Promotion of Green Industry and Eco-Industrial Park: Evidence from China

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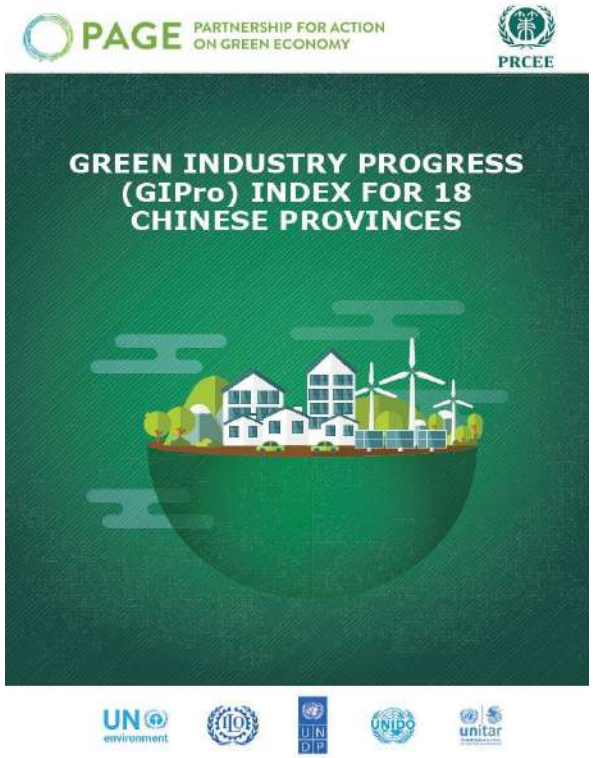
Abu Saieed
Green Industry Expert,
Division of Circular Economy and Environmental Protection,
United Nations Industrial Development Organization

Outline:

- Green Industry Progress (GIPro） Index for 18 Chinese Provinces
- A pilot EIP study on four Jiangsu industrial parks
- Identifying Industrial Symbiosis Opportunities in Shanghai Hangzhou Bay Industrial Park

Green Industry Progress (GIPro）Index for 18 Chinese Provinces



Background and objectives of GIPro

Background

- Focused on the manufacturing sector
- GIPro index is limited to 18 provinces where the average IVA during the period 2006 to 2016 is more than 40% of GDP.
- Good and Bad indicators are taken under environmental, economic and social dimension

Objectives:

- Estimating the progress toward Green Industrialization.
- Helping policymakers to understand policy relevance and set policy priorities at the provincial and country level

Data description

Indicator	Description	Unit	Data Source
GIVA	Industry Value Added of Less energy intensive sectors as a percent of total Industry Value Added	Percentage	National Bureau of Statistics (NBS); Provincial/Municipal statistics authority
GEMP	The number of employees in less energy intensive sectors as a percent of total industrial employees	Percentage	Provincial/Municipal statistics authority
ENERGY	Industrial Energy Consumption Intensity	Ton of oil equivalent (TOE)/1000 USD	Provincial/Municipal statistics authority
WATER	Industrial Water Withdrawal Intensity	m3/10000USD	National/Provincial Water Resources authorities
COD	Industrial Chemical Oxygen Demand Effluent Intensity	kg/1000USD	National/Provincial Environmental Protection authorities
SO_2	Industrial Sulfur Dioxide Emission Intensity	kg/1000USD	National/Provincial Environmental Protection authorities
HWASTE	Industrial Hazardous Waste Generation Intensity	kg/1000USD	National/Provincial Environmental Protection authorities

GIPro Methodology

Progress for each indicator

$$Progress = \begin{cases} \frac{dy}{dy^*} = \frac{y^1 - y^0}{max\{t, \lambda y^0\} - y^0}, & \lambda > 1 \\ \frac{d(-y)}{d(-y^*)} = \frac{y^0 - y^1}{y^0 - min\{t, \beta y^0\}}, & \beta < 1 \end{cases} \quad (1)$$

y^0 : the initial value of indicator,
y^1: the final value of indicator
y^*: the target value.

