UNIVERSIDADE DE SÃO PAULO
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RUBENS ROBLES DE SOUZA ORTEGA

Market Analysis and Investment Thesis on the Leading Industrial Gases Company in the United States: Air Products (NYSE: APD)

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Market Analysis and Investment Thesis on the Leading Industrial Gases Company in the United States: Air Products (NYSE: APD)

Undergraduate Thesis presented to the *Escola Politécnica da Universidade de São Paulo* to obtain the degree of Production Engineer.

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“No fim tudo dá certo. Se não deu certo, é porque ainda não chegou ao fim.”

Fernando Sabino

ABSTRACT

The global industrial gases industry has become a critical enabler of modern economies, while hydrogen has emerged as a key driver of the ongoing energy transition. This undergraduate thesis investigates Air Products and Chemicals, Inc., a major global company operating at the intersection of these two sectors. The general objective is to estimate the company's intrinsic value and assess its long-term investment attractiveness. The research applies a structured methodology that combines a review of the corporate finance and valuation literature, a sectoral analysis of the industrial gases and hydrogen markets, an in-depth examination of the company's financial and strategic performance, the development of financial projections and valuation models, and an evaluation of environmental, social, and governance factors. The findings indicate that Air Products holds a dual positioning, balancing the stability and resilience of the mature industrial gases business with the growth potential of large-scale hydrogen projects. This combination makes the company a unique case within its sector, and the integration of financial, sectoral, and sustainability perspectives supports a structured investment thesis on its long-term relevance and value creation capacity.

Keywords: Industrial Gases; Hydrogen Economy; Corporate Valuation; Investment Thesis; ESG Analysis; Air Products

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LIST OF ABBREVIATIONS AND ACRONYMS

NYSE	New York Stock Exchange
CAPEX	Capital Expenditures
D&A	Depreciation and Amortization
EBIT	Earnings Before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EBT	Earnings Before Taxes
EV	Enterprise Value
NOPAT	Net Operating Profit After Taxes
IRR	Internal Return Rate
HHI	Herfindahl-Hirschman Index
FX	Foreign Exchange
M&A	Mergers and Acquisitions
SG&A	Selling, General and Administrative
COGS	Cost of Goods Sold
OPEX	Operational Expenses
PP&E	Property, Plant and Equipment
WK	Working Capital
t	Tax Rate
EPS	Earnings per Share
ROIC	Return on Invested Capital
ROE	Return on Equity
GAAP	Generally Accepted Accounting Principles
IFRS	International Financial Reporting Standards
p.p.	Percentage Points
SEC	U.S. Securities and Exchange Comission
CAGR	Compound Annual Growth Rate
CQGR	Compound Quarterly Growth Rate
CPI	Consumer Price Index
ROCE	Return on Capital Employed

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1. INTRODUCTION

1.1 Contextualization

The industrial gases industry plays a central role in the global economy, supplying essential inputs to strategic sectors such as steelmaking, refining, chemicals, healthcare, food, and electronics. Its products — including oxygen, nitrogen, hydrogen, argon, and carbon dioxide — are critical for processes that cannot be easily substituted, which makes the sector highly resilient and structurally defensive. Historically, demand has grown steadily, in line with or above industrial GDP, supported by long-term contracts, diversified applications, and high entry barriers.

At the same time, the hydrogen economy has emerged as one of the main vectors of the global energy transition. Public policies, such as the Inflation Reduction Act (IRA) in the United States and the Fit for 55 package in the European Union, have accelerated investment in clean hydrogen, carbon capture (CCS), and decarbonization technologies. This context creates an environment in which companies traditionally focused on industrial gases are expanding their portfolios to include energy and sustainability solutions, combining stable operations with high-growth opportunities.

In this scenario, the present study focuses on Air Products and Chemicals, Inc. (APD), a major global player in the industrial gases market that has also positioned itself at the forefront of hydrogen megaprojects. This dual exposure — to a mature and resilient business on the one hand, and to a disruptive, fast-growing sector on the other — makes the company a unique case for analysis. Furthermore, the growing importance of Environmental, Social, and Governance (ESG) factors in investment decisions reinforces the relevance of examining Air Products not only for its financial performance and strategic positioning, but also for how it addresses sustainability challenges, manages stakeholder relations, and upholds governance standards. The research combines theoretical foundations in corporate finance and valuation with a sectoral study of the industrial gases and hydrogen markets, culminating in a complete investment thesis supported by financial projections and valuation models.

1.2 Motivations

The choice of Air Products and Chemicals, Inc. (APD) as the subject of this undergraduate thesis was motivated by both academic and professional interests, as well as by the strategic relevance of the industrial gases and hydrogen sectors in the context of the global energy transition.

On the academic side, the author's experience at Poli Finance, the Financial Markets Undergraduate Club at Poli-USP, fostered a continuous interest in company analysis and valuation, strengthened through active participation in equity research competitions. On the professional side, the internship at Lazuli Partners, a private equity firm, has provided practical exposure to investment analysis across a wide range of industries. However, this experience has not directly involved the industrial gases and hydrogen sector, which created interest in exploring a new segment and understanding its market dynamics.

The industrial gases sector presents unique characteristics that distinguish it from more traditional industries usually assessed in private equity. Air Products, in particular, is notable for its significant exposure to hydrogen, a key element in global decarbonization strategies. The rising demand for sustainable solutions and the growing role of hydrogen in the energy transition make the analysis of this company highly relevant.

1.3 Objectives

The main objective of this undergraduate thesis is to estimate the intrinsic value of Air Products and Chemicals, Inc. (APD) and assess its attractiveness as an investment opportunity. To achieve this, the study integrates theoretical foundations in corporate finance with a sectoral analysis of the industrial gases and hydrogen markets, culminating in a complete valuation of the company.

The specific objectives of the research are:

- To analyze the industrial gases sector, highlighting its history, competitive dynamics, growth drivers, and entry barriers.
- To examine the hydrogen economy, its technological routes, regulatory frameworks, and demand outlook, assessing its role in the global energy transition.
- To apply valuation methodologies to Air Products, with an emphasis on Discounted Cash Flow (DCF) and relative multiples, supported by company data, sectoral assumptions, and scenario modeling.
- To evaluate ESG aspects, with emphasis on Air Products' environmental commitments, disclosure practices, and alignment with decarbonization strategies.

- To develop an investment thesis that synthesizes theoretical, sectoral, and financial findings into a structured conclusion on the company's long-term attractiveness.

1.4 Methodology

This study is applied in nature, since it aims to use theoretical valuation models in a practical case study to estimate the intrinsic value of a specific company. Regarding its objectives, the research is descriptive and explanatory, as it seeks to describe the company's financial situation and explain the determinants of its value through financial modeling.

Concerning the approach to the problem, the study adopts a quantitative and analytical approach, based on financial data and market indicators.

As for the technical procedures, this research can be classified as a case study, since it focuses on the valuation of one selected company, using real and publicly available financial information.

This undergraduate thesis is structured in five stages:

1) **Literature review:** Builds the conceptual foundation in corporate finance, financial statement analysis, and valuation. Primary references include Damodaran (2006, 2012), Koller, Goedhart & Wessels (2020), and Rosenbaum (2013) for valuation, and Póvoa (2012), Iudícibus (2015, 2019), Málaga (2014) for accounting/financial statement analysis.
2) **Sector analysis:** Combines academic and industry references with market data to characterize structure, growth drivers, competitive dynamics, and regulation in industrial gases and hydrogen. Sources include the International Energy Agency (IEA, 2024) and investment-bank/consultancy reports (Goldman Sachs, BofA, J.P. Morgan, Morgan Stanley, UBS, Citi), as well as sectoral studies and statistics (Precedence Research, Statista). Macroeconomic and price series are drawn from FRED where applicable (e.g., CPI vs. sector price indices).
3) **Company analysis:** Uses Air Products' investor relations materials — 10-K, earnings releases, and investor presentations — complemented by sell-side equity research (Goldman Sachs, Citi, J.P. Morgan, Morgan Stanley, UBS, Bank of America). Benchmarks and peer comparisons are incorporated to frame strategy, risks, and performance drivers.

4) **Financial modeling and valuation:** Develops a financial model for Air Products, projecting statements and operating metrics. Assumptions rely on company history, sector projections, FRED macro indicators, and the cost-of-capital building blocks discussed in the literature (e.g., Damodaran datasets for ERP/CRP/beta framework). Methods include Discounted Cash Flow (DCF) and relative valuation based on trading multiples, with peer benchmarking from Capital IQ. Sensitivity and scenario analyses are applied to test robustness.
5) **ESG analysis:** Evaluates Environmental, Social, and Governance aspects using a structured ESG Index developed for this research, applied consistently across Air Products and its peers. The analysis is based on company sustainability reports, complemented by external frameworks and benchmarks (CDP, UN Global Compact, SBTi, GRI/SASB/TCFD, DJSI). The goal is to compare Air Products' ESG practices with those of competitors such as Linde, Air Liquide, Nippon Sanso, Messer, SOL, Venator, and Jinhong, highlighting strengths, weaknesses, and sector-specific challenges.

Together, these five stages provide a rigorous and integrated framework to assess Air Products' investment attractiveness, combining financial, sectoral, and ESG perspectives into a structured and critical analysis.

1.5 Structure of the Undergraduate Thesis

This study follows a logical sequence that allows for an in-depth analysis of the sectors, the company, and the valuation methodologies, ensuring a structured and coherent approach. The undergraduate thesis is divided into seven chapters, as described below:

Chapter 1 – Introduction: Presents the research topic, the central problem, and the motivations behind the choice of Air Products as the subject company. It also defines the main objectives, describes the methodological approach, and outlines the overall structure of the undergraduate thesis.

Chapter 2 – Literature Review: Provides the theoretical foundation for the analysis. It is organized into two main areas:

(i) interpretation of financial statements, including key accounting concepts, financial metrics, and performance evaluation;

(ii) valuation methods, covering the main approaches such as Discounted Cash Flow, market multiples, and relative valuation.

Chapter 3 – Sector Analysis: Examines the industrial gases and hydrogen industries, addressing their history, market dynamics, growth drivers, regulatory challenges, and long-term prospects. The chapter also analyzes the competitive landscape, highlighting the role of leading players and the factors driving investment in sustainable and low-carbon technologies.

Chapter 4 – Company Analysis: Provides a detailed assessment of Air Products, covering its history, organizational structure, business strategy, and financial performance. The chapter also discusses the company's main competitive advantages and risks that may affect its growth, laying the foundation for the valuation exercise in the following chapter.

Chapter 5 – Financial Projections and Valuation: Develops financial projections for Air Products, including revenue, costs, profitability, and cash generation. It applies valuation methodologies, primarily DCF and relative multiples, to estimate the company's fair value.

Chapter 6 – ESG Analysis: Investigates the Environmental, Social, and Governance (ESG) practices of Air Products. The analysis considers the company's sustainability initiatives, carbon footprint, governance structures, and social responsibility policies, with benchmarking against global peers such as Linde and Air Liquide.

Chapter 7 – Investment Thesis and Conclusions: Synthesizes the main findings of the study, integrating sectoral, financial, and ESG perspectives into a final investment thesis on Air Products.

2. LITERATURE REVIEW

In this chapter, the fundamental concepts of accounting, finance, and business valuation that support the analysis of Air Products will be addressed. The objective is to establish a solid conceptual basis, facilitating the understanding of the calculations and projections presented in the following chapters.

The literature review was based on classical authors who have traditionally developed and consolidated the main valuation methodologies in corporate finance. Among them, Aswath Damodaran (2001, 2012) stands out for his comprehensive framework on discounted cash flow and relative valuation models. Málaga (2014), Iudícibus (2019), and Póvoa (2012) were consulted for their significant contributions to financial statement analysis, company valuation, and the adaptation of international valuation practices to the Brazilian market. Their works provide a comprehensive understanding of the theoretical foundations and practical applications of valuation in emerging economies. In addition, Rosenbaum and Pearl (2013) provided a practitioner-oriented framework that bridges academic theory and real-world investment banking valuation techniques.

These authors were selected because their works represent the traditional and most widely accepted application of valuation methodologies, providing a solid theoretical foundation for the empirical analysis conducted in this study.

First, the three main financial statements will be presented: the Balance Sheet, the Income Statement, and the Cash Flow Statement. These reports provide a comprehensive view of the company's financial health, covering its capital structure, operational performance, and cash generation. Next, the main valuation methods will be discussed, with a focus on Discounted Cash Flow and market multiples analysis. These approaches make it possible to estimate the company's value based on financial projections and comparisons with industry peers.

Finally, in order to make the analysis more concrete and facilitate the connection with subsequent chapters, some essential figures for the valuation of Air Products will already be calculated. This anticipation will allow the concepts to be illustrated in a practical manner and advance calculations that will be used later.

2.1 Financial Statements

According to Damodaran (2012), there are three essential statements for understanding the economic situation of a company, providing a summary of its financial position, operating performance, and cash generation.

The Balance Sheet presents, at a given moment, the company's assets, their value, and the financing structure used, whether through debt or equity. The Income Statement details the revenues, expenses, and profit generated by the company over a period, which may be quarterly or annually. This statement allows for the evaluation of the company's profitability and operational efficiency. Finally, the Cash Flow Statement clarifies how the company obtained and used financial resources in its operating, investing, and financing activities. This statement explains the variations in the company's cash throughout the analyzed period.

Taken together, these three reports provide a comprehensive view of the company's financial health and serve as the basis for the analysis that will be developed throughout the study.

2.1.1 Balance Sheet

The Balance Sheet is a financial statement that presents the accounting position of a company at a given moment, detailing its assets, liabilities, and shareholders' equity. It reflects the fundamental accounting equation (IUDÍCIBUS, 2015):

Equation 1 – Fundamental Accounting Equation

$$\boldsymbol{Assets = Liabilities + Shareholders'Equity}$$

Source: Iudícibus (2019), adapted by the author

Its format, with the most commonly used data, is shown in Table 1.

Table 1 – Balance Sheet

Balance Sheet			
Assets	**1000**	**Liabilities**	**480**
Current Assets	**600**	**Current Liabilities**	**280**
Cash and cash equivalents	150	Suppliers	100
Notes receivable	100	Accounts payable	80
Short-term investments	50	Short-term debt	60
Accounts receivable	80	Other current liabilities	40
Inventory	200		
Other current assets	20		
Non-current assets	**400**	**Non-current liabilities**	**200**
Long-term receivables	50	Long-term debt	200
Long-term investments	100		
Investments in subsidiaries	80	**Shareholder's equity**	**520**
Property, plant and equipment	120	Share capital	400
Intangible assets	50	Retained earnings	120

Source: Own elaboration

Assets represent the company's goods and rights, divided into three main categories (PÓVOA, 2012):

- **Current Assets:** include resources expected to be realized within one year, such as cash, short-term financial investments, accounts receivable, and inventories.
- **Non-Current Receivables:** comprise rights to be received after 12 months, such as long-term loans.
- **Non-Current Assets:** composed of fixed assets (physical goods and records of intellectual property), investments (equity interests in other companies), and intangibles (such as goodwill from acquisitions and research and development expenses that may generate future benefits).

Liabilities represent the company's obligations and are classified according to their maturity (PÓVOA, 2012):

- **Current Liabilities:** debts and obligations due within one year, such as accounts payable and short-term loans.
- **Non-Current Liabilities:** financial commitments maturing after 12 months, such as long-term loans.

Shareholders' equity reflects the company's own resources, including share capital, retained earnings, and accounting reserves. Changes in shareholders' equity occur due to new contributions, profit distributions, and asset revaluations in accordance with international accounting standards (IFRS) (PÓVOA, 2012).

2.1.2 Income Statement

The Income Statement is one of the main accounting reports used to assess a company's financial performance over a given period. While the Balance Sheet provides a snapshot of the financial position at a specific date, the Income Statement summarizes operations and the net result (profit or loss) arising from these activities.

According to Iudícibus (2019), the Income Statement must present, in an orderly and deductive manner, the revenues, costs, expenses, and other components that affect the net result of the period. It makes it possible to understand not only the amount of profit, but also its composition, providing support for managerial analysis, investment decisions, and performance evaluation. Málaga (2014) emphasizes that the structure of the Income Statement follows the logic of operating result formation, beginning with Net Sales Revenue, moving to Gross Profit, and reaching Operating Income, which is subsequently adjusted by financial revenues and expenses, other operating revenues and expenses, and income tax, until arriving at Net Income.

For analytical purposes, Málaga (2014) proposes a reclassification of items in order to separate the sources of results: recurring operations, financial decisions, and non-recurring events. This separation facilitates the assessment of earnings quality, that is, whether profit was driven by operational improvement or by extraordinary and financial effects. In line with this, Damodaran (2012) argues that such adjustments are fundamental to ensure that operating profit and net income reflect the company's real value-creation capacity. According to the author, "the key is not to use the reported net income as is, but rather to understand and project the sustainable generation of profits".

Furthermore, Damodaran (2012) reinforces the analytical value of the Income Statement by pointing out that this report provides the essential data for evaluating profitability and return on capital. He highlights, for instance, the importance of EBIT (Earnings Before Interest and Taxes) as a financing-neutral operating metric, and of net income as the final return to shareholders.

Table 2 shows an example of a typical Income Statement structure:

Table 2 – Income Statement

Income Statement	
(=) Gross revenue	**1,000**
(-) Returns and allowances	(50)
(-) Sales taxes	(100)
(=) Net revenue	**850**
(-) Cost of goods sold (COGS)	(500)
(=) Gross profit	**350**
(-) Selling, general and administrative expenses (SG&A)	(150)
(=) Operating profit (EBIT)	**200**
(+/-) Financial result	(10)
(+) Financial income	20
(-) Financial expense	(30)
(=) Earnings before taxes (EBT)	**190**
(-) Income tax	(70)
(-) Social contribution tax (CSLL)	(20)
(=) Net profit	**100**

Source: Own elaboration

Main highlighted lines:

- **Net Revenue:** value of sales adjusted for tax and commercial deductions.
- **Gross Profit:** measures production and pricing efficiency.
- **Operating Income (EBIT):** assesses the performance of the core operation, excluding the effects of capital structure.
- **Financial Result:** reveals the impact of debt and investment management.
- **Net Income:** represents the final gain attributable to shareholders.

2.1.3 Cash Flow Statement

The Cash Flow Statement (CFS) has as its main objective to show the movement of inflows and outflows of financial resources in a company over a given period. This statement is essential to assess liquidity and the sustainability of business operations, going beyond what is presented in the Income Statement, which operates under the accrual basis and does not always reflect the actual cash movements of the entity (IUDÍCIBUS, 2019).

The standard structure of the CFS is divided into three major blocks:

- **Cash Flow from Operating Activities (CFO):** includes receipts and payments related to the company's core business, such as collections from customers, payments to suppliers, and salaries. It can be presented using the direct method — which itemizes the main inflows and outflows — or the indirect method — which starts from net income and adjusts for the effects of non-monetary items (IUDÍCIBUS, 2019).
- **Cash Flow from Investing Activities (CFI):** represents the generation or consumption of actual cash from investing activities during the period. It refers to acquisitions and disposals of long-term assets, such as property, plant, and equipment, and financial investments. Expenses for the purchase of machinery, for example, are recorded as cash outflows in this section (MÁLAGA, 2014).
- **Cash Flow from Financing Activities (CFF):** includes operations that affect equity or third-party capital, such as share issuance, borrowing and repayment of loans, and dividend distribution. It indicates how much was raised or repaid to creditors and shareholders (MÁLAGA, 2014).

Table 3 shows the typical structure of a Cash Flow Statement:

Table 3 – Cash Flow Statement

Cash Flow Statement	
(=) Net profit	**100**
(+) Depreciation and amortization (D&A)	10
(+/-) Change in working capital	10
(-) Inventory	(5)
(-) Suppliers	10
(-) Receivables	5
(=) Cash flow from operating activities (CFO)	**120**
(-) Maintenance CAPEX	(20)
(-) Expansion CAPEX	(30)
(+) Proceeds from asset sales	10
(=) Cash flow from investing activities (CFI)	**(40)**
(+) Loans received	50
(-) Debt repayment	(20)
(+) Capital increase	20
(-) Dividends	(10)
(=) Cash flow from financing activities (CFF)	**40**
Opening cash balance	150
Change in cash (CFO + CFI + CFF)	120
Closing cash balance	270

Source: Own elaboration

The combined analysis of the three cash flows allows for more robust conclusions about the company's performance. Initially, it can be stated that there is a relationship between the profile and the intensity of cash flows and the life cycle of companies, as presented in Table 4 (MÁLAGA, 2014).

Table 4 – Relationship Between the Corporate Life Cycle and Cash Flow Profile

Stage of the Company Life Cycle ->	**Startup**	**High Growth**	**Moderate Growth**	**Stable**	**Decline**
CFO	Negative (operations do not generate revenue)	Negative or reduced (operations not yet self-sustaining)	Moderate and growing	High	High
CFI	Negative (high investment demand)	Negative (high investment demand)	Negative, but less intense (reduction in investment intensity)	Negative or close to zero, near depreciation levels	Positive or zero
CFF	Positive (high demand to cover CFO and CFI)	Positive (high demand to cover CFO and CFI)	Positive, but less intense, since operations already generate cash and investments are smaller in magnitude	Negative, with debt amortization and dividend distribution	Negative, with debt amortization and capital return to shareholders

Source: Damodaran (2001)

In the early stages of life or in periods of accelerated growth, it is common for cash flow from operations (CFO) to be low or negative, while capital investments (CFI) are high and negative. To finance this expansion, companies resort to debt or equity issuance, resulting in a positive cash flow from financing (CFF) (MÁLAGA, 2014).

In contrast, mature companies present CFO sufficient to cover current investments, generating cash surpluses that are used to amortize debt or remunerate shareholders, making CFF negative. The combined and temporal analysis of the three flows — CFO, CFI, and CFF

— makes it possible to assess the financial health and sustainability of operations. A persistently negative CFO, accompanied by constant fundraising through CFF, may indicate an unviable business model (MÁLAGA, 2014).

In addition, Málaga (2014) highlights the concept of free cash flow, calculated as CFO minus the investments required to maintain productive capacity. Companies with high free cash flow tend to be healthier, as they have greater capacity to invest and remunerate their investors.

According to Málaga (2014), the analysis of the CFS makes it possible to understand whether the company is able to transform accounting profit into effective cash generation — which is vital to sustain future investments and remunerate shareholders and creditors. A profitable operation that does not generate cash may indicate structural or management problems.

Iudícibus (2019) reinforces that, in many cases, net income for the period may diverge from cash generation, due to the effect of items such as depreciation, amortization, and variations in accounts receivable and payable, among others. These elements are precisely the ones adjusted in the indirect version of the CFS.

2.2 Business Valuation

According to Rosenbaum (2013), there are three most common methods used to perform a valuation: (i) discounted cash flow; (ii) comparable companies analysis; and (iii) precedent transactions analysis. In this section, each of these methods will be addressed.

In addition, there is also the “Sum of the Parts” method, which can be associated with discounted cash flow or comparable companies analysis, and which consists of carrying out a separate analysis for each different segment of the company, each with its own cost of capital or multiple. The value for each is then summed to arrive at the implied Enterprise Value for the company as a whole (ROSENBAUM, 2013).

2.2.1 Discounted Cash Flow Valuation

According to Damodaran (2006), in valuation by the discounted cash flow (DCF) method, the value of an asset corresponds to the present value of projected cash flows, brought to the present by a rate that represents the risk associated with those flows. This methodology is widely addressed in academic environments and has a robust theoretical foundation. In this section, the principles of this approach and some initial aspects regarding how its components are estimated will be explored.

2.2.1.1 FCFE

Free Cash Flow to Equity (FCFE) measures the amount of cash left for shareholders after covering the company's operating and reinvestment needs, while also considering the impacts of the capital structure. It indicates how much the company can distribute to shareholders in the form of dividends or share repurchases without compromising its operations (Damodaran, 2012).

The calculation of FCFE starts from Net Income, subtracts capital expenditures (CAPEX), since they represent cash outflows to maintain and expand the business, adds back depreciation and amortization, which are accounting expenses with no cash impact, adjusts for changes in working capital, since variations in items such as inventories and accounts payable affect the company's liquidity, and considers the impact of debt, adding new issuances and subtracting principal repayments. The general equation for FCFE can be represented as:

Equation 2 – FCFE Calculation

$$\boldsymbol{FCFE = Net\ Income - CAPEX + \ D\&A - \Delta\ Working\ Capital}$$
$$\boldsymbol{+ (New\ debt\ issued\ -\ Debt\ repayments)}$$

Source: Damodaran (2012), adapted by the author

Growing companies generally have high capital expenditures (CAPEX), reducing the FCFE available in the short term. On the other hand, mature companies, with lower reinvestment needs, tend to generate a more stable and higher FCFE. If the company finances part of its investments with debt, the impact on FCFE may be reduced. In this case, part of the CAPEX and the change in working capital will be covered by new debt issuances, decreasing the need for equity resources. FCFE is an essential metric for valuation based on DCF, especially when the goal is to directly calculate the equity value. By discounting FCFE at the cost of equity (Ke), one arrives at the estimated value of the company for shareholders.

2.2.1.2 FCFF

Free Cash Flow to the Firm (FCFF) represents the total cash flow available to all capital holders of the company, including common shareholders, bondholders, and preferred shareholders. FCFF is an essential metric in business valuation, as it provides a view of the cash generated before the payment of financing and dividends (Damodaran, 2012). It is usually calculated starting from Earnings Before Interest and Taxes (EBIT), adjusted for the impact of taxes, adding back depreciation and amortization (non-cash expenses), and subtracting the investments required to maintain operations. The equation used is shown in Equation 3.

Equation 3 – FCFF Calculation

$$\boldsymbol{FCFF = EBIT * (1 - T) + D\&A - CAPEX - \Delta\, Working\ Capital}$$

Source: Damodaran (2012), adapted by the author

This approach is known as unlevered free cash flow, as it measures cash flow before debt payments. It is important to highlight that FCFF does not incorporate the tax benefits of interest payments, since these are already considered in the discount rate used in valuation, the Weighted Average Cost of Capital (WACC). If the tax benefits of interest were included in the cash flow, there would be double counting in the valuation.

FCFF is widely used in valuation models such as DCF, as it represents the amount effectively generated by the company before allocations to creditors and shareholders. It allows for the calculation of the company's value (Enterprise Value – EV) when discounted by WACC, being essential for the valuation of companies with different capital structures.

In addition to the direct calculation of FCFF, it can also be derived from FCFE, by adding back the cash flows destined for creditors and preferred shareholders, considering the tax benefit of interest paid on debt. The corresponding equation is:

Equation 4 – Calculation of FCFF from FCFE

$$\boldsymbol{FCFF = FCFE + Interest\ expense * (1 - T) + Principal\ repayments - New\ debt\ issues + Preferred\ dividends}$$

Source: Damodaran (2012), adapted by the author

2.2.1.3 Perpetuity

The Perpetuity Growth Method (PGM) is one of the most common approaches to calculate the terminal value in a DCF valuation model. This method assumes that the company's free cash flow in the last projected year will grow indefinitely at a constant rate ($\boldsymbol{g}$). Equation 5 presents the calculation of the perpetuity value, with $\boldsymbol{FCF_n}$ being the free cash flow of the last projected year.

Equation 5 – Perpetuity Growth Method

$$\boldsymbol{Terminal\ Value} = \frac{\boldsymbol{FCF_n} * (\boldsymbol{1} + \boldsymbol{g})}{\boldsymbol{WACC} - \boldsymbol{g}}$$

Source: Rosenbaum (2013), adapted by the author

The perpetual growth rate generally reflects the expected long-term growth of the sector and is based on nominal GDP growth, usually ranging between 2% and 4% per year. Since the terminal value represents a significant portion of the total valuation, the choice of $\boldsymbol{g}$ has a substantial impact on the result of the assessment. Small variations in this rate can significantly alter the final valuation, which reinforces the importance of sensitivity tests (ROSENBAUM, 2013).

2.2.1.3.1 Beta ($\boldsymbol{\beta}$)

Beta is an indicator of the risk that an asset adds to a diversified portfolio. In the Capital Asset Pricing Model (CAPM), it measures the relationship between the return of the asset and the return of the market, indicating its sensitivity to market fluctuations. In multifactor approaches, such as the Arbitrage Pricing Model (APM), risk is assessed through multiple betas, each associated with a specific factor (DAMODARAN, 2012).

In simplified terms, a stock with a beta lower than 1 tends to be less sensitive to market fluctuations, represented in this study by the S&P 500. In other words, the historical performance of the stock shows that it usually falls less/more than the S&P 500 in downturns/upturns. Conversely, a stock with a beta greater than 1 tends to be more sensitive to market fluctuations, depreciating more than the market when it falls and appreciating more when the index rises (PÓVOA, 2012).

According to Damodaran (2012), beta can be estimated in three main ways: (i) based on historical series of market prices, analyzing the correlation between the asset and the market over time; (ii) from the fundamental characteristics of the asset, such as its sector of activity and capital structure; and (iii) using accounting data, by comparing the company’s financial metrics. The choice of method depends on the availability of data and the objective of the analysis.

To calculate the beta of Air Products (NYSE: APD), the historical series of weekly stock prices and the S&P 500 index over the last five years was used. With these data, the covariance between the asset and market returns was calculated, allowing for the estimation of beta using Equation 6. The resulting beta of 0.77 reflects the company's relatively low systematic risk compared to the broader market, consistent with its stable cash flows and long-term contractual structure.

Equation 6 – Beta Calculation

$$\boldsymbol{\beta} = \frac{\boldsymbol{Cov(R_i, R_m)}}{\boldsymbol{Var(R_m)}}$$

Source: Damodaran (2012), adapted by the author

where:

- $\boldsymbol{\beta}$ is the asset's beta;
- $\boldsymbol{Cov(R_i, R_m)}$ is the covariance between the asset's return and the market return;
- $\boldsymbol{Var(R_m)}$ is the variance of market returns.

This method provides a direct measure of the asset's sensitivity to market fluctuations, supporting the calculation of the required rate of return by the investor in the Capital Asset Pricing Model (CAPM). To validate the consistency of the result, Aswath Damodaran's website was also consulted, which provides beta estimates based on the fundamental characteristics of companies from different sectors. This alternative method resulted in a beta of 0.76 for the Chemical (Specialty) sector, a value consistent with that obtained through the historical price series analysis, reinforcing the robustness of the estimate.

Additionally, it is important to consider the influence of capital structure on beta. The beta calculated directly from stock prices reflects the asset's risk already considering the company's financial leverage (levered beta). For comparative analyses and cost of capital construction, it is common practice to remove the effect of capital structure (unlever the beta) and then adjust it back to the target financing structure (re-lever the beta). According to Rosenbaum (2013), the process follows the formula:

Equation 7 – Unlevering and Re-levering Beta

$$\beta_U = \frac{\beta_L}{1 + \frac{D}{E} * (1 - T)}$$

Source: Rosenbaum (2013)

where:

- β_U is the unlevered beta;
- β_L is the levered beta;
- $\frac{D}{E}$ is the company's debt-to-equity ratio;
- T is the marginal tax rate.

These adjustments ensure that the beta used reflects either the company's standalone operating risk or is adapted to the target capital structure projected for valuation purposes.

2.2.1.3.2 Risk-Free Rate and Market Risk Premium

The risk-free rate (r_f) represents the minimum compensation required by investors to allocate their capital without default risk or short-term reinvestment risk. In valuation practices, the risk-free rate is usually estimated from the yield on long-term sovereign bonds, such as 10-year or 30-year U.S. Treasury Bonds (DAMODARAN, 2012; ROSENBAUM, 2013). The choice of the appropriate maturity should be aligned with the projection horizon of the company's cash flows: long-term cash flows must be discounted using long-term bond yields.

The market risk premium ($r_m - r_f$) represents the additional return required by investors to be exposed to more volatile assets, such as stocks, compared to risk-free assets. This premium can be estimated from historical return series or future market expectations. Historically, in the United States, it has ranged between 4.5% and 5.5% (KOLLER, GOEDHART, WESSELS, 2020).

The proper definition of the risk-free rate and the market risk premium is crucial for the correct calculation of the cost of equity using the CAPM model.

2.2.1.4 Equity Risk Premium (ERP)

The equity risk premium (ERP) represents the compensation required by investors to allocate capital in equity assets rather than risk-free assets. It is a central concept in determining the cost of capital and, consequently, in business valuation and investment decisions. According to Damodaran (2023), the ERP reflects aggregated perceptions about risk aversion, macroeconomic uncertainties, information quality, and even catastrophic risks. Classical models such as CAPM use ERP as a key component in estimating the expected return on equity, multiplied by the company's beta.

The literature proposes three main approaches to estimate ERP: (i) historical premiums, based on the excess return observed of stocks over low-risk bonds over time; (ii) survey premiums, derived from the expectations of investors, managers, and academics; and (iii) implied premiums, obtained through discounted cash flow models based on current market prices. Each approach has advantages and limitations, and the choice of ERP is one of the most sensitive and influential variables in financial analyses (DAMODARAN, 2023).

In this study, the value of the equity risk premium disclosed by Damodaran on his personal website was used, as it is a widely recognized reference both in academia and in financial markets. In July 2025, the ERP estimated for the U.S. market is 4.21%, calculated based on the implied premium approach from expected future cash flows and current prices of the S&P 500 index.

While certain nuances exist between the concepts of Market Risk Premium and Equity Risk Premium - particularly regarding their theoretical scope - both essentially represent the excess return expected by investors for assuming exposure to market risk instead of holding risk-free assets. Therefore, in line with standard valuation practice, this study will treat the two measures as equivalent for analytical purposes.

2.2.1.5 Country Risk Premium (CRP)

The country risk premium (CRP) reflects the additional compensation required by investors to account for risks associated with operating in economies with political, institutional, or economic instability. According to Damodaran (2023), although the cost of capital may start from a global market risk premium, multinationals and investors should adjust this value according to their actual exposure to riskier countries. The author argues that country risk should not be determined by the company's headquarters, but rather by the geographical distribution of its revenues and operations.

In practical contexts, CRP is often estimated as a sovereign risk spread (derived from ratings or CDS – Credit Default Swaps), adjusted by a country risk beta factor, reflecting the higher risk of equities compared to sovereign risk.

In this study, the CRP values were obtained directly from Professor Damodaran's website. The CRP of Air Products was calculated based on a weighted average of the risk premiums of the countries in which the company operates, using the share of each region in the company's consolidated revenue as weights. Table 5 presents the detailed calculation, arriving at the CRP value of 1.83% adopted:

Table 5 – CRP Calculation

CRP		
Country	**% of 2024 NR**	**CRP**
US/Canada	43.0%	0.40%
Latin America	4.0%	5.09%
Europe, Middle East, India, Africa	26.0%	3.91%
China	16.0%	1.04%
Asia excluding China	11.0%	2.48%
Weighted Average CRP		**1.83%**

Source: Damodaran (2025), own elaboration

2.2.1.6 Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAPM) is one of the most widely used models in asset pricing and in determining the cost of equity. It establishes that the expected return of an asset is determined by the risk-free rate plus a risk premium proportional to the systematic risk of the asset, measured by beta (KOLLER, GOEDHART, WESSELS, 2020). The CAPM equation is expressed as:

Equation 8 – CAPM Calculation

$$\boldsymbol{Cost\ of\ Equity}\ (r_e) = r_f + \beta_L * (r_m - r_f)$$

Source: Rosenbaum (2013)

where:

- r_f = risk-free rate;
- β_L = levered beta;
- r_m = expected market return;
- $r_m - r_f$ = market risk premium.

The CAPM is based on the premise that investors should be compensated for systematic risk — that which cannot be eliminated through diversification — via a risk premium (Rosenbaum, 2013). In contrast, company-specific risks (unsystematic risk) can be mitigated through diversification and therefore do not generate additional expected return.

The model further assumes that markets are efficient, that all investors have access to the same information, and that they can diversify their portfolios without significant costs (DAMODARAN, 2012).

The relationship between risk and return in CAPM is determined by beta. Companies with high betas, such as those in the technology sector, tend to have higher expected returns to compensate for their greater volatility relative to the market. On the other hand, companies with low betas, such as those in the consumer goods sector, present lower expected returns, since they offer more protection against market fluctuations (KOLLER, GOEDHART, WESSELS, 2020).

Additionally, some analyses adjust CAPM to include a size premium for smaller companies, since studies suggest that smaller firms carry higher risk and, consequently, a higher cost of capital (ROSENBAUM, 2013).

Despite the widespread use of CAPM, other methodologies such as the Fama-French Three-Factor Model and Arbitrage Pricing Theory (APT) may also be applied to estimate the cost of equity. However, CAPM remains the most used approach due to its simplicity and practical applicability in valuation (DAMODARAN, 2012). Nevertheless, CAPM has practical limitations, mainly related to the choice of the risk-free rate, the definition of the market premium, and the volatility of betas over time.

2.2.1.6.1 Cost of Equity (Ke)

The cost of equity represents the rate of return expected by shareholders when investing in a company. Since shareholders assume a higher level of risk compared to creditors, the cost of equity tends to be higher than the cost of debt. This concept is fundamental for business valuation and for determining the Weighted Average Cost of Capital (WACC), as it reflects the minimum required rate of return for investors to be compensated for the company’s risk.

The most common way to estimate the cost of equity is through the CAPM, which establishes that the expected rate of return for shareholders is determined by the sum of the risk-free rate and a risk premium adjusted for the company’s systematic risk (beta) relative to the market (ROSENBAUM, 2013). The equation used is the same as Equation 8.

For Air Products, the cost of equity was calculated using CAPM, with a risk-free rate obtained from the 10-year U.S. Treasury Bonds, following Damodaran's (2023) methodology, an ERP of 4.21%, and a historical beta of 0.77 from Equation 6, estimated based on the correlation between the company's stock returns and the market. Additionally, a CRP of 1.83% was added, weighted by the geographic distribution of revenues, and a tax rate of 21% was applied.

A rolling cost of equity (Ke) was adopted to reflect expected changes in the company's capital structure over time. This approach allows the discount rate to adjust dynamically to potential variations in leverage, ensuring that the cost of equity remains consistent with the firm's evolving financial profile throughout the projection period. These changes in capital structure are derived directly from the financial model developed in this study and will be detailed in a later section; in general terms, they reflect higher cash generation and a gradual deleveraging of the company.

Table 6 – Ke Calculation

Ke	Unit	2025	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E	2035E
Risk Free (10y Treasury Bond)	[%]	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%
Unlevered Beta (Chemical (Specialty))	[#]	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Debt	[USD m]	15,842	17,113	17,146	16,568	16,235	16,038	15,962	16,019	16,225	16,595	17,144
Equity	[USD m]	15,025	16,105	17,167	18,202	19,213	20,183	21,098	21,945	22,709	23,374	23,924
Debt/Equity	[#]	1.05	1.06	1.00	0.91	0.85	0.79	0.76	0.73	0.71	0.71	0.72
t	[%]	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%
Levered Beta	[#]	1.41	1.41	1.37	1.32	1.28	1.25	1.23	1.21	1.20	1.20	1.20
Equity Risk Premium	[%]	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%
Nominal Ke (USA)	[%]	10.03%	10.05%	9.89%	9.66%	9.50%	9.37%	9.27%	9.20%	9.16%	9.15%	9.17%
Country Risk Premium	[%]	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%
Ke	**[%]**	**11.86%**	**11.88%**	**11.72%**	**11.50%**	**11.33%**	**11.20%**	**11.10%**	**11.04%**	**11.00%**	**10.98%**	**11.00%**

Source: Own elaboration

2.2.1.6.2 Cost of Debt (Kd)

The cost of debt is the effective rate that a company pays to raise funds through borrowing, reflecting the risk perceived by creditors. This cost directly influences the calculation of WACC and is fundamental for valuation and investment assessment.

According to Rosenbaum (2013), when the company already operates with its target capital structure, the cost of debt can be estimated by the average yield of its existing debt instruments, such as public and private bonds. If the structure is not consolidated, the cost of debt from comparable companies is used as a reference.

For public debt, the cost is based on the current yield of the securities; for private debt, it may be necessary to consult market specialists. If no recent data is available, an alternative is to consider historical issuance rates, although this method does not always reflect current market conditions (ROSENBAUM, 2013).

The cost of debt is related to the company's credit risk. Companies with higher default risk pay higher rates to finance themselves, while safer companies are able to borrow at lower costs (Damodaran, 2006; Damodaran, 2012). An important advantage of debt financing is the tax deductibility of interest, which reduces the effective cost of debt. The relationship between pre-tax and after-tax cost is expressed by the formula:

Equation 9 – Calculation of the Effective Cost of Debt

$$\boldsymbol{K_{d,\ after-tax} = K_{d,\ pre-tax} * (1 - Tax\ Rate)}$$

Source: Damodaran (2012)

where $\boldsymbol{K_d}$ represents the cost of debt and Tax Rate is the company's tax rate. According to Damodaran (2012), this tax advantage makes the effective cost of financing through debt lower than the cost of equity, making debt an attractive option within a balanced capital structure.

In the case of Air Products, the cost of debt was calculated from the analysis of the company's existing debt. For this purpose, the principal amounts and effective rates of each issuance were collected, and the pre-tax cost of debt was obtained through a weighted average of these rates, using the nominal amounts of the respective debts as weights. The result was 3.68% per year. Alternatively, the cost of debt could also be estimated based on the company's credit rating — A2 by Moody's — using the market average yield of corporate bonds with the same level of risk, estimated at 4.71%. In this study, the cost of debt derived from the company's actual debt breakdown was adopted, as it reflects the effective rates incurred by Air Products and therefore provides a more precise and company-specific estimate than the rating-based market yield. The detailed breakdown used in this calculation is presented in Table 3.

Table 7 – Kd Calculation

#	Currency	Type	Description	Maturities	End used	Value	Interest Rate
1	USD	Medium-term Notes (weighted average rate)	Series E 7.6%	2026	2026	17	7.60%
2	USD	Senior Notes	Note 1.50%	2026	2026	550	1.50%
3	USD	Senior Notes	Note 1.85%	2027	2027	650	1.85%
4	USD	Senior Notes	Note 4.60%	2029	2029	750	4.60%
5	USD	Senior Notes	Note 2.05%	2030	2030	900	2.05%
6	USD	Senior Notes	Note 4.75%	2031	2031	600	4.75%
7	USD	Senior Notes	Note 4.80%	2033	2033	600	4.80%
8	USD	Senior Notes	Note 4.85%	2034	2034	1,150	4.85%
9	USD	Senior Notes	Note 2.70%	2040	2040	750	2.70%
10	USD	Senior Notes	Note 2.80%	2050	2050	950	2.80%
11	USD	Other (weighted average rate)	Variable-rate industrial revenus bonds 3.38%	2035 to 2050	2040	619	3.38%
12	USD	Other (weighted average rate)	Other variable-rate 7.11%	2025	2025	39	7.11%
13	EUR	-	Eurobonds 1.000%	2025	2025	334	1.00%
14	EUR	-	Eurobonds 0.500%	2028	2028	557	0.50%
15	EUR	-	Eurobonds 0.800%	2032	2032	557	0.80%
16	EUR	-	Eurobonds 4.000%	2035	2035	779	4.00%
17	SAR	-	Saudi Riyal Loan Facility variable-rate 7.35%	2027	2027	451	7.35%
18	SAR	-	Saudi Riyal Loan Facility 2.00%	2026 to 2034	2030	222	2.00%
19	NT	-	New Taiwan Dollar Loan Facility 1.86%	2025 to 2028	2026	132	1.86%
20	NT	-	New Taiwan Dollar Loan Facility 2.66%	2026 to 2029	2027	191	2.66%
21	NT	-	New Taiwan Dollar Loan Facility variable-rate 2.72%	2026 to 2030	2028	95	2.72%
22	-	-	Other 4.07% (weighted average rate)	2033 to 2034	2033	9	4.07%
23	CNY	Related Party Debt	Chinese Renminbi 5.5%	2025 to 2027	2026	280	5.50%
24	CNY	Related Party Debt	Chinese Renminbi 5.7%	2033	2033	25	5.70%
25	USD	Non-Recourse Debt Associated With NGHC	USD variable-rate facilities 6.17%	2027 to 2053	2035	1,945	6.17%
26	USD	Non-Recourse Debt Associated With NGHC	USD variable-rate facility 5.82%	2027 to 2041	2035	346	5.82%
27	USD	Non-Recourse Debt Associated With NGHC	USD stated-rate facility 5.00%	2027 to 2053	2035	246	5.00%
28	SAR	Non-Recourse Debt Associated With NGHC	Saudi Riyal Loan Facility stated-rate facility 2.00%	2028 to 2041	2035	735	2.00%
29	-	Finance Lease Obligations (weighted average rate)	Foreign 10.8%	2025 to 2036	2030	8	10.80%
Kd							**3.678%**

Source: Company (2024), own elaboration

2.2.1.6.3 WACC

The Weighted Average Cost of Capital (WACC) represents the average cost of the resources a company uses to finance its operations. It is calculated by weighting the costs of equity (Ke) and debt (Kd) according to their proportions in the company's capital structure (Rosenbaum, 2013). The general WACC equation is given by:

Equation 10 – WACC Calculation

$$WACC = \left(\frac{E}{E+D} * K_e\right) + \left(\frac{D}{E+D} * K_d * (1-T)\right)$$

Source: Rosenbaum (2013)

where:

- K_d = cost of debt;
- K_e = cost of equity;
- T = company's tax rate;
- D = market value of debt;
- E = market value of equity.

