South Korea Plastic Pyrolysis Industry White Paper

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As global concerns over plastic pollution grow, plastic pyrolysis has emerged as a recognized method of resource recovery. South Korea, with its well-established recycling infrastructure, is actively promoting the resource utilization of plastic waste. Plastic pyrolysis has become a major focus of government-supported initiatives.

This report focuses on South Korea's plastic pyrolysis industry. It covers the national context, industry development environment, profitability analysis, plastic pyrolysis market trends and strategic suggestions. It aims to offer valuable insights for industry stakeholders, enabling them to better identify opportunities in this evolving field.

1. Country Overview: South Korea

The Republic of Korea is located in the northeastern part of the Asian continent, occupying the southern half of the Korean Peninsula. It has a land area of approximately 100,000 square kilometers and a population of around 51 million (as of 2024). Seoul serves as the capital. South Korea is a highly urbanized and industrialized nation, having advanced infrastructure and strong capabilities in technological innovation. Since July 2021, it has been recognized by the United Nations as a developed country. It is a key member of the Organisation for Economic Co-operation and Development (OECD) and the the Group of Twenty (G20).

1.1 Political and Economic System

South Korea operates as a presidential democratic republic with political stability and a well-established legal system. Its economy is driven by an export-oriented industrial structure, consistently ranking among the world's top 10 to 14 economies (depending on the source of data). Core industries include semiconductors, automobiles, shipbuilding, chemicals, steel, consumer electronics, among others.

1.2 Resources and Environmental Conditions

South Korea is relatively scarce in natural resources and is heavily reliant on imports for energy and raw materials. This dependency has led to the development of a high value-added manufacturing sector and an efficient resource recycling system. In response to escalating environmental challenges, the South Korean government has accelerated its green economic transition in recent years. The resource recovery of plastic waste has become a key component of its environmental policy agenda.

1.3 International Economic Cooperation

South Korea actively engages in global trade and economic cooperation. It has signed and implemented 21 Free Trade Agreements (FTAs) with 59 economies (as of 2023), including China, the United States, and the European Union. China remains South Korea's largest trading partner, while close economic ties are also maintained with the U.S., Japan, and others. This high level of trade openness provides a favorable environment for cross-border collaboration and exchange in plastic waste recycling technologies and solutions.

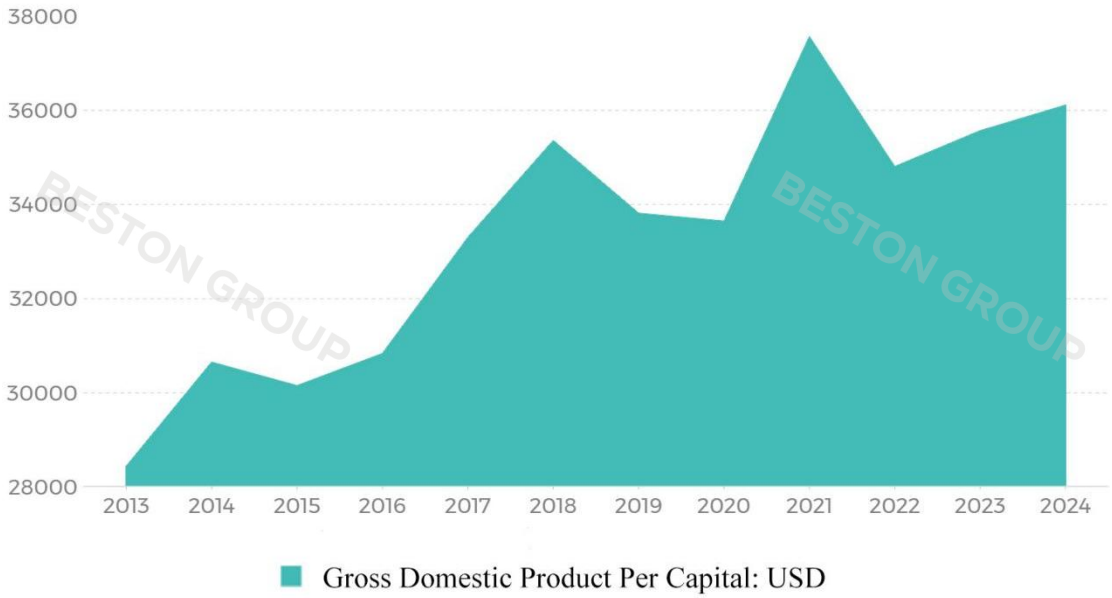
2. Industry Development Environment Analysis

