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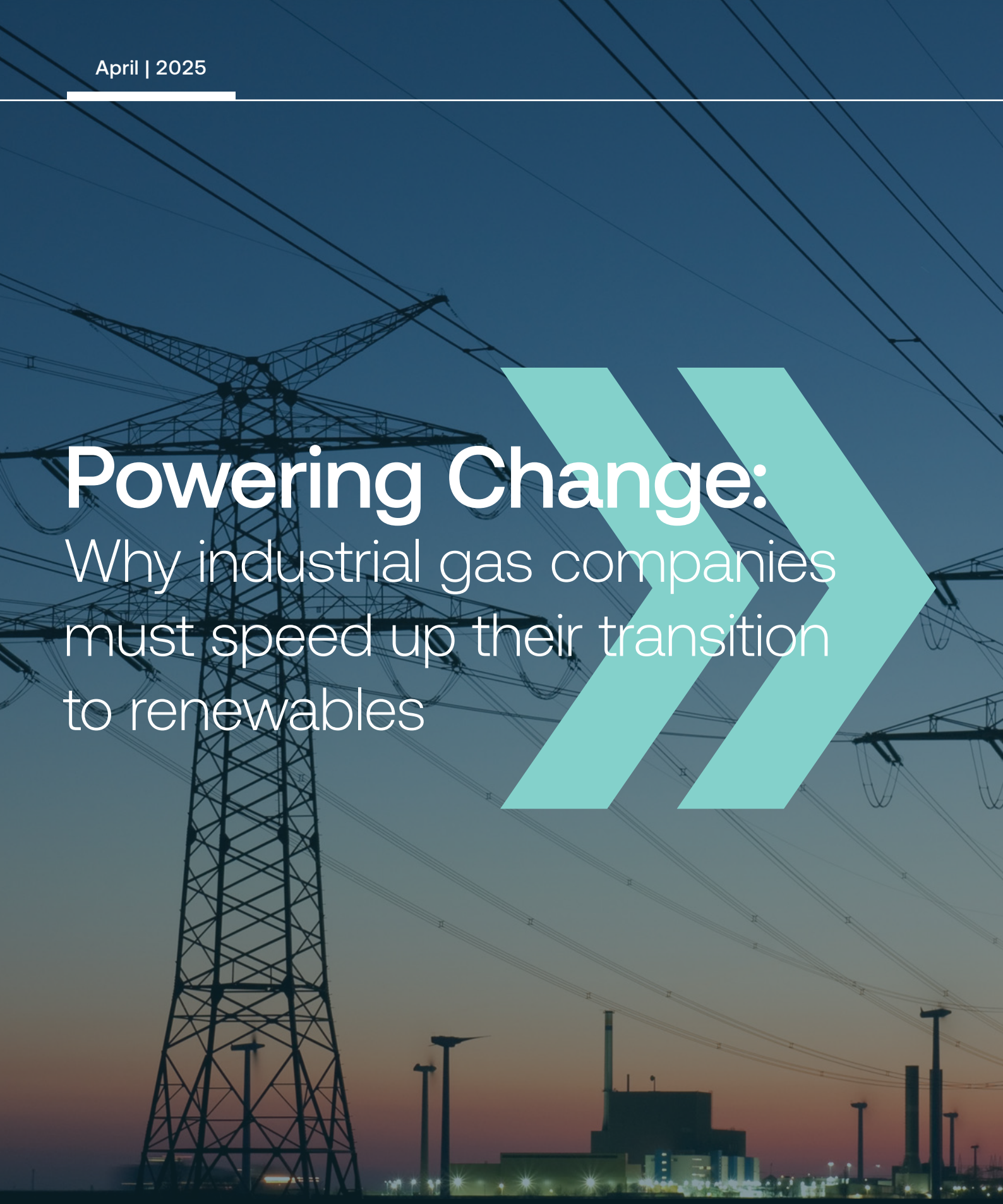

# Powering Change:

## Why industrial gas companies must speed up their transition to renewables

ShareAction»

# About ShareAction

ShareAction is an independent charity and an expert on responsible investment. We work to build a world where the financial system serves our planet and its people.

We set ambitious standards for how financial institutions, through their investment decisions, can protect our planet and its people and we campaign for this approach to become the norm. We convene shareholders to push companies to tackle the climate crisis, protect nature, improve workers' lives and shape healthier societies. In the UK and EU, we advocate for financial regulation that has society's best interests at its core.

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# Author

**Lydia Heinrichs**
Senior Research and Campaign Consultant

# Editor

**Jane Garton**

# Contact

ClimateTeam@shareaction.org

## Disclaimer

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# Executive summary

# Executive summary

**The industrial gas sector is critical to the global economy; it is also highly energy-intensive.** Linde, Air Liquide, and Air Products – the largest industrial gas companies globally, and the focus of this report – aren't household names. But the products they manufacture, including oxygen, hydrogen, and nitrogen, serve a range of critical applications across the global economy, supplying gases for medical anaesthetics, semiconductor manufacturing, and steel production, among other things. These companies are also highly energy-intensive. Linde and Air Liquide are two of the world's largest corporate electricity consumers, outstripping even tech giants such as Google and Microsoft.[1] Combined, the top three industrial gas companies have an annual electricity consumption the size of Belgium's.[2]

**Today, industrial gas companies' energy use comes largely from fossil fuels, generating high levels of planet-warming emissions.** Linde, Air Liquide, and Air Products – and the industrial gas sector as a whole – must take rapid action to transition away from fossil fuels in their electricity and other energy use in order to align with net-zero. This report outlines the steps industrial gas companies need to take to deeply reduce their emissions from procured energy – 'scope 2 emissions' – and assesses their progress in doing so.

**At present, the three main industrial gas companies lack robust strategies to transition to renewable energy in their operations.** The three main industrial gas companies each procure less renewable electricity as a proportion of total electricity consumption[3] than the global share of renewables in electricity generation, which was 30 per cent in 2023.[4] Linde, for example, procures only 11.5 per cent renewable electricity.[5] Despite this, companies do not have clear strategies in place to transition to renewables. Neither Linde nor Air Liquide is currently on track to achieve the level of procurement recommended by this report by 2030, and Air Products' disclosures are too poor to assess their performance against our benchmark. Current near- and long-term targets are opaque, often excluding expected future increases in electricity consumption, and sometimes deploying invalid electricity accounting methodologies.[i] Companies also lack ambitious strategies to electrify assets powered by fossil-based steam.

**ShareAction calls on investors in Linde, Air Liquide, and Air Products to engage with these companies to ensure that they make deep, rapid and lasting cuts to their scope 2 emissions in the coming years.**

i See chapter 4 for our analysis of companies' current renewable energy targets and procurement trajectory, and for our explainer on companies' use of 'passive' renewable electricity in their electricity accounting.

## Our recommendations

**To make deep cuts to their emissions in the near term, companies need to electrify their air gas production assets (air separation units, or 'ASUs') and rapidly increase the proportion of renewable energy used to power them.** The technologies required to do this – electric motors, wind, solar and batteries – are already commercially competitive and widely deployed. With the levelised cost[ii] of new renewable power generation now lower than that of fossil-fired generation globally,[6] this transition also offers commercial benefits to industrial gas companies and their customers.

**Industrial gas companies should aim to triple their procurement of renewable energy by 2030, in line with the global pledge made by signatories to the Paris Agreement at the COP28 climate negotiations.** Many countries in both developed and emerging markets already have national policies in place that will enable them to double their renewable energy capacity by 2030.[7] In China, current growth rates are approaching what is required to triple capacity by 2030.[8] As some of the world's largest electricity consumers, industrial gas companies have the buying power and influence to catalyse faster decarbonisation in global grids. Their procurement sends a demand signal to electricity markets for increased supply of renewables. It can provide direct financial support for renewable projects. It encourages policymakers to increase their ambition on grid decarbonisation. It can also offer a crucial demand-pull for technologies needed to operate grids on high levels of renewable energy, such as batteries and long-duration energy storage.

**Companies must adopt transparent, ambitious strategies to ensure that their renewable energy procurement will result in real emissions reductions.** Many of the most widely used renewable energy procurement mechanisms, such as unbundled energy attribute certificates ('EACs'), contribute very little to real-world decarbonisation, since they do not drive additional renewable energy capacity in the grid. To ensure procurement truly enables grid decarbonisation, companies must adopt strict criteria for procurement mechanisms and the types of renewables projects contracted; commit to procure only renewable energy generated on the same grid as it is consumed; and develop granular targets which seek to maximise the procurement of renewable energy generated at the same time as it is consumed. While the major industrial gas companies do not yet have policies aligned with these criteria, other major electricity consumers, such as Google and Microsoft, have already committed to operate on local, clean electricity around the clock by 2030.[9]

**Running industrial gas companies' operations on renewables around the clock will require investment in technologies that are currently nascent.** At present, ASUs need to be run continuously; this poses challenges to integrating very high levels of renewable energy into industrial gas companies' operations, given the variability of wind and solar power. However,

ii The levelised cost of energy is a measure of the average cost of generating electricity from an energy asset, such as a power plant or solar farm, over the whole lifetime of that asset, including upfront investment costs and operating costs.

companies are developing flexible ASUs which can adjust to the variable output of renewables without disrupting production, and are piloting these in commercial assets. Companies can also consider investing in long-duration energy storage technologies, which store renewable electricity to ensure continuous supply during long periods of reduced generation. These technologies will enable industrial gas companies to power their operations on renewables around the clock in the mid- to long-term.

**While barriers to the procurement of renewable energy persist in some regions, companies can use their influence in these markets to advocate for supportive renewable energy policies.** In some markets, electricity market regulations prevent companies from signing long-term agreements directly with renewable energy generators, which can make procurement challenging. However, regulations are rapidly changing for the better, including in key markets such as China and South Africa. Companies should engage with local utilities, regulators and policymakers to expand the procurement options available to them.

**The electricity sector's transition is already well underway, and industrial gas companies must plan for a renewable future.** Renewables now account for nearly a third of global electricity production.[10] New generation from wind and solar is less costly than new fossil generation in all major markets,[11] making these 'the default source of low-cost new power generation', according to the International Renewable Energy Agency (IRENA).[12] While international climate governance is currently strained, the economics of the energy transition remains favourable. Industrial gas companies must make sure they are prepared for a future led by wind and solar.

**This report recommends a set of standards for investors to use in their assessment of and engagement with these industrial gas companies, as set out below.**

# Standards for assessing industrial gas companies' renewable energy strategies

## Investor Engagement Ask 1: Process Electrification

- **Disclose:**
  1. the proportion of the company's ASUs which are steam-driven;
  2. a breakdown of ASU emissions by country; and
  3. the location of steam-driven ASUs.

- **Publish a target** to electrify all remaining steam-driven ASUs by 2030.

## Investor Engagement Ask 2: Renewable Electricity Accounting

- **Disclose** the proportion of annual electricity consumption the company sources from renewable energy generated[iii] within the same hour as consumption, on the same grid as consumption.

## Investor Engagement Ask 3: Renewable Electricity Targets

- **Set targets** aiming for a rapid increase in the company's renewable electricity procurement in the near- and long-term, as laid out below:
  - **Publish a long-term target** to match 100 per cent of the company's electricity consumption with renewable energy generated within the same hour and on the same grid as consumption.
  - **Publish an ambitious intermediate target** to match a proportion of the company's electricity consumption with renewable energy generated within the same hour and on the same grid as consumption.

iii In this paper, we include renewable energy that is discharged from storage within the same hour as consumption in our definition of renewable energy generated within the same hour as consumption, though we use the latter phrase for simplicity.