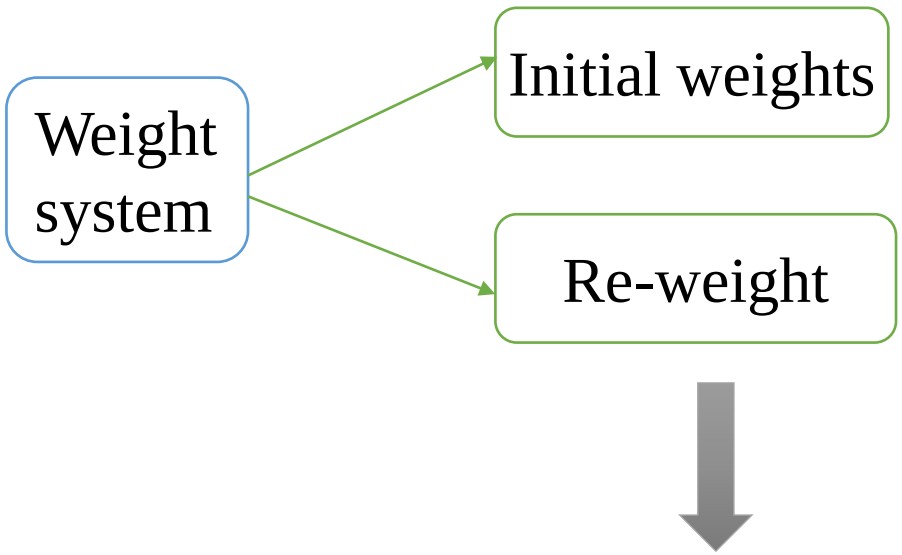
$$y^* = \max\{t, \lambda y^0\}, \lambda > 1 \qquad y^* = \min\{t, \beta y^0\}, \beta < 1 \quad (2)$$

T : threshold value

λ : the target ratio between the final (y1) and initial (y0) values (for “goods”)

β: the target ratio between the final (y1) and initial (y0) (for “bads”)

Weight system



$$\hat{\pi}_j = \begin{cases} t_j / y_j^0, & if\ j \in G \\ y_j^0 / t_j & if\ j \in B \end{cases}$$

$$\pi_j = \frac{\hat{\pi}_j}{\sum_{j \in J} \hat{\pi}_j}, \quad \sum_{j \in J} \pi_j = 1$$

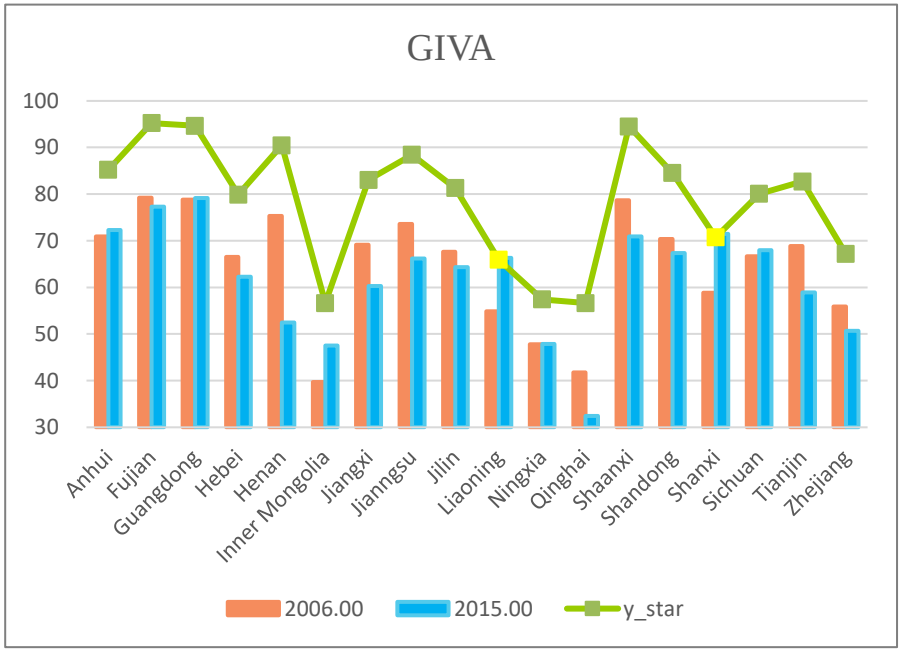
$$GIP = \sum_{j \in G} \pi_j \frac{dy_j}{dy_j^*} + \sum_{j \in B} \pi_j \frac{d(-y_j)}{d(-y_j^*)} \quad (3)$$