2.1 Economic Environment

As a high-income nation, South Korea boasts robust economic strength and substantial consumer purchasing power. This provides a favorable macroeconomic backdrop for business investment and expansion within the Korean market. In 2024, the country's Gross National Income (GNI) per capita reached USD 36,624—higher than that of Japan and Taiwan. Among countries and regions with populations exceeding 50 million, South Korea ranks sixth, following only the United States, Germany, the United Kingdom, France, and Italy. According to the International

Monetary Fund (IMF), South Korea's per capita GDP is projected to reach USD 37,672 in 2025.

Despite these economic advantages, South Korea faces distinct challenges in terms of resource availability. It is a resource-scarce country, with over 95% of its energy needs—including crude oil, natural gas, and coal—relying on imports. Its industrial and manufacturing sectors remain heavily reliant on fossil fuels, urgently requiring the adoption of renewable alternatives. The ongoing surge in prices for imported crude oil and petrochemical feedstocks has led to elevated raw material costs for manufacturers.Against this backdrop, the South Korean government is vigorously promoting waste-to-resource initiatives. Within this framework, plastic pyrolysis oil has emerged as a promising domestic substitute for fossil fuels and petrochemical feedstocks.



2.2 Policy Environment

The South Korean government maintains a proactive stance on environmental protection and sustainable development, consistently introducing regulations and policies. It places significant emphasis on addressing plastic waste, setting ambitious targets to reduce plastic waste by 50% and achieve a 70% recycling rate by 2030. Emerging environmental technologies—particularly plastic pyrolysis—have received strong policy backing. The government supports such technologies through subsidies, R&D funding, and regulatory incentives. These measures are designed to encourage corporate participation and attract investment into the sector.

2.2.1 Evolution and Enhancement of Environmental Regulations

In the 1980s, Korea's solid waste policy focused on safe waste treatment. The Waste Management Act of 1986 largely concerned waste disposal. However, since then, Korea's waste management policy has evolved. Starting in the 1990s, the country has emphasized recycling, and from 2000 onwards, resource recirculation.

- 1992 – Act on the Promotion of Saving and Recycling of Resources: It concerned the more efficient use of resources through recycling. The Act's instruments require reducing the volume of waste, increasing the rate of recycling, and ensuring environmentally sound waste treatment.
- 1995 – Adjustment of the Waste Management Act: It introduced the Volume-based Waste Fee, which imposes disposal charges based on the volume of waste. This Act is considered to have made the greatest contribution of all legislation by substantially reducing Korea's waste generation and increasing the country's recycling rate. Waste segregation at source also began with this Act, and has resulted in high quality and uncontaminated recyclables.
- 2003 – Extended Producer Responsibility (EPR) Act: It obligates producers to assume full financial responsibility for treating the waste from their products and packaging over their entire lifespan.
- 2005 – Food Waste Landfill Ban: Accelerated the shift toward waste reuse and recycling.
- 2016 – Framework Act of Resource Circulation: Promoted the sustainable management of waste through all stages of a product's lifespan from manufacturing through to safe disposal.
- 2018 – Comprehensive Measures for Waste Recycling: Introduced a series of specific actions to be carried out at each stage of the resource cycle from production, consumption, and collection/separation, to recycling and disposal.
- 2020 – 2050 Carbon Neutral Strategy: Promotes circularity through the maximization of resource efficiency and the minimization of resource inputs. This covers a product's entire lifespan from the extraction of resources to make the product, through its production, distribution, and consumption, to its recycling and disposal. The Carbon Neutrality Practice Point (CNPP) system, which is stipulated in Article 67 of the Framework Act on Carbon Neutrality and Green Growth for Coping with the Climate Crisis, encourages consumers to practice various eco-friendly activities, including reusing products. Between 2022 and 2023, the government's budget for the CNPP system tripled from $1.8 million to $6.8 million (won 2.4 billion to won 8.9 billion).

