Oxford Analytical

Quality, Service, Scientific Excellence

WHITE PAPER

Can Sustainability and Chemistry Coexist?

The chemical industry is one of the world's top contributors to global carbon emissions, but does chemistry have a vital role to play in our fight against climate change?

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Introduction

Chemistry plays a key role in the development of new materials, processes, and technologies that could help reduce environmental impact, increase resource efficiency, and improve quality of life.

One example is green chemistry, which focuses on the design of products and processes that minimise the use and generation of hazardous substances. This field has led to innovations such as biodegradable plastics, energy-efficient manufacturing processes, and cleaner fuel alternatives.

Another area where chemistry contributes to sustainability is through the development of renewable energy technologies, such as solar cells and batteries. By improving the efficiency and affordability of these technologies, chemists could help to reduce our dependence on non-renewable resources and decrease greenhouse gas emissions.

In agriculture, chemistry aids in the development of sustainable farming practices, including precision agriculture and the design of eco-friendly fertilisers and pesticides. These advancements could help to increase crop yields, reduce the environmental impact of farming, and promote food security.

Despite these positive contributions, it is crucial to recognise that not all chemical processes and products are inherently sustainable. In some cases, the production and use of chemicals could result in negative environmental and social impacts. Therefore, it is essential to promote research and development in sustainable chemistry and support policies that encourage responsible chemical production and use.

This white paper aims to provide an overview of the key issues facing the chemical industry regarding sustainability, climate change, and carbon emissions. Throughout this white paper, we will discuss the chemical industry's ever-changing relationship with energy, its problem with carbon emissions, and most importantly the industry's role in fighting climate change.

We hope you find the paper insightful, and thank you for taking the time to read it.

Energy and the Chemical Industry: An Evolving Relationship

The chemical industry has had a long-standing relationship with energy, with innovations in both sectors contributing to advancements in the other. From its beginnings in the 19th century, the chemical industry has become a vital part of the global economy, manufacturing a wide range of products that are essential to our daily lives.

In this section, we provide a brief overview of the chemical industry's relationship with energy, discussing its history, current state, and possible future directions.

Brief History

The chemical industry's relationship with energy dates back to the early days of coal-derived synthetic chemicals. The development of the industrial revolution in the 19th century saw a growing demand for chemicals to support various industries, such as textiles, fertilisers, and pharmaceuticals. During this time, coal was the primary source of energy used to produce chemicals, and the chemical industry was heavily reliant on fossil fuels.

In the early 20th century, the chemical industry began to diversify its energy sources, shifting towards oil and natural gas. The shift was driven by the development of new technologies and the realisation that petroleum-derived chemicals had several advantages over coal-derived chemicals, such as higher yields and lower production costs. During this time, the Haber-Bosch process was developed, which enabled the large-scale production of ammonia, a critical component of synthetic fertilisers, by using natural gas as a feedstock.

Energy and the Chemical Industry: An Evolving Relationship

Where We Are Today

The chemical industry continues to be heavily reliant on fossil fuels, with the majority of chemical production processes depending on energy from coal, oil, and natural gas. However, there is increasing awareness of the environmental and economic risks associated with this dependence.

As a result, the industry has begun to explore and invest in more sustainable and renewable energy sources. Several companies are incorporating wind, solar, and hydroelectric power into their operations, while others are investigating the use of biomass and waste as feedstocks for chemical production.

Additionally, the chemical industry is actively involved in the development of energy storage technologies, such as batteries and fuel cells, which are essential for the widespread adoption of renewable energy sources.

Where We Might Be Going

The chemical industry's future relationship with energy is likely to be shaped by the global push towards sustainability and the need to reduce greenhouse gas emissions. The transition to a low-carbon economy presents both challenges and opportunities for the chemical sector.

Energy and the Chemical Industry: An Evolving Relationship

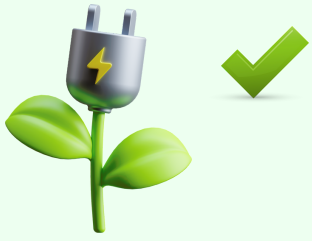
Furthermore, the industry faces the challenge of decarbonising its operations and moving away from fossil fuel-based feedstocks. This shift will require the development of new technologies and processes that could efficiently produce chemicals using renewable energy sources and alternative feedstocks.

Nevertheless, the chemical industry has the potential to be a key enabler of the energy transition by providing innovative materials and solutions for renewable energy generation, energy storage, and energy efficiency. For example, advanced materials developed by the chemical industry are crucial for improving the performance of solar panels, wind turbines, and batteries.

Positives & Negatives

The chemical industry's evolving relationship with energy has both positive and negative aspects.

