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**FROM GAP ANALYSIS TO ACTION PLAN: A STRATEGIC ROADMAP FOR THE
PNOC INDUSTRIAL PARK'S EIP TRANSFORMATION**

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This is to certify that:

- I. The special problem comprises only my original work towards the MENRM except where indicated in the Preface
- II. Due acknowledgment has been made in the text to all other material used
- III. The special problem is fewer than 25,000 words in length, exclusive of tables, maps, bibliographies and appendices.

Lailanie Angela A. Ngojo

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Abstract

This paper is an evaluation of the manner of management of the PNOC Industrial Park, located in Mariveles, Bataan, analyzing its current practices and performance and comparing them against International Frameworks for Eco-Industrial Parks. A comprehensive analysis of the a. PNOC Industrial Park's management services, b. environmental, c. social, and d. economic performance was conducted. Through this comprehensive analysis, several gaps were identified, of which includes gaps in the availability of critical structure, in governance and in being a proactive Park manager. The study further showed that the PNOC Industrial Park has not updated its Locator or Legal Agreements since the issuance of the Programmatic ECC in 2001, which may have limited its potential as an industrial park. As a result of the analysis, a three-phased implementation roadmap was proposed. This shall include a. foundational governance and data gathering, b. strategic planning and the rehabilitation of critical infrastructures and finally, c. long-term green investment. The transformation of the PNOC Industrial Park into an Eco Industrial Park will pave way to resolve long overdue operational issues, in attracting new investors and developing the Industrial Park into a thriving and profitable asset to help PNOC economic sustainability.

I. INTRODUCTION

Eco-Industrial Parks (EIPs), as documented by (Chertow, 2000) represent a significant change in industrial development. For manufacturing industries to develop in a country, availability of adequate land is an essential precondition. Moreover, the land needs to be equipped with basic infrastructure, such as water, electricity, gas, transportation, and telecommunication. Although individual manufacturers can create infrastructure in some cases, the cost of doing so would be a heavy burden for most and would therefore discourage many potential companies from building new factories. As public infrastructure benefits from economies of scale advantages, land development of multiple industrial plots in a single area, or an 'industrial estate' (IE), has emerged as an effective strategy (ERIA Study Team 2016).

Undeniably, traditional industrial parks are critical factors for economic growth, however, they often pose several environmental challenges. The agglomeration of possible industrial stressors in a small area can exacerbate air, water, and even land pollution, if left unchecked. Likewise, the cheaper costs of setting up manufacturing facilities can spur more industries to locate and develop in these areas, which can also be a burden on government as higher populations may require more social services.

To address these, EIP frameworks were developed by pushing businesses to better collaborate with each other and incorporate environmental and resource management into operations to minimize the impacts on the environment. Through resource efficiency, pollution reduction, and industrial symbiosis between tenants, the environmental, economic, and social performance are enhanced throughout the EIP (Chertow, 2000).

An International Framework was developed collaboratively by World Bank, UNIDO, and GIZ. This provides the guidelines in developing Eco-industrial estates. The guidelines may be used by new developments or by existing industrial parks, transforming them into estates that go beyond environmental compliance. This was developed to help enhance an Industrial Park's sustainability (United Nations Industrial Development Organization (UNIDO) W. B., 2021). An important element of the EIP approach is to create a more sustainable operating environment for firms, and to promote competitiveness and job creation. These Eco-Industrial Parks should be designed to use resources more efficiently and improve productivity. They should provide investors with environments specifically adapted to support the achievement of their social responsibility goals. They should also increase market access to sustainable products, and lower exposure to climate change risks. Additionally, Eco-Industrial Parks will contribute to the attainment of the Paris Climate Change Accord's Nationally Determined Contributions at the country level (United Nations Industrial Development Organization (UNIDO) W. B., 2021).

The PNOC Industrial Park located in Bataan (formerly PNOC Petrochemical Park) is an established industrial estate and is keen on attracting industrial investments, including petrochemicals and energy. Through continuous implementation of HSSE initiatives and Corporate Social Responsibility (CSR) Programs, PNOC has demonstrated some degree of awareness of the requirements for eco-industrial development. However, most of the focus is on complying with current national laws and regulations, rather than aligning with international benchmarks. This was a far cry from the Park of the early 2000s, where PNOC emerged as a leader in environmental management through its piloting of the programmatic management system of the government.

Within the Philippines, the Philippine National Oil Company (PNOC) plays a significant role in the energy sector, with the PNOC Industrial Park serving as a hub for various industrial activities. PNOC has demonstrated awareness of issues on sustainability and environmental challenges (Philippine National Oil Company (PNOC), n.d.). As mentioned previously, it was previously at the forefront of environmental management in the country. It had also hosted the Persistent Organic Pollutants (POPs) destruction facility of the UNIDO in its premises. It also has the first, if not the only, risk-based masterplan for its facilities, and regularly conducts quantitative risk assessments of its facilities once a new locator comes in.

While these initiatives were exemplary and even extraordinary at that time, the environmental management system of the Park has not been up to date with the latest developments and may even be attributed as stagnant. This study will focus on analyzing the gaps of PNOC's current practices and those with the established international framework for Eco-industrial parks. This study will also include proposals on how the PNOC Industrial Park can transform towards an EIP model.

Background of the Study

The motivation to move to industrial estates in the Philippines was based mostly on economic reasons, with such estates providing government incentives and shared infrastructure and services. While some industrial estates provided shared environmental services such as common wastewater treatment plants, there was little incentive to improve further. The initial benefit of locating in industrial parks for mainly economic reasons only with co-located environmental protection has highlighted the limitations of conventional industrial Parks. These centers of industry, while economically vital, may sometimes contribute disproportionately to environmental degradation by concentrating possible environmental stressors in a smaller area.

Turning these industrial parks into eco-Industrial Parks (EIPs) is a practical solution, promoting and championing resource efficiency, cleaner production, and inter-locator collaboration to minimize environmental impacts and enhance economic resilience. To initiate this transformation to an EIP international organizations including the World Bank, UNIDO, and GIZ have created structured EIP frameworks, providing valuable guidance and benchmarks to make it easier to convert to an EIP framework for existing industrial parks.

The PNOC Industrial Park (Philippine National Oil Company (PNOC), n.d.), a major industrial site in the Philippines with a focus on the petrochemical and energy sector, presents a good case for examining EIP potential. PNOC has always marketed the Park as being at the forefront of environmentalism, having the only functional programmatic environmental management system in the country. Companies locating in the Park need not secure a separate Environmental Compliance Certificate from the Department of Environment and Natural Resources (DENR), with PNOC managing compliance with the Environmental Impact Assessment law. In fact, previous correspondence with the DENR has cemented the view that PNOC can operate as a mini-DENR within the Park Premises. It is the first to provide locators with Maximum Allowable Loadings (in terms of air emissions) and Total Maximum Daily Loads (in terms of its water pollutants). It is the first and only industrial estate that determines the locations of its plants through a quantitative risk approach, in which local communities are considered in master planning the estate. While this initiative had previously propelled PNOC to the forefront of environmental initiatives particularly in the heavy industries, a strategic transition towards an EIP model guided by international standards could unlock significant further improvements and meet the gap in environmental management brought about by both economic stagnation and

continuous government reorganization¹. Yet, there exists a critical gap: the applicability of the international EIP frameworks (World Bank, UNIDO, GIZ) (United Nations Industrial Development Organization (UNIDO) W. B., 2018) to the specific conditions and needs of the PNOC Industrial Park has not been investigated. This study is designed to fill that void by rigorously evaluating how well these international frameworks can be applied to the PNOC context and assessing the feasibility of adapting them to promote genuine industrial-environmental coexistence within the Park.

There are likewise limitations:

- The petrochemical estate did not reach full integration since the Naphtha Cracker was not built and there are only two locators currently operating which do not have operational synergies with each other.
- There are different companies that operate each plant and each has its own environmental management program. Both Philippine Resins Industries Inc. and Philippine Polypropylene Inc are IMS certified to three standards (ISO 14001, 9001, and OSHAS 18001 which may be a good starting point and PNOC itself is also IMS certified.
- PNOC environmental management has maintained an almost *Laizzes-faire* approach since the failure of industry integration despite its inherent advantage in environmental management.

¹ The Park was formerly under the PNOC Petrochemical Development Corporation before the company was reorganized as PNOC Alternative Fuels Corporation that almost completely neglected the petrochemical integration of the Estate. It has since then reverted to the PNOC mother company.

Problem Statement

PNOC Industrial Park faces a dilemma; it has marketed the Park as being in the forefront of environmental management through the programmatic system but it falls short of displaying the kind of collaborative system that it is indicative of modern eco-industrial parks. As other Parks in the country are now also pushing the boundaries of environmental management, PNOC faces increasing pressure to align its operations with global sustainability standards while maintaining economic growth and regain its eminent status as an Eco-industrial park. There is a gap in assessing how international EIP frameworks can be applied to PNOC Industrial Park's governance and environmental management practices, considering that it already has the regulatory advantage by adapting the programmatic system. This study addresses the essential problem of how to transform the PNOC Industrial Park from its current environmental setup into a profitable and sustainable Eco-Industrial Park (EIP). This analysis will aim to provide the methodology for the transformation between the Park's current state and its potential by systematically benchmarking its operations against international EIP frameworks, identifying specific deficiencies in its management, operational, and legal structures, and proposing a feasible and strategic roadmap to unlock its economic and environmental value.

II. REVIEW OF RELATED LITERATURE

Eco-Industrial Parks: Concepts and Principles

Locating inside industrial zones is not a new concept, many industries started to locate in common industrial areas. The first Export processing zone, which was the precursor to the modern industrial estates, was established in Bataan in 1972 while the first private industrial park was the Light, Industry, and Science Park I in Cabuyao Laguna established in 1991. The impetus was more due to economic reasons rather than environmental concerns. However, the new paradigm of sustainable development has created the need for innovative approaches to managing industrial development and one of the pre-eminent approaches is the concept of the Eco - Industrial park.

This model represents a shift from traditional industrial estates and export processing zones, with the aim of coalescing environmental sustainability with economic growth through collaboration in resource management and creation of circular systems. Understanding the important definitions, concepts, and fundamental principles of EIPs is crucial for evaluating their potential application in various contexts, including its application to PNOC Industrial Park.

Collaboration among the locators and businesses inside such an EIP, if done correctly, can improve the overall environmental performance of an industrial estate including reduction of wastes, improved resource efficiency, improved regulatory compliance, and the promotion of innovation within the locators of an estate.

Defining the Eco-Industrial Park: A multifaceted concept

An Eco-Industrial Park (EIP) is a designated industrial area wherein operating plants and other businesses engage in intentional collaboration to achieve benefits, whether environmental, economic, or social through coordinated resource management. This is differentiated from traditional Industrial parks that have independent operations and which only use common facilities for better economies. The main objective is enhanced and systematic cooperation, often extending to the local community, aimed at reducing waste and pollution and optimizing the shared use of resources, including materials, water, energy, infrastructure, and information, thereby advancing sustainable development goals (Lowe, 2001). There already exists some degree of cooperation in the PNOC Park regarding community engagement with these being centered within PNOC as the operator of the estate. But there may be further collaboration possible with the MAL and TMDL systems in place, and the risk based master planning. With the inclusion of energy firms in the list of possible locators, some degree of collaboration in terms of energy flow may be possible, although this may be difficult at best considering that the Park is not authorized to distribute electricity. Water resources are shared but efficiency in water use is not a core requirement for locators nor is water stewardship. Earlier projections show that there may not be enough fresh water that is available for a fully developed park but with only two main locators, water is still plentiful for operations.

The concept of an EIP is not however, cast in stone as there are other agencies and organizations that define the eco-industrial park concept further. The European Environment Agency (EEA) highlights the proactive pursuit of enhanced triple bottom line performance (environmental, economic, social) and positive impacts on adjacent communities (European Environment Agency, 2017). The World Bank places

importance on the systemic integration of sustainability objectives throughout the EIP lifecycle, from siting and planning to management and operations. The United Nations Industrial Development Organization (UNIDO) explicitly identifies industrial symbiosis—the exchange of materials, energy, water, and by-products between firms—as a principal mechanism for achieving these enhanced outcomes and fostering competitive advantage.

Combining and synthesizing these perspectives, EIPs can be defined by geographic concentration, inter-company collaboration, cost-effective and efficient resource management, waste minimization via strategies like industrial symbiosis, and the pursuit of integrated environmental, economic, and social performance. The important determinant is the generation of synergistic benefits, where the collective outcomes exceed the sum of individual optimization efforts, promoting a more resilient and sustainable industrial development model. EIPs can be established as a new development (greenfield) or by retrofitting an existing industrial park as will be the case in this study.

Table 2.1

Key Definitions of Eco-Industrial Parks

Source	Key Elements of the Definition
Wikipedia	Cooperation, resource sharing, waste/pollution reduction, sustainability, local community involvement.
EEA	a community of manufacturing and service businesses located on a common property that collaborates to enhance environmental, economic, and social performance through the management of environmental and resource issues

World Bank	Cross-industry and community collaboration, common economic, social, and environmental benefits, integration into siting, planning, management, and operations.
UNIDO Eco-Industrial Park Handbook	a dedicated industrial area that enhances environmental, economic, and social performance through collaboration on management of environmental and resource issues, such as symbiosis shared, and efficient resource usage
Dartmouth	Network of firms and organizations, working together to improve environmental and economic performance, seeking a collective benefit greater than the sum of individual efforts.

Core concepts driving Eco-Industrial Park development and its applicability to the Park

Beyond the definition, understanding how Eco-Industrial Parks (EIPs) function and achieve their sustainability goals requires exploring several core concepts that provide their theoretical and practical framework.

The concept of an EIP is rooted on industrial ecology, which encourages thinking about industrial systems like natural ones, aiming for cyclical resource flows that will maximize recycling and minimize waste. Industrial ecology will serve as the impetus for companies and businesses within an EIP to consider how they fit into a larger network of resource exchange (Chertow, 2000). Supplementing the aforementioned concepts is the concept of performance requirements which are provided under the International Framework on EIPs (United Nations Industrial Development Organization, World Bank Group, & Deutsche Gesellschaft für

Internationale Zusammenarbeit, 2021). In all of these frameworks environmental performance is just one of the key performance indicators that are measured. A holistic view of evaluating industrial park management is encouraged in these frameworks that looks also on social and economic performance as well. (United Nations Industrial Development Organization (United Nations Industrial Development Organization, World Bank Group, & Deutsche Gesellschaft für Internationale Zusammenarbeit, 2021)

Operationally, EIPs rely on principles like ensuring closed material flows – which, in its simplest form, ensures that one company's waste or by-product can be used as another company's resource for production into other materials, thus reducing the need for new materials and minimizing disposal which frees disposal space and provides better economic returns. Similarly, energy cascading aims to maximize efficiency by using waste heat or energy from one process to power another (Dartmouth College, n.d.). This would have been the case had the petrochemical estate been vertically integrated with the naphtha cracker, with products of the cracker flowing into the polyethylene and polypropylene plants. However, with the greater diversity of energy and petrochemical firms in the park, maximizing energy and material flows becomes more complicated and requires greater practice.

The most important operational concept is industrial symbiosis. This is industrial ecology in practice, where businesses collaborate not just on waste exchange, but on sharing materials, energy, water, by-products, and even infrastructure and services. The key is mutual benefit – creating economic value while reducing environmental impact through synergistic relationships (United Nations Industrial Development Organization, n.d.). For a petrochemical estate, this industrial symbiosis is a key element if the estate achieved full integration. However, with the lack of integration,

raw materials are either piped from the refinery or shipped through specialized hydrocarbon ships. With the advent of energy companies, raw materials may even be more disparate but there are still chances for exchange of water, energy, and by-products. The challenge is the degree the symbiotic relationship between companies may be taken, given that these companies are totally different entities that will have to trust and rely on each other's operation.

Finally, successful EIPs depend on holistic and integrated planning. This means development considers not just internal or park related technical and economic factors, but also the local context, community relationships, and input from all stakeholders, aligning the Park with broader sustainability goals (United Nations Industrial Development Organization (United Nations Industrial Development Organization (UNIDO) W. B., 2021).

These concepts are inter-related; Industrial ecology provides the philosophy, industrial symbiosis offers the mechanism, performance requirements set the benchmarks, and holistic planning provides the necessary supportive environment for a truly successful and sustainable EIP (Chertow, 2000). A strong industrial estate management and good inter-company relations is important in creating deeper connections among companies in an industrial estate. In this almost utopian concept, companies have to trust each other in supplying raw materials, excess energy, and even water to other companies. Park locators should also be chosen based on the possibility of these symbiotic relationships to exist and park planning should provide the key in creating the correct atmosphere for better symbiosis among companies.

Table 2.2*Core Concepts Driving EIP Development*

Concept	Description	Sources
Industrial Ecology	Viewing industrial systems through an ecological lens, emphasizing cyclical resource flows and waste minimization.	Ehrenfeld, J. R. (2004). <i>Industrial ecology: A new field or only a metaphor?</i> Journal of Cleaner Production, 12(8–10), 825–831.
Performance Requirements	Holistic evaluation of EIP success across Park management, environmental, social, and economic dimensions.	UNIDO. (2017). <i>An International Framework for Eco-Industrial Parks</i> . United Nations Industrial Development Organization
Closing Material Flows	Minimizing waste by ensuring the reuse or recycling of materials within the Park's network, where one process's output becomes another's raw material.	Lowe, E. A. (2001). <i>Eco-industrial park handbook for Asian developing countries</i> . Indigo Development
Energy Cascading	Maximizing energy utilization by using waste heat or	Chertow, M. R. (2000). <i>Industrial symbiosis:</i>

	energy outputs from one process as inputs for another, increasing overall energy efficiency.	<i>Literature and taxonomy.</i> Annual Review of Energy and the Environment, 25(1), 313–337.
Industrial Symbiosis	Collaborative relationships between companies involving the exchange of materials, energy, water, by-products, and the sharing of infrastructure and services for mutual economic and environmental benefit.	Chertow, M. R. (2007). “ <i>Uncovering</i> ” <i>industrial symbiosis</i> . Journal of Industrial Ecology, 11(1), 11–30
Holistic Planning	Integrated consideration of technical, economic, social, and environmental performance indicators, along with stakeholder mapping which results in better stakeholder engagement, in the development and management of EIPs.	GIZ & BMZ. (2020). <i>International Framework for Eco-Industrial Parks</i> . Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

Fundamental principles of Eco-Industrial Parks

The core concept behind Eco-industrial estates as espoused in these frameworks is the creation of key operating principles vital for achieving environmental sustainability and better industrial performance holistically taken together. These revolve around using resources wisely, minimizing waste, and embracing circular economy thinking. These principles are not entirely new concepts and have been part of our industrial terminology for decades: Resource efficiency, waste minimization, and circular economy.

Resource efficiency in industrial ecosystems. In its most simple form, resource efficiency means to lower the use of resources while maintaining or increasing productivity. These resources include raw materials, energy, water, land, and even people. Most industrial parks already naturally promote this through co-location, which allows for shared infrastructure like central wastewater treatment or energy systems, leading to economies of scale (European Environment Agency, 2017). What is needed is deeper sharing of resources and capital to make an industrial estate an EIP. Pooling utility needs can also lead to better rates and access to more efficient technologies (World Bank, UNIDO, & GIZ, 2017). Smart water management, including harvesting and reuse, is also key (United Nations Industrial Development Organization). Integral to this is adopting Resource Efficient and Cleaner Production (RECP) strategies – continually applying preventative measures to processes and products to improve efficiency and competitiveness, often facilitated by the collaborative EIP network (United Nations Environment Programme, 2012)

Waste minimization and by-product synergy. With the rising costs of waste management, waste minimization has become a fundamental element in the operations of most companies. EIPs tackle this by prioritizing waste reduction at the

source (e.g., optimizing processes, better inventory management), followed by reuse and recycling (European Environment Agency, 2017). A cornerstone strategy is by-product synergy (often called industrial symbiosis in this context), where one company's waste or by-product becomes a valuable input for another (Chertow, 2000). This could involve exchanging materials, energy, or water (European Commission, 2020). Such synergy dramatically reduces landfill waste, lessens demand for virgin resources, saves costs, and can even create new revenue streams, made easier by the close proximity within the EIP (Chertow, 2000). However, deeper circular relationships between plants will really depend on the kind of plants that are co-located inside the industrial estate, since plants will have a variety of material, energy, water, and human capital requirements.

Embracing the circular economy within industrial parks. The circular economy concept represents a shift from the linear "take-make-dispose" archetype towards closed-loop or circular systems where resources may be kept in use longer, their value maximized, and materials recovered as much as possible. EIPs are well-positioned to implement circular economy practices (Geissdoerfer, 2017). Industrial symbiosis is a key enabler, turning waste into assets and reducing reliance on new materials (Chertow, 2000). EIPs can also support shared infrastructure for recycling or remanufacturing, making recovery economically viable (Kirchherr, 2018). Promoting circular design (using durable, recyclable materials; designing for reuse/repair; enabling locators that reuse the materials of existing locators, among others) is also encouraged. This approach, when done holistically, may create some environmental benefits (better resource use and reduced wastes and pollution) and possible economic advantages that are central to circular economies like cost savings, new

business opportunities, and enhanced competitiveness, which are created under the cooperative and collaborative environment created (Lieder, 2016).

The Impact of international frameworks on EIP concepts and principles

International frameworks that are created by multinational organizations have substantially shaped how Eco-Industrial Parks (EIPs) are comprehended, homogenized, and promoted worldwide. These frameworks offer definitions, key performance indicators with set objectives, and concrete guidance for putting EIPs into action (UNIDO, 2017).

An important example is the "International Framework for Eco-Industrial Parks," created mutually by UNIDO, the World Bank Group, and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). Its objectives are to provide basic requirements and performance expectations for existing Parks which have decided to become an Eco-Industrial Park. This framework guides the existing estate policymakers and practitioners in creating sustainable industrial areas or eco-industrial estates from ordinary industrial Parks (UNIDO, 2017). This framework covers essential operational aspects of industrial parks such as industrial planning, management, environmental, social, and economic performance, which will help encourage the shift to EIP.