- 2023 – Recycling Industry Growth Fund: Created to foster and support the recycling industry

2.2.2 Extended Producer Responsibility (EPR) System

Under the EPR system, producers are obligated to manage the collection and recycling of their products and packaging materials. They may fulfill these responsibilities through:

- Direct recycling and reuse;
- Outsourcing to licensed recycling companies;
- Participating in the Korea Waste Resources Mutual Aid Association (KWRMAA).

Currently, most producers pay recycling fees to the KWRMAA, which then allocates the funds to recycling companies to fulfill producers' obligations.

Producers failing to comply must pay a penalty recycling fee, calculated at up to 130% of the standard recycling cost.

2.3 Technological Development

South Korea's approach to plastic recycling has undergone significant transformation across multiple dimensions. The country has advanced from policy-driven source waste reduction to optimized collection and transportation, and further to innovations in sorting technologies and the expansion of reuse models, the country have built a more efficient and eco-friendly plastic circular economy.

Annually, the plant can treat 8,000 tons of general waste (unsegregated plastic waste) and produce 4,700 tons of high-quality oil.

2.3.1 Current Plastic Recycling Methods

Methods	Description	Advantages	Disadvantages
Mechanical Recycling (Physical Recycling)	Cleaned and sorted plastics are crushed, melted, and pelletized for reuse.	• Low cost • Mature technology • Low energy consumption	• Limited applicability (requires clean and homogeneous plastic materials) • Plastic quality degrades easily • Material properties declines after multiple recycling cycles
Chemical Recycling (Pyrolysis)	Plastics are decomposed into monomers or oils via thermal pyrolysis, used for producing fuel or new plastics.	• Can process mixed or contaminated plastics • Enable “molecular-level recycling” • Expand recycling scope	• Relatively high initial investment • High technical threshold • Require stable operation conditions
Incineration for Power (Heat Recovery)	Waste plastics are burned to generate heat or electricity.	• Rapidly process large amounts of plastic waste • Recover energy	• Produce dioxins and other pollutants • Face carbon emission regulation pressure • Negative environmental image
Landfilling	Plastics that cannot be processed are directly buried.	• Simple and fast	• Land resource scarcity • Environmental pollution • Increasingly restricted by policy
Solvent Dissolution Or Biodegradation	Uses green solvents or biological agents to treat plastic waste.	• Effective for some hard-to-recycle plastics • Promising research frontier	• Immature technology • High cost • Difficult to scale industrially

2.3.2 Characteristics of Recycling Technological Development

(1) 2013–2018: Predominance of Mechanical Recycling

During this period, South Korea primarily relied on mechanical recycling to dispose plastic waste. This approach involved sorting, cleaning, shredding, and reprocessing plastics, mainly applicable to clean, single-type plastics such as clear PET bottles. However, as the volume and diversity of plastic waste increased, the limitations of mechanical recycling became apparent, as it struggled to effectively process mixed or contaminated plastics.

(2) 2019–2024: Transition Towards Chemical Recycling Technologies

- Mechanical recycling remained the mainstream method but increasingly failed to meet the recycling demands for mixed and contaminated plastics. It has a declining trend in usage.
- Chemical recycling (pyrolysis) emerged as a new growth area. South Korea is gradually promoting its commercial implementation.
- Incineration has faced growing policy restrictions and is being progressively phased down.
- National policies are steering the industry toward "advanced recycling," supporting resource regeneration and carbon neutrality objectives.

2.4 Financial Support

South Korea has developed a mature green finance system. Banks and investment institutions actively support financing for circular economy projects. They offers preferential financial services such as "green loans" and "low-interest credit" to eco-friendly pyrolysis projects. In South Korea, ESG projects generally receive higher credit ratings and enjoy easier access to funding. Given that plastic pyrolysis aligns closely with ESG principles, such projects hold a financing advantage.

Since 2024, the South Korean government has been encouraging private enterprises to develop the environmental industry. This has increasingly attracted mainstream capital to pyrolysis projects. With ongoing policy support and growing market awareness, plastic pyrolysis projects are expected to gain broader access to financial resources.