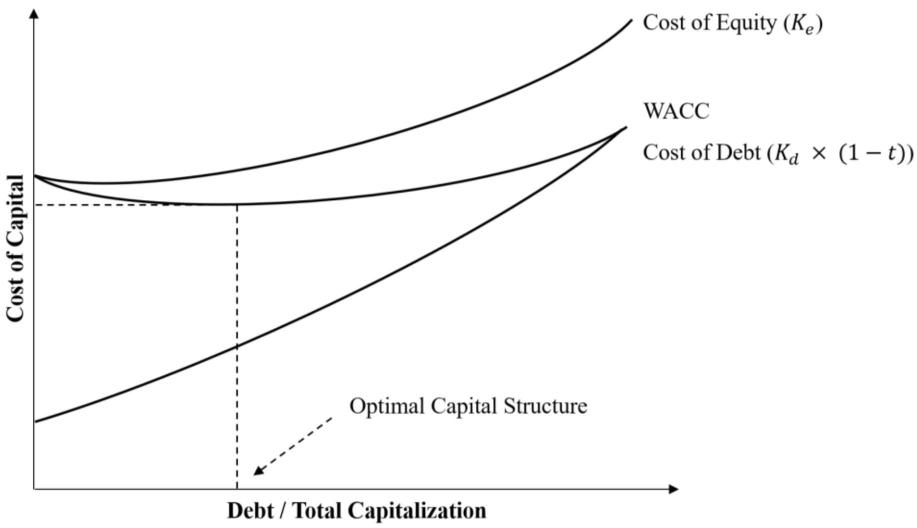
WACC reflects the minimum rate of return that a company must generate to cover its financial costs and adequately compensate its investors. It is widely used in valuation, especially in DCF, as the discount rate for calculating the present value of a company's future cash flows (ROSENBAUM, 2013).

To calculate WACC correctly, the following components must be estimated:

- **Capital Structure:** The weight of each source of financing should be based on the market values of debt and equity, not on book values. According to Koller, Goedhart, and Wessels (2020), mature companies generally use their current capital structure as a reference, while private companies may rely on the industry average.
- **Cost of Debt (Kd):** The cost of debt reflects the rate a company pays to obtain financing through loans and bonds. Since interest expenses are tax deductible, WACC considers the after-tax cost of debt, making debt financing more advantageous than equity (DAMODARAN, 2012).
- **Cost of Equity (Ke):** The cost of equity reflects the return required by shareholders and is generally estimated through CAPM. Companies with higher systematic risk present a higher Ke, which increases WACC (ROSENBAUM, 2013).

The proportion between debt and equity directly influences WACC. According to Rosenbaum (2013), as a company increases its use of debt, its WACC tends to decrease due to the tax deductibility of interest. However, excessive leverage increases bankruptcy risk, raising both the cost of debt and the cost of equity, which may result in a higher WACC. The point at which a company minimizes its WACC is known as the optimal capital structure, shown in Figure 1.

Figure 1 – Optimal Capital Structure



Source: Rosenbaum (2013), adapted by the author

In the case of Air Products, the WACC was calculated based on the cost of equity and cost of debt presented previously. The capital structure adopted reflects the projected relationship between debt and equity for 2025, which serves as the reference point for the model. From this base year, a rolling WACC was applied, allowing the discount rate to evolve in line with the company's expected deleveraging and gradual decline in financial leverage over time. The following table summarizes the results, with a starting WACC of 7.27% in 2025, increasing slightly throughout the projection period.

Table 8 – WACC Calculation

WACC		2025	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E	2035E
Debt	[USD m]	15,842	17,113	17,146	16,568	16,235	16,038	15,962	16,019	16,225	16,595	17,144
Equity	[USD m]	15,025	16,105	17,167	18,202	19,213	20,183	21,098	21,945	22,709	23,374	23,924
Cost of Debt post-tax	[%]	2.91%	2.91%	2.91%	2.91%	2.91%	2.91%	2.91%	2.91%	2.91%	2.91%	2.91%
Debt/(Debt + Equity)	[%]	51.3%	51.5%	50.0%	47.6%	45.8%	44.3%	43.1%	42.2%	41.7%	41.5%	41.7%
Cost of Equity	[%]	11.86%	11.88%	11.72%	11.50%	11.33%	11.20%	11.10%	11.04%	11.00%	10.98%	11.00%
Equity/(Debt + Equity)	[%]	48.7%	48.5%	50.0%	52.4%	54.2%	55.7%	56.9%	57.8%	58.3%	58.5%	58.3%
WACC	**[%]**	**7.27%**	**7.26%**	**7.32%**	**7.40%**	**7.47%**	**7.53%**	**7.57%**	**7.60%**	**7.62%**	**7.63%**	**7.62%**

Source: Company, own elaboration

2.2.1.6.4 Inflation Differential

In valuations involving different currencies, it is essential to ensure consistency between the cost of capital and the currency of the projected cash flows. When the cost of equity is originally estimated in U.S. dollars and there is a need to express it in local currency, the value must be adjusted by considering the expected inflation differential between the two currencies.

Damodaran (2012) proposes the use of an adaptation of the Fisher formula for this conversion. The methodology consists of multiplying the cost of equity in dollars by the correction factor between the inflations, as shown in the Equation 11.

Equation 11 – Inflation Differential

$$\boldsymbol{K_{e\,BR} = (1 + K_{e\,US}) * \left(\frac{1 + Inflation_{LC}}{1 + Inflation_{US}}\right) - 1}$$

Source: Damodaran (2006)

where $\boldsymbol{K_{e\,US}}$ represents the cost of equity in dollars, $\boldsymbol{Inflation_{LC}}$ is the expected inflation of the local currency, and $\boldsymbol{Inflation_{US}}$ is the expected inflation in the United States.

In the case of Air Products, this conversion was not necessary, since the company is headquartered in the United States and the valuation was conducted in U.S. dollars. Additionally, country risk premiums (CRPs) were incorporated separately to reflect the company's exposure to operations in other markets.

This adjustment avoids distortions that could arise from simply applying a country risk premium without considering the difference in purchasing power between currencies. In practice, a domestic environment of higher inflation requires a higher nominal rate of return, reflecting the risk of devaluation of the local currency's purchasing power. Thus, the use of the inflation differential allows the cost of capital to properly reflect the specific economic environment of the country under analysis.

2.2.2 Relative Valuation by Multiples

Relative valuation by multiples is one of the most popular approaches in financial markets, mainly due to its apparent simplicity and its ability to allow direct comparison between companies. It is based on the premise that similar assets should be priced similarly, using standardized metrics such as Price/Earnings (P/E), Enterprise Value/EBITDA (EV/EBITDA), Price/Book Value (P/BV), among others.

According to Póvoa (2012), the main attractiveness of multiples lies in their practicality, which often leads to the illusion that this methodology dispenses with the assumptions and estimates required by models such as discounted cash flow. The author argues that valuation by multiples is mistakenly seen as a "shortcut in valuation", when in reality it embeds, even if implicitly, the same factors: growth, risk, and expected profitability.

Multiples can be classified according to the nature of the variables used:

- **Equity multiples:** such as P/E (Price/Earnings) and P/BV (Price/Book Value), which relate the market value of equity to metrics derived from the Income Statement or Balance Sheet.
- **Firm value multiples:** such as EV/EBITDA and EV/Revenue, which consider the total value of the firm, including net debt, in relation to operating variables (PÓVOA, 2012).

Dimensional consistency between numerator and denominator is a fundamental principle: firm value multiples must use operating indicators, while equity multiples must rely on post-financial metrics (PÓVOA, 2012).

Another important classification concerns the reference time frame:

- **Past multiples:** use historical results and have little predictive power.
- **Trailing multiples:** use recent and known results.
- **Forward multiples:** based on estimates, being the most aligned with investment decisions (PÓVOA, 2012).

The magnitude of a multiple is directly related to growth expectations and inversely related to the perceived risk of the asset. As Póvoa (2012) points out, “the lower the risk and the higher the projected growth, the more the investor will be willing to pay for the stock,” which translates into higher multiples.

Despite their wide use, the multiples approach requires rigor in the choice of the peer group. Málaga (2014) emphasizes that multiples can lead to misleading conclusions if comparables do not share structural characteristics, such as sector, size, capital structure, and operating margin. The absence of proper adjustments may result in significant distortions in pricing.

Póvoa (2012) also warns against the “indiscriminate” use of multiples, without controlling for fundamental variables such as sustainable growth and return on capital. According to him, “there is no reason for three models, if consistently built, to generate such distinct results,” reinforcing that multiples should be used based on fundamentals, and not as substitutes for intrinsic valuation.

2.2.3 Valuation by Precedent Transactions

According to Rosenbaum (2013), precedent transaction analysis is a valuation methodology based on past transactions of comparable companies to estimate a value range for an asset, whether an entire company, a division, or a set of assets. This method uses financial multiples derived from actual mergers and acquisitions (M&A) operations, reflecting the prices paid in the market.

Its main advantage is that it reflects effectively practiced prices, but selecting comparable transactions can be challenging, especially in sectors with few recorded deals or limited financial information. The process involves the following steps:

- **Selection of comparable transactions:** identification of acquisitions of companies similar in terms of sector, business model, size, and financial profile.
- **Collection of financial information:** extraction of available financial data, more accessible in transactions involving public companies than private ones.
- **Calculation of transaction multiples:** obtaining multiples such as EV/EBITDA and Equity Value/Net Income from transaction data.
- **Analysis and adjustment of transactions:** filtering out outliers to ensure that multiples reflect consistent market conditions.
- **Determination of the valuation range:** applying the selected multiples to the company under analysis and comparing with other methodologies, such as DCF and comparable companies analysis.

Although based on real data and aligned with market conditions, precedent transaction analysis presents limitations, such as the difficulty of finding truly comparable deals and the influence of transaction-specific factors, such as synergies or financing conditions.

3. ANALYSIS OF AIR PRODUCTS' MARKETS

3.1 Industrial Gases Sector

3.1.1 Emergence and History of the Sector

The emergence of the industrial gases industry dates back to the fundamental scientific discoveries of the 18th century, particularly in the field of chemistry. It was during this period that scholars such as Joseph Black, Joseph Priestley, Carl Wilhelm Scheele, and Antoine Lavoisier began identifying and isolating the gaseous components of air. These discoveries not only transformed chemistry into a quantitative science but also paved the way for the industrial exploitation of these elements, such as oxygen, nitrogen, and hydrogen (ALMQVIST, 2003).

The identification of the so-called "fixed airs," an expression used at the time for gases with specific properties, was central to the subsequent establishment of an industry. Black demonstrated carbon dioxide; Priestley discovered oxygen; Scheele, almost simultaneously, isolated oxygen and other gases; while Lavoisier was responsible for consolidating the theory of combustion based on oxygen, establishing the foundation for modern chemistry (ALMQVIST, 2003).

At the end of the 19th century, technological advances in gas compression and liquefaction, such as those developed by Carl von Linde and William Hampson, enabled production on an industrial scale. These innovations gave rise to the first commercial applications, such as oxygen-acetylene welding and the use of liquid air in industrial processes. From that point on, companies such as Linde AG in Germany and Air Liquide in France began systematic operations of gas production and supply (STOKES; BANKEN, 2016).

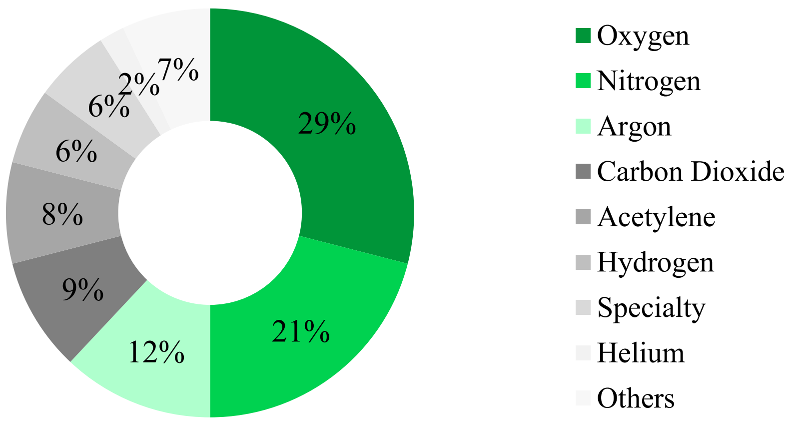
Initially, the industry was highly fragmented and regionalized, with plants installed close to consumption sites due to transportation difficulties. Commercialization occurred mainly through high-pressure cylinders, giving rise to the "merchant" supply model. Over time, the "on-site" model also developed, in which cryogenic plants were installed inside or adjacent to customers' industrial facilities, creating long-term supply relationships (ALMQVIST, 2003; STOKES; BANKEN, 2016).

Thus, the sector was born from the convergence between scientific advances and technological innovations, and its consolidation was driven by the demands of global industrialization. From its beginnings to the first decades of the 20th century, the gases industry evolved from an experimental field to an essential infrastructure of the modern industrial economy.

3.1.2 Main Concepts and Applications

Industrial gases are pure substances or gas mixtures used in production processes with chemical, thermal, or operational functions. They are present in sectors such as steelmaking, chemicals, food and beverages, electronics, healthcare, pulp and paper, water treatment, and general manufacturing. Chart 1 presents the composition of a typical output of companies in the sector, highlighting the main gases produced and their respective relative shares.

Chart 1 – Share of Different Gases in Industrial Production (%)



Source: Goldman Sachs

Among the most relevant gases are (J.P. MORGAN, 2023):

- **Oxygen (O_2):** used in industrial combustion and heating, gasification, steelmaking, non-ferrous metal production, glass, and cement.
- **Nitrogen (N_2):** applied in food freezing and preservation, inerting of environments, and chemical and electronic processes.
- **Argon (Ar):** used in welding, foundry, and semiconductor manufacturing, due to its inertness and thermal conductivity.
- **Hydrogen (H_2):** employed in refining processes, ammonia and methanol production, and increasingly highlighted as an energy vector.

- **Carbon Dioxide (CO_2):** used in carbonated beverages, welding, agricultural processes, and fire extinguishers;
- **Acetylene (C_2H_2):** mainly directed to welding and metal cutting;
- **Helium and specialty gases:** applied in cryogenics, medical imaging (magnetic resonance), fiber optics, and aerospace.

In addition, industrial gases are fundamental in hospital applications, water treatment, pulp and paper, as well as welding and atmosphere control. These uses are generally critical and difficult to substitute, giving the sector high added value and low demand elasticity in the short term.

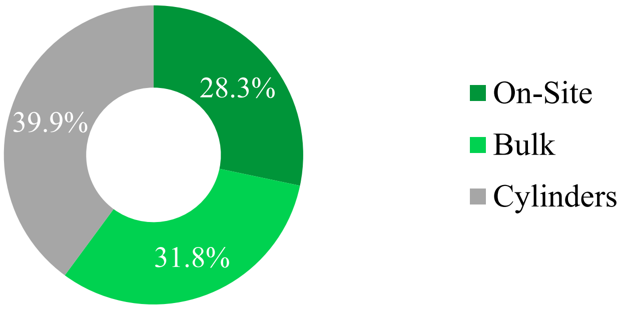
Gases can be supplied through different logistic models, chosen according to the demanded volume, customer profile, and consumption stability. The three main supply modes are presented in Table 9, and their segmentation is shown in Chart 2.

Table 9 – Modes of Supply of Industrial Gases

Mode of Supply	Description	Contract Type	Characteristics
On-site / Pipeline	Production at the customer's site or supply through pipelines; used by industries with continuous and high consumption (refining, chemicals, steelmaking).	Long-term (15–20+ years)	Highest revenue stability, margin, capital intensity, and volume; lowest unit price.
Liquid Bulk (Merchant)	Delivery in tanks or trailers, stored at the customer with vaporization equipment.	Medium-term (1–5 years)	Intermediate stability and margins; moderate price, volume, and capital intensity.
Packaged Gases (Cylinders)	Delivered in cylinders or dewars, aimed at customers with low demand and specific applications (such as helium in magnetic resonance imaging).	Short-term (up to 1 year)	Low stability and margins; higher unit price; low volume and capital intensity.

Source: J.P. Morgan (2023), Seeking Alpha (2020)

Chart 2 – Global Market Segmentation by Supply Mode, by Value (%)



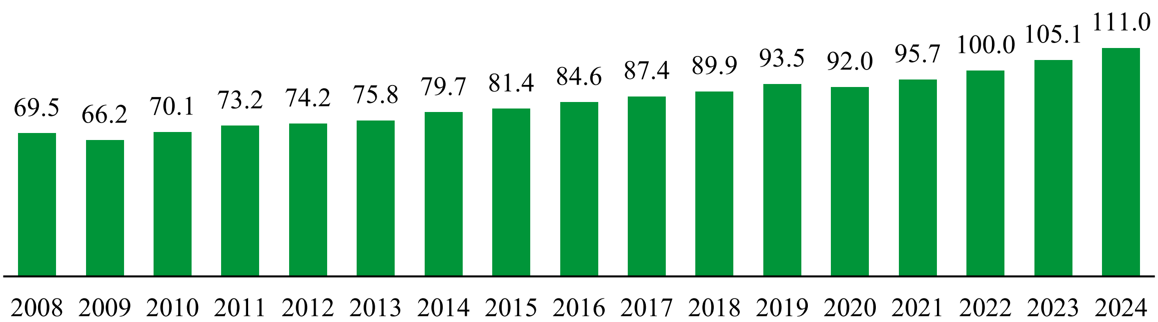
Source: Frost & Sullivan Research & Analysis (2024)

3.1.3 Market Overview

The global industrial gases market is characterized by being mature, concentrated, and resilient, with stable growth over the past decades. Companies in the sector have historically grown in line with or slightly above industrial GDP. Air Products, for example, expanded its volumes at an average annual rate of 3.9% between 2005 and 2018, while global industrial production grew 2.3% per year, and that of the United States only 0.7% per year over the same period (SEEKING ALPHA, 2023).

After the downturn during the pandemic, global demand has been gradually recovering. In 2023, volumes had not yet fully returned to 2019 levels, but market projections indicate average annual growth of approximately 4% through 2026, reflecting the defensive and recurring nature of the sector (GRAND VIEW RESEARCH, 2024). Chart 3 presents the historical trajectory of global industry revenue between 2008 and 2024, highlighting its sustained secular growth.

Chart 3 – Revenue of the Industrial Gases Sector (USD bn)



Source: Eurostat, Grand View Research

Currently, the market is estimated to generate USD 111 billion per year, with the three global leaders — Linde, Air Liquide, and Air Products — concentrating more than USD 70 billion in combined revenues (CITI, 2023). The combination of long-term supply contracts, global presence, and exposure to critical sectors sustains the stability of the sector even in adverse cycles.

To broaden the prospective analysis beyond short-term estimates, a statistical modeling based on time series was applied to forecast the gas sector's revenue over a ten-year horizon. The modeling process involved analyzing historical revenue data, testing for stationarity, and identifying the most appropriate specification through the evaluation of autocorrelation and partial autocorrelation functions. The entire time-series modeling was implemented in Python, using the statsmodels library for estimation and diagnostic testing. The complete code used in this analysis is provided in Appendix A. Based on these diagnostics, an ARIMA (AutoRegressive Integrated Moving Average) model was used, given its robustness in identifying historical patterns and generating reliable projections from univariate data.

The modeling followed the steps below:

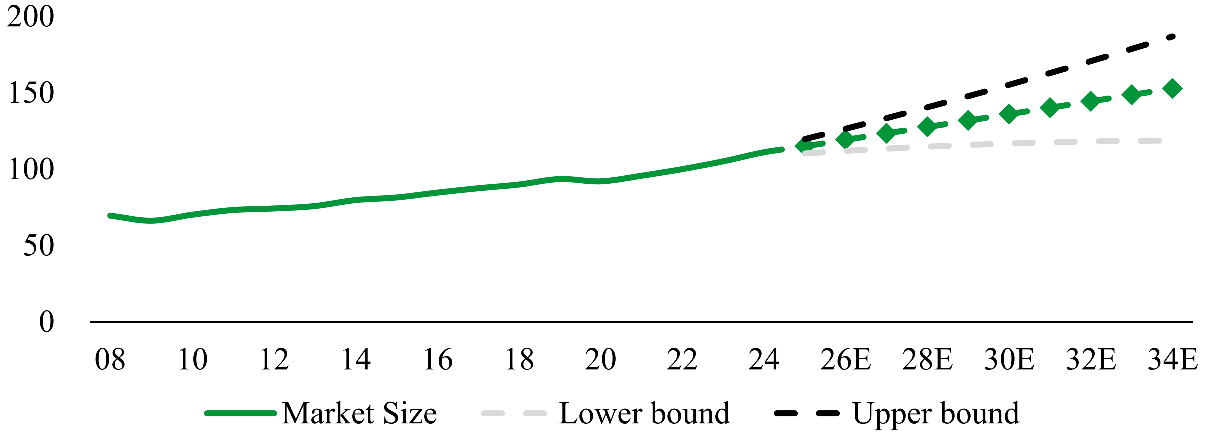
- **Stationarity test (ADF):** the original series presented a p-value = 0.96, characterizing it as non-stationary. After two differencings (d = 2), the p-value dropped to approximately 0.02, indicating statistically valid stationarity.
- **Autocorrelation analysis:** the ACF and PACF plots suggested the presence of an autoregressive component of order 1 (p = 1) and a moving average component of order 1 (q = 1).
- **Model training and selection:** several parameter combinations were tested, with the following AIC results:
  - ARIMA (1,1,1): AIC = 80.75
  - ARIMA (1,2,1): AIC = 75.74
  - ARIMA (0,2,1): AIC = 73.87

Despite the slightly lower AIC of the ARIMA (0,2,1) model, the residuals showed instability. Therefore, the ARIMA (1,2,1) model was chosen as it offered the best balance between fit and statistical behavior of the residuals.

- **Residual validation:** the residuals showed an approximately normal distribution, absence of significant autocorrelation (clean ACF), and centering around zero — validating the adequacy of the model.

Based on the trained model, projections were generated for the period from 2025 to 2034, with 95% confidence intervals. The results indicated a compound annual growth rate of approximately 3.33%, taking the market from around USD 111 billion in 2024 to around USD 154 billion in 2034.

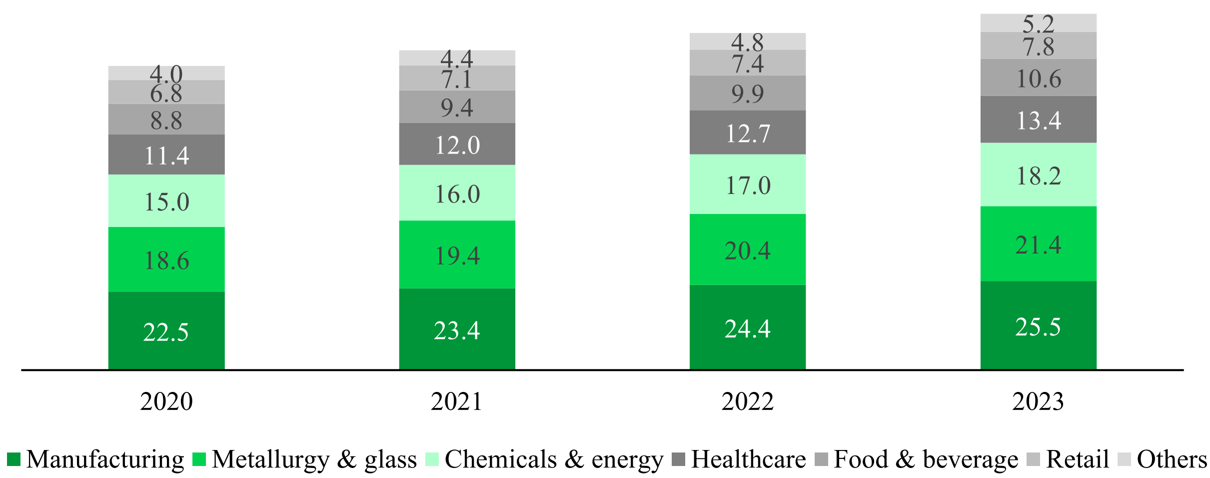
Chart 4 – Revenue Projection of the Industrial Gases Market (USD bn)



Source: Own elaboration

In terms of demand composition, there is a broad sectoral diversification, with emphasis on the manufacturing, chemical, energy, healthcare, food, and semiconductor sectors. The detailed distribution between the years 2020 and 2023 can be seen in Chart 5.

Chart 5 – Global Industrial Gases Market Value by Application (USD bn)

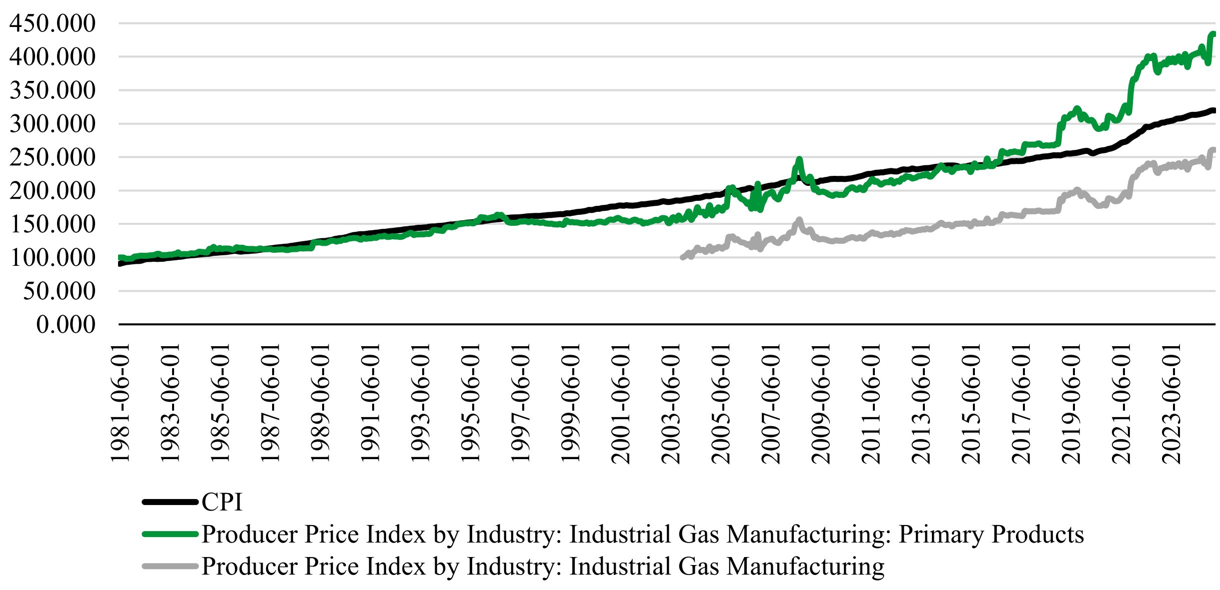


Source: Statista (2023)

Chart 6 compares the evolution of three important price indices in the United States (FRED, 2025):

- **Consumer Price Index (CPI):** measures the average variation in the prices of a basket of goods and services consumed by American households, being the main reference for consumer inflation in the country.
- **Industrial Gases Primary Products Price Index:** reflects exclusively the price evolution of the main products manufactured by industrial gases companies, such as oxygen, nitrogen, argon, carbon dioxide, and hydrogen. This index considers only the core products of industrial activity, excluding services or by-products.
- **Industrial Gases Industry Price Index (Total):** captures the price variation of all goods and services produced by companies in the sector, including both industrial gases and associated services and complementary activities.

Chart 6 – Price Evolution: CPI vs. Industrial Gases Indices (1981–2024)



Source: FRED (2025)

The analysis shows that between 1981 and the mid-2000s, the prices of primary products in the industrial gases industry closely followed the general inflation of the economy (CPI). However, from 2005 onwards, a significant divergence can be observed, with the prices of core industrial gases growing at rates higher than consumer inflation. This trend reflects factors such as the increase in demand for strategic industrial applications, rising production costs —

especially electricity — and the growing importance of the sector in decarbonization and energy transition initiatives.

In contrast, the price index of the industrial gases industry as a whole shows a more moderate growth trajectory with greater volatility, indicating the influence of lower value-added products and services, with pricing dynamics distinct from those of primary products.

Between 1981 and 2024, the primary products index of the industrial gases industry recorded a compound annual growth rate (CAGR) of 3.34%, compared to 2.80% for the general Consumer Price Index (CPI). In the same period, the compound quarterly growth rates (CQGR) were 0.28% for primary products and 0.24% for CPI. Furthermore, the correlation between CPI and the industrial gases primary products price index was high, with a coefficient of determination (R^2) of 95.1%, indicating a strong relationship between the series up to the point of divergence observed in recent years.

These differences in the evolution of the indices are relevant for industry analysis, as they suggest greater resilience and pricing power for core industrial gases — fundamental aspects in building the investment thesis in Air Products.

3.1.4 Regional Dynamics

Although the industrial gases market is global in structure, its dynamics vary significantly across regions, reflecting differences in industrial profiles, degree of economic maturity, and energy policies.

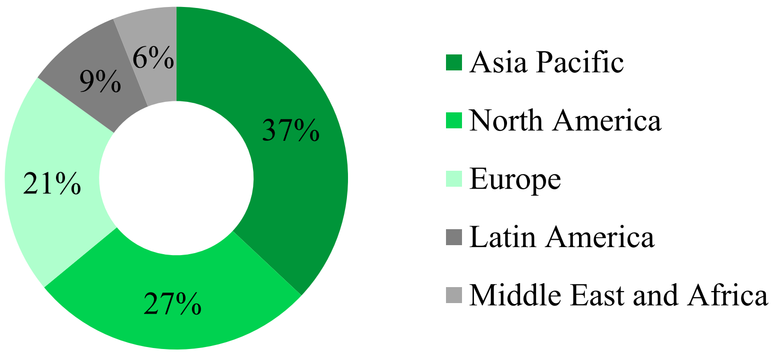
As shown in Chart 7, the Asia-Pacific region is the largest in terms of revenue, accounting for around 37% of the global market in 2023, driven by the strong concentration of manufacturing and steelmaking hubs in countries such as China, India, Japan, and South Korea (PRECEDENCE RESEARCH, 2025). China, for example, produces more than 1.1 billion tons of crude steel per year, a process highly intensive in oxygen. In addition, the Asian electronics value chain — semiconductors in Korea, Japan, and Taiwan, and displays in China — drives demand for ultra-high-purity gases. The region's sustained economic growth has led all major companies in the sector to invest heavily in capacity expansion, with new air separation units (ASUs) and hydrogen plants spread across the continent.

North America and Western Europe are mature markets, with estimated shares of 27% and 21%, respectively, as shown in Chart 7. Both regions have widely diversified applications: from petrochemical clusters (Gulf Coast in the U.S., North Sea in Europe) to steel mills, automotive manufacturers, and hospitals. In the United States, the expansion of the liquefied natural gas

(LNG) and hydraulic fracturing (fracking) industries has increased the consumption of nitrogen and CO_2, in addition to fostering helium production as a by-product of natural gas. In Europe, the energy transition has created opportunities for new applications, such as the use of oxygen in more efficient combustion processes and hydrogen in green steelmaking projects.

Latin America and the Middle East/Africa represent smaller shares, with 9% and 6% of the global market, respectively. Latin America is led by Brazil as the main market, with a significant presence of Linde (via White Martins), Air Liquide, and Air Products, operating in sectors such as steelmaking, food and beverages, healthcare, and oil & gas. In the Middle East, the concentration of refineries and petrochemical plants in the Gulf countries drives demand for industrial gases. Despite their smaller share in the global total, these regions show growth rates above the world average, driven by industrialization and energy investments.

Chart 7 – Industrial Gases Market Share by Region in 2023 (%)



Source: Precedence Research (2023)

3.1.5 Value Chain and Industry Dynamics

The value chain of industrial gases is highly integrated, combining large-scale production, specialized distribution, and critical applications at the end customer. The production stage is mainly based on air separation units (ASUs) — responsible for obtaining oxygen, nitrogen, and argon from atmospheric air — and reformers for generating hydrogen and CO_2 from fossil sources. These facilities operate continuously and require high investment and capital intensity, generally being installed close to large industrial consumption hubs.

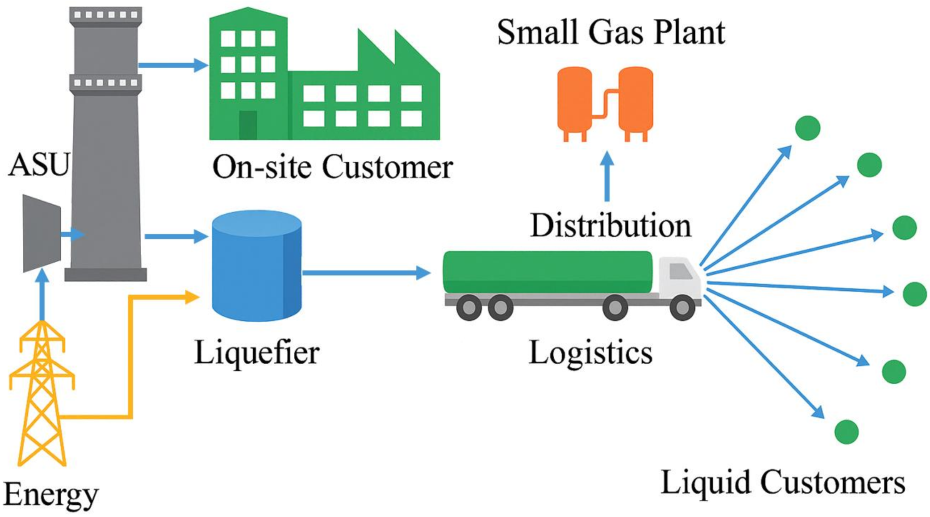
The distribution of gases occurs through three logistic channels — on-site/pipeline, liquid bulk (merchant), and cylinders (packaged gases) — as previously detailed. Each mode serves distinct consumption profiles, combining contracts with different durations and pricing structures. This system enables commercial reach and operational flexibility, making it possible to serve clients ranging from large refineries to small hospitals or laboratories (J.P. MORGAN, 2023).

This integrated structure creates significant entry barriers. Gas supply is often mission-critical: failures can completely halt customer operations. Therefore, there is a strong preference for suppliers with reputation, local presence, and proven track record of reliability. Long-term contracts — especially in the on-site model, which often include capital remuneration clauses and automatic renewal — reinforce the bond between customer and supplier (SEEKING ALPHA, 2023).

Leading companies also benefit from economies of scale, operating multiple plants in networks and leveraging industrial clusters (such as on the U.S. Gulf Coast or in the Ruhr Valley in Germany), which reduces average costs and allows for the capture of synergies — such as recovering and reselling CO_2 as a by-product in sectors like food and beverages.

In summary, the industrial gases value chain favors companies with capital intensity, operational excellence, and customer proximity, characteristics that define the global leaders of the sector.

Figure 2 – Supply Chain of the Industrial Gases Sector



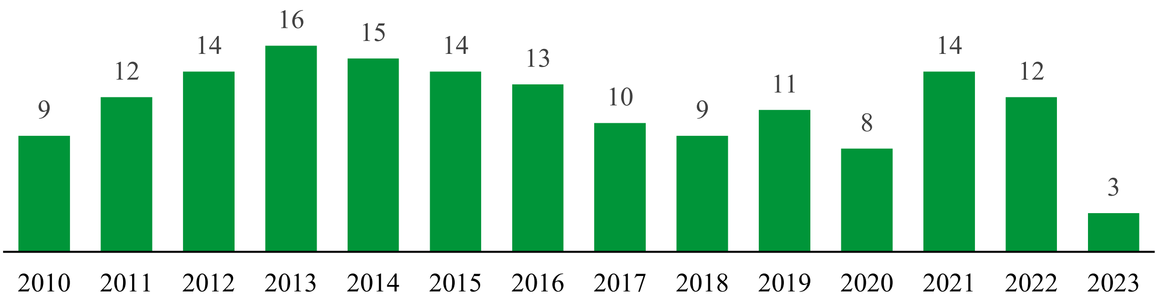
Source: Air Products (2015)

3.1.6 Competitive Landscape

The global industrial gases market is highly concentrated and shaped by a significant history of M&A. Over the past decades, the sector has undergone intense consolidation, driven by strategic moves such as Air Liquide's acquisition of Airgas (2016) and the merger between Linde and Praxair (2018).

Chart 8 shows the number of M&A transactions per year, highlighting the active consolidation cycle between 2010 and 2016, with a peak in 2013 (16 transactions), followed by a recovery in 2021. In 2023, a sharp slowdown was observed, with only three deals completed, reflecting an already consolidated environment and a more restrictive macroeconomic scenario.

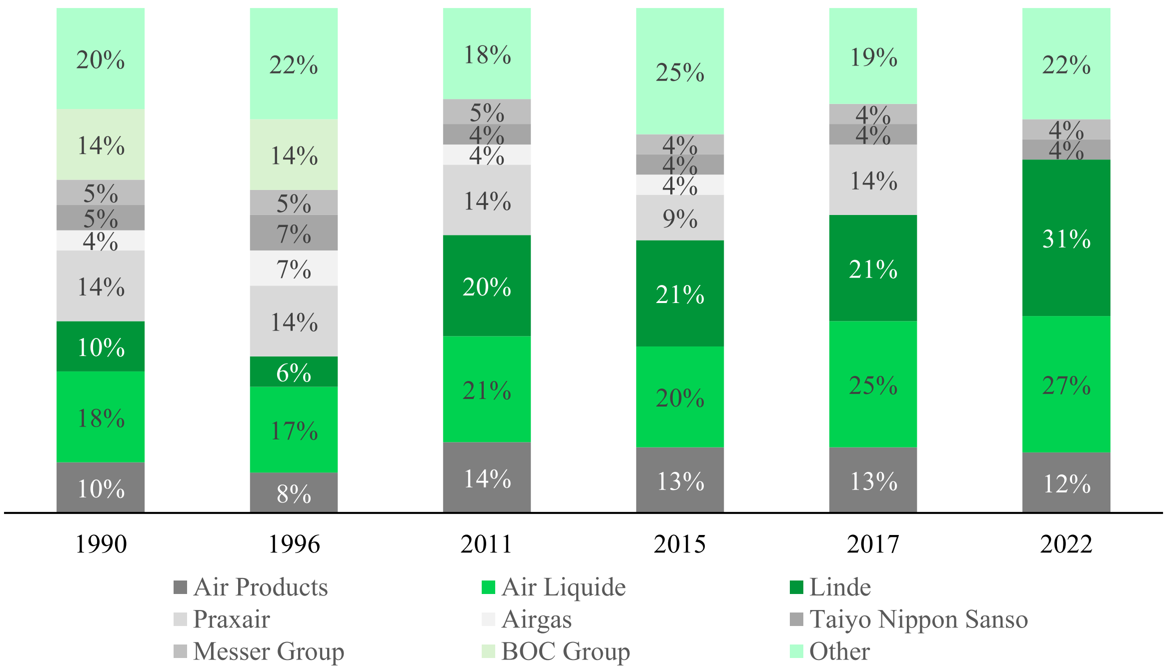
Chart 8 – M&As in the Industrial Gases Sector (#)



Source: Deloitte Tohmatsu Limited (2018), Statista (2023)

As a result, the sector has transformed into a highly concentrated oligopoly. According to the most recent data, Linde leads the market with a 31% global share, followed by Air Liquide with 27% and Air Products with 12%. Together, these three companies account for roughly 70% of the global market. This level of concentration is clearly evidenced in Chart 9, which shows the evolution of market shares over recent decades and highlights the progressive consolidation that has shaped the sector's current oligopolistic structure.

Chart 9 – Evolution of Market Share in the Industrial Gases Sector (%)



Source: TNSC, Gas Diorama, Goldman Sachs, UBS, Scope Ratings

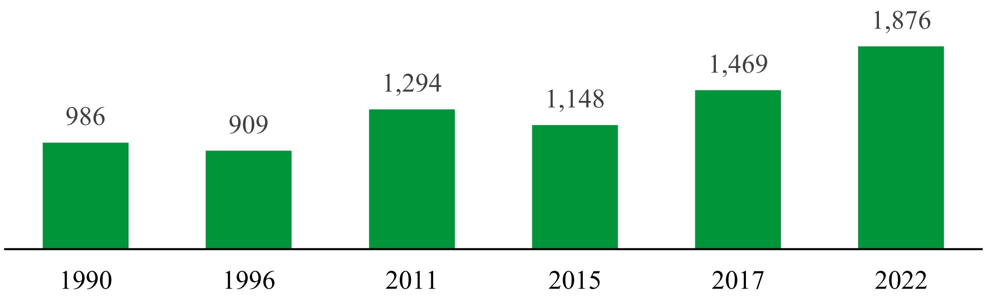
Below the three leaders, some regional groups remain relevant in their respective markets:

- **Taiyo Nippon Sanso Corporation (TNSC):** strengthened its presence in Europe by acquiring divested assets from the Linde–Praxair merger;
- **Messer:** expanded its operations also through assets sold in the same transaction;
- **Yingde Gases (China) and Air Water (Japan):** operate in regional niches with less scale and capital.

These players have more limited technical reach and capital, which constrains their operations outside their core territories. However, they remain relevant in specific segments — especially in Asia.

The degree of concentration in the sector can be measured by the Herfindahl-Hirschman Index (HHI), which adds the squares of the market shares of the companies (e.g., a company with 30% share contributes with $30^2 = 900$ points). Chart 10 shows that the index fell between 1990 and 1996 (from 986 to 909) but rose again with the recent major consolidations, reaching 1,876 points in 2022 — a level close to what the U.S. antitrust authority considers “highly concentrated” (above 2,500).

Chart 10 – HHI of the Industrial Gases Sector (#)



Source: Own elaboration

As a result of the level of concentration, the sector is not characterized by price wars. Competition is driven by innovation, technical excellence, reliability, and operational efficiency. Companies compete for new projects — for example, the construction of on-site plants or supply to expanding factories — but rarely attempt to take over active contracts from rivals, especially in markets with “captive clients.”

Each of the three major companies has distinct strategic strengths (GOLDMAN SACHS, 2022):

- **Air Liquide:** strong presence in emerging markets and leadership in specialty gases for electronics;
- **Linde:** broad vertical integration and a strong industrial engineering division;
- **Air Products:** focus on large-scale on-site projects and leadership in hydrogen.

Regional strategies also vary: Linde and Air Liquide operate significant packaged gases businesses (cylinders) in Europe and the U.S., while Air Products sold its cylinder division years ago to focus on larger and more stable contracts (SEEKING ALPHA, 2020).

China is a peculiar market within the sector. Local companies such as Yingde Gases and Hangzhou Hangyang have been gaining share, driven by state support. However, there is cooperation between global groups and local state-owned enterprises through operational joint ventures — as in the case of plants operated in partnership by Air Liquide or Air Products with Chinese state-owned companies.