In practice, these frameworks reinforce core EIP concepts such as industrial symbiosis and resource efficiency, which are the most important constructs in EIP development. They offer structured ways to implement these ideas, often suggesting specific indicators and best practices (World Bank, UNIDO, & GIZ, 2017). These guidebooks highlight the need for greater collaboration and better stakeholder engagement. Essentially, sustainability should be part of the core of EIP's planning and operations.

The presence of these frameworks makes it easier for existing industrial parks to be encouraged to change to EIPs. They provide valuable input for national policies and regulations supporting EIP growth, while also guiding investment decisions and technical assistance efforts (World Bank Group, 2017). Frameworks offer easier methodologies for industrial estates to develop, since they can be applied to a wide variety of parks and the method of adaptation of specific concepts can be varied but the core principles are not changed.

International Frameworks for Eco-Industrial Parks

World Bank Framework

Core principles and objectives of the framework. The World Bank's perspective on Eco-Industrial Parks is closely tied to the joint "International Framework for Eco-Industrial Parks," developed with UNIDO and GIZ. At its core, this framework champions collaboration between industries and the community for shared economic, social, and environmental gains (UNIDO, 2017). Collaboration becomes an integral part of every EIP and the community and are not just concepts, if an industrial estate aims to become an EIP.

The most important starting objective is to set clear benchmarks for action—performance requirements covering compliance to legal and regulatory requirements, socio-economic factors that include stakeholder engagement, environmental standards, and management systems. This helps the development of new EIPs, modify existing ones, and, in many other cases when the full EIP performance cannot be realized, recognize genuine efforts to create EIPs (GIZ, & UNIDO, 2016). The framework is also designed for adaptability and malleability, allowing key performance standards to be adapted to different national laws and milieu, levels of development, and even tiered into rating systems (e.g., bronze to platinum) depending on the degree

that an industrial estate or a country would want to develop its industrial estates. This ensures it's applicable whether building new Parks or retrofitting older ones, in developing or developed nations (World Bank, UNIDO, & GIZ, 2017). Ultimately, the goal is to lift the performance, sustainability, and inclusivity of all industrial estates to a standard that can be recognized worldwide.

Key components and guidelines for developing and managing EIPs.

Comprehensive guidelines for putting the framework into practice are detailed in resources like "A Practitioner's Handbook for Eco-Industrial Parks" (World Bank Group, 2017). Implementation involves steps at both national and Park levels:

- National Level:
 - Developing a national EIP approach (stakeholder engagement, policy alignment) (UNIDO, 2017) Several DENR regulations already recognize some of the concepts in an EIP and resources are available at the national level;
 - Conducting diagnostics (analyzing the industrial landscape, identifying gaps, assessing needs) (GIZ, & UNIDO, 2016);
 - Creating a national EIP roadmap (policy reforms, governance, financing) (World Bank Group, 2017);
 - Launching, monitoring (MRV), and scaling up programs (UNIDO, 2017).
- Park or industrial estate Level:
 - Developing stakeholder commitment (feasibility studies, buy-in) (GIZ, & UNIDO, 2016) In this case stakeholders include the industrial estate management and the locators, apart from the community;
 - Establishing an EIP management team (capacity building, defining roles) (World Bank Group, 2017);

- Creating the framework for the development of the EIP and developing standards of performance and indicators ;
- Developing the Park into an EIP;
- Conducting performance audits (monitoring against indicators) (UNIDO, 2017) to determine if the goals of an EIP has been met and how much more need to be done;
- Reporting and marketing the EIP's performance and benefits (World Bank Group, 2017).

Supporting tools, many developed by UNIDO, cover assessment, industrial symbiosis identification, policy support, and monitoring, among others. The Handbook guides users through these steps, emphasizing engagement, thorough diagnostics, strategic planning, and effective monitoring (GIZ, & UNIDO, 2016).

There are four specific performance requirements according to the framework across four key areas: environmental, economic, social, and estate management. Following the framework should push companies to go beyond basic legal compliance, aiming for meaningful improvements through qualitative prerequisites and quantitative indicators (UNIDO, 2017).

- Environmental: Covers air emissions, wastewater discharges, solid and hazardous waste management, noise, and protection of biodiversity, promoting resource efficiency and environmental management systems (World Bank Group, 2017);
- Economic: Focuses on job creation (especially local), promoting local businesses, economic value addition, saving on resources by common facilities and investment readiness (GIZ, & UNIDO, 2016);

- **Social:** Addresses worker well-being (OH&S, grievance processes, anti-harassment) and community relations (outreach, dialogue, social infrastructure) (UNIDO, 2017);
- **Park Management:** Concerns effective governance, including an empowered management entity, fee collection ability, and efficient infrastructure and services, often measured by tenant satisfaction (World Bank Group, 2017). This should also include proper estate planning or the determination of the proper mix of industries that would comprise the estate.

Case studies and examples of EIPs developed using the World Bank's Framework. Since the framework was developed, this has been applied several times globally, often with the help of the World Bank through technical assistance and through requirements for its funded projects. A prime example is South Korea's Ulsan Mipo and Onsan Industrial Park, where an existing industrial complex was transformed into an EIP via investments in efficiency and symbiosis, which provided the locators with significant environmental and economic returns (UNIDO, 2017; World Bank Group, 2017). Apart from individual projects involving singular industrial estates, the World Bank also actively supports national framework development and Park transformations in countries like Turkey (e.g., Izmir Ataturk OIZ), Vietnam (piloting national criteria), and China (e.g., Jiangxi Eco-industrial Parks Project focusing on institutional strengthening and green investment). These cases show the framework's real-world application across diverse settings (World Bank Group, 2017).

Possible benefits of the EIP Framework. Implementing the EIP framework is expected to yield the following benefits if done to the greatest extent possible without constraints:

- **Environmental:** Substantial savings through reduction in resource consumption (raw materials, water, energy), less waste generation, and lower pollution (air, water); likewise, there may be contributions to the lowering of carbon emissions and biodiversity protection (World Bank Group, 2017);
- **Economic:** The reduction in resource consumption and environmental management translates to real cost savings for companies (resource use, plant efficiency, lower costs to treat and manage wastes), increased competitiveness (shared services, innovation among companies within the specific area), attraction of investment since there will be a wide variety of companies that will be co-located, job creation with the influx of workers that will and regional development (World Bank Group, 2017);
- **Social:** Improved public health due to better community engagement of multiple companies, enhanced worker safety and well-being through sharing of standards and safety environment, stronger community relations, skills development, and overall quality of life (World Bank Group, 2017).

Recent Developments and Evolution of the World Bank's EIP Framework.

The World Bank and its international and national partners continue to evolve and promote the EIP framework. Version 2.0 (which was released around 2021) aimed to improve applicability, address data gaps in the original submission, add new indicators for monitoring, and incorporate lessons learned from the implementation of the original framework (World Bank Group, 2017). At that time, there were ongoing EIP projects such as Jiangxi in China where the new framework was implemented and further refined. There's also a growing emphasis on integrating circular economy principles with the EIP development, highlighted by events like the 2023 APEC conference and reflected in programs like the World Bank's C-JET initiative (World Bank Group, 2017).

International World Bank Partners like UNIDO and GIZ continue improving on the EIP concept and releasing supporting resources (guidelines, tools, reports) and implementing projects globally, showing sustained commitment to EIPs as a key strategy for sustainable industrial development (World Bank Group, 2017).

UNIDO Framework

Role and EIP definition. The United Nations Industrial Development Organization (UNIDO) is a major proponent of sustainable industrial development across the world and views Eco-Industrial Parks (EIPs) as vital tools for sustainable development. UNIDO sees EIPs as communities of businesses that collaborate with each other and is located on shared property working together to improve environmental, economic, and social outcomes. A key mechanism highlighted by UNIDO is industrial symbiosis – the exchange of materials, energy, water, and by-products for competitive advantage to the greatest extent possible. This approach helps embed industry within society, promote resource efficiency and circular practices, and bridge urban-industrial divides.

UNIDO's definition of EIP (aligned with the aforementioned International Framework 2.0). Aligned with the joint framework, UNIDO's definition describes EIPs as industrial areas that adopts cross-industry and community collaboration for shared economic, social, and environmental benefits as described above. These goals are integrated into the Park's planning and operations. The focus of an EIP is on collective action for sustainability, often achieved through industrial symbiosis, ultimately aiming for harmony between industry and society. The framework provides benchmarks covering compliance, socio-economic aspects, environmental factors, and management practices to guide EIP assessment and development.

UNIDO's Framework for Eco-Industrial Parks: Core Principles and Objectives. Aligned with the "International Framework 2.0," UNIDO's approach centers on promoting partnership and cooperation for shared advantages across the lifetime of the EIP. Key objectives include :

- establishing clear benchmarks (prerequisites and performance requirements) to help stakeholders develop or transition Parks,
- ensure international relevance and adaptability,
- improve the global industrial sector's performance, sustainability, and inclusivity (United Nations Industrial Development Organization (UNIDO), 2019).

Key Components and Guidelines for Developing and Managing EIPs According to UNIDO. UNIDO use the guidelines developed with its partners, notably the "A Practitioner's Handbook for Eco-Industrial Parks." Implementation generally follows a four-step process at both national and Park levels (United Nations Industrial Development Organization (UNIDO), 2019):

- National: Developing a national approach, conducting diagnostics, creating a roadmap, and finally launching, monitoring, and evaluating;
- Park: Developing stakeholder commitment, establishing a management team, conducting performance audits, and reporting/marketing;
- Performance Requirements Across Key Dimensions in UNIDO's Framework.

The framework outlines performance requirements across the following dimensions: environmental, economic, social, and estate management, setting standards beyond basic compliance in each of the dimensions. Environmental aspects cover emissions, resource use, waste (solid and hazardous wastes), discharges, and biodiversity. Economic aspects include job creation, local business promotion, shared services that save on capital and operations costs, and value

creation. Social aspects address worker well-being (OH&S, etc.) and community relations, including relations with indigenous groups, if any. Industrial estate management focuses on effective governance and services (United Nations Industrial Development Organization (UNIDO), 2019).

Case Studies and Examples of EIPs Utilizing UNIDO's Framework. The application of UNIDO's framework for EIP has been done in estates like Ulsan (South Korea), where existing complexes were transformed via the use of more efficient operations and investments that promote industrial symbiosis. Other EIP projects in Vietnam focus on developing national criteria and piloting the framework, while work in Izmir Ataturk OIZ in Turkey supported national framework development with a focus on symbiosis. These illustrate the framework's practical use in driving sustainable industrial development.

Anticipated Benefits of UNIDO's EIP Framework. Adopting the UNIDO-supported framework is expected to bring significant advantages: environmental (reduced resource use by lessening wastage and reduced pollution), economic (cost savings, competitiveness, investment, jobs), and social (better health, safety, community relationships, skills development that zero in on the requirements of the EIP) (United Nations Industrial Development Organization (UNIDO), 2019).

GIZ Guidelines

GIZ's Sustainable Industrial Areas (SIA) Approach. The GIZ promotes sustainable development through its specific SIA approach which does emulate several EIP principles but with some distinctiveness based on the experience of GIZ . SIA emphasizes a stable and steady integration of the same environmental, economic, and social factors, also aiming for resource efficiency, strong environmental management and protection, and social coordination within industrial zones (GmbH,

SIA Concept, 2019). This SIA concept of GIZ provides real-world support through key publications like the "Guidelines for Sustainable Industrial Areas," the "Implementing the EIP Framework: GIZ Guidance Document," and the comprehensive SIA Toolbox (which offers tools, training, best practices, and manuals on many sustainability topics). The strongest emphasis in GIZ's approach is establishing sound industrial estate management structures with clear sources of authority and management of resources, seen as crucial for driving and maintaining sustainability initiatives.

Key Elements of GIZ's EIP Guidelines. It can be seen that GIZ's specific guidelines agrees with the EIP Framework's structure, focusing on the same four performance areas:

- **Industrial Estate Management:** Requires an empowered industrial estate management body with clear responsibilities, resources, enforcement authority, and the provision of efficient infrastructure and services within the industrial estate;
- **Environmental Performance:** Advocates strongly for resource efficiency, cleaner production, and a circular economy (in which the empowered management body ensures and facilitates resource exchange wherever possible). Within this performance area are naturally included waste reuse and reduction, natural resource and environmental protection, and climate change mitigation and adaptation;
- **Social Performance:** The empowered management body must be able to create operative systems for occupational health and safety (OH&S), management of external and internal grievances, adequate social infrastructure, stakeholder outreach and management, and promoting human capital development, gender equality, and women's empowerment (GmbH, Green PSD Navigator: Overview of Green Growth Approaches for Private Sector Development., 2022);

- **Economic Performance:** All of these above performance areas should not discard but instead encourage and recognize the need for economic sustainability, which includes job creation at the local level, supporting for local businesses and supply and value chains, and creating the investment environment that attracts firms that look for sustainable growth.

GIZ's Tools and Methodologies. GIZ offers practical tools to aid implementation:

- **SIA Toolbox:** An exhaustive collection of instruments, training materials, case studies, and best practices;
- **PREMA (Profitable Resource-Efficient Management):** A procedure that will help businesses analyze both costs and environmental impacts to identify where resource use can be improved. The aim is for economic, environmental, and social "triple wins.";
- **Guidance on Implementing the EIP Framework:** A comprehensive and step-by-step guide for transforming existing traditional Parks into EIPs, which outlines all the steps required from preparing to operating, maintaining, and monitoring the performance indicators;
- **Assessment Tools:** Assessment and monitoring will be required to evaluate newly minted EIPS performance to ensure consistent implementation against international criteria. This is provided by assessment tools that are developed collaboratively with UNIDO and the World Bank (World Bank, UNIDO, & GIZ, 2017).

Global Implementation Examples. GIZ applies its guidelines and tools globally through various projects:

- Ethiopia's S.I.C. Project: The project focused on enhancing Park operations, sustainability practices, and worker welfare;
- Uzbekistan's Green Industrialization Project: with the country is collaborating with UNIDO to pilot EIP development at specific sites;
- India's SEIP Project: The project is focused on promoting environment-oriented modernization, focusing on specific challenges like wastewater management.

Table 2.3

Comparison of Emphasis in EIP Guidelines

Organization	Key Focus Areas/Strengths	Specific Guidelines or Tools
GIZ	Holistic sustainability (environmental, economic, social), strong management structures	Sustainable Industrial Areas (SIA) Guidelines, SIA Toolbox (training material, best practices), PREMA (resource efficiency methodology), Guidance Document on Implementing the EIP Framework
UNIDO	Industrial development, resource efficiency, cleaner production, industrial symbiosis	International Framework for Eco-Industrial Parks (co-developer), EIP Assessment Tool, Opportunities Monitoring Tool, Policy Support Tool, Industrial Symbiosis Identification Tool, RECP Monitoring Tool, Management Services Tool, Concept Planning Tool, Master Plan

			EIP Review Tool, Implementation Handbook for EIPs
World Bank Group	Economic development, financing mechanisms, policy and regulatory frameworks		International Framework for Eco-Industrial Parks (co-developer), Practitioner's Handbook for Eco-Industrial Parks, support for country EIP roadmap development, and financial instruments (PPP, sustainable finance)

III. STATEMENT OF THE STUDY

This study, entitled “Gap analysis to action plan: A strategic roadmap for the PNOC Industrial Park’s EIP transformation”, aims to deliver a strategic plan for transforming the PNOC Industrial Park from its current state of development into a profitable and sustainable Eco-Industrial Park (EIP) under the aforementioned framework plans and programs provided. It follows a step-by-step progression of diagnosis, analysis, and planning to provide PNOC with a clear and actionable path toward modernization and long-term viability. The Park has always been touted as being at the forefront of environmental management in the country and this study also aims to return the Park into leadership and attract more investments and locators that can help in the development of an EIP.

IV. OBJECTIVES OF THE STUDY

This study's foremost objective is to deliver a strategic step by step plan for transforming the PNOC Industrial Park from its current state of industrial development into a profitable and sustainable Eco-Industrial Park (EIP) as indicated above. To achieve this involves three core components:

- First, it will conduct a comprehensive benchmark analysis, evaluating the Park's current management based on its environmental, social, and economic practices against international EIP standards included in the framework and other tools developed as provided above;
- Second, based on the comparison from above, the study will define the specific deficiencies within the Park's governance, legal framework, stakeholder practices, and operational procedures. A gap analysis will be done in which these deficiencies will be analyzed as to how these may impede the transformation into a modern EIP;
- Third, it will propose a feasible, step by step and time-bound implementation plan that will be designed to unlock the Park's full economic and environmental value, attracting more locators, saving more resources, and creating value where none currently exists, which will hopefully turn it into a new stable source of income for the PNOC.

V. RATIONALE

The PNOC Industrial Park is at a critical juncture in its development, facing significant operational challenges such as chronic underperformance, a long-standing low occupancy rate (<25%), and deteriorating critical infrastructure. Throughout its history, this was never always true, environmental management was previously the best marketing strategy that was used to attract locators. Heavy industrial plants did not need to undergo an extensive two-year EIA process, the programmatic system cuts down the process by about a year, with PNOC doing the bulk of the environmental studies upfront. Many petrochemical firms were excited about the possibility of a naphtha cracker being built in Bataan, and an integrated petrochemical estate was the dream. This sadly did not push through.

This situation is compounded by an urgent corporate need for PNOC to develop new, stable revenue streams to replace those from declining legacy assets which are becoming too costly to maintain and to justify government funding and expenditure. While the symptoms are clear, the root causes behind this persistent stagnation require a systematic investigation. It is hypothesized that foundational issues within the Park's governance, including a passive landlord-tenant model and outdated legal agreements, no new locators which may have provided better venues for symbiosis, among others may be key factors preventing modernization and deterring new investment. Likewise, there is a need to further market the Park's inherent advantages; faster EIA process, risk-based master planning, a protected Bay which is the prime location for a harbor, near Manila, among others. Reorganizing the Park as an EIP will further cement these advantages not only to potential locators but also to the public in general.

A significant gap appears to exist between the Park's current operations and the internationally recognized Eco-Industrial Park (EIP) framework that will provide the strategic economic, social, and environmental benefits. This study is designed to formally investigate this gap, providing a necessary analysis to chart a viable path forward.

VI. SCOPE AND LIMITATIONS

This study uses and applies established international frameworks for eco-industrial parks as stated above—particularly those developed by organizations such as the World Bank, UNIDO, and GIZ—to the PNOC Industrial Park in Bataan, Philippines. The scope of the study includes the following:

- an assessment of current Park management, environmental, social and economic management practices within the park,
- identification of key challenges in achieving sustainable industrial development,
- comparative analysis of how international standards and strategies can be adapted to the local context.

The study is, however limited to the use of secondary, key informant interviews, and available documentation provided by relevant agencies and stakeholders. It does not include a full environmental impact assessment or primary data collection such as environmental sampling or on-site audits. The last environmental impact assessment was created about 25 years ago and only some are relevant information. Additionally, while the study assesses social and economic factors as required by the EIP framework, its primary focus is on the governance and environmental management systems needed for the transformation.

The key informant for this study is the Park Manager due to his comprehensive understanding of the PNOC Industrial Park's operations, existing infrastructures, challenges and issues. His insights are critical for providing an accurate perspective on the Park Management and operations. Likewise, a previous member of the environmental management team who was also responsible for the programmatic system and the risk-based masterplan provided his inputs.

The recommendations provided are intended as strategic guidance for estate management and plant operators' policy and planning purposes and will require further validation through more comprehensive feasibility studies or pilot implementations before capital investment.

VII. DESCRIPTION OF THE STUDY AREA

The PNOC Industrial Park is located in the province of Bataan, approximately 40 kilometers west of Metro Manila across Manila Bay, and about 140 kilometers by land via the North Luzon Expressway. It covers a total area of 557.2 hectares, which includes 530 hectares of reserved industrial land and 27.2 hectares proposed for reclamation. It is situated across two barangays—Barangay Lamao in the municipality of Limay and Barangay Batangas Dos in the municipality of Mariveles. The Park is bisected by the Lamao River, which serves as the natural boundary between the two municipalities and divides the northern unused portion and the southern portion of the site.

The Roman National Highway runs through the site, with the eastern portion fronting Manila Bay and the western area extending toward the foothills of Mt. Limay. Surrounding the park are several major industrial and energy facilities, including Planters Products, Inc., Limay Grinding Mill, the Petron Bataan Refinery, the National Power Corporation (NPC) Thermal Power Plant, and the ABB Combined Cycle Power Plant. In the western border of the park lies the Department of National Defense (DND) Arsenal.

The PNOC Industrial Park currently holds a Programmatic Environmental Compliance Certificate (PECC), a unique facet of the Philippine Environmental Impact Statement law, which enables integrated environmental management under a unified regulatory framework that enjoys some degree of autonomy in designing the park within Philippine laws and regulations. The Park has a total designated industrial area of 530 hectares but current development is limited, with existing locators consisting of a propylene (PP) plant, a polyvinyl chloride (PVC) plant, a polyethylene (PE) plant, an

explosives manufacturing facility, and a non-combustion treatment facility for persistent organic pollutants (POPs). This programmatic system is a key feature that can set the Park apart from other possible industrial sites. Since the ECC has been pre-approved for the entire site, new locators need not apply for an ECC at the DENR EMB national or regional office but must satisfy the requirements of PNOC for a Certificate of Conformance (COC) to the Programmatic ECC.

Under Presidential Decree No. 10516, the use of the PNOC Industrial Park, once limited to petrochemical and related industries, has been expanded to formally accommodate energy and energy-related industries. This legislative directive aligns with the Philippine government's broader agenda of promoting industrial diversification, energy security, and sustainable economic development and opens up an area near the capital for further energy development.

Below is a photo of the map of PNOC Industrial Park:

Figure 7. 1 Map of the PNOC Industrial Park.