## Investor Engagement Ask 4: Alignment with the Tripling Goal

- **Air Liquide should aim to triple** procured renewable energy consumed in the company's operations by 2030, on a 2022 baseline.
- **Linde and Air Products should aim to match the same proportion of procured renewable energy** in overall consumption of electricity as Air Liquide (52 per cent of 2022 consumption) by 2030.

## Investor Engagement Ask 5: Renewable Electricity - Additionality

- **Disclose** a breakdown of current renewable electricity consumption, including:
  - the amount of renewable electricity that is self-generated;
  - a breakdown of the company's renewable electricity purchases, including the contractual instruments used, the amount of renewable energy purchased, and the location of procured generation;
  - the location of the load served by these purchases; and
  - the commissioning or repowering date of contracted projects, along with the date of contract signing.
- **Commit publicly** to procuring only renewable energy which drives additional renewable energy capacity in the local grid, and **disclose a procurement policy** aligned with the following criteria:
  - Procurement maximises **on-site generation and long-term power purchase agreements** (PPAs) in the company's renewable electricity portfolio.
  - Procurement prioritises **new (unbuilt) renewable assets and older renewable assets which are being repowered** after government subsidies have expired.
  - Procurement **excludes unbundled energy attribute certificates (EACs)** and contracts based on unbundled EACs from procurement, unless the company can demonstrate that no other procurement options are available, that it is working to remove barriers to other forms of procurement, and that EACs clearly support additional renewable generation in the relevant market.

## Investor Engagement Ask 6: Storage and Flexibility

- **Disclose** a near- and long-term strategy to invest in or procure:

  1 Energy storage, including batteries and/or long-duration energy storage; and
  2 ASU flexibility.

## Investor Engagement Ask 7: Stakeholder Engagement

- **Communicate clearly** the company's renewable energy targets and strategies to local electricity market stakeholders, such as policymakers and utilities.
- In regions where regulatory barriers prevent or discourage direct corporate renewable energy procurement, **work with regulators, generators and utility companies** to expand options for direct procurement.
- **Advocate for public policies** which target rapid decarbonisation of the power system, enable consumer choice in electricity procurement, and provide standardised regulatory frameworks for power purchase agreements.

## Principles for impactful renewable energy strategies in the industrial gas sector

**100% ASU electrification** by 2030

×3 **Tripling renewable energy procurement** by 2030

++ Procuring only renewable energy that leads to **additional renewable energy capacity** in the grid

Procuring all renewable energy **on the same grid as consumption**

Maximising renewable energy generated **at the same time as consumption**

Investments in **energy storage** and **electricity demand flexibility**

# Introduction

# Introduction

## Industrial gas companies: The world's largest corporate electricity consumers, with a critical role to play in enabling power sector decarbonisation

**Industrial gas companies are major energy consumers. A rapid transition to renewable energy will be critical for these companies to align with the Paris Agreement.** The production of air gases such as oxygen and nitrogen requires large amounts of energy, in the form of electricity and steam, to draw gases down from the atmosphere and liquefy them. Linde and Air Liquide were two of the three largest corporate electricity consumers reporting to the Carbon Disclosure Project (CDP) in 2023, with Amazon rounding off the top three.[13] Linde, Air Liquide, and Air Products are currently heavily dependent on fossil fuels to power their processes, and must rapidly increase the use of renewable energy in their operations in order to reduce their emissions in the coming years.

**A swift transition to renewables in the industrial gas sector could have wider system benefits, catalysing faster decarbonisation in the global electricity system.** The global power sector[iv] is the single largest source of global emissions,[14] responsible for nearly a third of greenhouse gas emissions every year.[15] As such, it will need to be the first to decarbonise to enable the world to reach net zero.[16] Voluntary private-sector demand for renewable energy has historically been a major factor driving renewables expansion; in 2023, corporate power purchase agreements supported a quarter of additional renewable capacity globally outside China.[17] As some of the world's biggest electricity consumers, Linde, Air Liquide and Air Products could play a key role in bringing the date of grid decarbonisation closer.

**Industrial gas companies have both the resources and the ability to rapidly decarbonise their procured energy.** As major electricity consumers with operations on nearly every continent, these companies have deep expertise and large buying power in electricity markets around the world. Their influence in local power markets can help overcome regional barriers to corporate renewable energy procurement and shift policy in favour of renewables. With consistently strong cash generation and a business model that enables them to maintain consistent profits even during downturns in the broader chemical sector,[18] these companies also have the financial means to implement ambitious policies.

**A slow transition to renewables would extend companies' exposure to electricity market volatility and rising carbon prices.** Electricity costs account for more than 30 per cent of industrial gas companies' operating expenditures.[19] Without ambitious policies to increase their use of renewables, these companies will remain exposed to fossil fuel volatility and energy market shocks of the kind seen following Russia's invasion of Ukraine in 2022. Rising

iv Including electricity and heat.

carbon prices in key markets could also impact companies' operating expenditures. In China, for example – where these companies have major, and growing, operations – the Emissions Trading System (ETS) could expand to cover chemicals in the next few years.[20]

**Ambitious renewable energy policies can help mitigate these risks.** Long-term renewable energy contracts, such as power purchase agreements (PPAs), give companies and their investors long-term cost certainty and provide hedging against market volatility. Companies can eliminate, or come close to eliminating, exposure to fossil price volatility by pursuing 'granular matching' policies, which aim for round-the-clock use of renewable electricity (discussed in detail in chapter 2). A 2023 study of 24/7 PPAs in Europe showed that these contracts offer greater absolute hedging benefits in most pricing scenarios than traditional PPAs, compensating for the higher cost of 24/7 procurement.[21]

**This report will outline the steps industrial gas companies need to take to rapidly decarbonise their power emissions.** The first chapter gives an overview of the industrial gas sector and the sources of its emissions, with a focus on power-related emissions. It then lays out investor engagement asks, setting out what companies will need to do to address emissions from their procured energy in the coming years, including process electrification, transitioning to renewable energy, and investing in storage and flexibility for their operations.

**The quality of renewable energy procurement matters as much as the quantity.** Chapter 2 discusses why not all corporate renewable energy strategies contribute equally to driving additional renewable energy – and therefore decarbonisation – in the electricity system. It then sets out standards which investors can use to assess and engage with industrial gas companies on their procurement strategies.

While high-quality procurement mechanisms are increasingly available in electricity markets around the world, **there are still a few markets in which corporates face regulatory and other barriers to long-term power purchase agreements.** Chapter 3 describes some of these challenges and the steps companies can take to address them.

**The final chapter assesses the performance of the three leading global industrial gas companies – Air Liquide, Linde and Air Products – against the standards laid out in this report,** to guide investors' engagements with these companies.

# How industrial gas companies can decarbonise air gas production

1

# Chapter 1: How industrial gas companies can decarbonise air gas production

This chapter gives a brief overview of the industrial gas sector and the main sources of its emissions, before describing air gas production – the main source of industrial gas companies' emissions from procured energy – in more detail. It then discusses the steps companies need to take to address emissions from air gas production.

## Industrial gas companies: The world's forgotten carbon emitters

**The industrial gas sector plays a critical, if often overlooked, role in an array of sectors across the global economy.** Industrial gas companies manufacture hydrogen and air gases such as oxygen, nitrogen and argon for a wide range of uses. Familiar applications include oxygen and medical anaesthetics for hospitals and home healthcare, carbonation for fizzy drinks, and high-purity gases for semiconductor manufacturing. Heavy industry also makes up a significant proportion of the sector's customer base. For example, industrial gas companies provide gases, technology and equipment for upstream oil and gas extraction, as well as hydrogen for midstream refinery operations.[22] Hydrogen is also widely used in chemical production, and increasingly in steel manufacturing.

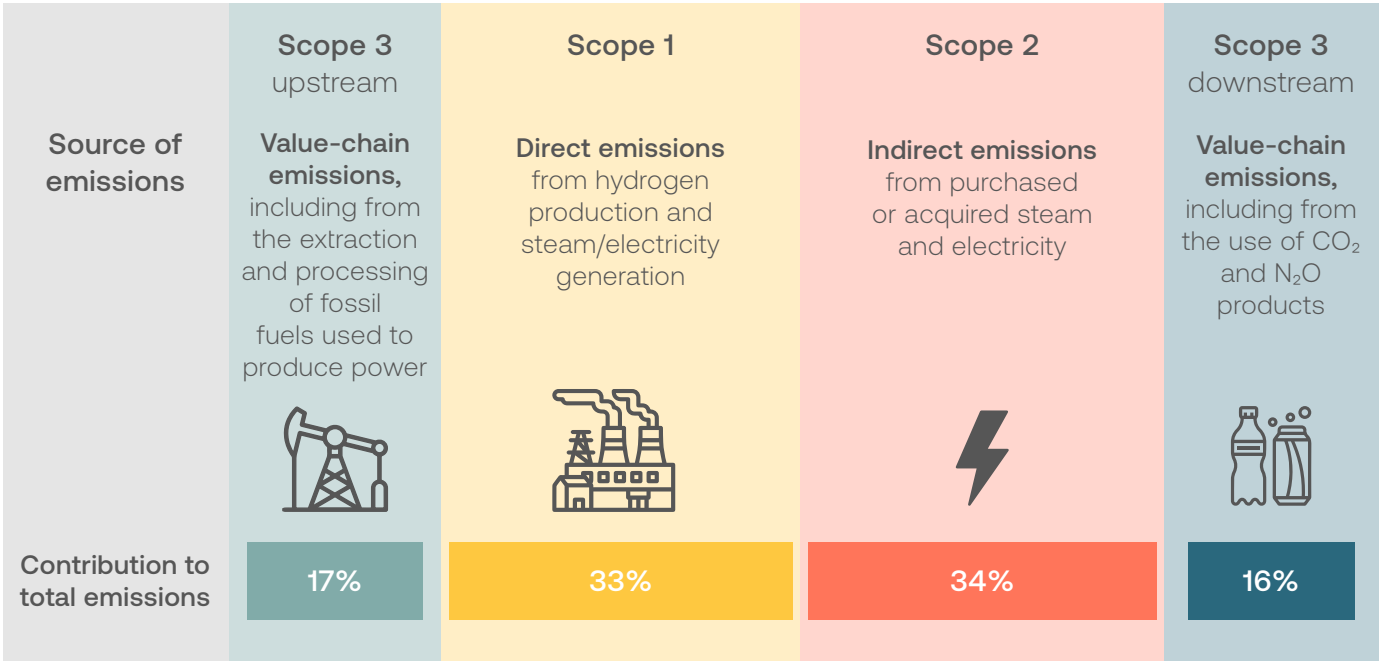
**The industrial gas market is highly concentrated, with three companies controlling more than 70 per cent of market share.**[23] These are Linde, which is headquartered in the UK and domiciled in Ireland; Air Liquide, which is based in France; and the US-based Air Products. Though they are not familiar consumer brands, Linde and Air Liquide rank among the top 200 largest companies globally by market capitalisation;[24] Linde's market capitalisation is four times that of BASF, the world's largest chemical company by revenue.[25] Because of their dominance of global industrial gas markets, this report primarily focuses on these three companies.

