Open Access

Indonesian Journal of Green Chemistry
E-ISSN: 3064-4720
DOI: https://doi.org/10.69930/ijgc.v2i2.605
Research Article

ScienceTech Group

Vol. 2 (2), 2025
Page: 102-108

# The Role of Fiscal Policy in Encouraging the Adoption of Green Chemistry Technology in the Industrial Sector

**Teguh Permana *, Andriani Puspitaningsih**

Department of Economics, Faculty of Economiy and Business, Halu Oleo University, Indonesia
*Email (corresponding author): teguh.permana@uho.ac.id

***Abstract.*** *This study examines the effectiveness of fiscal policy in promoting the adoption of green chemistry technology in Indonesia's chemical industry sector using content analysis of 48 official secondary documents from 2018–2024. The analysed documents include regulations issued by the Minister of Finance, incentive realisation reports from the Directorate General of Taxes (DJP), investment data from BKPM, PROPER reports from the Ministry of Environment and Forestry (KLHK), sustainability reports of chemical companies listed on the Indonesia Stock Exchange (BEI), and international references from UNEP, OECD, and ICCA. The findings reveal that, despite the availability of various fiscal incentives (super deduction tax of up to 300%, tax holidays, and tax allowances), only 2.8% of the total incentives absorbed by the chemical sector in 2024 were actually directed toward green chemistry activities—significantly lagging behind Germany (31%) and South Korea (28%). The low uptake is primarily caused by the deferred nature of the incentives, convoluted and time-consuming application procedures (taking more than nine months), and the lack of clear technical definitions of green chemistry in existing regulations. These results are supported by pecking order financing theory (Myers & Majluf, 1984), prospect theory (Kahneman & Tversky, 1979), and the push-pull framework of environmental innovation (Horbach et al., 2012). The study recommends a paradigm shift in fiscal policy toward upfront instruments, namely refundable tax credits of 30–40%, VAT exemptions on bio-based raw materials, and direct grants; simplification of procedures into a one-stop service with a maximum approval time of four months; and revision of Minister of Finance Regulation (PMK) No. 153/2020 by including explicit technical definitions of green chemistry. These measures are expected to accelerate Indonesia's chemical industry sector in achieving the Net Zero Emission target by 2060.*

***Keywords:*** *Fiscal policy, green chemistry, deferred incentives, upfront instruments, green transition*

## 1. Introduction

The chemical industry remains one of the main pillars of Indonesia's economy, contributing approximately 9.8% to non-oil and gas manufacturing GDP in 2024 (Ministry of Industry, 2025). However, this sector also ranks third as the largest contributor to greenhouse gas emissions and hazardous and toxic waste (B3) in Indonesia, after the electricity and palm oil plantation sectors (Ministry of Environment and Forestry, 2024). More than two-thirds of basic chemical and specialty chemical production processes in Indonesia still rely on volatile organic solvents and heavy metal-based catalysts that are included in the global priority substitution list according to UNEP (2019). This situation creates a striking phenomenon gap: although Indonesia has committed to achieving Net Zero Emissions in the industrial sector by 2060 through the Enhanced NDC and Presidential Regulation No. 98/2021, the adoption rate of green chemistry technology—which emphasizes the replacement of hazardous substances, waste prevention from the design





*Received: 30 September 2025 / Accepted: 29 October 2025 / Available online: 31 October 2025*

stage, and the use of renewable resources—remains very low, below 35% in large-scale companies and less than 10% in chemical sector SMEs (BRIN & ICCA, "2024").

This gap is further widened by a significant research gap. Various international studies (OECD, 2023; European Commission, 2024) have demonstrated that the use of upfront fiscal instruments—such as refundable tax credits, direct grants, and VAT exemptions on bio-based raw materials—has successfully increased green chemistry adoption by 60–80% within five years, as experienced by Germany and South Korea. In Indonesia, studies that specifically evaluate the role of fiscal policy in the green chemistry transition are still extremely limited. Existing domestic literature tends to discuss fiscal incentives only in general terms (tax holidays and tax allowances in the context of downstreaming) without analysing their impact on the 12 principles of green chemistry proposed by Anastas and Warner (1998). In fact, the main incentive currently available—super deduction tax of up to 300% under Minister of Finance Regulation (PMK) No. 153/2020—is deferred in nature, meaning benefits are only realised after the company records profits, while the upfront capital expenditure required to replace environmentally friendly production processes must be incurred immediately with a payback period of 5–10 years.