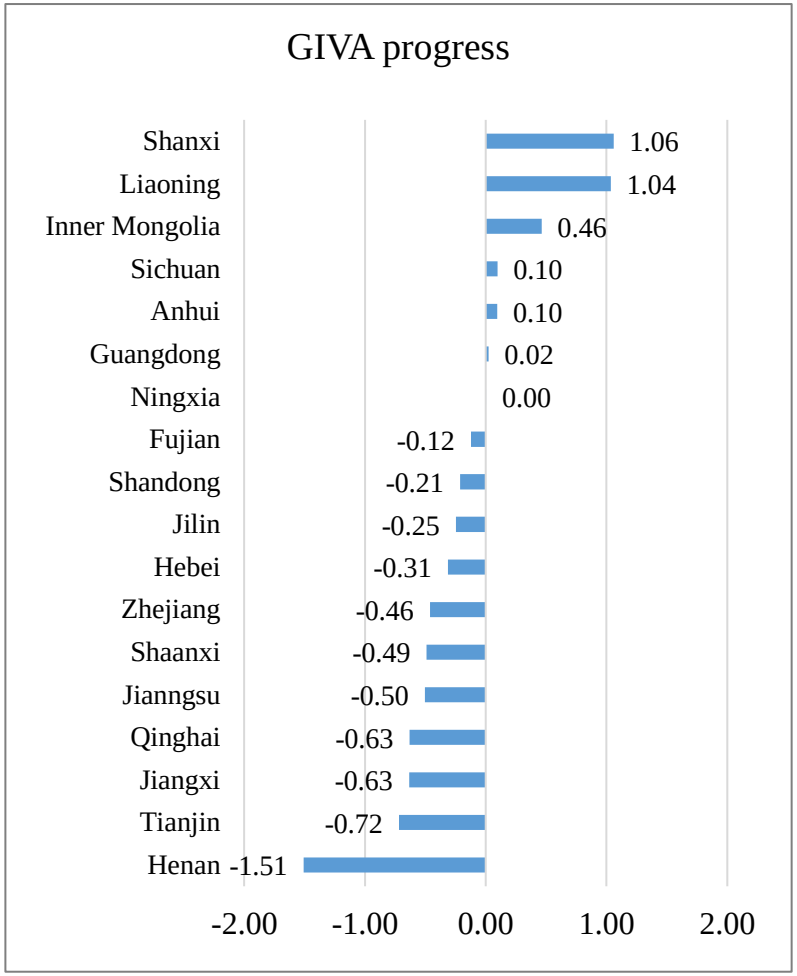
G : the set of "goods" indicators; B : the set of "bads" indicators

