly with different science parks, including sulfuric acid, nitric acid, hydrochloric acid, hydrofluoric acid, phosphoric acid, acetic acid, chlorine, ammonia, volatile organic compounds, carbon monoxide, Particulate Matter 10 (PM10), sulfur oxides, nitrogen oxides, total suspended particulates, sulfur dioxide, nitrogen dioxide, and other pollutants. The permitted emission of various air pollutants in all the six science parks are lower than EIA commitment values, demonstrating that the process of air pollutant emissions is strictly and reasonably controlled which can guarantee the employees' and surrounding residents' health.

Air Pollutant Monitoring

Unit: tons/year

Pollutant	Sulfuric acid		Nitric acid		Hydrochloric acid		Hydrofluoric acid		Phosphoric acid		Acetic acid		Chlorine		Ammonia		VOCs		Carbon monoxide		Nitrogen oxides	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Hsinchu	EIA approved quantity																					
	Total approved quantity																					
	Actual emission																					
Jhunan	EIA approved quantity																					
	Total approved quantity																					
	Actual emission																					
Longtan	EIA approved quantity																					
	Total approved quantity																					
	Actual emission																					
Tongluo	EIA approved quantity																					
	Total approved quantity																					
	Actual emission																					

Pollutant	Total Suspended Particles (TSP)		Sulfur dioxide		Nitrogen dioxide		Carbon monoxide		VOCs		Sulfuric acid		Nitric acid		Hydrochloric acid		Hydrofluoric acid		Phosphoric acid		Chlorine		Ammonia	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Yilan	EIA approved quantity																							
	Total approved quantity																							
	Actual emission																							

Note 1: Actual emission estimation method = (Emissions of detected pollutants/detected production capacity) x annual production capacity.

Note 2: From September 2019 onwards, echoing to Environmental Impact Statement of Hsinchu Science Industry Park (Baoshan Land) Expansion Project, emissions of various air pollutants will be revised and new pollutant control items, SO_x and NO_x, are added to Baoshan Land. Besides, the factories in Baoshan site started obtaining the operation permit from August 2022, and thus actual emissions are only available from 2022.

Note 3: From March 2020 onwards, some air pollutants and health hazardous substances are newly added in accordance with "Environmental Impact Assessment Statement of Yilan Science Park, Hsinchu Science Park".

Note 4: Starting from January 14, 2022, the emissions of sulfuric acid, nitric acid and hydrofluoric acid will be revised in accordance with the "Environmental Impact Assessment Report of Tongluo Science Park Development Project at Hsinchu Science Park Phase IV Expansion Site".

*1: Acetic acid is not yet available for testing and therefore actual emission data are not available.

*2: The park manufacturer has not yet applied for the pollutant species.

*3: Actual emissions are not available because of non-permitted manufacturers or permit applications for mass balance calculation.

Note 5: Since there is no air pollution control in Hsinchu Biomedical Park, there is no survey of actual emissions.

Wastewater pollutant discharge control

HSPB requires the manufacturers to integrate wastewater discharges into sewage treatment plants for processing and decides the volume to be managed based on approved amount by EIA. The total wastewater allocations to be piped in each science park should be lower than amount approved by EIA to prevent the effects of discharge from sewage treatment plants and preserve surrounding ecosystem.

Wastewater discharge allocations

Unit: Cubic meters/day (CMD)

Science park	Items	Approved amount by EIA	Total approved allocation	Approved amount of management	Discharge of waterbody
Hsinchu		185,000	169,192	156,500	Keya Creek
Jhunan		56,500	36,255	40,412	Hsing Kang River
Longtan		41,168	22,163	22,102	Dakeng Quexi
Biomedical		4,990	1,809	1,346	Fongshan River
Tongluo		14,000	5,133	2,050	Xihu River
Yilan		4,900	466	180	Yilan River

Note 1: Refers to the volume of waste (sewage) approved in the Environmental Impact Assessment Statement.

Note 2: Refers to the amount of wastewater to be piped and the estimated amount to be retained.

Note 3: Refers to amount of wastewater (sewage) to be included in the sewerage of the park.