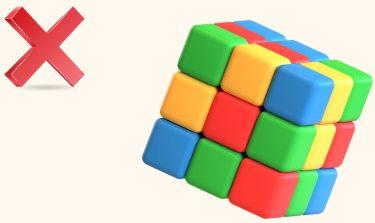
On the positive side, the transition towards renewable energy sources and more sustainable production methods could lead to reduced greenhouse gas emissions, increased energy security, and new business opportunities.



- Reduced greenhouse gas emissions
- Increased energy security
- New business opportunities

Energy and the Chemical Industry: An Evolving Relationship

On the other side, there are also challenges associated with this transition. The shift towards renewable energy sources and alternative feedstocks may require significant investments in research and development, as well as the retooling of existing production facilities. Furthermore, the increased demand for lab space in the life sciences industry has presented many challenges for life science businesses.



- Investments in R&D
- Retooling of existing production facilities
- Challenges for life science businesses

Therefore, without the space required for natural science businesses to have a positive impact, the life science industry's issues translate to wider challenges concerning the ability to practise greener chemistry. Additionally, the industry must address potential concerns related to the environmental impact of new technologies and the availability and sustainability of alternative feedstocks.

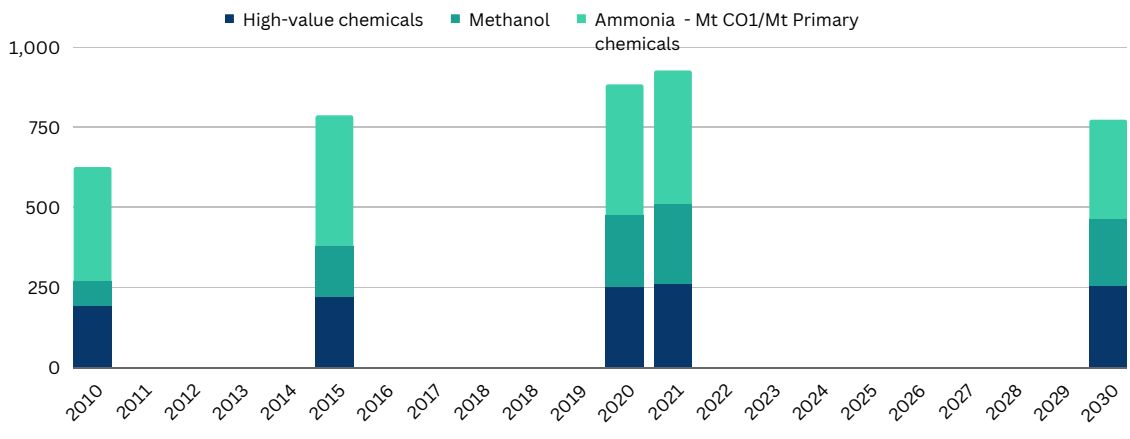
Tackling the Chemical Industry's Carbon Emissions Problem

Despite the chemical industry's vital role in modern society, producing essential materials for various sectors, it also significantly contributes to global carbon emissions, exacerbating climate change. Therefore, we examine the chemical industry's carbon emissions problem to better understand the issue and discuss potential solutions.

Carbon Emissions in the Chemical Industry: The Numbers

According to a report by the International Energy Agency (IEA, 2021), the chemical sector accounts for 7% of global energy-related CO2 emissions. In 2019, the sector emitted 1.2 billion tonnes of CO2, with the largest contributors being China (35%), the United States (14%), and the EU (9%).

The production of ammonia, ethylene, propylene, and chlorine account for more than half of the industry's CO2 emissions. The manufacturing of these chemicals involves energy-intensive processes, such as steam cracking, which requires large amounts of fossil fuels like natural gas or coal.



Direct CO2 emissions from primary chemical production in the Net Zero Scenario, 2000-2030 (IEA, 2021)

Tackling the Chemical Industry's Carbon Emissions Problem

The chemical industry faces several challenges in reducing its carbon emissions. Firstly, many processes rely on high-temperature heat, which is difficult to generate with renewable energy sources (9). Additionally, many chemical reactions release CO2 as a by-product, making it challenging to eliminate emissions entirely.

Three Potential Solutions

CARBON CAPTURE AND STORAGE (CCS)

By capturing CO2 emissions and storing them underground, the chemical industry could significantly reduce its carbon footprint. Several CCS projects are already in operation, such as the NER300 project in Europe.

ELECTRIFICATION

By replacing fossil fuel-based heat sources with renewable electricity, the industry could lower its emissions. Some companies are exploring the use of electrically heated steam crackers to produce chemicals.

CIRCULAR ECONOMY

By capturing CO2 emissions and storing them underground, the chemical industry could significantly reduce its carbon footprint. Several CCS projects are already in operation, such as the NER300 project in Europe.