The Industrial Park has several industrial locators, each using different chemical processes and, therefore, different raw materials and products. These include a Polyvinyl Chloride (PVC) plant (15.65 ha.); a Polyethylene (PE) plant (18.72 ha.); an explosives manufacturing facility (90 ha.); a Polypropylene (PP) plant (21.88 ha.); and a Non-Combustion POPs (Persistent Organic Pollutants) Destruction Facility (0.82 ha). Support facilities include a substation (1.39 ha.) and a Steam methane Reforming Plant (1.39 ha.).

The total area of the Industrial Park spans 557.2 hectares, of which about 227.51 hectares has been fenced for secure operations. Of this, approximately 139.96 hectares are occupied by the industrial plants themselves, while 57.93 hectares are

currently inhabited by informal dwellers. The remaining 284.35 hectares are open for future development, offering significant opportunities for expansion and new projects within the Park.

Within the context of this paper, the occupied areas in the Park are identified as brownfield sites, which refer to land that has been developed and used for industrial purposes, and may contain existing infrastructures and structures. Available lots are classified as greenfield sites, referring to undeveloped land that has not been previously used for industrial activities and is available for new development.

Table 7.1

Geographic coordinates of the PNOC Industrial Park

	Latitude	Longitude
1	14°31'5.42"N	120°36'30.62"E
2	14°31'8.85"N	120°36'11.26"E
3	4°31'11.45"N	120°36'4.41"E
4	14°31'4.88"N	120°35'49.66"E
5	4°30'57.01"N	120°34'58.77"E
6	4°30'40.45"N	120°35'6.39"E
7	4°30'27.27"N	120°35'20.55"E
8	4°30'17.07"N	120°35'13.75"E
9	14°30'2.82"N	120°35'9.39"E
10	14°30'2.82"N	120°35'17.05"E
11	14°30'14.13"N	120°35'38.92"E
12	4°30'16.76"N	120°36'11.30"E
13	14°29'44.36"N	120°35'57.43"E

14	4°29'28.89"N	120°36'3.65"E
15	14°29'26.55"N	120°36'10.73"E
16	14°29'22.06"N	120°36'26.44"E
17	14°29'20.56"N	120°36'30.98"E
18	14°29'46.29"N	120°36'33.29"E
19	14°30'7.43"N	120°36'36.87"E
20	14°30'32.11"N	120°36'38.45"E
21	14°30'50.07"N	120°36'36.51"E

VIII. METHODOLOGY

Research Design

This study employs a mixed-methods research design, integrating a myriad of quantitative and qualitative techniques to evaluate the applicability of several international Eco-Industrial Park (EIP) frameworks to the specific context of the PNOC Industrial Park for it to become an EIP.

A survey of employees and locators was also conducted as an interview instrument and this survey was designed to gather specific information on Park Management and Governance, Environmental Management and Performance, Social and Economic Performance, and Risk Management.

Data Collection

Data acquisition involved gathering secondary information of which the Park provided quite a number of, considering that the environmental and social monitoring has been ongoing since its inception. Quantitative secondary data consisted of environmental quality monitoring reports from PNOC Industrial Park which are submitted to the DENR-EMB covering the preceding three years, specifically detailing air, water, and noise pollution levels and hazardous wastes. Qualitative secondary data were obtained which included procedures and manuals and minutes of Parkwide Meetings, to gain insights into existing operational practices and challenges. Secondary data collection involved reviewing relevant national and local policies and regulations including locator park policies, established industry best practices concerning sustainable industrial operations in the Philippines, and analyzing the prominent international EIP frameworks developed by the World Bank, UNIDO, and GIZ.

Data Analysis and Gap Identification

A multi-faceted mixed method comparative analysis was conducted to systematically identify discrepancies between the Park's current state and international EIP standards. A structured gap analysis methodology was employed, using a detailed matrix to compare PNOC's existing management practices, policies, and operational data against the key principles, standards, and performance indicators from the World Bank, UNIDO, and GIZ frameworks. Placing these existing practices against the requirements of the frameworks shows specific variances ("gaps") across Park management, environmental, social, and economic domains.

Roadmap Development and Limitations

Following the gap analysis, the required actions to narrow or remove the gaps were assessed based on the plans formulated in the frameworks. Based on this comprehensive analysis, a feasible, step by step and time-bound implementation roadmap was developed, proposing strategies for policy enhancements, infrastructure development, and improved stakeholder engagement aligned with EIP principles.

The research did not include new environmental sampling or on-site audits, but there is a plethora of recent environmental and social data that may be used which can supplant this data. The recommendations that are provided as part of the study are intended as strategic guidance for policy and planning purposes and will require further validation through more comprehensive feasibility studies or pilot implementations before any capital investment.

IX. RESULTS

Current environmental practices in PNOC Industrial Park

Overview of existing sustainability initiatives and regulatory compliance.

Park Management

Management and Governance Structure. The PNOC Industrial Park is owned by the Philippine National Oil Company and is managed by PNOC's Park Management Department, operating under the supervision of the Senior Vice President for Finance and Administrative Services. In conjunction with the Asset Management Department, the Park Management Department oversees property management functions, including Master Planning or land allotment, development oversight and land use monitoring.

The Park Management Department is divided into 3 divisions: the Environmental Management and Technical Services Division (EMTSD), the Construction, Facilities, and Equipment Management Division (CFEMD), and Support Services Division (SSD). While the department is currently staffed with 14 out of 24 approved Plantilla personnel, its day-to-day operations are supplemented by a contracted workforce comprising of 54 security personnel and 20 ground maintenance personnel.

The PNOC Industrial Park covers a 530-hectare industrial property. The administration, management, and ownership of this land parcel were vested in PNOC by virtue of P.D. No. 949. This decree transferred the property to PNOC "subject to private rights, if any". With this, PNOC holds the title to the majority of the Industrial

Park, except for land parcels occupied by the PVC, PP, and PE Plant, as these were acquired by their respective companies prior to the government's 1976 proclamation.

The Park Management Department's core responsibilities include: overall administration, operation and development of the Industrial Park, management and maintenance of common areas and facilities, ensuring environmental compliance, ensuring safety and security of Park perimeter and assets, and in charge of Locator relations.

Park Services and Infrastructure. PNOC's management approach varies based on land ownership. For Locators leasing land from PNOC (Explosives Plant and Non-Com POPs Facility), the company manages Lease and Locatorship Agreements. For entities that own their land (PVC Plant, PP Plant and PE Plant), PNOC manages a Locatorship Agreement. This governs their operations within the Park and the use of common areas and facilities. This variability in PNOC's management approach has created a disadvantage for the PNOC's transformation goals as this will hinder the provision of critical centralized services, and will ultimately undermine the Park's strategic transformation.

The Park's approved Master Plans from 2002 and 2018 have both failed to materialize, largely due to the inability to secure key projects and a recurring pattern of failed lease negotiations. For example, the planned Naphtha Cracker Plant (included in the 2002 masterplan) which is a critical component of the original vision, was constructed in Batangas instead. More recently, the proposed Chlor Alkali Project (which was also included in the 2002 and 2018 masterplan), which has already completed the EIA phase, was also cancelled due to economic and financial constraints. Initial interest from several potential locators were also received over the

years, however, these companies or industries eventually do not proceed with a lease agreement.

An in-house maintenance team conducts regular upkeep and repair for Park and the Park is also responsible for perimeter security, operating a total of 16 surveillance cameras, and has emergency response equipment and trained personnel.

The Park also provides the landscaping of common areas, maintenance of buffer zone, ensures sufficient lighting, and conducts regular street cleaning.

Waste management (collection) is decentralized. Each locator is individually responsible for contracting accredited haulers for waste collection, hauling, treatment and disposal. There is currently no centralized waste collection and treatment system.

Regular Parkwide meetings are held with Locators to report on their current operational status and address collective issues. PNOC's team presents reports on ESH compliance and activities, the current status of Park equipment, recent CSR initiatives and disseminates new policies. Following these updates, Locator representatives are given the floor to address pressing issues, with recurring topics including the rehabilitation of the Jetty Facility, Fire Engine Capacity Testing, and inadequate ground maintenance.

Deficiencies and Limitations. As discussed above, Locators are currently unsatisfied with the current state of common infrastructure, citing major issues such as the dilapidated Jetty, low current pressure and poorly maintained common area. These have not been upgraded much since the Park's conception in the 90's.

All Locators in the Park have signed either a Lease and Locatorship Agreement or a Locatorship Agreement. A review of these Locatorship Agreements shows critical weaknesses that may have impeded Park Management and its future development

- Inconsistent management fees – Lack of consistency in fee structures (PVC Plant has no provision of 17.5% management fee, which is applied to others) creates inequity, which will make it difficult to fairly fund shared environmental initiatives, resources management and efficiency projects, and other common services for an EIP;
- Absence of Locators' Association – The Locatorship agreements do not mandate the creation of a Locators' Association, which will weaken collective governance and hinders implementation of key EIP functions such as Industrial Symbiosis planning, integrated environmental initiatives, and by-product exchange;
- Weak environmental compliance clauses – Although the existing locatorship agreements states the need for compliance to the PECC and CoC, these do not bind locators to higher EIP standards like sharing of resources, GHG reduction targets, or circular economy practices;
- Limited rights for Centralized Utilities – PNOC's right to provide centralized utilities is not universally applied to all agreements. Achieving parkwide environmental sustainability targets through integrated facilities (centralized WWTP, shared renewable energy, etc.) may not be feasible without enforceable utility facilities;
- Insufficient enforcement and collection mechanism – the absence of strong lien provision in the agreements limit PNOC's leverage to enforce payments, especially for new EIP-related services or green infrastructure costs;

- Restrictive pre-termination clauses – this will hinder PNOC’s ability to recover or repurpose land for higher-value EIP uses or to effectively manage non-cooperating locators;
- Outdated Fees for key services – rates have decades old basis for enforcement and a new set of standard rates may be needed to build further infrastructure as required.

Design and Construction. The PNOC Industrial Park is equipped with comprehensive but aging infrastructure designed to support industrial operations with an emphasis on reliability, safety, and environmental compliance. These were state of the art in the 1990s but are now old and outmoded. The Park also operates a feedstock pier that includes a port facility with a rock causeway, berthing pier, jetty platform, and integrated firefighting systems to support marine and loading activities.

Water supply is sourced from several deep wells in the property and is distributed throughout the Park via a pressurized piping network powered by pumps and motors. This system serves both industrial processes and domestic needs. Separate from the raw water system, the fire water system is maintained through a dedicated network supported by six (6) fire engines, strategically located across the Park to ensure immediate response capability. These include designated fire engines at the Jetty Area and R1 Area, each equipped with its own diesel supply tank to ensure independent operational readiness. However, as of the writing of this report, only 4 of these fire engines are operational (2 out of the 3 fire engines in Jetty are not operational). Water provided is generally raw and is somewhat turbid so all locators have their own water treatment systems.

Power distribution within the Park is supported by a centralized system though some locators opt for a direct connection to the grid, with provisions for continuity

through standby generator sets (gensets). To sustain generator operations during power interruptions for the water supply system, dedicated diesel storage tanks are installed for Genset 1, Genset 2, and Genset 5. Additional diesel tanks are provided specifically for the Jetty Fire Engine and R1 Fire Engine to support emergency response activities.

Regular infrastructure includes a wide two-lane road network for trucks and storm drainage system for efficient transportation and flood management, perimeter security systems, electrical power distribution system for common areas and facilities, fire protection equipment, and on-site medical support. This integrated infrastructure enables the PNOC Industrial Park to maintain operational resilience while ensuring the safety and well-being of its locators and personnel.

Monitoring and Risk Management. Apart from some monitoring done by its locators, PNOC regularly monitors environmental performance of the Industrial Park through conduct of quarterly Water Quality, Air Quality, and Noise Level Monitoring – these are regularly reported to DENR through submission of the Park’s Self-Monitoring Report (SMR), Compliance Monitoring Report (CMR) and Compliance Monitoring and Validation Report (CMVR). The Park also hold ISO 9001:2015, 14001:2015, and 45001:2018 certifications limited only to the Management of Facilities and Administration of the Industrial Park (Raw and fire water distribution system operation and maintenance, road network and drainage maintenance, power distribution system maintenance, jetty operation and administration, locator management and park administration), as well as a Programmatic ECC for the 530-ha land area.

PNOC and some Locators conduct Social Development Programs, however, these efforts are not integrated into a consolidated performance report. The key gap with the International Framework is a lack of a unified system that consolidates

environmental, social, and economic performance data for a holistic, park-level review every 6 months, as required.

The Park's emergency management operates on a clearly delineated two-level response system. PNOC's Emergency Response Plan (ERP) directly covers all incidents within the common areas, but for emergencies originating from Locator Plants, the locator will serve as the primary responder, and is responsible for activating their Emergency Response Plan and Team. During these events, PNOC will provide the support and resources as the secondary responder.

PNOC has plans for immediate disasters, however, there is no long-term climate change adaption strategy. There are no plans to address risks such as drought, groundwater depletion, sea-level rise, or increased typhoon intensity, which are highly relevant given that the Park is located near Bataan's coast.

While PNOC is anchored to the Programmatic ECC and ISO 14001, PNOC manages its own compliance. Waste management, for example, is decentralized – there is no unified system to ensure best practices among locators.

Planning and Zoning. The Park's master plan has been dynamic and has evolved; however, it still lacks the single, comprehensive and up-to-date plan that aligns with the pre-requisites of EIP.

The 2002 Master Plan has envisioned a dedicated petrochemical complex (upstream, midstream, and downstream). By 2018, the vision shifted to a mix of existing petrochemical plants and new energy industries. This shift was a result of R.A. 10516, which expanded the Park's utilization to energy and energy related industries.

There are current planning efforts as PNOC Management acknowledge the need to update the Master Plan and is currently in the process of procuring a

consultant to develop a master plan for PIP-2 (part of the 530-hectare land, outside of the fenced area). Furthermore, PNOC engages in planning activities with the LGU and housing authorities to address concerns regarding illegal settlers in PNOC land.

PNOC has its own rules and protocols for accepting Locators for the PNOC Industrial Park. The types of plants or facilities are allowed to operate at the Park: a. Manufacturers or Processors of Petrochemicals, b. Utility Providers, and c. Service Providers, d. Energy and energy-related infrastructures, and e. Other business activities will promote the Park's best economic use (as determined by the PNOC Board of Directors).

The proponent shall submit a formal expression of interest to PNOC, which would trigger discussions between the two parties. Initial site visits and technical discussions will be conducted afterwards to identify possible site for the proposed project. The initial identification of a project's location will be based on the size of the lot the project requires, and later on, the location will be confirmed through the conduct of a Quantitative Risk Assessment (QRA) using PHAST SAFETI. A pre-feasibility study and confirmation of interest to locate and the Park would be the next step if the proponent is convinced that the Park is indeed the best site for its project. PNOC will then conduct a technical evaluation of the project's Feasibility Study and Environmental Impact Assessment (EIA).

Historically, several companies have already expressed their interest in locating at the PNOC Industrial Park. Proposals have included an energy city, a bio plant farm with production facilities, solar farms, a chlor-alkali plant, and an LNG Plant. However, for unknown reasons, they do not proceed beyond initial site visits and technical discussions, with the proponents not proceeding with their applications to locate at the Park.

Environment

Management and Monitoring. PNOC Industrial Park is ISO 14001:2015-certified. However, the scope of the certification is limited only to the Management of Facilities and Administration of the Industrial Park (Raw and fire water distribution system operation and maintenance, road network and drainage maintenance, power distribution system maintenance, jetty operation and administration, locator management and park administration). This certification does not cover the environmental management systems within each individual locator's plants. Based on interviews with locators, it was found that only 2 out of 5 locators currently hold their own ISO 14001 Certifications (PVC Plant and Explosives Plant).

PNOC employs several mechanisms to monitor the compliance of Locators. This includes direct oversight through commissioning of third-party laboratory to conduct effluent sampling, ambient air and noise monitoring. Additionally, PNOC tracks compliance through mandatory submission of SMRs from each Locator. Further, compliance is also enforced through specific conditions on the CoC (ex. Submission of monthly production report, CSR plans, etc.)

Energy. The Park's energy supply is sourced from the national grid through a local distributor and conventional power generator, which means that the energy consumed is mostly generated from fossil fuels, resulting in a very high carbon footprint.

Table 9.1*2022 to 2024 Power Consumption of PNOC Industrial Park*

	2022	2023	2024
PNOC	1,877,870.00	1,644,200.00	1,385,690.00
PVC Plant	35,305,589.04	34,906,858.16	35,106,223.60
PP Plant	9,504,926.04	13,821,136.18	5,188,715.90
Explosives Plant	1,148,000.00	3,761,100.00	2,108,424.28
PE Plant	126,020.00	126,000.00	126,000.00
Non Com POPs	34,247.60	53,689.08	57,305.96
	47,996,652.68	54,312,983.42	43,972,359.74

Based on 2022-2024 data, the PVC Plant is the Park's largest and most consistent energy consumer, whereas the consumption is stable due to the continuous operations of the plant. PP Plant on the other hand showed volatility in power consumption due to shutdown of operations. The PE Plant and Non- Com POPs are small energy consumers as the former is on shutdown operations and the latter is on minimal operations.

The Park's reliance on a grid supplied by major coal-fired power generators is a direct opposite to the EIP principles of decarbonization and sustainability. The Park is currently a passive consumer of conventional energy, which is a misalignment with the EIP standards.

In alignment with Eco-Industrial Park (EIP) principles, several energy initiatives are implemented within the park. The Park administration has already demonstrated a commitment to renewable energy by installing solar-powered streetlights for common infrastructure. At the locator level, the most significant initiative is the PVC

Plant's proposed 4.5–7.6 MW Cogeneration facility, which exemplifies industrial symbiosis by generating both heat and power to drastically improve its energy efficiency. Furthermore, both Park management and various locators report the implementation of ongoing energy conservation programs to support these efforts.

Water. Water quality is safeguarded through routine and comprehensive monitoring of effluent discharges to ensure full compliance with applicable environmental standards. The performance of the Industrial Park's wastewater management system is benchmarked against the Total Maximum Daily Load (TMDL), which is computed annually. This TMDL defines the maximum amount of a specific pollutant that the water body can carry without exceeding water quality standards. Based on the combined contribution of all current Locators, the Park's actual computed load (ACL) is measured against its TMDL allocation (this TMDL allocation is declared/stipulated in the Park's Programmatic ECC).

Results from 2022 to 2024 show that the Park operated only at a fraction of its allowable limits. For Biochemical Oxygen Demand (BOD), the usage was consistently low. With a TMDL allocation of 5,850 kg/day, the usage was only at 1.6283% in 2022 and at 0.0969% in 2024.

Other heavy metals and phenolic substances' ACL also show control over hazardous discharges. For Phenols, Mercury (Hg), Arsenic (As), Cadmium (Cd), Chromium (Cr), and Lead (Pb), the actual loads used are only at 0.0571%, 0.100%, 0.0291%, 0.0306%, 0.0093% and 0.0396% respectively. A detailed table on these is shown in Annex B.

Additionally, key parameters—including temperature, pH, color, heavy metals, organic matter, nutrients, and microbial content—are regularly assessed, with monitoring results detailed in Annex C. From 2022 to 2024, all measured values

consistently remained within the allowable limits set by regulatory authorities. Dissolved oxygen levels remained at healthy levels, while both biochemical oxygen demand (BOD) and chemical oxygen demand (COD) values—although slightly elevated in late 2024—continued to meet compliance thresholds. Concentrations of heavy metals in wastewater such as arsenic, cadmium, mercury, lead, and hexavalent chromium were consistently below detection limits or present only at trace levels all throughout the testing period. Similarly, nutrients, oil and grease, suspended solids, phenols, and microbial counts were all maintained within permissible ranges, affirming the reliability and effectiveness of the wastewater management system in place. Within each locator are wastewater treatment plants that treat whatever wastewaters it creates.

The Park's average annual groundwater extraction between 2022 and 2024 remained between 1.658 and 2.532 MCM, volume that is below the Park's established Safe Yield for extraction as provided by the National Water Resources Board. Control is maintained even at the level of Locators, where individual usage limits are stipulated as a condition of their Certificate of Conformance (CoC). Water Balance studies have been done for petrochemical operations and may need to be updated if energy infrastructure will be built in the Park.

Air Quality Management. Air quality management is maintained through regular monitoring of key pollutants, including sulfur oxides (SO_x), nitrogen oxides (NO_x), particulate matter (PM₁₀), total suspended particulates (TSP), and lead (Pb). Lead was included since this was an important air pollution in the 80s and 90s and which has tapered off only with the use of unleaded gasoline in the late 90s. From 2022 to 2024, results have consistently shown concentrations were fully compliant and well below national regulatory limits, where the results are tabulated in Annex A. SO₂

and NO₂ readings were frequently below detectable levels, indicating minimal emissions or highly effective control technologies. While PM₁₀ and TSP levels varied slightly over time and across sites—particularly near school zones—they remained within acceptable limits. Lead concentrations were negligible throughout the period, demonstrating excellent control or the absence of significant sources.

PNOC tracks its own Greenhouse Gas (GHG) emissions through an inventory of its fuel and electricity consumption. To expand this monitoring park-wide, the Certificate of Compliance (CoC) for locators issued from 2019 onwards now includes a mandatory condition for the submission of Annual GHG Inventories. However, a data gap exists as this requirement does not apply to locators with CoCs issued prior to 2019.

Waste and Material use. The PNOC Industrial Park has implemented a comprehensive and structured approach to resource conservation and waste management, guided by its official Resource Conservation Manual. The Park actively works to minimize the consumption of electricity, water, paper, and fuel through specific, enforced policies that are communicated to its locators.

Key conservation measures include the installation of water-saving fixtures, regular leak inspections, and promoting responsible water use among employees. Paper usage is reduced through a "paperless meeting" policy, encouraging digital documentation, and mandating double-sided printing. Fuel conservation is addressed by optimizing vehicle trips, promoting carpooling, and ensuring regular maintenance of generators and service vehicles. These efforts extend to office supplies, with an emphasis on reusing materials and transitioning to digital processes.