**The global energy transition could be a major commercial opportunity for industrial gas companies, if they choose to take advantage of it.** Industrial gas companies sit at the beginning of many industrial and manufacturing value chains, so their own decarbonisation trajectory will have a significant influence on the ability of the rest of the global economy to decarbonise. As major hydrogen producers, these companies are also extremely well placed to facilitate the emergence of renewable hydrogen. This is expected to play an essential role in reducing emissions from some applications which are harder to decarbonise, such as chemical feedstock, steel production and long-duration energy storage.[26]

**The production of industrial gases is highly emissions-intensive, and companies will need to take rapid action to reduce their emissions in order to align with Paris Agreement scenarios.** Industrial gas companies' emissions can be divided into three categories:[27]

- **'Scope 1' emissions** are emissions that companies release **directly** from the energy and raw materials used in their processes. For industrial gas companies, these stem primarily from hydrogen production from fossil gas, as well as some on-site power and steam production. Scope 1 emissions usually account for a quarter to a third of industrial gas companies' total emissions.
- **'Scope 2' emissions** are released during the production of the electricity, steam and heat that companies procure externally. For industrial gas companies, these are heavily dominated by air separation processes to produce oxygen, nitrogen and argon, the so-called 'air gases'. Scope 2 accounts for 30 to 40 per cent of industrial gas companies' emissions.
- **'Scope 3' emissions** are emissions that lie **upstream** and **downstream** of companies' direct operations, accounting for between 30 and 40 per cent of their emissions. These include upstream emissions from the extraction and processing of fossil fuels which they or their suppliers use for energy and raw materials, and downstream emissions from the use of products which are greenhouse gases themselves – such as $CO_2$ used in carbonated beverages and $N_2O$ used as a medical anaesthetic.

## Figure 1: Breakdown of the three major industrial gas companies' emissions by scope




Note: The proportional contribution of each scope to total emissions reflects the average across the three main industrial gas companies in 2023.
Source: Linde (2024), *Sustainable Development Report 2023*, pp. 69-74; Air Liquide (2024), *Climate Transition Plan 2024*, p. 21; Air Products (2024), *Generating a Cleaner Future: Sustainability Report 2024*, p. 48.

**Emissions from power production are especially critical for the industrial gas sector.** Scope 2 emissions account for an unusually large proportion of industrial gas companies' emissions compared to those of other companies in the chemical sector, whose emissions are usually dominated by scope 3.[v] This is because of the enormous electricity and steam consumption required for air separation – industrial gas companies' main production process. However, unlike other industrial sector processes such as cement-making and steam cracking, the majority of air separation emissions can be decarbonised with technologies that are already commercially viable, such as electric motors, wind, solar and batteries. Because of the significance of scope 2 emissions to the sector and the opportunities for deep and rapid emissions cuts in this area, scope 2 decarbonisation will be the subject of the rest of this report.[vi]

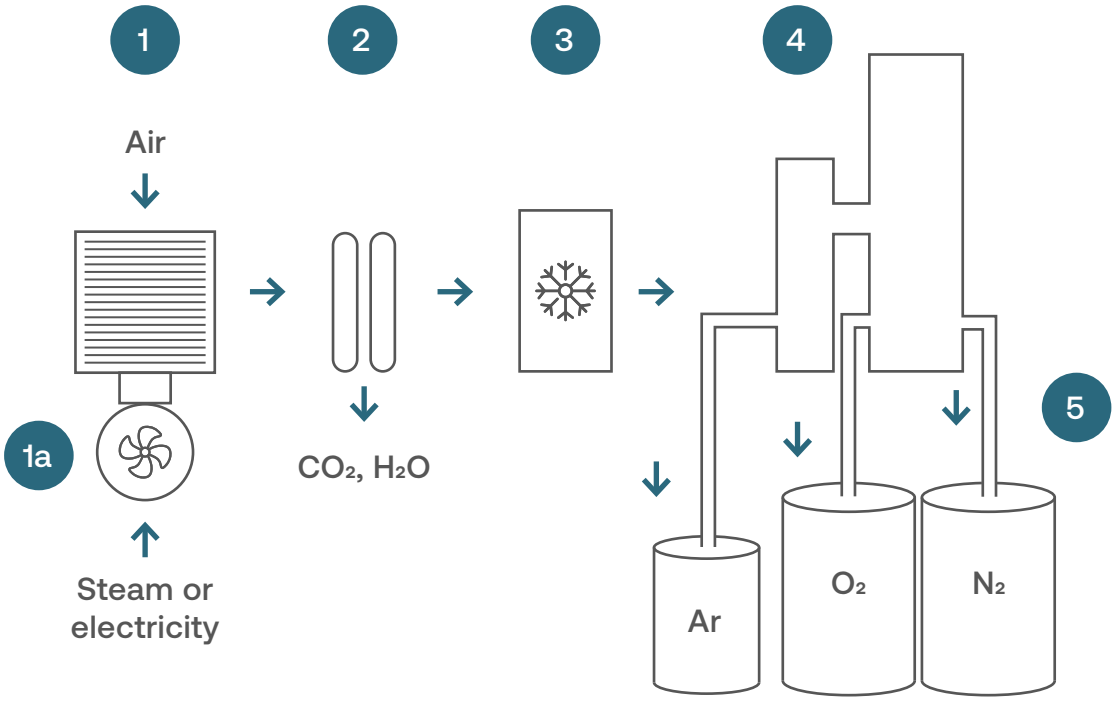
## How industrial gas companies can decarbonise air gas production: Electrification, renewables, storage, and flexibility

**Air separation can account for as much as 90 per cent of companies' scope 2 emissions, according to the disclosures of one major industrial gas company.**[28] The air separation process is used to draw air gases such as nitrogen, oxygen and argon down from the atmosphere, purify them, and render them into a form which can be delivered to customers, either as a liquid or as a compressed gas. Although there are other air separation technologies, more than 90 per cent of air gas production today uses a process called 'cryogenic separation',[29] in which air is compressed and cooled to its boiling point to enable the separation of gases at high levels of purity. Figure 1 gives a detailed overview of this process.

v On average, scope 2 emissions account for only 6.5 per cent of chemical sector emissions, while scope 3 emissions account for 70-80 per cent. Roland Berger (2024). 'Extraordinary measures: Ways to decarbonize the chemicals industry'. Available online at: https://www.rolandberger.com/en/Insights/Publications/Extraordinary-measures-ways-to-decarbonize-the-chemicals-industry.html [accessed 18 March 2025].

vi ShareAction has discussed how chemical companies can decarbonise hydrogen production in our 2022 report *Beyond the Blue: Renewable hydrogen in the chemical industry*. Available online at: https://cdn2.assets-servd.host/shareaction-api/production/resources/reports/ShareAction_Hydrogen-Report_2022.pdf [accessed 31 March 2025].

Figure 2: The cryogenic air separation process[30]




1 **Air compression:** Atmospheric air enters the main air compressor, where it is filtered and compressed to high pressure. Air compressors are powered either by electric motors or steam turbines (1a).[31]
2 **Air cleaning:** The air is moved to a cleaning unit, where water, $CO_2$ and hydrocarbons which could freeze and damage plant equipment are removed.
3 **Air cooling:** The air is then cooled to cryogenic temperatures (roughly -170°C) and partially liquefied.
4 **Air separation:** The air enters a series of distillation columns, where the 'fractional distillation' process takes place. This process takes advantage of the different boiling points of oxygen, nitrogen and argon to separate them out from one another.
5 **Product delivery or storage:** Following distillation, gases are either delivered directly to the customer via a pipeline or liquefied and sent to storage tanks.[32]

**Addressing emissions from air separation units (ASUs) will require companies to electrify steam-driven assets, transition them to renewable energy, and invest in technologies to enable better integration of variable renewables in their operations.** These include technologies to enable ASUs to respond dynamically to variations in wind and solar supply – known as 'flexibility' or 'demand-side management' technologies – as well as on-site or off-site energy storage.

## Electrification of air separation units: Low-hanging fruit for air gas decarbonisation

**The first step in reducing industrial gas companies' scope 2 emissions is to electrify remaining steam-driven air compressors so they can be run on renewable energy.** The vast majority of energy used in ASUs is consumed during the compression of atmospheric air at the beginning of the process.[33] Air compressors can be powered either by a steam turbine or by an electric motor.[34] Historically, industrial gas companies and their customers often chose to invest in steam-driven air compressors, particularly in coal-rich countries such as China and South Africa,[35] where cheap coal supplies could power steam production. In recent years, however, best-in-class ASUs have tended to use electric motors, which offer decarbonisation opportunities. Air Liquide, for example, reported in early 2023 that 95 per cent of its ASUs were already electrified.[vii] (Other companies have not disclosed the proportion of steam-driven ASUs in their asset base.)

**Steam-driven ASUs drive a significant proportion of companies' scope 2 emissions, even when they make up only a fraction of companies' total assets**. Air Liquide has said that the remaining five per cent of its ASUs which are still steam-driven – located exclusively in China and South Africa – account for more than a quarter of its scope 2 emissions.[36]

**ASU electrification is commercially viable, highly competitive economically, and has already been widely deployed.** Existing steam-driven ASUs can be retrofitted with electric motors without the need for investment in a new ASU.[viii] Furthermore, electrified technologies are generally more efficient than their combustion counterparts,[37] and the vast majority of new renewable energy generation is now cheaper than fossil alternatives.[38] Process electrification thus offers opportunities to reduce operational costs, providing long-term benefits both to industrial gas companies and their consumers. While the electrification of ASUs which are co-located with customers' assets needs to be coordinated with production scheduling, sufficient planning and communication with customers about the benefits of ASU electrification can enable timely transition of these assets.

vii Air Liquide (2023). Letter in response to ShareAction. Available online at: https://www.airliquide.com/sites/airliquide.com/files/2023-03/air-liquide-letter-to-shareaction-march-2023.pdf [accessed 4 February 2025]. We have drawn extensively on data from Air Liquide in this section because its disclosures are more detailed than those of the other companies and not because its performance is better or worse than that of its peers.

viii For an example of a recent ASU retrofitted to enable electrification, see Air Liquide (2023). 'Air Liquide to modernize and lower the carbon footprint of two oxygen production units in Tianjin, China'. Available online at: https://www.airliquide.com/group/press-releases-news/2023-03-21/air-liquide-modernize-and-lower-carbon-footprint-two-oxygen-production-units-tianjin-china [accessed 21 February 2025].

### Investor engagement asks: ASU Electrification

- **Disclose:**
  - the proportion of the company's ASUs which are steam-driven;
  - a breakdown of ASU emissions by country; and
  - the location of steam-driven ASUs.
- **Set a target** to electrify all remaining steam-driven ASUs by 2030.

## Transitioning to renewable electricity: Companies can significantly increase renewable energy use in the near term, while reaching round-the-clock renewables will require investment in flexibility and storage

**Electrification is only part of the solution: industrial gas companies must also rapidly increase the use of renewable energy in their operations.** While ASU electrification is a crucial first step in reducing emissions, full scope 2 decarbonisation will require companies to transition rapidly to using a high proportion of renewable energy in their operations. This is particularly the case because the main industrial gas firms have extensive operations in regions with highly emissions-intensive, coal-dependent grids, such as China, India and South Africa. For example, more than 50 per cent of Linde's scope 2 emissions stem from markets in Asia Pacific,[39] even though this region accounts for only 20 per cent of the company's revenues.[40]

**Industrial gas companies can make significant progress on renewable energy procurement in the near term using existing, commercially viable technologies, such as wind, solar, and batteries.** Currently, industrial gas companies actively source between 10 and 20 per cent of their electricity from renewable energy (see chapter 4).[ix] This leaves significant room to increase their renewable energy procurement. Air Liquide claims that by 2026 it will reach 70 per cent renewable energy sourcing in the Benelux region,[x] where it has rapidly expanded its sourcing of offshore wind in the last few years;[41] this indicates the technical feasibility of reaching high levels of renewable energy use before 2030. Combining wind and solar with

ix This applies to Linde and Air Liquide; Air Products does not disclose actively sourced renewable energy (see chapter 4).

x It is likely that this claim refers to annually rather than hourly matched consumption, as is also the case for industrial gas companies' global annual procurement claims. See chapter 2 for further details on annual and hourly matching methodologies.

lithium-ion batteries for short-term (1-8 hour[42]) flexibility can further increase the proportion of renewable energy that companies use in their operations, in a cost-effective manner. The levelised cost of solar plus battery storage is already competitive with fossil electricity generation in several major markets, such as the US[43], the EU[44], and India[45]. Long-term battery storage agreements, similar to renewable PPAs, are now available in the US and Europe, with large electricity consumers such as Google already using these contracts to power their operations.[46] To date, there is no evidence that industrial gas companies have taken advantage of battery storage to add flexibility to their operations.