In summary, this is a global and rational oligopoly, sustained by historical consolidation, structural entry barriers, and an installed base of assets that are difficult to replicate. The sector remains competitive in terms of quality, innovation, and execution, but shielded from predatory competition, which contributes to its long-term stability and resilience.

3.1.7 Entry Barriers and Regulation

Entry barriers in the industrial gases sector are notoriously high. First, customers tend to prefer suppliers with a proven track record of reliability, since gases are essential to their operations — for example, oxygen is a critical input in steelmaking and refining (SCOPE RATINGS, 2016). Second, long-term supply contracts are the norm, especially in the on-site model, and often include automatic renewal clauses. This creates strong commercial inertia and makes it rare for competitors to capture already established supplies (GOLDMAN SACHS, 2022).

Additionally, the installed base of plants, pipelines, and logistics infrastructure acts as a true moat, making it difficult for new players to enter. Building a new operation requires hundreds of millions of dollars in upfront investments, with long-term returns and an estimated payback of over ten years — a factor that, by itself, deters the entry of new competitors (SCOPE RATINGS, 2016; GOLDMAN SACHS, 2022; SEEKING ALPHA, 2020).

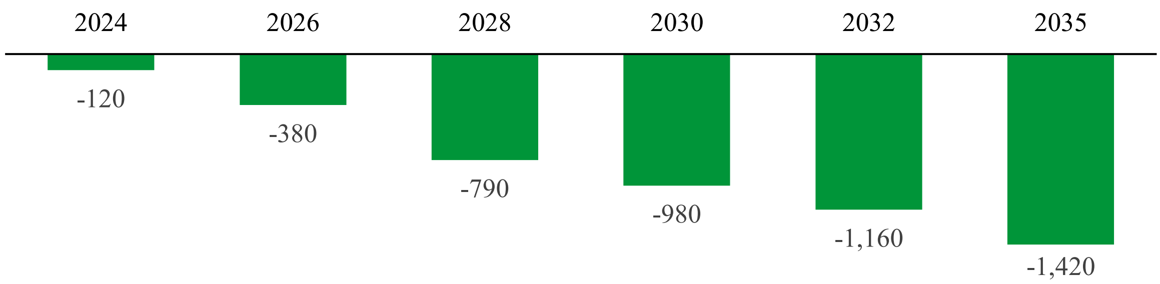
From a regulatory standpoint, the sector is not subject to price control like traditional utilities, since competition among a few large players and private contracts already ensures commercial balance. However, there is strict regulation in safety and environment: the transport of hazardous gases, cryogenic storage, and ASU operation require compliance with specific standards and regular audits (SCOPE RATINGS, 2016). Companies invest heavily in safety culture, training programs, and compliance. In M&A transactions, antitrust authorities often impose conditions: the most notable example was the Linde–Praxair merger, approved in 2018 upon the divestment of assets in the U.S. and Europe, which gave rise to the new Messer and strengthened Japan's TNSC (GOLDMAN SACHS, 2022).

More recently, climate policies have begun to act as indirect instruments of sectoral regulation, creating new incentives and competitive distortions. The most emblematic example is the United States Inflation Reduction Act (IRA), approved in 2022, which created massive subsidies and tax credits for decarbonization. Among them, the following stand out:

- **45V Credit:** up to USD 3.00/kg of clean hydrogen, depending on carbon intensity;
- **45Q Credit:** USD 85/ton of captured CO_2;
- **45X Credit:** for domestically manufactured equipment and components (BOFA, 2024; PRECEDENCE RESEARCH, 2025).

These subsidies repositioned the U.S. as a global competitive hub for hydrogen and benefited companies such as Air Products, which lead large-scale projects with access to these credits. Chart 11 illustrates the projected reduction in greenhouse gas (GHG) emissions in the U.S. through 2035, driven by IRA measures.

Chart 11 – Estimated IRA Effect on U.S. GHG Emissions to 2035 (Mt CO_2)



Source: Rapid Energy Policy Evaluation (2022)

However, the election of Donald Trump in 2024 introduced uncertainties regarding the continuity of these policies. The new administration has already signaled its intention to reassess the credits associated with the climate agenda, which introduces a relevant regulatory risk to ongoing projects. Companies such as Air Products may be forced to review timelines or seek new contractual forms of financial protection (BOFA, 2024).

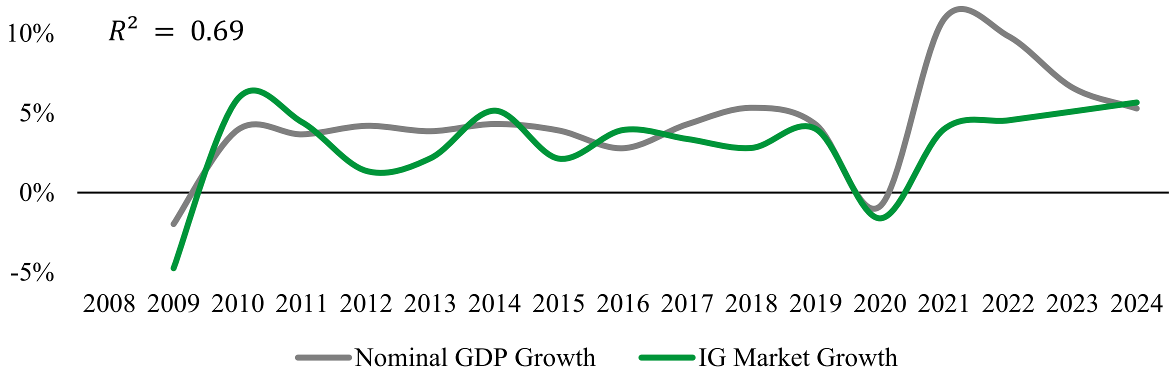
In summary, this is a sector that combines high entry costs, long-term contractual ties, and strict regulatory requirements. Climate policies, although initially catalytic, now face a phase of political reassessment that could significantly impact the pace of the energy transition in the U.S.

3.1.8 Growth Driver and Trends

Despite fluctuations in the macroeconomic environment, industrial gases demonstrate resilient performance. One of the key drivers is the diversification of end markets: sales are distributed across the Americas, Asia, and Europe, serving both defensive sectors (food, healthcare) and cyclical ones (metallurgy, energy). This diversification ensures that even when manufacturing or heavy industry is weak in certain periods, there is steady demand from other segments such as healthcare and food (SEEKING ALPHA, 2023).

In addition, the supply contract structure — often 15 to 20 years with take-or-pay clauses — secures minimum volumes and cost pass-throughs, stabilizing revenues even during crises (GOLDMAN SACHS, 2024).

Chart 12 – Growth of the U.S. Industrial Gases Market and U.S. GDP (%)



Source: Grand View Research, FRED (2025)

On the technological side, there are trends that drive new demand. For example, industrial processes are becoming more intensive in high-purity gases, such as in semiconductor manufacturing, boosting sales of ultrapure nitrogen and rare gases (J.P. MORGAN, 2024a). Another trend is the energy transition and sustainability: carbon capture technologies (CCS) use high-purity oxygen; more efficient industrial furnaces employ oxy-combustion; and, most importantly, green hydrogen is emerging as a future energy vector. The major gas players are at the forefront of hydrogen and clean energy projects, driven, for example, by the Inflation Reduction Act, which subsidizes clean energy projects in the U.S. (GOLDMAN SACHS, 2024a).

In the short term, although volumes in certain markets remain modest due to weak industry (such as in China), gas prices remain positive, sustaining margins (GOLDMAN SACHS, 2024b). In sum, the combination of defensive characteristics and new technological applications makes industrial gases a sector with steady and long-term growth.

The main drivers of the industrial gases market include:

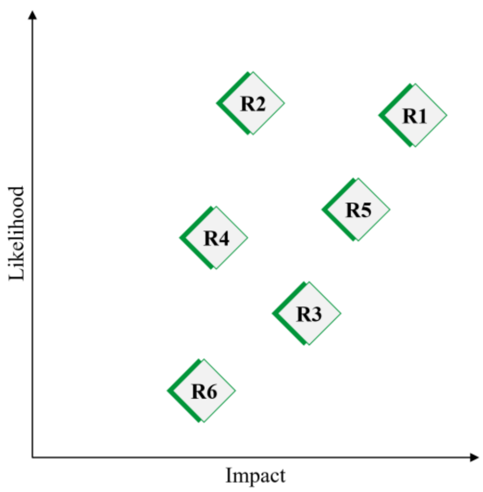
- **Global industrial expansion:** growth in steel, chemicals, electronics, and manufactured goods directly increases demand. Markets such as Southeast Asia, India, and Latin America offer opportunities for new on-site plants. The reindustrialization of the U.S. also fosters demand, especially in semiconductors (GOLDMAN SACHS, 2024a).

- **Healthcare sector:** population aging and expanded access increase the use of medical oxygen and hospital gases. Companies such as Air Liquide and Linde have dedicated arms focused on this sector (J.P. MORGAN, 2024b).
- **High technology:** semiconductors and OLED displays demand ultra-pure gases (nitrogen, neon, fluorinated gases). Even the food industry adopts controlled atmospheres, boosting the use of N_2 and CO_2 (J.P. MORGAN, 2024a).
- **Energy and environment:** green steel technologies, bioenergy, and CCS increase the use of O_2, CO_2, and H_2. Expertise in LNG and hydrogen liquefaction (e.g., Air Products) may translate into new revenue streams (SEEKING ALPHA, 2023).
- **Contract model and sector structure:** the oligopolistic nature and long-term contracts ensure stability and sustainable margins. The model allows for joint planning and co-investment with customers (GOLDMAN SACHS, 2024a).

3.1.9 Risks

The industrial gases sector operates with high capital intensity, long-term contracts, and complex logistics, which expose companies to structural, operational, and regulatory uncertainties. Identifying these risks is essential to understanding the resilience of the business model and the potential variability of future cash flows. The main risk factors relevant to the sector are summarized in Figure 3.

Figure 3 – Industrial Gases Risk Matrix



Source: Own elaboration

- **(R1) Energy Cost Pressure:** The separation and liquefaction of gases (such as O_2, N_2, H_2) is extremely energy intensive. Volatility in electricity prices, especially in regions such as Europe, can erode operating margins even under contracts with partial cost pass-through.
- **(R2) Regulatory and Political Risk (e.g., IRA, ESG):** Political changes (such as the possible reversal of IRA credits in the U.S.) or stricter climate requirements may alter the expected return of hydrogen, CCS, or bioenergy projects.
- **(R3) Dependence on Large Industrial Clients:** Many on-site supply contracts serve refineries, steelmakers, or chemical companies. Industrial shutdowns, the energy transition, or reshoring may lead to underutilization of assets and contractual losses.
- **(R4) Limited Growth in Mature Markets:** North America and Europe show industrial saturation. Growth depends on technological substitutions or entry into emerging markets, which imposes higher country risk and regulatory complexity.
- **(R5) Logistics and Supply Risks:** The distribution of cryogenic gases depends on specialized trucks, liquefaction hubs, and a reliable network. Operational disruptions or bottlenecks (such as those recorded with helium in the U.S.) affect service continuity.
- **(R6) Operational Accidents and Safety:** The handling of gases such as hydrogen, oxygen, and acetylene involves risks of explosions, leaks, and intoxications. Operational failures can cause severe reputational, legal, and financial impacts.

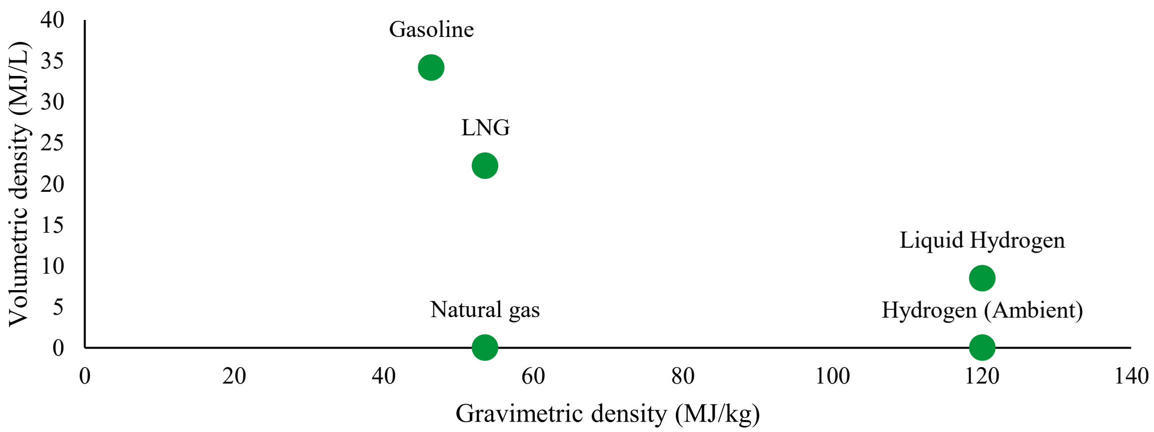
3.2 Hydrogen Sector

3.2.1 Fundamentals of Hydrogen

Hydrogen (H_2) is the lightest chemical element and the most abundant in the universe. On Earth, however, it is bound in compounds such as water and hydrocarbons, and must be extracted for use as an energy carrier or feedstock. Chart 13 shows that its key characteristic is a gravimetric energy density of about 120 MJ/kg (Lower Heating Value – LHV), one of the highest among fuels, but combined with an extremely low volumetric density at ambient conditions. This explains why hydrogen is powerful as a fuel per unit of mass but challenging to store and transport in practice (TÖPLER; LEHMANN, 2015).

Hydrogen's versatility and absence of emissions at the point of use make it a promising vector for decarbonizing hard-to-abate sectors such as refining, chemicals, steelmaking, shipping and aviation, and for enabling seasonal energy storage (IEA, 2024a; HYDROGEN COUNCIL; McKINSEY, 2024).

Chart 13 – Energy Content: Hydrogen vs. Conventional Fuels (Mass vs. Volume)



Source: Goldman Sachs (2022)

Hydrogen is commonly described using a "color code" that reflects its production route:

- **Grey hydrogen:** natural gas reforming without carbon capture, emitting about 10–12 kg CO_2/kg H_2 (IEA GLOBAL HYDROGEN REVIEW 2024).

- **Blue hydrogen:** the same process with carbon capture and storage (CCS), reducing emissions to 0.9–2.5 kg CO_2/kg H_2 depending on capture scope and methane leakage (GOLDMAN SACHS, 2022).
- **Coal-based hydrogen ("black/brown"):** gasification of coal, with emissions around 22–26 kg CO_2/kg H_2 (IEA, 2024a).
- **Green hydrogen:** electrolysis powered by renewables, with emissions near zero if the electricity is carbon-free (IRENA, GREEN HYDROGEN STRATEGY DESIGN 2024).

Chart 14 – Lifecycle CO_2 Emissions per kg of Hydrogen, by Production Route

Source: Goldman Sachs (2022)

Currently, global hydrogen production amounts to about 95 Mt per year, of which around 95% is grey hydrogen produced from fossil fuels without carbon capture (~90 Mt). Blue hydrogen represents less than 1 Mt (<1%), while green hydrogen production from electrolysis is still limited to about 0.5 Mt (<1%) (IEA, 2024a). This underscores that despite its role as a clean energy vector, hydrogen today remains overwhelmingly fossil-based.

Hydrogen also poses physical and material challenges that influence its infrastructure requirements. Because of its small molecular size, hydrogen can permeate through materials and cause embrittlement in metals, requiring specialized alloys or linings for pipelines and storage tanks. Its low volumetric energy density necessitates either compression to high pressures, liquefaction at -253 °C, or conversion into chemical carriers for long-distance transport (TÖPLER; LEHMANN, 2015).

3.2.2 Hydrogen in the Global Energy Transition

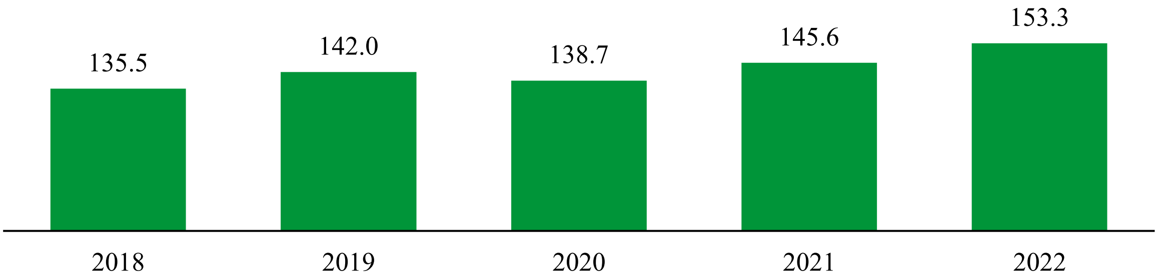
Hydrogen is increasingly recognized as a central pillar in the decarbonization of the global energy system. In all major pathways compatible with limiting global warming to 1.5 °C, hydrogen demand expands far beyond today's industrial feedstock role to become a multi-sectoral energy carrier. The IEA's Net Zero by 2050 roadmap projects hydrogen use to reach 530 Mt in 2050, equivalent to around 10% of final energy consumption, compared to about 2% today (IEA, 2021). Similarly, IRENA's World Energy Transitions Outlook places hydrogen at 12% of total final energy by mid-century, highlighting its strategic role in coupling renewable power to end-use sectors (IRENA, 2023).

This expansion is concentrated in so-called hard-to-abate sectors. Hydrogen and its derivatives are projected to displace fossil fuels in iron and steel, chemicals, long-haul trucking, shipping, and aviation. For instance, the IEA Net Zero scenario foresees hydrogen-based direct reduced iron (H_2-DRI) supplying more than 50% of primary steel production by 2050 (IEA, 2021). In maritime transport, synthetic fuels such as ammonia and methanol derived from hydrogen are expected to account for 40–60% of energy demand by 2050 in different scenarios (IRENA, 2023; DNV ENERGY TRANSITION OUTLOOK, 2024). Aviation follows a similar path, with e-fuels covering a significant share of jet fuel demand after 2035.

Beyond direct use, hydrogen underpins the large-scale integration of renewables by providing flexibility and seasonal storage. Electrolytic hydrogen allows conversion of variable solar and wind into storable molecules, mitigating curtailment and supporting electricity security (IEA GLOBAL HYDROGEN REVIEW, 2024). In this role, hydrogen serves not only as an energy carrier but also as a system integrator.

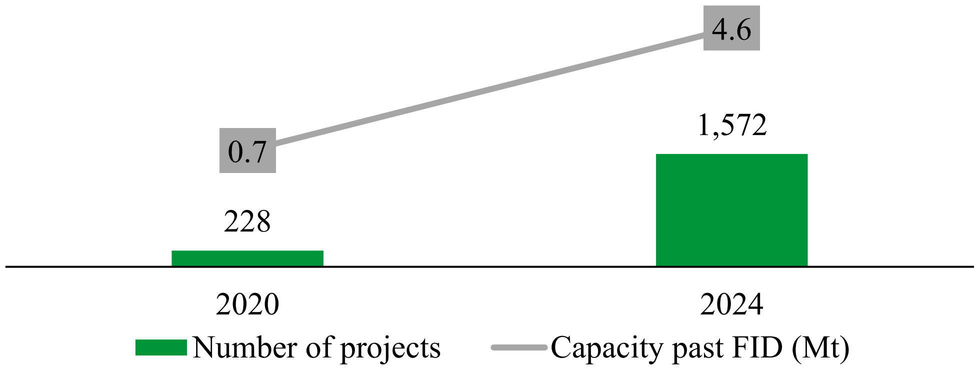
The current market reflects both momentum and gaps. The global hydrogen market size was estimated at USD 153 billion in 2022 (see Chart 15), projected to exceed USD 270 billion by 2032 (STATISTA, 2024). At the same time, the pipeline of clean hydrogen projects has expanded rapidly: by May 2024, 1,572 projects were announced worldwide, representing about USD 680 billion in investments, though only USD 75 billion had reached final investment decision (FID) or construction, as shown in Chart 16 (MCKINSEY, 2024).

Chart 15 – Global Hydrogen Generation Market (USD bn)



Source: Technavio (2025)

Chart 16 – Global hydrogen project pipeline growth (2020–2024) (#, Mt)



Source: McKinsey (2024)

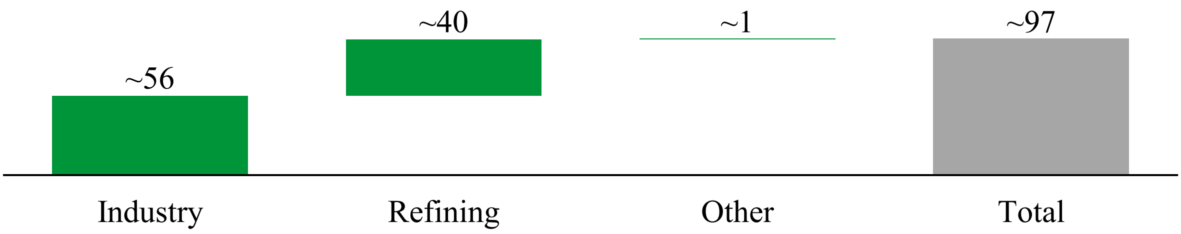
Despite its potential, there is a widening gap between ambition and reality. As of 2024, announced government targets for hydrogen production by 2030 sum to about 43 Mt/year, while policies on the demand side cover less than 11 Mt/year, indicating that offtake remains the weakest link (IEA GLOBAL HYDROGEN REVIEW, 2024). This mismatch threatens the viability of many projects unless stronger demand-pull measures are enacted.

Overall, hydrogen's role in the energy transition is dual: as an industrial feedstock replacement and as an energy system enabler. The degree to which these ambitions materialize depends on rapid deployment, cost reductions, and strong policy support across regions.

3.2.3 Global Hydrogen Demand Outlook

Hydrogen demand today is concentrated in a few mature industrial sectors. In 2023, global consumption was about 97 Mt, with roughly 50% in refining and 40% in ammonia and methanol production, while low-carbon hydrogen represented less than 1 Mt (IEA GLOBAL HYDROGEN REVIEW, 2024). The dominance of fossil-based hydrogen underscores both the scale of the challenge and the opportunity for decarbonization.

Chart 17 – Global hydrogen demand by sector in 2023 (Mt H_2)



Source: IEA (2024)

Looking forward, all major net-zero aligned scenarios foresee a sharp rise in hydrogen demand. The IEA Net Zero by 2050 scenario represented in Table 10 projects demand growing to 530 Mt by 2050, with the increase coming mainly from new applications: ~200 Mt for transport fuels (shipping and aviation), ~130 Mt for industry (steel and chemicals), and ~90 Mt for power and building sectors (IEA, 2021). IRENA's World Energy Transitions Outlook 2023 offers a similar forecast, with hydrogen reaching 12% of total final energy consumption in 2050, equivalent to ~550 Mt (IRENA, 2023).

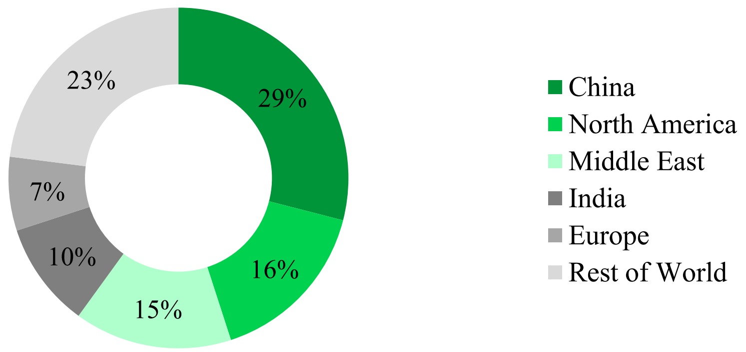
Table 10 – Milestones for hydrogen and hydrogen-based fuels

Sector	2020	2030	2050
Total production hydrogen-based fuels (Mt)	**87**	**212**	**528**
Low-carbon hydrogen production	9	150	520
share of fossil-based with CCUS	95%	46%	38%
share of electrolysis-based	5%	54%	62%
Merchant production	15	127	414
Onsite production	73	85	114
Total consumption hydrogen-based fuels (Mt)	**87**	**212**	**528**
Electricity	**0**	**52**	**102**
of which hydrogen	0	43	88
of which ammonia	0	8	13
Refineries	**36**	**25**	**8**
Buildings and agriculture	**0**	**17**	**23**
Transport	**0**	**25**	**207**
of which hydrogen	0	11	106
of which ammonia	0	8	44
of which synthetic fuels	0	5	56
Industry	**51**	**93**	**187**

Source: IEA (2021)

Regional dynamics are also crucial. Demand growth will be uneven, with Asia (China, Japan, Korea, India) expected to account for the largest share (see Chart 18), driven by industrial demand and net-zero commitments. Europe is forecast to see strong demand for green hydrogen and derivatives to meet climate targets and fuel imports. North America benefits from policy support under the Inflation Reduction Act and industrial clusters. Meanwhile, the Middle East and Latin America could see demand both domestically and as exporters (IRENA, 2024).

Chart 18 – Hydrogen use by region in 2024 (%)



Source: IEA Green Hydrogen Review (2025)

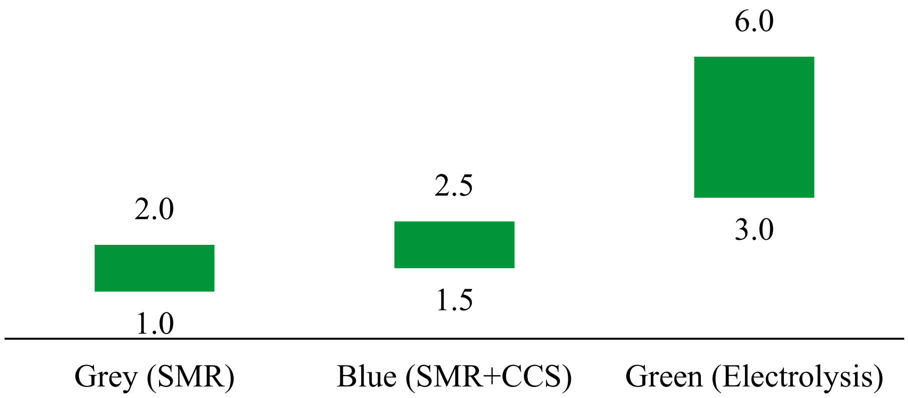
In the nearer term, to 2030, the Hydrogen Council estimates that projects under development could enable demand of ~35 Mt/year, but actual offtake agreements cover much less. Their 2024 report stresses that without stronger demand-side measures, only a fraction of the announced supply capacity will find buyers, with demand likely closer to 15–20 Mt/year by 2030 (McKINSEY, 2024).

In summary, hydrogen demand is set to grow from a narrow base of industrial feedstock today to a diversified global market by 2050, spanning industry, transport, power and heating. The trajectory will depend not only on technology costs but also on policies that create markets and de-risk offtake agreements.

3.2.4 Costs, Competitiveness and Parity

The cost of hydrogen production is the decisive factor for its competitiveness against fossil-based alternatives. Current costs vary significantly by production route, as Chart 19 illustrates, and geography. In 2023, grey hydrogen from natural gas reforming typically cost USD 1–2/kg, blue hydrogen with CCS between USD 1.5–2.5/kg, and green hydrogen via electrolysis in the range of USD 3–6/kg (IEA, GLOBAL HYDROGEN REVIEW, 2024; IRENA GREEN HYDROGEN STRATEGY DESIGN, 2024).

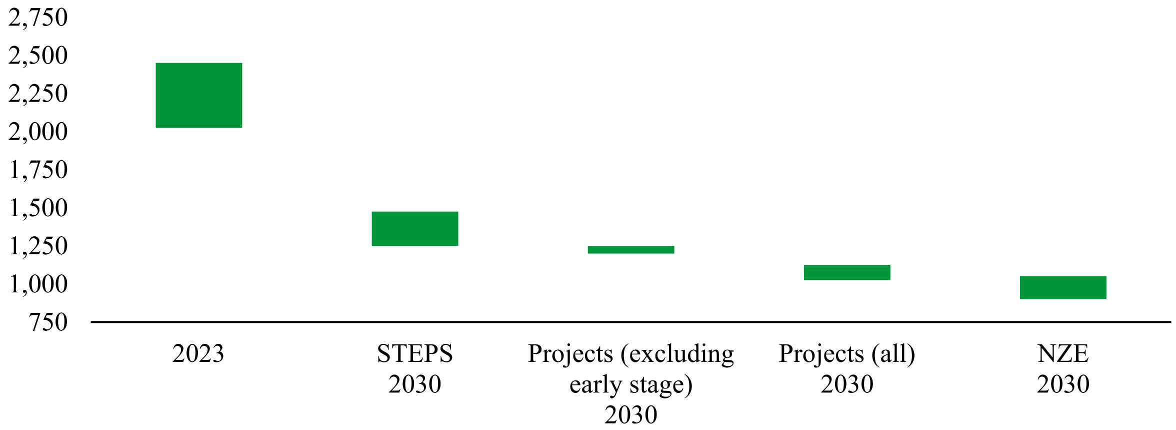
Chart 19 – Global hydrogen production costs by route in 2023



Source: IEA (2024)

Cost reduction is expected from both economies of scale and technology learning. The IEA's Net Zero by 2050 pathway projects average electrolyzer CAPEX to fall from ~USD 2,160/kW in 2023 to ~USD 960/kW in 2030 (see Chart 20), with further reductions possible to ~USD 450–600/kW by 2050 (IEA, 2021; IEA, 2024b), which would enable green hydrogen costs below USD 2/kg in regions with excellent renewable resources. Learning rates are estimated at 15–18%, meaning that each doubling of installed capacity could cut costs by nearly one-fifth (IRENA, 2024a).

Chart 20 – Electrolyzer CAPEX cost curve in Europe-US (USD/kW)



Source: IEA Green Hydrogen Review (2024)

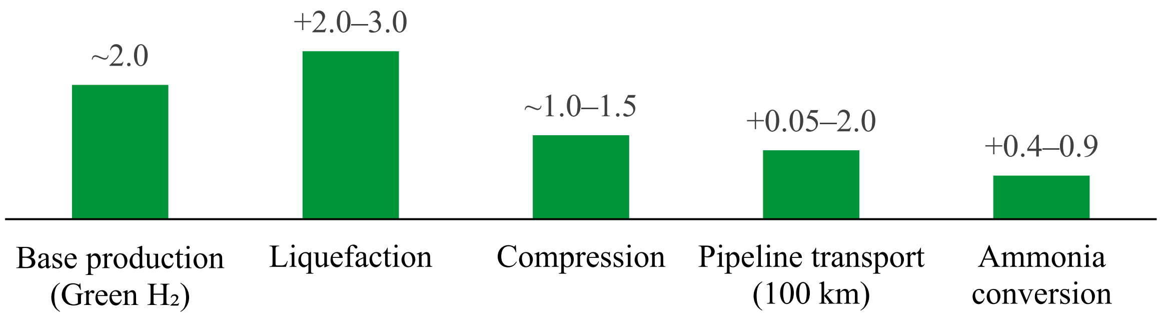
Beyond costs, it is important to note the efficiency of different routes. According to the IEA Global Hydrogen Review (2024), steam methane reforming (SMR) operates at ~76% efficiency (LHV), SMR with CCS at ~69%, coal gasification at ~60%, and coal gasification with CCS at ~58%. By contrast, water electrolysis operates at ~66% efficiency today, with potential to reach ~69% by 2030. These values highlight the trade-off between process maturity, efficiency, and carbon intensity.

Regional variations are key. In regions with abundant low-cost renewable electricity such as Latin America, the Middle East, Australia, and North Africa, green hydrogen could reach USD 1.5–2/kg by 2030, while in regions with higher power costs, it may remain above USD 3/kg (IRENA, 2023; IEA, 2024a). By contrast, blue hydrogen remains competitive in regions with cheap natural gas and favorable CO_2 storage conditions, such as North America and the Middle East.

Parity with fossil fuels is a moving target. At today's fossil fuel prices, hydrogen is not yet competitive in most applications. However, in the IEA NZE scenario, green hydrogen is projected to reach USD 2–4/kg globally by 2030, while the cost of unabated grey hydrogen is expected to increase with higher carbon pricing and methane leakage penalties (IEA, 2024a). Analyses suggest that parity with fossil fuels could be achieved by the early 2030s in regions with strong renewable resources and supportive policy (GOLDMAN SACHS, 2022). In practice, this means that hydrogen for industrial heat would approach parity at around USD 2.5/kg, comparable to natural gas, while in heavy transport, parity is expected at roughly USD 3–3.5/kg, close to diesel prices.

It is also important to account for conversion and transport costs. Chart 21 shows that liquefaction adds USD 2–3/kg, conversion to ammonia USD 0.4–0.9/kg, and pipeline transport between USD 0.05–0.2/kg per 100 km (IRENA GREEN HYDROGEN STRATEGY DESIGN, 2024). These add-ons can double the delivered cost of hydrogen in import-dependent regions, making local production or derivative imports more competitive than long-distance transport of pure hydrogen.

Chart 21 – Delivered hydrogen cost: production vs. conversion/transport



Source: IRENA Green Hydrogen Strategy Design (2024)

Overall, the competitiveness of hydrogen will depend on a combination of technological learning, scale effects, regional resource advantages, and policy frameworks. Reaching parity with fossil fuels across multiple sectors by the 2030s is possible but requires both rapid cost declines and strong regulatory support.

3.2.5 Infrastructure and Logistics of Hydrogen

The physical properties of hydrogen make its infrastructure one of the most complex aspects of the energy transition. Because hydrogen has low volumetric energy density and can cause material embrittlement, it requires dedicated or adapted solutions for transport and storage (TÖPLER; LEHMANN, 2015).

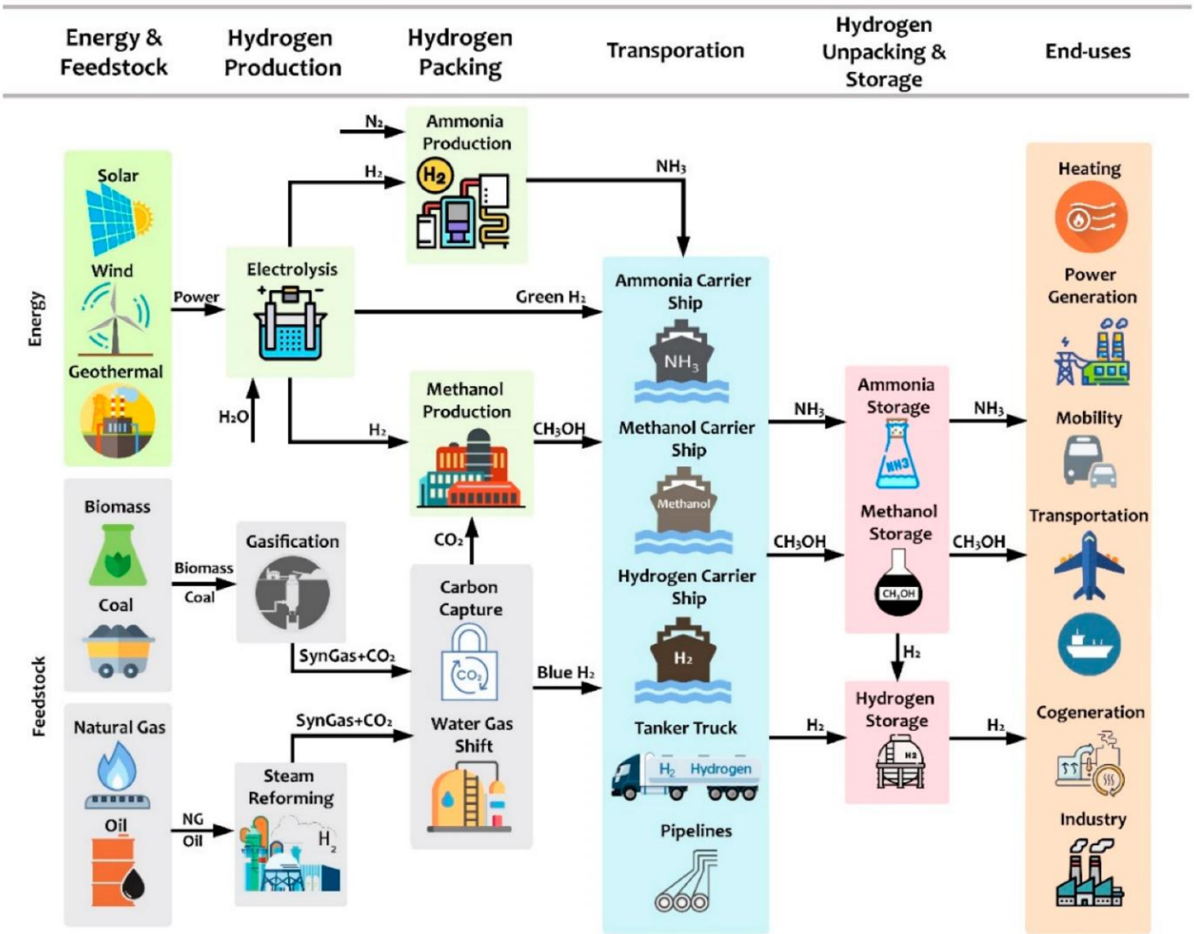
Pipeline transport is the most efficient option for large, continuous flows over land. The European Hydrogen Backbone initiative projects a network of ~40,000 km of dedicated hydrogen pipelines by 2040, of which the majority would be repurposed natural gas pipelines (European Hydrogen Backbone, 2022). Transport costs are estimated at USD 0.05–0.20/kg per 100 km, depending on capacity and pressure (IRENA, 2024a). As discussed in Chapter 3.2.4 (Chart 21), transport and conversion can double the delivered cost of hydrogen in import-dependent regions.

For intercontinental trade, hydrogen is generally converted into carriers. Liquefaction reduces volume by 800x but is energy intensive, adding USD 2–3/kg to costs. Conversion to ammonia is cheaper (~USD 0.4–0.9/kg) and allows use of existing chemical shipping and storage infrastructure, though reconversion is costly; in many cases, imported ammonia is expected to be used directly in fertilizers or as a marine fuel (IRENA, 2024a; IEA, 2024a). Liquid organic hydrogen carriers (LOHCs) and solid carriers such as metal hydrides are under development, but remain at pilot scale (IEA, 2024a).

Storage solutions are equally critical. Underground salt caverns are the most promising for large-scale, seasonal storage. North America alone is estimated to have potential for ~52 bcm of hydrogen storage capacity by 2050, of which 85% could be repurposed from methane facilities (IEA GLOBAL HYDROGEN REVIEW 2024). Other geological formations (depleted gas fields, aquifers) are possible but present greater technical challenges.

Beyond bulk storage, compressed gas tanks and liquid hydrogen tanks are used for mobility and small-scale distribution. These solutions are well established but costly at scale and not suitable for seasonal balancing. In practice, the hydrogen economy will rely on a hybrid infrastructure system: pipelines for local and regional transport, ammonia and derivatives for intercontinental trade, and underground caverns for balancing seasonal demand.

Figure 4 – Hydrogen infrastructure value chain



Source: Energies, MDPI (2022)

3.2.6 Public Policies and International Regulation

Public policy is the critical enabler of the hydrogen economy. Without state intervention through subsidies, mandates, and regulatory frameworks, the cost gap between fossil fuels and low-carbon hydrogen remains prohibitive. Over the last five years, governments worldwide have introduced comprehensive strategies and funding programs to stimulate both supply and demand, though with differing approaches.

The United States has centered its efforts on the IRA of 2022, which introduced the 45V production tax credit. This provides up to USD 3/kg for hydrogen produced with near-zero emissions, declining with higher carbon intensity (U.S. DEPARTMENT OF ENERGY, 2023). The rule finalized in late 2024 requires hourly matching of renewable electricity from 2028 onwards, aligning incentives with additionality principles (IRS, 2024). However, by 2025, political debate on loosening these criteria had already created uncertainty for investors, underlining the importance of regulatory stability.

In the European Union, the Fit for 55 package and subsequent delegated acts established the framework for Renewable Fuels of Non-Biological Origin (RFNBOs). These include strict criteria for additionality, temporal correlation, and geographical matching of renewable power used in electrolysis (EUROPEAN COMMISSION, 2023). At the same time, the EU launched the Hydrogen Bank, which awarded its first auction in April 2024, allocating EUR 720 million to seven projects, with a clearing price of EUR 0.37/kg of renewable hydrogen produced (EUROPEAN COMMISSION, 2024).

Germany has complemented EU policy with the H2Global mechanism, which operates through a double auction system. Under this scheme, the government signs long-term purchase agreements of about ten years with foreign producers of hydrogen derivatives at fixed prices and then resells these products in Germany under shorter-term contracts of one to two years. The price gap between the two transactions is covered with public funds, effectively de-risking import projects. This design provides price stability for producers while ensuring flexibility for domestic buyers (BMWK, 2023). Several other EU countries are now adapting this model.

Asia has also moved decisively. Japan adopted a hydrogen Contracts-for-Difference (CfD) scheme in 2023, supported by an envelope of JPY 3 trillion (USD 20 billion), providing 15-year price guarantees (METI, 2023). South Korea implemented a hydrogen portfolio standard and subsidies for fuel cell vehicles, while China has prioritized hydrogen in its Five-Year Plan, funding industrial clusters and electrolyzer manufacturing capacity.

Other regions are emerging. Australia is investing heavily in export-oriented hydrogen hubs, supported by the Australian Renewable Energy Agency (ARENA). Brazil approved its first national hydrogen strategy in 2024 (Law 14.948/2024), defining guidelines for low-carbon hydrogen certification, infrastructure planning, and fiscal incentives (Governo Federal do Brasil, 2024). The Middle East, particularly Saudi Arabia and the UAE, is linking hydrogen development to large-scale renewable projects and export ambitions. Table 11 summarizes the different regions' policies.

Table 11 – Comparative overview of hydrogen policy instruments by region

Region	Policy instrument(s)	Key features	Source
US	IRA (45V tax credit)	Up to $3/kg; hourly matching by 2028	DOE 2023; IRS 2024
EU	RFNBO rules; Hydrogen Bank	Strict additionality; €720m in first auction (€0.37/kg)	EC 2023; EC 2024
Germany	H2Global	10-year purchase, 1–2 year resale, subsidy gap	BMWK 2023
Japan	CfD scheme	¥3tn fund (~$20bn), 15-year guarantees	METI 2023
Korea	Portfolio standard	Subsidies for FCEVs	IEA 2024
Brazil	National H_2 Law 14.948/2024	Certification + incentives	Gov. Brazil 2024
Middle East	Export hubs	Integrated with renewables	IEA 2024

Source: IEA (2024), METI (2023), BMWK (2023), DOE (2023)

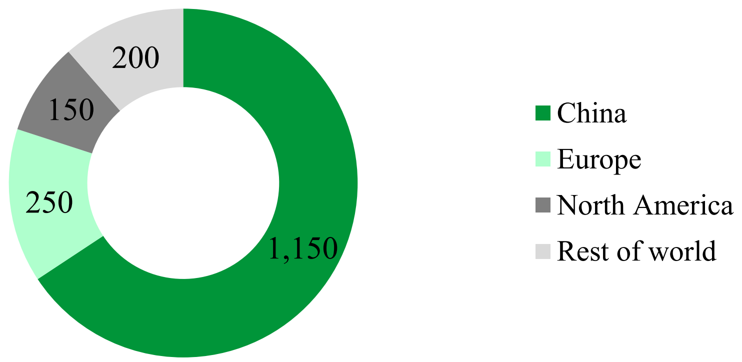
These instruments differ in design but share a common goal: bridging the cost gap until hydrogen becomes competitive. Policy frameworks also extend beyond subsidies, encompassing certification schemes (such as CertifHy in Europe and IPHE's emission methodology), standards for Guarantees of Origin, and trade frameworks to enable international hydrogen markets (IRENA; WTO, 2024). Without clear and credible rules, cross-border trade in low-carbon hydrogen and its derivatives cannot scale.

In summary, while hydrogen policies are proliferating, they remain uneven across regions. The most advanced markets — Europe, North America, and parts of Asia — are creating detailed regulatory and financial frameworks, while emerging economies are still at early stages. The effectiveness of these policies will determine whether announced supply capacity translates into real demand and whether hydrogen can meet its projected role in global decarbonization.