3. Plastic Pyrolysis Market Analysis

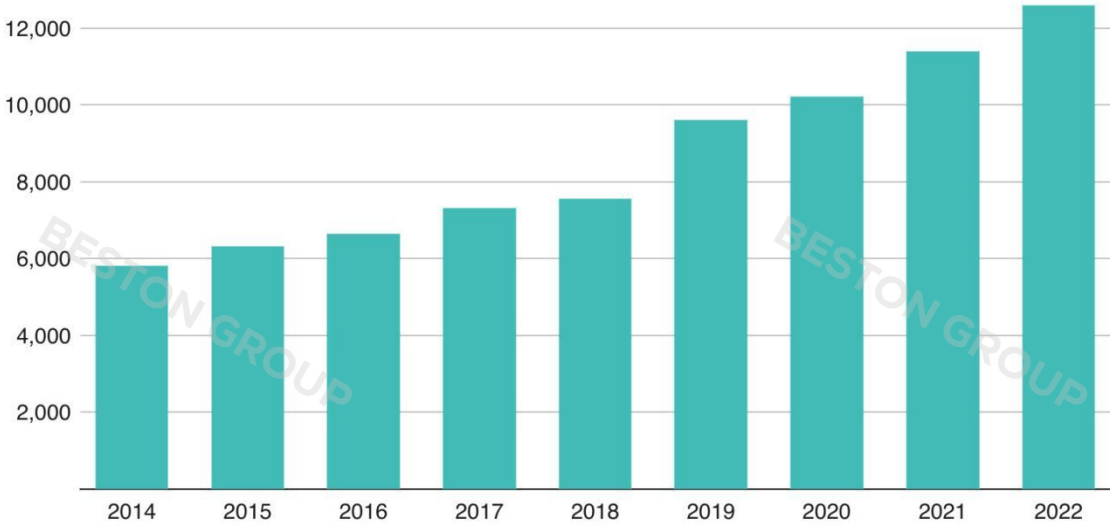
3.1 Plastic Waste Generation and Recycling

South Korea is one of the world's major plastic producers, having a highly developed chemical industry. According to data from the Korea Environment Corporation (KECO), the annual volume of domestic plastic waste surged from 5.8 million tons in 2014 to 12.6 million tons in 2022.

Although the overall plastic recycling rate reached around 70% (from government statistics), a significant portion of mixed and contaminated plastics remains difficult to recycle using traditional mechanical recycling. Therefore, chemical recycling technologies, particularly pyrolysis, are emerging as complementary solutions and are actively encouraged by government policies.

South Korea's Plastic Waste Generation

Plastic waste generation in the country has jumped since COVID



Unit: 1,000 tonnes

• Source: Korea Environment Corporation

3.2 Market Capacity and Forecast for Plastic Pyrolysis Recycling

On June 21, 2021, South Korea's Ministry of Environment announced a policy target: to increase domestic plastic pyrolysis capacity from 10,000 tons in 2021 to 900,000 tons by 2030. This underscores the government's strong emphasis to pyrolysis recycling technology, and provides clear direction for industry development. According to industry insiders, South Korea plans to build approximately 225 plastic pyrolysis facilities by 2030 to support this target.

On April 11, 2023, the Seoul Metropolitan Government signed a business agreement with four domestic oil refineries and chemical companies (GS Caltex, HD Hyundai Oilbank, LG Chem, and SK Geo Centric) to promote a zero waste program that recycles discarded vinyl waste into pyrolysis oil. This further reinforced policy

support and collaborative platforms for the pyrolysis industry.

With the advancement of demonstration projects and the refinement of supportive policies, South Korea's plastic pyrolysis recycling market is expected to enter a rapid growth phase. Over the next few years, besides large enterprises, small and medium-sized businesses will also begin to invest relevant equipment and technologies. The industry will move toward greater scale, efficiency, and value-added development, with market capacity projected to grow steadily.

3.3 Plastic Pyrolysis Project Competitive Landscape

3.3.1 Number of Projects and Technology Types

As of 2024, South Korea has approximately 5 to 10 plastic pyrolysis projects in operation or pilot phases. Among these, about 70% to 80% utilize pyrolysis technology, that is converting plastic waste into pyrolysis oil under high-temperature, oxygen-free conditions. The pyrolysis oil is then further processed by refineries or chemical companies. This represents the most mainstream commercial pathway currently. A smaller number of projects are exploring alternative methods such as pyrolytic gasification, but these have not yet reached large-scale commercial viability.