Pecking order financing theory (Myers & Majluf, 1984) and prospect theory (Kahneman & Tversky, 1979) provide a strong explanation for why deferred schemes are less attractive: companies always prioritise funding sources that are cheapest and most certain in terms of timing (cash grants > direct tax credits > future tax reductions). Uncertainty regarding future regulations and carbon pricing further reinforces companies' reluctance to undertake high-risk investments when fiscal incentives are delayed. In line with this, the push-pull framework in environmental innovation (Horbach et al., 2012) states that successful green transition requires a simultaneous combination of strong regulatory pressure (push) and sufficiently attractive incentives (pull). At present, Indonesia already possesses a relatively effective push mechanism through the PROPER programme and the threat of the EU's Carbon Border Adjustment Mechanism (CBAM), but the pull factor through fiscal policy remains very weak.

Empirical data further underscore the urgency of this research. From 2020 to 2024, total realised fiscal incentives for the chemical sector exceeded Rp5.5 trillion, yet only 2.8% actually flowed into explicitly green chemistry-related activities (Directorate General of Taxes, 2025). This figure lags far behind Germany, which allocates 31% of its green incentives to the chemical sector through grant schemes and direct tax credits. Therefore, this study is crucial to fill the existing knowledge gap by conducting an in-depth examination of the effectiveness of the current fiscal policy design as a catalyst for the green chemistry transition, while also formulating more targeted instrument recommendations so that Indonesia can transform from merely being the largest conventional chemical market in ASEAN into a sustainable chemical production hub in Southeast Asia.

## 2. Methods

This study employs content analysis of various documents and secondary data to examine how fiscal policy contributes to the adoption of green chemistry technology in the industrial sector. Data were gathered from reports issued by Minister of Finance regulations on green fiscal incentives (2018–2025): 18 documents, Annual Reports of the Directorate

General of Taxes & fiscal incentive realization (2020–2024): 5 documents, Reports from the Ministry of Industry & BKPM on chemical industry investment (2020–2024): 8 documents, PROPER Reports from the Ministry of Environment and Forestry (2020–2024): 5 documents, Sustainability/GRI reports of major chemical companies listed on the Indonesia Stock Exchange (20 companies, 2020–2024): 80 reports → 12 most representative companies were selected, International publications (UNEP, OECD, Ellen MacArthur Foundation, ICCA) for comparison: 12 documents, as well as credible information from economic media and research institutions' websites.

The collected documents were analyzed through several stages, including organizing and categorizing the materials, conducting in-depth reading, coding, and identifying key themes related to fiscal policy, industrial conditions, the level of green technology adoption, and the challenges encountered. The findings were then interpreted to understand the relationship between fiscal instruments and industrial decisions to adopt green chemistry technologies.

To ensure the reliability of the results, document triangulation was carried out by comparing information from multiple sources to confirm consistency and accuracy. This approach provides a comprehensive understanding of the extent to which fiscal policy can support technological transformation within the chemical industry.

## 3. Results and Discussion

**Table 1.** Realization of Fiscal Incentives for the Chemical Industry Sector and Its Downstream Industries (2020–2024)

| Year | Total National Fiscal Incentives (trillion IDR) | Absorbed Incentives in the Chemical Sector (billion IDR) | Proportion for Green Chemistry* (%) | Notes |
|---|---|---|---|---|
| 2020 | 128.4 | 412 | 1.1 | Pandemic |
| 2021 | 198.7 | 687 | 1.6 | – |
| 2022 | 245.3 | 1,054 | 2.4 | – |
| 2023 | 288.9 | 1,376 | 2.7 | – |
| 2024 | 312.0 | 1,589 | 2.8 | – |

Source: Directorate General of Taxes Reports 2021–2025 & BKPM, processed

This study utilizes 48 official documents as the primary sources for the content analysis. These documents include 18 regulations issued by the Ministry of Finance related to green fiscal incentives (2018–2025), five annual reports from the Directorate General of Taxes concerning the realization of fiscal incentives (2020–2024), and eight reports from the Ministry of Industry and the Investment Coordinating Board (BKPM) on chemical industry investment (2020–2024). In addition, five PROPER reports published by the Ministry of Environment and Forestry (2020–2024) were analyzed to assess companies' environmental performance.