**In the longer term, using renewable energy around the clock in industrial gas companies' operations will require the deployment of technologies which are currently nascent.** The daily and seasonal variability of wind and solar power poses challenges for the integration of very high levels of renewables into ASUs, which have historically been designed for continuous operation. Conventional ASUs are limited in their ability to adjust their output in response to renewable energy supply – partly because frequent load changes can inflict damage on plant equipment,[47] and partly because plant start-up times following a complete shutdown can be very slow, affecting plants' operating efficiency.[48] Nonetheless, a range of ASU flexibility and long-duration energy storage technologies can support companies to reach round-the-clock renewables in the long term.

**Emerging ASU technologies increasingly enable companies to adjust ASU production schedules in response to variable renewable energy availability.** Ongoing research in the last 20 years has studied various ways of maximising the operational flexibility of ASUs, with a focus on developing ASU technologies which can handle frequent load changes in the full load capacity range, including plant shutdown scenarios.[49] These technologies enable companies to ramp up production of air gases when renewable energy is abundant and store them in liquid form, ensuring a continuous supply of gases to customers even when renewable power generation is limited.[50] Liquefied gases can also be recycled back into the process to minimise the use of electricity-intensive air compressors.[51]

**Industrial gas companies are already deploying some of these techniques in their operations.** Linde – which is currently leading research on flexible ASUs, under the FlexASU project funded by the German Federal Ministry of Education and Research – has already integrated increased flexibility into its oxygen and nitrogen plant in Vejle, Denmark, which has been operational since 2020.[52] While fully demand-flexible ASUs are not yet market-ready,[53] companies can take significant steps to make their assets more flexible by equipping all new ASUs with state-of-the-art technology and modernising existing ASUs to enable greater integration with renewable energy resources.[54] Doing so could offer financial as well as decarbonisation benefits, allowing companies to minimise operating expenditures by aligning their production schedules with low electricity market prices.[55]

**In the medium and long term, long-duration energy storage is another option for companies to increase the integration of renewables into their operations.** Long-duration energy storage technologies use a range of chemical, thermal, mechanical and other methods

to store electricity for more than eight hours, and include flow batteries, hydrogen storage, compressed air energy storage, liquefied air energy storage and pumped hydropower, among others.[56] With the exception of pumped hydropower,[57] these technologies are still in the early stages of development and commercial deployment, but in some cases could be lower-cost than batteries for storage above eight hours by 2030.[58] Industrial gas companies – with their expertise in hydrogen, hydrogen storage[xi] and cryogenic air liquefaction – are well placed to contribute to the development of these technologies. Early deployment by these companies would also have wider system benefits, helping to accelerate innovation and drive down costs.[59] Air Liquide's ASU in Moerdijk, the Netherlands, which began operations in 2022, uses cryogenic liquid air to store renewable energy, which it cycles back into the air separation process at times of low renewable availability.[60]

## Investor engagement ask: Renewable electricity targets

- **Set long-term targets** to transition to **100 per cent renewable energy, with near-term, intermediate renewable energy targets.** (See chapter 2 for more details on how these targets should be articulated).

## Investor engagement ask: Storage and flexibility

- **Disclose** a near- and long-term strategy to invest in or procure:

  1 Energy storage, including batteries and/or long-duration energy storage; and
  2 ASU flexibility.

xi Air Liquide and Linde operate the largest salt cavern for hydrogen storage in the world, in Beaumont, Texas, though the cavern is used for product rather than energy storage. See Linde (2025). 'Storing Hydrogen in Underground Salt Caverns'. Available online at: https://www.linde.com/clean-energy/our-h2-technology/hydrogen-storage [accessed 11 February 2025]; and Air Liquide (2025). 'H2 Storage & Power'. Available online at: https://usa.airliquide.com/sustainability/hydrogen/h2-storage-power [accessed 11 February 2025].

# How industrial gas companies can drive grid decarbonisation

2

# Chapter 2: How industrial gas companies can drive grid decarbonisation through high-quality renewable energy procurement

As discussed in the last chapter, rapidly increasing the use of renewable energy will be central to industrial gas companies' decarbonisation. However, renewable energy procurement strategies and mechanisms vary widely in quality. Some enable companies to claim high levels of renewables in their energy mix while doing little to drive additional renewable energy capacity in the electricity system. A 2022 study of 115 corporate scope 2 targets under the Science-Based Targets initiative (SBTi) showed that nearly half (42 per cent) of targeted scope 2 emissions reductions could result in no real-world emissions mitigation because of companies' dependence on low-quality procurement constructs.[61]

This chapter will set out detailed criteria which investors can use to assess industrial gas companies' renewable energy procurement policies, to ensure that these are truly contributing to mitigating emissions from companies' electricity consumption.

## The aim: Tripling renewable energy procurement by 2030

**At COP28 in December 2023, countries pledged to triple global installed renewable energy capacity by 2030 compared to 2022 levels.**[62] This target – which aligns with recommendations from the International Energy Agency (IEA)[63] and the International Renewable Energy Agency (IRENA)[64] – is challenging, but achievable. Many countries in both developed and emerging markets already have national policies in place that will enable them to double or more than double renewable energy capacity by 2030.[65] In China, current growth rates are approaching what is required to triple capacity by 2030.[66]

**As major electricity consumers with international reach, industrial gas companies have an important role to play in meeting this pledge.** Corporate renewable energy procurement sends demand signals to markets to increase supply of renewables; it can provide long-term revenue certainty for new renewable energy projects, helping them obtain financing from investors;[67] and it can increase deployment of technologies which enable better integration of wind and solar into grids.[68] All of these factors can drive faster electricity system decarbonisation to reach global goals.

**Industrial gas firms should aim to align their electricity procurement goals with this pledge.**[xii] As previously discussed, industrial gas companies currently source only a small proportion of renewable energy for their operations. For Air Liquide, which has been the most active in procuring renewable energy, renewables accounted for only 7.5 terawatt hours (TWh), or 17.4 per cent, of its electricity use in 2022.[69] Tripling this would mean sourcing 52 per cent of its electricity from renewables by 2030 – if its electricity consumption does not increase, which the company expects it to.[70] This target is well within what Air Liquide has said it will achieve in at least one of its markets, which will reach 70 per cent renewables by 2026,[71] indicating the technical feasibility of tripling 2022 procurement. Linde and Air Products currently lag behind Air Liquide in their renewable energy use (see chapter 4). Given their highly similar business models, they should seek to reach the same proportion of renewable energy use in their operations (52 per cent).

### Investor engagement ask: Aligning with the COP28 renewable energy pledge

- **Air Liquide** should aim to triple its procurement of renewable energy by 2030 on a 2022 baseline, reaching 22.5 TWh of renewable energy (52 per cent of 2022 total electricity consumption).
- **Linde and Air Products** should aim to match this level of procurement, deriving 52 per cent of their 2022 total electricity consumption from renewable sources by 2030.

## How companies can drive impact – and real decarbonisation – with high-quality renewable energy procurement

**While setting an overarching, ambitious procurement target is an essential first step in developing a renewable energy strategy, the quality of renewable energy procurement matters as much as the quantity.** Companies' renewable electricity procurement claims and associated scope 2 emissions claims often bear little relation to the physical composition of the electricity they use. This discrepancy stems from the fact that electricity grids pool electricity from all generators – renewable and non-renewable – prior to distributing them to consumers, which makes it impossible to distinguish between the renewable and fossil electrons a company receives from the grid. Unless a company is generating its own electricity

xii The COP28 pledge aims to triple capacity, not consumption, of renewable energy. However, industrial gas companies have not historically disclosed total procured renewable energy capacity. We have therefore used consumption of renewable energy as the basis for the engagement ask presented here.

or sourcing it directly from a generator, its renewable energy procurement claims are based on contractual instruments that enable it to claim ownership of the attributes of renewable generation. These contractual instruments vary in their ability to support decarbonisation, and some enable companies to make emissions reduction claims that are far greater than their real-world decarbonisation impact. The different types of renewable energy procurement mechanisms are described in the 'Explainer' below.

To drive real electricity system decarbonisation, companies must ensure: that **all procured renewable energy is additional** – that is, it leads to additional renewable energy capacity in the electricity system; that it is **generated on the same grid as it is consumed;** and that as much of it as possible is **generated within the same hour that it is consumed**.

## Explainer: The different types of renewable electricity procurement mechanisms

There are many ways in which a company can source renewable electricity for its operations. Most of these involve contractual mechanisms that may or may not entail the delivery of physical renewable electrons to a company's assets. The most popular means of sourcing renewables include on-site generation, power purchase agreements (PPAs), unbundled energy attribute certificates (EACs), and various types of power supply contracts.

### On-site generation

**On-site (or 'behind-the-meter') generation** is where a company chooses to generate its own electricity for its operations, for example by using rooftop solar panels. The asset may be owned and operated by the company, or may be managed by a third party.

### Power purchase agreements (PPAs)

**Power purchase agreements (PPAs)** are direct contracts with renewable energy generators to deliver a certain amount of renewable energy over a specific time period, typically 10 years or longer. There are many types of PPAs, but these can generally be divided into two categories: physical and virtual PPAs.

- **Physical PPAs** involve physical delivery of electricity from a renewable generator to a corporate consumer. With **'direct-line'** PPAs, electricity is provided via a cable

directly to the consumer, without the need for transmission through the grid. With **'sleeved' or 'wheeled' PPAs**, the electricity is delivered through the grid, with the generator and consumer entering into an agreement with a utility company to take responsibility for the transmission and distribution of the electricity.

- **Virtual PPAs** do not involve any physical delivery of electricity to a consumer and are essentially a financial construct. At the beginning of the contract, the counterparties agree to a 'strike price' based on the cost of generation. When the market price for electricity falls below the strike price, the counterparty pays the generator the difference between the market price and the strike price. Generators do not need to be located on the same grid as the consumer, although they often are.

## Energy attribute certificates (EACs)

**Energy attribute certificates (EACs)** are instruments that certify the generation of one megawatt hour (MWh) of renewable electricity and give buyers ownership of the environmental attributes of this electricity. These are also known as Renewable Energy Certificates (RECs) in the US, and Guarantees of Origin (GOs) in the UK and EU. There are two main types of EACs: bundled and unbundled.

- **Bundled EACs** are delivered to consumers along with contracted renewable electricity, such as PPAs, and are effectively a tracking mechanism for that electricity.
- With **unbundled EACs** – which are the most common means of purchasing renewable electricity[72] – EACs are bought and sold separately from the electricity they certify. Generators deliver their electricity to the grid and sell the associated EACs to third-party retailers, who then sell them to consumers. Consumers buying EACs purchase default electricity from the grid, and then use EACs to offset their grid-sourced electricity in their emissions and electricity accounting. The EACs are then retired to prevent them from being double counted if purchased by another consumer. A critical weakness of unbundled EACs is that they usually have little to no geographical or temporal correlation with the load to which they are applied. This has led to concerns about the credibility of associated renewable energy and emissions claims (see below for more on the importance of location and timing in procurement).[73]

**There is a growing movement among companies toward time-based EACs**, which would provide greater granularity about the location and timing of renewable generation to ensure closer alignment with companies' consumption. Time-based EACs are currently only available in a few electricity markets but are expected to expand rapidly in the next few years as both regulation and corporate renewable

electricity commitments move toward greater granularity in renewable electricity accounting.[74]

### Green electricity supply contracts

Companies can purchase electricity through various **green electricity supply contracts,** which are contracts with a utility or electricity supplier for the supply of renewable electricity.