GIPro methodology: An example

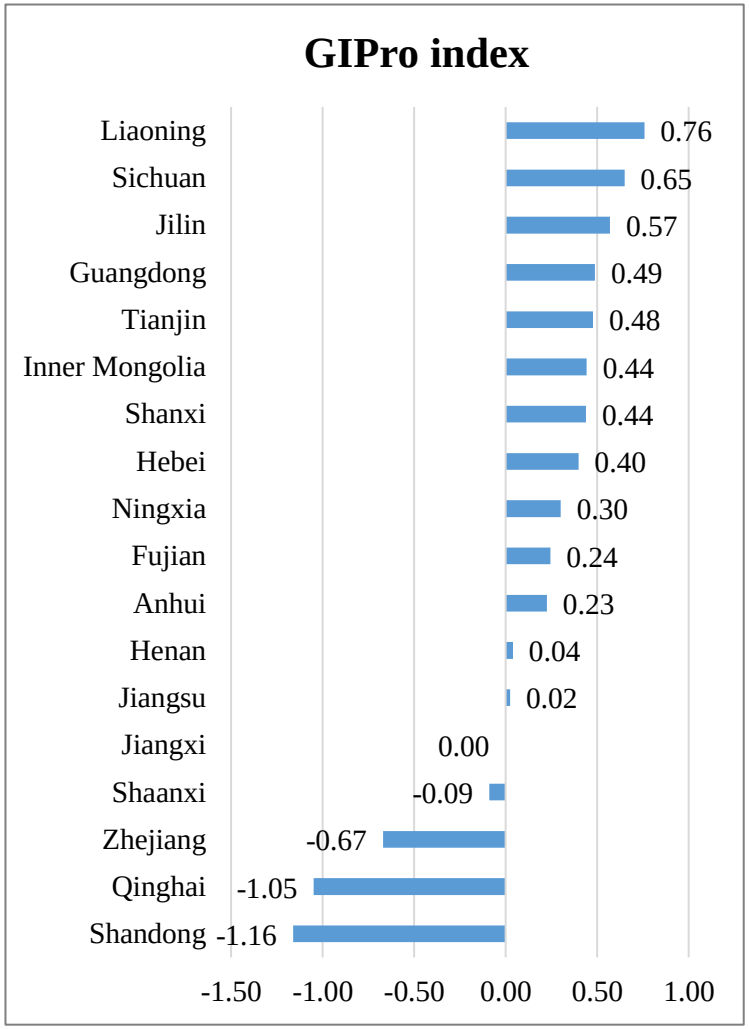
The target and threshold for GIVA (goods)

Provinces	2006	2016	change	Ch ratio	Target Ch ratio (λ)	y_star	threshold (t)	GIVA progress	Ranking
Shanxi	58.87	71.44	12.57	1.21	1.20	70.73	56.64	1.06	1
Liaoning	54.86	66.32	11.46	1.21	1.20	65.90	56.64	1.04	2
Inner Mongolia	39.68	47.55	7.86	1.20	1.20	56.64	56.64	0.46	3
Sichuan	66.65	67.96	1.31	1.02	1.20	80.07	56.64	0.10	4
Anhui	70.91	72.28	1.37	1.02	1.20	85.19	56.64	0.10	5
Guangdong	78.78	79.17	0.39	1.00	1.20	94.65	56.64	0.02	6
Ningxia	47.80	47.84	0.04	1.00	1.20	57.43	56.64	0.00	7
Fujian	79.26	77.32	-1.93	0.98	1.20	95.22	56.64	-0.12	8
Shandong	70.34	67.35	-2.99	0.96	1.20	84.50	56.64	-0.21	9
Jilin	67.66	64.30	-3.36	0.95	1.20	81.28	56.64	-0.25	10
Hebei	66.50	62.29	-4.20	0.94	1.20	79.89	56.64	-0.31	11
Zhejiang	55.90	50.70	-5.19	0.91	1.20	67.16	56.64	-0.46	12
Shaanxi	78.65	70.91	-7.74	0.90	1.20	94.49	56.64	-0.49	13
Jiangsu	73.61	66.16	-7.44	0.90	1.20	88.44	56.64	-0.50	14
Qinghai	41.78	32.42	-9.35	0.78	1.20	56.64	56.64	-0.63	15
Jiangxi	69.11	60.28	-8.83	0.87	1.20	83.03	56.64	-0.63	16
Tianjin	68.84	58.89	-9.95	0.86	1.20	82.71	56.64	-0.72	17
Henan	75.28	52.43	-22.85	0.70	1.20	90.44	56.64	-1.51	18


GIVA
100
90
80
70
60
50
40
30
Anhui
Fujian
Guangdong
Hebei
Henan
Inner Mongolia
Jiangxi
Jianngsu
Jilin
Liaoning
Ningxia
Qinghai
Shaanxi
Shandong
Shanxi
Sichuan
Tianjin
Zhejiang
2006.00
2015.00
y_star


GIVA progress
Shanxi 1.06
Liaoning 1.04
Inner Mongolia 0.46
Sichuan 0.10
Anhui 0.10
Guangdong 0.02
Ningxia 0.00
Fujian -0.12
Shandong -0.21
Jilin -0.25
Hebei -0.31
Zhejiang -0.46
Shaanxi -0.49
Jianngsu -0.50
Qinghai -0.63
Jiangxi -0.63
Tianjin -0.72
Henan -1.51
-2.00
-1.00
0.00
1.00
2.00