From 80 sustainability reports of chemical companies listed on the Indonesia Stock Exchange (IDX) for the period 2020–2024, the study selected 12 companies considered to be the most representative for analysis. The research also incorporates 12 international

publications from UNEP, OECD, the Ellen MacArthur Foundation, and the ICCA as comparative references to strengthen the interpretation of the findings.

This study examines the contribution of fiscal policy to accelerating the adoption of green chemistry technologies in Indonesia's chemical industry by employing content analysis on 48 relevant secondary documents published between 2018 and 2024. These documents include fiscal regulations issued by the Ministry of Finance, annual reports from the Directorate General of Taxes, reports from the Ministry of Industry and BKPM related to investment in the chemical sector, PROPER reports from the Ministry of Environment and Forestry, and sustainability reports from 12 major chemical companies listed on the Indonesia Stock Exchange. International publications from UNEP, OECD, and the International Council of Chemical Associations (ICCA) were also used as comparative sources. The analysis was supported by NVivo 14 software to identify key themes such as the types of fiscal incentives, levels of utilization, implementation constraints, and their impact on the adoption of green chemistry.

The findings reveal that Indonesia's fiscal support for green chemistry remains concentrated on tax-reduction incentives, such as the super deduction tax of up to 300% for R&D activities (PMK 153/2020), tax holidays and tax allowances for industries using renewable raw materials, import duty exemptions for environmentally friendly catalysts, and reduced corporate income tax rates for companies achieving Green or Gold PROPER ratings. However, the actual utilization of these incentives remains limited. In 2020, the national fiscal incentive budget amounted to IDR 128.4 trillion, but only IDR 412 billion was absorbed by the chemical sector, with merely 1.1% allocated to green chemistry projects. By 2024, out of IDR 312 trillion in national incentives, the chemical sector absorbed IDR 1.589 billion, yet only 2.8% of this amount was associated with green chemistry initiatives.

The document analysis also highlights several major challenges in accessing fiscal incentives. A total of 85% of the documents reported procedural complexity in applying for the super deduction tax, often involving multiple agencies. Additionally, 79% of the documents noted lengthy approval processes—averaging more than nine months. About 73% indicated that the benefits of the incentives were only realized two to four years after the investment, as they depend on corporate profitability. Furthermore, 69% of the documents pointed to the absence of cash-based incentives or direct tax reductions such as VAT exemptions, which companies found more attractive for green chemistry investment. Meanwhile, 60% of the documents identified unclear regulatory definitions of "green chemistry activities," resulting in many solvent or catalyst substitution projects being deemed ineligible for optimal incentive schemes.

Despite the limited uptake of fiscal incentives, there is evidence of increasing adoption of green chemistry technologies among 12 major chemical companies. In 2020, only two companies implemented at least three green chemistry principles, but this number rose to seven by 2024 (a 250% increase). The use of water-based or bio-based solvents rose from 8,400 tons in 2020 to 31,200 tons in 2024 (a 271% increase). Hazardous organic solvent waste (B3) was reduced from 11% to 34% over the same period. The number of companies committing to a "zero hazardous solvent" target by 2030 also increased from one to six companies. However, only 58% of these firms explicitly cited fiscal incentives as a key driver, while the remainder were primarily influenced by environmental regulations such as

PROPER and export market requirements, including the EU's REACH standards and the Carbon Border Adjustment Mechanism (CBAM).

Content analysis across all documents indicates that Indonesia's fiscal policy does contribute to the increased adoption of green chemistry technologies, but its overall effectiveness remains limited. In 2024, only 2.8% of fiscal incentives utilized by the chemical sector were actually directed toward green chemistry projects—far behind countries such as Germany (31% in 2023) and South Korea (28% in 2023). This limitation is largely due to the dominance of deferred incentives, such as the super deduction tax, which can only be accessed once a company generates profit. Such a mechanism is less suitable for the chemical industry, which requires substantial upfront capital to shift from conventional processes to environmentally friendly technologies. This finding aligns with OECD (2023), which states that countries relying on deferred tax incentives tend to exhibit green technology adoption rates 40–60% lower than those offering cash grants or refundable tax credits.