Waste management follows a strict hierarchy focused on segregation at the source into biodegradable, recyclable, non-biodegradable, and hazardous categories.

Recyclable materials are processed at a dedicated Materials Recovery Facility (MRF), the management of which is overseen by the PNOC PCO -for non-hazardous solid wastes generated by PNOC alone while hazardous wastes are securely handled and transferred to accredited treatment facilities. This systematic approach, combined with continuous training and sustainability initiatives like reducing single-use plastics, underscores the Park's commitment to minimizing its environmental footprint, improving operational efficiency, and serving as a model for responsible industrial development.

The Park and its Locators generate a variety of hazardous wastes, including used oils, solvent, paint sludge, contaminated materials, used lead-acid batteries, busted fluorescent lamps. To ensure proper handling and disposal of these hazardous wastes, both the Park and Locators engage third-party DENR accredited haulers. For resource recovery, the rice hull ash generated by the PVC Plant is transported to and reused by other firms in neighboring municipalities. For non-hazardous solid wastes, locators follow standard disposal routes, either selling or donating recyclables and discarding residual wastes to accredited sanitary landfills. As of date, no Locator uses another locator wastes and/or by-product.

Climate Change and the natural environment. The Park operates under the Programmatic ECC issued in 2002, which established the foundational environmental standards for the Industrial Park. This is supported by risk management actions such as the Qualitative Risk Assessments conducted in 2022 and 2018 using DNV's PHAST SAFETI, which resulted in mitigating measures being implemented to safeguard additional structures of current locators.

In line with this, all locators also have their own risk management framework and utilizes pollution prevention and emission reduction technologies for their

operations. While the Park conducts Ambient Air Quality Monitoring and Management, the monitoring of each individual locator's fugitive emissions has not yet been translated into a comprehensive, Park-level GHG inventory.

Despite these, a dedicated climate change adaptation strategy and specific GHG reduction target for the Park as a whole was not seen. Although PNOC conducts its yearly GHG inventory, the requirement for Locators to submit individual inventories was only recently implemented (since 2019). Consequently, a comprehensive, Park-level GHG inventory has yet to be consolidated -this was noted to be a significant gap for an industrial park aiming to become an EIP.

Social

The Park lacks dedicated personnel focused on strategically planning and managing social quality standards. While the responsibility for CSR activities is assigned to an Administrative Officer IV, this is not her primary role. Her involvement is limited to the administrative functions of preparing budget requests and facilitating occasional events rather than strategic program development. Activities are most often repetitive every year, with the usual activities such as tree planting, coastal cleanup, donations (upon request of the barangay), and partnership with the host community for skills training program. This confirms that the Park's current social initiatives are largely symbolic and lack the continuous, strategic oversight required by the EIP framework.

While there are plans for housing projects, their focus is on addressing the issue of illegal settlers occupying PNOC properties, not on providing essential social infrastructure for the Park's locators and their employees. This means that key infrastructure needs of the Park's working community are not being met by current initiatives, representing a significant gap in fulfilling the EIP standard.

Social Management Systems. All of the Locators in the Industrial Park have active Occupational Safety and Health (OH&S) Management System as this is a mandatory requirement under DOLE Department Order No. 198-18, which stipulates the formation of an OSH Committee for every workplace.

To ensure Park-wide coordination, a representative from each Locator's OSH Committee takes part of the Parkwide HSSE Committee. This serves as the platform conducted monthly for locators to report on their compliance status, as well as incidents and accidents within their Plants.

The Park Management has shown efficiency in handling minor complaints, such as those related to grass cutting, water line repairs, billing queries, and other assistance requests. These issues are most often address promptly and updates are provided to the Locators.

However, there was a significant backlog in resolving complaints on major infrastructure – a.) the Park's Jetty which is already dilapidated and in an unsafe condition for the past 10 years, posing a serious concern, and 2.) a recurring issue, repeatedly raised by the PP Plant over the last year, which is the failure of PNOC to provide capacity testing results for the Jetty Fire Engines. These long overdue issues highlight a critical gap in the management of infrastructure assets and response to safety concerns.

Social Infrastructure. The last Customer Satisfaction Survey (CSS), conducted in 2021, commissioned through UPLBFI, indicated a high level of overall satisfaction among the Locators. This CS engaged senior management and key officers from the Locators, who emphasized that staff performance and service delivery were key strengths while raising concerns regarding facility maintenance and slow response time in addressing issues (operational weaknesses). Since 2021, this

survey has been replaced by a more limited, transaction-based feedback form under ARTA Citizens Charter, narrowing the scope of official Locator feedback. This new feedback mechanism is typically completed by junior staff or messengers (tasked to process documents at the Park Admin), changing the nature and depth of customer feedback received by the Park.

Compared with the previous survey mechanism, the shift in respondent profile means that the feedback received is now tactical rather than strategic. The ARTA survey is limited to measuring performance on certain transactions, such as issuance of work permits, construction debris disposal permits, vehicle stickers, entry permits, invoices, and berthing permit approvals, as well as the receipt of documents, complaints, collections, and the provision of fire water. It no longer includes the broader perspective of locator management on the overall customer service, Park operations, and infrastructure.

From the perspective of an EIP, social infrastructure typically involves facilities and programs designed to improve the quality of life and well-being and community integration of the workforce and the surrounding community.

Based on the interview with the Park Manager, the PNOC Industrial Park's current employee welfare facilities and social provisions are limited to the following:

- a.) Food services: no centralized canteen or food services provided by the Park, locators are responsible for own provision;
- b.) Recreational facilities: there is a designated jogging/bike lane within the Park area;
- c.) Healthcare: some locators have their own clinic, but there is no central clinic managed by PNOC;
- d.) Spiritual spaces: there are no dedicated prayer rooms or multi-faith spaces available within the Park;

e.) Worker accommodation and transportation: worker housing, accommodation, and transportation are provided to selected employees of some individual locators, not as a universal Park service.

Local Community Outreach. PNOC does not currently maintain a schedule of regular, proactive dialogues with the host community. Community engagement is at present, reactive and project-driven, during project proposals and Environmental Impact Assessment (EIA) preparations.

In the last year, the only community outreach initiative was a bread-making skills training, which was conducted in coordination with Barangay Batangas Dos (host community) and TESDA. PNOC's role was limited to sponsoring the ingredients while Brgy. Batangas Dos was responsible for the overall coordination and facilitation of the event. A survey on the community's perception was conducted in line with this single program and it was noted that this was the first feedback gathered in recent years. However, this practice was not sustained, as no surveys were initiated for subsequent CSR activities in early 2025 (ex. Donation Drive for Brigada Eskwela, Coastal Cleanup, and [Donation for] Operation Tuli) and the result of the conducted survey was not reflected in the succeeding year's projects and programs for the community.

Economic

As a Government-Owned and Controlled Corporation (GOCC), PNOC's mandate and projects are aligned with national strategies like the Philippine Energy Plan (PEP) and Philippine Development Plan, which include employment generation targets. New investments and locators in the Park are implicitly tied to these national job creation goals.

Employment Generation. Majority of the Park's total workforce resides within daily commuting distance. The accessibility of the Industrial Park is supported by

Bataan's public transport. In addition to these, each locator provides dedicated service vehicles and shuttle vehicle for their local employees. Further, some locators provide nearby housing facilities for their staff (PP Plant, PVC Plant and Explosives Plant).

The Park and its locators utilized both direct hires and contracted services. Regular workers are employed directly by PNOC and Locators. In addition, both Park and its locators engage third- party agencies to staff non-core functions (security and maintenance staff).

Recent and future projects emphasize the Park's role in job creation. For example, the recent PP Plant project (installation of a transfer line from the Refinery to the Park), required 228 workers for the construction phase and created 90 new permanent positions for direct labor of the new line. Moving forward, the projected development of the PVC Plant's new facility is expected to even greater employment opportunities, with an estimated requirement of 1,163 workers for the construction phase alone.

Local Business and SME promotion. Based on the approved Master Plans of the Industrial Park, the main focus is to attract and host large-scale industries, however, the plan also accommodates establishments of smaller facilities and businesses that can provide support to the primary Locators.

The Locators within the Park utilize a flexing procurement strategy, making use of both locally sourced and imported materials depending on the requirements of their operation. For small value procurements need of PNOC, sourcing of goods and services from local providers are prioritized.

Economic Value Creation. As of writing, there are no specific, large-scale green infrastructure projects such as central solar farm or waste-to-energy plants planned for the Park. A water recycling facility has been identified as a potential

opportunity to enhance sustainability, however, this proposal has not yet advanced to a formal study phase.

For economic contribution, as a Government-Owned and Controlled Corporation (GOCC), the Philippine National Oil Company (PNOC) adheres to strict financial reporting requirements. It submits regular performance reports, including revenues and contributions to the national government, to oversight bodies such as the Governance Commission for GOCCs (GCG). The operations and investments facilitated by the Park contribute directly to national economic targets.

The Park, at present, shows a profile of low occupancy but Locator stability is noted. While the current Locators occupy less than 25% of the Park's total area, the commitment of these companies is key indicator of their strategic value.

All current locators own their land (except for the Explosives Plant) and have maintained continuous operations in the Park since 1996. This high degree of stability among these Locators show that the Park is a proven and valuable location for long-term industrial investment.

Identified gaps from EIP pre-requisites

Below are tables which provide a systematic gap analysis of current state and practices of PNOC Industrial Park vs. the pre-requisites of the EIP framework. This assessment covers 4 key topics: Park Management Services, Environment, Social and Economic Performance. Each table align specific benchmarks and a direct evaluation whether the Park currently meets the standards.

Table 9. 2

Park Management Performance vs. EIP Pre-requisites

Topic	EIP pre-requisites and performance indicators	Does Park meet EIP benchm ark AT PRESE NT	Identified Gaps
PRE-REQUISITES (MUST HAVES FOR EIP)			

Park Management services	A distinct park management entity (or alternative agency, where applicable) exists to handle park planning, operations and management, and monitoring.	No	PNOC serves most likely as an administrative arm, and not a distinct, empowered EIP management entity. It lacks the authority (to current locators) and strategic focus to implement Parkwide EIP policies.
	Park management entity to manage and maintain the industrial park property, common infrastructure, and services as prescribed in the tenant contract and the park's Master Plan. This should include, but is not limited to the following: • Property management, including plot allotments, re-allotments, development, land use monitoring, and so on.	No	(Partial) Basic property management is observed, however, PNOC's failure to execute the approved master plans and secure key locators and industries indicates a serious weakness in property development and attraction to investments. (No) The lack of maintenance of major infrastructure is a safety issue. The Park lacks the legal and operational capacity to develop centralized EIP facilities (such as Centralized WWTP) as the right to build these types of facilities is not guaranteed in all Locatorship Agreements.

• Utilities, roads, and technical units such as waste and wastewater treatment plants and operations, power and energy systems. • Waste collection areas and services. • Maintenance and repair workshops. • Security and emergency response services and facilities. • Common landscaping, buffer zones, street lighting, security surveillance and street cleaning. • Common employee and tenant facilities.	(No) There is an absence centralized waste collection service, preventing opportunities for resource recovery, cost sharing, or ensuring best practices Parkwide. (Yes) An in-house maintenance team is in place. (Partial) Security and emergency response framework exists but it is severely compromised by non-operational critical equipment (Jetty Fire Engine) (Yes) Landscaping, buffer zones, street lightings, security surveillance and street cleaning (basic services) are provided by the Park Management. (No) The Park does not provide proactive services to facilitate collaboration, networking, industrial symbiosis or joint training to its Locators (Partial) Although there is regular meeting conducted, these engagements are operational and problem-focused and
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	• Provide facilitating services to and between tenant firms (for example, networking, collaboration and training opportunities). • Engagement with the park's stakeholders and business representatives.	non-strategic. Approach to engaging Locators in long-term sustainability, economic development, and partnership with the community are lacking.
Monitoring and Risk Management	Park management entity maintains a monitoring system in place, tracking: • Progress on environmental, social and economic performance at the park level. • Critical risk factors and related responses, at least for:	(No) There is no unified system to track and review environmental, social, and economic performance at a park-wide level. Data is gathered and used for compliance, not for strategic EIP management and continuous improvement. (Partial) An ERP exist, but its reliability is uncertain due to failing safety equipment. Furthermore, the risk plan focuses on immediate incidents and accidents but neglects long-term large-scale risks such as climate change.

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- o Risk points where the accidental release of poisonous solid, liquid and gaseous effluents, including during transportation and disposal when fire hazards are possible; and
 - o Applicable natural disaster risks (for example, earthquakes)

Where required, Park management No has a plan in place to react to possible negative impacts due to climate change risks (heat waves and droughts, storms and floodwater events). All adaption needs for infrastructure and services are identified and in place for the industrial estate to protect against

A complete absence of a strategy to address climate risks such as sea-level rise, groundwater depletion, and increased typhoon intensity. This is a critical failure for a coastal park.

	climate change risks and potential damages.	
	Park management entity has a functioning system in place to comply with local/national regulations and international standards applicable to the industrial park. Park management informs compliance by resident firms including compliance information that firms share with the park management entity.	Yes (Partial) PNOG ensures compliance with national regulations, however, there is no structure to implement or enforce higher EIP standards. In addition, the narrow scope of the ISO 14001 certification of the Industrial Park is misleading regarding the Park's overall performance.
Planning and zoning	A Master Plan (or equivalent planning document) for any new and existing industrial park has been developed and is reviewed	No The Park lacks an updated Master Plan where EIP principles are incorporated. The planning process is reactive and not holistic and fails to integrate key concepts like industrial symbiosis, climate resilience or green infrastructure.

periodically (and updated if required), including the following core elements:

- Site selection study based on various risk analyses; essential and efficient infrastructure, utilities, and transportation network; environmental and social issues; internal park land zoning; buffer zone around the park; procedure to safely locate high risk industries; and cluster synergistic industries.
- Integration into Master Plan of relevant requirements specified in these international EIP benchmarks that have spatial implications.

PERFORMANCE INDICATORS

Park management services	100% of firms in the industrial park have signed a residency contract/ park charter/code of conduct (depending on what is legally binding on park firms according to the existing legislation in the country); and additional legally binding arrangements that empower the park management entity to perform its responsibilities and tasks and charge fees (sometimes absorbed in rental fees) for common services. This may include transparent fees for services	Yes	(Partial) Although all Locators have signed Locatorship and/or Lease Agreements, these agreements have deficiencies and inconsistencies and do not sufficiently empower the management of the Park for EIP functions. These existing agreements lack clauses that enforce higher EIP standards. Likewise, these do not guarantee PNOC's right to build and charge for centralized EIP utilities. Moreover, consistent fee structures are not established in this agreement.
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	pertaining to the achievement of EIP performance targets.	
	At least 75% of resident firms indicate satisfaction with regard to the provision of services and common infrastructure by the park management's entity (or alternative agency, where applicable).	No Although the 2021 CSS showed high satisfaction, recurring complaints about the Jetty structure indicates that this is not met. The Park's failure to maintain critical structures and assets show the Park's inability to provide satisfactory level of service.
Monitoring and Risk management	At least every 6 months, park management entity monitors and prepares consolidated reports regarding the achievement of target values (as documented in this framework) to encompass the following: • Environmental performance;	No Monitoring is fragmented. CMRs and CMVRs only reflect environmental performance (economic performance are not reflected). There is no unified system to consolidate environmental, social, and economic data into a single park level performance report every six months. Social and economic performance are not systematically tracked or reported in a consolidated manner.

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- Social performance;
 - Economic performance; and
 - Critical risk management at the level of the park.
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Table 9.3

Environment Performance vs. EIP Pre-requisites

Topic	EIP pre-requisites and performance indicators	Does Park meet EIP benchmark AT PRESENT	Identified Gaps
PRE-REQUISITES (MUST HAVES FOR EIP)			
Management and Monitoring	Park management entity operates an environmental / energy management system in line with internationally certified standards, monitoring park performance and supporting resident firms in the maintenance of their own firm-level management systems.	Yes	(Partial) The PNOC Park is ISO 14001- certified for Park admin and operations, however, it does not cover Parkwide performance, nor actively supports Locators in achieving certification.

Energy	Supporting programs and documents are in place to improve the energy efficiency of resident firms, especially for the top 50 percent of major energy-consuming businesses in the park.	Yes	(Partial) Although there are general conservation programs, there is no formal, documented, and Park-driven program specifically designed to support the largest energy consumers (PVC and PP Plants) in improving their energy efficiency.
	An industrial heat recovery strategy is in place to investigate opportunities for heat and energy recovery for the major energy-consuming firms in the park. (Typically, these are firms that individually consume at least 10-20 percent of total firm level energy consumption).	No	Although the PVC Plant has a heat recovery project proposal, there is no Park-wide strategy to identify and promote industrial heat and energy recovery opportunities for all locators

Water	Park management entity has No demonstrable plans and (preferably) prior documented evidence to increase water reuse in the short and medium term. This would be achieved by either reuse of industrial effluents, or by rainwater/storm water collection.	Strong compliance on water quality management is observed but there are no seen concrete plans or projects on water reuse, recycling of wastewater, or systematic rainwater/stormwater harvesting to reduce overall water intake.
Climate change and the natural environment	A program is established to monitor, Yes mitigate and/or minimize GHG emissions, such as carbon dioxide (CO ₂), methane (CH ₄), nitrogen oxide (NO _x), and so on. There is clear evidence of steps taken to introduce mitigation activities.	(Partial) There is a program to monitor to GHG, but is incomplete. The GHG monitoring program has a significant data gap from pre-2019 locators, preventing a complete park-level inventory. Mitigation efforts are ad-hoc (e.g., solar lights) rather than part of a comprehensive park-wide decarbonization strategy.

	The park management entity has a plan in place to assess operational environmental impacts, and aims to limit the impact on prioritized local ecosystem services.	No	There is no specific plan to assess the Park's cumulative impacts on prioritized local ecosystem services such as groundwater replenishment, biodiversity re-assessment). Park focuses more on hazard risk and not on the health of the ecosystem.
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PERFORMANCE INDICATORS

Management and Monitoring	At least 40% of resident firms with more than 250 employees have an environmental / energy management system in place that is in line with internationally certified standards.	Yes
Energy	At least 90% of combined park facilities and firm-level energy consumption have metering and monitoring systems in place.	Yes

Total renewable energy use in the industrial park is equal to or greater than the annual national average energy mix.	No	The park is almost entirely reliant on fossil-fuel-based energy, falling short on the national average for RE use.
Park management entity sets and works toward ambitious (beyond industry norms) maximum carbon intensity targets (maximum kilograms of carbon dioxide equivalent (kg CO ₂ -eq) / kilowatt hour (kWh) for the park and its residents. Targets should be established for the short, medium, and long term, in line with local norms and industry sector benchmarks.	No	The Park lacks a key performance metric for decarbonization. It tracks consumption but does not manage carbon efficiency.

	Park management entity sets and works toward ambitious maximum energy intensity targets per production unit (kWh/\$ turnover) for the park and its residents. Targets should be established for the short, medium, and long term, in line with local norms and industry sector benchmarks.	No	Lack of intensity target for energy
Water	100% of total water demand from firms in industrial park do not have significant negative impacts on local water sources or local communities.	Yes	
	At least 95% of industrial wastewater generated by industrial park and resident firms is treated to	Yes	

	appropriate environmental standards.		
	At least 50% of total industrial wastewater from firms in the park is reused responsibly within or outside the industrial park.	No	There is no water reuse (Parkwide), thus, a major opportunity is missed. Despite the effluent meeting the general standards, none of it is being reused, putting unnecessary pressure on groundwater resource.
Waste and material use	At least 20% of solid waste generated by firms is reused by other firms, neighboring communities, or municipalities.	No	While an external symbiosis link exists, the Park has no system to track waste volumes and has not fostered internal consumers or customers from by-product exchange.
	100% of firms in park appropriately handle, store, transport and dispose of toxic and hazardous materials.	Yes	
	Less than 50% of wastes generated by firms in the industrial park goes to landfills.	No	Recyclables are sold/donated and residual wastes are sent to accredited sanitary landfills, but it provides no data on the percentage breakdown of these streams. Since

		there are no Parkwide Waste Audit or consolidated data, there no way to determine the percentage of wastes diverted to landfills
Climate change and the natural environment	At least 5% of open space in the park is used for native flora and fauna.	Yes
	At least 50% of firms in park have pollution prevention and emission reduction strategies to reduce the intensity and mass flow of pollution/emission release beyond national regulations.	Yes
	At least 30% of largest polluters in industrial park have a risk management framework in place that: (a) identifies the aspects which	Yes

have an impact on the environment
and; (b) assign a level of
significance to each environmental
aspect.