Map of Green Industry Progress (GIPro)



Policy Recommendation

Top three policy priorities for each provinces

Provinces	GIVA	GEMP	ENERGY	WATER	HWASTE	COD	SO2	Top three priority indicators
Liaoning	0.192	0.178	0.12	0.053	0.195	0.134	0.128	HWASTE, GEMP, GIVA
Sichuan	0.127	0.149	0.138	0.165	0.117	0.161	0.143	WATER, COD, GEMP
Jilin	0.114	0.122	0.095	0.076	0.366	0.154	0.073	HWASTE, COD, GEMP
Guangdong	0.197	0.202	0.041	0.145	0.269	0.072	0.073	HWASTE, GEMP, GIVA
Tianjin	0.227	0.228	0.115	0.134	0.169	0.051	0.076	GEMP, GIVA, HWASTE
Inner Mongolia	0.146	0.112	0.143	0.041	0.203	0.169	0.187	HWASTE, COD, SO_2
Shanxi	0.158	0.171	0.263	0.05	0.025	0.126	0.208	ENERGY, SO_2, GEMP
Hebei	0.168	0.204	0.202	0.046	0.109	0.144	0.127	GEMP, ENERGY, GIVA
Ningxia	0.092	0.078	0.204	0.046	0.001	0.327	0.252	COD, SO_2, ENERGY
Fujian	0.18	0.198	0.131	0.255	0.059	0.083	0.093	WATER, GEMP, GIVA
Anhui	0.137	0.147	0.148	0.297	0.045	0.122	0.104	WATER, ENERGY, GEMP
Henan	0.175	0.216	0.174	0.091	0.056	0.138	0.151	GEMP, GIVA, ENERGY
Jiangsu	0.173	0.178	0.109	0.218	0.189	0.066	0.067	WATER, HWASTE, GEMP
Jiangxi	0.150	0.183	0.113	0.237	0.047	0.125	0.146	WATER, GEMP, GIVA
Shaanxi	0.159	0.196	0.116	0.068	0.079	0.159	0.224	SO2, GEMP, COD
Zhejiang	0.241	0.176	0.118	0.062	0.175	0.135	0.093	GIVA, GEMP, HWASTE
Qinghai	0.038	0.036	0.054	0.036	0.759	0.042	0.034	HWASTE, ENERGY, COD
Shandong	0.209	0.202	0.116	0.021	0.262	0.086	0.103	HWASTE, GIVA, GEMP

Top priority indicators are chosen based on the higher value of weight 2

Weight 2 is relative importance of one indicator with respect to others in a given province

A pilot study on applying the International Framework for Eco-Industrial Parks to four Jiangsu industrial parks in China

Research objectives

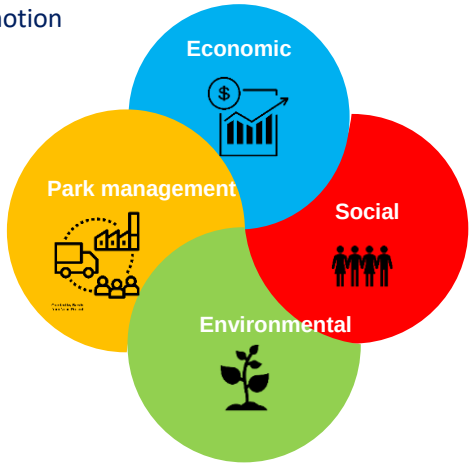
How can the international community on greening industrial development benefit from China's long and rich experience and lessons in greening IPs?

How can China's IPs benefit from the EIP knowledge and experience worldwide, in particular from the newly released international EIP guidelines?