Statistics till December 31, 2022

The sewage treatment capacities for Hsinchu, Jhunan, Longtan, Tongluo and Yilan Science Parks are 185,000CMD, 60,000CMD, 25,305CMD, 12,000CMD and 2,450CMD respectively, with all exceeding the total approved allocations for each science park to ensure sufficient water treatment capacity for each park. Besides, HSPB monitors the effluent concentration of each park at all times to comply with national effluent standards and EIA commitment values. Statistics of effluent from each sewage treatment plant in 2021-2022 showed that the treated water concentrations were all lower than national effluent standards and EIA commitment values, demonstrating high stability and efficiency of sewage treatment system in every plant.



Tongluo Science Park sewage treatment plant



Yilan Science Park sewage treatment plant

2021-2022 effluent data of sewage treatment plant in each park

Items		Hsinchu Science Park		Jhunan Science Park		Longtan Science Park		Tongluo Science Park		Yilan Science Park	
Discharge location		Keya Creek		Hsing Kang River		Dakeng Quexi		Xihu River		Yilan River	
Year		2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Annual water discharge (million liters)		37,804	43,418	5,973	5,973	5,264	5,241	39.9	24.9	37.3	53.6
Average daily water discharge (CMD)		103,575	118,954	16,364	16,364	14,422	14,361	109.3	68.3	102.2	146.9
BOD (mg/L)	Effluent standards	25		25		25		30		25	
	EIA commitment value	15	16	10	10	20	15	16	10	10	20
	Average monitoring value	3.1	4.5	2.7	2.1	3.0	2.3	<2.0	<2.0	<2.0	<2.0
COD (mg/L)	Effluent standards	80		80		80		100		80	
	EIA commitment value	80		66		80		40		80	
	Average monitoring value	19.8	20.9	27.0	21.4	23.7	20.6	9.9	9.7	10.7	<10
SS (mg/L)	Effluent standards	25		25		25		30		25	
	EIA commitment value	10		16		10		5		20	
	Average monitoring value	5.9	6.0	5.4	4.4	2.9	2.1	<2.5	<2.5	<2.5	<2.5
Total dissolved solids (mg/L)	Average monitoring value		2,827	2,660	1,790	1,550	-	-	-	-	-

Note: The wastewater from the Biomedical Science Park flows into the Hsinchu County Jhubei Water Recycling Center through the sewage sewer for treatment, so the statistical value is not included in the reference.

In response to rising environmental awareness, EPA of Executive Yuan announced the implementation of Science Park Sewer System Effluent Standards which sets the target of ammonia nitrogen concentration value below 30mg/L. Hsinchu Science Park adopted a double-pronged approach of source reduction control and improvement of sewage treatment efficiency, while other parks achieved target through source reduction control. All parks have met the standards since its implementation.

Sewage treatment plants in Hsinchu Science Park treat the ammonium nitrogen concentration in wastewater using AO-MBR, in which Zone A and Zone B have been officially launched in January 2017 and March 2018 respectively with a total treated sewage capacity of 55,000CMD. From the starting of operation till end of year 2022, AO-MBR showed efficient treatment and the ammonia nitrogen reduction rate reached above 95%. Ammonia nitrogen concentration in effluent is able to consistently reach the target of less than 30mg/L, which is the effluent standard for science park as regulated by EPA.

Furthermore, corresponding to water resources recycling to increase consumption efficiency of reclaimed water, sewage treatment plants in Hsinchu Science Park installed additional plate-frame filter press and reclaimed water pipelines in 2021 and replace fresh water with effluent from AO-MBR for filter cleaning purpose. These actions helped to save about 51,658m³ freshwater consumption with a reduction rate of 46%, avoid water wastage and have showed significant results.