Retail supply contracts go by different names in different regions, but generally they fall into two categories: **green tariffs** and **green power products**.[75] A green tariff is an electricity supply contract through which a company's consumption of electricity is matched with renewable generation that the supplier generates themselves or purchases from specific projects, usually through PPAs. With green power products, by contrast, companies are simply paying a premium for unbundled EACs in addition to a regular electricity tariff. They do not involve PPAs with specific renewable projects or renewable energy generated by suppliers themselves.

### Equity investments in renewable assets

In recent years, some companies have chosen to **invest directly in renewable assets**, such as wind farms. These are capital investments; they should not be counted towards companies' renewable energy *procurement* unless companies have signed an agreement with the generator to offtake electricity and associated EACs from the project.[76] Without an offtake agreement, claiming renewable electricity from these assets presents a high risk of double-counting. This is because, in the absence of a PPA giving the equity investor the right to claim the electricity, other consumers can sign an agreement with the project themselves, claiming the EACs toward their own renewable electricity consumption.[77]

## Additionality: To reduce real-world emissions, companies' procurement needs to drive new renewable energy capacity

**Additionality is the single most important factor determining whether companies' procurement strategies will have a real-world emissions impact.** To enable a reduction in emissions in the electricity system, corporate procurement must facilitate new renewable energy capacity in the grid. The level of additionality provided depends on both the types of contracts companies use to procure renewable energy and the projects they choose to contract with.

## Companies' procurement portfolios should maximise on-site generation and PPAs

**On-site generation provides the clearest additionality, and should be prioritised.** On-site generation is one of the best ways of ensuring that the renewable energy used by companies is additional, since it directly reduces companies' consumption of fossil-based electricity from the grid.[78] On-site generation can also offer cost benefits compared to external procurement because it enables corporates to avoid transmission and distribution costs.[79] However, for industrial gas companies the potential for on-site generation may be limited by space constraints, especially when ASUs are co-located with customers' assets or are part of a larger industrial cluster.

**Long-term PPAs can provide important financial support for new renewable energy generation,[80] but strict criteria must be followed in selecting projects for contracts.** For developers of new renewable assets, PPAs offer a crucial source of long-term revenue certainty, making it easier for them to secure financing for their project from investors.[81] PPAs also offer benefits to the offtaker, providing long-term cost visibility and a hedge against electricity market volatility.[82] However, not all PPAs contribute equally to grid decarbonisation. Contracts signed with assets which have already been built,[83] or are being fully supported by government schemes and would have been built even in the absence of corporate procurement,[84] will not lead to additional renewable energy capacity. PPAs signed outside the local grid will also not directly address emissions from corporate demand, even if they may provide additional renewable capacity.[85]

**To ensure maximum additionality, PPAs should only be signed with new (unbuilt) assets located on the same grid as consumption, which are not receiving full support from government subsidies.** PPAs signed with older assets which are being repowered after government support has expired can also provide additionality.[86]

## Unbundled Energy Attribute Certificates (EACs) provide little additionality and should be excluded from company procurement portfolios in most cases

**Unbundled EACs have little impact in driving additional renewable energy in grids,** as abundant evidence from empirical studies and electricity system modelling has shown.[87] EACs are usually tied to renewable projects that are already in operation; thus the purchase of these certificates merely reallocates existing generation.[88] This has led to oversupply and consequently low prices in EAC markets, and it is widely recognised that unbundled EACs do not on their own provide a sufficient revenue stream to support new renewable capacity investments.[89] EAC markets have also struggled with double counting issues, further undermining their credibility.[90]

**In markets where procurement options are limited, companies should focus on overcoming regulatory and other barriers to high-quality procurement constructs.** Unbundled EACs may have a very limited role to play in markets where, for regulatory and other reasons, PPAs are not available. However, PPAs are becoming increasingly available across most major global markets.[91]

Where constraints on private energy contracts remain, corporates should lobby to remove these constraints rather than depending on low-quality procurement mechanisms. EACs should be used only if companies have exhausted all other options and if they can provide credible evidence that procurement of EACs in that region will lead to additional renewable energy capacity.[92]

## Green electricity supply contracts may provide additionality, but only if based on specific renewable projects

**Green electricity supply contracts vary in their ability to support additionality, depending on whether they support specific projects or merely deliver unbundled EACs.** Contracts which do not involve procurement from specific projects are no more effective in supporting additional renewable capacity than the unbundled EACs on which they depend, and therefore should only be counted towards companies' procurement in the limited cases described for EACs above.[93] Electricity products which are based on supplier self-generation or PPA procurement are more likely to support additional generation, and may be a good option in regions where procurement volumes are not large enough to meet requirements for PPA contracts.[94] However, companies should ensure that renewable energy projects meet the conditions described for PPAs above.

## Equity investments in renewable assets must be accompanied by offtake agreements and follow strict additionality criteria

**Procurement sourced from renewable assets in which companies hold equity needs to follow strict criteria to be considered additional.** While equity investments can provide an important source of financing for new renewable assets, they should not be counted towards companies' renewable energy procurement unless companies are actually offtaking electricity from the plants, as discussed earlier. If companies do offtake electricity from plants they have invested in, assets need to comply with the additionality criteria identified for PPA procurement above.

## Investor engagement ask: Renewable energy – Additionality

- **Disclose** a breakdown of current renewable electricity consumption, including:
  - the amount of renewable electricity that is self-generated;
  - a breakdown of the company's renewable electricity purchases, including the contractual instruments used, the amount of renewable electricity purchased, and the location of procured generation;
  - the location of the load served by these purchases; and
  - the commissioning or repowering date of contracted projects, along with the date of contract signing.
- **Commit publicly** to procuring only renewable energy which drives additional renewable energy capacity in the local grid, and **disclose a procurement policy** aligned with the criteria discussed above.

### Time and location, part 1: Why companies should adopt granular accounting methodologies

**To maximise the additionality of renewable energy procurement, industrial gas companies should aim to procure renewable energy that is matched both geographically and temporally to consumption.** Geographical and temporal matching are crucial both to transparent renewable energy accounting and to setting ambitious, impactful renewable energy targets; these are discussed in turn below.

**The most commonly used carbon accounting methodologies today have adopted extremely broad geographical criteria for renewable energy procurement. These methodologies can mask companies' true dependence on fossil electricity.** The GHG Protocol's market-based methodology – the single most influential approach to scope 2 carbon accounting – currently allows companies to count renewable electricity towards their scope 2 emissions reductions that has been generated on a different grid from the one on which the company operates. For example, companies are permitted to match renewable electricity generated in Norway with an industrial load based in Italy.[95] But it is highly unlikely, given physical transmission constraints, that any electricity generated in Norway could be transmitted to Italy or could decarbonise a company's electricity demand there. Furthermore, there is no guarantee that the emissions reduced by renewable energy generated in one grid will be equivalent to the emissions caused by a corporate load in another. An EAC connected to a generator in Norway, where renewables already account for 98 per cent of the grid

mix,[96] is unlikely to lead to additional renewable energy capacity (and therefore emissions reductions). But industrial consumption in Italy, where electricity generation is still dominated by natural gas,[97] would likely be supplied by fossil generation, leading to high levels of emissions.

**Temporal criteria in existing carbon accounting frameworks are similarly permissive.** The GHG Protocol's market-based approach also allows companies to calculate their scope 2 emissions based on an 'annual matching' methodology. This means that a company can claim zero emissions over the course of a year by matching its electricity consumption with an equivalent amount of procured renewable energy generated during that year.[98] This approach fails to account for the variability of renewable energy resources. Consider, for example, a company that has signed a PPA with a wind farm. During hours when renewable energy availability is low and the wind farm does not generate the contracted electricity, the company will be dependent on fossil electricity from the grid to make up the deficit. During hours when renewable energy availability is high and the wind farm generates more than the contracted amount, the excess electricity will be delivered to the grid, where, instead of contributing to additional generation, it could force other renewable assets to reduce their output. Despite this, the company can still claim the full emissions reductions from the total generation it contracted for.

**The current market-based methodology leads to emissions accounting that does not accurately reflect the emissions impact of procurement.** A recent study of 109 corporate scope 2 emissions claims by the carbon management firm FlexiDAO found that companies could be underestimating their electricity emissions by at least 45 per cent under the current accounting approaches.[99] Because of these credibility concerns, the GHG Protocol is considering updating the market-based methodology as it undergoes revision this year and next year. (See the 'Explainer' below for further details.)

**Granular matching is an alternative approach to electricity accounting, which better reflects the emissions addressed by companies' electricity procurement.** Under this approach, companies can only count procured renewable energy towards their renewable energy use if it has been generated within a one-hour window of consumption, on the same grid as consumption. Granular matching ensures a much closer alignment between the emissions companies claim to reduce through their electricity procurement and the emissions stemming from a corporate's load.[100]

**Industrial gas companies do not currently disclose temporally or geographically matched renewable energy procurement.** The renewable energy procurement claims of the three major industrial gas companies cited in this report are based on annual matching methodologies. These claims may therefore not fully capture companies' true dependence on fossil-powered electricity.

## Investor engagement ask: Renewable electricity - Granular accounting

Companies should disclose the proportion of their current electricity consumption derived from renewable energy that is generated within the same hour as consumption, on the same grid as consumption.

## Explainer: Revisions to the Greenhouse Gas Protocol – and implications for industrial gas companies

**The Greenhouse Gas Protocol is undergoing major revisions, with important implications for companies' scope 2 emissions accounting.** First published in 2015, the GHG Protocol is the most widely used standard for corporate carbon accounting today, serving as the basis for emissions targets validated under the SBTi[101] as well as renewable energy targets set by companies in the RE100 coalition.[xiii, 102] Since 2023, the GHG Protocol has been undergoing a major review, which is expected to conclude in 2026. Electricity accounting is shaping up to be one of the most contested areas currently under consideration by the standards group.

**The GHG Protocol currently offers two methodologies for scope 2 emissions accounting: market-based and location-based.** Location-based emissions are calculated based on the average emissions factor of the grid on which a corporate has operations.[103] Market-based emissions are calculated based on the electricity consumer's purchases through contractual agreements with suppliers or generators.[104] While location-based methodologies do not enable corporates to demonstrate scope 2 emissions reductions on the basis of their electricity procurement decisions, the market-based approach also contains major flaws. In particular, criteria related to the timing and location of renewable electricity generation are not granular enough to reflect the true impact of companies' electricity procurement on emissions, enabling them to claim greater emissions reductions than they are actually facilitating in the real world.

**Two main revisions to the market-based approach are currently under consideration: granular matching and emissions matching.**

xiii RE100 is a coalition of 400 companies globally who have committed to transition to 100 per cent renewable electricity. See RE100 (2025). 'About us'. Available online at: https://www.there100.org/about-us [accessed 27 March 2025].