Research methodology
The International EIP Framework

Economic performance

- Employment generation
- Local business and SME promotion
- Economic value creation



Social performance

- Social management systems
- Social infrastructure
- Community outreach and dialogue

Park management

- Park management services
- Monitoring
- Planning and zoning

Environmental performance

- Environmental management and monitoring
- Energy management
- Water management
- Waste and material use
- Climate change and the natural environment

World Bank, UNIDO, and GIZ

EIP Performance of 4 Selected EIPs in Jiangsu against the EIP Framework

Name of EIP	Park management	Environment performance	Social performance	Economic performance	Overall performance
Suzhou Industrial Park	0.972	0.958	0.827	0.750	0.888
Nanjing ETDZ	0.889	0.833	0.769	0.722	0.806
Zhenjiang ETDZ	0.917	0.903	0.808	0.667	0.837
Huai'an ETDZ	0.889	0.861	0.769	0.667	0.806
Average Performance	0.917	0.889	0.793	0.701	0.834

EIP performance score (between 0.0 and 1.0)

Strengths and weaknesses of China's IPs as compared to the EIP Framework

Performance	Weakness	Strength
Park Management	Information disclosure, Stakeholder dialogue	Administrative Committee, environmental protection units and statistics divisions established
Environmental performance	Climate change adaptation, conservation of local ecosystems, deployment of renewable energy	All four IPs have adopted Strategic Environmental Assessments
Social performance	Trade unions & NGOs, local employment, & gender equality.	Telephone hotlines and social media
Economic performance	Support to SME	Innovation & Green technology

Potential improvement for the EIP Framework

- **First, Balancing the economic, environmental and social performance :**

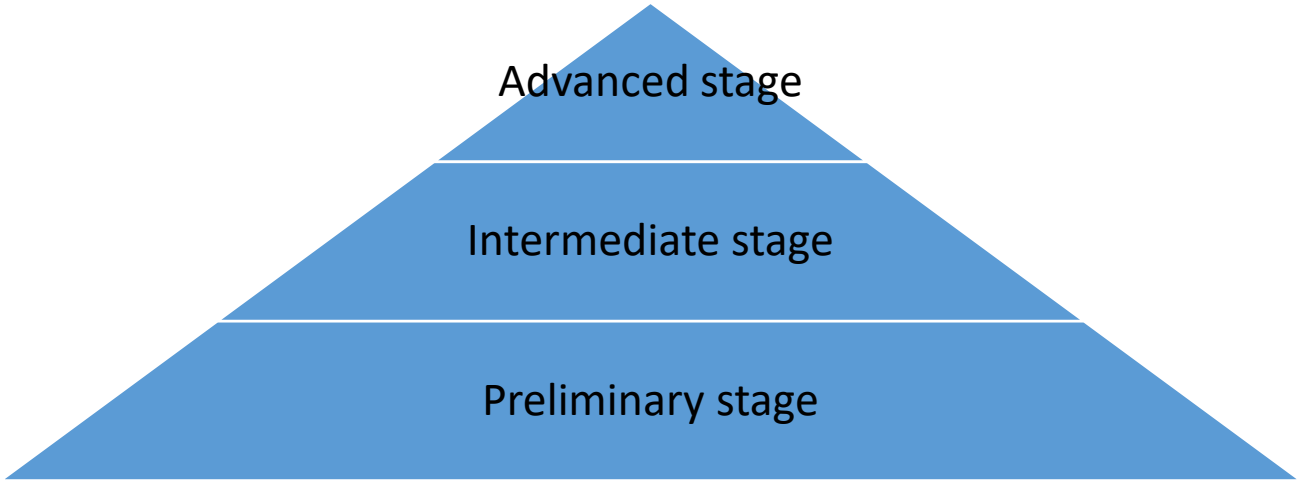
Current indicator: Environmental (18), social (13) and economic performance (9).

For example: ***green public procurement*****, green industrial sector development**, green investment promotion can be included as economic performance

- **Second, Additional Indicators:**

✓Additional evidence, Strategic Environmental Assessment, telephone hotlines, land productivity (i.e. economic value added created per unit of land annually) could be included

Third, how can the target values for the EIP Framework performance indicators adapt to very diverging socio-economic development levels of IPs in different countries