Waste management

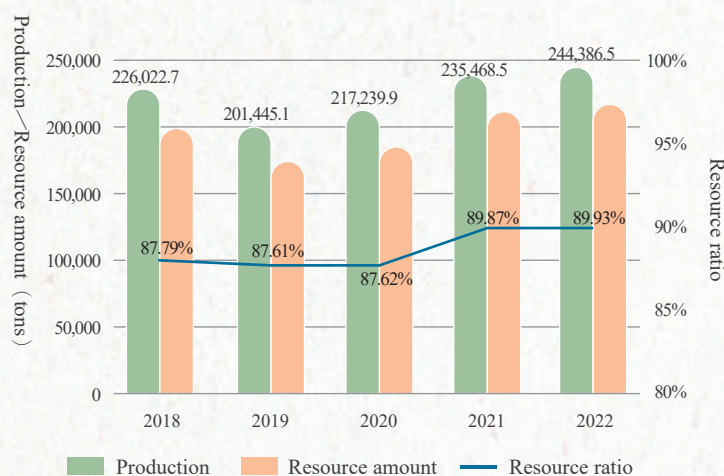
HSPB randomly conducts auditing and counseling for the manufacturers. They are required to prepare an industrial waste disposal plan in accordance with the regulations and implement waste disposal and treatment based on the Waste Disposal Act and other related regulations. The industrial waste is mainly divided into general and hazardous industrial waste. The total amount of waste generated and its resourcefulness in 2021~2022 are shown in the table below.

Unit: Metric tons

Year	2021	2022
General industrial waste	147,679.90	142,706.95
Hazardous industrial waste	87,788.63	101,679.54
Proportion of waste recycling and reclamation	89.87%	89.93%
Total declared waste generated	235,468.53	244,386.49

Besides the aforementioned control practices, HSPB collaborated with Central Taiwan Science Park (CTSP) and South Taiwan Science Park (STSP) to draft “Management Regulations for Reuse of Industrial Waste in Science Parks”, which provides the manufacturers and reuse facilities with applications of relevant permits for reuse purposes, in order to effectively improve efficiency of waste recycling. The total number of approved and still effective cases was 16 as of 2022 with total permitted reuse capacity of 4,137.56 metric tons per month.

The sources of industrial waste in HSPB are mainly the chemical agents discarded in the laboratories of the sewage treatment plants and the sludge after wastewater treatment. 235,468.53 tons and 244,386.49 metric tons of industrial waste were generated in 2021 and 2022 respectively. There was no significant leakage or spillage cases from 2021 to 2022.



Declaration and reuse of industrial waste from 2018 to 2022

The total declared waste generated in entire HSP was approximately 235,468.53 metric tons in 2021, with 89.87% being recycled treatment. The reuse rate was ranked highest in the IC industry among the six industries in park with a rate of 91.79% and followed by 83.28% in the optoelectronics industry.

Reuse of waste among six industries in 2021

Industry	Declared production (metric tons)	Reuse quantity (metric tons)	Reuse rate (%)
IC	180,887.41	166,037.81	91.79%
Optoelectronics	30,561.91	25,452.88	83.28%
Computer and peripherals	3,335.62	1,851.69	55.51%
Telecommunication	789.40	402.33	50.97%
Precision machinery	1,812.45	674.06	37.19%
Biotechnology	2,570.84	2,093.52	81.43%
Others	15,510.90	15,114.97	97.45%

In 2022, the total amount of waste generated in the whole park was 244,386.49 metric tons, of which 89.93% will be reused treatment. The reuse rate remained the highest in IC industry, which was 91.24%, followed by 84.93% in biotechnology industry. The reuse details are shown in the table below:

2021 HSP Composition of waste and treatment methods

Industry	Declared production (metric tons)	Reuse quantity (metric tons)	Reuse rate (%)
IC	190,481.70	173,791.09	91.24%
Optoelectronics	25,248.36	20,931.96	82.90%
Computer and peripherals	3,419.89	1,727.05	50.50%
Telecommunication	981.86	654.78	66.69%
Precision machinery	1,698.97	987.17	58.10%
Biotechnology	3,423.98	2,908.11	84.93%
Others	19,131.73	18,765.59	98.09%

E.1.5 Implementation of environmental monitoring

In order to enhance the environmental protection park, HSPB has invited experts and scholars, representatives of environmental protection authorities, leaders of neighboring communities, environmental protection organizations and park manufacturers to form the "Environmental Protection Supervisory Group of Hsinchu Science Park Bureau, National Science and Technology Council", and holds regular meetings to review the situation according to the size of the science park. It consists of 8 to 16 members, including experts and scholars, representatives of county (city) environmental protection authorities where the science park is located, neighboring community leaders and park manufacturers, who jointly participate and supervise the inspection and evaluation of environmental protection affairs, put forward improvement suggestions and track the effectiveness, so as to strengthen and ensure the implementation of various environmental protection practices.