Embracing Sustainability: The Chemical Industry's Role in Fighting Climate Change

Climate change poses a significant threat to the stability and health of the global environment. The chemical industry, as one of the largest industrial sectors, has a crucial part to play in mitigating the impacts of climate change. Here, we outline the various ways in which the chemical industry could contribute to this fight and adopt sustainable practices.

Energy Efficiency Improvements

The chemical industry consumes vast amounts of energy during the production process. By improving energy efficiency, the industry could reduce greenhouse gas emissions and decrease its reliance on fossil fuels. Strategies include updating and retrofitting outdated equipment, optimising production processes, and implementing advanced automation and control systems.

Carbon Capture and Utilisation

Carbon capture and utilisation (CCU) technologies offer a promising approach to reducing CO2 emissions. The chemical industry could lead the way by investing in research and development of innovative CCU technologies, and by integrating these technologies into their production processes.

Embracing Sustainability: The Chemical Industry's Role in Fighting Climate Change

Developing Sustainable Materials

The chemical industry is responsible for producing a wide range of materials, many of which have significant environmental impacts. By focusing on the development of sustainable materials, such as bio-based plastics and eco-friendly alternatives to traditional chemicals, the industry could reduce its environmental footprint.

Circular Economy

The concept of a circular economy involves minimising waste by reusing, recycling, and repurposing materials. The chemical industry could incorporate circular economy principles into its operations by developing technologies that facilitate the recycling of plastics and other materials, and by promoting the use of recycled feedstocks. R&D could also make more use of recycling chemicals and solvents through purification techniques and include measures to extend expiry dates rather than generate new material.

Embracing Sustainability: The Chemical Industry's Role in Fighting Climate Change

Collaboration and Partnerships

Addressing climate change requires a collective effort from various stakeholders. The chemical industry should actively collaborate with governments, research institutions, and other industries to develop sustainable solutions and promote best practices.

Conclusion

The chemical industry has the potential to play a pivotal role in combating climate change. By embracing energy efficiency, investing in carbon capture and utilisation, developing sustainable materials, promoting circular economy principles, and fostering collaboration, the industry could contribute to a more sustainable future.

Oxford Analytical's Roadmap Towards Sustainability & Combating Climate Change

Oxford Analytical has a deep understanding of the pressing need to address climate change and foster sustainable practices. Our company has demonstrated a firm commitment to the fight against climate change by implementing a holistic approach that encompasses multiple strategies, including a focus on sustainability, a comprehensive refurbishment plan, and a strong adherence to core values.

Our Sustainability Journey

We have embarked on a sustainability journey, seeking to reduce our environmental footprint, save resources, and maintain a healthy work environment for our employees. This journey began with the identification of Oxford Analytical's primary environmental impacts and the establishment of targets to address them.

In our pursuit of sustainability, we have adopted innovative technologies, such as energy-efficient LED lighting, solar panels, and low-energy HVAC systems. We have also prioritised waste reduction, recycling, and composting, in addition to encouraging employees to adopt eco-friendly commuting options, such as cycling or using public transportation.

Oxford Analytical's Roadmap Towards Sustainability & Combating Climate Change

Oxford Analytical's 5-Year Plan for Refurbishment

Recognising the potential for positive change through the refurbishment of its facilities, Oxford Analytical has developed a 5-year plan to transform its workspaces into energy-efficient and environmentally friendly lab spaces.

At the beginning of our 5-year refurbishment plan, we managed to digitalise our work processes, reduced our paper footprint by 70% since 2021, and introduced measures to recycle and extend expiry dates rather than dispose of chemicals.

In addition to this, we are working on partnering with reputable waste suppliers accredited to ISO14001 to reduce the volume of waste we produce, and properly dispose of the waste we do produce to be recycled.

- ✅ Digitalisation of work processes
- ✅ 70% reduction in paper footprint since 2021
- ✅ Partnering with reputable waste suppliers accredited to ISO14001
- ✅ Recycling and extending expiry dates of chemicals
- Creating awareness among the team about waste minimisation and reducing unnecessary orders
- Reducing the number of deliveries to further reduce emissions
- Researching greener alternatives for sample preparation
- Retrofitting the company's buildings with energy-efficient systems
- Incorporating cutting-edge technology for waste and resource management
- Using sustainable materials and adopting green building principles

Oxford Analytical's Roadmap Towards Sustainability & Combating Climate Change

Oxford Analytical's 5-Year Plan for Refurbishment

Internally, we have spent the time to create awareness amongst the team in regards to minimising waste and ordering unnecessary products, therefore reducing the number of deliveries to further reduce emissions. We continue to research greener alternatives for use in sample preparation and ensure that any purchasing decisions we make are made with our sustainability values in mind.