3.2.7 Value Chain and Strategic Players

The global hydrogen value chain spans from upstream production equipment to downstream end-use applications, and is increasingly shaped by the strategies of a few leading players. On the supply side, the manufacturing of electrolyzers is a rapidly consolidating industry. In 2023, China accounted for over 50% of global electrolyzer manufacturing capacity (see Chart 22), followed by Europe and North America, though many projects outside China are still at planning or early commercial stages (IEA GLOBAL HYDROGEN REVIEW, 2024).

Chart 22 – Global cumulative installed electrolysis capacity (MW)



Source: McKinsey (2024)

Large industrial gas companies—Air Products, Linde, and Air Liquide—are at the forefront of project development. Collectively, these three firms are involved in dozens of major projects worldwide, spanning on-site hydrogen production, liquefaction plants, and export hubs. For example, Air Products is the lead investor in the NEOM Green Hydrogen Project in Saudi Arabia, which will produce 600 tons of green ammonia per day from 2026, one of the largest announced projects globally (AIR PRODUCTS, 2023).

Oil and energy majors are also entering aggressively. Shell, BP, TotalEnergies, Equinor, and Sinopec have all announced hydrogen strategies. Shell, for instance, operates Europe's largest PEM electrolyzer (20 MW) in Germany and is developing multiple 100 MW+ projects. Sinopec is building a 260,000 ton/year green hydrogen project in Inner Mongolia, positioning itself as a global leader (SINOPEC, 2023).

On the downstream side, equipment manufacturers, shipping companies, and steelmakers are becoming key stakeholders. CMA CGM and Maersk are investing in ammonia and methanol bunkering infrastructure, while ArcelorMittal and Thyssenkrupp are piloting hydrogen-based direct reduced iron (H_2-DRI). Automotive and heavy-duty truck companies (Toyota, Hyundai, Daimler) continue to develop fuel cell vehicles, though deployment remains modest compared to industrial demand.

Investment pipelines reflect a concentration of leadership. According to the Hydrogen Council (2024), over 75% of large-scale hydrogen projects announced worldwide involve partnerships with either industrial gas companies, oil majors, or governments, underscoring the need for collaboration across the value chain.

In sum, the strategic players shaping hydrogen are a combination of industrial gas leaders, oil and energy majors, technology manufacturers, and end-use pioneers in steel, shipping, and aviation. Their investments and partnerships will define the pace and direction of hydrogen deployment through 2030 and beyond.

3.2.8 Sector Challenges and Future Perspectives

Despite rapid progress, the hydrogen sector faces a number of structural challenges that will determine its future trajectory. One of the most pressing is the persistent gap between supply ambition and real demand. As previously discussed in Chapter 2, announced government production targets for 2030 far exceed policies supporting demand, leaving many projects without clear offtakers (IEA, 2024a). Without long-term contracts or regulatory mandates, projects risk cancellation or delay.

Regulatory uncertainty compounds this problem. In the United States, the final 45V rule issued in December 2024 established strict hourly matching requirements for renewable electricity, but political debates in 2025 suggested possible revisions. This uncertainty undermines investment confidence (IRS, 2024; DOE, 2023). In Europe, the complexity of RFNBO delegated acts has raised concerns among developers regarding compliance costs and administrative burdens.

Another barrier lies in infrastructure and conversion. As shown in Chapter 3.2.4, transporting hydrogen as liquid or ammonia can add several dollars per kilogram to delivered costs, which constrains the competitiveness of intercontinental trade unless breakthroughs reduce these penalties (IRENA, 2024a).

The supply chain for electrolyzers and critical minerals also presents risks. Over 50% of current electrolyzer manufacturing capacity is concentrated in China, raising concerns over dependency and vulnerability to trade disruptions (IEA, 2024a). Moreover, the production of electrolyzers requires materials such as iridium and platinum for PEM technology, which face resource constraints.

Hydrogen uptake in end-use sectors may also proceed slower than expected. In shipping, large-scale adoption of ammonia and methanol fuels is projected only after 2040 in conservative scenarios (DNV ENERGY TRANSITION OUTLOOK, 2024). In aviation, e-fuels face high production costs and competing demand from other sectors. In steel, while pilots are underway, scaling to commercial DRI plants will take years of operational proof and infrastructure buildup.

Finally, hydrogen's long-term role will depend on policy stability, technological innovation, and integration with broader decarbonization strategies. Projections vary: the Hydrogen Council sees hydrogen demand exceeding 600 Mt by 2050, while the IEA Net Zero scenario forecasts ~530 Mt, and more conservative pathways such as DNV's expect ~250–300 Mt. The actual outcome will hinge on how quickly cost parity is achieved and whether large-scale infrastructure and markets can be built in time.

In summary, hydrogen's future will be shaped less by technological feasibility — which is largely proven — and more by demand creation, cost reductions, infrastructure build-out, and regulatory clarity. Achieving the ambitious visions of hydrogen as a cornerstone of decarbonization requires unprecedented policy coordination and private investment mobilization.

4. AIR PRODUCTS

4.1 Company Background and Evolution

Air Products & Chemicals, Inc. was founded in 1940 in Detroit, Michigan, by Leonard Pool, with the novel idea of producing industrial gases on-site at customer facilities, thereby reducing distribution costs and ensuring reliability of supply (AIR PRODUCTS, 2023). Over more than eight decades, the company has grown from a regional supplier into one of the three global leaders in the industrial gases sector, alongside Linde and Air Liquide (J.P. MORGAN, 2024a). Today, Air Products operates in more than 50 countries, serving industries including refining, chemicals, electronics, metals, healthcare, and increasingly, clean energy (GOLDMAN SACHS, 2024).

Table 12 – Corporate Timeline of Air Products (1940–2025)

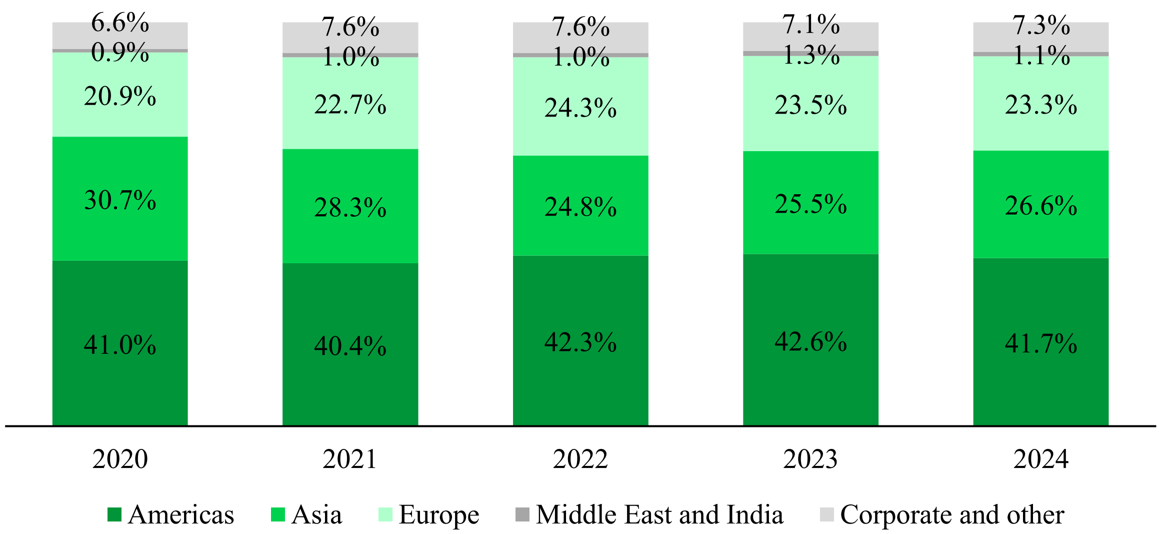
Air Products Timeline	
1940s	Foundation by Leonard Pool in Detroit (1940), pioneering the on-site gas supply model; supply of mobile oxygen generators to the U.S. military during World War II.
1950s	Entry into tonnage gases and supply of liquid hydrogen for the U.S. space program.
1960s	Headquarters relocated to Trexlertown; listing on the NYSE (1962); diversification into chemicals.
1970s	International expansion into Europe, Africa, and Asia; acquisition of Airco (1978).
1980s	Growth in cogeneration and environmental control technologies; leadership in hydrogen supply for refineries.
1990s	Consolidation in electronics and semiconductor gases; acquisitions in Europe and Asia.
2000s	Strengthening of LNG process technology, membranes, and advanced gas separation.
2010s	Expansion of ASU projects in China; acquisition of Indura in South America (2012); spin-off of Versum Materials (2016); divestiture of Performance Materials (2017); appointment of Seifi Ghasemi as CEO (2014) and strategic refocus on gases; announcement of large-scale hydrogen projects including NEOM JV (2018–2020).
2020s	Inauguration of new global headquarters (2021); NEOM project financial close (2023, US$8.4 bn); sale of LNG equipment to Honeywell (2024, US$1.8 bn); CEO transition to Eduardo Menezes and Dennis Reilley as Chair (2025).

Source: Air Products, own elaboration

Throughout its history, the company has followed a consistent strategic orientation: combining stable long-term contracts with large industrial customers and selective bets on transformational projects. During the 1980s and 1990s, Air Products expanded aggressively in Europe and Asia, entering joint ventures with local partners and consolidating its helium and hydrogen businesses (UBS, 2024). In the 2000s, APD developed competencies in complex engineering and plant construction, though this division was later divested to refocus on the core gases business. More recently, under CEO Seifi Ghasemi (2014–2025), the company exited non-core activities such as packaged gases and its Performance Materials division, sharpened its focus on industrial gases, and initiated bold moves into large-scale hydrogen and carbon capture projects (CITI, 2025).

The company's global footprint is now well balanced across the Americas, Europe, and Asia. In fiscal year 2024, the regional revenue split was approximately 42% Americas, 23% Europe, 27% Asia, and 1% Middle East (J.P. MORGAN, 2024b).

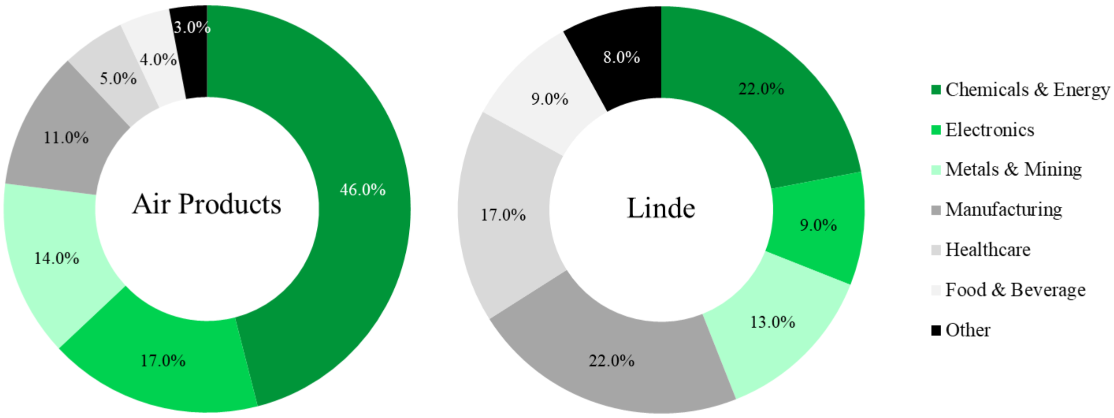
Chart 23 – Revenue Split by Geography (%)



Source: Air Products

This distribution highlights APD's strong positioning in North America, where it is the market leader in hydrogen and helium supply, while also underscoring growth opportunities in the Middle East with the development of projects such as the NEOM Green Hydrogen joint venture. Compared with its peers, Air Products is less exposed to healthcare and electronics, areas where Air Liquide and Linde hold dominant positions (GOLDMAN SACHS, 2023). Instead, APD differentiates itself by focusing on on-site projects with long-term take-or-pay contracts, ensuring revenue stability and protecting margins (AIR PRODUCTS, 2024a).

Chart 24 – Comparative Exposure to End-Markets (%)



Source: Goldman Sachs (2023), Companies

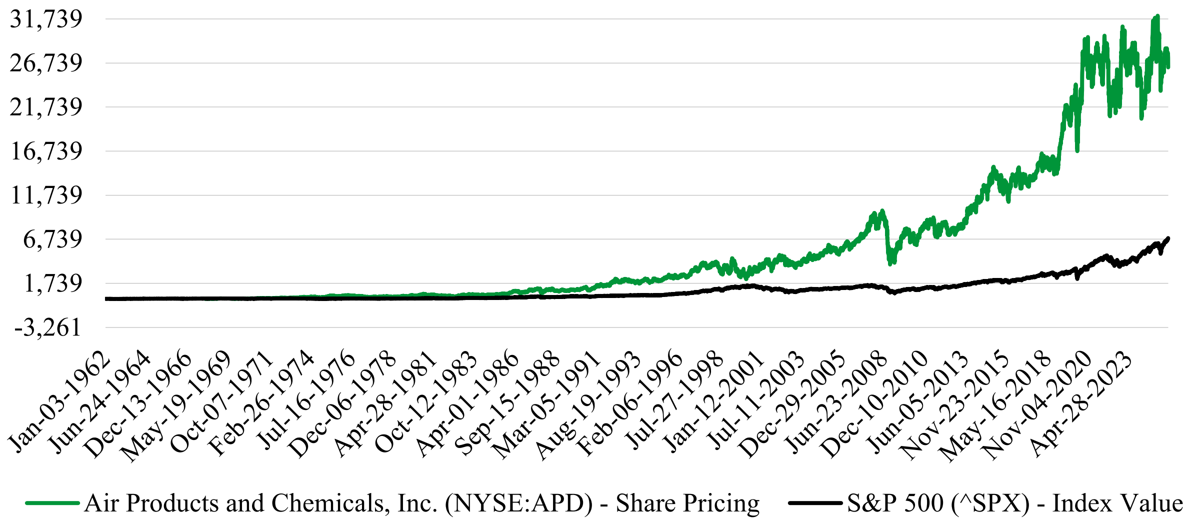
From a governance and organizational perspective, APD has historically maintained a streamlined structure with centralized decision-making. The leadership transition in 2025, when Eduardo Menezes — formerly of Praxair (Linde) — was appointed CEO, marked a significant step in the company's evolution, ensuring continuity of expertise in industrial gases while responding to shareholder concerns about succession planning (J.P. MORGAN, 2025). This change also symbolized a cultural shift: moving from an expansionist, project-driven strategy under Ghasemi to a more disciplined and shareholder-aligned approach, as demanded by activist investors such as D.E. Shaw (UBS, 2025).

The evolution of Air Products can thus be divided into three broad phases: (i) its foundation and regional growth (1940–1980), (ii) diversification and internationalization (1980–2010), and (iii) portfolio optimization and clean energy expansion (2010–present). This trajectory demonstrates the company's ability to adapt to changing industrial and regulatory environments, while maintaining its identity as a specialist in large-scale gas supply solutions. The current decade represents both a continuation of this tradition and a major inflection point, as Air Products aims to leverage its technological and financial strength to lead the global hydrogen economy.

4.2 Governance and Shareholding Structure

Air Products has historically maintained a relatively simple governance structure compared with many global industrial peers. The company is incorporated in the United States and listed on the NYSE under the ticker APD, with a market capitalization of approximately USD 56 billion as of November 20th, 2025. Its shareholder base is broadly institutional, with the majority of equity owned by large asset managers such as Vanguard and BlackRock, alongside long-only mutual funds and pension funds (UBS, 2024). Free float is therefore substantial, and there is no dominant controlling shareholder, which makes governance practices and board oversight especially relevant. APD's performance vs. S&P 500 is shown in Chart 25.

Chart 25 – APD Stock vs S&P500



Source: Capital IQ (2025)

Table 13 – Shareholder Base of Air Products

Type	Common Stock Equivalent Held	% of Inst. Ownership
Traditional Investment Managers	177,388,908	84.4%
Banks/Investment Banks	11,802,608	5.6%
Hedge Fund Managers (<5% stake)	10,246,961	4.9%
Sovereign Wealth Funds (<5% stake)	4,022,144	1.9%
Government Pension Sponsors	3,267,688	1.6%
Family Offices/Trusts	1,803,036	0.9%
Insurance Companies	1,002,956	0.5%
VC/PE Firms (<5% stake)	352,405	0.2%
Corporate Pension Sponsors	164,810	0.1%
Educational/Cultural Endowments	24,080	0.0%
Total	**210,075,596**	**100.0%**

Source: Capital IQ (2025)

The company is overseen by a Board of Directors composed of a majority of independent members, consistent with U.S. governance norms. Historically, Seifi Ghasemi held a dual role as Chairman and Chief Executive Officer from 2014 until early 2025. In February 2025, Air Products announced a significant governance change: the appointment of Eduardo Menezes as CEO, Wayne T. Smith as Chairman of the Board and Dennis H. Reilley as Vice Chairman of the Board (J.P. MORGAN, 2025). This separation of roles was welcomed by investors as a move toward stronger oversight and alignment with best practices in corporate governance (UBS, 2025). Management is detailed in Table 14 and the Board of Directors in Table 15.

Table 14 – Air Products' Management

Name	Title
Eduardo Menezes	Chief Executive Officer
Ivo Bols	President of Europe & Africa
Wolfgang Brand	President of Project Delivery, Equipment Sales & Plant Support
Victoria Brifo	Executive VP of Corporate Communications & Corporate Relations and Chief Human Resources Officer
Brian Galovich	Executive VP & Chief Information Officer
Ahmed Hababou	President of Middle East & India
Kurt Lefevere	President of Asia
Matt Lepore	Executive VP, General Counsel, Chief Compliance Officer and Secretary
Francesco Maione	President of Americas and Global Helium & Rare Gases
Walter L. Nelson	President of Equipment Businesses & Technical Solutions
Melissa Schaeffer	Executive Vice President and Chief Financial Officer

Source: Air Products (2025)

Table 15 – Air Products' Board of Directors

Name	Title
Wayne Smith	Chairman of Board
Eduardo Menezes	CEO & Director
Dennis Reilley	Vice Chairman of Board
Lisa Davis	Independent Director
Jessica Trocchi Graziano	Independent Director
Tonit Calaway	Independent Director
Andrew William Evans	Independent Director
Paul Charles Hilal	Independent Director
Bhavesh Patel	Independent Director
Alfred Stern	Independent Director
Howard Ungerleider	Director

Source: Air Products (2025)

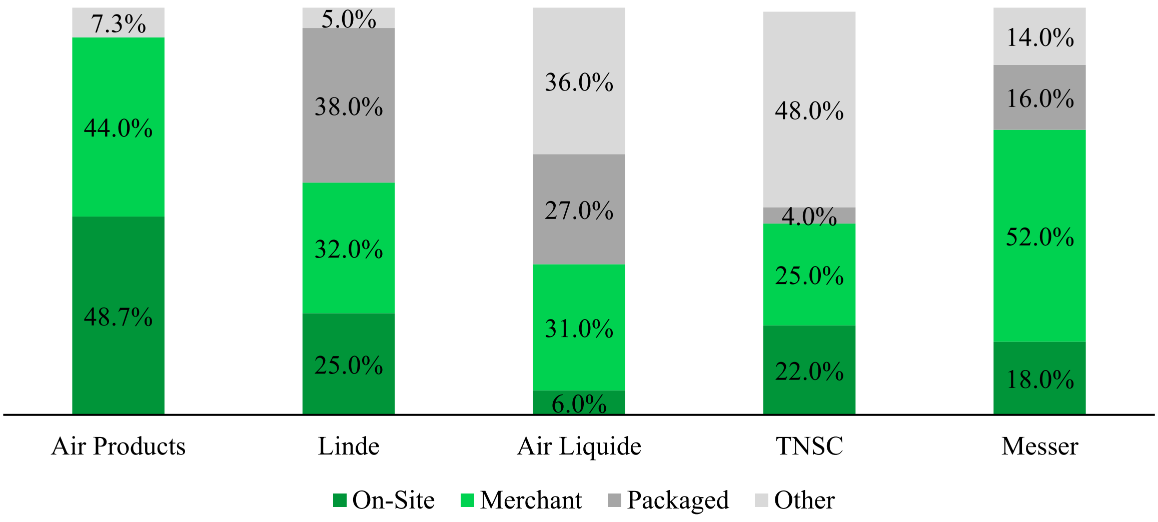
Shareholder activism played an important role in accelerating this transition. In 2023, hedge fund D.E. Shaw disclosed a significant stake in Air Products and began pressuring the board on issues including negative free cash flow, project execution risk, and the absence of a succession plan (GOLDMAN SACHS, 2024). As a response, management announced that no new large projects would be approved without at least 75% of offtake volumes contracted, and it committed to being free cash flow positive by 2027 (UBS, 2024). The subsequent appointment of an experienced outsider, Menezes (formerly with Praxair/Linde), reinforced investor perception that the company was addressing concerns over governance discipline and long-term shareholder alignment (J.P. MORGAN, 2025).

In sum, Air Products' governance has evolved significantly in recent years. What was once a CEO-centric model under Ghasemi has shifted toward a more balanced structure with independent oversight and a clarified succession path. This evolution reflects both external pressure from shareholders and internal recognition that the scale of APD's investment program requires stronger governance controls. These changes are likely to reduce perceived governance risk and support investor confidence in the company's ability to execute its ambitious strategy while maintaining shareholder alignment.

4.3 Business Model and Revenue Streams

Air Products' business model is distinct within the global industrial gases industry. The company focuses primarily on large on-site gas supply contracts, whereby it designs, finances, builds, and operates production facilities adjacent to customer sites. Customers commit under long-term take-or-pay agreements (typically 15–20 years), which guarantee minimum revenue even if demand fluctuates. These contracts often include clauses for energy and feedstock cost pass-through, significantly reducing margin volatility (AIR PRODUCTS, 2024a; J.P. MORGAN, 2024a). Compared with peers such as Linde and Air Liquide, which maintain substantial packaged gas and healthcare segments, Air Products has deliberately exited those activities, as shown in Chart 26, sharpening its model around high-return, capital-intensive projects and stable contracted cash flows (GOLDMAN SACHS, 2023).

Chart 26 – Revenue Breakdown by Supply Mode – Industrial Gas Majors (%)



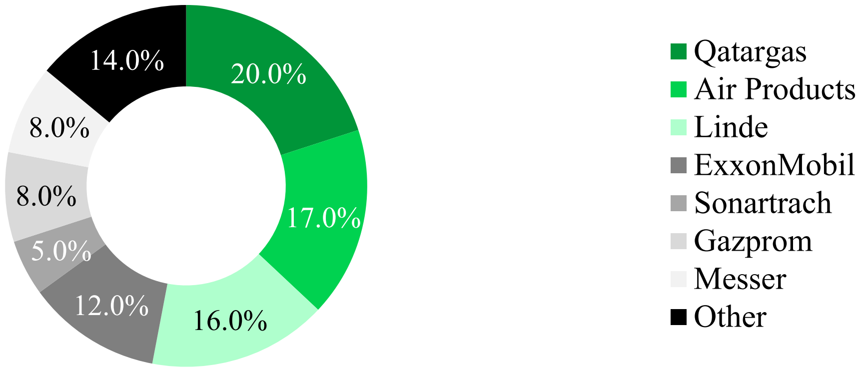
Source: Companies

The company's revenue base is concentrated in industrial gases, representing over 95% of total sales. Within this, the main streams are atmospheric gases (oxygen, nitrogen, argon), process gases (hydrogen, carbon monoxide, syngas), and specialty gases such as helium. Equipment sales, once a larger part of the portfolio, now contribute less than 5% following the divestiture of the LNG process equipment business in 2024 to Honeywell (UBS, 2024). This divestiture reflects APD's strategy to reduce exposure to cyclical equipment markets and focus on recurring revenues.

A distinguishing feature of Air Products is its leadership in hydrogen. The company is the largest supplier of hydrogen in North America and one of the global leaders, with a strong pipeline of blue and green hydrogen projects designed to serve refining, ammonia, and clean energy markets (CITI, 2025). This segment represents both a continuation of the company's core competency (supplying hydrogen to refineries under pipeline contracts) and an expansion into energy transition opportunities.

Another strategically relevant component of Air Products' portfolio is helium, which accounts for roughly 7% of company sales and positions APD among the largest global suppliers, with an estimated 17% share of worldwide helium capacity, shown in Chart 27 (J.P. MORGAN, 2024). This segment serves high-value markets such as medical imaging, semiconductors, and fiber optics, where helium's cooling and inert-gas properties are critical. While representing a relatively small portion of total revenue, the business benefits from high margins, long-term contracts, and Air Products' leadership in cryogenic logistics and purification technologies, reinforcing its differentiation among industrial-gas peers.

Chart 27 – Helium Capacity by Producer (%)



Source: J.P. Morgan (2024)

Regionally, APD's revenue is diversified but slightly more weighted to the Americas, reflecting its strong hydrogen and helium businesses in the U.S. Gulf Coast and Canada. As mentioned, in FY2024, revenues were distributed ~42% Americas, 23% Europe, 27% Asia, and 1% Middle East. The Middle East share is expected to expand significantly after 2026 with the commissioning of the NEOM Green Hydrogen Project.

In conclusion, Air Products' business model is characterized by capital intensity and contractual stability. By prioritizing large-scale, long-term projects, the company reduces exposure to short-term market fluctuations, though it assumes significant execution and capital deployment risks. The deliberate choice to focus on hydrogen and helium further differentiates APD's revenue structure from peers, positioning it at the forefront of the global energy transition.

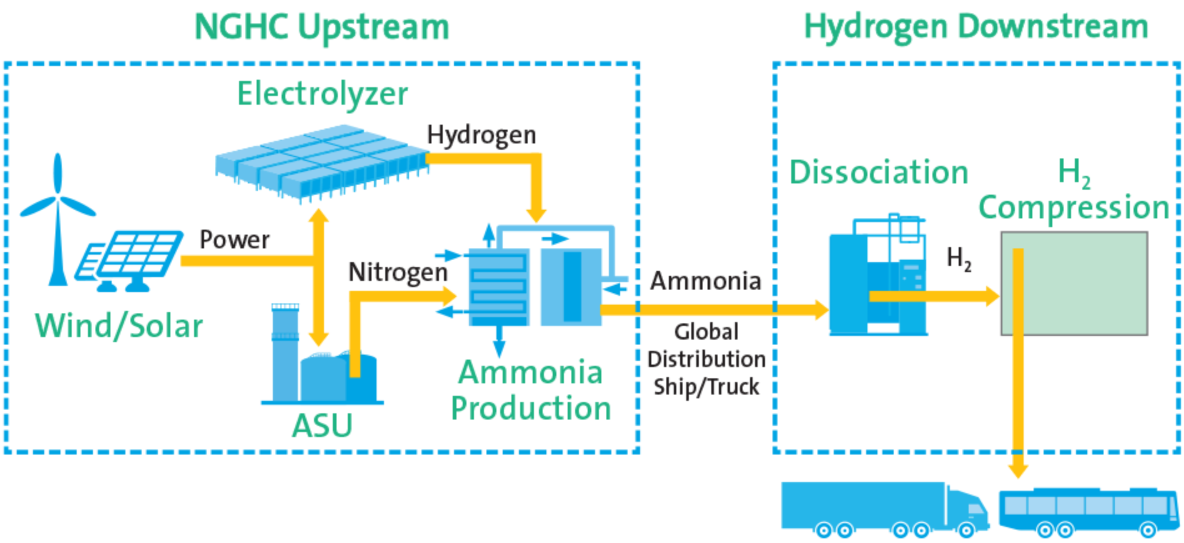
4.4 Strategic Initiatives and Major Projects

Air Products has positioned itself as one of the most ambitious players in the global industrial gases sector by pursuing large-scale, capital-intensive projects aimed at decarbonization and clean energy. This strategy builds upon its traditional strengths in hydrogen production, gasification, and project execution, while differentiating APD from competitors that favor incremental or smaller-scale investments (GOLDMAN SACHS, 2024). The company's major initiatives focus on green and blue hydrogen, carbon capture and storage (CCS), and gasification projects in emerging markets, with three flagship ventures defining its current strategic trajectory: NEOM in Saudi Arabia, the Louisiana Blue Hydrogen project, and the Alberta Net-Zero Hydrogen Complex in Canada (J.P. MORGAN, 2024a).

The NEOM Green Hydrogen Project is Air Products' most prominent initiative and a cornerstone of its energy transition strategy. Structured as a joint venture between Air Products, ACWA Power, and NEOM, each holding a one-third equity stake, the project reached financial close in May 2023 with a total investment of USD 8.4 billion, of which USD 6.1 billion was secured as non-recourse project debt from 23 international lenders (NEOM CASE STUDY, 2023). The facility will utilize approximately 4 GW of solar and wind capacity to power 2.2 GW of electrolyzers, producing 600 tonnes per day of green hydrogen, which will be converted into 1.2 million tonnes per year of ammonia for export (WORLD BANK, 2023). Construction progress surpassed 80% completion by 2025, involving more than 18,000 workers and over 42 million labor hours, with USD 0.8 billion in equity cash expenditure committed by Air Products.

The company holds a 30-year exclusive offtake agreement for all production, covering ~35% of total output under take-or-pay commitments, while negotiations for additional volumes are ongoing (AIR PRODUCTS, 2024a). Commercial operations are targeted for late 2026, with full ramp-up expected in early 2027. The project's unprecedented scale — featuring over 5 million solar panels, 250 wind turbines, and 4 GW of dedicated renewable power — positions it as the world's largest green hydrogen complex and a cornerstone of Air Products' long-term decarbonization strategy. Figure 5 illustrates the production flow.

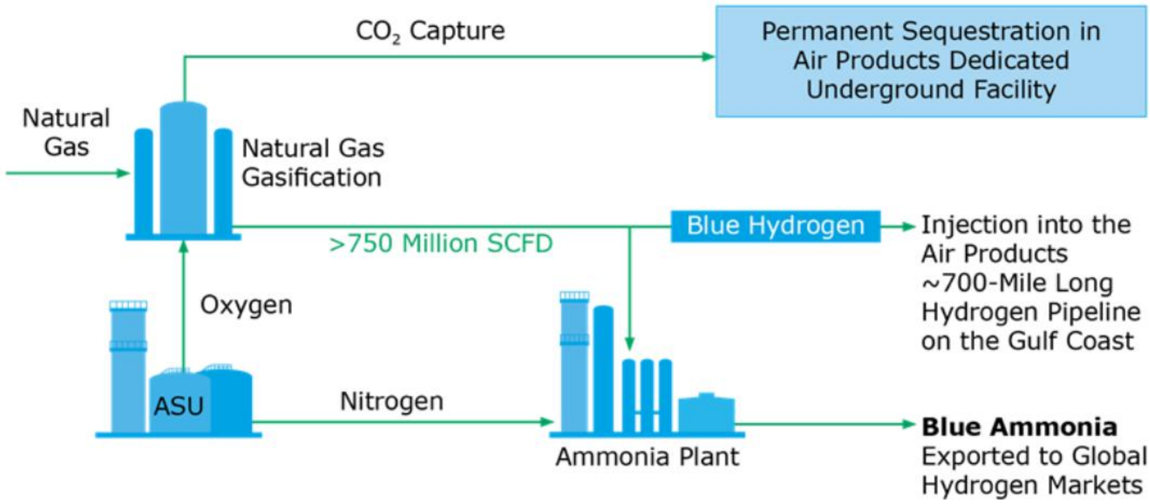
Figure 5 – NEOM Green Hydrogen Company – Project Flow Diagram



Source: Air Products (2025)

The second major project is the Louisiana Blue Hydrogen and Ammonia Complex, announced in 2021 and initially budgeted at USD 4.5 billion, later expanded to USD 7 billion following the approval of the U.S. Inflation Reduction Act (AIR PRODUCTS, 2024a). The facility will produce blue hydrogen and ammonia from natural gas using CCS technology, capturing over 95% of CO_2 emissions, equivalent to ~5 million tonnes per year, for permanent underground storage. Air Products plans to monetize the 45Q tax credit (USD 85/t CO_2) and expects a project IRR above 10%, including infrastructure expansion costs. As of early 2025, the company is advancing permitting and evaluating scope optimization, while maintaining a cautious approach — with offtake agreements and equity partnerships still under negotiation and start-up now expected between 2028 and 2029.

Figure 6 – Louisiana Blue Hydrogen and Ammonia Project – Process Flow

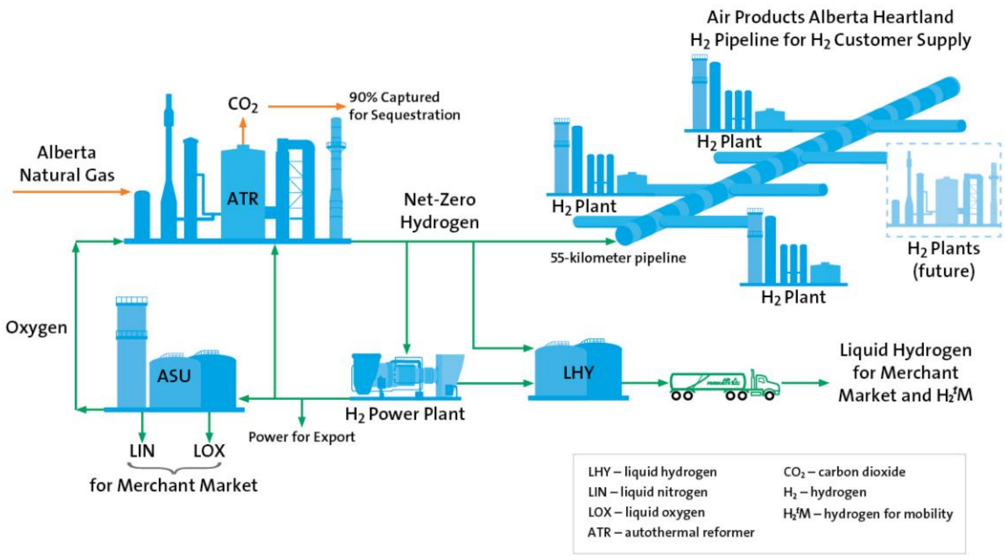


Source: Air Products (2025)

The Alberta Net-Zero Hydrogen Complex represents APD's strategic push into Canada (see Figure 7). Initially announced with an estimated CAPEX of CAD 1.3 billion (later revised upward to CAD 1.6 billion), the project integrates an auto-thermal reformer with CCS to produce blue hydrogen and supply both local pipelines and a new liquefaction facility (J.P. MORGAN, 2024c). Government support has been secured, including CAD 475 million in federal funding (GOVERNMENT OF CANADA, 2022). However, execution has faced challenges: cost overruns, schedule slippage, and delays in contracting volumes have led management to reclassify Alberta among "underperforming" projects (UBS, 2025). Start-up is now expected only in late 2025.

The facility is designed to operate with >95% carbon capture efficiency, producing net-zero pipeline hydrogen, liquid hydrogen for mobility, and hydrogen-based export power. Air Products holds 100% ownership, adopting an on-site/merchant hybrid business model to leverage its existing Heartland Hydrogen Pipeline System. Despite short-term headwinds, the project remains aligned with APD's long-term strategy, with potential expansion to over 1,500 TPD of hydrogen production and 3 million TPY CO_2 capture capacity (AIR PRODUCTS, 2024a).

Figure 7 – Alberta Net-Zero Hydrogen Project – Process Flow



Source: Air Products (2025)

In June 2024, Air Products signed a 15-year take-or-pay agreement with TotalEnergies to supply 70,000 tons per year of green hydrogen starting in 2030, making it the world's largest long-term hydrogen supply contract. The hydrogen will be used to decarbonize TotalEnergies' Leuna refinery in Germany, reducing emissions by approximately 700,000 tons of CO_2 per year (AIR PRODUCTS, 2024a). The partnership also includes ongoing discussions to expand hydrogen supply to other European refineries, strengthening Air Products' role as a key enabler of industrial decarbonization in Europe.

Beyond these projects, Air Products has scaled back or canceled other ventures that lacked contracted offtake or sufficient economics, including a green hydrogen project in Texas and a sustainable aviation fuel (SAF) joint venture in California (GOLDMAN SACHS, 2024). The decision to withdraw from such speculative ventures underscores a new governance principle: capital will only be deployed in projects with sufficient offtake commitments and de-risked financing (UBS, 2025). This marks a strategic pivot from the aggressive expansion under

Ghasemi to a more disciplined "back-to-core" focus under the leadership of Eduardo Menezes. A summary of Air Products project portfolio can be seen in Table 16.

Table 16 – Air Products' Strategic Project Portfolio – Current Status

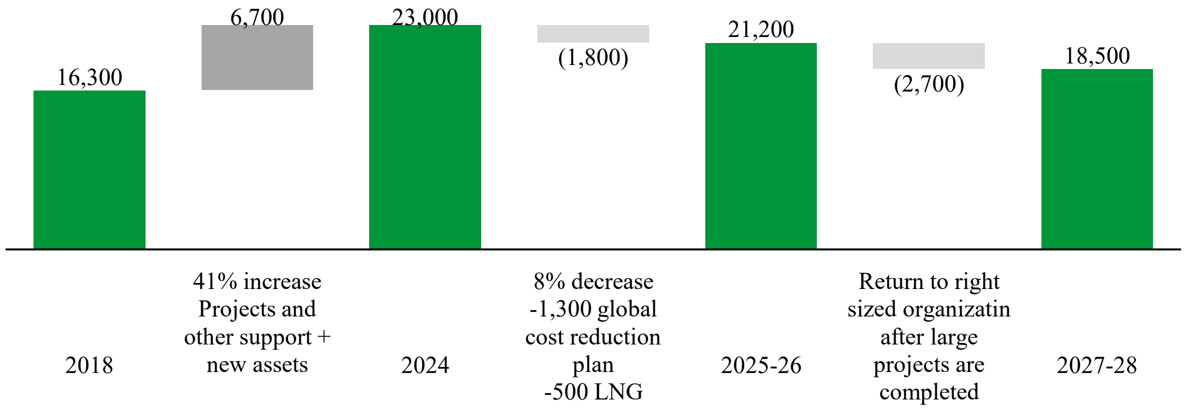
Plant	Customer / Location	Supply Mode / Off-take	Status	Project Approximate Capital
Green H2	AP/NEOM, Saudi Arabia	Long Term	On track	USD ~8,400M
Blue H2	Production/LA, USA	Pipeline/Long Term	On track	USD ~4,500M
Net-zero blue H2	IOL/Canada	Pipeline/Long Term	Underperforming	CAD ~1,600M
Blue H2	ExxonMobil/Rotterdam NL	Pipeline/Long Term	Underperforming	USD ~850M
Low-carbon H2	Downstream H2 distribution	Long Term	Underperforming	USD ~2,000M
Blue H2	Sequestration & Shipping/LA, USA	Pipeline/Long Term	Underperforming	Not Disclosed
Carbon Monoxide	LyondellBasell/TX, USA	Pipeline/Long Term	Underperforming	Not Disclosed
Semiconductor	Not Disclosed/Taiwan	Pipeline/Long Term	Underperforming	USD ~900M
H2/SAF	World Energy/CA, USA	Pipeline/Long Term	Cancelled	USD ~2,500M
Green H2	NY, USA	Long Term	Cancelled	USD ~500M
Carbon Monoxide	Ineos/TX, USA	Pipeline/Long Term	Cancelled	Not Disclosed

Source: Air Products

In summary, Air Products' major projects demonstrate both the company's ambition and its exposure to execution risks. If successful, they could transform APD into the leading hydrogen supplier globally, with significant earnings contribution from 2027 onwards. However, the magnitude of required investments and the technical complexity of these projects demand careful governance and disciplined capital allocation to ensure long-term shareholder value creation.

At the same time, the company has outlined a plan (see Chart 28 and Table 17) to right-size its cost structure as large projects are completed, including a gradual reduction in SG&A and headcount. This effort is expected to unlock margin improvement and sustain profitability, with adjusted operating margins projected to approach 30% by the early 2030s.

Chart 28 – Evolution of Air Products' Headcount (2018–2028) (%)



Source: Air Products (2025)

Table 17 – Air Products Current Strategy

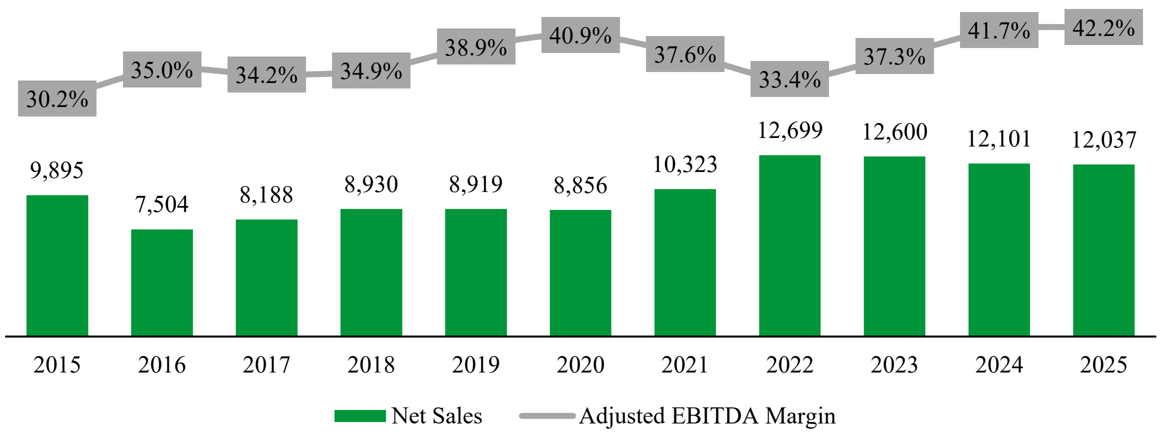
	As of today	Improve core / Re-focus CapEx *(2026-2029)*	Achieve potential *(approx. 2030+)*
	- High quality base obscured by underperforming projects - Committed to our A/A2 rating	- Unlock base earnings through significant margin improvement - Optimize underperforming projects	- Strong base growth - NEOM / Darrow more than offset underperforming projects
Adjusted EPS	**$11.85 - $12.15** FY25 Forecast	**High single-digit annual growth**	**Double-digit annual growth**
Adjusted Op. Margin	**24%** FY25 Forecast	**High 20's**	**~30's**
Adjusted ROCE	**10%** FY25 Forecast Cash and Construction in Progress (~500bps)	**Low-to-mid-teens** Cash and Construction in Progress (~500bps)	**Mid-to-high teens**
Net Cash Flow	**Significant capital to fund projects**	**Net cash-flow neutral-to-positive**	**Net cash-flow positive**
Cash to Shareholders	**Continue dividend increases**	**Dividends and share buybacks**	**Dividends and share buybacks**

Source: Air Products (2025)

4.5 Financial Performance

Air Products' financial profile reflects the resilience of its core industrial gas operations combined with the capital intensity of its growth strategy. As shown in Chart 29, in fiscal year 2025, the company reported revenues of USD 12.1 billion, Adjusted EBITDA of USD 5.1 billion, and adjusted earnings per share (EPS) of USD 12.03, broadly in line with consensus estimates (UBS, 2024; J.P. MORGAN, 2024a). EBITDA margins remained robust at ~42%, supported by contractual pass-through mechanisms and disciplined cost control, despite weaker macroeconomic conditions in Europe and Asia (GOLDMAN SACHS, 2024).