- **Granular matching** (sometimes referred to as '24/7 matching'[105]) would involve the introduction of strict geographical and temporal criteria into scope 2 electricity accounting, permitting companies to count renewable electricity towards emissions reductions only if it has been generated within a one-hour window and on the same grid as consumption.[106] This approach has been promoted by a coalition of companies including Google, Microsoft and AstraZeneca.[107]
- **Emissions matching** would involve an 'avoided emissions' approach alongside the complete abolishment of geographical boundaries in sourcing criteria.[108] Instead of matching one MWh of renewable electricity to one MWh of electricity consumption, as under the existing market-based approach, in this approach companies seek to match the emissions stemming from their demand with emissions 'avoided' by their procurement of renewable electricity. In effect, a company could 'decarbonise' emissions from a load in California by matching it with emissions 'reduced' by renewable electricity from a project in South Africa. This methodology has been promoted by the so-called 'Emissions First Partnership', including tech companies Meta and Amazon.[109]

**While granular matching has been shown to drive system decarbonisation, emissions matching is unlikely to provide significant support for new renewable energy capacity.** The emissions matching approach, like the current market-based approach, provides an incentive for companies to procure renewable electricity where it is cheap, not where it will most directly address emissions from corporate demand. Because wind and solar are now the lowest-cost generation technologies in most markets, procurement guided by this approach is likely to support renewable projects that would have been built anyway, even in the absence of the company's procurement.[110] A recent study of US grids by researchers at Princeton University and Tsinghua University concluded that the emissions matching approach, like the current market-based methodology, has 'minimal impact' on long-term power system emissions reductions. Granular matching was the only methodology shown to significantly reduce emissions.[111]

**The direction the GHG Protocol takes could have major consequences for industrial gas companies' scope 2 reporting.** A decision in favour of the emissions matching approach could enable companies to make emissions claims that have little correlation with their real-world emissions impacts, diminishing the transparency and credibility of corporates' climate targets and strategies. Industrial gas companies' electricity disclosures are currently too poor to quantify the potential impact of a switch to granular matching on their on-paper emissions. However, if we assume their procurement profile aligns with that of most other companies in depending significantly on unbundled EACs, a decision in favour of the granular matching approach could contribute to a substantial increase in their reported scope 2 emissions by restricting geographical market boundaries and imposing temporal constraints on procured generation of renewables.[112] By the same token, it would provide a strong incentive for companies to invest in high-quality procurement which would lead to real-world emissions reductions.

## Time and location, part 2: Why companies should set granular renewable energy targets

**In addition to adopting granular accounting methodologies, companies should also set renewable electricity targets using granular accounting.** These targets commit to matching a company's electricity consumption with renewables generated at the same time and on the same grid as consumption. Major electricity consumers such as Google and Microsoft have articulated their renewable targets in these terms, committing to run their operations on 24/7 carbon-free energy by 2030.[113]

**Granular matching targets are more transparent than annual matching targets and lead to greater emissions reductions.** Modelling studies conducted by the IEA, Princeton University and others have demonstrated that ambitious temporal matching targets drive higher displacement of fossil generation in electricity systems, and consequently lower system-wide emissions, than annual matching strategies – even if they do not target 100 per cent hourly matching.[114] Indeed, the Princeton study, which focused on US grids, concluded that granular matching was the only target-setting methodology that would result in significant system-wide emissions reductions at all.[115] By requiring companies to operate on local, clean electricity even during hours when renewable generation is low, hourly matching targets provide a crucial incentive for companies to invest in the full range of technologies required to decarbonise grids, such as batteries, long-duration storage and demand-side management.[116] This in turn promotes flexibility in the grid, enabling grids to operate on higher levels of renewable electricity around the clock. Further, corporate procurement of more nascent technologies, such as long-duration energy storage, can help drive technology learning and cost declines, with wider benefits for system decarbonisation.[117]

**While it would be challenging for industrial gas companies to reach 100 per cent hourly matched renewables immediately, high-quality procurement alongside investment in storage and flexibility can support ambitious hourly matching goals in the near term.** As discussed in the previous chapter, industrial gas processes have limited demand flexibility, so companies may not be able to reach 24/7 procurement as quickly as corporates in other sectors. Nonetheless, high-quality, additional procurement of wind, solar and battery power can support significant increases in companies' use of renewable energy in the short term, while investment in more nascent technologies can support further integration of renewables over a longer time horizon.

**Industrial gas companies should aim to reach 24/7 local, clean electricity in the medium to long term.** To align with the IEA's Net Zero by 2050 scenario, industrial gas companies should set a granular matching goal targeting 100 per cent clean electricity by 2045 at the latest, the date by which global grids need to decarbonise.[118]

**In the meantime, companies should set ambitious near-term granular matching targets.** These could take a few different forms. A company could decide to target a certain number of hours per year to match 100 per cent of consumption with renewables. Alternatively, a

company could target a certain proportion of its electricity mix to be matched with renewables during every hour of the year. For example, it could commit to matching 90 per cent of its electricity consumption with renewable energy it generates or procures during every hour of the year, while depending on the grid for the remaining 10 per cent.[xiv] The level of ambition is key – the impact of procurement is highly sensitive to the targeted level of renewable procurement.[119] Granular matching goals targeting a relatively low level of renewable energy procurement may not provide any more support for decarbonisation than 100 per cent annual matching targets.[120] The higher the targeted level of renewables, furthermore, the more likely the target will be to prompt investments in storage and flexibility.[121]

**Data availability is not a significant barrier to granular accounting and target-setting.** Industrial gas companies already have the data they need to sign 24/7 PPAs and set granular matching targets; hourly renewable generation and consumption data are required for price settlement for any PPA, and more generally for the settlement of electricity bills around the world. Incoming regulation and an emerging data infrastructure are also creating an enabling environment for temporal matching commitments. The EU, for example, will require renewable electricity procurement for renewable hydrogen installations to be matched on an hourly basis from 2030 onwards.[122] Registries for time-based EACs are emerging in the EU, US and elsewhere to enable companies to track and verify the renewable electricity they procure.[123]

## Investor engagement ask: Renewable electricity - Granular target-setting

- **Set long-term targets** to match 100 per cent of electricity consumption with actively procured renewable energy generated within the same hour and on the same grid as consumption.
- **Set ambitious intermediate targets** to match a proportion of electricity consumption with actively procured renewable energy generated within the same hour and on the same grid as consumption.

xiv For an example of how an intermediate target could be calculated, see IEA (2022). *Advancing Decarbonisation through Clean Electricity Procurement*, p. 24. Available online at: https://iea.blob.core.windows.net/assets/4a07d1b5-1beb-4611-874d-7acd4f21d9eb/AdvancingDecarbonisationthroughCleanElectricityProcurement.pdf [accessed 2 April 2025].

# How industrial gas companies can address barriers to renewable energy procurement

3

# Chapter 3: How industrial gas companies can address barriers to renewable energy procurement

**Achieving ambitious renewable energy goals will require high-quality procurement based mainly on PPAs and on-site generation. In some markets, however, companies may face regulatory barriers to PPA procurement.** This chapter gives a brief overview of these barriers, with examples focused on markets that are particularly relevant to industrial gas companies, especially China and South Africa. It also discusses steps companies can take to address these barriers.

**At the same time, electricity markets around the world are changing rapidly to enable greater uptake of and access to renewables.** Liberalisation of power markets around the world in recent years has significantly opened up companies' options for procurement. This trend is likely to continue in the coming years, as countries increasingly look to provide enabling policy environments for corporates with ambitious sustainability goals.

## Regulatory barriers continue to present challenges for corporate PPAs, but are easing in many key markets

**The options available to companies for renewable energy procurement vary depending on the market.** While most major electricity markets offer unbundled EACs, companies' ability to sign long-term PPAs depends on the structure of the electricity markets in which they operate. In fully liberalised, competitive electricity markets such as those in Europe and much of the US, there are usually few barriers to corporates signing long-term renewable energy agreements alongside other procurement mechanisms.[124] However, in other electricity markets, regulatory restrictions on the involvement of private actors may make it more difficult for companies to sign PPAs.

**Electricity market regulations in some regions prevent companies from contracting directly with generators for long-term supply**. Around 50% of the world's electricity is generated in highly vertically integrated electricity markets,[125] where a single, often state-owned, entity controls some or even all of the electricity value chain, including generation, transmission and retail. In these markets, corporates are often legally required to purchase their electricity from the state utility. In Indonesia, for example, the state-owned utility PLN has a monopoly on electricity transmission and distribution. While private actors – called 'independent power producers', or IPPs – are allowed to participate in electricity generation, they are required to sell their electricity to PLN, and corporates are required to purchase their electricity only from the utility company.[126] To date, only one company – Amazon – has managed to sign a PPA with the utility, enabling it to procure renewable electricity from four solar sites in Bali and Java.[127]

**Lack of clarity regarding arrangements for grid use can constitute a further hurdle to PPA procurement in these markets.** Where on-site or direct-line PPAs are not an option, corporates and the generators they contract with must negotiate an agreement with a utility company to take responsibility for the transmission and distribution of the electricity via the grid. This is known as a 'wheeling agreement'. In some countries electricity market regulations prevent power wheeling;[128] other countries lack standardised frameworks for allocating wheeling costs, which can complicate PPA negotiations.[129]

**Regulatory frameworks for corporate PPAs may differ significantly between regions within countries, requiring detailed familiarity with regulations at a subnational level.** In India, for example, the availability of renewable PPAs has historically varied significantly across states, as have charges for wheeling and other grid services.[130] While the government has issued guidelines in the last few years to enable synchronisation of states' PPA policies, discrepancies between state and national policies persist in many cases.[131] Lack of regulatory standardisation is especially challenging when generating facilities are located in a different region from the site of consumption, requiring separate agreements in each region around permitting regulations and grid use.

**Reforms in the power market in key regions are increasing companies' access to PPAs, even in more challenging regions.** China, for example, is a key and growing market for industrial gas producers,[132] but has historically been one of the most difficult regions for companies to secure long-term power supply agreements. Chinese power generators today sell most of their electricity to the state utility for a fixed price,[133] and while the Chinese government set up a dedicated green power trading market in 2021, so-called 'green PPAs' generally could only be signed for one-year terms.[134] However, China's power crisis in recent years has prompted the government to liberalise electricity markets,[135] providing a greater incentive for power generators to contract with private companies for long-term electricity supply. In 2022, the German chemical company BASF was the first international corporation to sign a 25-year renewable energy supply agreement in China,[136] followed by other large electricity consumers, including both Linde and Air Liquide.[137] In response to these developments, the Chinese state has issued new green power trading rules explicitly encouraging five- to ten-year agreements, and is expected to release standardised templates for renewable PPAs in the near future, helping to address challenges with interregional PPAs and PPA pricing.[138] China is not the only example of a country where regulatory reform has proceeded in step with corporate demand for PPAs: ongoing liberalisation of South Africa's power generation market in the last ten years[139] has enabled Air Liquide to sign several PPAs to supply its facilities at Secunda,[140] the world's largest oxygen production site.[141]

**BASF's renewable energy activities in China demonstrate how corporate engagement with local stakeholders can help address regulatory barriers to procurement.** Although facilitated by government-led reforms, BASF's PPAs in China have also been the result of the company's ongoing engagement with the government, power generators and retailers to develop new mechanisms for corporate renewable energy supply.[142] Large corporate electricity consumers have major buying power and influence in the markets they operate in, and can use that influence to expand the options available to them for energy procurement.

## Limited availability of renewable energy in some markets

**Renewables remain limited in availability in certain markets where industrial gas companies operate, particularly in Asia-Pacific countries such as South Korea and Indonesia.**[143] A number of structural factors can make it challenging for renewable energy markets to get off the ground in these regions. These include high technology costs compared to developed markets;[144] a lack of policy mechanisms for supporting new renewables;[145] land use and permitting regulations, which limit where new projects can be located and can lead to lengthy lead-times, driving up project costs;[146] and high financing costs due to perceived higher risks in emerging markets.[147] Lack of adequate transmission and distribution infrastructure can also be a major hurdle, preventing new projects from obtaining access to the grid to transmit the electricity they generate. In South Africa, for instance – a country with immense solar and wind potential[148] – severe grid capacity shortages in 2023 led the state utility to deny grid connections to new renewable energy projects in the country's most renewable-rich provinces,[149] where 75 per cent of its private renewable energy projects are located.[150]

**Strong corporate demand for renewable energy in local markets, signalled by publicly disclosed targets, can help overcome these barriers.** Corporate demand sends a signal to markets to increase supply of renewables, and can also provide an incentive for regional governments to step up investment in burgeoning renewable energy sectors. The global cost of renewable energy has declined rapidly over time as renewable energy markets have gained experience and taken advantage of economies of scale,[151] and in recent years renewable energy generation has become competitive with fossil fuels even in more challenging markets, such as Indonesia.[152] Where structural barriers – such as siting and permitting regulations or lack of adequate grid infrastructure – prevent consumers from taking advantage of the low cost of renewables, corporates should advocate with local policymakers for regulatory reform and increased investment in the grid.