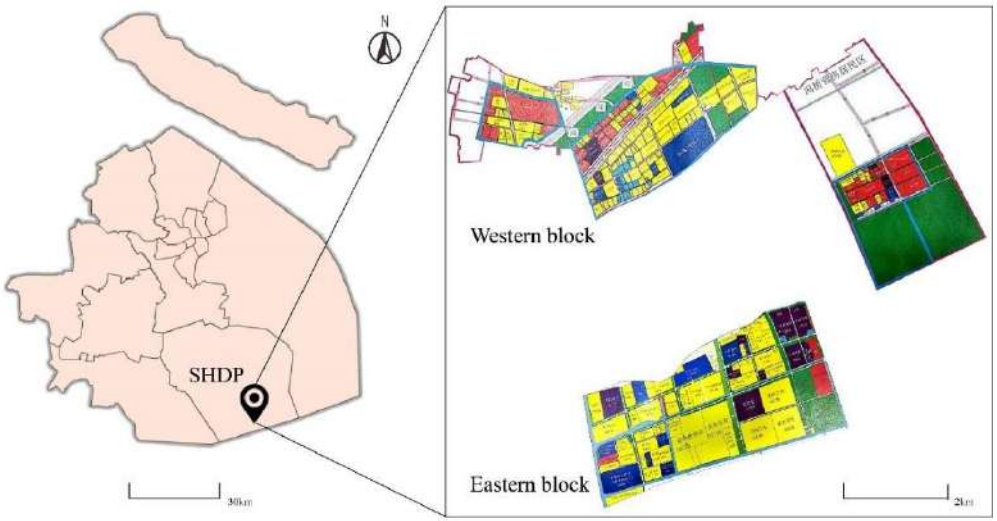


Fourth, the institutional arrangement for Data: It is very important to establish the institutional arrangement in the IPs to continually monitoring and collecting the relevant performance data.

Identifying Industrial Symbiosis & Synergy Opportunities in Shanghai Hangzhou Bay Industrial Park