The industrial clusters in HSP are quite dense and getting closer to neighboring residential areas, thus having higher sensitivity towards environmental impacts. HSPB also takes timely actions to minimize impacts to neighboring residents if environmental impacts have exceeded the capacity.

In order to perform environmental monitoring for every park which include quality of air, noise (including vibration), water, soil, groundwater and traffic flow, etc., the monitoring systems of different items are gradually integrated to improve the quality of data monitoring. "Hsinchu Science Park Environmental Quality Monitoring Results Information Network" was established to regularly disclose the current status of environmental quality monitoring to manufacturers and public.



Air quality monitoring



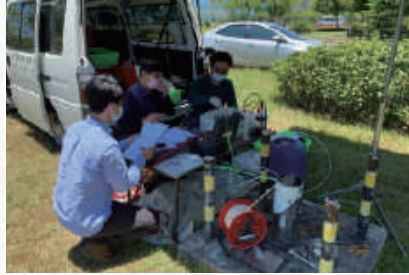
Noise quality monitoring



Water quality monitoring



Soil quality monitoring



Groundwater sampling



Effluent sampling

Hsinchu Science Park Environmental Protection Information Website

<https://saturn.sipa.gov.tw/SPAEPi/index.do>



Contractor environmental audits

In order to implement honest declaration system in park, install pollution prevention and control equipment as well as refine operation and maintenance according to regulations, HSPB applies on-site inspection, tracking and guidance to carry out relevant audits and tracking which include daytime inspections and mobile audits.

In particular, HSPB conducts annual auditing and counseling for the park manufacturers, cross-referencing air, water and waste declaration data with the permit documents and visiting the site to inspect the operation of environmental protection equipment. If there is any discrepancy, the manufacturer will be asked to make improvement and submit relevant application documents for change. In case of major violations, HSPB will issue a separate report to the environmental protection authorities for disposal.

In 2022, 377 daytime audits were completed with 158 abnormal results and the improvement rate has reached 99.37%. Meanwhile, a total of 117 mobile audits have been completed with 16 abnormal results and the improvement rate has reached 100%. The tracking of improvement status is still ongoing.

Smart monitoring system

In order to control the air quality in the vicinity of Hsinchu, Zhunan, and Longtan Science Park, HSPB promotes smart management in accordance with the "Using ICT Technology for the Development of Smart Park Project " to closely monitor the air quality and display real-time monitoring results and have completed the construction of four air quality monitoring stations and one digital signage in each of Hsinchu, Zhunan, and Longtan Science Park.

The air quality monitoring items include sulfur dioxide, nitrogen oxides, total hydrocarbons, ozone, carbon monoxide, suspended particulates and fine suspended particulates, wind direction and speed, atmospheric temperature and humidity, rainfall, etc. One set of noise meter and visibility meter is also installed in each park to understand real-time air quality information through long-term continuous monitoring.

Hsinchu and Jhunan Science Park became controlled special industrial parks on August 26, 2022, and February 23, 2022, respectively due to the expansion and change of the special industrial area. According to Article 9 of the Standards for Buffer Zones and Air Quality Monitoring Facilities in Special Industry Parks, manual testing of air pollutants must be performed. The items to be tested include nickel, arsenic, cadmium, manganese, beryllium, lead compounds in suspended particulates (PM10), hexavalent chromium (Cr⁶⁺) in TSP, inorganic acids (hydrofluoric acid, hydrochloric acid, nitric acid, phosphoric acid and sulfuric acid), acetic acid, ammonia and chlorine. The above monitoring items have been carried out at all monitoring stations in the park since the beginning of the control period.

The digital signage of each park displays the air quality monitoring results of the park and the water quality monitoring information of the effluent from the sewage treatment plant. It is also used to play the promotional video of the bureau, which can provide the employees with various real-time information. HSPB has set up "Hsinchu Science Park Air Quality Monitoring Network" for the public to inquire the real-time air quality status of the park and the nearby EPA monitoring stations. Besides, the function of "Environmental Monitoring Data" was added to the "Science Industrial Park Action Wizard 2.0" app for public to check the instantaneous air quality of Hsinchu, Jhunan and Longtan Science Park as well as the quality of effluent from the sewage treatment plants in science park.