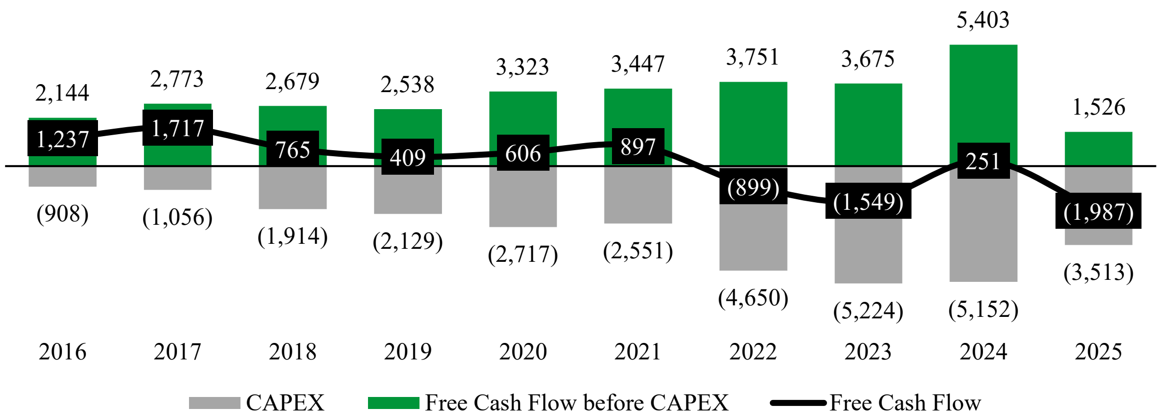
Chart 29 – Revenue and EBITDA Evolution (USD m, %)



Source: Company, own elaboration

The company's CAPEX program remains the most significant factor shaping financial results. Between 2020 and 2024, annual CAPEX averaged USD 4–5 billion, significantly above historical levels, as shown in Chart 30, reflecting large-scale project commitments. This elevated investment led to negative free cash flow (FCF) in recent years, with management guiding that FCF will turn positive only after 2027, once major projects ramp up.

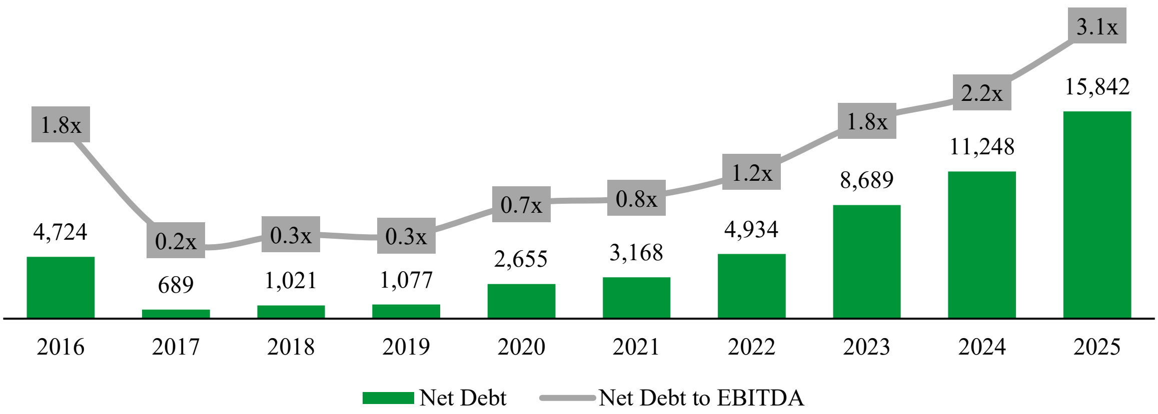
Chart 30 – CAPEX vs. Free Cash Flow (USD m)



Source: Company, own elaboration

In terms of balance sheet, APD ended FY2025 with net debt/EBITDA of ~3.1x, up from ~0.8x in FY2021 (see Chart 31), reflecting debt-funded growth. However, the company maintains investment grade ratings (A2/A), supported by stable contracted cash flows and the use of non-recourse financing for megaprojects such as NEOM (NEOM CASE STUDY, 2023). Liquidity remains solid, with over USD 3 billion in available credit facilities (UBS, 2025).

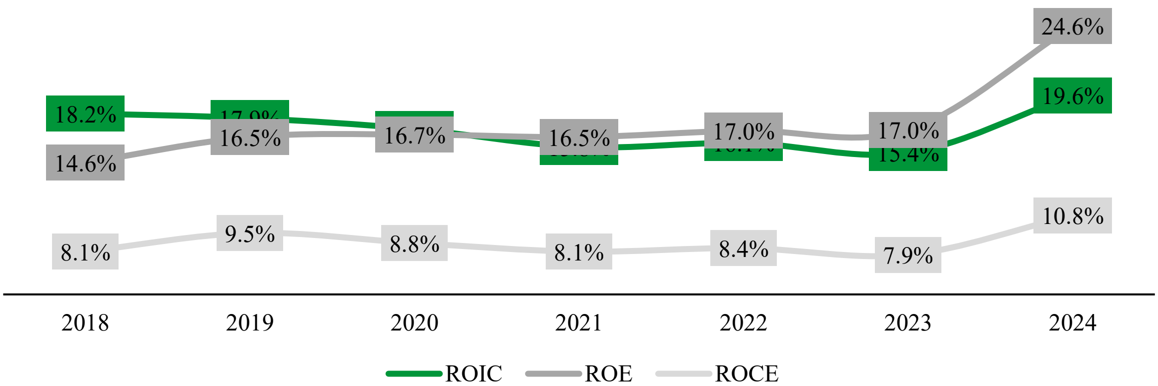
Chart 31 – Net Debt and Net Debt/EBITDA Evolution (USD m, x)



Source: Company (2024), own elaboration

Air Products has maintained solid profitability and returns over the past years, even amid elevated capital expenditures related to its major hydrogen and industrial gas projects. The company's return indicators show consistent performance and gradual improvement toward 2024, reflecting operational efficiency and disciplined capital allocation, as shown in Chart 32.

Chart 32 – Air Products ROIC, ROE and ROCE (%)



Source: Company (2024), own elaboration

Despite pressures on free cash flow, Air Products has continued its long-standing policy of dividend growth. FY2024 marked the 41st consecutive year of dividend increases, with the quarterly dividend raised to USD 1.77 per share (equivalent to USD 7.08 annualized). Dividend payout has historically ranged between 60–70% of earnings, reflecting management's emphasis on shareholder returns even during CAPEX-heavy years (CITI, 2025).

In early 2025, management reaffirmed FY2025 EPS guidance of USD 12.70–13.00, noting that results would benefit modestly (~USD 0.10/sh) from a one-off helium sale in 1Q25 (J.P. MORGAN, 2025). Sequential industrial gas pricing was described as “flat,” underscoring stable but unspectacular growth in the base business.

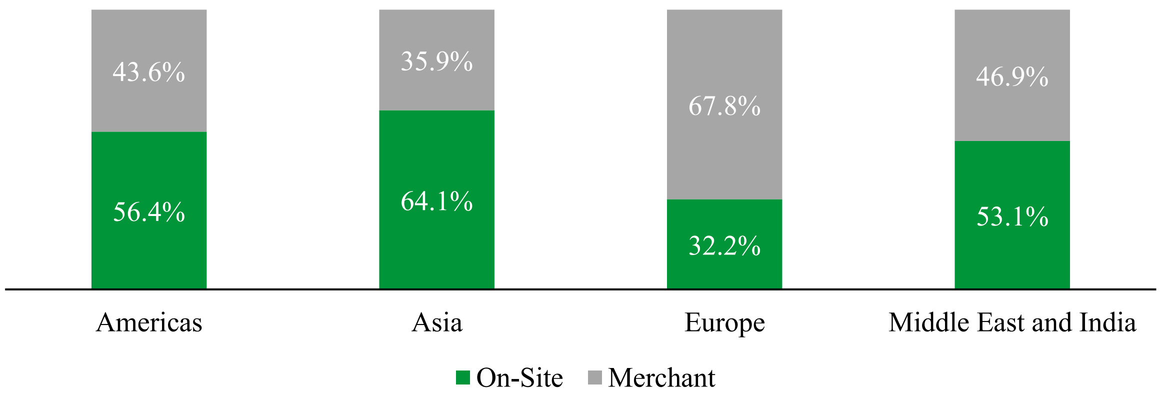
Looking ahead, the company’s financial trajectory is heavily tied to the execution of its large project pipeline. The timing, cost control, and contractual visibility of projects such as NEOM and Louisiana will be critical in shaping leverage, free cash flow, and ultimately shareholder returns over the coming years.

4.6 Competitive Advantages and Risks

Air Products’ competitive position rests on three pillars: its contractual stability, its unique exposure to hydrogen and helium, and its ability to execute complex, capital-intensive projects. These elements have historically enabled the company to deliver strong margins and defend returns, even during periods of macroeconomic weakness (UBS, 2024; J.P. MORGAN, 2024a).

First, APD benefits from a business model heavily oriented toward long-term take-or-pay contracts, which reduce volatility compared with merchant sales. These agreements, often with durations exceeding 15 years, include pass-through mechanisms for electricity and feedstock costs (see Chart 33). This ensures that margins remain stable even in periods of input price fluctuation, a feature that differentiates APD from less contract-intensive players in the sector (AIR PRODUCTS, 2024a).

Chart 33 – Air Products Revenue Breakdown by Supply Mode and Region (%)



Source: Company (2024), own elaboration

Second, APD has greater exposure to hydrogen and helium than its global peers. Hydrogen represents a core franchise, particularly in the U.S. Gulf Coast, where the company operates the world's largest hydrogen pipeline system. Helium contributes roughly 7% of sales, positioning APD as a differentiated supplier in markets such as healthcare and electronics (UBS, 2024). While helium prices are volatile, this segment provides APD with a unique competitive lever not easily replicated by peers.

Third, APD has established itself as one of the few industrial gas companies willing and able to sponsor multi-billion-dollar projects. The company's role in NEOM and Louisiana highlights its scale, engineering expertise, and ability to mobilize project financing. This differentiates APD from competitors who have been more cautious in allocating capital to greenfield ventures.

Despite these advantages, Air Products also faces material risks. Execution risk is paramount: megaprojects such as NEOM and Alberta have experienced CAPEX inflation and delays, with NEOM's budget rising from USD 5 billion to USD 8.4 billion (NEOM CASE STUDY, 2023). Cost overruns or schedule slippages could erode expected returns. Moreover, while non-recourse financing and long-term offtakes mitigate balance sheet exposure, APD still assumes significant integration and construction risk (UBS, 2025).

Additional risks stem from macroeconomic and commodity price exposure. Industrial gas volumes are correlated with global industrial production, meaning demand can soften in downturns. Sequential pricing has recently been described as "flat," indicating limited upside near-term (J.P. MORGAN, 2025). Helium prices, while a differentiator, remain highly volatile, with European import prices falling ~30% in November 2024 after a temporary spike in September (J.P. MORGAN, 2025).

Finally, governance and leadership transition present uncertainties. While investors welcomed the 2025 appointment of Eduardo Menezes as CEO and the separation of Chair and CEO roles, this transition also raises questions about potential changes in strategy. Activist investors, particularly D.E. Shaw, continue to pressure management to prioritize free cash flow discipline and reduce exposure to speculative projects (UBS, 2025).

In sum, Air Products' competitive advantages—contractual stability, unique product mix, and project execution capacity—differentiate it from peers. Yet the company's high capital intensity and execution risks make investor confidence highly contingent on disciplined governance and timely delivery of megaprojects.

5. AIR PRODUCTS VALUATION

This chapter explains how the fair value of Air Products was estimated. The primary methodology was a DCF analysis, which projected the company's free cash flows and discounted them at an appropriate WACC to arrive at a fair enterprise and equity value. To cross-check this result, a multiples approach was performed, comparing APD's P/E ratio and ROE with those of comparable industrial gas companies. The DCF served as the core valuation, while the multiples analysis provided a sanity check on market positioning.

5.1 Financial Statements

5.1.1 Balance Sheet

Table 18 presents the company's Balance Sheet for the period 2009–2025, summarizing its assets, liabilities, and shareholders' equity over time.

Table 18 – Historical Balance Sheet

Balance Sheet	[Unit]	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Assets	**[USD m]**	**13,029**	**13,506**	**14,291**	**16,942**	**17,850**	**17,779**	**17,335**	**18,055**	**18,467**	**19,178**	**18,943**	**25,169**	**26,859**	**27,193**	**32,003**	**39,575**	**41,060**
Current Assets	**[USD m]**	**2,998**	**3,034**	**3,190**	**3,416**	**3,439**	**3,295**	**2,794**	**4,317**	**5,877**	**5,082**	**4,618**	**8,685**	**8,376**	**6,283**	**5,201**	**6,363**	**5,826**
Cash & cash items	[USD m]	488	374	421	454	450	337	206	1,501	3,274	2,791	2,249	5,253	4,469	2,711	1,617	2,980	1,856
Short-term investments	[USD m]	0	0	0	0	0	0	0	0	404	185	166	1,105	1,332	591	332	5	0
Trades Receivable, net	[USD m]	1,363	1,482	1,362	1,545	1,544	1,486	1,406	1,440	1,174	1,207	1,260	1,275	1,451	1,794	1,700	1,822	1,901
Inventories	[USD m]	510	572	670	787	706	706	658	620	335	396	388	405	454	514	652	766	777
Contracts in Progress, Less Progress Billings	[USD m]	132	164	147	191	182	155	111	82	85	78	0	0	0	0	0	0	0
Prepaid expenses	[USD m]	100	70	78	82	121	88	67	100	191	130	77	165	119	157	177	180	175
Other receivables and current assets	[USD m]	405	372	269	342	432	523	344	556	403	296	478	483	551	516	722	611	690
Assets held for sale	[USD m]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	428
Current assets of discontinued operations	[USD m]	0	0	243	16	3	0	2	19	10	0	0	0	0	0	0	0	0
Non Current Assets	**[USD m]**	**10,031**	**10,472**	**11,101**	**13,526**	**14,411**	**14,484**	**14,541**	**13,738**	**12,591**	**14,096**	**14,325**	**16,484**	**18,483**	**20,910**	**26,802**	**33,212**	**35,234**
Fixed Assets, Net	[USD m]	6,860	7,051	7,223	8,241	8,974	9,532	8,745	8,853	8,440	9,924	10,338	11,965	13,255	14,161	17,472	23,371	25,338
Property Plant & Equipment at Cost	[USD m]	15,751	16,310	16,859	18,046	19,530	20,224	19,463	20,190	19,548	21,490	22,334	25,176	27,489	28,160	32,746	39,951	42,755
Less: Accumulated Depreciation	[USD m]	-8,892	-9,258	-9,636	-9,806	-10,556	-10,691	-10,718	-11,337	-11,108	-11,567	-11,996	-13,212	-14,234	-14,000	-15,274	-16,580	-17,417
Goodwill, net	[USD m]	916	915	796	1,598	1,654	1,237	1,131	1,150	722	789	797	892	912	823	862	905	964
Intangible assets, net	[USD m]	263	286	261	762	717	616	508	488	368	439	420	436	421	348	335	312	294
Investment in net assets of and advances to equity affiliates	[USD m]	868	913	1,012	1,176	1,196	1,258	1,266	1,288	1,287	1,277	1,276	1,432	1,649	3,354	4,618	4,793	5,366
Operating lease right-of-use assets, net	[USD m]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	974	1,048	944
Noncurrent lease receivables	[USD m]	687	770	1,043	1,329	1,477	1,415	1,350	1,222	1,132	1,013	890	816	740	583	495	392	307
Financing receivables	[USD m]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	817	1,220	1,000
Other noncurrent assets	[USD m]	438	537	478	394	394	426	649	737	642	655	604	943	1,507	1,642	1,230	1,172	1,021
Noncurrent assets of discontinued operations	[USD m]	0	0	289	27	0	0	892	0	0	0	0	0	0	0	0	0	0
Liabilities and Shareholders' Equity	**[USD m]**	**13,029**	**13,506**	**14,291**	**16,942**	**17,850**	**17,779**	**17,335**	**18,055**	**18,467**	**19,178**	**18,943**	**25,169**	**26,859**	**27,193**	**32,003**	**39,575**	**41,060**
Liabilities	**[USD m]**	**8,099**	**7,808**	**8,352**	**9,926**	**10,275**	**9,971**	**9,953**	**10,842**	**8,282**	**8,002**	**7,555**	**12,725**	**12,771**	**13,490**	**16,342**	**20,901**	**23,710**
Current Liabilities	**[USD m]**	**2,504**	**2,244**	**2,342**	**2,690**	**3,228**	**2,963**	**3,644**	**3,283**	**2,489**	**2,338**	**1,821**	**2,417**	**2,799**	**3,466**	**3,896**	**4,180**	**4,219**
Accounts payable and accrued liabilities	[USD m]	620	662	800	964	1,945	1,591	1,642	1,811	1,814	1,818	1,636	1,833	2,218	2,772	2,890	2,926	3,238
Accrued liabilities (legacy)	[USD m]	1,055	1,040	842	964	510	0	0	19	16	0	0	0	0	0	0	0	0
Accrued income taxes	[USD m]	43	74	66	49	63	78	56	147	99	60	87	106	94	135	131	559	179
Short-term borrowings	[USD m]	786	469	635	633	710	1,229	1,494	936	144	54	58	8	2	11	260	84	35
Current Portion of Long-Term debt	[USD m]	0	0	0	74	0	65	436	371	416	407	40	470	485	548	615	611	716
Current liabilities of discontinued operations	[USD m]	0	0	0	6	0	0	17	0	0	0	0	0	0	0	0	0	0
Revolving Credit Facility	[USD m]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Current Liabilities	**[USD m]**	**5,596**	**5,564**	**6,010**	**7,236**	**7,048**	**7,008**	**6,309**	**7,559**	**5,793**	**5,664**	**5,734**	**10,309**	**9,972**	**10,024**	**12,446**	**16,721**	**19,491**
Long Term Debt	[USD m]	3,716	3,660	3,928	4,584	5,056	4,825	3,949	4,918	3,402	2,967	2,907	7,133	6,876	6,434	9,281	13,429	16,770
Long-Term Debt - related party	[USD m]	0	0	0	0	0	0	0	0	0	384	320	297	275	652	151	104	178
Other Noncurrent Liabilities	[USD m]	1,522	1,569	1,512	1,981	1,164	1,188	1,554	1,873	1,612	1,537	1,712	1,916	1,641	1,691	1,749	2,028	1,964
Deferred Income Taxes	[USD m]	358	335	570	671	827	996	803	767	778	775	794	963	1,181	1,247	1,266	1,160	580
Noncurrent liabilities of discontinued operations	[USD m]	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Noncontrolling Interests	[USD m]	138	151	143	539	533	443	132	134	99	319	335	363	548	558	1,347	1,637	2,325
Shareholders' Equity	**[USD m]**	**4,792**	**5,547**	**5,796**	**6,477**	**7,042**	**7,366**	**7,249**	**7,080**	**10,086**	**10,858**	**11,054**	**12,080**	**13,540**	**13,144**	**14,313**	**17,037**	**15,025**
Common stock	[USD m]	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249
Additional paid in capital	[USD m]	823	802	806	811	799	842	905	970	1,001	1,020	1,060	1,095	1,116	1,141	1,191	1,253	1,253
Retained earnings	[USD m]	7,235	7,852	8,600	9,235	9,646	9,993	10,580	10,476	12,847	13,572	13,559	14,876	15,678	16,520	17,290	19,546	17,607
Unrealized gain on investment	[USD m]	-205	-66	-140	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accumulated other comprehensive income (loss)	[USD m]	11	21	0	-1,349	-1,021	-1,242	-2,126	-2,388	-1,847	-1,878	-1,781	-2,140	-1,516	-2,786	-2,449	-2,028	-2,101
Treasury stock	[USD m]	-2,353	-2,198	-2,605	-2,468	-2,632	-2,477	-2,360	-2,227	-2,164	-2,106	-2,034	-2,000	-1,988	-1,981	-1,967	-1,984	-1,984
Shares in trust	[USD m]	-967	-1,114	-1,113	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Company (2025), own elaboration

5.1.2 Income Statement

Table 19 shows the Income Statement for 2009–2024, detailing the evolution of revenues, expenses, and profitability.

Table 19 – Historical Income Statement

Income Statement - GAAP	[Unit]	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Sales	**[USD m]**	**8,256**	**9,026**	**9,674**	**9,612**	**10,180**	**10,439**	**9,895**	**7,504**	**8,188**	**8,930**	**8,919**	**8,856**	**10,323**	**12,699**	**12,600**	**12,101**	**12,037**
Growth	*[%]*	*NA*	*9.3%*	*7.2%*	*-0.6%*	*5.9%*	*2.5%*	*-5.2%*	*-24.2%*	*9.1%*	*9.1%*	*-0.1%*	*-0.7%*	*16.6%*	*23.0%*	*-0.8%*	*-4.0%*	*-0.5%*
Cost of Products Sold	[USD m]	-6,042	-6,503	-7,098	-7,052	-7,472	-7,635	-6,939	-5,177	-5,752	-6,190	-5,976	-5,858	-7,186	-9,339	-8,833	-8,169	-8,256
Gross Profit	**[USD m]**	**2,214**	**2,523**	**2,575**	**2,560**	**2,708**	**2,804**	**2,956**	**2,326**	**2,436**	**2,741**	**2,943**	**2,998**	**3,137**	**3,360**	**3,767**	**3,932**	**3,781**
Gross Margin	*[%]*	*26.8%*	*28.0%*	*26.6%*	*26.6%*	*26.6%*	*26.9%*	*29.9%*	*31.0%*	*29.8%*	*30.7%*	*33.0%*	*33.9%*	*30.4%*	*26.5%*	*29.9%*	*32.5%*	*31.4%*
Operating Expenses (SG&A)	**[USD m]**	**-1,368**	**-1,134**	**-1,067**	**-1,277**	**-1,384**	**-1,476**	**-1,248**	**-791**	**-996**	**-775**	**-799**	**-761**	**-856**	**-1,021**	**-1,272**	**534**	**-4,658**
Selling and Administrative	[USD m]	-943	-957	-942	-947	-1,066	-1,059	-939	-684	-714	-761	-750	-776	-828	-901	-957	-942	-906
Research & Development	[USD m]	-116	-115	-119	-126	-134	-141	-137	-72	-58	-65	-73	-84	-94	-103	-106	-100	-96
Other Income (Expense)	[USD m]	-308	-62	-7	-204	-184	-276	-171	-36	-225	50	24	99	66	-18	-210	1,577	-3,656
Operating Income	**[USD m]**	**846**	**1,389**	**1,508**	**1,282**	**1,324**	**1,328**	**1,708**	**1,535**	**1,440**	**1,966**	**2,144**	**2,238**	**2,281**	**2,339**	**2,495**	**4,466**	**-877**
Operating Margin	*[%]*	*10.3%*	*15.4%*	*15.6%*	*13.3%*	*13.0%*	*12.7%*	*17.3%*	*20.5%*	*17.6%*	*22.0%*	*24.0%*	*25.3%*	*22.1%*	*18.4%*	*19.8%*	*36.9%*	*-7.3%*
Equity affiliates' income	[USD m]	112	127	154	154	168	151	155	147	80	175	215	265	294	482	604	648	648
% of Net Sales	*[%]*	1.4%	1.4%	1.6%	1.6%	1.6%	1.5%	1.6%	2.0%	1.0%	2.0%	2.4%	3.0%	2.8%	3.8%	4.8%	5.4%	5.4%
EBIT	**[USD m]**	**958**	**1,516**	**1,662**	**1,436**	**1,492**	**1,480**	**1,863**	**1,682**	**1,520**	**2,140**	**2,360**	**2,502**	**2,576**	**2,820**	**3,099**	**5,114**	**-229**
EBIT Margin	*[%]*	*11.6%*	*16.8%*	*17.2%*	*14.9%*	*14.7%*	*14.2%*	*18.8%*	*22.4%*	*18.6%*	*24.0%*	*26.5%*	*28.3%*	*24.9%*	*22.2%*	*24.6%*	*42.3%*	*-1.9%*
Interest expense	[USD m]	-122	-122	-116	-124	-142	-125	-104	-115	-121	-131	-137	-109	-142	-128	-178	-219	-214
Other non-operating income (expense), net	[USD m]	0	0	0	0	0	0	0	-5	17	5	67	31	74	62	-39	-74	3
Loss on extinguishment of debt	[USD m]	0	0	0	0	0	0	-17	-7	0	0	0	0	0	0	0	0	0
		0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Income From Continuing Operations Before Taxes	**[USD m]**	**837**	**1,394**	**1,547**	**1,313**	**1,350**	**1,355**	**1,743**	**1,555**	**1,416**	**2,015**	**2,290**	**2,424**	**2,507**	**2,755**	**2,882**	**4,821**	**-441**
Income tax provision	[USD m]	-185	-340	-375	-287	-308	-369	-418	-433	-261	-524	-480	-478	-463	-501	-551	-945	94
Tax rate	[%]	22.1%	24.4%	24.3%	21.9%	22.8%	27.3%	24.0%	27.8%	18.4%	26.0%	21.0%	19.7%	18.5%	18.2%	19.1%	19.6%	21.4%
Income From Continuing Operations	**[USD m]**	**651**	**1,055**	**1,172**	**1,025**	**1,043**	**985**	**1,324**	**1,122**	**1,155**	**1,491**	**1,809**	**1,945**	**2,045**	**2,254**	**2,331**	**3,876**	**-346**
(Loss) Income from discontinued operations, net of tax	[USD m]	-9	0	90	168	-10	5	-7	-461	1,866	42	0	-14	70	13	7	-14	-8
Net Income	**[USD m]**	**643**	**1,055**	**1,262**	**1,193**	**1,033**	**990**	**1,318**	**662**	**3,021**	**1,533**	**1,809**	**1,931**	**2,115**	**2,267**	**2,339**	**3,862**	**-354**
Net Margin	*[%]*	*7.8%*	*11.7%*	*13.0%*	*12.4%*	*10.1%*	*9.5%*	*13.3%*	*8.8%*	*36.9%*	*17.2%*	*20.3%*	*21.8%*	*20.5%*	*17.8%*	*18.6%*	*31.9%*	*-2.9%*

Source: Company (2025), own elaboration

5.1.3 Cash Flow Statement

Table 20 presents the Cash Flow Statement for 2009–2024, outlining the company's cash generation and use across operating, investing, and financing activities.

Table 20 – Cash Flow Statement

Cash Flow Statement	[Unit]	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Operating Activities																		
(=) Net Income	**[USD m]**	**633**	**1,030**	**1,224**	**1,021**	**1,169**	**987**	**1,278**	**631**	**1,134**	**1,456**	**1,760**	**1,901**	**2,029**	**2,244**	**2,293**	**3,842**	**-387**
(+) Depreciation and Amortization	[USD m]	840	863	874	841	907	957	936	926	866	971	1,083	1,185	1,321	1,338	1,358	1,451	1,564
(+/-) Deferred Income Taxes	[USD m]	-52	96	186	65	13	126	3	63	-38	-55	58	165	94	32	-25	-69	-555
(-) Unremitted Earnings of Affiliates	[USD m]	-58	-51	-48	-54	-59	-76	-103	-52	-60	-52	-76	-162	-138	-215	-261	-206	-270
(+/-) Loss (Gain) on Sale of Assets	[USD m]	2	-15	-13	-94	-20	4	-30	-10	-24	-7	-24	-46	-37	-24	-16	-1,607	-134
(+/-) Other	[USD m]	7	-42	-158	-114	-184	289	135	1,090	-358	508	195	262	50	-89	281	419	3,889
(+/-) Special Charge	[USD m]		84	-108	22	100												
(+/-) Working Capital Changes:	[USD m]	-62	-443	-205	100	-208	-247	219	-20	48	-265	-25	-40	17	-116	-425	-183	-852
Accounts Receivable	[USD m]	159	-143	-104	-73	-72	-36	-30	-62	-74	-43	-69	43	-131	-475	131	-111	-36
Inventories	[USD m]	-18	-66	-102	1	75	-24	8	33	6	-64	-3	-5	-47	-94	-129	-138	-36
Accounts Payable	[USD m]	-283	-294	-32	250	-130	-235	158	57	164	-278	-42	-32	188	533	-213	-339	-224
Other	[USD m]	80	59	33	-78	-80	48	82	-48	-49	119	89	-46	7	-79	-213	405	-556
(=) Operating Cash Flow from Operating Activities	**[USD m]**	**1,309**	**1,523**	**1,753**	**1,787**	**1,717**	**2,040**	**2,438**	**2,628**	**1,568**	**2,555**	**2,970**	**3,265**	**3,335**	**3,171**	**3,206**	**3,647**	**3,257**
Investing Activities																		
(-) Capital Expenditures	[USD m]	-1,179	-1,031	-1,352	-1,521	-1,524	-1,684	-1,615	-1,056	-1,040	-1,568	-1,990	-2,509	-2,464	-2,927	-4,626	-6,797	-7,023
(-) Acquisitions	[USD m]	-33	-37	-11	-863	-225		-35	0	-8	-345	-123	0	-11	-65	0	0	-60
(-) Investments and Advances to Uncons. Affiliates	[USD m]	-25	-5	-46	-175	1	2	-4	0	-8	0	-16	-24	-76	-1,658	-912	0	-390
(+) Asset Sales	[USD m]	109	52	82	53	53	46	55	86	43	49	11		38	46	25	1,879	246
(+/-) Other	[USD m]	87	-36	115	72	-2	-1	-1	-99	3,346	216	4	-1,027	-220	747	-403	-1	58
(=) Cash Flow from Investing Activities	**[USD m]**	**-1,040**	**-1,057**	**-1,212**	**-2,435**	**-1,697**	**-1,638**	**-1,600**	**-1,069**	**2,333**	**-1,649**	**-2,113**	**-3,560**	**-2,733**	**-3,857**	**-5,916**	**-4,919**	**-7,169**
Financing Activities																		
(+) Short Term Debt, Net	[USD m]	0	0	0	0	438	149	284	-144	-799	-79	0	0	0	0	0	0	0
(+) Long Term Debt, Net	[USD m]	528	-210	223	410	490	-148	-370	475	-482	-418	-429	4,489	-284	366	2,901	4,192	3,957
(+/-) Commercial Paper, Net	[USD m]	-123	-75	234	10				0	0	0	4	-55	1	18	268	-290	-75
(+) Proceeds from Stock Options	[USD m]	70	112	196	155	264	170	121	141	68	76	68						
(-) Dividends	[USD m]	-373	-399	-457	-515	-566	-628	-678	-721	-788	-898	-994	-1,104	-1,257	-1,383	-1,497	-1,565	-1,584
(+/-) Other	[USD m]	0	-8	-31	-85	-49	-48	-303	-22	28	-42	-20	-46	119	-1	-63	278	497
(-) Repurchase of Common Stock	[USD m]	0	0	-649	-53	-462												
(=) Cash Flow from Financing Activities	**[USD m]**	**102**	**-580**	**-485**	**-78**	**115**	**-504**	**-945**	**-271**	**-1,971**	**-1,360**	**-1,371**	**3,285**	**-1,421**	**-1,001**	**1,610**	**2,615**	**2,795**
(+/-) Cash provided by discontinued operations	[USD m]									0	6	0	0	7	60	1	0	0
(+/-) Foreign Exchange	[USD m]	1	-0		-19	11	-11	-23	8	13	-34	-29	15	28	-130	7	20	-7
(=) Net Cash Flow	**[USD m]**	**371**	**-113**	**56**	**-745**	**147**	**-114**	**-130**	**1,295**	**1,943**	**-482**	**-543**	**3,004**	**-784**	**-1,758**	**-1,094**	**1,363**	**-1,124**

Source: Company (2025), own elaboration

5.2 Financial Modeling

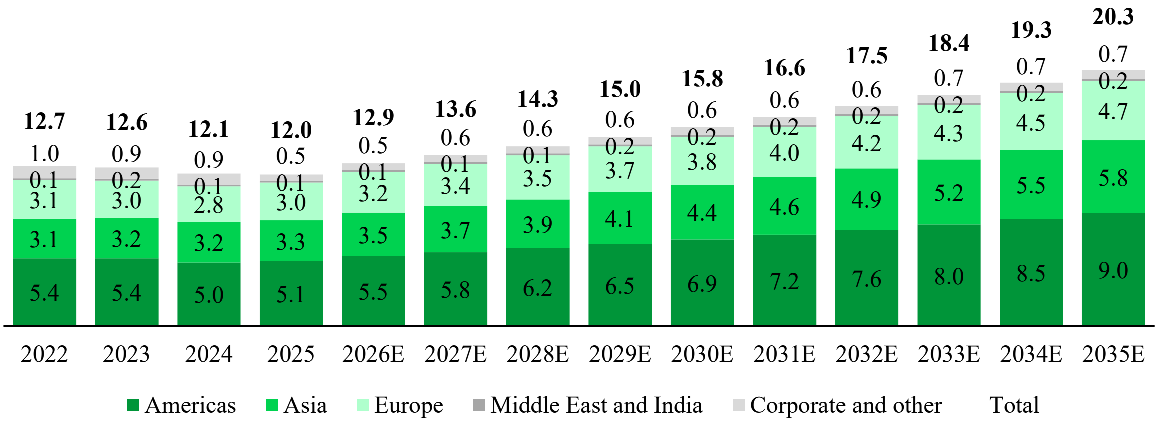
The financial model projects Air Products' future performance based on assumptions for revenues, costs, capital spending, working capital needs, and financing structure. Each sub-section summarizes the rationale behind the assumptions and indicates where a corresponding chart should display the evolution of each item over time.

5.2.1 Revenue Build Up

Revenues were projected by region (Americas, Asia, Europe, Middle East & India, Corporate and Other), in line with company disclosure. Growth in each geography was broken down into four drivers: volume, price, energy cost pass-through, and currency.

The model applies this structure consistently: volume captures demand trends and project ramp-ups, price reflects contractual adjustments, energy represents pass-through of input costs, and currency accounts for FX translation. Together, these drivers explain the yearly revenue trajectory, shown in Chart 34.

Chart 34 – Net Sales Evolution (USD bn)

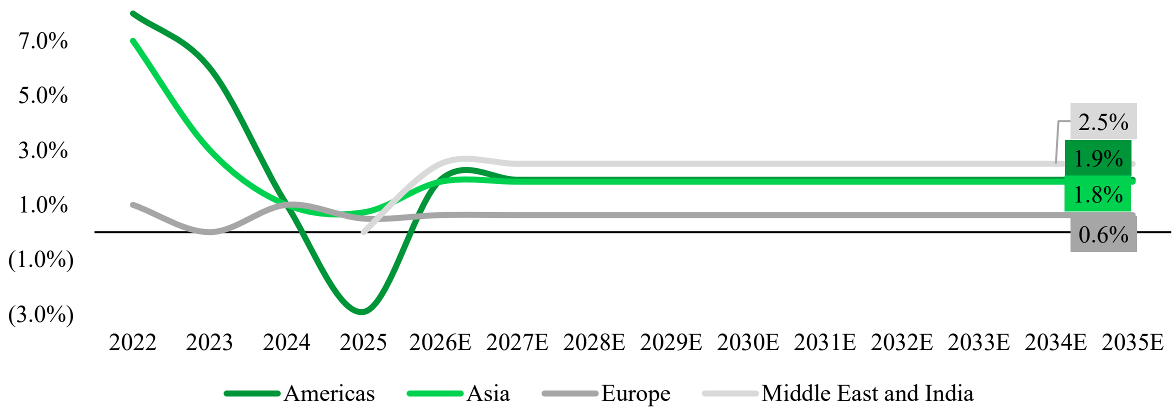


Source: Own elaboration

5.2.1.1 Volume

Volume growth (see Chart 35) was projected based on historical averages by region, reflecting the company's consistent demand trends across its core industrial gas segments. This approach captures the structural stability of Air Products' on-site and merchant contracts, which tend to evolve in line with industrial output and economic activity in each geography.

Chart 35 – Volume Evolution (%)

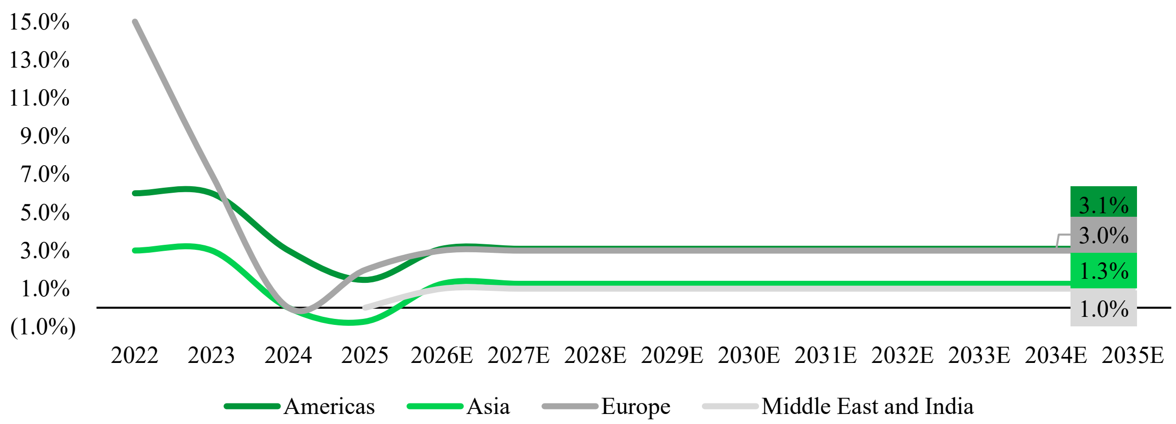


Source: Own elaboration

5.2.1.2 Price

Price growth (see Chart 36) was projected using historical regional averages, consistent with the company's long-term pricing dynamics. This reflects Air Products' ability to pass through inflation and energy cost variations to customers, while maintaining stable contractual frameworks in its on-site and merchant businesses.

Chart 36 – Price Evolution (%)

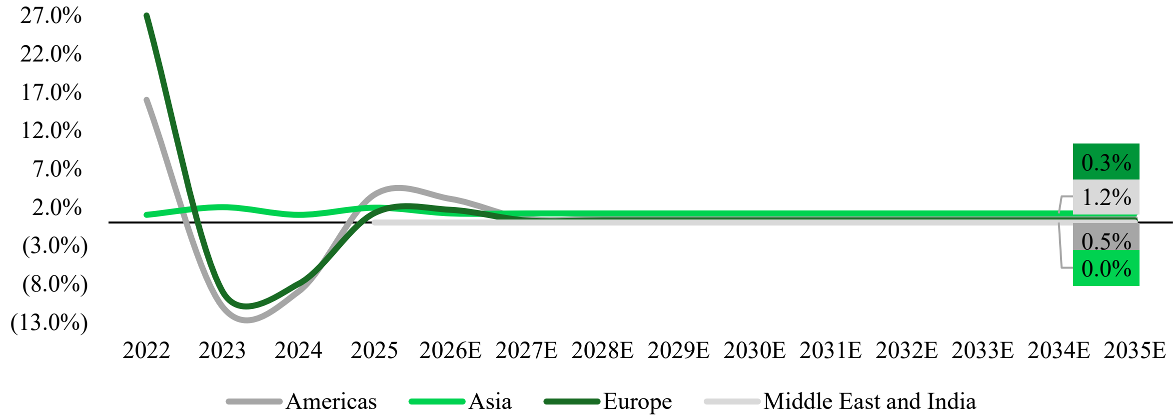


Source: Own elaboration

5.2.1.3 Energy cost pass-through to customers

Energy cost pass-through (see Chart 37) was projected using historical correlations between natural gas benchmarks and Air Products' reported pass-through rates. For the Americas, the Henry Hub Natural Gas price was used as the reference, while for Europe, the TTF (Title Transfer Facility) benchmark was applied. A historical factor relating these indices to the company's pass-through levels was calculated and used to project future energy cost adjustments across regions.

Chart 37 – Energy cost pass-through to customers Evolution (%)



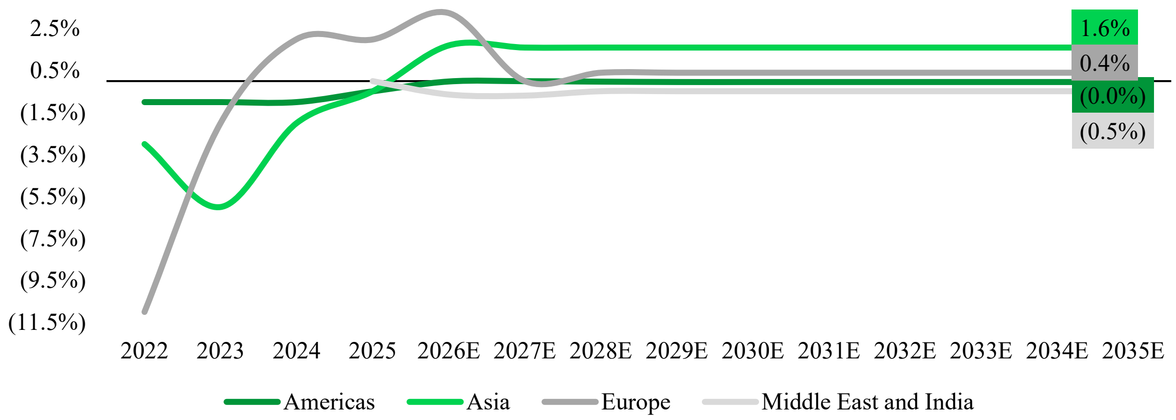
Source: Own elaboration

5.2.1.4 Currency

Exchange rate effects (see Chart 38) were projected using FX and inflation forecasts, applying the inflation differential method to derive currency movements against the U.S. dollar.

For the Americas, the currencies modeled were USD – U.S. Dollar (United States), CAD – Canadian Dollar (Canada), BRL – Brazilian Real (Brazil), and MXN – Mexican Peso (Mexico). For Asia, the model included CNY – Chinese Yuan (China). For Europe, EUR – Euro (Eurozone) was applied. For Middle East & India, the currencies used were INR – Indian Rupee (India) and SAR – Saudi Riyal (Saudi Arabia).

Chart 38 – Currency Evolution (%)

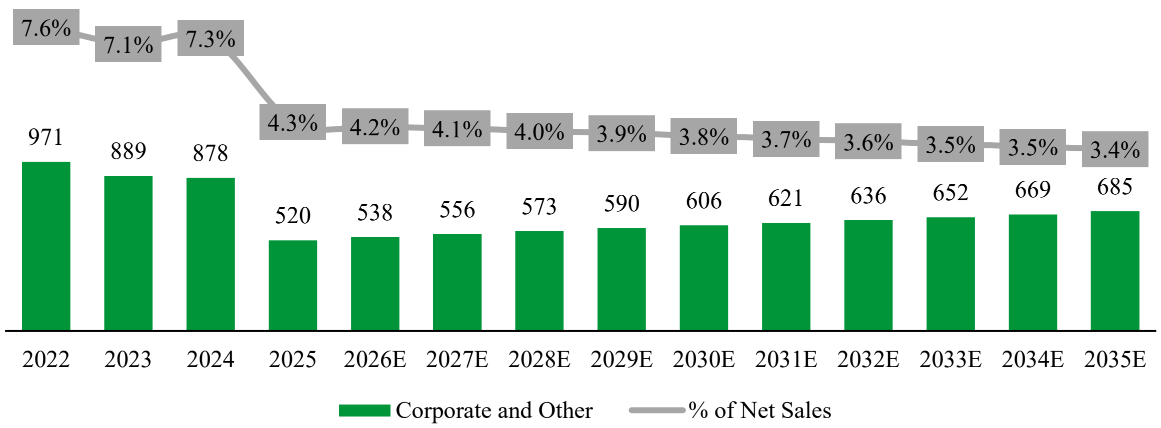


Source: Own elaboration

5.2.1.5 Corporate and other

The Corporate and Other segment (see Chart 39) was projected using a growth rate that starts at 3.5% and gradually declines over the forecast horizon.

Chart 39 – Corporate and Other Evolution (USD m)



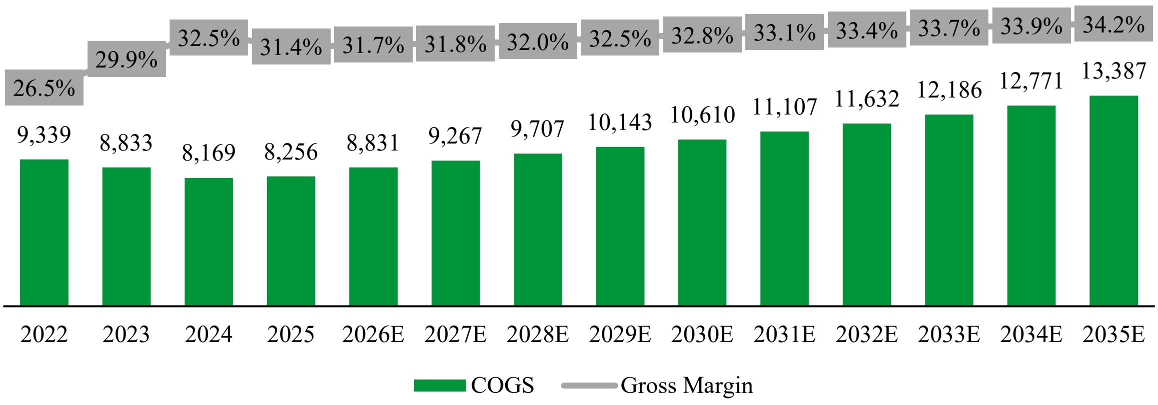
Source: Own elaboration

5.2.2 COGS

The company does not disclose a detailed breakdown of costs. For modeling purposes, total costs were split into ex-D&A costs and D&A, with the latter allocated based on the historical ratio of COGS/(COGS+SG&A), which suggests that ~85% of total D&A relates to costs.