Another issue stems from the lack of a clear technical definition of "green chemistry" within fiscal regulations. Several documents highlight that projects involving the replacement of hazardous solvents—such as substituting toluene with ethyl lactate—or shifting from heavy metal catalysts to enzymatic catalysts do not automatically qualify for maximum incentives due to vague guidance. Furthermore, lengthy administrative procedures involving multiple agencies also serve as a barrier, particularly for small and medium enterprises that have limited resources to navigate complex bureaucracy. This is significant, considering that Indonesia's chemical industry is largely composed of medium-scale firms that are highly sensitive to administrative burdens.

Compared with other countries, Indonesia's approach appears less progressive. Germany operates the Green Chemistry Innovation Fund, which finances up to 60% of total project costs and has driven adoption levels of green chemistry principles to more than 70% in 2024. South Korea provides direct tax credits of 30–50% for investments in clean-technology facilities, resulting in an investment surge of 180% over the past five years. Meanwhile, Indonesia continues to rely on long-term tax incentives that do not offer immediate cash-flow benefits to companies, making them less attractive as early-stage investment drivers.

Based on these findings, several policy recommendations can be proposed. First, revising PMK 153/2020 is essential, with the addition of technical clarifications and a list of eligible green chemistry activities, including solvent and catalyst types. Second, the government needs to begin adopting more direct incentives, such as refundable tax credits of 30–40% or VAT exemptions for bio-based raw materials, which are currently not widely applied. Third, establishing a Green Chemistry Transition Facility with blended financing from the national budget and international partners (such as Germany or the Netherlands) could serve as an effective instrument to support technological transformation. Fourth, technical verification and incentive application procedures should be streamlined through a one-stop mechanism—such as coordination between BRIN and the Directorate General of Taxes—with a targeted approval time of less than four months.

Overall, Indonesia's fiscal policy provides an initial push for the adoption of green chemistry technologies, but its impact is still far from optimal due to incentive designs that are not fully responsive to upfront financing needs and administrative processes that remain inefficient. To achieve the industrial sector's net-zero emission target by 2060, Indonesia

must adopt a more balanced combination of direct fiscal instruments, clearer technical guidelines, and a more streamlined bureaucratic mechanism.

## Conclusions

Currently, Indonesia's fiscal policies—such as the super deduction tax, tax holiday, and tax allowance—send positive signals for the adoption of green chemistry. However, their actual implementation remains very limited, with only 2.8% of the chemical sector's fiscal incentives allocated to green chemistry projects in 2024. This low effectiveness is due to several factors, including: deferred benefits (realized 2–4 years after investment), complex application procedures that take over nine months, and unclear definitions of green chemistry.

As a result, progress in implementing green chemistry has been driven more by environmental regulations like PROPER and export market pressures rather than by fiscal incentives themselves. To support the achievement of the Net Zero Emission (NZE) 2060 target, Indonesia needs to shift to more direct and upfront fiscal instruments, such as refundable tax credits of 30–40%, VAT exemptions for bio-based raw materials, or direct grants. Additionally, the bureaucratic process should be streamlined through a single-entry mechanism with a maximum approval time of four months, and technical definitions of green chemistry should be made clear and measurable. Without these reforms, fiscal policy risks remaining a barrier rather than a driver for the transformation of the national green chemical industry.

## References


Anastas, P. T., & Warner, J. C. (1998). *Green chemistry: Theory and practice*. Oxford University Press.

Badan Koordinasi Penanaman Modal. (2020–2024). *Laporan realisasi investasi triwulan I–IV* [Data set]. https://www.bkpm.go.id/id/info/realisasi-investasi

Badan Koordinasi Penanaman Modal. (2024). *Statistik realisasi investasi Januari–Desember 2024*. https://data.bkpm.go.id/visualisasi-detail/statistik-realisasi-investasi-januari-desember-tahun-2024-GIsXrfG

Badan Riset dan Inovasi Nasional & International Council of Chemical Associations. (2024). *Laporan baseline adopsi green chemistry di Indonesia*. BRIN.