3.3.2 Geographic Distribution and Site Selection Criteria

(1) Main Concentration Areas

- Ulsan: South Korea's largest petrochemical and energy industry hub. Pyrolysis oil produced here can directly enter refinery units or chemical processes, achieving efficient resource recovery and reuse. Local government is developing the "Carbon Neutral Industrial Zone", providing policy support and infrastructure for

plastic pyrolysis projects.

- Yeosu: Home to large national petrochemical industrial complex. Plastic pyrolysis projects in this region benefit from synergy with traditional refining facilities. It can reduce logistics and processing costs while improving economic returns on outputs.
- Dangjin: Local industrial base in steel, petrochemicals, and energy, offers reliable downstream demand for pyrolysis products. Local government supports green investments with incentive policies. Coastal location enables efficient logistics for both feedstock and product distribution.

(2) Site Selection Criteria

- Proximity to Petrochemical Value Chain: Leveraging existing refinery and chemical infrastructure facilitates the sale or further processing of pyrolysis oil and syngas; utilizing existing energy supply networks lowers construction costs.
- Priority to Strong Environmental Policy Support: Local government incentives such as financial subsidies, streamlined approvals, and carbon emission quotas are key considerations for plastic pyrolysis project location.
- Transportation and Port Advantages: Most pyrolysis projects are located near ports or maritime hubs (e.g., Yeosu Port, Ulsan Port), which benefits raw material import and product export logistics, enhancing overall economic efficiency.

3.4 Potential Customer Profile of Plastic Pyrolysis Technology

3.4.1 Customer Industry Segmentation and Core Needs

Industry	Customers	Features	About Pyrolysis
Plastic waste processors and owners	Recycled resources companies / Plastic recycling companies	Have large volumes of plastic waste with stable supply but limited advanced process capability	Pyrolysis offers a higher value-added pathway for plastic waste management, shifting briquetting or export toward energy recovery.
	Large-scale municipal or waste treatment firms	Capable of processing urban solid waste and integrating plastic waste resources	Integrate pyrolysis into the heat energy recovery to promote waste resourcing

Energy-intensive industries / Refinery operators	Industrial boiler users / energy-intensive enterprises	Face high energy costs and carbon reduction pressure drive interest in alternative fuels	Directly use pyrolysis fuel oil to reduce costs and build sustainable image
Manufacturers with carbon neutral or ESG pressure	Export-driven manufacturers (Especially automotive, electronics, and appliances sectors)	Face strict carbon emissions scrutiny in the European and North American markets, requiring circular economy solutions	Invest in plastic pyrolysis projects to enhance ESG ratings and improve brand image
Government / Research institutions / Environmental funds	Public-private projects supported by government	Promote circular economy and Korea 2050 Carbon Neutral goal	Policy-aligned pyrolysis project is more likely to get government funding or approval
	Green tech startups / Investment institutions	Korea has recently promoted circular economy and green investment, encouraging co-investment or collaboration	• Green funds and sustainable investment firms (e.g., Korea Development Bank, KB Green Ventures) • University and research institute programs (e.g., KAIST, POSTECH)

3.4.2 Customer Concerns and Driving Factors Analysis

Industry	Key Concerns	Driving Factors
Plastic recycling companies	• Is plastic pyrolysis equipment cost too high? • Is the pyrolysis process too complex, and is it easy to operate? • Are there stable sales channels	• Convert plastic waste into higher-value products (e.g., pyrolysis oil) • Desire to establish closed-loop systems and reduce third-party dependence