SHDP

Shanghai Hangzhou Bay Economic & Technical Development Park



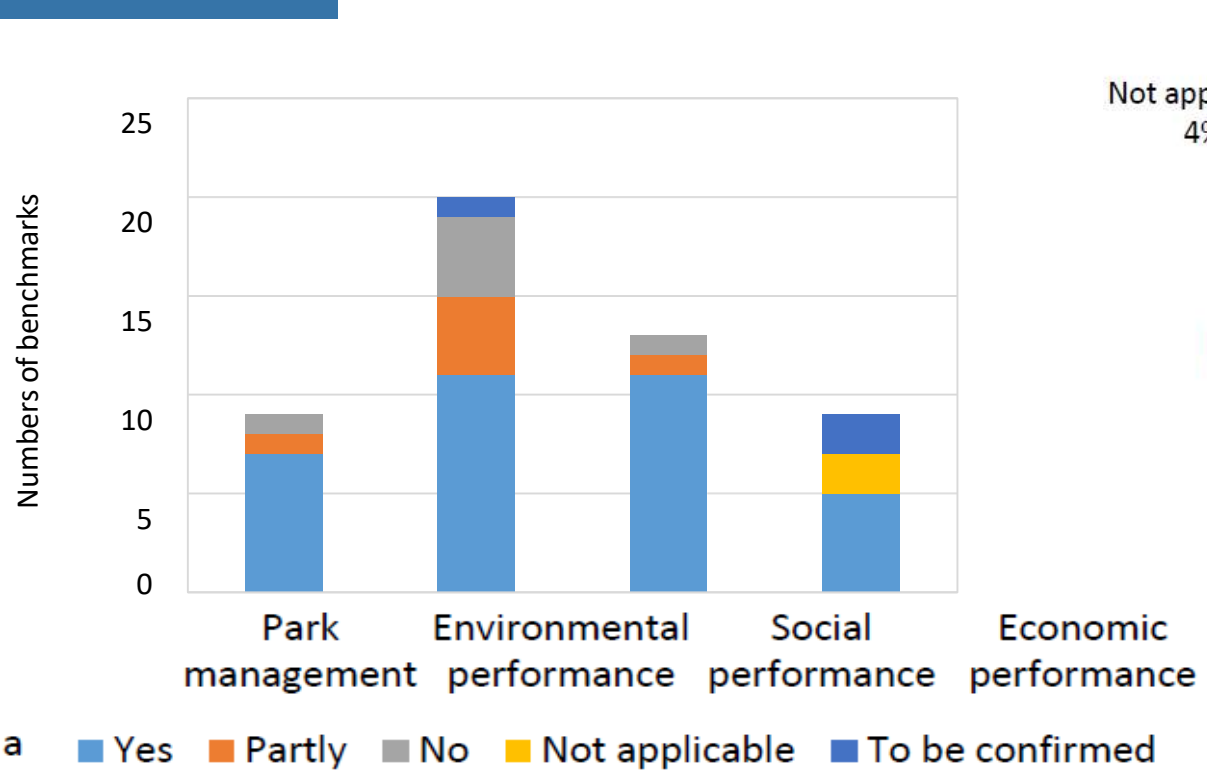
Data

Industries:
New materials industry-48%,
Fine chemical industry-13%,
Biomedical industry-14%,
Equipment manufacturing-12%,
Other industries-11%

Enterprises: 345 (273 industrial enterprises, 5 construction enterprises and 67 service enterprises)
Employees: 22,882

Total industrial output value: RMB 26.26 billion (among the **top 20** industrial parks in Shanghai) *(2017)*

Evaluation



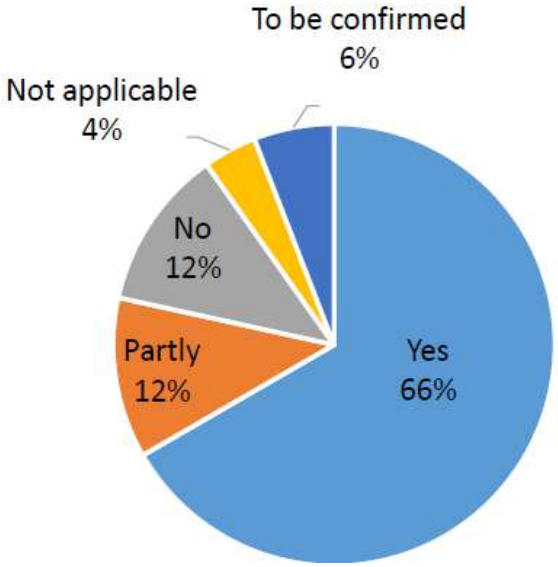


Figure: Summary of SHDP performance based upon International Framework for EIPs

In summary, **66.67% of the proposed benchmarks are fully met and 11.76% are partly met**. Among the four categories, those **social performance indicators** show the best consistence with the international framework.

Details of opportunities

22 companies included in the list of key clean production enterprises in Shanghai but not passed cleaner production audit

① Low water reuse rate (21 companies)

- ✓ Consider possible **water reuse/recycling** within the park
- ✓ With the help and coordination of the park management team

② 3 Key energy consumption companies

- ✓ Establish **energy management systems**

③ Lack real-time monitors (most companies)

- ✓ Purchase and install wastewater/gas air emission **real-time monitoring devices**

④ Emergency response plans (only 3 companies have)

- ✓ **APELL**

⑤ Underutilization of solid waste

- ✓ The park management - collect key waste data from these companies and seek technological help to **seek potential synergy opportunities and facilitate the implementation of recognized synergy cases**.
- ✓ Seek **specific licensed waste reuse/recycling companies** if necessary

⑥ Excess COD concentration (3 companies)

- ✓ Improve water management and wastewater quality
- ✓ At first step, **abide by the national wastewater discharge standards**

⑦ ISO 14001 (only 7 companies passed)

- ✓ **Help and financial support from the park management**

Conclusions and recommendations

- Compared to the benchmarks in the International Framework for EIPs, SHDP has **satisfied about 78.43% of the requirements**, which indicates that this park is moving toward sustainable development, but a gap exists. The **current monitoring system, infrastructure and services, and water management** are important drivers of such a performance.

- Potential improvements of RECP and industrial synergies identified cover the following aspects: **less water and energy consumption, by-products exchanges, integrated solid waste management, green investment and green infrastructure**. Such measures are expected to be promoted successfully with **comprehensive plans, serious implementation and support from all the stakeholders**.

- The identified improvements can create enormous social, economic and environmental benefits. The proposed actions are predicted **to save inputs purchased from outside, reduce total loss caused to local ecosystem and human health**.

- The improvements need to be **implemented step by step.**

- **Regular capacity-building activities** should be organized

Thank you !