Table 9. 4

Social Performance vs. EIP Pre-requisites

Topic	EIP performance indicators	pre-requisites	and Does Park meet EIP benchmark AT PRESENT	Identified Gaps
PRE-REQUISITES (MUST HAVES FOR EIP)				
Social Management Systems	Dedicated personnel exist (as part of the park management entity) to plan		No	There are no dedicated personnel for this function and is handled as a secondary, administrative task by a non-specialist staff member. Since the current personnel

	and manage social quality standards.				lacks the specific mandate and expertise to strategically plan, develop and manage social quality standards, this results in repetitive CSR activities rather than strategic social programs.
Social Infrastructure	Essential primary social	No			There is no planned social infrastructure for the workforce in the masterplan and Park fails to maintain existing common infrastructure in a fully operational and safe condition, therefore impacting the Park community.
PERFORMANCE INDICATORS					
Social management systems	At least 75% of all firms in the industrial park with more than 250 employees have a well-functioning OH&S management system in place.	Yes			

100% of grievances received by the park management entity are addressed within 90 days.	No	Minor grievances are handled immediately, major infra and safety grievances remain unaddressed for years. With this, the Park Management failed to address critical grievances related to infrastructure and safety within the committed timeframe, which indicates system failure in grievance mechanism for significant issues
At least 60% of grievances received by the park management entity are brought to conclusion.	No	Failure to conclude major grievances to a conclusion shows a large deficiency in grievance process, even if minor issues are resolved
At least 75% of all firms in the industrial park with more than 250 employees have a code of conduct system in place to deal with grievances.	Yes	
At least 75% of all firms in the industrial park with more than 250	Yes	

	employees have a harassment prevention and response system in place.		
Social infrastructure	At least 80% of the surveyed employees report satisfaction with social infrastructure.	No	The Park has no mechanism to measure employee satisfaction with social infrastructure (such as employee canteen, housing, etc.)
	100% of reported security and safety issues are adequately addressed within 30 days.	No	The dilapidate Jetty is a 10-year old safety issue. Also, the failure to provide fire engine capacity testing results is a recurring issue. There is an adequacy to address critical safety issues within committed timeframe., posing significant safety risks to park operations and personnel.
	75% of all firms in the industrial park with more than 250 employees have a program for skills/vocational training and development.	Yes	

	At least 20% of female workforce benefit from available supporting infrastructure/programs for skills development.	Yes	
Local community outreach	At least 80% of surveyed community members are satisfied with the community dialogue.	No	Community dialogue is not regular or proactive, making sustained satisfaction unlikely. The Park lacks a structured and proactive community dialogue, which is a prerequisite for achieving and measuring sustained community satisfaction
	At least two outreach activities that are implemented by the park management entity annually are regarded as positive by over 80 percent of the surveyed community members.	No	The Park does not meet the minimum frequency requirement of 2 outreach activities per year.

Table 9.5

Economic Performance vs. EIP Pre-requisites

Topic	EIP pre-requisites and performance indicators	Does Park meet EIP benchmark AT PRESENT	Identified Gaps
PRE-REQUISITES (MUST HAVES FOR EIP)			
Employment generation	Park management entity has plans to generate specific numbers and types of jobs (including diversity and inclusiveness) in line with government targets.	Yes	(Partial) As a GOCC, PNOC's mandate aligns with national employment goals. Job creation is a significant outcome of new locator projects (e.g., 228 construction jobs and 90 permanent roles from a recent project). However, Park Management does not have its own formal plan with specific targets for job creation, types of jobs, or diversity and inclusiveness. Job generation is a passive result of locator investments rather than a managed, park-level objective.

Local business and SME promotion	Park management entity allows and promotes the establishment of SMEs that provide services and add value to park residents.	Yes	(Partial) The park allows for the establishment of SMEs but does not have programs to actively promote them. The approach is passive. There is no evidence of a formal program to actively promote SMEs through business matching, a local supplier development program, or incentives to integrate them into the supply chains of the large locators.
Economic value creation	A market demand and feasibility study, supported by a business plan, for specific “green” infrastructure and service offerings has been undertaken to justify planning and implementation in the industrial park.	No	There is no market analysis and feasibility studies to plan for and invest in modern, green infrastructure, which is a key component of EIP Economic value creation

	Tracked by the park management	Yes	
	entity, the industrial park fulfils relevant government targets, including domestic, foreign direct investment, and tax revenues.		
PERFORMANCE INDICATORS			
Employment	At least 60% of total workers	Yes	
generation	employed in industrial park live within daily commuting distance.		
	At least 25% of total firm workers in industrial park are employed through direct employment (that is, not employed on a fee-for-output basis or provided through a labor supply firm) and permanent contracts.	No	The Park does not report on the specific percentage breakdown of the employment structure of Locators

Local business and SME promotion	At least 25% of resident firms use local suppliers or service providers for at least 80 percent of their total procurement value.	No	Locators' procurement data, specifically the value % sourced locally, is not collected or reported by the Park
	At least 90% of total procurement value of park management entity are supplied by local firms or service providers.	No	Although PNOC has a policy to prioritize sourcing from local providers for Small Value Procurement, this does not cover all procurements and no data is available to verify that the threshold for total procurement value.
Economic value creation	On average, the occupancy rate of space available for resident firms was >50% over the last 5 years.	No	The Industrial Park's current locators occupy less than 25% of the Park's total area, signifying a long-standing difficulty in attracting new locators and utilizing available land.

To establish a comprehensive baseline, the PNOC Industrial Park's performance was evaluated against the 51 benchmarks of the International EIP Framework. Table 9.6 provides a detailed compliance scorecard, breaking down the results across park management, environmental, social, and economic performance categories. The findings from this table are visualized in Figure 9.1, which clearly illustrates the number of benchmarks currently met versus those that are not, highlighting key areas for improvement.

Building on this baseline analysis, the assessment also outlines a clear path forward. Table 9.7 synthesizes the overall performance into a current fulfillment rate of 39% and sets a target of 78% to be achieved by the end of the GEIPP initiative. This significant improvement potential is visually summarized in Figure 9.1, which directly compares the park's current performance with its intended future state.

Table 9.6

PNOC Industrial Park: EIP Compliance Scorecard

Assessment categories	CURRENT PERFORMANCE: Number of benchmarks				
	Yes	Partly	No	To be confirmed	Not applicable
Park management	3	0	6	0	0
Environmental performance	9	0	11	0	0
Social performance	5	0	8	0	0
Economic performance	3	0	6	0	0
Overall performance	20	0	31	0	0

Table 9.7

PNOC Industrial Park: EIP Benchmark Fulfillment (Current vs. Target)

Industrial park	% of applicable EIP benchmarks fulfilled										
	According to International EIP Framework (UNIDO, WBG, GIZ (2017)										
	Current performance					Intended performance at end of GEIPP					Improvement potential
	Counts	Total	%	of	Counts	Counts	Total	%	of	Counts	
	"Yes"	benchmark s excl.	applicable benchmark s fulfilled	"To be confirmed"	"Yes"	benchmark s excl. "Not applicable"	benchmark s fulfilled	"To be confirmed"			
PNOC Industrial Park	20	51	39%	0	40	51	78%	0	39%		

Figure 9.1 Performance of the Industrial Park against the 51 benchmarks of the International EIP Framework.

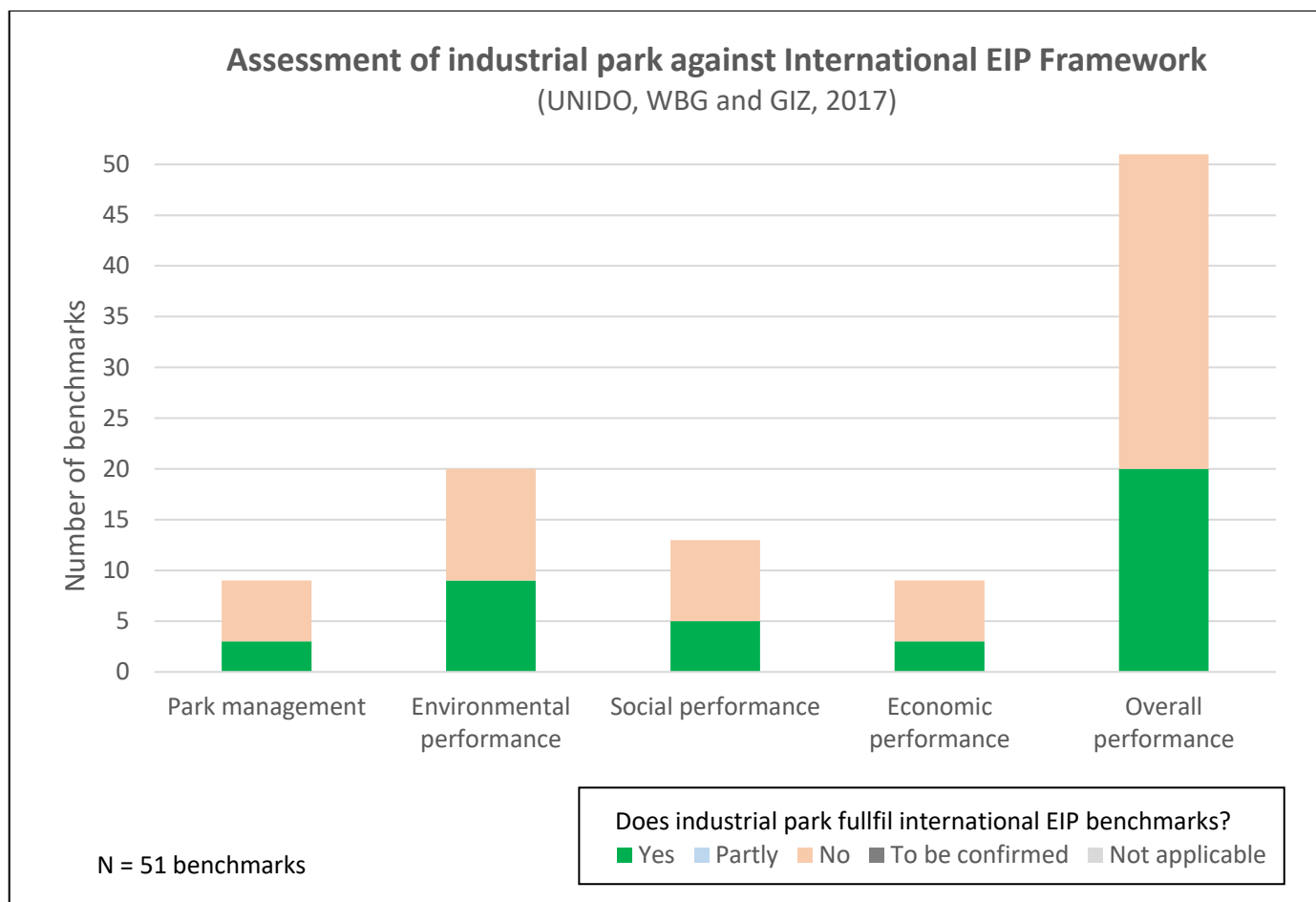
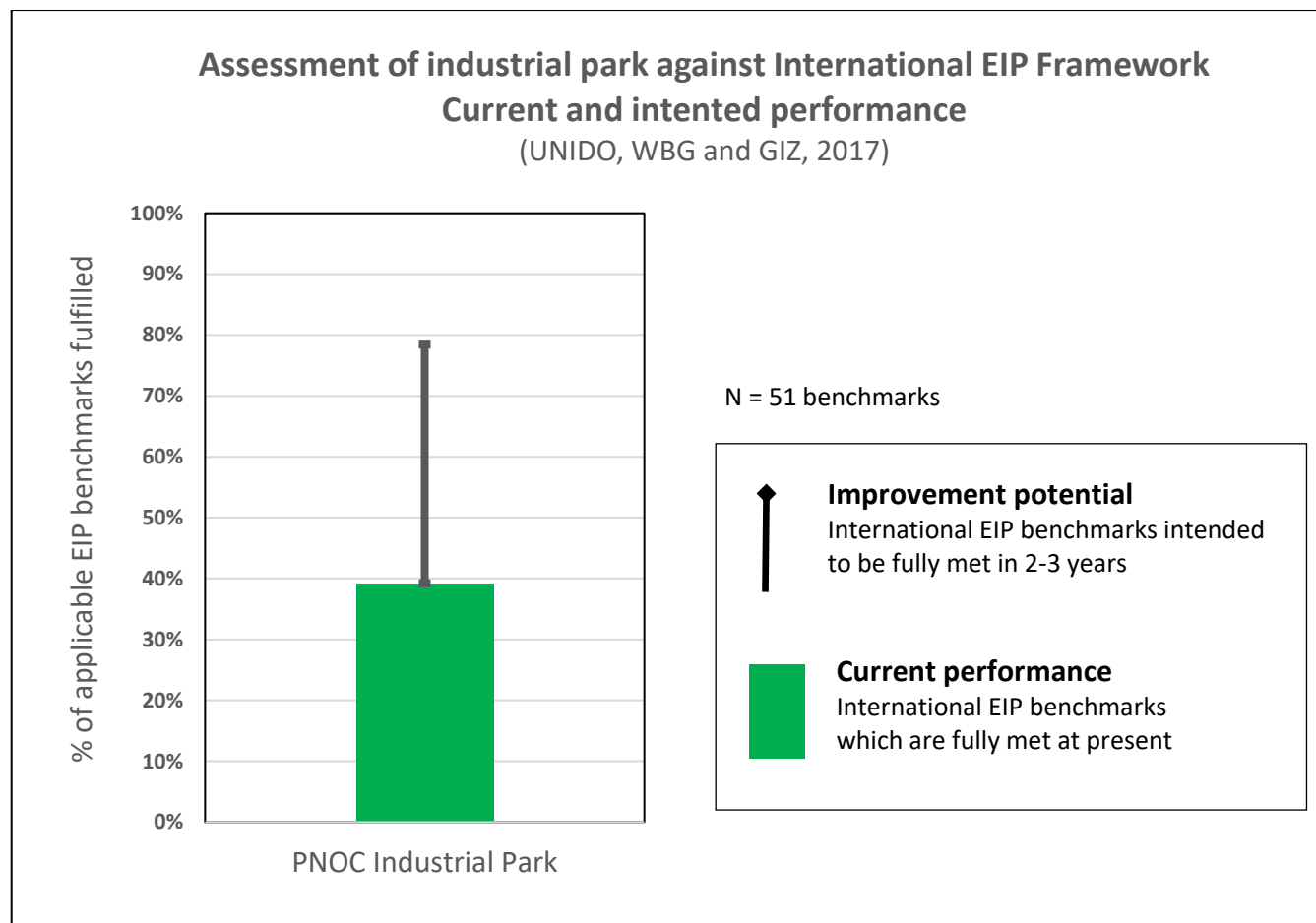


Figure 9.2 Assessment of PNOC IP against International EP Framework: Current and intended performance.



This performance assessment provides a clear, data-driven snapshot of the PNOC Industrial Park's current standing against the International EIP Framework. The results are stark: the Park currently fulfills only 39% of the applicable EIP benchmarks, signifying a substantial gap between its present operational state and recognized international standards for sustainable industrial development.

The breakdown reveals that the deficiencies are systemic and spread across all major assessment categories. The Park fails to meet the majority of benchmarks in Park Management (3 'Yes' vs. 6 'No'), Environmental Performance (9 'Yes' vs. 11 'No'), Social Performance (5 'Yes' vs. 8 'No'), and Economic Performance (3 'Yes' vs. 6 'No'). This data quantitatively validates the study's central argument that the park's challenges are not isolated but are rooted in foundational issues of governance, integrated environmental management, and strategic social and economic planning.

However, the assessment also highlights a significant 39% improvement potential. This figure represents the gap that can be closed through the implementation of the proposed roadmap, transforming the Park's performance from its current 39% fulfillment to a potential 78%. This not only quantifies the scale of the challenge but also frames the transformation as an achievable goal with a clear target, providing a compelling justification for adopting the recommended strategies.

Proposed EIP Opportunities for PNOC

Considering that PNOC is a Government Owned and Controlled Corporation (GOCC), there is a need for practical, actionable, and feasible EIP opportunities for the Industrial Park. With this, a roadmap was established to substantiate “quick wins” that PNOC can initiate with existing authority, leading to strategic projects that will align with the planning and budgeting cycles.

Phase 1. Foundational Initiatives and Security Buy-in (Feasible within 1-2 years). These are high impact, low-cost actions focused on achieving strategic alignment, building consensus, data gathering and improving governance and connections.

Table 9. 8

Phase 1 EIP opportunities for the Industrial Park

EIP requisite	Pre- EIP Opportunity for the Industrial Park	Rationale	Key
			Performance
			Indicators (KPIs)
			for success
Strategic Alignment and Governance	Develop and present an EIP transformation business case	This is the first, and the most critical step. As a GOCC, it is necessary to secure top-level approval for any new strategic direction.	Formal approval of the EIP transformation strategy

	Formalize this gap analysis into a business case- to be presented to the Park Manager, the Supervising SVP for the Industrial Park, to the PNOC President and Board, and subsequently to the Park Locators, to secure top-level approval for the EIP transition.	This step is a low-cost action, but high-impact	Presentation of the strategy to 100% of Locators
Park Management and Collaboration	Establish a Collaborative Governance Framework	This is also a low-cost action, but with high impact.	Established EIP TWG with representation of
	Action 1. Form a voluntary EIP Technical Working Group (TWG) with locators to discuss challenges and identify efficiencies	This will operationalize the “buy-in” from the initial step. It will foster collaboration, strengthen existing monitoring structures and improve risk management.	at least 80% of all Locators Reorganized
	Action 2. PNOC will lead the reorganization of the Multi-Partite Monitoring Team (MMT) to		MMT charter signed and

	enhance the effectiveness and align the Park's objectives with the EIP framework.	approved by all parties
	Action 3. Initiate semi-annual Park-wide Health and Safety Audit to proactively identify and mitigate risks	1 st Parkwide Health and Safety Audit completed and report submitted
Environmental Monitoring and Data Management	Established a Centralized Environmental Database Action 1. Launch a data collection drive for a Parkwide Resource Inventory, which will include mandatory submission of fugitive emission estimates and mitigation plans of all locators	This is an administrative task which will provide critical data needed to identify opportunities for Industrial Symbiosis, manage air and water resources effectively and justify future centralized and green infrastructure projects. 100% of Locators submitted required data for the Parkwide Resource Inventory

	Action 2. Create a formal Air Quality database to consolidate emissions sources, stack testing results, and ambient monitoring data	Centralized Air Quality and Resource Inventory database is operational
	Action 3. Enhance the existing groundwater monitoring program. Include regular tracking of water levels and quality from both the Park and nearby LGU deep wells.	Expanded groundwater monitoring program is fully implemented
Water Conservation	Launch a proactive Water Conservation Program	This is a low cost and practical approach that will demonstrate the Park's commitment to environmental sustainability, will somehow reduce groundwater Achieve a 5% reduction in the total Park groundwater

	Action 1. Implement a Parkwide program operational costs and protect extraction focused on reducing water wastage groundwater source. compared to the 2024 baseline Action 2. Conduct regular maintenance checks 100% of main and leak detection on all water lines to minimize water distribution losses lines inspected for leaks, with report Action 3. Through the organized TWG, on repairs encourage the locators to implement their own completed internal water recycling and employee awareness initiatives
Community Engagement	Launch a Strategic Community and This program will address social Environmental Stewardship Program gaps at a low cost.

Action 1. Formalize and schedule quarterly dialogues with the host and adjacent Barangay	At least 4 community dialogues held annually, starting Year 1
Action 2. Initiate and maintain a disaster preparedness and environmental awareness programs with the host and adjacent Barangay	At least 2 joint disaster preparedness or environmental awareness programs conducted
Action 3. Systematically gather community feedback and perception data, and ensure this	annually

data is formally reflected in the Annual
Workplan.

Annual
community
perception survey
conducted with a
measurable year-
on-year
improvement in
satisfaction
ratings

Phase 2. Strategic Planning and Mid-Term Projects (Feasible within 2-4 years). These involve formal studies, development of policies and moderate investments.

Table 9.9

Phase 2 EIP Opportunities for the Industrial Park

EIP requisite	Pre- EIP Park	Opportunity for the Industrial Park	Rationale	Key Indicators for success	Performance (KPIs) for success
Park Infrastructure		Resolve procurement deadlock and execute critical infrastructure rehab	Successfully completing this step should be on top of PNOC's list. Ongoing failure represents a significant business continuity risk, a major liability on safety and lowers locator trust. Given the history of failed bidding for the Jetty Rehab, PNOC must take immediate steps to diagnose and resolve procurement issues		Successful award of the Jetty Rehabilitation contract 100% completion of the project and official turnover of the fully operational Jetty

Green Infrastructure	Conduct formal Feasibility Studies for Green and Shared Infrastructure These studies can be done by either commissioned third-party consultants or by engaging the internal expertise of PNOC's Business Research and Development Department (BRDD). Focus should be on: Park-scale solar farm, Centralizing Water Recycling Facility, and Centralized Solid and Hazardous Waste Management Facility (compliant with Sanitary Landfill Level 2 and capable of treating common THWs).	Utilizing in house experts could expedite the process and reduce initial costs. The feasibility study will be essential to secure funding and approval.	At least two (2) formal feasibility studies for green infrastructure completed and submitted to management At least one high-potential project selected and approved for inclusion in the next corporate budget cycle.
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Park Planning and Zoning	Develop a new, integrated EIP Master and Land Use Plan	This will become the official blueprint for all future development and will ensure that growth is sustainable, strategic, and bankable.	New EIP Master and Land Use Plan drafted and presented to the PNOC Board
	Based on the output of the FS and new strategic direction, develop a new master plan for the remaining areas. This plan should now integrate EIP principles by zoning for synergistic industries and formally allocating land for shared green infrastructure.		Formal adoption of the new Master Plan via a Board Resolution
Waste Management Planning	Prepare a Parkwide Solid Waste Management Plan	The plan will be the output of the FS and will become the core document for procuring a contractor or partner for the facility's construction and operation.	Comprehensive Park-wide Solid Waste Management Plan completed and formally approved by the EIP TWG and Park Management

	the design, operation and cost-sharing scheme for common facilities	
Governance and Legal Framework	Initiate Legal review and redrafting of Locatorship Agreements	This will prepare the legal groundwork for future projects.
	The Legal Department will draft new template clauses that will integrate EIP frameworks, grant the PNOC the right to build and charge for centralized infrastructure via clear cost-sharing mechanisms and mandate compliance with new environmental policies.	Draft of new EIP-aligned template clauses for Locatorship Agreements completed by the Legal Department New template Locatorship Agreement approved by the PNOC Board for all future locators

PHASE 3: Transformative, Long-Term Investments (Feasible in 5+ years). These are major capital-intensive projects, guided by the principle that all new facilities must be designed and constructed to a high standards

Table 9.10

Phase 3 EIP Opportunity for the Industrial Park

EIP requisite	Pre- EIP Opportunity for the Industrial Park	Rationale	Key Performance Indicators (KPIs) for success
Park infrastructure	Rehabilitate critical infrastructure and implement Flagship Green Projects Action 1. Implement the rehab of the Jetty and Fire Safety Systems Action 2. Implement the most viable green or shared infrastructure project identified in	The PPP model is a well-established mechanism in the Philippines for large infrastructure projects, making it a highly feasible financing route. This will deliver tangible, large-scale improvements based	Jetty and Fire Safety Systems are 100% rehabilitated and fully operational At least one flagship green infrastructure project (e.g., PPP for a solar farm) has its contract awarded and

	Phase 2 (preferably through a Public-Private Partnership or PPP)		financial closure achieved.
Governance and Legal	Implement renewed Locatorship Agreements	This long-term goal becomes feasible once PNOC can	At least 50% of existing locators (by land area)
	Using the built trust and values demonstrated, complete renegotiation and execution of new locatorship agreement using the new template generated in Phase 2	demonstrate the tangible financial and operational benefits of EIP initiatives, making a compelling case for locators to adopt the new, equitable terms.	have successfully renegotiated and signed new EIP-located Locatorship Agreements by the end of the roadmap period.
			100% of all new locators entering the park from Year 5 onwards sign the new

EIP-aligned
agreement.