	for the pyrolysis oil? • Is there policy support for pyrolysis project?	• Possibility of government subsidies, tax incentives • Align with resource circulation and EPR requirements
Industrial fuel users (e.g. cement plants, boilers)	• Can pyrolysis oil directly replace diesel/heavy oil? • Is machine modification required to use pyrolysis oil? • Does the oil meet environmental standards? • Is the oil legally permitted as fuel?	• Lower fuel procurement costs • Increase flexibility and security in energy use • Avoid carbon taxes or meet environmental requirements • Reduce reliance on traditional fossil fuels, enhancing green image
Government agencies / municipalities	• Does the project meet environmental laws? • Are there reliable technologies and corporate partners? • Can the project create jobs and attract investment? • Is central or local government support available?	• Raise local plastic treatment and recycling rates • Develop regional green infrastructure projects • Support carbon neutrality goal • Promote environmental tech innovation and economic strcuture transformation.
Export-oriented manufacturers	• Is it possible to obtain environmental certifications? • Is the recycling process traceable? • Is a stable and long-term oil supply achievable?	• Meet the environmental requirements of international buyers and brand partners • Build a transparent ESG-compliant supply chains • Enhance brand image and expand overseas markets • Reduce overseas risks and increase resilience
Green tech startups / Environmental investors	• Is the technology commercially viable?	• Seize early opportunities in the green investment market

	• Is the pyrolysis process mature with successful case studies? • Is the project replicable? • Do regulations allow startup companies to operate in this field?	• Achieve environmental benefit and financial returns • Expand international markets and showcase South Korea's environmental capabilities • Leverage government incentives for the green industry to accelerate growth

4. Profitability Analysis

The cost of plastic waste treatment in South Korea is generally high. Local landfill fees and transportation expenses are higher than in most other Asian countries. For mixed and contaminated plastics, mechanical recycling is difficult and pyrolysis becomes the preferred method.

(1) Raw Material Side: Waste Plastic Procurement

Plastic Type	Market Price	Description
PE/PP	100–200 USD/ton	High oil yield, well-suited for pyrolysis
Other types	Varies based on the Korean market	• Low cleanliness/highly mixed plastic: lower purchase price due to higher processing difficulty • High cleanliness/single-type plastic: relatively high purchase price

(2) Product Side: Pyrolysis Revenue

Source	Market Price	Description	Market Demand
Sale of pyrolysis oil	¥4000-5000/ton (2024 average estimate)	Price is determined by oil quality	• Shipping industry has strong demand for pyrolysis oil. South Korea's four major refineries purchase large volumes of plastic pyrolysis oil for co-processing into marine fuel. • Large refineries with carbon reduction targets must blend at

			least 30% fuel oil into production process. Current demand for pyrolysis oil exceeds supply.
Sale of Renewable Energy Certificates (REC)	¥350/ton	Pyrolysis oil made from plastic waste can qualify for REC certification, which can be resold for additional revenue.	Companies that do not meet carbon emission target can purchase RECs to achieve compliance.
Subsidies for plastic recycling	• Unwashed plastic: ¥800/ton • Washed plastic: ¥200–450/ton • Fishing nets: ¥1800/ton	Subsidy amounts vary depending on Korean government policies	—

5. Industry Development Opportunities

5.1 Strong Policy Support for Plastic Resource Recovery

The South Korean government has enacted regulations such as the Framework Act of Resource Circulation and the Carbon Neutral Green Growth Act to promote plastic waste reduction and resource recovery. Pyrolysis technology, categorized as a method of “thermal energy recovery” or “resource recovery,” is explicitly encouraged under policies. In line with the 2050 carbon neutrality goal, pyrolysis projects are considered key to reducing carbon emissions and providing alternative energy sources. The projects are eligible for priority policy and financial support.

5.2 Export Restrictions Drive Domestic Pyrolysis Capacity Expansion

Due to plastic waste import bans in China and other Asian countries, South Korea has gradually imposed restrictions on plastic waste exports since 2021. This shift has forced the country to seek alternative treatment solutions. Pyrolysis offers an effective solution to fill the gap between mechanical recycling and energy recovery.

5.3 ESG and Carbon Neutral Goal Promote Investment in Pyrolysis

The rising importance of Environmental, Social, and Governance (ESG) and carbon neutrality goals is spurring the growth of green investments. Companies should demonstrate tangible carbon reduction outcomes as part of their ESG commitments. Plastic pyrolysis technology offers both carbon emission mitigation and energy recovery potential. More an more investors are showing interest in "sustainable technologies," and green projects are more likely to receive support from governments or sustainability-focused funds.