## Four steps companies can take to address barriers to renewable energy procurement

While not all of the issues outlined above are within corporates' direct control, industrial gas companies can use their influence in electricity markets to advocate for regulations and a market environment that are favourable to renewables generally and to corporate procurement specifically. Investors engaging with industrial gas companies on their renewable energy procurement should ask them to take the following steps, to ensure transparent communication about the barriers companies face and how they plan to address them:

1 **Disclose information about where the company's air separation units are located, in which markets the company is struggling to obtain high-quality procurement contracts, and what steps the company is taking to overcome these barriers.**

Clear disclosures about the location of companies' electricity-intensive assets enable investors to better assess companies' exposure to fossil electricity in different markets, the challenges they face in those markets, and their strategy for addressing these barriers.

**2 Communicate renewable energy targets and strategies clearly to stakeholders.**

Ambitious corporate renewable energy targets send a demand signal to renewable energy markets to increase supply, and can encourage governments to adopt more ambitious decarbonisation policies.[153] Clear communication of short-, mid- and long-term procurement plans to local stakeholders also enables utilities and grid operators to better forecast future electricity system requirements, both on the demand and the supply side. This is key to their ability to plan investments in transmission and distribution resources to avoid grid congestion, as well as in grid stability, flexibility and modernisation to achieve better integration of variable renewables.[154]

**3 Work with policymakers, regulators, generators and utility companies to expand available renewable energy procurement options.**

As discussed above, where PPA procurement is challenging due to electricity market structure or regulations, corporates should collaborate directly with regulators, utility companies and generators to develop new contract structures and procurement mechanisms.[155] Companies should also use their lobbying power to advocate at the national level for liberalisation in generation markets and greater consumer choice in electricity procurement,[156] as well as for the simplification and standardisation of PPA regimes.[157]

**4 Advocate for public policies which target rapid grid decarbonisation and promote a favourable environment for corporate renewable energy procurement.**

More broadly, industrial gas companies should promote market environments that are favourable to renewables, by encouraging governments to adopt ambitious strategies to decarbonise the electricity system, invest in grid infrastructure and modernisation, and remove barriers to the expansion of renewables, such as siting constraints and lengthy permitting processes.[158] Companies can also lobby governments to adopt the data infrastructure needed to make impactful procurement decisions and verify claims associated with these decisions, such as data on grid generation mix and registries for granular EACs.[159] These efforts would have larger, system-wide benefits, making it easier for smaller companies in the region to access renewable energy and develop high-quality clean electricity goals.

# A benchmark for the industrial gas sector: Linde, Air Liquide and Air Products

4

# Chapter 4 – A benchmark for the industrial gas sector: Linde, Air Liquide and Air Products

This chapter assesses the three leading global industrial gas companies against the standards and criteria set out in this paper, serving as a benchmark for the sector that investors can use in their company engagement. It provides an overview of key themes before looking at each company in detail.

## Industrial gas companies' renewable energy strategies lack transparency and ambition, risking a slow transition away from fossil fuels

**The three main industrial gas companies remain heavily dependent on fossil-powered energy and lack robust strategies for increasing their use of renewables.** Linde and Air Liquide each claim to procure between 10 and 20 per cent renewable energy in their operations,[160] lower than the global grid average of 30 per cent in 2023.[161] While Air Products claims to use 23 per cent renewable electricity in its operations,[162] the proportion the company actually procures itself is unclear (see the 'Explainer' on 'active' and 'passive' renewables below). None of the companies has a credible long-term target to phase out fossil electricity, and existing near-term targets are opaque, failing to cover future increases in electricity consumption or, in some cases, relying on unprocured electricity claimed from the grid mix. Their ASU electrification targets also lack ambition, with no company targeting full electrification of ASUs by 2030.

**While the companies are beginning to sign more PPAs for renewable electricity, none is currently anywhere close to reaching the renewable energy benchmark set out in this report.** Air Liquide, which has been the most active of the three in renewable energy procurement, is on track to source 29 per cent of its electricity from renewable energy by 2030, a little over half of what would be required to triple renewable energy consumption. Linde is on track to source only 12 per cent of its electricity from renewable energy by 2030. Air Products' disclosures are too poor to assess their progress against the benchmark.

**There is little evidence that the companies have any plans to increase investments in storage and flexibility.** As discussed elsewhere in this report, battery storage is a commercially viable technology which can enable companies to significantly increase their use of renewable energy today. But none of the three companies appears to have invested in this technology to date, whether on-site or via a storage PPA. While Air Liquide and Linde are piloting ASU flexibility technologies, they have not publicly discussed plans for adopting these technologies at a wider scale.

**The companies' disclosures are poor.** No company has disclosed its current renewable electricity consumption using granular accounting methodologies, making it difficult to assess companies' true exposure to fossil-powered electricity. Disclosures of the renewable energy constructs used in procurement are also patchy, failing to detail key information about the type of procurement mechanisms used and the age of contracted renewable projects.

## Explainer: Demystifying industrial gas companies' 'passive renewables' claims

**Industrial gas companies, including both Linde and Air Products, sometimes count renewable energy from the grid mix towards their own renewable energy consumption, without having actually procured that renewable energy themselves.** That is, these companies count the average renewable energy generation in the grids on which they operate toward their own renewable electricity use, even if they have not purchased the contractual instruments (such as PPAs or EACs) required to validate their claim to that electricity.[163] Linde and Air Products refer to this as 'passive electricity', in contrast to 'active electricity', which is renewable electricity the company has generated themselves or actively procured through PPAs, green power contracts or unbundled EACs.[164]

**Except in specific cases, it is not valid for companies to count renewables from the grid mix toward their renewable energy consumption.** In general, companies can only claim the use of renewable electricity if they have generated it themselves or if they have actively purchased it.[165] This is to avoid double-counting, which occurs when one company claims renewable energy from the grid mix which other consumers have actively purchased.[166] There are two exceptions to this rule which are allowed by RE100, which provides one of the most widely accepted corporate renewable electricity accounting standards, based on GHG Protocol criteria. First, corporates can claim renewable energy from default grid electricity if suppliers retire an equivalent amount of EACs on their behalf, giving them exclusive claim to that renewable energy; this is primarily relevant in markets with regulatory mandates requiring the supply of renewable electricity to consumers (such as Renewable Portfolio Standards).[167] Corporates can also claim renewable energy from default grid supplies in markets which have more than 95 per cent renewable energy in the grid mix and no mechanism for allocating it to consumers; currently, this applies only to Paraguay, Uruguay, and Ethiopia.[168] Except in these cases, counting renewable energy from the average grid mix without voluntarily procuring that renewable energy is not a valid approach to renewable energy accounting.

**Counting unprocured renewable electricity from the average grid mix towards companies' consumption of clean electricity can result in renewable energy**

**claims which are much higher than the amount companies are actively sourcing themselves.** [xv] For example, Linde claimed to use 43 per cent 'low-carbon electricity' – including both active and passive renewables and active and passive nuclear electricity - in 2023.[169] However, actively procured electricity – including both renewables and nuclear – accounted for only 14.4 per cent of total electricity consumption, while actively procured renewables accounted for only 11.5 per cent.[170] Meanwhile, Air Products has stated that it used 23 per cent active and passive renewable energy in its electricity mix in 2023,[171] but does not quantify how much of this is actively procured,[172] leaving it unclear how much renewable energy the company is actually sourcing for its operations.

xv Linde and Air Products do not specify that either of the exceptions discussed above applies to the grid averages they use in calculating passive renewable electricity; instead, default grid averages appear to be applied automatically across all the markets they operate in. Linde (2024), *Sustainable Development Report 2023*, p. 62. Available online at: https://assets.linde.com/-/media/global/corporate/corporate/documents/sustainable-development/2023-sustainable-development-report.pdf [accessed 2 April 2025]. Air Products (2024). *Generating a Cleaner Future: Sustainability Report 2024*, p. 83. Available online at: https://www.airproducts.com/-/media/files/en/900/900-24-001-us-sustainability-report-2024.pdf [accessed 2 April 2025].

## Assessment of companies' performance

Below, we assess each company's performance relative to the first six standards set out in this report. We do not assess companies' engagement with electricity market stakeholders.

To assess each company's progress to increase the proportion of purchased renewable energy they consume, we reviewed data on their signed PPAs up to December 2024. This data was sourced from Bloomberg NEF and compiled by Zero Carbon Analytics, and some PPAs may not be accounted for.

To project consumption out to 2030, we assumed that each company continues to procure renewable energy at the same rate it has between 2022 and 2024. To produce an estimate of future consumption, we converted from PPA capacity figures using global average capacity factors.

Please see the full methodology at the end of this chapter for more information.

## Key

| | |
|---|---|
| ✓ | The company has met the criterion |
| ✗ | The company has not met the criterion |

| Air Separation Unit (ASU) electrification | | | |
|---|---|---|---|
| | Linde | Air Liquide | Air Products |
| **Disclose:** | | | |
| *The proportion of the company's ASUs which are steam-driven* | ✗ | ✓ | ✗ |
| *A breakdown of ASU emissions by country* | ✗ | ✗ | ✗ |
| *The location of steam-driven ASUs* | ✗ | ✓ | ✗ |
| **Publish a target:** | | | |
| *To electrify all remaining steam-driven ASUs by 2030* | ✗ | ✗ | ✗ |

| Renewable electricity accounting | | | |
|---|---|---|---|
| | Linde | Air Liquide | Air Products |
| **Disclose:** | | | |
| *The proportion of annual electricity consumption the company sources from renewable energy generated within the same hour as consumption, on the same grid as consumption* | ✗ | ✗ | ✗ |

| Renewable electricity targets | | | |
|---|---|---|---|
| | Linde | Air Liquide | Air Products |
| **Publish:** | | | |
| *A **long-term target** to match 100 per cent of the company's electricity consumption with renewable energy generated within the same hour and on the same grid as consumption* | ✗ | ✗ | ✗ |
| *An **ambitious intermediate target** to match a proportion of the company's electricity consumption with renewable energy generated within the same hour and on the same grid as consumption* | ✗ | ✗ | ✗ |

| Renewable electricity – Alignment with the tripling goal | | | |
|---|---|---|---|
| | Linde | Air Liquide | Air Products |
| **The company is on track:** | | | |
| *To triple renewable energy consumption by 2030 on a 2022 baseline (Air Liquide), or reach 52% renewable energy in total electricity consumption by 2030 (Linde and Air Products)* | ✗ | ✗ | ✗ |
| Total capacity of wind and solar PPAs signed to date (megawatts [MW]) | 85 | 911 | 134 |
| Expected renewable energy consumption by 2030 (gigawatt-hours [GWh]) | 5200 | 12,400 | Unable to assess[xvi] |
| Expected renewable energy consumption by 2030, as proportion of 2022 total electricity consumption | 12% | 29% | Unable to assess[xvii] |

xvi We were unable to assess Air Products' total consumption of actively procured renewable energy in 2030 and their progress against our 2030 benchmark because they did not disclose active procurement of renewable energy in 2022, the baseline year for our benchmark.

xvii See note xvi.