Ex-D&A costs were then projected to grow at around 5.5% per year, consistent with revenue dynamics, inflation, and pass-through mechanisms. COGS evolution is shown in Chart 40.

Chart 40 – COGS Evolution (USD m)



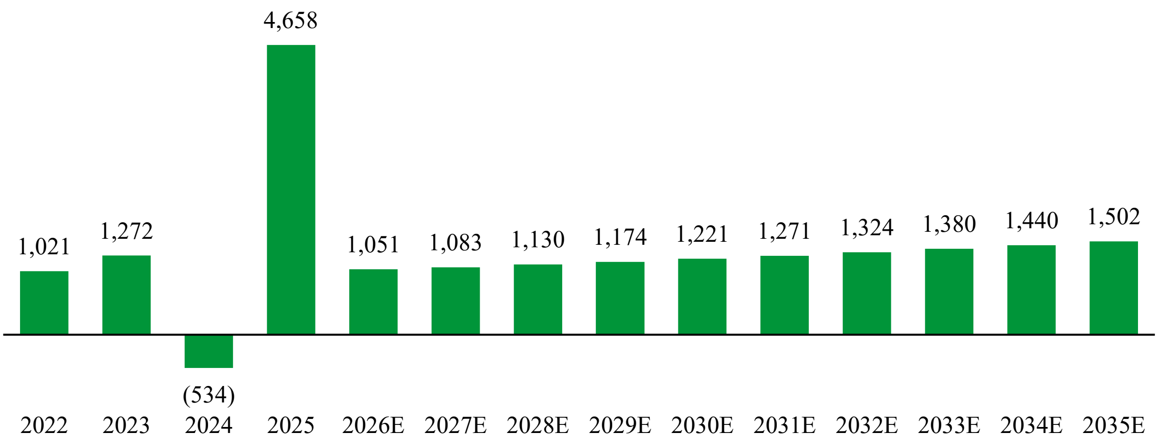
Source: Own elaboration

5.2.3 SG&A

The company discloses SG&A broken into Selling and Administrative (S&A), Research and Development (R&D), and Other Income (Expense). Since Other Income (Expense) is unpredictable, it was projected as zero.

Within the remaining SG&A, S&A represents ~80% and R&D ~20%. The 15% share of D&A allocated to SG&A was distributed proportionally between these two categories. This results in S&A ex-D&A projected at ~5.4% of net sales and R&D ex-D&A projected at ~0.6% of net sales. SG&A evolution is shown in Chart 41.

Chart 41 – SG&A Evolution (USD m)

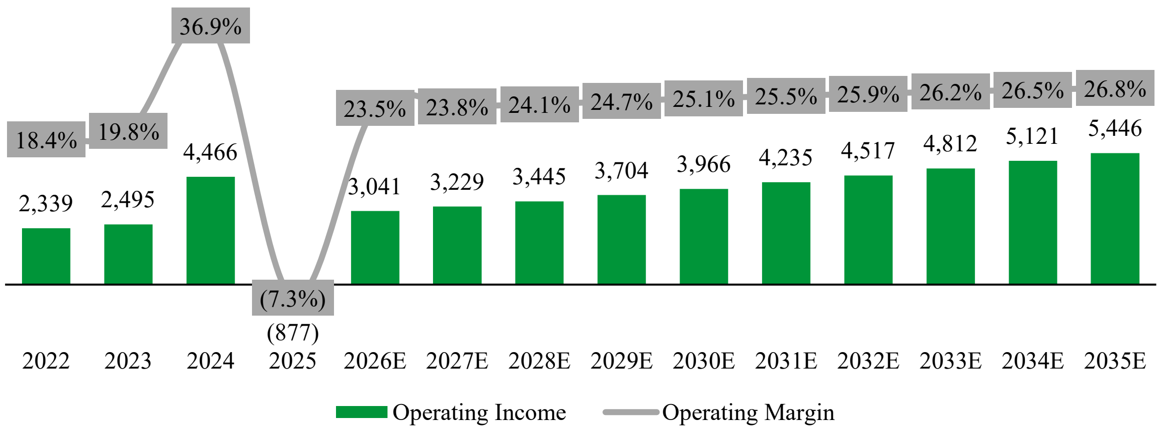


Source: Own elaboration

5.2.4 Resulting Operating Income

Operating income was obtained by summing net sales and subtracting COGS and SG&A (see Chart 42). This measure reflects the company's core profitability before accounting for equity affiliates, financial result, and taxes.

Chart 42 – Operating Income Evolution (USD m)



Source: Own elaboration

5.2.5 Equity affiliates' income

Equity affiliates' income represents the results from Air Products' subsidiaries and joint ventures, referred to as equity affiliates. As of September 30, 2024, the main affiliates and ownership stakes were as follows:

- Abdullah Hashim Industrial Gases & Equipment Co., Ltd. (25%);
- Air Products South Africa (Proprietary) Limited (50%);
- Bangkok Cogeneration Company Limited (49%);
- Bangkok Industrial Gases Co., Ltd. (49%);
- Chengdu Air & Gas Products Ltd. (50%);
- Helios S.p.A. (49%);
- INFRA Group (40%);
- INOX Air Products Private Limited (50%);
- Jazan Integrated Gasification and Power Company (51%);
- Kulim Industrial Gases Sdn. Bhd. (50%);

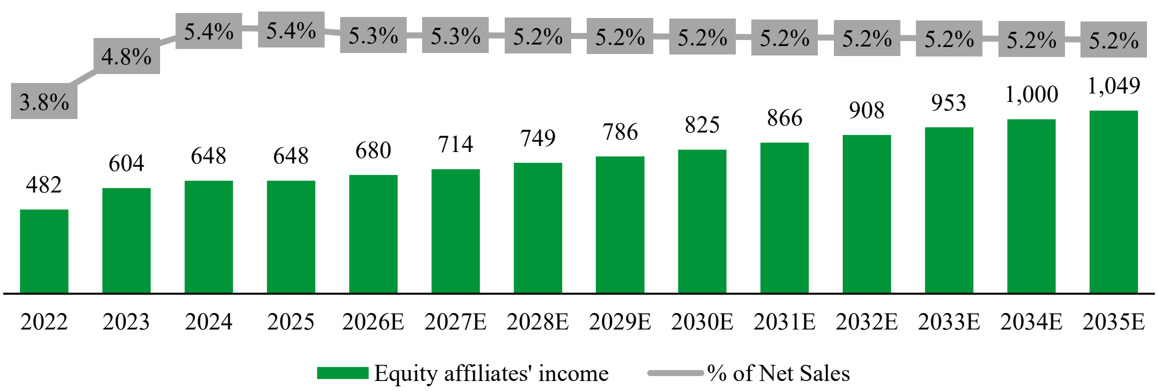
- Sapio Produzione Idrogeno Ossigeno S.r.l. (49%);
- Other industrial gas producers.

The company discloses only the main lines of equity affiliates' performance: net sales, gross profit, operating income, and net income, in addition to a regional split that was not used in this model.

For projections, revenues of equity affiliates were assumed to grow at 4% per year, with a gradual slowdown in the growth rate over time. Margins were also modeled with modest improvements: incremental gains in gross margin, operating margin, and net margin.

To consolidate into the income statement, the equivalent APD share ratio was calculated: the division of reported equity affiliates' income in APD's consolidated statements by the affiliates' income on a 100% combined basis. This ratio was applied each year to derive the projected equity affiliates' income (Chart 43) to be included in the consolidated income statement.

Chart 43 – Equity affiliates' income Evolution (USD m)

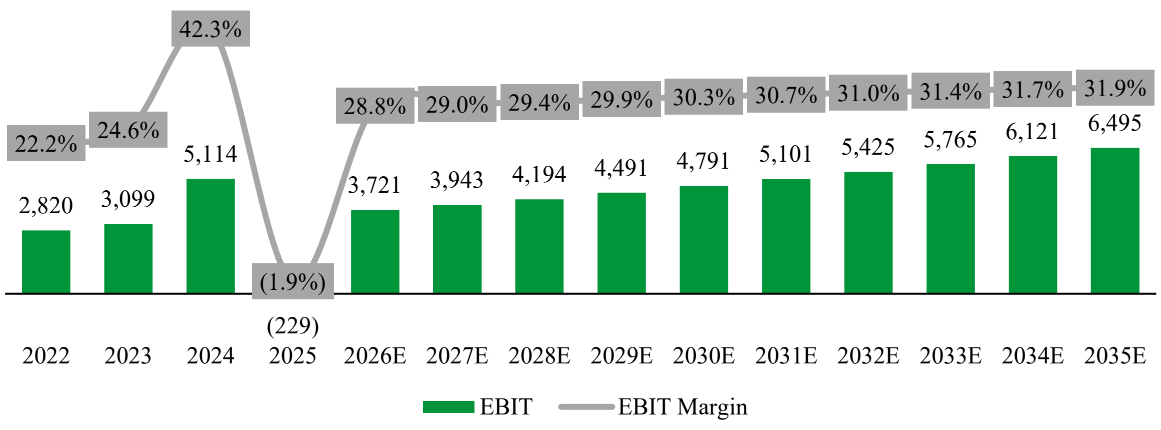


Source: Own elaboration

5.2.6 Resulting EBIT

EBIT was obtained by adding equity affiliates' income to operating income, resulting in the company's consolidated operating profit before financial result and taxes. See Chart 44.

Chart 44 – EBIT Evolution (USD m)



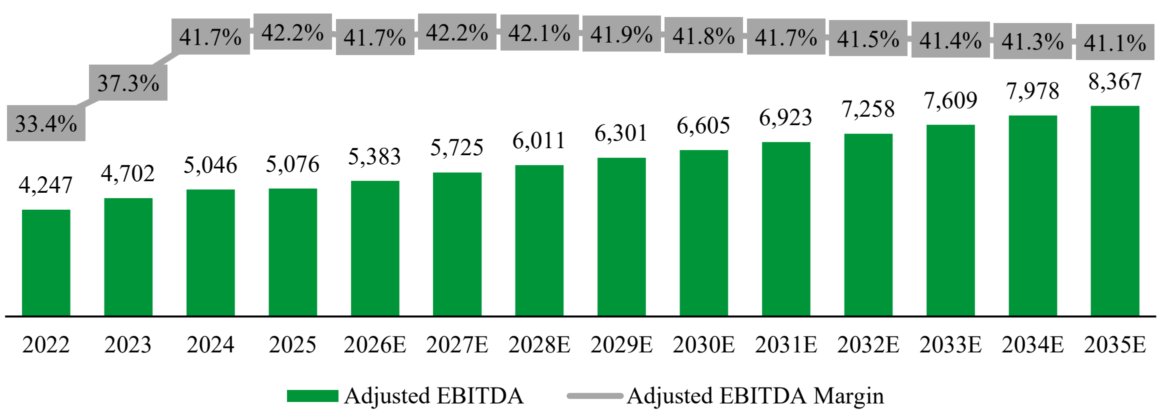
Source: Own elaboration

5.2.7 Resulting EBITDA

Air Products reports adjusted EBITDA as its primary profitability metric. According to the company: "We define adjusted EBITDA as net income less income (loss) from discontinued operations, net of tax, and excluding certain items that we do not believe are indicative of underlying business trends, before interest expense, other non-operating income (expense), net, income tax provision, and depreciation and amortization expense."

Historically, adjustments vary by year, reflecting their non-recurring nature and lack of connection to the core business. Going forward, no additional adjustments were projected, resulting in EBITDA and adjusted EBITDA (see Chart 45) converging in the forecast period.

Chart 45 – Adjusted EBITDA Evolution (USD m)

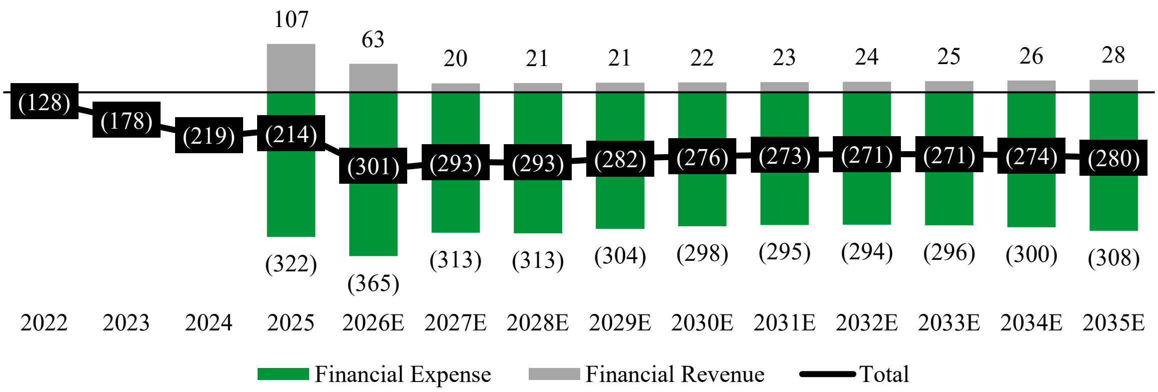


Source: Own elaboration

5.2.8 Financial Result

The financial result was projected by separating financial expenses and financial revenues. Financial expenses were modeled as the Fed Funds rate plus a spread, reflecting the company's cost of capital. Financial revenues were assumed to earn the Fed Funds rate on available cash balances. This breakdown can be seen in Chart 46.

Chart 46 – Financial Result Evolution (USD m)

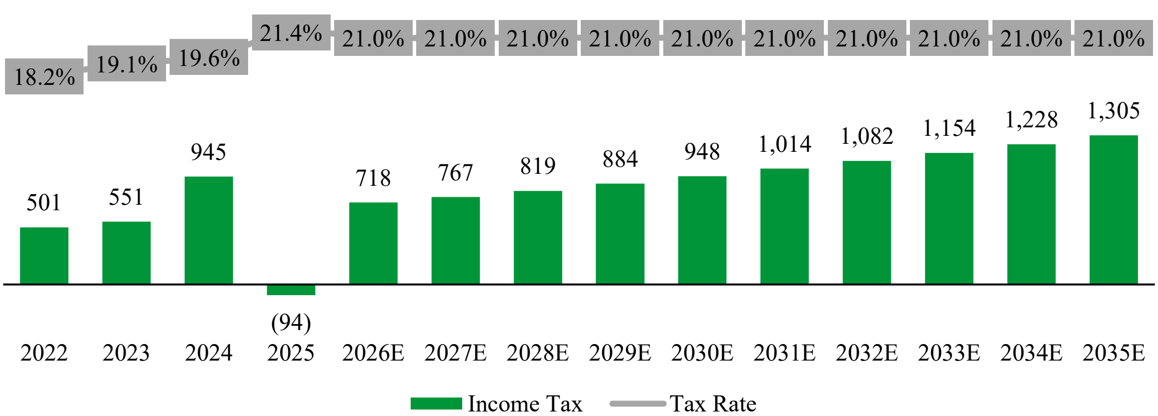


Source: Own elaboration

5.2.9 Taxes

Although historical effective tax rates have varied, projections assumed a 21% U.S. federal corporate tax rate (see Chart 47), consistent with the statutory rate for corporations in the United States. No tax benefits or incentives were incorporated in the model.

Chart 47 – Taxes Evolution (USD m)

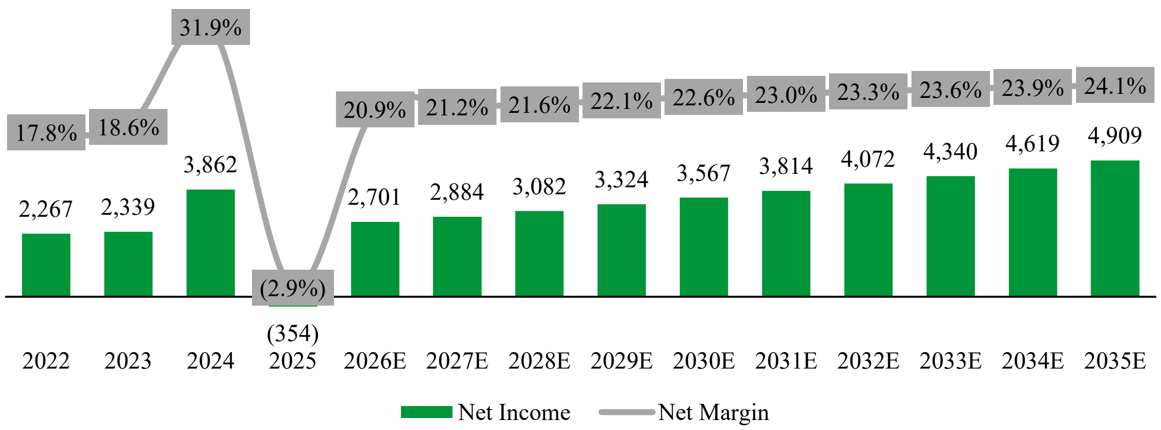


Source: Own elaboration

5.2.10 Resulting Net Income

Net income was obtained by adding EBIT and then subtracting interest expense and taxes, yielding the company's consolidated bottom line (see Chart 48).

Chart 48 – Net Income Evolution (USD m)



Source: Own elaboration

5.2.11 Working Capital

Working capital was calculated as:

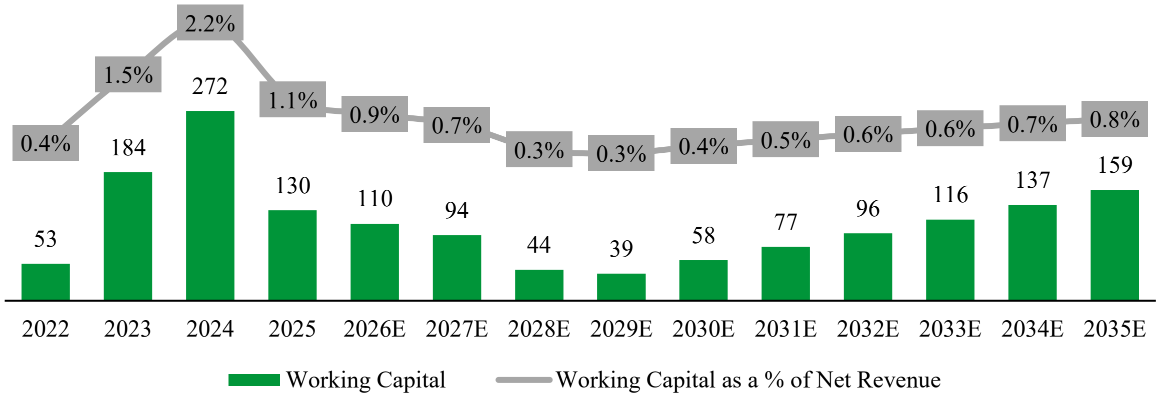
Equation 12 – Working Capital Calculation

$$\textit{Trade Receivables} + \textit{Inventories} + \textit{Other Receivables and Current Assets} - \textit{Payables}$$

Source: Own elaboration

Days receivables, days inventories, and days payables were computed and assumed to remain in line with current levels. This resulted in a cash conversion cycle of -35 days, with working capital representing 0.9% of net sales initially and decreasing to 0.8% over the forecast period, as shown in Chart 49

Chart 49 – Working Capital Evolution (USD m)

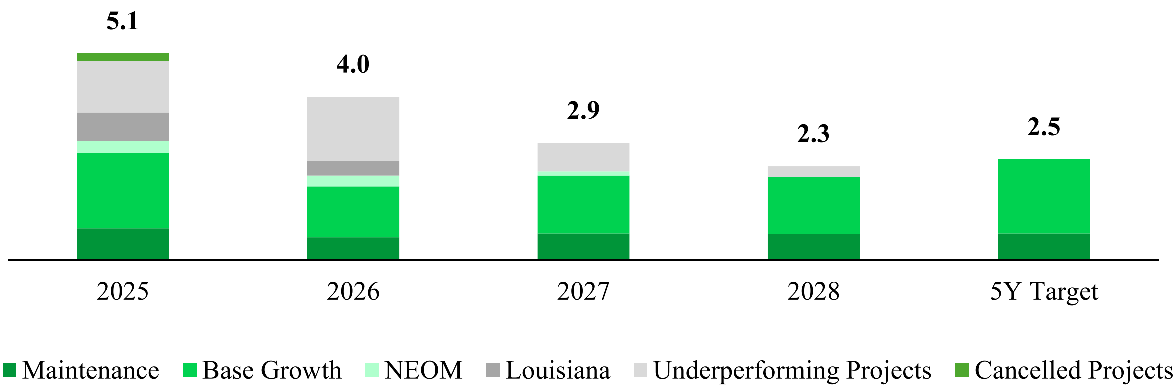


Source: Own elaboration

5.2.12 CAPEX

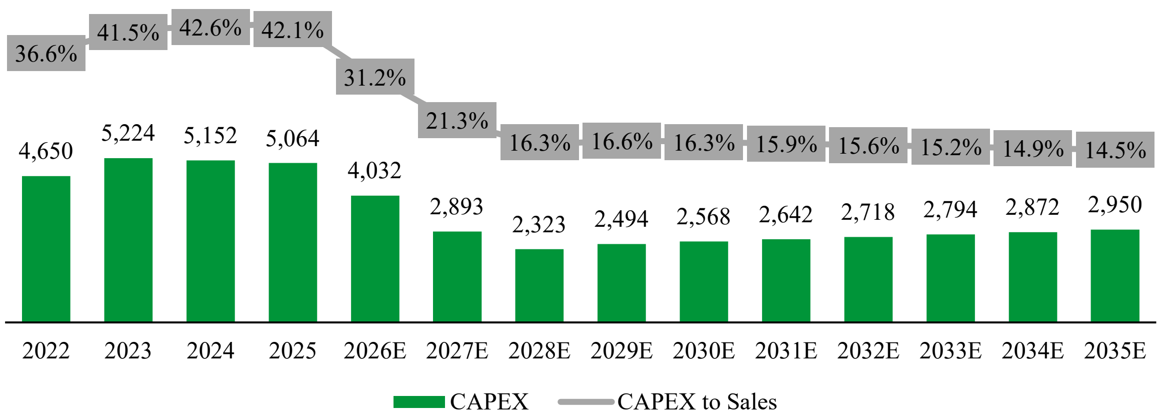
Capital expenditures were projected in line with company guidance (see Chart 50), distributed across maintenance, base growth, NEOM, Louisiana, underperforming projects, and cancelled projects. All such expenditures were allocated to PP&E, which after 2029 was modeled as a percentage of net sales based on historical averages, while 0.1% of net sales was assumed for intangibles, consistent with historical levels. Projections are shown in Chart 51.

Chart 50 – CAPEX Guidance (USD bn)



Source: Own elaboration

Chart 51 – CAPEX Evolution (USD m)

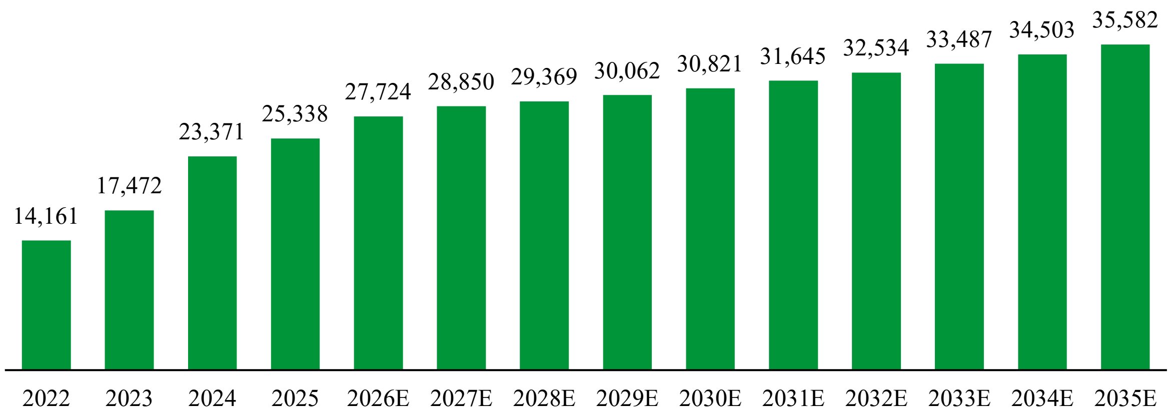


Source: Own elaboration

5.2.13 Property, Plant and Equipment (PP&E)

Depreciation was modeled as a percentage of PP&E, declining from 6.4% at the beginning of the forecast to 5.4% by 2035. CAPEX assumptions were discussed above, with significantly higher levels in the early years due to the large hydrogen projects. The year-end PP&E balance was calculated as the opening balance plus capex minus depreciation (see Chart 52).

Chart 52 – PP&E Evolution (USD m)

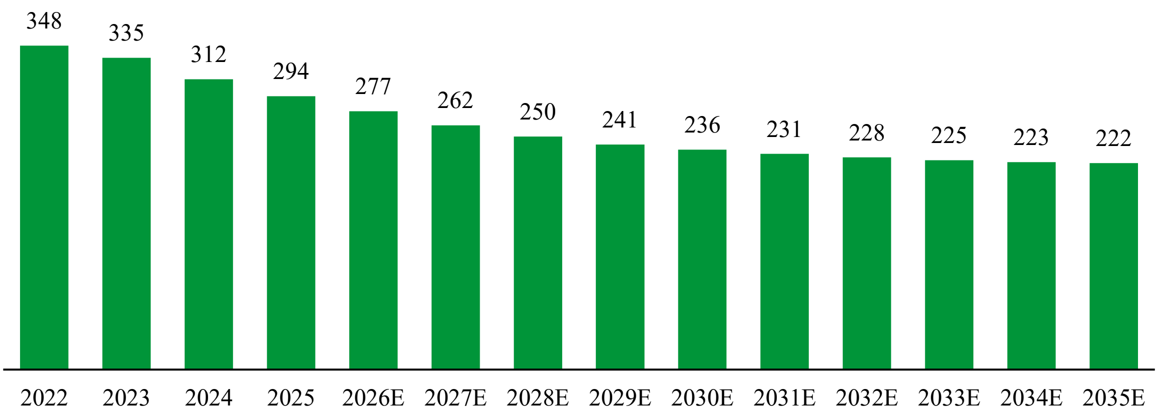


Source: Own elaboration

5.2.14 Intangibles

Amortization was projected according to the schedule provided by the company (see Chart 53). The year-end intangible asset balance was calculated as the opening balance plus CAPEX allocated to intangibles minus amortization.

Chart 53 – Intangibles Evolution (USD m)



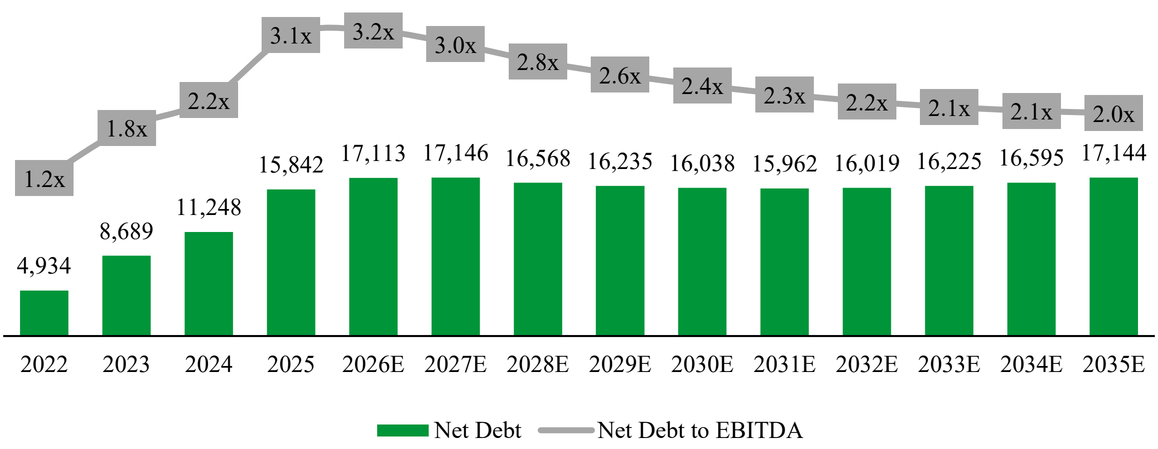
Source: Own elaboration

5.2.15 Debt

Debt was modeled as the sum of short-term borrowings, current portion of long-term debt, long-term debt, and long-term debt – related party. Scheduled repayments were incorporated based on the company's maturity profile, with a table prepared to show yearly amortizations.

New debt issuances were assumed at the same cost of capital as existing borrowings, with a small portion raised as short-term borrowings and repaid the following year. In addition, a revolving credit facility (RCF) was introduced to ensure a minimum cash balance of 5% of net sales, gradually declining to 4.6% by 2035. For clarity, this RCF line was included in the model as a separate item under non-current liabilities, making it the only departure from the company's reported balance sheet presentation. The Debt evolution is shown in Chart 54

Chart 54 – Debt Evolution (USD m)



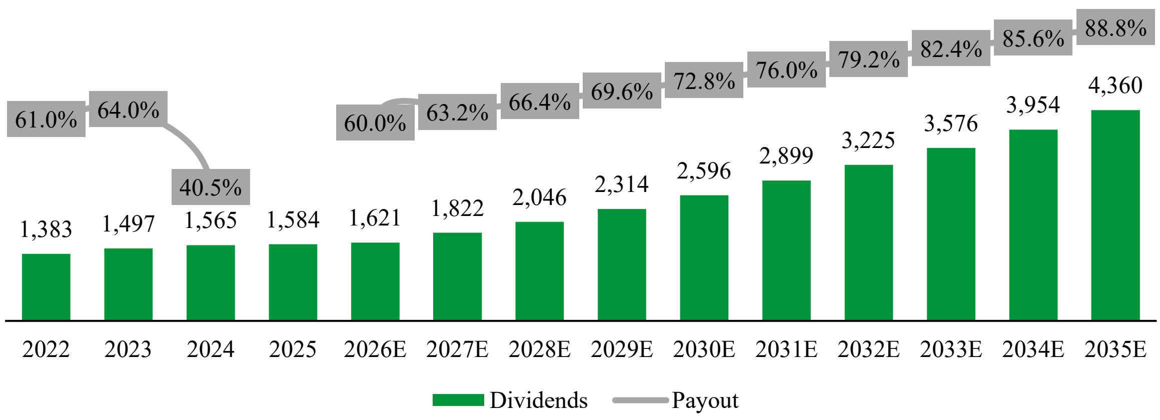
Source: Own elaboration

5.2.16 Dividends

The company has increased its dividend for 41 consecutive years, making dividend growth a core long-term objective.

Therefore, the model assumes a payout policy that supports continuing dividend increases, even during near-term profit volatility. The projected payout ratio begins at 60 % and grows to 88.8% through the remainder of the forecast period.

Chart 55 – Dividend Evolution (USD m)

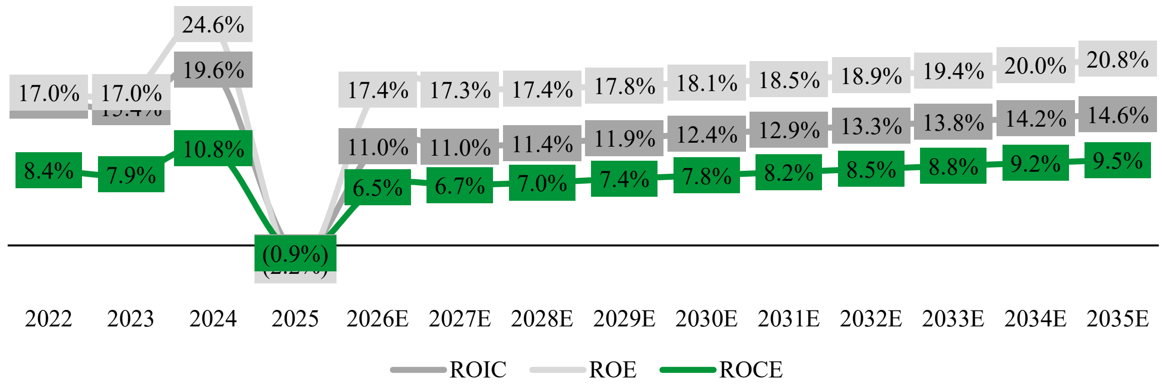


Source: Own elaboration

5.2.17 Resulted Profitability

As shown in Chart 56, the projected financial performance converges to a stable profile from 2026 onwards, with ROIC, ROE, and ROCE gradually normalizing after the temporary decline in 2025. The projections incorporate the company's expected capacity additions, margin recovery, and incremental returns from ongoing projects, resulting in a steady upward trajectory of all three return metrics over the forecast horizon.

Chart 56 – ROIC, ROE and ROCE Evolution (%)



Source: Own elaboration

5.2.18 Projected Statements

Tables 21, 22, and 23 present the projected Balance Sheet, Income Statement, and Cash Flow Statement for the period up to 2035, providing the forward-looking financial foundation used in the valuation analysis.

Table 21 – Projected Income Statement

Income Statement - GAAP	[Unit]	2025	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E	2035E
Net Sales	**[USD m]**	**12,037**	**12,923**	**13,579**	**14,282**	**15,021**	**15,797**	**16,613**	**17,473**	**18,378**	**19,331**	**20,335**
Growth	*[%]*	*-0.5%*	*7.4%*	*5.1%*	*5.2%*	*5.2%*	*5.2%*	*5.2%*	*5.2%*	*5.2%*	*5.2%*	*5.2%*
Cost of Products Sold	[USD m]	-8,256	-8,831	-9,267	-9,707	-10,143	-10,610	-11,107	-11,632	-12,186	-12,771	-13,387
Gross Profit	**[USD m]**	**3,781**	**4,092**	**4,312**	**4,575**	**4,878**	**5,187**	**5,506**	**5,841**	**6,192**	**6,561**	**6,948**
Gross Margin	*[%]*	*31.4%*	*31.7%*	*31.8%*	*32.0%*	*32.5%*	*32.8%*	*33.1%*	*33.4%*	*33.7%*	*33.9%*	*34.2%*
Operating Expenses (SG&A)	**[USD m]**	**-4,658**	**-1,051**	**-1,083**	**-1,130**	**-1,174**	**-1,221**	**-1,271**	**-1,324**	**-1,380**	**-1,440**	**-1,502**
Selling and Administrative	[USD m]	-906	-948	-974	-1,016	-1,056	-1,098	-1,143	-1,191	-1,241	-1,295	-1,351
Research & Development	[USD m]	-96	-103	-109	-114	-118	-123	-128	-133	-139	-145	-151
Other Income (Expense)	[USD m]	-3,656	0	0	0	0	0	0	0	0	0	0
Operating Income	**[USD m]**	**-877**	**3,041**	**3,229**	**3,445**	**3,704**	**3,966**	**4,235**	**4,517**	**4,812**	**5,121**	**5,446**
Operating Margin	*[%]*	*-7.3%*	*23.5%*	*23.8%*	*24.1%*	*24.7%*	*25.1%*	*25.5%*	*25.9%*	*26.2%*	*26.5%*	*26.8%*
Equity affiliates' income	[USD m]	648	680	714	749	786	825	866	908	953	1,000	1,049
% of Net Sales	*[%]*	5.4%	5.3%	5.3%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%
EBIT	**[USD m]**	**-229**	**3,721**	**3,943**	**4,194**	**4,491**	**4,791**	**5,101**	**5,425**	**5,765**	**6,121**	**6,495**
EBIT Margin	*[%]*	*-1.9%*	*28.8%*	*29.0%*	*29.4%*	*29.9%*	*30.3%*	*30.7%*	*31.0%*	*31.4%*	*31.7%*	*31.9%*
Interest expense	[USD m]	-214	-301	-293	-293	-282	-276	-273	-271	-271	-274	-280
Other non-operating income (expense), net	[USD m]	3	0	0	0	0	0	0	0	0	0	0
Loss on extinguishment of debt	[USD m]	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0
Income From Continuing Operations Before Taxes	**[USD m]**	**-441**	**3,419**	**3,650**	**3,901**	**4,208**	**4,515**	**4,828**	**5,154**	**5,493**	**5,846**	**6,214**
Income tax provision	[USD m]	94	-718	-767	-819	-884	-948	-1,014	-1,082	-1,154	-1,228	-1,305
Tax rate	[%]	21.4%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%
Income From Continuing Operations	**[USD m]**	**-346**	**2,701**	**2,884**	**3,082**	**3,324**	**3,567**	**3,814**	**4,072**	**4,340**	**4,619**	**4,909**
(Loss) Income from discontinued operations, net of tax	[USD m]	-8	0	0	0	0	0	0	0	0	0	0
Net Income	**[USD m]**	**-354**	**2,701**	**2,884**	**3,082**	**3,324**	**3,567**	**3,814**	**4,072**	**4,340**	**4,619**	**4,909**
Net Margin	*[%]*	*-2.9%*	*20.9%*	*21.2%*	*21.6%*	*22.1%*	*22.6%*	*23.0%*	*23.3%*	*23.6%*	*23.9%*	*24.1%*

Source: Own elaboration

Table 22 – Projected Balance Sheet

Balance Sheet	[Unit]	2025	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E	2035E
Assets	**[USD m]**	**41,060**	**42,426**	**43,711**	**44,361**	**45,230**	**46,207**	**47,279**	**48,429**	**49,657**	**50,965**	**52,352**
Current Assets	**[USD m]**	**5,826**	**4,822**	**4,996**	**5,139**	**5,325**	**5,548**	**5,800**	**6,064**	**6,343**	**6,637**	**6,947**
Cash & cash items	[USD m]	1,856	646	665	686	706	727	764	804	845	889	935
Short-term investments	[USD m]	0	0	0	0	0	0	0	0	0	0	0
Trades Receivable, net	[USD m]	1,901	2,010	2,074	2,142	2,253	2,370	2,492	2,621	2,757	2,900	3,050
Inventories	[USD m]	777	809	824	836	845	884	926	969	1,015	1,064	1,116
Contracts in Progress, Less Progress Billings	[USD m]	0	0	0	0	0	0	0	0	0	0	0
Prepaid expenses	[USD m]	175	175	175	175	175	175	175	175	175	175	175
Other receivables and current assets	[USD m]	690	754	830	873	918	965	1,015	1,068	1,123	1,181	1,243
Assets held for sale	[USD m]	428	428	428	428	428	428	428	428	428	428	428
Current assets of discontinued operations	[USD m]	0	0	0	0	0	0	0	0	0	0	0
Non Current Assets	**[USD m]**	**35,234**	**37,604**	**38,715**	**39,222**	**39,905**	**40,659**	**41,479**	**42,364**	**43,314**	**44,328**	**45,405**
Fixed Assets, Net	[USD m]	25,338	27,724	28,850	29,369	30,062	30,821	31,645	32,534	33,487	34,503	35,582
Property Plant & Equipment at Cost	[USD m]	42,755	0	0	0	0	0	0	0	0	0	0
Less: Accumulated Depreciation	[USD m]	-17,417	0	0	0	0	0	0	0	0	0	0
Goodwill, net	[USD m]	964	964	964	964	964	964	964	964	964	964	964
Intangible assets, net	[USD m]	294	277	262	250	241	236	231	228	225	223	222
Investment in net assets of and advances to equity affiliates	[USD m]	5,366	5,366	5,366	5,366	5,366	5,366	5,366	5,366	5,366	5,366	5,366
Operating lease right-of-use assets, net	[USD m]	944	944	944	944	944	944	944	944	944	944	944
Noncurrent lease receivables	[USD m]	307	307	307	307	307	307	307	307	307	307	307
Financing receivables	[USD m]	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Other noncurrent assets	[USD m]	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021
Noncurrent assets of discontinued operations	[USD m]	0	0	0	0	0	0	0	0	0	0	0
Liabilities and Shareholders' Equity	**[USD m]**	**41,060**	**42,426**	**43,711**	**44,361**	**45,230**	**46,207**	**47,279**	**48,429**	**49,657**	**50,965**	**52,352**
Liabilities	**[USD m]**	**23,710**	**23,996**	**24,219**	**23,834**	**23,692**	**23,700**	**23,855**	**24,158**	**24,623**	**25,266**	**26,103**
Current Liabilities	**[USD m]**	**4,219**	**4,505**	**6,020**	**6,286**	**6,894**	**8,032**	**8,788**	**9,647**	**10,737**	**12,529**	**13,367**
Accounts payable and accrued liabilities	[USD m]	3,238	3,463	3,634	3,807	3,978	4,161	4,356	4,562	4,779	5,008	5,250
Accrued liabilities (legacy)	[USD m]	0	0	0	0	0	0	0	0	0	0	0
Accrued income taxes	[USD m]	179	179	179	179	179	179	179	179	179	179	179
Short-term borrowings	[USD m]	35	75	75	75	75	75	75	75	75	75	75
Current Portion of Long-Term debt	[USD m]	716	-262	-262	-262	-262	-262	-262	-262	-262	-262	-262
Current liabilities of discontinued operations	[USD m]	0	0	0	0	0	0	0	0	0	0	0
Revolving Credit Facility	[USD m]	0	999	2,343	2,437	2,875	3,829	4,389	5,043	5,916	7,479	8,074
Non Current Liabilities	**[USD m]**	**19,491**	**19,491**	**18,199**	**17,548**	**16,798**	**15,668**	**15,068**	**14,511**	**13,886**	**12,736**	**12,736**
Long Term Debt	[USD m]	16,770	16,770	15,478	14,827	14,077	12,947	12,347	11,790	11,165	10,015	10,015
Long-Term Debt - related party	[USD m]	178	178	178	178	178	178	178	178	178	178	178
Other Noncurrent Liabilities	[USD m]	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964
Deferred Income Taxes	[USD m]	580	580	580	580	580	580	580	580	580	580	580
Noncurrent liabilities of discontinued operations	[USD m]	0	0	0	0	0	0	0	0	0	0	0
Noncontrolling Interests	[USD m]	2,325	2,325	2,325	2,325	2,325	2,325	2,325	2,325	2,325	2,325	2,325
Shareholders' Equity	**[USD m]**	**15,025**	**16,105**	**17,167**	**18,202**	**19,213**	**20,183**	**21,098**	**21,945**	**22,709**	**23,374**	**23,924**
Common stock	[USD m]	249	249	249	249	249	249	249	249	249	249	249
Additional paid in capital	[USD m]	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253
Retained earnings	[USD m]	17,607	18,688	19,749	20,785	21,795	22,765	23,681	24,528	25,291	25,957	26,506
Unrealized gain on investment	[USD m]	0	0	0	0	0	0	0	0	0	0	0
Accumulated other comprehensive income (loss)	[USD m]	-2,101	-2,101	-2,101	-2,101	-2,101	-2,101	-2,101	-2,101	-2,101	-2,101	-2,101
Treasury stock	[USD m]	-1,984	-1,984	-1,984	-1,984	-1,984	-1,984	-1,984	-1,984	-1,984	-1,984	-1,984
Shares in trust	[USD m]	0	0	0	0	0	0	0	0	0	0	0

Source: Own elaboration

Table 23 – Projected Cash Flow Statement

Cash Flow Statement	[Unit]	2025	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E	2035E
(=) Net Income	**[USD m]**		**2,701**	**2,884**	**3,082**	**3,324**	**3,567**	**3,814**	**4,072**	**4,340**	**4,619**	**4,909**
(+) D&A	[USD m]		1,662	1,782	1,816	1,810	1,814	1,822	1,833	1,844	1,858	1,872
(+/-) Change in Working Capital	[USD m]		19	17	50	6	-19	-19	-19	-20	-21	-22
(=) CFO	**[USD m]**		**4,382**	**4,682**	**4,948**	**5,141**	**5,361**	**5,618**	**5,885**	**6,164**	**6,456**	**6,760**
(-) CAPEX	[USD m]		-4,032	-2,893	-2,323	-2,494	-2,568	-2,642	-2,718	-2,794	-2,872	-2,950
(=) CFI	**[USD m]**		**-4,032**	**-2,893**	**-2,323**	**-2,494**	**-2,568**	**-2,642**	**-2,718**	**-2,794**	**-2,872**	**-2,950**
(+/-) Debt change	[USD m]		61	52	-558	-312	-176	-39	97	248	413	595
(-) Dividends	[USD m]		-1,621	-1,822	-2,046	-2,314	-2,596	-2,899	-3,225	-3,576	-3,954	-4,360
(=) CFF	**[USD m]**		**-1,560**	**-1,770**	**-2,604**	**-2,626**	**-2,773**	**-2,938**	**-3,128**	**-3,328**	**-3,540**	**-3,764**
Cash BoP	**[USD m]**		**1,856**	**646**	**665**	**686**	**706**	**727**	**764**	**804**	**845**	**889**
Cash variation	**[USD m]**		**-1,210**	**19**	**20**	**20**	**21**	**38**	**40**	**42**	**44**	**46**
Cash EoP	**[USD m]**	**1,856**	**646**	**665**	**686**	**706**	**727**	**764**	**804**	**845**	**889**	**935**

Source: Own elaboration

5.2.19 New Business – NEOM Green Hydrogen Company (NGHC)

To assess the value contribution of Air Products' largest growth initiative, a standalone unit-economics model was constructed for NGHC (see Table 24). The project deploys approximately USD 8.40 billion in CAPEX between 2024 and 2026, funded with 73% project debt and 27% equity. This highly leveraged structure differs from Air Products' consolidated capital profile and directly affects the project's cost of capital and equity returns.