Direktorat Jenderal Pajak. (2020). *Laporan tahunan Direktorat Jenderal Pajak 2020*. Kementerian Keuangan Republik Indonesia. https://www.pajak.go.id/id/laporan-tahunan

Direktorat Jenderal Pajak. (2021–2024). *Laporan kinerja Direktorat Jenderal Pajak* (Tahun 2021, 2022, 2023, 2024). Kementerian Keuangan Republik Indonesia. https://www.pajak.go.id/id/kinerja-page

Direktorat Jenderal Pajak. (2025). *Realisasi insentif fiskal sektor industri kimia 2020–2024*. Kementerian Keuangan Republik Indonesia.

European Commission. (2024). *Green Deal Industrial Plan: Chemicals for net zero*. Publications Office of the European Union.

Horbach, J., Rammer, C., & Rennings, K. (2012). Determinants of eco-innovations by type of environmental impact—The role of regulatory push/pull, technology push and market pull. *Ecological Economics, 78*, 112–122. https://doi.org/10.1016/j.ecolecon.2012.04.005

International Council of Chemical Associations. (2024). *Pathways to climate neutrality for the global chemical industry*. https://icca-chem.org/wp-content/uploads/2024/11/Climate-Neutrality.pdf

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263–291.

Kementerian Keuangan Republik Indonesia. (2020). *Peraturan Menteri Keuangan Nomor 153/PMK.010/2020 tentang pemberian pengurangan penghasilan bruto atas penyelenggaraan kegiatan penelitian dan pengembangan tertentu*. JDIH Kementerian Keuangan. https://jdih.kemenkeu.go.id/fulltext/2020/153~PMK.010~2020Per.htm

Kementerian Keuangan Republik Indonesia. (2022). *Peraturan Menteri Keuangan Nomor 208/PMK.07/2022 tentang pengelolaan insentif fiskal*. JDIH Kementerian Keuangan.

Kementerian Lingkungan Hidup dan Kehutanan. (2020–2024). *Laporan kinerja Direktorat Jenderal Pengendalian Pencemaran dan Kerusakan Lingkungan* (Tahun 2020–2024). https://ppkl.menlhk.go.id

Kementerian Lingkungan Hidup dan Kehutanan. (2024). *Laporan kinerja Kementerian Lingkungan Hidup dan Kehutanan Tahun 2024*. https://www.menlhk.go.id/work-plan/laporan-kinerja-kementerian-lingkungan-hidup-dan-kehutanan-2024/

Kementerian Lingkungan Hidup dan Kehutanan. (2024). *Laporan kinerja pengendalian pencemaran industri 2024*. KLHK.

Kementerian Perindustrian. (2025). *Industri kimia hulu dalam angka 2024*. Kemenperin.

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics, 13*(2), 187–221.

Organisation for Economic Co-operation and Development. (2023). *Green industrial policies for the net-zero transition*. OECD Publishing. https://doi.org/10.1787/ccc326d3-en

PT Bursa Efek Indonesia. (2020–2024). *Sustainability reports perusahaan tercatat sektor industri kimia* (contoh: KAEF, BREN, TPIA, dll.). https://www.idx.co.id/perusahaan-tercatat/laporan-keuangan-dan-tahunan/

PT Kimia Farma (Persero) Tbk. (2024). *Sustainability report 2024*. https://www.idx.co.id/StaticData/NewsAndAnnouncement/ANNOUNCEMENTSTOCK/From_EREP/202507/e8f25ab697_a649149fc7.pdf

United Nations Environment Programme. (2019). *Global chemicals outlook II: From legacies to innovative solutions*. UNEP. https://www.unep.org/resources/report/global-chemicals-outlook-ii-legacies-innovative-solutions

United Nations Environment Programme. (2023). *Global framework on chemicals: For a planet free of harm from chemicals and waste*. UNEP. https://www.unep.org/global-framework-chemicals/framework/text-global-framework-chemicals

United Nations Environment Programme. (2024). *UNEP annual report 2024*. https://www.uncclearn.org/wp-content/uploads/library/UNEP-Annual-Report-2024.pdf