| Renewable electricity – Additionality | | | |
|---|---|---|---|
| | Linde | Air Liquide | Air Products |
| **Disclose** a breakdown of the company's renewable energy consumption, including details about: | | | |
| *The amount of renewable electricity that is self-generated* | ✓ | ✓ | ✓ |
| *A breakdown of the company's renewable energy purchases, including contractual instruments used, amount of renewable energy purchased, and the location of procured generation* | ✓ | ✗ | ✗ |
| *The location of the load served by these purchases* | ✓ | ✗ | ✗ |
| *The commissioning or repowering date of contracted projects, along with the date of contract signing* | ✗ | ✗ | ✗ |
| **Commit publicly:** | | | |
| *To procure only renewable energy which drives additional renewable energy capacity in the local grid* | ✗ | ✗ | ✗ |
| **Disclose** a procurement policy aligned with the following criteria: | | | |
| *Procurement maximises on-site generation and long-term power purchase agreements (PPAs) in the company's renewable electricity portfolio* | ✗ | ✗ | ✗ |
| *Procurement prioritises new (unbuilt) renewable assets and older renewable assets which are being repowered after government subsidies have expired* | ✗ | ✗ | ✗ |
| *Procurement excludes unbundled energy attribute certificates (EACs) and contracts based on unbundled EACs from procurement, unless the company can demonstrate that no other procurement options are available, that it is working to remove barriers to other forms of procurement, and that EACs clearly support additional renewable generation in the relevant market* | ✗ | ✗ | ✗ |

| Storage and flexibility | | | |
|---|---|---|---|
| | Linde | Air Liquide | Air Products |
| Disclose a near- and long-term strategy to invest in or procure: | | | |
| *Energy storage, including batteries and/or long-duration energy storage* | ✗ | ✗ | ✗ |
| *ASU flexibility* | ✗ | ✗ | ✗ |

## Air Liquide: Leading on renewable energy procurement, but greater ambition is required

**Air Liquide is far ahead of its peers in both electrification investments and procurement of renewable energy.** The company has said that 95 per cent of its ASUs are already electrified[173] and it has set an objective to electrify half of its remaining ASUs by 2035.[174] This is significantly more ambitious than Linde's objective to transition 50 per cent of its assets to electricity by 2035 (see below).[175] Air Liquide has also outstripped its peers in both the number and capacity of wind and solar PPAs it has signed, having contracted for nearly 13 times the total capacity Linde has contracted for and nearly 3 times the total capacity Air Products has contracted for to date,[176] when adjusted for differences in company size.[177]

**Nonetheless, the company's renewable energy strategy lacks transparency and falls short of real leadership in driving the renewable energy transition.** Air Liquide's ASU target does not commit to full electrification, implying that it will remain dependent on steam-driven ASUs in China and South Africa[178] even after 2035. The company currently sources only 18 per cent of its electricity from renewable energy,[179] and while its procurement targets are more rigorous than those of its peers, they lack transparency and ambition. Air Liquide has said it will source an additional 10 TWh of renewable and nuclear electricity by 2035.[180] However, this target is not granular, and it excludes electricity consumption from new and acquired assets, which the company acknowledges will likely cause consumption to rise.[181] Air Liquide also lacks a clear policy detailing the additionality criteria it uses in its procurement of renewable energy[xviii] and has not disclosed a detailed breakdown of the contractual instruments supporting their current renewable electricity procurement. These factors make it difficult to assess exactly how reliant the company will be on fossil-powered electricity in the next decade.

xviii Air Liquide does note that its zero-carbon electricity procurement target will 'preferably' be met with PPAs, but provides no further details. Air Liquide (2024). *Climate Transition Plan 2024*, p. 26. Available online at : https://www.airliquide.com/sites/airliquide.com/files/2024-09/air-liquide-climate-transition-plan-september-2024.pdf [accessed 2 April 2025].

**At current rates of PPA procurement, Air Liquide will not triple renewable energy procurement by 2030.** Our analysis indicates that, if 2022-2024 trends in PPA procurement continue, the company will source 12,400 GWh by 2030, a little over half of what would be needed to triple its renewable energy consumption by 2030.

**Air Liquide has a clear opportunity to be a leader in the sector's transition to renewables**. But to do so, it must increase the ambition of its targets and provide a clearer strategy for decarbonising its whole electricity mix.

## Linde: Slow progress on renewables leaves company significantly trailing Air Liquide

**Falling behind Air Liquide in its renewable energy sourcing and lacking transparent targets to increase its use of renewable energy, Linde risks being perceived as a laggard in addressing scope 2 emissions.** Actively sourced renewables account for only 11.5 per cent of Linde's current electricity use,[182] and the company has been slow to sign PPAs to increase renewable energy procurement for its operations, having signed PPAs for 85 MW of wind and solar capacity to date, compared to Air Liquide's 911 MW.[183] At its current rate of PPA procurement, Linde is on track to source only 12 per cent of its electricity from renewable sources by 2030.[184]

**Linde does not have a clear strategy to transition away from fossil-powered electricity in the near and long term.** Linde has set targets to double 'low-carbon electricity' sourcing by 2028 on 2018 levels [185] and to triple low-carbon electricity sourcing by 2035.[186] It also aims to reach 100% renewable or low-carbon power by 2050.[187] However, these targets include 'passive' electricity claimed from the average grid renewable mix,[xix] which should not be counted towards companies' electricity sourcing claims (see the 'Explainer' above). This leaves it highly unclear how much low-carbon electricity Linde plans to purchase themselves to address their scope 2 emissions. While Linde says its 2028 target will be met 'primarily' with actively sourced renewables,[188] passive renewable electricity currently accounts for 1.7 times the amount of active renewable energy that Linde sources,[189] suggesting that the company could remain heavily dependent on renewable energy they have not actually procured to meet their goals.

**Electrification targets similarly lack ambition.** Linde's ASU electrification target, which commits to electrify only 50 per cent of its total ASUs by 2035,[190] is much less ambitious than Air Liquide's, and the company has provided few details about how many of its ASUs are currently steam-driven or where these assets are located.

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xix In its 2023 Sustainability Report, Linde specifies that 'low carbon electricity' includes 'both active and passive renewable electricity and nuclear'. Linde (2024). *Sustainable Development Report 2023*, p. 62. Available online at: https://assets.linde.com/-/media/global/corporate/corporate/documents/sustainable-development/2023-sustainable-development-report.pdf [accessed 17 February 2025].

**A significant portion of Linde's current renewable energy sourcing is unlikely to be contributing to real-world emissions reductions.** Disclosures of Linde's current renewable electricity procurement suggest that at least 38% of Linde's active procurement in 2023 came from constructs that are unlikely to contribute to additional renewable energy capacity in the grid (non-project-specific retail supply contracts and unbundled EACs).[191] At least one renewable supply agreement, signed in Brazil, appears to have been contracted with wind and solar projects that were commissioned in 2011.[192] Linde has not disclosed a policy detailing the additionality criteria it uses in renewable procurement.

**Linde must develop a credible, transparent strategy to transition away from fossil-powered electricity and accelerate its progress on renewable energy procurement.**

## Air Products: Poor-quality disclosures make it difficult to assess company's renewable energy policies

**Air Products' renewable energy disclosures are extremely poor, making it difficult to assess the company's progress.** Unlike Linde and Air Liquide, Air Products has not released any target for ASU electrification, suggesting that the company could remain dependent on steam-driven ASUs as its competitors increasingly electrify. Renewable electricity disclosures also contain major omissions. Although it claims to have used 23 per cent renewable electricity in 2023,[193] Air Products does not disclose its active renewable energy sourcing at all, and the proportion of renewable energy that the company actually procures itself could be much lower. The company's renewable energy targets commit to quadruple the company's use of renewable electricity by 2030, including a 15-fold increase in actively procured renewable electricity by 2030.[194] However, Air Products' failure to disclose current active procurement of renewable electricity prevents an assessment of how ambitious this target really is, and how dependent the company will be on fossil-powered electricity by 2030.

**Air Products is lagging in its PPA procurement.** The company has signed 134 MW of wind and solar capacity to date;[195] this places it ahead of Linde but significantly trailing Air Liquide, having achieved only 34 per cent of Air Liquide's PPA procurement to date,[196] when adjusted for the different sizes of the two companies.[197] We have not been able to assess Air Products' progress against our 2030 benchmark due to the company's insufficient disclosures about its current active procurement of renewable electricity.

**Air Products must improve the transparency of its renewable energy disclosures and release ambitious targets that make clear how the company plans to transition away from fossil-powered electricity in its operations.**

## Methodological note

Below, we describe the methodologies used to estimate each company's total PPA procurement to date and its progress against the aim of tripling renewable procurement by 2030.

### PPA procurement to date

We calculated the total number of wind and solar PPAs that each company had signed by the end of 2024, and the total capacity procured through these PPAs.

Information about the capacity of PPAs signed to date is drawn from Zero Carbon Analytics analysis using BloombergNEF PPA data.

In the case of the PPAs Air Liquide has co-signed with Sasol to supply its site in Secunda, South Africa, we allocated 4/9ths of total expected capacity to Air Liquide. This is based on the companies' original Request for Proposal (RFP), which requested 900 MW of renewable capacity from the market, with 400 allocated to Air Liquide and 500 MW to Sasol.[198]

### Expected performance relative to the aim of tripling renewables by 2030

We use the PPA data described above to assess companies' progress against the 2030 procurement pathway set out in chapter 2. This requires Air Liquide to triple procured renewable energy in the company's electricity mix on a 2022 baseline, and requires Linde and Air Products to meet the same level of renewable procurement as a proportion of their 2022 total electricity consumption.

To calculate each company's projected renewable electricity consumption by 2030, we assume that procured volumes from PPA contracts increase at the same average annual rate in the 2024-2030 period as they have in the 2022-2024 period. We then add the total amount estimated to be procured in the 2024 to 2030 period to the company's 2023 renewable electricity consumption (the latest year for which we have data from all three companies). 2022-2024 was chosen as a reference point for companies' average PPA procurement because it was the first period during which all three companies had scope 2 emissions reduction targets in place. The PPA data we used reflects PPAs that were signed between 2022 and 2024, not those that were active in those years, since PPAs are often signed several years before the associated renewable energy projects begin operation.

Because the PPA data we used discloses contracted capacity, not consumption, we needed to estimate contracted offtake volumes from PPAs signed to date. This was calculated by multiplying the capacity of each PPA by the average global annual capacity factor of the relevant renewable technology in 2023 (16% for solar PV, 36% for onshore wind, and 41% for offshore wind)[199] and by the total number of hours in the year (8760).

On-site renewable energy generation was excluded because not all of the companies publicly disclose their use of self-generated renewables, and for those that do, it accounts for only a small proportion of total renewable consumption (less than 1 per cent of Linde's total renewable energy use in 2023[200]). Other procurement mechanisms were also excluded due to the concerns about lack of additionality identified earlier in this report.

# Conclusion

# Conclusion

As some of the world's largest electricity consumers, Linde, Air Liquide and Air Products must deeply and rapidly reduce emissions from procured energy in the coming years. Doing so would not only enable them to decarbonise their own operations but could help catalyse faster transition in the global electricity sector – a sector which will be critical to meeting global climate goals. To date, industrial gas companies have been slow to transition to renewables in their operations, and their targets and strategies remain opaque and unambitious, suggesting that companies could remain heavily dependent on fossil energy well into the next decade.

ShareAction calls on investors in Linde, Air Liquide and Air Products to engage with the companies in detail on their scope 2 decarbonisation strategy, ensuring they have the strategies and targets in place to make deep, rapid and lasting cuts to their emissions in the coming years.

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## Author

Lydia Heinrichs

## Contact

ClimateTeam@shareaction.org


ShareAction»


shareaction.org
info@shareaction.org
+44 (0)20 7403 7800

Runway East,
2 Whitechapel Road,
London, E1 1EW, UK

Registered Charity Number: 1117244

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