Once operational in 2027, the facility is designed to produce 600 metric tonnes of hydrogen per day, supported by 1.6 GW of wind and 2.2 GW of solar capacity. The model applies capacity factors of 40% for wind and 25% for solar, consistent with high-resource Middle Eastern conditions and publicly disclosed project expectations. Hydrogen is produced via ammonia synthesis for export. The model assumes annual ammonia output of 1.2 million tonnes and an ammonia sale price free on board (FOB) of USD 800/tonne, which implies a hydrogen sale price of USD 4.4/kg and results in USD 960 million of annual revenues.

Operating costs include electricity priced at USD 20/MWh, reflecting the expected levelized cost of renewable power in Saudi Arabia; electrolyzer O&M of USD 80 million per year, based on a 4% O&M factor applied to a USD 1,000/kW installed electrolyzer cost over 2.0 GW of capacity; and G&A equal to 20% of total operating costs, consistent with similar large-scale hydrogen and ammonia export facilities. These cost assumptions imply an estimated hydrogen production cost of USD 1.65/kg at the JV level. In aggregate, this results in USD 599 million of EBIT and a 62.4% EBIT margin, consistent with the economics of a long-term contracted asset with low variable costs.

Additionally, Air Products has a long-term offtake agreement securing 35% of NGHC's hydrogen output for thirty years, under which it purchases the product from the JV and resells it internationally. Because the transfer price under this contract has not been publicly disclosed, the model assumes a purchase cost consistent with NGHC's production economics and a resale price of USD 7.0/kg. The analysis also incorporates the distribution expenses required to deliver hydrogen to end-markets, including shipping and ammonia dissociation. Under these assumptions, the offtake arrangement is estimated to generate approximately USD 145 million of incremental EBIT per year for Air Products.

Table 24 – NGHC Unit Economics

NEOM Green Hydrogen Company	Unit	Aux	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
JV														
CAPEX	**[USD m]**		**-2,550**	**-3,400**	**-2,550**									
Debt	[USD m]	73%	-1,862	-2,482	-1,862									
Equity	[USD m]	27%	-689	-918	-689									
Sales	**[USD m]**					**960**	**960**	**960**	**960**	**960**	**960**	**960**	**960**	**960**
Daily Hydrogen Production	[metric tonnes]					600	600	600	600	600	600	600	600	600
Days in the year	[days]					365	365	365	365	365	365	365	365	365
Annual Hydrogen Production	[thousand metric tonnes]					219	219	219	219	219	219	219	219	219
Ammonia conversion per year	[million tonnes]					1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Ammonia Sale Price (FOB)	[USD/ton]					800	800	800	800	800	800	800	800	800
Implied Hydrogen Sale Price	[USD/kg]					4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Costs and Expenses	**[USD m]**					**-361**	**-361**	**-361**	**-361**	**-361**	**-361**	**-361**	**-361**	**-361**
Electricity Cost	**[USD m]**					**-208**	**-208**	**-208**	**-208**	**-208**	**-208**	**-208**	**-208**	**-208**
Levelized Cost of Electricity in Saudi Arabia	[USD/MWh]					20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Renewable Electricity Generation	**[TWh]**					**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**
Annual Wind Energy Generation	**[TWh]**					**5.6**	**5.6**	**5.6**	**5.6**	**5.6**	**5.6**	**5.6**	**5.6**	**5.6**
Wind Installed Capacity	[MW]					1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
Wind Capacity Factor	[%]					40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
Annual Solar Energy Generation	**[TWh]**					**4.8**	**4.8**	**4.8**	**4.8**	**4.8**	**4.8**	**4.8**	**4.8**	**4.8**
Solar Installed Capacity	[MW]					2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200
Solar Capacity Factor	[%]					25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Electrolyzer O&M Cost	**[USD m]**					**-80**	**-80**	**-80**	**-80**	**-80**	**-80**	**-80**	**-80**	**-80**
Electrolyzer Installed Capacity	[GW]					2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Electrolyzer Specific CAPEX	[USD/kW]					1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
O&M as % of Electrolyzer CAPEX	[%]					4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
G&A Expenses	**[USD m]**					**-72**	**-72**	**-72**	**-72**	**-72**	**-72**	**-72**	**-72**	**-72**
% of total Costs and Expenses	[%]					20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
Implicit Hydrogen Cost	**[USD/kg]**					**1.65**	**1.65**	**1.65**	**1.65**	**1.65**	**1.65**	**1.65**	**1.65**	**1.65**
Electricity Cost	[USD/kg]					0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Electrolyzer O&M Cost	[USD/kg]					0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
G&A Expenses	[USD/kg]					0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
EBIT	**[USD m]**					**599**	**599**	**599**	**599**	**599**	**599**	**599**	**599**	**599**
EBIT Margin	[%]					62.4%	62.4%	62.4%	62.4%	62.4%	62.4%	62.4%	62.4%	62.4%
Financial Expenses	**[USD m]**					**-279**	**-279**	**-279**	**-279**	**-279**	**-279**	**-279**	**-279**	**-279**
Interest rate	[%]					4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
EBT	**[USD m]**					**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**
Taxes	**[USD m]**					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Tax Rate	[%]					0%	0%	0%	0%	0%	0%	0%	0%	0%
Net Income	**[USD m]**					**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**
Net Margin	[%]					33.4%	33.4%	33.4%	33.4%	33.4%	33.4%	33.4%	33.4%	33.4%
Distribution														
Implied Hydrogen Cost	[USD/kg]					3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Hydrogen Sale Price	[USD/kg]					7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Sales	**[USD m]**					**537**	**537**	**537**	**537**	**537**	**537**	**537**	**537**	**537**
Take-or-pay share	[%]					35%	35%	35%	35%	35%	35%	35%	35%	35%
Costs/Expenses	**[USD m]**					**-392**	**-392**	**-392**	**-392**	**-392**	**-392**	**-392**	**-392**	**-392**
COGS	**[USD m]**					**-230**	**-230**	**-230**	**-230**	**-230**	**-230**	**-230**	**-230**	**-230**
Ammonia Expenses	**[USD m]**					**-162**	**-162**	**-162**	**-162**	**-162**	**-162**	**-162**	**-162**	**-162**
Shipping cost	[USD/ton]					-75	-75	-75	-75	-75	-75	-75	-75	-75
Dissociation cost	[USD/ton]					-60	-60	-60	-60	-60	-60	-60	-60	-60
Incremental EBIT	**[USD m]**					**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**
EBIT Margin	[%]					26.9%	26.9%	26.9%	26.9%	26.9%	26.9%	26.9%	26.9%	26.9%

Source: Own elaboration

5.2.20 Determination of Fair Value

The discounted cash flow valuation was based on FCFF (see Table 25). As outlined previously, a rolling WACC was applied, starting at 7.27% in 2025 and gradually increasing over the projection period. The valuation assumes a perpetual growth rate (g) of 3.8% and a statutory tax rate of 21%. The projected FCFFs were discounted using the WACC, and the terminal value was added to determine the enterprise value, from which net debt was subtracted to obtain the equity value. In addition, the USD 145 million of EBIT related to hydrogen distribution from the NGHC offtake arrangement was incorporated into the valuation.

Table 25 – FCFF Calculation

Free Cash Flow to Firm	Unit	2025	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E	2035E	Perpetuity
(=) Total EBIT	**[USD m]**	**-229**	**3,721**	**4,087**	**4,339**	**4,635**	**4,936**	**5,245**	**5,570**	**5,909**	**6,265**	**6,639**	**177,895**
(=) EBIT	**[USD m]**	**-229**	**3,721**	**3,943**	**4,194**	**4,491**	**4,791**	**5,101**	**5,425**	**5,765**	**6,121**	**6,495**	**176,404**
(=) EBIT from NGHC	**[USD m]**	**0**	**0**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**1,492**
(-) EBIT * Taxes	[USD m]	48	-781	-858	-911	-973	-1,036	-1,102	-1,170	-1,241	-1,316	-1,394	-37,358
(=) NOPAT	**[USD m]**	**-181**	**2,940**	**3,229**	**3,428**	**3,662**	**3,899**	**4,144**	**4,400**	**4,668**	**4,950**	**5,245**	**140,537**
(+) D&A	[USD m]	0	1,662	1,782	1,816	1,810	1,814	1,822	1,833	1,844	1,858	1,872	50,847
(+/-) ΔWK	[USD m]	0	19	17	50	6	-19	-19	-19	-20	-21	-22	-585
(-) CAPEX	[USD m]	0	-4,032	-2,893	-2,323	-2,494	-2,568	-2,642	-2,718	-2,794	-2,872	-2,950	-50,847
(=) FCFF	**[USD m]**	**-181**	**588**	**2,135**	**2,970**	**2,984**	**3,126**	**3,305**	**3,495**	**3,698**	**3,915**	**4,146**	**139,953**
WACC	[%]	7.27%	7.26%	7.32%	7.40%	7.47%	7.53%	7.57%	7.60%	7.62%	7.63%	7.62%	7.62%
Adjusted EBITDA	[USD m]	5,076	5,383	5,725	6,011	6,301	6,605	6,923	7,258	7,609	7,978	8,367	
Net Income	[USD m]	-354	2,701	2,884	3,082	3,324	3,567	3,814	4,072	4,340	4,619	4,909	
Fair Enterprise Value	**[USD m]**	**87,524**	**93,289**	**97,979**	**102,261**	**106,917**	**111,839**	**117,003**	**122,406**	**128,040**	**133,894**	**139,953**	
Fair Exit EV/EBITDA LTM	[x]	17.2x	17.3x	17.1x	17.0x	17.0x	**16.9x**	16.9x	16.9x	16.8x	16.8x	16.7x	
Fair Exit EV/EBITDA FWD	[x]	16.3x	16.3x	16.3x	16.2x	16.2x	**16.2x**	16.1x	16.1x	16.0x			
Net Debt	[USD m]	15,842	17,113	17,146	16,568	16,235	16,038	15,962	16,019	16,225	16,595	17,144	
Fair Equity Value	**[USD m]**	**71,682**	**76,176**	**80,833**	**85,693**	**90,682**	**95,801**	**101,041**	**106,386**	**111,814**	**117,299**	**122,809**	
Fair Exit P/E LTM	[x]	-202.3x	28.2x	28.0x	27.8x	27.3x	**26.9x**	26.5x	26.1x	25.8x	25.4x	25.0x	
Fair Exit P/E FWD	[x]	26.5x	26.4x	26.2x	25.8x	25.4x	**25.1x**	24.8x	24.5x	24.2x			

Source: Own elaboration

Based on these assumptions, the intrinsic value per share is estimated at USD 322.0, which represents an upside of 28.3% relative to the current market price of USD 251.0 (see Table 26).

Table 26 – Fair Equity Value Calculation

(=) Enterprise Value	[USD m]	**87,524**
(-) Net Debt	[USD m]	15,842
(=) Equity Value	[USD m]	**71,682**
(÷) Number of Shares	[#]	222.6
(=) Target Price	**[USD m]**	**322.0**
Current Price	[USD]	251.0
Upside	[%]	**28.3%**

Source: Own elaboration

5.2.21 NGHC Addition to Fair Value

The NGHC valuation was also performed using FCFF. Operating cash flows were projected until 2056, with a terminal value computed thereafter. A distinct WACC was applied to the project, reflecting both its location in Saudi Arabia and its different debt-to-equity structure. The cost of equity was derived using the CAPM, maintaining all parameters consistent with the Air Products corporate cost of equity except for three project-specific adjustments (Table 27): an unlevered beta of 0.49, consistent with renewable and green hydrogen infrastructure; a country risk premium of 0.89% for Saudi Arabia; and a λ (lambda) of 0.33, following Damodaran's approach, which applies only a fraction of the country risk premium given NGHC's USD-denominated revenues and long-term take-or-pay contracts.

Table 27 – NGHC Ke Calculation

Ke		2025	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E	2035E
Risk Free (10y Treasury Bond)	[%]	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%	4.11%
Unlevered Beta (Green & Renewable Energy)	[#]	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Debt	[USD m]	1,862	4,344	6,205	6,205	6,205	6,205	6,205	6,205	6,205	6,205	6,205
Equity	[USD m]	689	1,607	2,295	2,295	2,295	2,295	2,295	2,295	2,295	2,295	2,295
Debt/Equity	[#]	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
t	[%]	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Levered Beta	[#]	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81
Equity Risk Premium	[%]	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%	4.21%
Nominal Ke (USA)	[%]	11.75%	11.75%	11.75%	11.75%	11.75%	11.75%	11.75%	11.75%	11.75%	11.75%	11.75%
Country Risk Premium (Saudi Arabia)	[%]	0.89%	0.89%	0.89%	0.89%	0.89%	0.89%	0.89%	0.89%	0.89%	0.89%	0.89%
λ	[#]	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Ke		**12.05%**	**12.05%**	**12.05%**	**12.05%**	**12.05%**	**12.05%**	**12.05%**	**12.05%**	**12.05%**	**12.05%**	**12.05%**

Source: Own elaboration

Table 28 – NGHC WACC Calculation

WACC		2025	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E	2035E
Debt	[USD m]	1,862	4,344	6,205	6,205	6,205	6,205	6,205	6,205	6,205	6,205	6,205
Equity	[USD m]	689	1,607	2,295	2,295	2,295	2,295	2,295	2,295	2,295	2,295	2,295
Cost of Debt post-tax	[%]	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
Debt/(Debt + Equity)	[%]	73.0%	73.0%	73.0%	73.0%	73.0%	73.0%	73.0%	73.0%	73.0%	73.0%	73.0%
Cost of Equity	[%]	12.05%	12.05%	12.05%	12.05%	12.05%	12.05%	12.05%	12.05%	12.05%	12.05%	12.05%
Equity/(Debt + Equity)	[%]	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%
WACC	**[%]**	**6.54%**	**6.54%**	**6.54%**	**6.54%**	**6.54%**	**6.54%**	**6.54%**	**6.54%**	**6.54%**	**6.54%**	**6.54%**

Source: Own elaboration

The resulting project WACC is 6.54%, as shown in Table 29. Discounting the NGHC FCFFs at this WACC and subtracting the project's USD 4.3 billion in net debt results in a project fair equity value of USD 2.3 billion (Table 29).

Converting this FCFF-based valuation into FCFE from Air Products' perspective — incorporating interest payments and construction-period net borrowings — yields an equity IRR of 12.2% in USD terms, consistent with expectations for long-term contracted renewable mega-projects.

Table 29 – NGHC Fair Value Calculation

NGHC Valuation			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Perpetuity @ 2056
(=) EBIT	**[USD m]**		**0**	**0**	**0**	**599**	**599**	**599**	**599**	**599**	**599**	**599**	**599**	**599**	**14,471**
(-) EBIT * Taxes	[USD m]		0	0	0	0	0	0	0	0	0	0	0	0	0
(=) NOPAT	**[USD m]**		**0**	**0**	**0**	**599**	**599**	**599**	**599**	**599**	**599**	**599**	**599**	**599**	**14,471**
(+) D&A	[USD m]		0	0	0	0	0	0	0	0	0	0	0	0	0
(+/-) ΔWK	[USD m]	2.0%	0	0	0	-19	-19	-19	-19	-19	-19	-19	-19	-19	-464
(-) CAPEX	[USD m]		-2,550	-3,400	-2,550	0	0	0	0	0	0	0	0	0	0
(=) FCFF	**[USD m]**		**-2,550**	**-3,400**	**-2,550**	**580**	**580**	**580**	**580**	**580**	**580**	**580**	**580**	**580**	**14,007**
WACC	[%]			6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
Fair Enterprise Value	**[USD m]**			**6,657**	**9,643**	**9,693**	**9,746**	**9,803**	**9,864**	**9,929**	**9,998**	**10,071**	**10,149**	**10,232**	
Net Debt	[USD m]			4,344											
Fair Equity Value	**[USD m]**			**2,314**											
(=) FCFF	**[USD m]**		**-2,550**	**-3,400**	**-2,550**	**580**	**580**	**580**	**580**	**580**	**580**	**580**	**580**	**580**	**14,007**
(-) Interest Expense (1 - Taxes)	[USD m]		0	0	0	-279	-279	-279	-279	-279	-279	-279	-279	-279	-6,741
(+) Net Borrowings	[USD m]		1,862	2,482	1,862	0	0	0	0	0	0	0	0	0	0
(=) FCFE	**[USD m]**		**-689**	**-918**	**-689**	**301**	**301**	**301**	**301**	**301**	**301**	**301**	**301**	**301**	**7,266**
IRR				**12.2%**											

Source: Own elaboration

Air Products' proportional one-third equity share translates into a USD 0.77 billion addition to its equity value. Incorporating this amount into the base-case valuation results in a revised target price of USD 332.4, equivalent to an additional 1.4 percentage-point upside relative to the current market capitalization (Table 30) and a total upside of 29.7%.

Table 30 – NGHC Equity Value Addition

NGHC Equity Value	**[USD m]**	**771**
New Target Price	[USD m]	325.5
Upside	[%]	**29.7%**

Source: Own elaboration

5.2.22 NGHC Sensitivity Analysis

A joint sensitivity analysis was conducted to evaluate how variations in the implicit hydrogen production cost and the ammonia sale price (FOB) affect the project's equity IRR (see Table 31). The results show that NGHC maintains solid equity returns across a wide range of commercially plausible scenarios. Even under less favorable combinations of higher hydrogen costs or lower ammonia prices, the project continues to deliver positive and economically meaningful returns, while upside scenarios materially enhance its performance.

Table 31 – NGHC Sensitivity Analysis

Implicit Hydrogen Cost [USD/kg]	Ammonia Sale Price [USD/ton]				
	720	760	800	840	880
1.41	11.2%	12.8%	14.4%	15.9%	17.3%
1.65	8.9%	10.6%	**12.2%**	13.8%	15.3%
1.88	6.2%	8.2%	10.0%	11.6%	13.2%
2.12	2.7%	5.4%	7.4%	9.3%	11.0%
2.36	(5.0%)	1.4%	4.4%	6.7%	8.6%

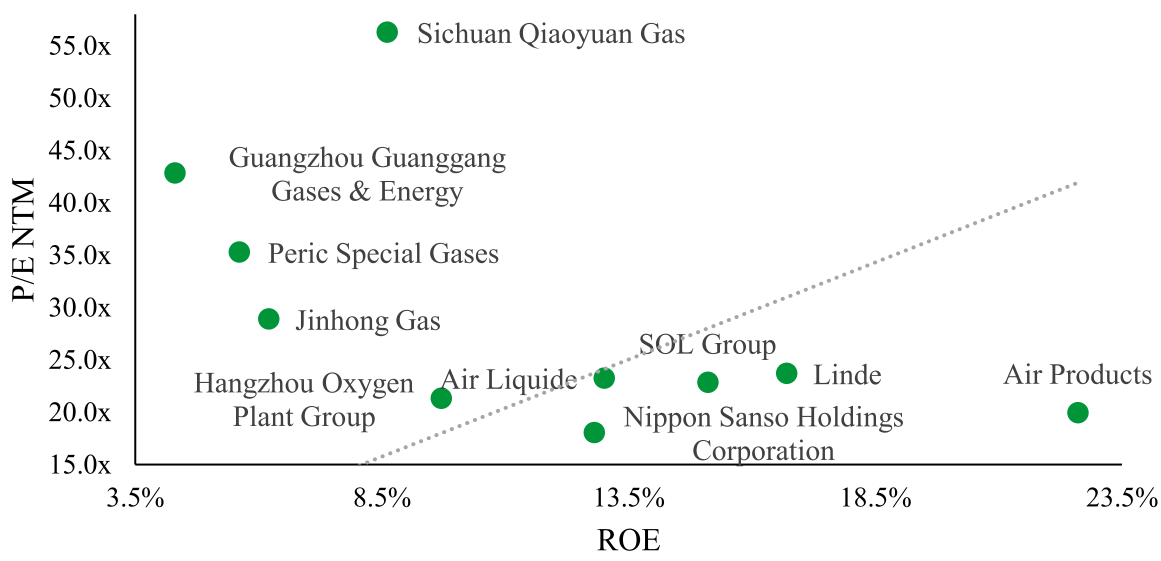
Source: Own elaboration

5.3 Multiples Valuation

A multiples-based valuation was also conducted using the full peer set shown in Chart 57, including Sichuan Qiaoyuan Gas, Guangzhou Guanggang Gases & Energy, Peric Special Gases, Jinhong Gas, Hangzhou Oxygen Plant Group, Air Liquide, SOL Group, Nippon Sanso Holdings Corporation, and Linde.

The analysis employed next-twelve-month price-to-earnings (P/E NTM) and ROE as the core metrics. Air Products trades at lower P/E NTM multiples than Linde and SOL Group, despite exhibiting the highest ROE in the sample. In the scatter plot, the company is positioned below the fitted regression line (P/E NTM vs. ROE), indicating valuation below what would be implied by its profitability profile.

Chart 57 – P/E NTM x ROE (x, %)



Source: Own elaboration

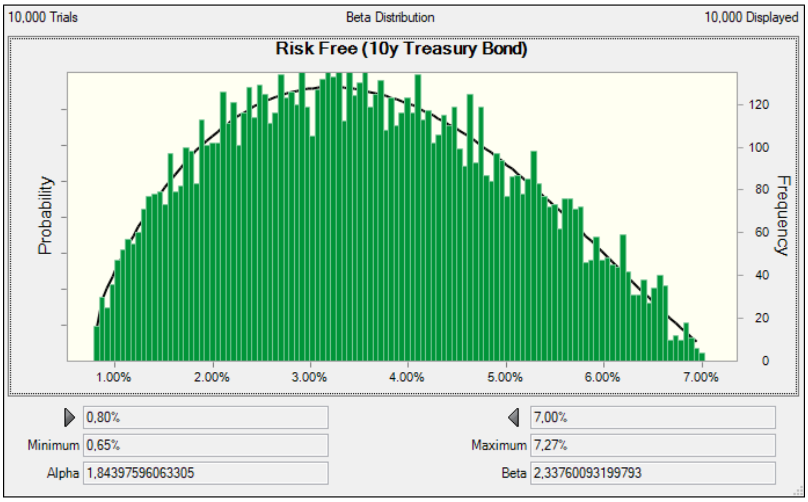
5.4 Monte Carlo Simulation

To assess the robustness of the valuation and quantify the uncertainty surrounding the estimated upside, a Monte Carlo simulation with 10,000 trials was conducted using Oracle Crystal Ball software. The simulation applies probability distributions to the key parameters that drive valuation outcomes — namely the U.S. 10-year Treasury rate (risk-free rate), the Equity Risk Premium, the pre-tax cost of debt, and the perpetual growth rate g — and evaluates how simultaneous variation in these inputs affects the resulting upside relative to the current share price.

Historical data for the risk-free rate, ERP, and corporate bond yields were collected from 1996 onward, ensuring that the simulation reflects the behavior of modern financial markets and avoids structural breaks associated with earlier macroeconomic regimes (see Figures 8–11, which also include the estimated probability distributions). Crystal Ball then identified the best-fitting distribution for each parameter based on this historical dataset. To prevent non-economic outcomes — such as discount rates approaching or falling below the perpetual growth rate — the distributions were truncated at economically reasonable bounds, ensuring that all simulated values remain within plausible ranges.

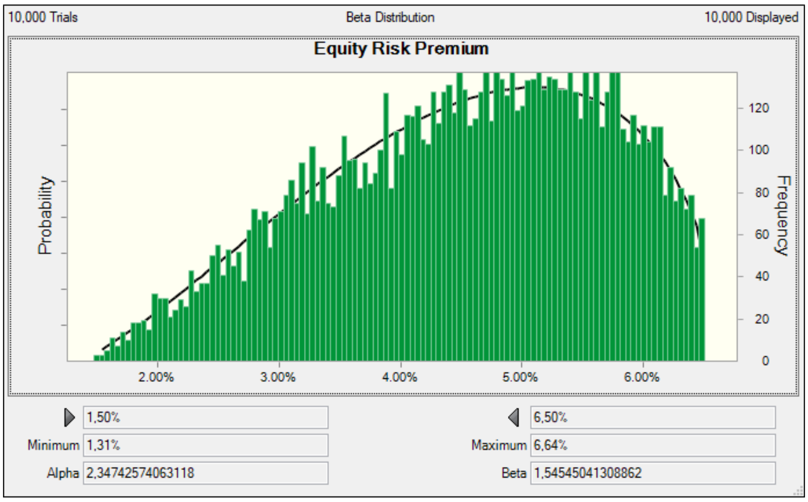
For the perpetual growth rate g, which has no observable historical series and must necessarily reflect a forward-looking assumption, a normal distribution was applied with mean 3.8% and standard deviation 0.4%, also subject to truncation.

Figure 8 – Risk Free Distribution



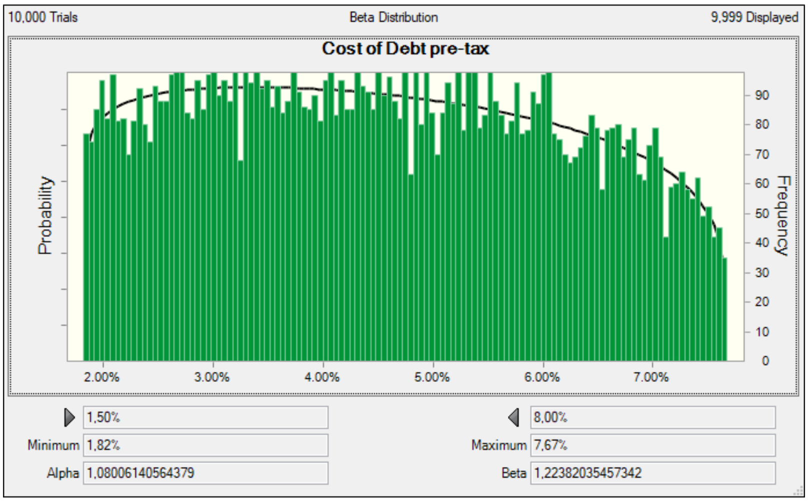
Source: Crystal Ball, own elaboration

Figure 9 – Equity Risk Premium Distribution



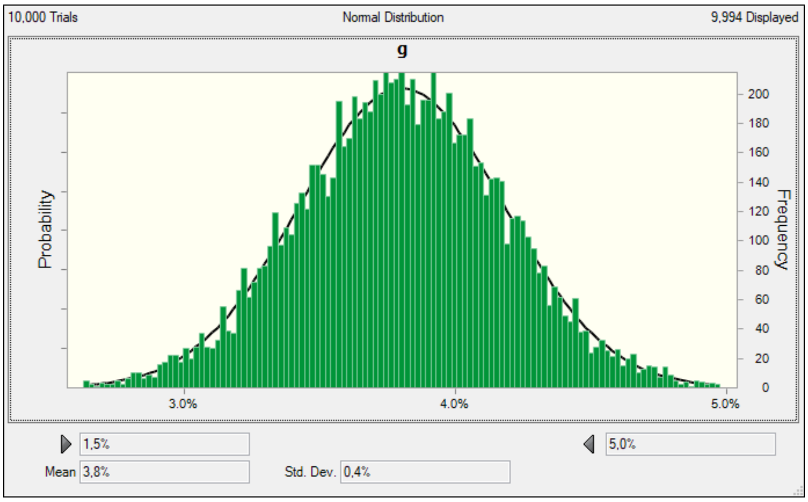
Source: Crystal Ball, own elaboration

Figure 10 – Cost of Debt pre-tax Distribution



Source: Crystal Ball, own elaboration

Figure 11 – Growth in Perpetuity Distribution



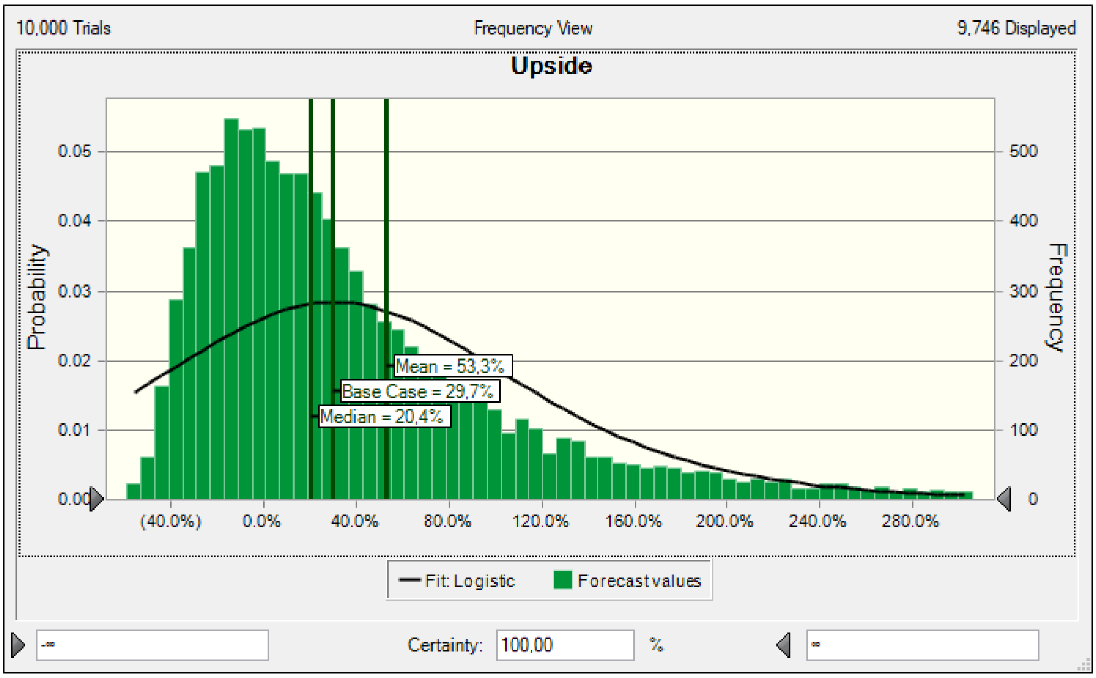
Source: Crystal Ball, own elaboration

The combined effect of the four distributions produces the upside distribution shown in Figure 12. The resulting distribution is asymmetric, with a meaningful probability mass between approximately –40% and 60% upside. This reflects the model's sensitivity to movements in discount rates: higher discount-rate scenarios compress the present value of cash flows and generate downside outcomes, while lower-rate scenarios expand the valuation and produce a long right tail.

The deterministic base case (29.7%) lies near the center of the simulated distribution, while the median upside is 20.4%, indicating that half of all simulated scenarios produce results broadly in line with — or slightly below — the base case. The mean upside of 53.3% is substantially higher than the median, driven by the right tail of the distribution, where combinations of lower risk-free rates and lower equity risk premia lead to materially higher valuations.

The left tail remains bounded, with the most adverse outcomes showing moderate negative upside rather than extreme losses, consistent with the cash-flow characteristics of a long-duration, investment-grade industrial business. Overall, the simulation suggests that the valuation is positively skewed: while downside exists under adverse macroeconomic conditions, the probability-weighted outcome remains favorable.

Figure 12 – Monte Carlo Simulation

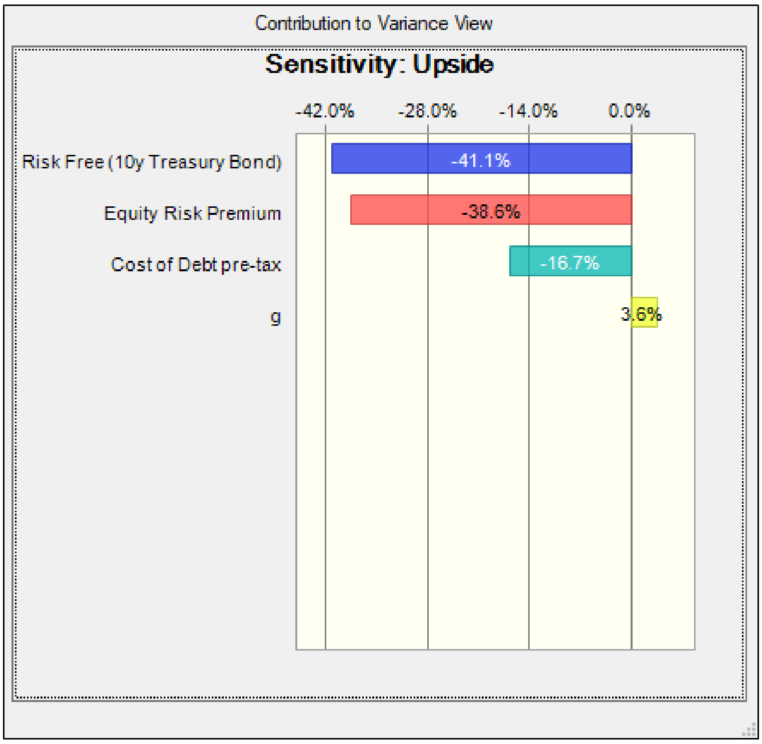


Source: Crystal Ball, own elaboration

Figure 13 presents the sensitivity (tornado) chart for the Monte Carlo simulation. The U.S. 10-year Treasury rate is the dominant driver of valuation uncertainty, explaining –41.1% of the variance in upside outcomes, followed closely by the Equity Risk Premium at –38.6%. The pre-tax cost of debt has a more moderate influence (–16.7%), while the perpetual growth rate g contributes only +3.6%, reflecting both its narrower distributional range and its comparatively smaller effect on present value relative to WACC-driven components.

This hierarchy is consistent with theoretical expectations for long-duration assets: discount-rate parameters—especially the risk-free rate—naturally exert the greatest influence on intrinsic value. Overall, the sensitivity results indicate that the upside is primarily affected by macroeconomic rate conditions rather than company-specific modelling choices, reinforcing the robustness of the investment case under a wide range of plausible capital-market environments.

Figure 13 – Sensitivity Analysis: Contribution to Variance



Source: Crystal Ball, own elaboration

6. ESG ANALYSIS

In recent years, Environmental, Social, and Governance (ESG) criteria have become central to corporate strategy and investment decision-making. Global investors increasingly recognize that ESG performance is linked not only to reputational value but also to long-term financial resilience (FRIEDE; BUSCH; BASSEN, 2015). For heavy industries such as industrial gases, ESG is especially relevant because of their energy-intensive operations, dependence on natural resources, and exposure to regulatory and stakeholder pressure regarding climate change (INTERNATIONAL ENERGY AGENCY, 2021).

Within this context, Air Products stands out as a key player. The company is the world's largest hydrogen supplier and has committed more than USD 15 billion to energy transition projects, particularly in clean hydrogen, carbon capture and renewable energy integration (AIR PRODUCTS, 2024). As global climate policies such as the Inflation Reduction Act in the U.S. and the Fit for 55 package in Europe advance, the ability of industrial gas companies to reduce emissions, enhance resource efficiency, and demonstrate robust governance will directly affect competitiveness and license to operate (EUROPEAN COMMISSION, 2021).

6.1 ESG Index

To assess the ESG maturity of Air Products relative to its peers, a proprietary ESG Index was developed. The index is built on 27 structured questions divided into three categories — Environmental (8 questions), Social (9), Governance (7) — plus a separate block for Future Commitment (3). Each question is scored on a 0 – 5 scale, following a standardized guidance shown in Table 32. The questions were inspired by CFA Institute ESG frameworks and adapted to the industrial gases sector to ensure comparability.

The evaluation covered eight companies: Air Products, Air Liquide, Linde, Nippon Sanso, Messer, SOL Group, Venator, and Jinhong Gas. Scores were assigned based on official sustainability reports, integrated annual reports, and additional public sources, such as CDP and EcoVadis assessments. This structure provides a balanced and evidence-based view of ESG performance, allowing for meaningful comparison across global leaders and smaller regional competitors.

Table 32 – ESG Questions grading scale

Environmental, Social and Governance questions	
Grade	**Meaning**
0	The company doesn't disclose information on the criterion, nor shows awareness
1	The company doesn't disclose plans but shows some management awareness
2	Plans exist but have low expected impact
3	Plans are in development and show medium expected impact
4	Strong, well-developed plans exist but haven't reached full potential
5	Strong plans exist with clear evidence of significant, positive results

Future Commitment	
Grade	**Management Awareness**
0	Management doesn't say anything about ESG
1	Management talks about ESG, but still doesn't dedicate too much time for it
2	Management recognizes the importance of ESG, but doesn't have strong plans for it
3	Management knows the importance of ESG, have plans, but lack people to accomplish it
4	Management has a great understanding of the theme, but could dedicate more time to build the best ESG practices
5	Management has a complete understanding of the theme, dedicates time and have prepared people in charge of it
Grade	**Clear Goals**
0	Management doesn't have any goals regarding ESG practices
1	Management make declarations about some general objectives, but it does not specify them clearly
2	Management has clear but few ESG goals
3	Management has specified and disclosed goals regarding some ESG practices, but not traceable
4	Management has specified, disclosed and traceable goals regarding some ESG practices
5	Management has specified, disclosed and traceable goals regarding each one of ESG practices (E, S and G)
Grade	**Execution ability**
0	Management doesn't mention anything about HOW it is going to make it
1	Management talks about HOW to execute, but it has already failed before and/or other maangements have failed before
2	Management has a detailed execution plan but is has already failed before and/or other managements have failed before
3	Management has a detailed execution plan and it already did it once and/or other companies succeeded before
4	Management has a detailed execution plan and it is already putting it into practice, but the execution scheduled is delayed
5	Management has a detailed execution plan and it is already putting it into practice on time

Source: CFA, own elaboration

6.1.1 Environmental

Table 33 presents the Environmental questions and the assigned scores, which are subsequently justified in the paragraphs that follow.

Table 33 – Environmental Questions and Grades

#	Question	Air Products	Linde	Air Liquide	Taiyo Nippon Sanso	Messer Group	SOL Group	Jinhong Gas	Venator Materials
Environmental		3.8	4.8	4.5	4.4	3.6	2.5	2.4	4.1
E1	Does the company have a clearly defined environmental responsibility policy with specific goals (e.g., carbon neutrality, biodiversity)?	5	5	5	4	3	2	3	4
E2	Is the company a signatory of specific international environmental pacts (e.g., UN Global Compact, Science-Based Targets)?	2	5	5	5	5	1	1	5
E3	Is the company transparent in its ESG disclosures, including regular reporting on operational practices?	5	5	5	5	4	5	4	5
E4	Are there clear, ambitious environmental targets, and is there evidence of historical compliance?	4	5	5	4	4	3	3	4
E5	Does the company have an effective waste management policy, and has it evolved positively?	3	5	3	5	4	2	2	5
E6	Is the company actively adding greener products and sustainability practices?	5	5	5	5	4	4	4	4
E7	Does the company have specific initiatives to protect biodiversity and water resources?	3	4	4	3	2	1	1	2
E8	Is there a clear policy for managing hazardous and non-hazardous waste effectively?	3	4	4	4	3	2	1	4

Source: Own elaboration

E1 (Environmental policy & goals): Air Liquide, Linde and Air Products present the most ambitious policies, each targeting net-zero emissions by 2050 with interim goals. Air Liquide reduced CO_2 emissions by more than 11% versus 2020 and set a –33% target by 2035. Linde aims for a 35% absolute reduction by 2035 and has already achieved a –16% cut in 2024, reducing Scope 1+2 emissions from 5.63 Mt to 4.74 Mt. Air Products' "Third by '30" program commits to a 33% intensity reduction by 2030, supported by large hydrogen investments. Nippon Sanso plans a 32% cut by 2031 and had already achieved –15.3% by 2024 against its –18% by 2026 milestone. Messer targets a 40% intensity reduction by 2030, while Venator set a 50% Scope 1+2 cut by 2030 and reports –13% in 2024. SOL and Jinhong disclose incremental goals: SOL highlights renewable integration without neutrality commitments, and Jinhong aligns with China's carbon peak 2030 and neutrality 2060, reporting ~120,000 tCO_2 avoided annually via natural gas substitution.

E2 (International environmental pacts): Linde and Air Liquide validate their commitments through the UN Global Compact and the Science Based Targets initiative. Air Liquide's 2035 trajectory is SBTi-approved, while Linde's climate targets received SBTi validation in 2023. Nippon Sanso became a UNGC signatory in 2022 and commits to TCFD disclosure, while Messer signed UNGC in 2024 and adheres to UN Women's Empowerment Principles. Venator, though smaller, holds an EcoVadis Gold rating, placing it in the top 5% of companies assessed globally. Air Products participates in CDP and Dow Jones indices but has not formalized UNGC or SBTi commitments. SOL cites alignment with Agenda 2030 but lacks external validations.

Jinhong’s ESG engagement remains primarily domestic, reflecting national rather than global alignment.

E3 (ESG disclosure & transparency): The major multinationals provide the most detailed and externally assured disclosure. Air Liquide publishes an integrated annual report with audited climate metrics, and Linde reports under GRI, SASB and TCFD, supported by 22 consecutive years in the Dow Jones Sustainability Index. Air Products discloses progress against 2030 and 2050 goals, including annual emissions and safety data. Nippon Sanso’s integrated report includes KPIs for eight non-financial programs and traces year-on-year progress. Venator reports with GRI alignment and external assurance, presenting metrics such as a 100,000 t reduction in non-hazardous waste in 2024. Messer’s first global sustainability report in 2023 disclosed 5.63 Mt Scope 1+2 emissions (market-based), down to 4.74 Mt in one year, while SOL reports 24% renewable energy consumption in 2024. Jinhong provides less international transparency, though it outlines environmental projects aligned with Chinese sustainability mandates.

E4 (Environmental targets & compliance): Linde demonstrates strong compliance, cutting emissions by –16% in one year and surpassing its “zero waste” target four years ahead of schedule. Air Liquide remains on track for its 2035 milestone, having achieved –11% by 2024. Air Products reports a –13.4% reduction in Scope 1+2 emissions in 2024 alone, reflecting rebaselined but more ambitious goals. Nippon Sanso is nearly at its 2026 target, with –15.3% already achieved against an –18% goal. Venator, after restructuring, reduced emissions by 13% in 2024 and continues toward its 2030 50% cut. Messer’s reductions mirror Linde’s at –16% in 2023, though intensity-based rather than absolute. SOL shows steady but smaller gains, emphasizing renewable procurement and efficiency. Jinhong demonstrates compliance by reaching all its 2023 environmental goals and avoiding major incidents, though reporting lacks global comparability.