Science Industrial Park Air Quality Monitoring Stations



Hsinchu Science Park-Jingsin Lake Station



Jhunan Science Park-Jhunan East Station



Longtan Science Park-Longtan Service Center Station

Digital signage in science industrial parks



Hsinchu Science Park



Jhunan Science Park



Longtan Science Park

Science industrial park air quality and effluent quality of sewage treatment plants monitoring results disclosure platform

Dedicated to environmental protection

In order to improve the effectiveness of every industrial operation, HSPB has organized the selection of "Hsinchu Science Park Excellent Environmental Dedicated Personnel" to commend the well-performed dedicated personnel and encourage the implementation of the environmental protection practices among institutions in the park. The scope of selection includes four major categories, namely "air pollution control personnel", "wastewater treatment personnel", "waste disposal professional technical personnel", and "toxic and chemical substance professional technical management personnel", which are set up in accordance with the relevant laws and regulations and an evaluation team is formed. In 2021 and 2022, HSPB has selected outstanding environmental dedicated personnel for each year and official award ceremonies have been conducted.



Photo of 2021 Excellent Environmental Dedicated Personnel receiving awards



Photo of 2022 Excellent Environmental Dedicated Personnel receiving awards

E.1.6 Landscaping

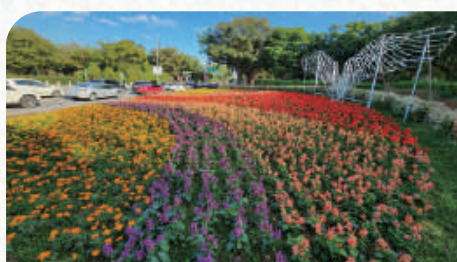
For the sake of improving the quality of environmental landscape and creating a conducive working environment, HSPB is actively promoting the establishment of sustainable environment. In addition to the acquisition of Green Building Logo for public buildings in conjunction with policy, HSPB also provides guidance to the park manufacturers to obtain Diamond Award for the “Ecology, Energy Saving, Waste Reduction and Health-Ecological Community Evaluation System (EEWC-EC)” through the control of the construction license issuance of factories, making them a benchmark in eco-friendly and sustainable development. As of end of year 2021, there were 78 green buildings within area under charge of HSPB with a total of 13 buildings being certified with Green Building Logo Diamond Award.

Number of green buildings constructed in all six science parks

Park	Number of green buildings
Hsinchu Science Park	29
Jhunan Science Park	15
Longtan Science Park	13
Biomedical Science Park	7
Tongluo Science Park	8
Yilan Science Park	6

Besides, HSPB continues to carry out planting maintenance, environmental cleaning and drainage work in the common areas of the park on a long-term basis, and regularly replaces grasses and shrubs in the imagery zones at the park entrance or along the main roads during different seasons, so as to improve the landscape with seasonal sceneries. In 2021, the respective new planting area of each park is: Hsinchu 4,572.6 m², Biomedical 860.7 m², Jhunan 936 m², Tongluo 106 m², Longtan 166 m², and Yilan 418.9 m². In 2022, the respective new planting area of each park is: Hsinchu 4,067.1 m², Biomedical 353.7 m², Jhunan 957 m², Tongluo 1,080 m², Longtan 783 m², and Yilan 553.7 m².

Also, pruned branches or recycled waste will be reused to create installation art, which will bring a livelier atmosphere to the park. On top of that, HSPB actively promotes the adoption of green areas in parks by manufacturers, and will hold a competition for park green area adoption units in 2021 to encourage manufacturers to improve the environment of the park.



Four seasons planting in Hsinchu Science Park



New ground cover planting in Yilan Science Park

During plant construction, HSPB requires the installation of a retreating green belt with a green area of more than 50% of the legal open space, so as to form a green corridor by linking the green belts of the park, making greenery everywhere in the park as if in a large park. It also aims in achieving the purpose of beautification, pressure relief, sound insulation and air purification through planting.



Outdoor view of Innodisk Corporation



Outdoor view of Taimide Tech Inc.

At present, 22 manufacturers or institutions have participated in the foster-park program in Hsinchu Science Park, Longtan Science Park, Jhunan Science Park and Tongluo Science Park, with an area of 28.6 hectares in 2022. With the joint effort of HSPB and park manufacturers, the environmental and landscape quality will constantly be improved.