5.4 Early-Stage Industry and Unformed Market Landscape

Although several pyrolysis projects are already underway in Korea, their operational performance has generally not meet expectations. This indicates that the market structure remains underdeveloped, leaving significant room for competition in capturing future market share. For companies with mature technology, strong financing, and proven operational expertise, this presents a good opportunity to enter the plastic pyrolysis sector and establish a competitive advantage.

6. Investment and Development Suggestions

6.1 Suggestions for Policymakers

(1) Strengthen Policy Guidance and Pilot Support

- Clarify technology positioning and industrial pathway: Incorporate plastic pyrolysis technology into the core technology list under South Korea's environmental regulations and develop mid-to-long-term plans. Define its priority within the plastic waste resource recovery chain.
- Enhance financial incentives and pilot demonstrations: Provide equipment purchase subsidies and tax credits for pyrolysis projects that meet green certification standards. Support local governments to collaborate with enterprises to develop “Zero-Waste Plastics Industrial Zone” demonstration projects.

(2) Improve Regulatory Framework and Supervision Standards

- Define the regulatory attributes of pyrolysis oil to remove compliance barriers: Work with relevant departments to establish quality standards for pyrolysis oil. Officially classify it as recycled resources to support commercial compliance.
- Unify safety and emission standards: Establish various emission limits for plastic pyrolysis plants to prevent public trust crisis.

6.2 Suggestions for Enterprise Operations

(1) Leverage Policy Benefits

Closely monitor and actively utilize environmental incentive policies at national and local levels related to plastic recycling, pyrolysis, and renewable energy. Proactively apply for funding support and demonstration project approvals to reduce initial investment costs and accelerate project implementation and return cycles.

(2) Clarify Business Positioning and Operating Models

Choose development paths based on internal resources and capabilities to avoid blind investment and resource waste. For example:

- Model 1: Equipment Manufacturing + Operation Services: Suitable for technology-driven firms. Focus on R&D and manufacturing of pyrolysis equipment, offering equipment sales and operational services as revenue streams.
- Model 2: Raw Material Processing + Oil Sales: Ideal for companies with stable waste plastic supply. Purchase reliable pyrolysis equipment and focus on large-scale oil production and sales, securing profits through long-term contracts with refineries or chemical companies.
- Model 3: Collaborate with Leading Chemical/Energy Corporations: Partner with industry leaders to develop closed-loop industry chains—"waste plastic → pyrolysis oil → high-value chemicals (e.g., recycled plastics)"—to integrate resources and achieve synergies.

(3) Clarify Business Positioning and Operating Models

South Korea's plastic pyrolysis industry remains in its early stages with limited commercialization. Enterprises should continuously track cutting-edge technological advancements from leading corporations, research institutes, and industry associations, identifying innovations withindustrialization potential. Examples include:

- Intelligent sorting and pre-treatment system: improve feedstock purity and reduce impurities that interfere with pyrolysis reactions, thereby improving efficiency and product quality.
- High-efficiency catalyst and low-energy pyrolysis process: reduce operational costs and enable more enterprises to participate.
- Pyrolysis oil refining technology: improve oil quality to meet downstream requirements in refining and chemical sectors, increasing product commercial value.

(4) Build Upstream and Downstream Synergies

Successful pyrolysis projects depend on stable raw material supply and smooth product sales. Enterprises should actively establish collaborative relationship.

- Establish long-term feedstock supply agreements with municipal solid waste management operators;
- Form strategic procurement partnerships with refineries and petrochemical companies for pyrolysis oil;
- Develop efficient logistics systems to minimize transportation costs for both raw materials and end products.

6.3 Comprehensive Outlook

The plastic pyrolysis industry in South Korea is currently in the "pilot promotion and initial industrialization" stage. Driven by multiple factors, the sector is gradually shaping a development pattern featured by clear technological pathway, well-defined policy guidance, and increasing market attention. Although challenges remain, the industry's potential in resource recovery and carbon reduction is gaining recognition from both the government and the market. Looking ahead, through technology commercialization validation, demonstration project expansion, and multi-stakeholder collaboration, the industry is expected to enter a new phase of scale-up and mature commercialization.

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