X. RECOMMENDATION AND CONCLUSION

The study of PNOC Industrial Park's alignment with the EIP shows a critical irony: it is an Industrial Estate with excellence in operational management specifically in environmental compliance, but somehow it is hindered by a passive and outdated management model. As evidenced by its low occupancy rate, deteriorating critical infrastructure (Jetty), and the inability of the Park to execute master plans are not isolated problems, these are signs of central strategic weakness. Currently, the Park functions as a traditional landlord (estate manager), managing plots of land and collecting dues, but its future sustainability and viability is to become a proactive EIP ecosystem manager.

Continuing this passive and outdated management model poses a significant risk. Apparently, the Park will remain struggling to attract new, high-value Locators especially as industries increasingly prioritize environmental, social, and governance (ESG) performance together with operational efficiency. Moreover, the Park existing Locators will become more dissatisfied with the failing infrastructure, and the Park will fail to capitalize on its land assets, signifying failure on its mandate as a GOCC to drive national economic value.

The transformation therefore to an EIP is not merely an environmental upgrade; it is a strategic and economic necessity.

The single and critical deciding factor for this EIP transformation is the strategic commitment and political will of PNOC's leadership to change its governance model. Budget allocation, feasibility studies, and locator cooperation are of utmost importance, but are all just secondary. Tracing the root cause of almost all gaps identified in the EIP analysis of the Park traces down to a weak and passive

governance structure, outdated and inconsistent Agreements – and this foundational weakness hinders progress. Likewise, the Park cannot enforce higher EIP standards without a contractual framework which requires the Locators to participate beyond minimum legal compliance and regulatory requirement. The current Locatorship Agreements do not have this control. The Park's failure to resolve and rehabilitate the Jetty issue for over a decade is the most compelling sign of this governance failure. This just shows that PNOC, as the administrator of the Industrial Park, cannot fulfill its core responsibilities. As a result of this, the Park's economic potential is suppressed.

This commitment will be tested by great challenges and risks. PNOC must address strong resistance from the current Locators when attempting to renegotiate old Locatorship Agreements. Bringing back trust of Locators should also be addressed, through taking tangible actions on long-standing grievances. As a GOCC, PNOC will also face hurdles in budgeting and procurement and furthermore, there is a need to resolve the “chicken and egg” problem of attracting new investment to a Park that is not yet modernized, while requiring that investment to fund the modernization itself. This EIP transformation will also demand significant culture shift and a long-term commitment that can withstand changes in administration and political priorities.

The proposed three-phased roadmap provides a logical, actionable, and politically viable pathway to navigate the EIP transformation. Phase 1 is about building momentum at the least possible cost. By developing a business case for EIP transformation, the Park can secure necessary top-level buy-in. Establishing a voluntary EIP TWG and centralized environmental data base are also low-cost but high impact actions that will foster collaboration among PNOC, Locators, and Stakeholders and ensure that critical data are consolidated for planning purposes.

Phase 2 is where the leadership commitment will be tested as there will be planning and moderate investments. The conduct of feasibility studies for green infrastructures and initiating legal review of locatorship agreement will mitigate the root cause of the Park's stagnant condition.

Phase 3 will then involve major capital investments, likely through PPP, to be able to build flagship projects identified in Phase 2. At this stage, assuming that PNOC has already demonstrated tangible benefits and opportunities with the EIP model, PNOC will be in a strong position to renegotiate and implement equitable Locatorship Agreements.

By truly embracing this transformation, PNOC will gain strategic benefits that will go far beyond environmental compliance. This will include enhanced financial viability and revenue, as a modern and efficient Industrial Park with centralized utilities and green infrastructure which can demand higher lease rate and management fees as shared services will create sustainable revenue streams. This may also lead to increased occupancy, transforming the Park into a strategic location that will attract investors with ESG mandates. As a flagship EIP, it will also become a significant contributor to the Philippine Energy Plan and Philippine Development Plan, not just through passive job creation but as a model for sustainable industrialization and decarbonization.

Significantly, this transformation will be vital for the long-term survival and relevance of PNOC as a whole. With the decline of major revenue-generating assets like the Malampaya Project and the changes in the engagement with Petron, PNOC is in urgent need of new and stable income sources. The EIP is not just an environmental initiative, but is a strategic business pivot that can develop the Industrial Park into a core, profitable asset capable of helping replacing those lost revenue.

Lastly, this can result in a reinforced corporate image of PNOC, rebuilding trust with locators and fostering a positive relationship with the community and establishing PNOC as a forward-thinking leader among GOCCs.

The PNOC Industrial Park must now choose its future path. It can either remain as a passive landlord overseeing Locators on an underutilized and deteriorating property, or it can embrace hard work in transforming itself into an integrated and profitable Eco Industrial Park. The roadmap is clear and all the necessary tools are available. The output now rests entirely on the will of PNOC to not just manage an Industrial Park, but to build an ecosystem.

XI. REFERENCES

- Bataan Provincial Government. (2021). *Socio-economic profile of Bataan*.
- Chertow, M. R. (2000). Industrial symbiosis: Literature and taxonomy. *Annual Review of Energy and the Environment*, 313–337.
- Dartmouth College. (n.d.). *Eco-Industrial Parks*. Retrieved from <https://cushman.host.dartmouth.edu/courses/engs37/EIPs.pdf>
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). *SIA Concept*.
- Development, I. (n.d.). *Defining eco-industrial parks*. Retrieved from Defining eco-industrial parks: https://www.indigodev.com/Defining_EIP.html
- Devens Enterprise Commission. (n.d.). Sustainable Devens.
- European Commission. (2020). *Industrial symbiosis and the circular economy: A systematic review*.
- European Environment Agency. (2017). *Eco-industrial park*. Retrieved from <https://www.eea.europa.eu/help/glossary/eea-glossary/eco-industrial-park>
- Geissdoerfer, M. S. (2017). The Circular Economy – A new sustainability paradigm. *Journal of Cleaner Production*, 757–768.
- GIZ, & UNIDO. (2016). *International framework for eco-industrial parks: An integrated approach to sustainable industrial development*.
- GmbH, D. G. (2019). *SIA Concept*.
- GmbH, D. G. (2022). *Green PSD Navigator: Overview of Green Growth Approaches for Private Sector Development*.
- Invest Korea. (n.d.). Ulsan Mipo National Industrial Complex and Onsan Industrial Complex.
- Kalundborg Symbiosis. (n.d.). Kalundborg Eco-industrial Park.
- Kirchherr, J. R. (2018). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, 221-232.
- Lieder, M. &. (2016). Towards circular economy implementation: A comprehensive review in context of manufacturing industry. *Journal of Cleaner Production*, 36-51.
- Lowe, E. A. (2001). *Eco-Industrial Park Handbook for Asian Developing Countries*.
- National Economic and Development Authority. (2023). *Philippine Development Plan 2023–2028*.

- Nations, U. (n.d.). *Goal 9: Industry, innovation and infrastructure. United Nations Sustainable Development*. Retrieved from Goal 9: Industry, innovation and infrastructure. United Nations Sustainable Development.
- Negesa, D. G.-R. (2023). Eco-industrial transformation in Uganda: Performance evaluation of industrial parks using the international EIP framework.
- Philippine Economic Zone Authority. (n.d.). *Implementing Rules and Regulations. Philippine National Oil Company (PNOC)*. (n.d.).
- Provincial Government of Bataan. (2019). *Bataan Environmental Code (Ordinance No. 03, Series of 2019)*.
- UNIDO. (2017). *Eco-Industrial Parks: A manual for policymakers and industrial parks developers*.
- United Nations Environment Programme. (2012). *Resource efficient and cleaner production: The Global EIP Programme (GEIPP) and its impact*.
- United Nations Industrial Development Organization (UNIDO). (2019). *International framework for eco-industrial parks*.
- United Nations Industrial Development Organization (UNIDO), W. B. (2018). A practitioner's handbook for eco-industrial parks: Implementing the international EIP framework. Retrieved from <https://openknowledge.worldbank.org/handle/10986/30458>
- United Nations Industrial Development Organization (UNIDO), W. B. (2021). An international framework for eco-industrial parks: Version 2.0. Retrieved from <https://openknowledge.worldbank.org/handle/10986/36298>
- United Nations Industrial Development Organization [UNIDO]. (2020). *Eco-industrial parks: Sustainable industrial development*.
- United Nations Industrial Development Organization. (n.d.). *Eco-industrial parks*. Retrieved from Eco-industrial parks.
- United Nations Industrial Development Organization. (n.d.). *Eco-industrial parks: Resource efficiency and industrial symbiosis*.
- United Nations Industrial Development Organization, World Bank Group, & Deutsche Gesellschaft für Internationale Zusammenarbeit. (2021). *An international framework for eco-industrial parks: Version 2.0*.
- United Nations Philippines. (2023). *Philippines 2024–2028 United Nations Sustainable Development Cooperation Framework*.
- van Beers, D. T. (2020). Results and lessons learned from assessing 50 industrial parks in eight countries against the International Framework for Eco-Industrial Parks. *Sustainability*.
- Wikipedia. (2025, April 3). *Eco-industrial park*. Retrieved from Wikipedia, The Free Encyclopedia: https://en.wikipedia.org/wiki/Eco-industrial_park

- World Bank Group. (2017). *Eco-industrial parks and their role in sustainable development: A guide for practitioners*.
- World Bank Group, U. N. (2017). *An international framework for eco-industrial parks (Version 2.0)*. World Bank.
- World Bank, UNIDO, & GIZ. (2017). *An international framework for eco-industrial parks*.
- World Economic Forum. (2025). *Tianjin Economic-Technological Development Area (TEDA): Circular economy and waste-free digital platform*.

APPENDICES

Appendix A:

Air quality monitoring results for 2022-2024

PNOC Industrial Park AQ2: Utilities Area				
Parameters	1st Qtr 2022	2nd Qtr 2022	3rd Qtr 2022	4th Qtr 2022
TSP,ug/Ncm	17.4	28	14.6	37.9
PM10,ug/Ncm	7.9	14.3	6.1	16.2
NO2,ug/Ncm	<0.22	<0.22	<0.22	<0.22
SO2,ug/Ncm	<0.46	26.4	<0.46	83.6
Pb, ug	<0.10	<0.10	<0.10	<0.10

PNOC Industrial Park AQ5: Resettlement Area				
Parameters	1st Qtr 2022	2nd Qtr 2022	3rd Qtr 2022	4th Qtr 2022
TSP,ug/Ncm	12	54.8	19.8	52.5
PM10,ug/Ncm	3.4	38.4	15.3	31
NO2,ug/Ncm	<0.22	11.7	<0.22	<0.22
SO2,ug/Ncm	<0.46	22.1	<0.46	58.8
Pb, ug	<0.10	<0.10	<0.10	<0.1

PNOC Industrial Park AQ7: Brgy. Lamao School				
Parameters	1st Qtr 2022	2nd Qtr 2022	3rd Qtr 2022	4th Qtr 2022
TSP,ug/Ncm	12	37.4	29.1	111.8
PM10,ug/Ncm	4.5	21.5	15.3	9.9
NO2,ug/Ncm	<0.22	<0.22	10.3	<0.22
SO2,ug/Ncm	<0.46	<0.46	<0.46	<0.46
Pb, ug	<0.10	0.03	<0.10	<0.10

PNOC Industrial Park AQ9: Brgy. Batangas Dos Elementary School				
Parameters	1st Qtr 2022	2nd Qtr 2022	3rd Qtr 2022	4th Qtr 2022
TSP,ug/Ncm	30.4	54.8	13.3	71.4
PM10,ug/Ncm	34.8	35.9	7.6	26
NO2,ug/Ncm	<0.22	26.7	<0.22	39.3
SO2,ug/Ncm	<0.46	<0.46	<0.46	<0.46
Pb, ug	<0.10	0.04	<0.10	<0.10

PNOC Industrial Park AQ2: Utilities Area				
Parameters	1st Qtr 2023	2nd Qtr 2023	3rd Qtr 2023	4th Qtr 2023
TSP,ug/Ncm	28.2	13.4	14.9	14.2
PM10,ug/Ncm	7.2	6.7	6.6	5.3
NO2,ug/Ncm	<0.22	<0.22	<0.20	<0.22

SO ₂ ,ug/Ncm	<0.46	<0.46	<0.22	27.6
Pb, ug	<0.1	<0.1	<0.10	<0.1

PNOC Industrial Park AQ5: Resettlement Area

Parameters	1st Qtr 2023	2nd Qtr 2023	3rd Qtr 2023	4th Qtr 2023
TSP,ug/Ncm	113.4	10.7	22.7	12.8
PM ₁₀ ,ug/Ncm	46.7	4.4	7.8	5.3
NO ₂ ,ug/Ncm	<0.22	<0.22	<0.20	<0.22
SO ₂ ,ug/Ncm	<0.46	<0.46	<0.22	19.5
Pb, ug	<0.1	<0.1	<0.10	<0.1

PNOC Industrial Park AQ7: Brgy. Lamao School

Parameters	1st Qtr 2023	2nd Qtr 2023	3rd Qtr 2023	4th Qtr 2023
TSP,ug/Ncm	72.5	14.9	100.8	46.9
PM ₁₀ ,ug/Ncm	51.5	5.5	17.2	10.6
NO ₂ ,ug/Ncm	<0.22	<0.22	<0.20	<0.22
SO ₂ ,ug/Ncm	<0.46	<0.46	<0.22	22.1
Pb, ug	<0.1	<0.1	<0.10	<0.1

PNOC Industrial Park AQ9: Brgy. Batangas Dos Elementary School

Parameters	1st Qtr 2023	2nd Qtr 2023	3rd Qtr 2023	4th Qtr 2023
TSP,ug/Ncm	111.2	16	54.6	15.7
PM ₁₀ ,ug/Ncm	28.6	7.5	10.6	8
NO ₂ ,ug/Ncm	<0.22	<0.22	<0.20	<0.22
SO ₂ ,ug/Ncm	<0.46	<0.46	<0.22	16.7
Pb, ug	<0.1	<0.1	<0.10	<0.1

PNOC Industrial Park AQ2: Utilities Area

Parameters	1st Qtr 2024	2nd Qtr 2024	3rd Qtr 2024	4th Qtr 2024
TSP,ug/Ncm	-	19.5	63.3	44.9
PM ₁₀ ,ug/Ncm	-	9.9	32.1	16.8
NO ₂ ,ug/Ncm	-	<0.22	12.1	9.6
SO ₂ ,ug/Ncm	-	<0.46	27.2	<0.46
Pb, ug	-	0.03	<5	<5

PNOC Industrial Park AQ5: Resettlement Area

Parameters	1st Qtr 2024	2nd Qtr 2024	3rd Qtr 2024	4th Qtr 2024
TSP,ug/Ncm	-	12.9	13.4	14.9
PM ₁₀ ,ug/Ncm	-	7.1	6.7	9.6
NO ₂ ,ug/Ncm	-	<0.22	<0.22	11.3
SO ₂ ,ug/Ncm	-	<0.46	<0.46	<0.46
Pb, ug	-	<0.1	<5	<5

PNOC Industrial Park AQ7: Brgy. Lamao School				
Parameters	1st Qtr 2024	2nd Qtr 2024	3rd Qtr 2024	4th Qtr 2024
TSP,ug/Ncm	-	15.2	233.6	77.2
PM10,ug/Ncm	-	7.1	142.9	56.2
NO2,ug/Ncm	-	<0.22	21.4	12.6
SO2,ug/Ncm	-	<0.46	68.6	<0.46
Pb, ug	-	<0.1	<5	<5

PNOC Industrial Park AQ9: Brgy. Batangas Dos Elementary School				
Parameters	1st Qtr 2024	2nd Qtr 2024	3rd Qtr 2024	4th Qtr 2024
TSP,ug/Ncm	-	12.9	69.7	55.8
PM10,ug/Ncm	-	5.7	57.5	40.7
NO2,ug/Ncm	-	14.3	<0.22	<0.22
SO2,ug/Ncm	-	<0.46	<0.46	20.2
Pb, ug	-	<0.1	<5	<5

Appendix B:

TMDL Computation from 2022-2024

Parameters	TMDL Allocation for PNO Industrial Park	2024		2023		2022	
		ACL, kg/day	%Usage of TMDL	ACL, kg/day	%Usage of TMDL	ACL, kg/day	%Usage of TMDL
BOD, mg/L	5,850	5.6667	0.0969%	26.7932	0.4580%	95.2580	1.6283%
Phenols / Phenolic subs.	5.25	0.0030	0.0571%	0.0062	0.1187%	0.0062	0.1187%
Hg, mg/L	0.5	0.0005	0.1000%	0.0014	0.2770%	0.0014	0.2770%
As, mg/L	51.5	0.0150	0.0291%	0.0346	0.0672%	0.0346	0.0672%
Cd, mg/L	9.8	0.0030	0.0306%	0.0069	0.0707%	0.0069	0.0707%
Cr, mg/L	94.5	0.0088	0.0093%	0.0276	0.0292%	0.0277	0.0293%
Pb, mg/L	37.85	0.0150	0.0396%	0.0346	0.0915%	0.0346	0.0915%

Appendix C:

Water Quality Monitoring Results from 2022-2024

PNOC Industrial Park E1: (Propylene Plant Outfall)			2022			
Parameters	Effluent Standard		1st Qtr 2022	2nd Qtr 2022	3rd Qtr 2022	4th Qtr 2022
Biological Oxygen Demand	30	mg/L	4	3	4	<1
Total Suspended Solids	70	mg/L	13	5	7	5
Color	100	TCU	50	32	15	8
pH	6.5-9.0		8.2	8	7.4	7.3
Oil & Grease	5	mg/L	2	2	1.9	1.9
Temperature, C			31	32.5	30.6	29.9
Temperature Change, C	3	deg C	0.2	-2.3	-1.2	-0.7
Ammonia	3	mg/L	0.7	0.09	0.007	0.01
Chemical Oxygen Demand	60	mg/L	28	28	14	9.7
Sulfate	500	mg/L	70	57	51	45
Cyanide	0.04	mg/L	<0.007	<0.025	0.03	<0.025
Phenol and Phenolic Substances	0.01	mg/L	<0.0009	<0.0009	<0.0009	<0.0009
Benzene	0.1	mg/L	<1.2 ug/L	<1.2 ug/L	<1.2 ug/L	<1.2 ug/L
Toluene	5	mg/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L
Ethylbenzene	1	mg/L	<1.1 ug/L	<1.1 ug/L	<1.1 ug/L	<1.1 ug/L
m,p- Xylene			<1.9 ug/L	<1.9 ug/L	<1.9 ug/L	<1.9 ug/L
o-Xylene	5	mg/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L
Benzo(a)pyrene	1.5	ug/l	<0.072	<0.073	<0.078	
Arsenic	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Cadmium	0.006	mg/L	<0.001	<0.001	<0.001	<0.001
Lead	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Zinc	0.1	mg/L	0.03	0.03	0.02	0.01
Mercury	0.002	mg/L	<0.0002	<0.0002	<0.0002	<0.0002
Dissolved Oxygen		mg/L	5	7	2	<2
Hexavalent Chromium	0.1	mg/L	<0.004	<0.004	<0.004	<0.004
Nitrate	20	mg/L	<0.017	0.1	<0.017	<0.017
MBAS	3	mg/L				

PNOC Industrial Park E2: Polyvinyl Chloride Plant Outfall			2022			
Parameters	Effluent Standard		1st Qtr 2022	2nd Qtr 2022	3rd Qtr 2022	4th Qtr 2022
Biological Oxygen Demand	30	mg/L	10	16	29	10
Total Suspended Solids	70	mg/L	18	8.5	77	13
Color	100	TCU	8	8	8	8
pH	6.5-9.0		7.9	8.2	7.4	7.6
Oil & Grease	5	mg/L	2	2	1.8	1.9
Temperature, C			34.2 / 34.4	35.5	33.7	34.4
Temperature Change, C	3	deg C	5.7 / 5.9	3.6 / 1.3	3.4	5.2
Ammonia	3	mg/L	0.6	0.2	0.06	0.3
Chemical Oxygen Demand	60	mg/L	25	34	43	50
Sulfate	550	mg/L	9.3	9.9	<5	12
Cyanide	0.04	mg/L	<0.007	<0.025	<0.025	<0.025
Phenol and Phenolic Substances	0.01	mg/L	<0.0009	<0.0009	<0.0009	<0.0009
Benzene	0.1	mg/L	<1.2 ug/L	<1.2 ug/L	<1.2 ug/L	<1.2 ug/L
Toluene	5	mg/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L
Ethylbenzene	1	mg/L	<1.1 ug/L	<1.1 ug/L	<1.1 ug/L	<1.1 ug/L
m,p- Xylene	5	mg/L	<1.9 ug/L	<1.9 ug/L	<1.9 ug/L	<1.9 ug/L
o-Xylene	5	mg/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L
Benzo(a)pyrene	1.5	ug/l	<0.072	<0.073	<0.078	
Arsenic	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Cadmium	0.006	mg/L	<0.001	<0.001	<0.001	<0.001
Lead	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Zinc	0.1	mg/L	0.09	0.03	0.01	0.01
Mercury	0.002	mg/L	<0.0002	<0.0002	<0.0002	<0.0002
Dissolved Oxygen			6	7	4	6
Hexavalent Chromium	0.1	mg/L	<0.004	<0.004	<0.004	<0.004
Nitrate	20	mg/L	<0.017	0.2	0.1	<0.017
Phosphate	1	mg/L	2.3	0.4	0.4	0.5
PNOC Industrial Park E3: Polyethylene Plant Outfall			2022			