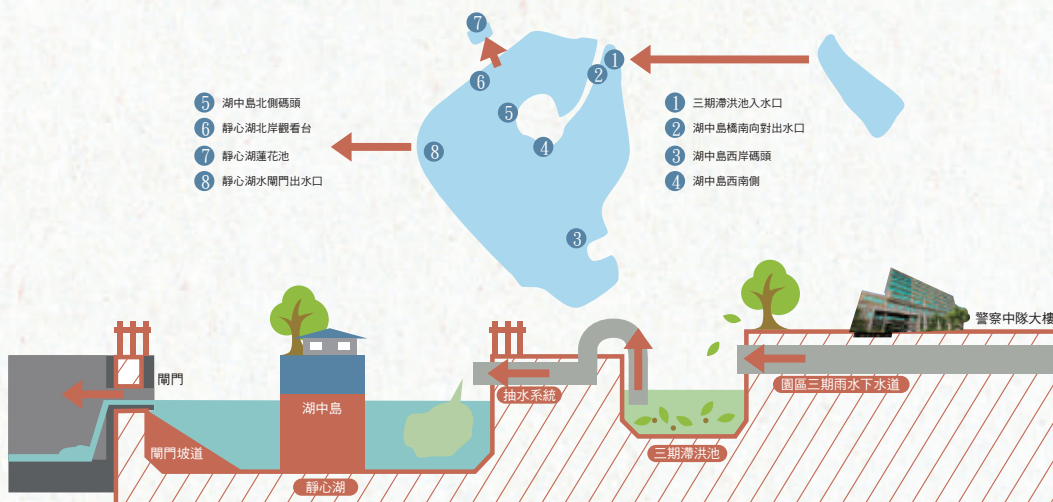
Jingsin Lake water quality testing and measures

Located in HSP, Jingsin Lake, which was early developed as a detention basin and recreational environment maintenance till now, is also a resting place for many birds and fishes. It has now become an important recreational and living place for the employees and residents of HSP, as well as an important role in the diversified culture and nature of HSP.

Jingsin Lake is an artificial lake that collects water from the stormwater drains of HSP Phase I and Phase III development area and plays a key role as a wet pond. However, in recent years, due to the climate change and reduced rainfall, the lake is prone to limited inflow during dry season which results in sluggish water storage. Therefore, most of the water is supplied by the inlet of the Phase III retention pond next to the police squadron. The design of outlet gate allows only discharge of a small amount of water when it overflows. Although this design secures water storage, it also makes it difficult to remove sediment and debris from Jingsin lake, leading to an increase in the accumulation of nutrients with nitrogen and phosphorus content over a long period of time, which is a concern for eutrophication.



Schematic diagram of inspection sampling



Cross-sectional view of Jingsin Lake and sampling sites

Analysis of study report shows that the nutrient concentrations in Jingsin Lake and Lotus Pond are still low with slightly alkaline water quality. Despite the signs of algae growth, the water quality is still considered healthy as the concentration can be regulated with a large volume of water in the lake. Plus, the water is not acidified and the eutrophication remains in its early stage, making it still safe for the aquatic animals living in Jingsin Lake.

The Phase III wet pond accounts for 70% of the total water inflow, demonstrating its importance in maintenance of the water level of the lake and the need to extend the water quality control measures to Phase III wet pond.

In response to the study report, the management unit of HSPB has proposed and initiated water quality improvement measures of Jingsin Lake. Firstly, to desilt the inlet of the Phase III wet pond and to improve the water quality by reducing the nutrient concentration. Besides, to promote feeding elimination and desilting at outlet to improve the overall water quality of the lake. Meanwhile, HSPB controls water quality through daily inspection sampling. Water quality analysis in 2022 showed good water quality in 2022 (conductivity 169 $\mu\text{mho/cm}$; fluoride ions 0.30 mg/L), except for pH 8.5 which is alkaline on average. Climate change and reduced rainfall in recent years will also be taken into future consideration in enhancing water supply improvement measures as well as maintenance of water retention and defense structure at the bottom of lake, in order to preserve water quality and environmental health of Jingsin Lake.