E5 (Waste management policies & progress): Leaders show measurable achievements. Linde reports 451 sites diverting over 90% of waste from landfill, achieving its 2028 goal in 2024. Nippon Sanso reduced landfill waste by 47% versus 2019, meeting its “halve by 2026” objective two years early. Venator exceeded its 2030 non-hazardous waste reduction target six years ahead of schedule, avoiding ~100,000 t in 2024 through recycling and reuse. Messer recycled 88% of its non-hazardous waste in 2023, though hazardous recycling remains lower

(41%). Air Liquide, Air Products and SOL report compliance but lack equivalent breakthroughs. Jinhong discloses minimal proactive waste strategies beyond ISO compliance.

E6 (Greener products and practices): The three global leaders dominate investment scale. Linde reports customer CO_2 avoidance of 96 Mt in 2024 — more than double its own footprint. Air Liquide launched its ECO ORIGIN low-carbon gas line and invested in large electrolyzers, such as a 20 MW unit in Germany. Air Products committed USD 15 billion to clean hydrogen, supplying green fuels to transport and refining. Nippon Sanso enabled 7.45 Mt of customer CO_2 reductions in 2024, exceeding its own Scope 1+2 footprint of 5.67 Mt. Messer pursues hydrogen fueling and biogenic CO_2 reuse projects, while SOL develops on-site gas supply to cut transport emissions. Venator applied a Product Carbon Footprint tool across its pigment portfolio, while Jinhong promoted gas substitution projects that reduced emissions by 120,000 tCO_2 annually.

E7 (Biodiversity and water initiatives): Air Liquide and Linde lead with quantified water strategies. Air Liquide targets full implementation of water management plans at high-stress sites by 2025 and has received multiple water stewardship awards. Linde set a –20% water withdrawal intensity target by 2035 and in 2024 implemented water plans at its high-risk sites. Nippon Sanso conducted a baseline water risk survey and launched recycling programs at facilities identified as high risk. Air Products aims to complete water management plans for key facilities by 2026. Venator, Messer, SOL and Jinhong comply with wastewater and biodiversity regulations but have not articulated quantitative global targets, limiting comparability.

E8 (Hazardous and non-hazardous waste management): Venator reports detailed circularity outcomes, with beneficial reuse of both hazardous and non-hazardous by-products at sites such as Greatham. Nippon Sanso's "Zero Waste" program reported consistent landfill reductions and increased hazardous waste treatment. Linde reduced hazardous waste to 345 t in 2023 across Asia and Europe, alongside its larger zero-waste achievements. Air Liquide and Messer disclose volumes and recycling shares but without major reductions. SOL reported 15,136 t of waste in 2024, partly due to new construction, with 323 t hazardous. Jinhong follows ISO protocols but provides no quantitative detail. The variance reflects differences between companies embedding circularity as a strategic lever versus those maintaining compliance.

6.1.2 Social

Table 34 presents the Social questions and the assigned scores, which are subsequently justified in the paragraphs that follow.

Table 34 – Social Questions and Grades

#	Question	Air Products	Linde	Air Liquide	Taiyo Nippon Sanso	Messer Group	SOL Group	Jinhong Gas	Venator Materials
Social		4.4	4.7	4.6	4.2	4.1	3.8	2.3	3.9
S1	Does the company have a customer-focused culture, effective complaint resolution channels, and good public reputation?	4	4	4	4	4	4	4	4
S2	Are there clear, explicit initiatives to promote workforce diversity?	5	4	5	5	5	4	1	4
S3	How is employee perception rated on platforms such as Glassdoor, LinkedIn, or Indeed?	4	5	4	3	4	3	2	2
S4	Does the company effectively attract and retain talent through clear career opportunities and competitive remuneration?	5	5	5	4	4	4	3	3
S5	Does the company actively invest in specific community-focused projects (education, health, social support)?	4	5	5	3	4	3	4	4
S6	Is consumer data protection and privacy a clear priority with robust practices?	4	4	4	4	3	4	2	4
S7	Has the company experienced problems with product regulation or sanitation standards?	5	5	5	5	4	5	5	5
S8	Does the company explicitly address human rights issues in its supply chain?	4	5	4	5	4	3	0	5
S9	Are there specific diversity targets and actions in leadership positions (gender, ethnicity)?	5	5	5	5	5	4	0	4

Source: Own elaboration

S1 (Customer-focused culture & reputation): All companies operate in sectors where reliability and safety are paramount. Air Liquide combines industrial reliability with a strong healthcare presence, reporting that over 1.9 million homecare patients are served annually, with 57% under personalized care plans. Linde emphasizes decades-long industrial partnerships and customer satisfaction surveys across more than 100 countries. Air Products highlights its customer-centric culture, frequently referring to “selling gas is selling safety,” with service reliability rates above 99%. Nippon Sanso differentiates itself through Total Gas Centers for semiconductor clients, embedding staff on site to ensure responsiveness. Messer, SOL and Jinhong maintain high satisfaction in regional markets, while Venator, despite operating in a different chemicals niche, maintains strong long-term supply relationships. Across the group, no significant controversies undermine customer trust.

S2 (Workforce diversity initiatives): Air Products, Air Liquide, Linde, Nippon Sanso and Messer have set measurable diversity goals. Air Products targets ≥28% women globally in professional roles by 2025, reaching 26% in 2023, and ≥30% U.S. minorities, now at 25%. Air Liquide aims for 35% women in management by 2025, already at 33%. Linde maintains ~28%

women in its workforce and supports global employee resource groups. Nippon Sanso's goal is 22% female employees and 18% female managers by 2026, supported by a D&I office established in 2024. Messer aims for 30% women in top management by 2030 and reached 27% in 2023. SOL shows strong inclusion with 42% women overall and 36% on its board, though without formal targets. Venator set a 30% leadership target but remains at ~18%. Jinhong provides no evidence of structured programs, relying only on basic equal-opportunity statements.

S3 (Employee perception and satisfaction): External recognition highlights leadership positions. Linde is consistently ranked among the world's most ethical and best employers, including Time's "World's Best Companies" and Forbes' "Top Companies for Women." Air Products has been recognized by Forbes as #4 in diversity in the U.S. and a best employer for women. Air Liquide reports high retention and benefits programs, such as a global health plan covering 92% of employees. Messer, though smaller, reports strong engagement, launching a Women's Network and mentoring initiatives. Nippon Sanso demonstrates progress in training and compliance but lacks external employer awards. SOL employs 7,291 people with a 16% turnover rate in 2024, suggesting retention challenges abroad. Venator's recent restructuring and layoffs negatively affected morale, while Jinhong discloses little on engagement.

S4 (Talent attraction and retention): The largest multinationals show robust systems. Air Liquide invests EUR 371 million annually in R&D and ties talent development to innovation, supporting career progression. Linde maintains global training academies and reskilling programs, with low voluntary turnover. Air Products emphasizes development through 12 employee resource groups and continuous learning, with workforce growth to 23,000 employees in 2023. Nippon Sanso promotes "Gas Professionals" training programs worldwide, reporting ~99% training completion in compliance topics. Messer has a long history of stable employment and international development programs. SOL grew its workforce by 919 in 2024, with 94% on permanent contracts, though turnover remains relatively high. Venator is rebuilding HR systems after bankruptcy, while Jinhong offers stability under state ownership but provides little evidence of structured talent programs.

S5 (Community investment and social initiatives): Linde led in 2024 with over 800 employee-led community projects globally, spanning education, health and environment. Air Liquide operates its Foundation, funding scientific research and solidarity programs, including

Access Oxygen™, which supplies over 300 clinics in Africa. Air Products focuses philanthropy on STEM education and long-term partnerships such as United Way. Nippon Sanso supports community programs mainly through its parent group in Japan. Messer contributes locally, such as projects supporting women's employment in Serbia. SOL sponsors healthcare and orthopedics projects in Europe, while Jinhong, as a state-linked company, engages in poverty alleviation and local social projects in China. Venator invests in local educational and environmental initiatives around its plants, supporting community resilience.

S6 (Consumer data protection & privacy): Air Liquide, Linde and Air Products demonstrate board-level oversight of data security and compliance with GDPR, with no reported breaches. Nippon Sanso achieved near-100% completion of information security training for employees. SOL has strong controls in its healthcare subsidiaries, handling sensitive patient data under EU rules. Messer, while compliant, reports less publicly about IT systems. Venator manages B2B and employee data with standard protections and no incidents reported. Jinhong follows China's cybersecurity regulations but does not disclose independent data protection initiatives.

S7 (Product safety and regulatory compliance): Given the criticality of gases and chemicals, product safety is a baseline requirement across all firms. Air Liquide, Linde and Air Products ensure 100% of products undergo hazard assessment and provide Safety Data Sheets. Nippon Sanso emphasizes its "Safety First" culture, operating hazard simulation training centers. Messer and SOL comply with strict medical and industrial gas regulations in Europe. Venator ensures REACH compliance for its chemical portfolio, and Jinhong reports no major accidents or regulatory violations. All companies perform well in this domain, reflecting industry standards.

S8 (Supply chain human rights): Linde enforces its Business Partner Code of Conduct, reviewing risks annually against State Department reports. Nippon Sanso supports the Responsible Business Alliance in electronics and embeds human rights in its global procurement policy. Venator integrates UNGC and ILO standards into supplier contracts and reported zero human rights violations in audits. Air Liquide and Air Products maintain supplier codes but disclose fewer audit results. Messer aligns contracts with UNGC principles. SOL reports 81% of Italian suppliers and 75% abroad assessed on sustainability criteria, though less explicitly on human rights. Jinhong discloses no structured supply chain due diligence.

S9 (Diversity in leadership): Air Liquide reports 33% women in management and 42% on its board, with a 35% management target for 2025. Linde's nine-person supervisory board includes five women (55%) and 45% independent directors. Air Products' board is one-third female and its senior management team includes women in key functions. Nippon Sanso raised board diversity to 22% women and aims for 18% in management by 2026. Messer's executive board includes two women out of five members, and its supervisory board is majority female. SOL has 36% women on its board, above Italian averages. Venator's board, chaired by a woman, is improving representation but remains below its 30% target. Jinhong discloses minimal information, with likely negligible representation.

6.1.3 Governance

Table 35 presents the Governance questions and the assigned scores, which are subsequently justified in the paragraphs that follow.

Table 35 – Governance Questions and Grades

#	Question	Air Products	Linde	Air Liquide	Taiyo Nippon Sanso	Messer Group	SOL Group	Jinhong Gas	Venator Materials
Governance		4.7	5.0	5.0	4.0	3.9	3.7	2.6	3.6
G1	Does the board composition follow best practices (at least 20% women, 1/3 independent members, ESG-specialized members)?	5	5	5	5	4	5	2	4
G2	Does the company have a history of corruption-related scandals, and have corrective actions been effectively implemented?	5	5	5	5	5	5	5	5
G3	Is executive compensation clearly linked to ESG metrics and sustainable performance?	4	5	5	2	3	2	0	1
G4	Does the company have clear value propositions and innovation-driven initiatives?	5	5	5	4	4	3	3	3
G5	Are there robust policies for minority shareholder protection and corporate control?	5	5	5	2	2	3	3	2
G6	Does the company have explicit policies against lobbying, corruption, and political funding?	4	5	5	5	5	4	4	5
G7	Does the company have an effective, structured, and independent whistleblower channel?	5	5	5	5	4	4	1	5

Source: Own elaboration

G1 (Board composition and ESG oversight): Air Liquide, Linde and Air Products present highly structured boards with strong diversity and independence. Air Liquide's board is 42% female and over 50% independent, supported by an Environment and Society Committee. Linde's supervisory board is 55% female, with members representing multiple nationalities and more than one-third independents. Air Products' board includes three women among nine directors, with eight of nine classified as independent. Nippon Sanso has improved governance, with 22% women and five of nine directors independent, alongside a Sustainability Committee. SOL's board is 36% female, with a majority of independent members, aligning with Italian best practice. Messer has strong diversity (five of nine supervisory board members are women, and two of five executive board members are women), though family ownership concentrates control. Venator refreshed its governance after restructuring, appointing a female chair, but independence remains limited by creditor-appointed directors. Jinhong Gas, under state control, likely meets China's minimum one-third independent requirement but shows little evidence of gender diversity or ESG expertise.

G2 (Corruption record and corrective action): Across all companies, no major corruption cases have been reported in recent years. Linde stands out as one of Ethisphere's "World's Most Ethical Companies" for five consecutive years. Air Liquide and Air Products maintain extensive anti-bribery training programs, with near-100% completion rates. Nippon Sanso reports 99.4% compliance training coverage, while Messer, SOL and Venator also enforce zero-tolerance codes of conduct. Jinhong Gas, as a partly state-owned company, is subject to Communist Party oversight, which reinforces internal controls. In practice, all eight firms maintain robust compliance frameworks and report no significant incidents.

G3 (Executive compensation linked to ESG performance): Air Liquide and Linde lead in explicitly linking executive pay to sustainability. At Air Liquide, 15% of variable pay for senior leaders and 10–15% for all bonus-eligible employees are tied to ESG performance, including CO_2, safety and diversity. Linde integrates safety and emissions targets into annual incentive plans, adjusting payouts based on ESG results. Air Products includes safety and environmental metrics in performance scorecards, though it does not disclose a fixed percentage. Messer, as a private company, likely incorporates qualitative ESG objectives but without formal transparency. SOL and Nippon Sanso provide no evidence of structured ESG pay linkage, and Venator, during restructuring, focused compensation on financial turnaround rather than ESG. Jinhong shows no sign of ESG integration in remuneration practices.

G4 (Clear value proposition & innovation drive): Air Liquide, Linde and Air Products clearly position innovation as a driver of long-term value. Air Liquide invests over EUR 370 million annually in R&D, developing technologies in hydrogen, CCUS and healthcare. Linde enabled customer avoidance of 96 Mt CO_2 in 2024 through low-carbon offerings, and Air Products committed USD 15 billion to hydrogen and energy transition projects. Nippon Sanso emphasizes its role as “Gas Professionals,” focusing on electronics gases and hydrogen applications, with KPIs embedded in its NS Vision 2026 strategy. Messer invests in application technologies, such as oxyfuel combustion and hydrogen refueling, to support customer decarbonization. SOL pursues steady but less transformative innovation, focusing on homecare services and incremental efficiency gains. Venator, in chemicals, applies innovation to product carbon footprint tools and new pigment technologies. Jinhong invests in infrastructure and renewable energy pilot projects but remains largely regional in scope.

G5 (Minority shareholder protection and corporate control): Air Liquide, Linde and Air Products provide dispersed ownership, equal voting rights and transparent governance, ensuring minority protection. SOL, with the Fumagalli family controlling 62% of shares, maintains independent oversight but concentrates influence. Nippon Sanso is majority-owned by Mitsubishi Chemical, reducing minority influence despite governance reforms. Messer is private, with family and private equity ownership, offering contractual protections to partners but no public minority class. Venator’s past bankruptcy severely impacted minority shareholders, whose equity was largely wiped out. Jinhong Gas is ~70% state-owned, leaving a small free float; while legally compliant, minority influence is minimal.

G6 (Anti-corruption and political involvement policies): Air Liquide, Linde, Nippon Sanso, Messer and Venator enforce strict bans on bribery and political donations, aligning with international standards. Linde and Air Liquide disclose zero tolerance and reinforce through training and supplier codes. Nippon Sanso and Messer integrate anti-corruption into compliance systems, with global training coverage close to 100%. Venator, subject to UK and U.S. laws, applies REACH and FCPA/Bribery Act compliance across markets. Air Products discloses policy engagement, particularly advocating hydrogen incentives in the U.S., but within legal and transparent frameworks. SOL follows Italian compliance norms, and Jinhong adheres to Chinese laws, where corporate political contributions are not a practice.

G7 (Whistleblower mechanisms): Air Liquide, Linde, Air Products, Nippon Sanso and Venator maintain independent, confidential whistleblower hotlines, available globally and monitored at board level. Messer and SOL have structured channels, though less visible publicly. Nippon Sanso reported 100% of employees trained in compliance and awareness of whistleblower systems in 2024. Jinhong provides little disclosure of internal hotlines, with reporting typically handled through state or Party mechanisms. The presence of secure, anonymous reporting channels remains a clear differentiator between international leaders and smaller, regionally focused firms.

6.1.4 Future Commitment

Table 36 presents the Future Commitment assigned scores, which are subsequently justified in the paragraphs that follow.

Table 36 – Future Commitment Grades

#	Question	Air Products	Linde	Air Liquide	Taiyo Nippon Sanso	Messer Group	SOL Group	Jinhong Gas	Venator Materials
Future commitment									
FC1	Management ESG Awareness	5	5	5	5	5	4	3	4
FC2	Clarity and traceability of ESG goals	4	5	5	5	4	3	2	4
FC3	Proven execution capability of ESG initiatives	4	5	5	4	4	3	2	3
FC		4.3	5.0	5.0	4.7	4.3	3.3	2.3	3.7

Source: Own elaboration

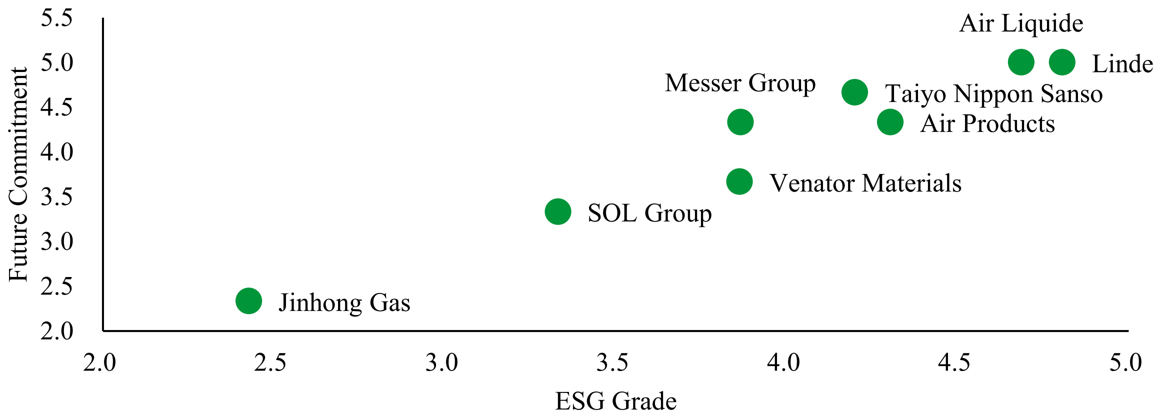
FC1 (Management's ESG awareness and leadership): Among the peer group, ESG awareness at the top management level is most explicit at Air Liquide, Linde, Air Products and Nippon Sanso. Air Liquide integrates ESG into its corporate purpose, with CEO Benoît Potier and the board regularly communicating on sustainability milestones, such as the 2035 CO_2 reduction target. Linde's executive committee directly oversees climate and safety goals, and ESG is embedded in strategic planning, as demonstrated by the USD 50 billion investment roadmap in clean technologies through 2035. Air Products highlights sustainability as its "higher purpose," with CEO Seifi Ghasemi linking hydrogen megaprojects directly to corporate strategy. Nippon Sanso's management has formalized oversight through its Sustainability Promotion Committee and linked ESG to "NS Vision 2026." Messer shows strong owner-driven awareness, with ESG themes (safety, decarbonization, diversity) named as strategic pillars in family-led governance. SOL frames ESG as part of its mission, though disclosure is less explicit at the executive level. Venator prioritizes ESG as a condition for regaining market trust after restructuring, with management highlighting circular economy initiatives. Jinhong Gas communicates alignment with national carbon peak and neutrality goals, but evidence of board-level ESG advocacy remains limited.

FC2 (Clarity and traceability of ESG goals): Linde, Air Liquide and Nippon Sanso present the clearest ESG roadmaps, with quantified targets, baseline years and public dashboards. Linde's "Our Sustainable Future" framework includes absolute reduction commitments (–35% CO_2 by 2035) and trackable metrics such as 451 sites already achieving "zero waste." Air Liquide sets transparent milestones of –33% CO_2 by 2035 and net zero by 2050, and publishes annual CO_2 trajectories. Nippon Sanso details 26 ESG KPIs, such as cutting landfill waste by 50% by 2026 (already reduced by 47% by 2024) and increasing renewable energy use by 25% by 2031. Air Products rebaselined its "Third by '30" goal in 2023, tightening the ambition, and discloses annual progress reports. Messer's targets — such as 40% emissions intensity reduction by 2030 — are measurable, though not externally validated. Venator discloses ambitious goals (–50% emissions and –50% waste by 2030) and reports progress annually, though execution depends on post-bankruptcy stability. SOL discloses renewable integration targets (24% achieved in 2024) but fewer quantified goals beyond energy. Jinhong aligns with China's carbon neutrality agenda but provides fewer traceable, time-bound commitments accessible to international investors.

FC3 (Proven execution capability on ESG initiatives): Execution is a key differentiator. Linde has already achieved multiple goals ahead of schedule, including zero-waste sites by 2024 instead of 2028, and delivered –16% emissions reductions in a single year. Air Liquide consistently delivers incremental CO_2 reductions (–11% vs 2020) and progresses toward its 2035 target while scaling global hydrogen projects. Air Products reduced Scope 1+2 emissions by –13.4% in 2024 and has committed USD 15 billion to projects that are already under construction or in operation. Nippon Sanso exceeded nearly all intermediate 2024 goals, including cutting landfill waste by 47% (against a 2026 milestone) and reducing emissions by 15.3% since 2019. Messer delivered a 16% emissions cut between 2019 and 2023, confirming progress toward its 2030 intensity goal. Venator achieved its 2030 non-hazardous waste reduction target six years early, reusing 100,000 t of by-products in 2024, and reports –13% CO_2 in one year. SOL steadily increased renewable energy share to 24% in 2024, though broader ESG execution remains limited. Jinhong reports successful compliance with all 2023 environmental objectives, including emissions reductions of 120,000 tCO_2 annually, but without the transparency and external assurance typical of larger peers.

To summarize the results across all evaluated companies, the following chart presents the aggregated ESG Index scores. The figure provides a visual comparison of overall performance, highlighting leaders and laggards within the peer group. By consolidating the detailed scores from the Environmental, Social, Governance and Future Commitment dimensions, the chart facilitates a clear understanding of relative positioning and overall ESG maturity among the eight companies analyzed (see Chart 58).

Chart 58 – ESG Index and Future Commitment



Source: Own elaboration

The ESG Index highlights substantial heterogeneity in maturity across the global industrial gases and specialty chemicals sector. Linde (4.8) and Air Liquide (4.7) emerge as clear leaders, with consistently high performance across all dimensions — strong environmental strategies validated by international compacts, advanced diversity and governance structures, and proven execution capability. Air Products (4.3) follows closely, with robust policies and major investments in clean hydrogen, but slightly less alignment with international frameworks. Nippon Sanso (4.2) demonstrates solid progress, particularly in diversity and waste reduction, though global transparency remains a relative limitation.

Messer (3.9) and Venator (3.9) occupy an intermediate position: both disclose ambitious targets and deliver credible progress, but their scale and governance frameworks are less developed compared to the global leaders. SOL Group (3.3) performs below the sector average, with reliable compliance but fewer ambitious goals and lower transparency. Jinhong Gas (2.4) ranks last, largely due to limited disclosure and reliance on domestic frameworks, which restricts comparability and visibility for international stakeholders.

Overall, the results confirm that ESG leadership is strongly correlated with global scale, international capital market exposure, and long-term strategic commitments. The chart visually reinforces these findings, highlighting the superior positioning of Linde and Air Liquide, the competitive performance of Air Products and Nippon Sanso, and the relative lag of smaller or regionally concentrated peers.

6.2 ESG Ternary Plot

The ternary plot (Chart 59) provides a complementary visualization of the ESG Index by showing how companies distribute their strengths across the Environmental (E), Social (S) and Governance (G) pillars. While the previous section compared the overall ESG scores, the ternary plot highlights how these scores are balanced internally, and Chart 60 further decomposes the E, S and G dimensions.

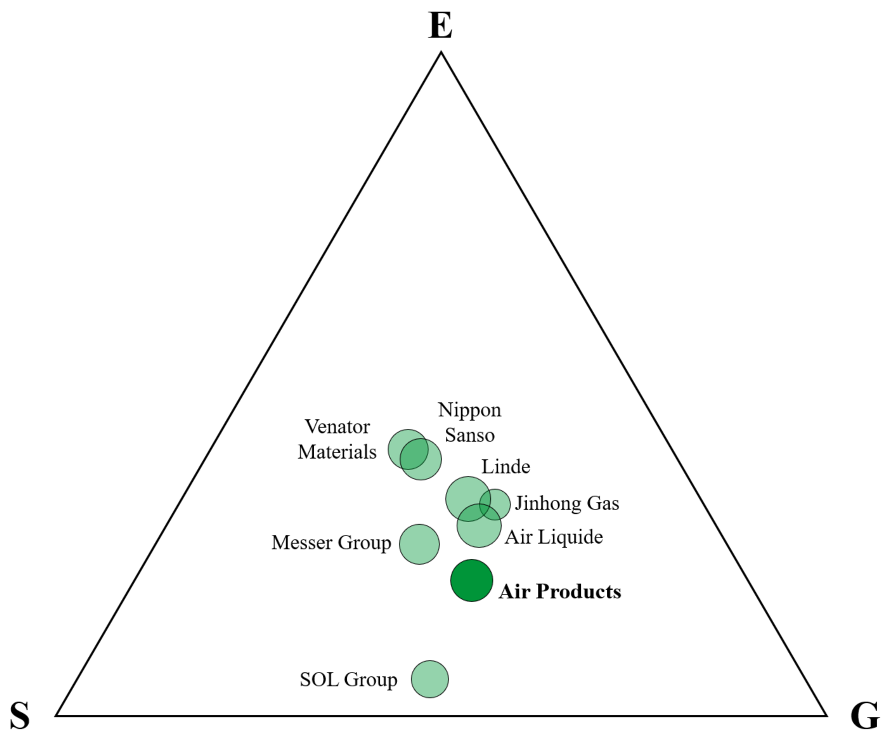
Most companies appear relatively close to the center of the triangle, indicating balanced development across the three pillars rather than extreme concentration in any single dimension. Linde and Air Liquide, which lead the ESG Index overall, occupy the central high-performance cluster, with strong and evenly distributed results across E, S and G. Their position reflects ambitious climate strategies, advanced workforce and diversity practices, and highly mature governance systems.

Air Products appears in close proximity to this cluster, with stronger results in Governance and Social and comparatively lower alignment to Environmental frameworks, which shifts its point slightly toward the G–S side rather than toward Environmental. Nippon Sanso also remains near the center, with relatively balanced results, though with marginally stronger Environmental performance.

Messer and Venator show intermediate ESG maturity but with more directional profiles: Venator scores higher in Environmental due to its rapid progress in waste reduction and circularity, while Messer is stronger in Social and Governance. These differences create visible separation in the plot.

SOL Group is positioned lower on the S axis due to significantly weaker Environmental performance relative to its Social and Governance scores, while Jinhong Gas, the lowest performer, remains the farthest from the central cluster, reflecting consistently limited transparency across E, S and G.

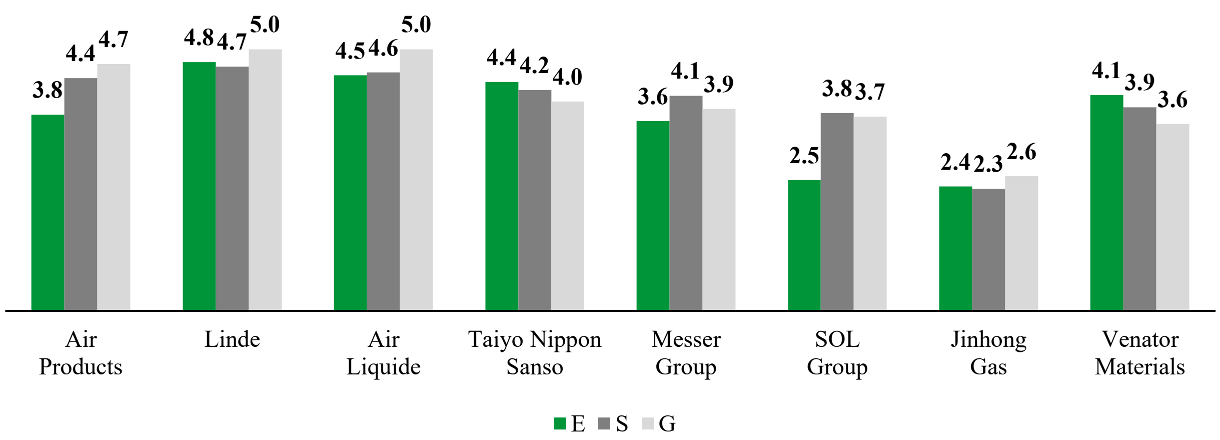
Chart 59 – ESG Ternary Plot



Source: Own elaboration

Overall, the ternary plot and the disaggregated E, S and G scores (Chart 60) confirm the conclusion from the ESG Index: top performers distinguish themselves not only through high absolute scores but also through balanced ESG development, while weaker peers show structural weaknesses concentrated in specific pillars.

Chart 60 – Disaggregated E, S and G Scores



Source: Own elaboration

7. INVESTMENT THESIS AND CONCLUSIONS

This final chapter brings together the evidence gathered throughout this report and formulates a structured investment thesis on Air Products and Chemicals, Inc. It summarizes the key sectoral, financial and sustainability insights developed in the preceding chapters and synthesizes them into a recommendation for long-term investors.

7.1 Summary of the Research

The thesis began with a review of the relevant literature in corporate finance and valuation, establishing the conceptual framework for analyzing companies. A detailed sector analysis showed that the industrial gases market is a critical enabler of modern economies, with products such as oxygen, nitrogen and hydrogen underpinning processes in steelmaking, refining, chemicals, health care, food and electronics. Structural characteristics such as high capital intensity, long-term take-or-pay contracts and diversified end-markets give the industry defensive qualities and relatively stable cash flows. Barriers to entry, economies of scale and the oligopolistic structure of the sector have resulted in sustained returns on capital for the leading players.

The study also examined the emerging hydrogen economy. Policy initiatives like the Inflation Reduction Act in the United States and the Fit for 55 package in the European Union are accelerating investment in green and blue hydrogen and carbon capture technologies. As the energy transition unfolds, hydrogen is expected to play an essential role in decarbonizing heavy industry, mobility and power generation. This context creates a dual opportunity for established industrial gas providers: they can leverage their engineering expertise and infrastructure to participate in fast-growing hydrogen projects while continuing to benefit from the resilience of their core gases business.

Chapter 4 assessed Air Products' strategic positioning and historical performance. The company holds a top-tier market share in the United States and a significant global footprint. Its revenue is balanced across the Americas, Europe, Asia and the Middle East, with a product mix that is more heavily weighted toward hydrogen and helium than its peers. Air Products' business model is built on long-term contracts that pass through electricity and feedstock costs to customers, reducing margin volatility. The company has a track record of healthy EBITDA margins (above 40%) and has increased its dividend every year for more than four decades, highlighting its commitment to shareholder returns.

The thesis further analyzed the company's major strategic initiatives. Air Products is one of the few industrial gas players capable of sponsoring multi-billion-dollar projects. The NEOM Green Hydrogen Company in Saudi Arabia, the Louisiana Blue Hydrogen and Ammonia complex, and the Alberta Net-Zero Hydrogen project illustrate management's willingness to commit significant capital to decarbonization. Although these ventures carry execution risk and have experienced cost inflation and delays, they also position Air Products at the forefront of the energy transition and could generate very high margins once operational. The financial modelling chapter projected revenue, costs, CAPEX and working capital for Air Products, providing a DCF valuation as the central estimate of intrinsic value. The DCF was cross-checked using trading multiples of comparable companies and sensitivity analyses on key drivers.

Finally, an ESG assessment reviewed Air Products' environmental, social and governance practices in comparison to its peers. The company has published ambitious carbon-reduction targets and is investing heavily in green and blue hydrogen, carbon capture and sustainable infrastructure. Its safety record, diversity initiatives and board independence compare favorably with global peers, although the execution of blue hydrogen projects means that the transition away from fossil-based feedstocks will be gradual.

7.2 Investment Thesis

The combination of a mature industrial gases business and a portfolio of transformative hydrogen projects defines Air Products' investment case. The core gases division provides contractual stability, with take-or-pay agreements often extending over 15 years. These contracts include indexation mechanisms that allow the company to pass energy and feedstock price changes on to customers, safeguarding margins. The oligopolistic structure of the sector limits competitive pressure, enabling Air Products to earn returns on invested capital above its cost of capital. Moreover, the company's exposure to helium, a scarce and high-margin gas, offers an additional source of differentiation.

On top of this stable foundation, Air Products is spearheading some of the world's largest hydrogen ventures. The NEOM project, for example, aims to produce 600 tonnes per day of green hydrogen from renewable energy, with a significant portion of output already secured under take-or-pay contracts. The Louisiana and Alberta projects will produce blue hydrogen using carbon capture technologies and benefit from tax incentives such as the U.S. 45Q credit. While these projects require substantial upfront capital and have experienced cost revisions, they are structured with non-recourse project debt and long-term offtake agreements that mitigate balance-sheet risk. If executed successfully, they could generate EBIT margins well above the company's existing industrial gas operations and lock in decades of high-growth earnings.

The financial model developed in this thesis indicates that Air Products should continue to deliver steady revenue and earnings growth over the next decade, driven by industrial gas demand in emerging and developed markets and the ramp-up of new hydrogen assets. Despite elevated capital expenditures, the company is expected to maintain a solid free cash-flow profile and a conservative balance sheet, thanks to the use of project financing and phased investment. The DCF analysis suggests that the intrinsic value of Air Products' equity is above its current market capitalization, implying meaningful upside potential for long-term investors. Relative valuation using peers such as Linde and Air Liquide also indicates that Air Products trades at a discount on a price-to-earnings basis despite its superior growth prospects.

In the ESG dimension, Air Products' commitments to decarbonization and strong governance practices enhance its investment attractiveness in a world where sustainability considerations are increasingly integrated into portfolio decisions. The company's 41-year track record of consecutive dividend increases, coupled with its investment-grade credit profile, provides additional confidence in its ability to navigate economic cycles and fund ambitious projects without compromising shareholder returns.

However, investors should remain mindful of the risks associated with Air Products' strategy. The capital intensity and engineering complexity of its megaprojects expose the company to cost overruns, execution delays and regulatory uncertainties. Macro-economic slowdowns could affect industrial gas demand, while helium prices can be volatile. Governance transitions and activist investor pressure may also lead to strategic shifts or changes in capital allocation. While these risks are non-trivial, the thesis concludes that they are adequately balanced by contractual protections, diversified revenue streams and disciplined management.

7.3 Final Remarks and Recommendation

From an academic perspective, this thesis demonstrates how a structured valuation framework, combining sectoral analysis, financial modelling and ESG assessment, can yield a nuanced understanding of a company operating at the crossroads of a mature industry and a nascent energy transition. The analysis highlights the importance of integrating qualitative insights — such as competitive positioning and regulatory trends — into quantitative models to arrive at robust conclusions.

From an investment perspective, Air Products stands out as a high-quality industrial gases company with a compelling pipeline of hydrogen projects that could unlock significant value in the coming decades. Its resilient core business, long-term contracts, differentiated product mix and scale advantage provide a strong foundation, while its early-mover status in green and blue hydrogen offers exposure to one of the most promising avenues of the energy transition. The DCF and multiples analyses conducted suggest that the shares are currently undervalued relative to their intrinsic worth.

Considering the balance of opportunities and risks, the thesis recommends the purchase of Air Products' shares for investors with a long-term horizon. The potential for outsized returns from hydrogen projects, combined with the defensive qualities of the core business and the company's commitment to shareholder remuneration, makes Air Products a compelling addition to a diversified portfolio. Investors should monitor project execution, commodity markets and regulatory developments, but the overall risk–reward profile appears favorable. Therefore, the final conclusion of this research is that Air Products represents an attractive investment opportunity consistent with both financial and sustainability objectives.

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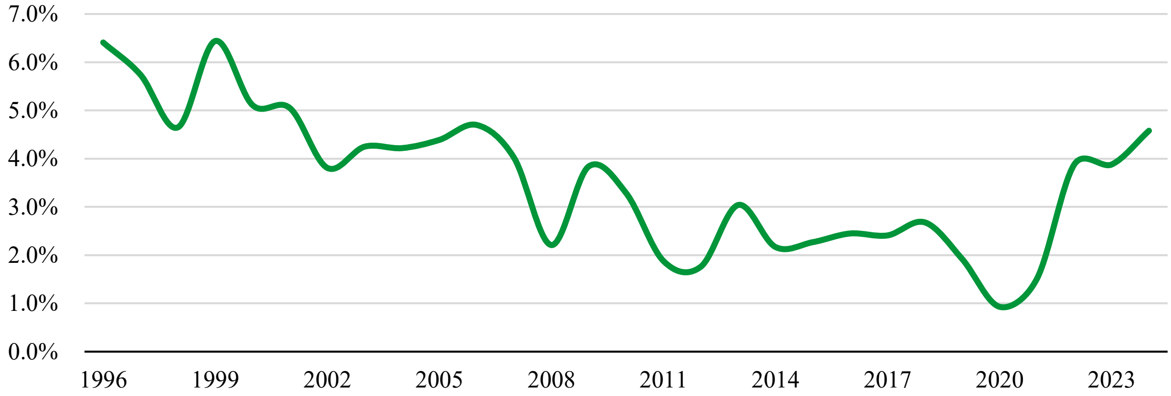
APPENDIX A – ARIMA PYTHON CODE

```
# Install libraries if necessary
!pip install statsmodels pandas matplotlib seaborn --quiet

# Import libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from statsmodels.tsa.stattools import adfuller
from statsmodels.graphics.tsaplots import plot_acf, plot_pacf

# Load historical series: Industrial gases market size from 2008 to 2024
data = [69.5, 66.2, 70.1, 73.2, 74.2, 75.8, 79.7, 81.4, 84.6, 87.4,
        89.9, 93.5, 92.0, 95.7, 100.0, 105.1, 111.0]
years = pd.date_range(start='2008', periods=len(data), freq='Y')

# Create time series
series = pd.Series(data, index=years)

# Plot bar chart with values displayed on top
plt.figure(figsize=(12,6))
sns.barplot(x=series.index.year, y=series.values, color="skyblue", edgecolor="black")

# Add labels above each bar
for i, v in enumerate(series.values):
    plt.text(x=i, y=v + 1, s=f"{v:.1f}", ha='center', va='bottom', fontsize=9)

plt.title('Industrial Gases Market Size (2008–2024)', fontsize=14)
plt.xlabel('Year', fontsize=12)
plt.ylabel('Market Size ($)', fontsize=12)
plt.xticks(rotation=45)
plt.grid(axis='y')
plt.tight_layout()
plt.show()

# Basic descriptive statistics
print('Basic statistics of the series:\n')
print(series.describe())

# Function to apply the ADF Test
def adf_test(series, title=''):
    print(f'ADF Test - {title}')
    result = adfuller(series.dropna(), autolag='AIC')
    labels = ['ADF Statistic', 'p-value', '# Lags Used', '# Observations Used']
    output = pd.Series(result[0:4], index=labels)

    for key, value in result[4].items():
        output[f'Critical Value ({key})'] = value

    print(output)

    if result[1] <= 0.05:
        print("\nThe series is stationary (p-value <= 0.05).")
    else:
        print("\nThe series is NOT stationary (p-value > 0.05).")

# Apply the test to the original series
adf_test(series, title='Original Series')

# Plot ACF and PACF correlograms with adjusted lags
fig, axes = plt.subplots(2, 1, figsize=(12,10))

# ACF
plot_acf(series, lags=15, ax=axes[0], title='Correlogram - ACF (Autocorrelation)')
axes[0].set_xlabel('Lags')
axes[0].set_ylabel('Autocorrelation')

# PACF (lags <= 50% of the series → max 7 here)
plot_pacf(series, lags=7, ax=axes[1], title='Correlogram - PACF (Partial Autocorrelation)')
axes[1].set_xlabel('Lags')
axes[1].set_ylabel('Partial Autocorrelation')

plt.tight_layout()
plt.show()
```

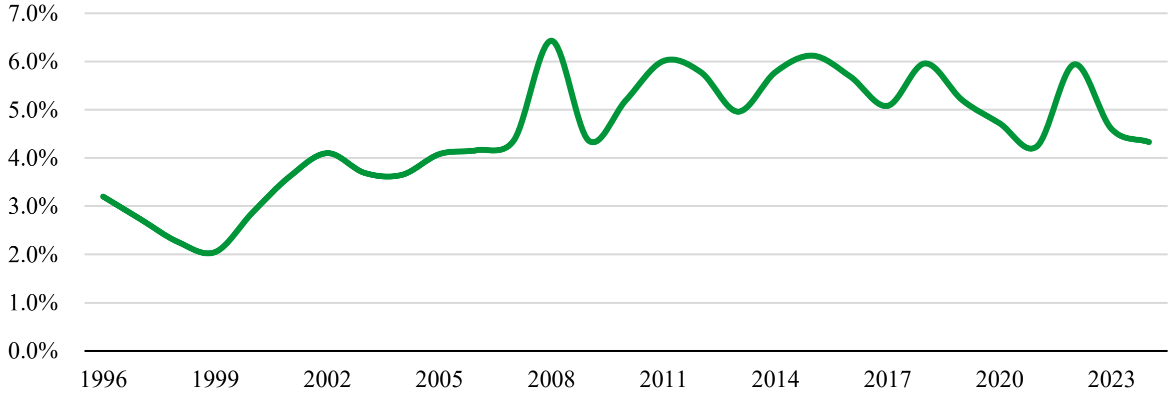
```python
from statsmodels.tsa.arima.model import ARIMA

# Train ARIMA(1,1,1)
model_111 = ARIMA(series, order=(1,1,1)).fit()
aic_111 = model_111.aic

# Train ARIMA(1,2,1)
model_121 = ARIMA(series, order=(1,2,1)).fit()
aic_121 = model_121.aic

# Compare AIC values
print(f"AIC - ARIMA(1,1,1): {aic_111:.2f}")
print(f"AIC - ARIMA(1,2,1): {aic_121:.2f}")

# Choose the best model based on the lowest AIC
if aic_111 < aic_121:
    final_model = model_111
    best_order = (1,1,1)
else:
    final_model = model_121
    best_order = (1,2,1)

print(f"\nBest model selected: ARIMA{best_order}")

# Residuals of the final model
residuals = final_model.resid

# Plot residuals over time
plt.figure(figsize=(12, 4))
plt.plot(residuals, marker='o')
plt.title('Residuals of the ARIMA Model')
plt.xlabel('Year')
plt.ylabel('Error')
plt.grid(True)
plt.tight_layout()
plt.show()

# Histogram of residuals
plt.figure(figsize=(8, 4))
sns.histplot(residuals, kde=True, bins=10, color='skyblue')
plt.title('Residual Distribution')
plt.xlabel('Error')
plt.tight_layout()
plt.show()

# Residual correlogram
plot_acf(residuals, lags=15)
plt.title('ACF of Residuals')
plt.tight_layout()
plt.show()

# Forecast the next 10 years (2025 to 2034)
forecast = final_model.get_forecast(steps=10)
forecast_mean = forecast.predicted_mean
conf_int = forecast.conf_int()

# Generate dates for future years
forecast_years = pd.date_range(start='2025', periods=10, freq='YE')

# Plot historical data + forecast + confidence interval
plt.figure(figsize=(12,6))
plt.plot(series, label='Historical Data', color='orange')
plt.plot(forecast_years, forecast_mean, label='Forecast (2025–2034)', linestyle='--', marker='o')
plt.fill_between(
    forecast_years,
    conf_int.iloc[:, 0],
    conf_int.iloc[:, 1],
    color='gray', alpha=0.3, label='95% Confidence Interval'
)
plt.title('Industrial Gases Market Projection (ARIMA)', fontsize=14)
plt.xlabel('Year')
plt.ylabel('Market Size ($)')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```

APPENDIX B – MONTE CARLO HISTORICAL DATA

I. T BOND HISTORICAL DATA



II. ERP HISTORICAL DATA



III. SINGLE-A US CORPORATE INDEX EFFECTIVE YIELD HISTORICAL DATA