Parameters	Effluent Standard		1st Qtr 2022	2nd Qtr 2022	3rd Qtr 2022	4th Qtr 2022
Ammonia	0.5	mg/L	No eff.	No eff.	No eff.	No eff.
pH	6.5-9.0					
Chemical Oxygen Demand	60	mg/L				
Oil & Grease	5	mg/L				
Sulfate	500	mg/L				
Cyanide	0.04	mg/L				
Phenol and Phenolic Substances	0.01	mg/L				
Temperature, C						
Benzene	0.1	mg/L				
Toluene	5	mg/L				
Ethylbenzene	1	mg/L				
Xylene	5	mg/L				
Benzo(a)pyrene	1.5	ug/l				
Arsenic	0.02	mg/L				
Cadmium	0.006	mg/L				
Lead	0.02	mg/L				
Zinc	0.1	mg/L				
Mercury	0.002	mg/L				
Color	100	TCU				
Dissolved Oxygen						
Biological Oxygen Demand	30	mg/L				
Total Suspended Solids	70	mg/L				
Hexavalent Chromium	0.1	mg/L				
Nitrate	20	mg/L				
Phosphate	1	mg/L				
Temperature Change, C	3	deg C				
Fecal Coliforms	200	MPN/100ml				

PNOC Industrial Park E5: Explosives Plant Outfall			2022			
Parameters	Effluent Standard		1st Qtr 2022	2nd Qtr 2022	3rd Qtr 2022	4th Qtr 2022
Biological Oxygen Demand	30	mg/L	2	<1	6	13

Total Suspended Solids	70	mg/L	3	<2.38	7	6
Color	150	TCU	5	5	5	20
pH	6.5-9.0		8.1	8.5	8.2	7
Oil & Grease	5	mg/L	2.1	1.9	1.9	1.9
Temperature, C		°C	28.5	29.4	27.2	29.1
Temperature Change, C	3	°C	0.1	2.4	2	0.1
Arsenic	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Cadmium	0.006	mg/L	<0.001	<0.001	<0.001	<0.001
Lead	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Mercury	0.002	mg/L	<0.0002	<0.0002	<0.0002	<0.0002
Dissolved Oxygen			7	7	4	<2
Chemical Oxygen Demand	60	mg/L	5.9	13	16	45
Surfactants (MBAS as LAS)	3	mg/L	0.2	0.4	0.3	1.5
Sulfate	500	mg/L	87	81	139	130
Hexavalent Chromium	0.1	mg/L	<0.004	<0.0004	<0.004	<0.004
Nitrate, N	20	mg/L	2.3	0.3	1	<0.017
Phosphate, P	4	mg/L	5	0.7	0.4	0.3
Phenol and Phenolic Substances	0.01	mg/L	<0.0009	<0.0009	<0.0009	<0.0009

PNOC Industrial Park E1: (Propylene Plant Outfall)			2023			
Parameters	Effluent Standard		1st Qtr 2023	2nd Qtr 2023	3rd Qtr 2023	4th Qtr 2023
Biological Oxygen Demand	30	mg/L	6	4	4	3
Total Suspended Solids	70	mg/L	24	4.5	9	4.7
Color	100	TCU	15	20	3	15
pH	6.5- 9.0		8.5	8.7	7.7	7.7
Oil & Grease	5	mg/L	1.9	1.9	1.9	
Temperature, C			30	33.4	30.1	31
Temperature Change, C	3	deg C	1.2	-3.2		
Ammonia	3	mg/L	<0.003	<0.003	0.1	0.1
Chemical Oxygen Demand	60	mg/L	16	31	18	15
Sulfate	500	mg/L	70	31	18	11
Cyanide	0.04	mg/L	<0.025	<0.025	0.03	<0.025
Phenol and Phenolic Substances	0.01	mg/L	<0.0009	<0.0009	<0.0009	<0.0009
Benzene	0.1	mg/L	<1.2 ug/L	<1.2 ug/L	<1.1 ug/L	
Toluene	5	mg/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L	
Ethylbenzene	1	mg/L	<1.1 ug/L	<1.1 ug/L	<1.1 ug/L	
m,p- Xylene			<1.9 ug/L	<1.9 ug/L	<1.9 ug/L	
o-Xylene	5	mg/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L	
Benzo(a)pyrene	1.5	ug/l	<0.072	<0.071	<0.075	
Arsenic	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Cadmium	0.006	mg/L	<0.001	<0.001	<0.001	<0.001
Lead	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Zinc	0.1	mg/L	0.03	0.05	0.03	0.05
Mercury	0.002	mg/L	<0.0002	<0.0002	<0.0002	<0.0002
Dissolved Oxygen		mg/L	9	6	7	<2

Hexavalent Chromium	0.1	mg/L	<0.004	<0.004	<0.004	<0.004
Nitrate	20	mg/L	<0.017	<0.017	0.09	0.6
MBAS	3	mg/L	0.3	0.5	0.08	0.1

**PNOC Industrial Park E2: 2023
Polyvinyl Chloride Plant Outfall**

Parameters	Effluent Standard		1st Qtr 2023	2nd Qtr 2023	3rd Qtr 2023	4th Qtr 2023
Biological Oxygen Demand	30	mg/L	8	3	<1	3
Total Suspended Solids	70	mg/L	36	11	15	8
Color	100	TCU	8	5	<3	3
pH	6.5-9.0		9.2	8.5	7.6	7.7
Oil & Grease	5	mg/L	1.9	2	1.9	0.9
Temperature, C			29	34.3	30.5	32.1
Temperature Change, C	3	deg C				-2.9
Ammonia	3	mg/L	0.7	<0.003	<0.003	0.2
Chemical Oxygen Demand	60	mg/L	16	11	14	7.8
Sulfate	550	mg/L	20	9.3	<5.0	<5.0
Cyanide	0.04	mg/L	<0.025	<0.025	<0.025	<0.025
Phenol and Phenolic Substances	0.01	mg/L	<0.0009	<0.0009	<0.0009	<0.0009
Benzene	0.1	mg/L	<1.2 ug/L	<1.2 ug/L	<1.2 ug/L	<1.2 ug/L
Toluene	5	mg/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L
Ethylbenzene	1	mg/L	<1.1 ug/L	<1.1 ug/L	<1.1 ug/L	<1.1 ug/L
m,p- Xylene	5	mg/L	<1.9 ug/L	<1.9 ug/L	<1.9 ug/L	<1.9 ug/L
o-Xylene	5	mg/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L	<1.0 ug/L
Benzo(a)pyrene	1.5	ug/l	<0.072	<0.071	<0.075	<0.075
Arsenic	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Cadmium	0.006	mg/L	<0.001	<0.001	<0.001	<0.001
Lead	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Zinc	0.1	mg/L	0.03	0.02	0.02	0.05
Mercury	0.002	mg/L	<0.0002	<0.0002	<0.0002	<0.0002

Dissolved Oxygen			8	7	8	8
Hexavalent Chromium	0.1	mg/L	<0.004	<0.004	<0.004	<0.004
Nitrate	20	mg/L	0.03	0.3	0.3	1.8
Phosphate	1	mg/L	1.4	0.5	0.6	1.5

PNOC Industrial Park E3: Polyethylene Plant Outfall 2023

Parameters	Effluent Standard	1st Qtr 2023	2nd Qtr 2023	3rd Qtr 2023	4th Qtr 2023
Ammonia	0.5 mg/L	No eff.	No eff.	No eff.	No eff.
pH	6.5-9.0				
Chemical Oxygen Demand	60 mg/L				
Oil & Grease	5 mg/L				
Sulfate	500 mg/L				
Cyanide	0.04 mg/L				
Phenol and Phenolic Substances	0.01 mg/L				
Temperature, C					
Benzene	0.1 mg/L				
Toluene	5 mg/L				
Ethylbenzene	1 mg/L				
Xylene	5 mg/L				
Benzo(a)pyrene	1.5 ug/l				
Arsenic	0.02 mg/L				
Cadmium	0.006 mg/L				
Lead	0.02 mg/L				
Zinc	0.1 mg/L				
Mercury	0.002 mg/L				
Color	100 TCU				
Dissolved Oxygen					
Biological Oxygen Demand	30 mg/L				
Total Suspended Solids	70 mg/L				
Hexavalent Chromium	0.1 mg/L				
Nitrate	20 mg/L				

Phosphate	1	mg/L
Temperature Change, C	3	deg C
Fecal Coliforms	200	MPN/100ml

**PNOC Industrial Park E5: 2023
Explosives Plant Outfall**

Parameters	Effluent Standard		1st Qtr 2023	2nd Qtr 2023	3rd Qtr 2023	4th Qtr 2023
Biological Oxygen Demand	30	mg/L	5	25	4	3
Total Suspended Solids	70	mg/L	3.3	17	2.7	2.7
Color	150	TCU	25	100	80	50
pH	6.5-9.0		8.2	8.3	7.9	7.7
Oil & Grease	5	mg/L	1.9	2	2	<0.26
Temperature, C		°C	29.4	30.5	28.3	27.9
Temperature Change, C	3	°C	-0.8	1.3		
Arsenic	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Cadmium	0.006	mg/L	<0.001	<0.001	<0.001	<0.001
Lead	0.02	mg/L	<0.005	<0.005	<0.005	<0.005
Mercury	0.002	mg/L	<0.0002	<0.0002	<0.0002	<0.0002
Dissolved Oxygen			3	<2	4	2
Chemical Oxygen Demand	60	mg/L	15	91	31	20
Surfactants (MBAS as LAS)	3	mg/L	0.1	3.3	0.3	0.03
Sulfate	500	mg/L	129	170	67	128
Hexavalent Chromium	0.1	mg/L	<0.004	<0.0004	<0.0004	<0.0004
Nitrate, N	20	mg/L	4.3	5.3	1	5.7
Phosphate, P	4	mg/L	0.5	0.2	0.2	0.9
Phenol and Phenolic Substances	0.01	mg/L	<0.0009	<0.0009	<0.0009	<0.0009

PNOC Industrial Park E1: (Propylene Plant Outfall)				2024			
Parameters		Effluent Standard		1st Qtr 2024	2nd Qtr 2024	3rd Qtr 2024	4th Qtr 2024
Biological Oxygen Demand		30	mg/L	No sampling	No eff.	No eff.	2
Total Suspended Solids		70	mg/L				18
Color		100	TCU				20
pH		6.5-9.0					6.98
Oil & Grease		5	mg/L				1.5
Temperature, C							28.8
Temperature Change, C		3	deg C				-1.5
Ammonia		3	mg/L				0.04
Chemical Oxygen Demand		60	mg/L				5.9
Sulfate		500	mg/L				<10
Cyanide		0.04	mg/L				<0.025
Phenol and Phenolic Substances		0.01	mg/L				0.001
Benzene		0.1	mg/L				<1.1 ug/L
Toluene		5	mg/L				<1.0 ug/L
Ethylbenzene		1	mg/L				<1.1 ug/L
m,p- Xylene							<1.9 ug/L
o-Xylene		5	mg/L				<1.0 ug/L
Benzo(a)pyrene		1.5	ug/l				<.023
Arsenic		0.02	mg/L				<0.005
Cadmium		0.006	mg/L				<0.001
Lead		0.02	mg/L				<0.005
Zinc		0.1	mg/L				0.05
Mercury		0.002	mg/L				<0.0002
Dissolved Oxygen			mg/L				5
Hexavalent Chromium		0.1	mg/L				<0.001
Nitrate		20	mg/L				0.5
MBAS		3	mg/L				0.09
PNOC Industrial Park E2: 2024 Polyvinyl Chloride Plant Outfall							

Parameters	Effluent Standard		1st Qtr 2024	2nd Qtr 2024	3rd Qtr 2024	4th Qtr 2024
Biological Oxygen Demand	30	mg/L	No sampling	<1	2	2
Total Suspended Solids	70	mg/L		5.7	9.7	23
Color	100	TCU		15	3	3
pH	6.5-9.0			7.9	7.6	7.6
Oil & Grease	5	mg/L		1.5	1	0.4
Temperature, C				32	33.6	32.4
Temperature Change, C	3	deg C		-0.1	2.5	2.1
Ammonia	3	mg/L		0.02	0.02	0.1
Chemical Oxygen Demand	60	mg/L		20	16	12
Sulfate	550	mg/L		<5.0	<5.0	<10
Cyanide	0.04	mg/L		<0.025	<0.025	<0.025
Phenol and Phenolic Substances	0.01	mg/L		<0.0010	0.001	0.001
Benzene	0.1	mg/L		<1.2 ug/L	<1.2 ug/L	<1.2 ug/L
Toluene	5	mg/L		<1.0 ug/L	<1.0 ug/L	<1.0 ug/L
Ethylbenzene	1	mg/L		<1.1 ug/L	<1.1 ug/L	<1.1 ug/L
m,p- Xylene	5	mg/L		<1.9 ug/L	<1.9 ug/L	<1.9 ug/L
o-Xylene	5	mg/L		<1.0 ug/L	<1.0 ug/L	<1.0 ug/L
Benzo(a)pyrene	1.5	ug/l		<0.075	<0.022	<0.023
Arsenic	0.02	mg/L		<0.005	<0.005	<0.005
Cadmium	0.006	mg/L		<0.001	<0.001	<0.001
Lead	0.02	mg/L		<0.005	<0.005	<0.005
Zinc	0.1	mg/L		0.05	0.05	0.09
Mercury	0.002	mg/L		<0.0002	<0.0001	<0.0001
Dissolved Oxygen				8	4	7
Hexavalent Chromium	0.1	mg/L		<0.004	<0.004	<0.01
Nitrate	20	mg/L		0.4	0.3	0.6
Phosphate	1	mg/L		1.2	0.07	1.9
PNOC Industrial Park E3: Polyethylene Plant Outfall				2024		

Parameters	Effluent Standard		1st Qtr 2024	2nd Qtr 2024	3rd Qtr 2024	4th Qtr 2024
Ammonia	0.5	mg/L	No sampling	No eff.	No eff.	No eff.
pH	6.5-9.0					
Chemical Oxygen Demand	60	mg/L				
Oil & Grease	5	mg/L				
Sulfate	500	mg/L				
Cyanide	0.04	mg/L				
Phenol and Phenolic Substances	0.01	mg/L				
Temperature, C						
Benzene	0.1	mg/L				
Toluene	5	mg/L				
Ethylbenzene	1	mg/L				
Xylene	5	mg/L				
Benzo(a)pyrene	1.5	ug/l				
Arsenic	0.02	mg/L				
Cadmium	0.006	mg/L				
Lead	0.02	mg/L				
Zinc	0.1	mg/L				
Mercury	0.002	mg/L				
Color	100	TCU				
Dissolved Oxygen						
Biological Oxygen Demand	30	mg/L				
Total Suspended Solids	70	mg/L				
Hexavalent Chromium	0.1	mg/L				
Nitrate	20	mg/L				
Phosphate	1	mg/L				
Temperature Change, C	3	deg C				
Fecal Coliforms	200	MPN/100ml				

PNOC Industrial Park E5: Explosives Plant Outfall				2024			
				1st Qtr 2024	2nd Qtr 2024	3rd Qtr 2024	4th Qtr 2024
Biological Oxygen Demand	30	mg/L		No sampling	2	<1	3
Total Suspended Solids	70	mg/L			<2.38	1.3	1.3
Color	150	TCU			3	3	8

pH	6.5-9.0		8.4	7.9	7.8
Oil & Grease	5	mg/L	1.3	1.4	0.4
Temperature, C		°C	28.3	28.2	28.7
Temperature Change, C	3	°C	4.1	3.1	0
Arsenic	0.02	mg/L	<0.005	<0.005	<0.005
Cadmium	0.006	mg/L	<0.001	<0.001	<0.001
Lead	0.02	mg/L	<0.005	<0.005	<0.005
Mercury	0.002	mg/L	<0.0002	<0.0002	<0.0001
Dissolved Oxygen			7	2	5
Chemical Oxygen Demand	60	mg/L	15	14	22
Surfactants (MBAS as LAS)	3	mg/L	0.2	0.1	0.3
Sulfate	500	mg/L	55	448	94
Hexavalent Chromium	0.1	mg/L	<0.0004	<0.004	<0.01
Nitrate, N	20	mg/L	6.3	7	1.2
Phosphate, P	4	mg/L	0.2	0.3	0.2
Phenol and Phenolic Substances	0.01	mg/L	<0.0010	0.001	0.001

Appendix D:
EIP Assessment Tool

UNIDO Assessment Tool (V2)	EIP									
ASSESS INDUSTRIAL PARK AGAINST THE INTERNATIONAL EIP FRAMEWORK AND SELECT OPPORTUNITIES		Name of industrial park:				PNOC Industrial Park				
		Date of assessment:				2025				
		Name of assessor:				Lailanie Angela A. Ngojo				
<u>The international benchmarks included in this worksheet are based on: UNIDO, World Bank, GIZ (2017). An International Framework for Eco-Industrial Parks. Version December 2017.</u>										
INTERNATIONAL EIP FRAMEWORK (UNIDO, WORLD BANK, GIZ, 2017)		STEP 1: ASSESSMENT OF INDUSTRIAL PARK								
Topic	EIP prerequisite s and performance indicators (including target values)	Doe s par k me et EIP ben ch mar k	(OP TIO NAL) Wh at is inte nde d perf orm	Notes and evidence on current performance of industrial park	EIP opportunity for industrial park	What is likely ACHI EVAB ILITY of EIP oppor tunity ?	What are likel y BEN EFIT S of EIP oppo rtuni ty?	Inte rest fro m par k man age men t?	Sele ct EIP opp ortu nity for sho rt- ter m	Comments

		AT PR ES EN T?	anc e? (e.g. in 2- 3 YEA RS)										acti on?
PARK MANAGEMENT: EIP prerequisites ("must have for EIPs")													
Park manage ment services	A distinct park management entity (or alternative agency, where applicable) exists to handle park planning, operations and management, and monitoring.	No	Yes	The management entity is a subordinate administrative department, not an empowered, distinct EIP body. Management is handled by a department (PMD) under PNOC's SVP for Finance & Admin. Its authority is limited by inconsistent locator agreements and fragmented land ownership.	Reorganize the Multi Partite Monitoring Team, consisting of LGUs, DENR, Health Units, and relevant agencies to enhance transparency, monitoring, collaborative planning and promotions.	High	High	Med ium	Yes	This is a key governance step to build trust among stakeholders and improve collaborative problem-solving			

Park management entity to manage and maintain the industrial park property, common infrastructure, and services as prescribed in the tenant contract and the park's Master Plan. This should include, but is not limited to the following:	No	No	While property management exists, it has failed in its strategic development and investment attraction role. Property Management: PNOC handles these functions but has a history of failed lease negotiations and master plans that did not materialize. Key anchor projects were lost to other locations. PNOC manages basic utilities (water, power distribution, roads), but critical infrastructure is failing (dilapidated Jetty, 1/3 of fire engines non-operational). The right to build centralized utilities is not guaranteed in	basic	Develop centralized Waste Collection System, Develop and promote a formal Industrial Symbiosis Program to identify and facilitate waste-to-resource exchanges among the Locators	a	Medium	High	Low	No	Core EIP activity that can be built on existing waste management coordination to generate environmental and economic gains
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waste and wastewater treatment plants and operations, power and energy systems.

- Waste collection areas and services.

- Maintenance and repair workshops.

- Security and emergency response services and facilities.

- Common landscaping, buffer zones, street lighting, security surveillance and street cleaning.

- Common employee

all contracts. Waste management is fully decentralized. Each locator is individually responsible for contracting its own haulers.

An in-house maintenance team conducts regular upkeep and repair. Perimeter security, surveillance, and a two-level emergency

response plan exist. These basic municipal services are provided. Parkwide meetings are held, but they are primarily used for one-way information dissemination by PNOC and to hear recurring locator complaints.

Engages through regular meetings and to address

	and tenant facilities. • Provide facilitating services to and between tenant firms (for example, networking, collaboration and training opportunities) . • Engagement with the park's stakeholders and business representatives.			concerns regarding illegal settlers.							
Monitoring and risk management	Park management entity maintains a monitoring system in place, tracking: • Progress on environmental, social and	Yes	Yes	There is no integrated system to track environmental, social, and economic data holistically at the park level. Environmental monitoring (air,	Publish a public, annual Sustainability Report based on the monitored data to benchmark performance and communicate	High	High	Medium	Yes		

economic performance at the park level.

- Critical risk factors and related responses, at least for:
 - o Risk points where the accidental release of poisonous solid, liquid and gaseous effluents, including during transportation and disposal when fire hazards are possible; and
 - o Applicable natural disaster risks (for example, earthquakes)

water, noise) is progress to conducted for stakeholders regulatory compliance (DENR reports). Social programs are ad-hoc and not integrated into performance reporting. Economic data is not tracked holistically.

Emergency Response Plan exists, but its reliability is questionable due to failing safety equipment.

There is a complete absence of a climate change adaptation strategy.

The system ensures compliance with national regulations but is not structured to implement or

				enforce higher international EIP standards.							
				PNOC holds ISO certifications (for its admin functions) and files all required government reports. However, it does not enforce standards beyond the minimum required by law across all locators.							
	Where required, Park management has a plan in place to react to possible negative impacts due to climate change risks (heat waves and droughts, storms and floodwater events). All adaption	No	No	While PNOC has plans for natural disasters like fire and earthquakes, there are no evidences that addresses long-term climate change adaptation risks such as drought, groundwater depletion, sea-level rise or increased typhoon intensity, which are significant since the	Conduct a Low High Medium Yes	Climate Change Risk and Vulnerability Assessment for the Park and develop an adaptation plan					Critical study to serve as foundation to ensure long-term resilience of the Park and its Locators.

needs for infrastructure and services are identified and in place for the industrial estate to protect against climate change risks and potential damages.				Park is located near Bataan's coast						
Park management entity has a functioning system in place to comply with local/national regulations and international standards applicable to the industrial park. Park management informs compliance	Yes	Yes	The Industrial Park operates under the Programmatic ECC issued by the DENR. PNOC manages compliance by regularly monitoring water, air, and noise emissions from specified sampling stations. Waste management is not centralized. But the Park holds an ISO 14001 certification	Move beyond compliance by establishing and promoting a "Green Initiative" Guideline for new and existing locators. These shall be incorporated in the CoC issued under the Park's Programmatic ECC	High	High	Medium	No	Establishment of baseline reports is needed	

	by resident firms including compliance information that firms share with the park management entity.											
Planning and zoning	A Master Plan (or equivalent planning document) for any new and existing industrial park has been developed and is reviewed periodically (and updated if required), including the following core elements: • Site selection study based	No	Yes	The park lacks a single, up-to-date Master Plan that integrates EIP principles. Planning is reactive and fragmented. Previous Master Plans (2002, 2018) failed to materialize. A new plan is being procured for only a portion of the park (PIP-2). Past and current plans lack specific EIP elements.	Formally include circular economy and industrial symbiosis principles in the next Master Plan update. This shall include pre-zoning areas to encourage co-location of synergistic industries	Medium	High	Medium	No	Complex long-term strategy	and	

on various risk analyses; essential and efficient infrastructure, utilities, and transportation network; environmental and social issues; internal park land zoning; buffer zone around the park; procedure to safely locate high risk industries; and cluster synergistic industries.

- Integration into Master Plan of relevant requirements specified in these international EIP

benchmarks
that have
spatial
implications.

**PARK MANAGEMENT:
Performance
indicators**

Park management services	100% of firms in the industrial park have signed a residency contract/ park charter/code of conduct (depending on what is legally binding on park firms according to the existing legislation in the country); and additional legally binding arrangements that	Yes	Yes	100% of the Locators have Lease and Locatorship Agreement. These are legally binding agreements for both parties. These agreements include park services and fees, conditions, and restrictions, as well as the duties of the owner (PNOC) and locators	Review and update locatorship agreement to explicitly include clauses on cooperation for EIP initiatives (such as participation in industrial symbiosis programs, data sharing, etc.) and consistent definition of service fees, along with standardization of agreement conditions	Medium	High	Medium	No	Medium to long-term action since contract is tied with renewal cycles
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empower the park management entity to perform its responsibilities and tasks and charge fees (sometimes absorbed in rental fees) for common services. This may include transparent fees for services pertaining to the achievement of EIP performance targets.

At least 75% of resident firms indicate satisfaction with regard to the provision of services and common	No	Yes	Almost all locators are unsatisfied with common infrastructure (dilapidated jetty/pier), low water pressure, poorly	Re-Implement a formal customer survey (aside from the ARTA) to confidentially gather feedback on	High	High	Medium	Yes	This will provide essential feedback for improvement of services and shall likewise strengthen Park-
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	infrastructure by the park management's entity (or alternative agency, where applicable).			maintained common areas	services, infrastructure and management, to be able to identify areas for improvement							and Locator relationships
Monitoring and risk management	At least every 6 months, park management entity monitors and prepares consolidated reports regarding the achievement of target values (as documented in this framework) to encompass the following: • Environmental performance; • Social performance;	No	Yes	While PNOC Industrial Park is ISO 14001 certified and regularly submits the semi-annual CMR and CMVR, there is no consolidation of the ff.: Social Performance, Economic Performance (every 6 months).	Develop a comprehensive dashboard for EIP performance (internal) to be regularly reviewed by the Management. This shall include reports on all the locators environmental, social performance, economic performance and risk management schemes implemented	Medium	High	Medium	Yes	This will leverage ISO 14001 and provide management with an integrated data needed to effectively track progress towards becoming an Eco-Industrial Park		

- Economic performance; and
- Critical risk management at the level of the park.

ENVIRONMENT: EIP prerequisites ("must have for EIPs")

Management and monitoring	Park management entity operates an environmental / energy management system in line with internationally certified standards, monitoring park performance and supporting resident firms in the maintenance of their own	Yes	Yes	The PNOC Park is ISO 14001 certified. Among its 4 locators, only 2 are ISO-14001 certified. No Locator is ISO 50001 certified	Offer technical support to locators in setting up their own ISO 14001 and 50001 certifications	High	High	Medium	No	This will build on PNOC's existing expertise
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	firm-level management systems.													
Energy	Supporting programs and documents are in place to improve the energy efficiency of resident firms, especially for the top 50 percent of major energy-consuming businesses in the park.	No	No	There are currently no programs or assistance offered to locators for the purpose of improving energy efficiency. Current programs only focus on lease and environmental compliance	Establish a Parkwide or Park-level Energy Efficiency Program. This could begin with energy audits for locators to identify opportunities for energy saving	a	Low	High	Medium	Yes	This will align with PNOC's goals on sustainability and national level push for energy efficiency, which could eventually lead to significant savings for the Locators			
	An industrial heat recovery strategy is in place to investigate opportunities for heat and energy recovery for the major energy-	No	Yes	There is no Park-wide strategy or feasibility study for Industrial Heat Recovery	Engage a Waste Heat and Mapping and Recovery Feasibility Study across the Industrial Park to identify potential synergy between	a	Medium	High	Low	No	Complex and high impact opportunity - key part of industrial symbiosis			

	consuming firms in the park. (Typically, these are firms that individually consume at least 10-20 percent of total firm level energy consumption)				existing and potential locators							
Water	Park management entity has demonstrable plans and (preferably) prior documented evidence to increase water reuse in the short and medium term. This would be achieved by either reuse of industrial	No	No	No Parkwide Water Reuse of Water Harvesting, though studies for Water Recycling are already prepared	Develop a Parkwide Water Management Plan which will include strategies for water reuse and piloting rainwater/storm water harvesting for non potable use of PNOC and Locators	Low	High	Medium	Yes	This can reduce operational cause and can aid in groundwater depletion		

	effluents, or by rainwater/storm water collection.											
Climate change and the natural environment	A program is established to monitor, mitigate and/or minimize GHG emissions, such as carbon dioxide (CO ₂), methane (CH ₄), nitrogen oxide (NO _x), and so on. There is clear evidence of steps taken to introduce mitigation activities.	No	Yes	Although Air Quality Monitoring is conducted quarterly, there is no comprehensive Park-level GHG inventory or GHG mitigation/reduction plan	Establish a GHG emissions inventory for the entire Park to identify major sources of GHG and formulate a GHG reduction roadmap	Medium	High	Medium	Yes	Measure GHG so the Park can come up with a reduction plan, which is the first step for climate action		
	The park management entity has a plan in place	No	No	The Park was issued a programmatic ECC in 2002, which was	Conduct a Biodiversity and Ecosystem Services	Low	High	Low	No	Advance EIP practice which will require ecological		

to assess operational environmental impacts, and aims to limit the impact on prioritized local ecosystem services.		based on an Initial Environmental Impact Assessment. However, there are no updates conducted by PNOC on these baseline data (specifically for marine biodiversity and groundwater availability). Groundwater Study procurement is currently ongoing but is expected to conclude in 2026	Impact Assessment for the Park's Ongoing Operations and develop a plan to protect or enhance priority services such as green buffer zone, coastal habitat protection, etc)		expertise and commitment beyond standard compliance
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**ENVIRONMENT:
Performance
indicators**

Management and monitoring	At least 40% of resident firms with more than 250 employees have an environmental / energy management system in	Yes	Yes	The PNOC Park is ISO 14001 certified. Among its 4 locators, only 2 are ISO-14001 certified. No Locator is ISO 50001 certified	Incentivize or provide technical support to locators to adopt Environmental and Energy Management Systems	Medium	High	Medium	No	Long -term goal to have all locators certified
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	place that is in line with internationall y certified standards.											
Energy	At least 90% of combined park facilities and firm-level energy consumption have metering and monitoring systems in place.	Yes	Yes	Metering devices for energy is only for the consumption of Industrial Park Facilities and there is no monitoring on the energy use of Locators. Although the bulk of energy consumption is reflected in the provided SMR, the Park does not monitor as to what facilities of the Locators consume bulk of this energy	Promote and support the installation of advance energy sub-metering for major energy consuming locators for better monitoring and efficiency improvements	Mediu	High	Low	No			
	Total renewable energy use in the industrial park is equal to or greater than the annual national	No	No	The Philippine renewable energy share is around 22-29%. With the Park's current scenario, renewal energy use is not greater than the national average energy	Develop a Renewable Energy Strategy for the Park, including feasibility studies for onsite solar generation on	Low	High	High	Yes	This aligns with PNOC's strategic support to the Philippine Energy Plan and sustainability		

	average energy mix.				rooftops and open spaces							
	Park management entity sets and works toward ambitious (beyond industry norms) maximum carbon intensity targets (maximum kilograms of carbon dioxide equivalent (kg CO ₂ -eq) / kilowatt hour (kWh) for the park and its residents. Targets should be established for the short, medium, and long term, in	No	No	No carbon intensity targets have been set for the Park and Locators	Set baseline for the Park's carbon intensity and establish clear and informed reduction targets	Low	High	Medium	No	Should follow GHG Inventory		

line with local norms and industry sector benchmarks.

Park management entity sets and works toward ambitious maximum energy intensity targets per production unit (kWh/\$ turnover) for the park and its residents. Targets should be established for the short, medium, and long term, in line with local norms and industry	No	Yes	No energy intensity targets have been set for the Park and Locators	Coordinate with Locators to establish baselines for energy intensity based on their industries' use	Medium	Medium	Medium	No
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sector benchmarks.										
Water	100% of total water demand from firms in industrial park do not have significant negative impacts on local water sources or local communities.	Yes	Yes	The Park's current water demand has no significant impact on the groundwater availability in Bataan. An ongoing procurement of Consultancy for groundwater study is being done and is expected to finish by 2026	Commission a comprehensive Groundwater Study and Water Balance Analysis to understand the total footprint and ensure sustainable water extraction	High	Medium	High	Yes	Critical study for long-term water security and relation with the community
	At least 95% of industrial wastewater generated by industrial park and resident firms is treated to appropriate environmental standards.	Yes	No	Park Locators have their individual WasteWater Treatment Facility and treated wastewater meets DENR standards prior to discharge	Go beyond compliance by exploring advance WW treatment for water recycling and reuse	Low	High	Medium	No	

	At least 50% of total industrial wastewater from firms in the park is reused responsibly within or outside the industrial park.	No	No	The is no Parkwide Water reuse or Recycling Program. Current practice is focused on discharge treatment and not circular use	Pilot wastewater recycling program	a	Low	High	Med ium	No
Waste and material use	At least 20% of solid waste generated by firms is reused by other firms, neighbouring communities, or municipalities .	No	Yes	For 1 Locator, only 8% of its solid wastes (non hazardous) are transported and reused by other firms (outside of the Park, but neighboring municipalities). For other Locators, solid wastes are either sold to recyclers or dumped in Sanitary Landfills	Launch Industrial Symbiosis Program, starting with mapping waste streams and identifying potential matches between locators		Mediu m	High	Med ium	No
	100% of firms in park appropriately handle, store,	Yes	Yes	PNOC and Locators engage DENR-accredited	Digitize tracking and reporting of hazardous		Mediu m	Medi um	Med ium	Yes

	transport and dispose of toxic and hazardous materials.			hazardous wastes hauler	wastes from generation to disposal					
	Less than 50% of wastes generated by firms in the industrial park goes to landfills.	No	Yes	Most of the wastes generated by firms go to DENR-accredited Sanitary Landfills	Establish Parkwide System to track waste streams and their final disposal methods	Medium	High	Medium	Yes	
Climat e change and the natural environ ment	At least 5% of open space in the park is used for native flora and fauna.	Yes	Yes	The Park implements the 10% buffer zone, where all locators are required to have 10% of their areas green. However, there are no details on whether they specifically use or are managed for native flora and fauna.	Monitoring of Locators' compliance on the 10% open space for green belts and planting native species	High	High	Medium	Yes	
	At least 50% of firms in park have pollution prevention and emission	Yes	Yes	All current locator have pollution prevention and emission reduction technologies and	Launch a "Beyond Compliance" Campaign to encourage and recognize	Medium	High	Medium	No	

reduction strategies to reduce the intensity and mass flow of pollution/emission release beyond national regulations.		strategies in their respective plant		Locator Plants that voluntarily adopted cleaner production technologies and pollution reduction targets					
At least 30% of largest polluters in industrial park have a risk management framework in place that: (a) identifies the aspects which have an impact on the environment and; (b) assign a level of significance to each environmental aspect.	Yes	Yes	All current locators have their risk management framework in place	Leverage the Park's ISO 14001 system to provide a template and guidance to Locators for them to develop their own environmental aspect/impact risk register	Medium	High	Medium	No	

SOCIAL: prerequisites ("must have for EIPs")		EIP ("must have for EIPs")									
Social management systems	Dedicated personnel exist (as part of the park management entity) to plan and manage social quality standards.	No	Yes	The park lacks dedicated personnel focused on strategically planning and managing social quality standards. While the responsibility for CSR activities is assigned to an Administrative Officer IV, this is not their primary role. Their involvement is limited to the administrative functions of preparing budget requests and facilitating occasional events like coastal cleanups and tree plantings, rather than strategic program development.	Formalize and implement a Social Performance and Community Engagement Plan that outlines specific goals and standards for labor, safety, health, and community relations	Medium	High	High	Yes		

Social infrastructure	Essential primary social infrastructure has been adequately provided in the site master plan, and is fully operational in the park.	No	Yes	While projects currently works, projects are for illegal settlers occupying PNOc properties, and not for park locators and employees	housing are under these	Conduct Social Infrastructure Needs Assessment among Park Locators and employees to identify and prioritize the development of shared facilities such as central clinic, transportation hub, etc.	a	Medium	High	Low	Yes			
SOCIAL: Performance indicators														
Social management systems	At least 75% of all firms in the industrial park with more than 250 employees have a well-functioning OH&S management system in place.	Yes	Yes	100% of locators have an active OH&S Management System as mandated by DOLE Department Order No. 198-18. A park-wide HSSE committee ensures coordination.		Launch a Parkwide Health and Safety Campaign to promote the adoption of OSH management system among locators, potentially offering incentives of	a	High	High	Medium	No	Long initiative	term	

shared training resources										
100% of grievances received by the park management entity are addressed within 90 days.	No	Yes	Not all complaints received by the Park management are addressed within 90 days, specifically infrastructure complaints (which are long overdue)	Establish transparent Park-level grievance redress mechanism for both locators and external community stakeholders, with a clear resolution timeline targets	Medium	High	Medium	Yes		
At least 60% of grievances received by the park management entity are brought to conclusion.	No	Yes	Minor complaints are addressed immediately	Grievance mechanism shall include a system for tracking cases from receipt to conclusion (ticketing system)	Medium	High	Medium	Yes		
At least 75% of all firms in the industrial park with more than 250	Yes	Yes	All current locators have code of conduct system in place to deal with grievances	Develop a Model Code of Conduct and Grievance Policy for the Park for	High	High	Medium	No		

	employees have a code of conduct system in place to deal with grievances.					adoption and benchmark of locators						
	At least 75% of all firms in the industrial park with more than 250 employees have a harassment prevention and response system in place.	Yes	Yes	All current locators have harassment prevention and response system in place	Offer Parkwide Anti Harassment and SOGIE (Sexual Orientation, Gender Identity and Expression) Sensitivity Training to foster a safer and more inclusive work environment	Medium	High	Medium	Yes	High impact initiative to promote social environment within the Industrial Park		
Social infrastructure	At least 80% of the surveyed employees report satisfaction with social infrastructure.	No	Yes	There is no longer a Customer Satisfaction Survey especially re: Social Infrastructure	Conduct the Park's Comprehensive Employee Needs and Satisfaction Survey focusing on Social	Medium	High	Medium	Yes	Essential for planning future infrastructure projects		

Infrastructure and Services										
100% of reported security and safety issues are adequately addressed within 30 days.	No	Yes	All reported issues on Safety and Security are immediately addressed. Incidents are also discussed during Parkwide HSSE Committee Meeting	Establish a data base for Security and Safety Incident Reports to log, track, and analyze resolution times and identify recurring issues	High	High	Medium	Yes	Operational improvement	
75% of all firms in the industrial park with more than 250 employees have a program for skills/vocational training and development.	Yes	Yes	3 Locators have no skills/vocational training and development	Establish Parkwide Skills Development Partnership with TESDA to offer relevant training courses to employees of locators	Medium	High	Medium	No		
At least 20% of female workforce benefit from available	Yes	Yes	Available supporting infrastructure/program for skills development for	Ensure Park-level skills development programs include specific	Medium	High	Medium	No		

	supporting infrastructure/ programs for skills development.			Park and Locator employees are made available to any gender	targets and support mechanisms to encourage female participation					
Local community outreach	At least 80% of surveyed community members are satisfied with the community dialogue.	No	Yes	Community dialogues are only conducted during project proposals, EIA preparation. No regular dialogues are conducted	Following CSR and outreach programs, Community Satisfaction Surveys should be formally conducted to gather feedback and measure the effectiveness of community engagement	High	High	Medium	Yes	
	At least two outreach activities that are implemented by the park management entity annually are regarded as positive by over 80	No	Yes	For the past year, only 1 outreach program was surveyed re: the community's perception.	Conduct survey after Community Outreach Programs	High	High	High	Yes	

	percent of the surveyed community members.										
ECONOMIC: EIP prerequisites ("must have for EIPs")											
Employment generation	Park management entity has plans to generate specific numbers and types of jobs (including diversity and inclusiveness) in line with government targets.	Yes	Yes	As a Government-Owned and Controlled Corporation (GOCC), PNOC's mandate and projects are aligned with national strategies like the Philippine Energy Plan (PEP) and Philippine Development Plan, which include employment generation targets. New investments and locators in the park are implicitly tied to these national job creation goals.	Develop a public-facing Employment Generation Plan for the park, with specific, measurable targets for job creation, including targets for local hiring and the promotion of diversity and inclusion	High	High	Medium	No		
Local business & SME	Park management entity allows	No	Yes	Based on approved Master Plans, the focus of the Park is	Consider including in the Master Plan	Medium	High	Medium	Yes	Opportunity to create a more inclusive and	

promotion	and promotes the establishment of SMEs that provide services and add value to park residents.			more on the Large scale industries, although support facilities to these industries are allowed	specific zones for SMEs, to simplify procurement processes for local suppliers						resilient supply chain, directly benefiting local economy
Economic value creation	A market demand and feasibility study, supported by a business plan, for specific "green" infrastructure and service offerings has been undertaken to justify planning and implementation in the industrial park.	No	Yes	There is no specific green infrastructure projects intended to the Park like Central Solar Farm, Waste-to Energy Plant, or Water Recycling Facility. The Water Recycling Facility has been an identifies opportunity but have not yet reach a formal study phase	Commission a Formal Feasibility Study for Green Infrastructure such as Parkwide Rooftop and Ground Mounted Solar Power System to serve locators	a	Medium	High	Medium	Yes	

Tracked by the park management entity, the industrial park fulfils relevant government targets, including domestic, foreign direct investment, and tax revenues.	Yes	Yes	As a GOCC, PNOC is required to report its financial performance, including revenues and contributions to the national government, to oversight bodies like the Governance Commission for GOCCs (GCG). Its operations and the investments it facilitates directly contribute to national economic targets.	Publish a dedicated section in an annual report on the park's Total Economic Contribution, quantifying its role in facilitating Foreign Direct Investment (FDI), local investment, and total tax revenues generated by the park's ecosystem.	High	High	Medium	Yes	This will articulate the Park's economic value to the nation
ECONOMIC: Performance indicators									
Employment generation	At least 60% of total workers employed in industrial park live within daily commuting distance.	Yes	No	More than 60% of the total workforce in the Industrial Park live within daily commuting distance. Service vehicles and shuttles are also provided by each locator. Some	Create a centralized, park-managed, low-carbon transportation network. This could involve consolidating individual shuttle routes	Low	High	Medium	No

				Locators also have nearby Housing Facilities for their employees	into a more efficient system using a fleet of electric or modern, low-emission buses.								
	At least 25% of total firm workers in industrial park are employed through direct employment (that is, not employed on a fee-for-output basis or provided through a labour supply firm) and permanent contracts.	No	Yes	Regular workers are employed through direct employment; however, the Park employs contracted services (employed through agencies)	Develop and promote a Park-Wide Social Charter that encourages locators to adopt best practices in direct hiring and regularization of employees, contributing to stable employment.	Medium	High	Medium	No	Voluntary and Long Term			
Local business and SME promotion	At least 25% of resident firms use local suppliers or service providers for	No	Yes	Materials are often local and/or imported	Establish a Local Supplier Development Program through vetting and accreditation,	Medium	High	Medium	Yes				

	at least 80 percent of their total procurement value.					capacity building, business matching					
	At least 90% of total procurement value of park management entity are supplied by local firms or service providers.	No	Yes	For small value procurement, Park sources items from Local Providers		Formalize and publish a "Local Sourcing First" Policy for the park management's own procurement of goods and services, with a clear and ambitious target.	High	High	Medium	Yes	
Economic value creation	On average, the occupancy rate of space available for resident firms was >50% over the last 5 years.	No	No	More than 10 years occupancy		Reinvest revenue in shared green infrastructure. Invest in centralized wastewater treatment and recycling plant, park-wide solar energy grid or integrated green mobility system (eg	Low	High	Medium	No	

electric
shuttles)