Our plans extend much further, including retrofitting the company's buildings with energy-efficient systems and incorporating cutting-edge technology for waste and resource management. By using sustainable materials and adopting green building principles, Oxford Analytical aims to achieve reduced energy consumption, lower greenhouse gas emissions, and minimise waste production.

Oxford Analytical's Core Values

Oxford Analytical's core values underpin the company's commitment to sustainability and the fight against climate change. These values emphasise a dedication to quality, customer service, integrity, and continuous improvement. By staying true to these principles, we ensure that our environmental initiatives remain in alignment with our mission and vision.

Oxford Analytical's Roadmap Towards Sustainability & Combating Climate Change

Committed to quality and integrity, Oxford Analytical maintains the highest standards of environmental performance. Our focus on continuous improvement ensures that we consistently seek new ways to reduce our impact on the environment while remaining responsive to the ever-changing landscape of sustainability.

Oxford Analytical's multi-faceted approach to sustainability and climate change mitigation highlights the company's dedication to being a responsible corporate citizen. By combining innovative technologies, comprehensive refurbishment plans, and adherence to core values, Oxford Analytical is actively working to make a difference in the fight against climate change. As we continue on this journey, the company serves as an inspiration and example for others in the industry to follow suit.

What’s more, Oxford Analytical inherently supports the chemical industry’s much-needed fight against climate change with the company's existing service offering. Our original focus was on providing GLP-compliant pesticide residue analysis. Now, with over thirty years of experience and sustained growth, we are able to offer a plethora of organically environment-inducing solutions such as biocides, bio-stimulants, and plant protection services. For example, plant protection may include practices such as environmental impact testing for soils and waters.

Recent examples of our work include a new novel plant protection product based on a natural biological micro-peptide, various other natural products such as those using Geraniol, essential oils such as Peppermint Oil and various amino acids such as those derived from seaweed.

Conclusion

In conclusion, chemistry and sustainability could coexist, as long as the focus remains on the development and implementation of innovative, eco-friendly solutions. Collaboration between scientists, industry, and policymakers is key to achieving this goal.

As explored throughout this white paper, there are many advantages and disadvantages chemistry could provide to the fight against climate change. As the world rightly demands sustainable ways of working across all industries, the chemistry industry finds itself behind in some areas and ahead of the curve in others.

However, with businesses such as Oxford Analytical prioritising sustainability, we could expect all areas of the chemical industry to begin working with sustainability as opposed to against it.

By reviewing their current processes and infrastructure, businesses across the chemical industry could implement positive changes by instilling a company culture which encourages sustainable practices.

Overall, if businesses within the chemical industry commit to the aforementioned changes, as well as practices such as energy efficiency improvements, carbon capture utilisation, developing sustainable materials, circular economy, collaboration and partnerships, the industry will move from a sporadic climate change combatant to a prolific one.

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References

1. Anastas, P. T., & Warner, J. C. (1998). Green Chemistry: Theory and Practice. Oxford University Press. (https://global.oup.com/academic/product/green-chemistry-9780198506980)
2. Lewis, N. S., & Nocera, D. G. (2006). Powering the planet: Chemical challenges in solar energy utilization. Proceedings of the National Academy of Sciences, 103(43), 15729-15735 (https://www.pnas.org/content/103/43/15729)
3. Tilman, D., Cassman, K. G., Matson, P. A., Naylor, R., & Polasky, S. (2002). Agricultural sustainability and intensive production practices. Nature, 418(6898), 671-677. (https://www.nature.com/articles/nature01014)
4. International Energy Agency (IEA). (2019). The Future of Petrochemicals. Retrieved from https://www.iea.org/reports/the-future-of-petrochemicals
5. Oxford Analytical Services. Supporting the growth of the Life Sciences sector in the UK. Retrieved from https://www.oxford-analytical.co.uk/supporting-the-growth-of-the-life-sciences-sector-in-the-uk/
6. International Energy Agency (2021). The Chemical Industry: A major energy consumer and greenhouse gas emitter. Retrieved from https://www.iea.org/reports/the-chemical-industry
7. Heede, R. (2020). Carbon Majors: Accounting for carbon and methane emissions 1854-2010. Climatic Change, 121(2), 229-241
8. European Chemical Industry Council (2021). Energy and Climate Change. Retrieved from https://cefic.org/app/uploads/2021/01/CEMBUREAU-Cefic_Energy-and-Climate-Change.pdf
9. Reuter, M., & Nilsson, L. J. (2021). Decarbonization of the chemical industry: Strategies and challenges. Environmental Science & Technology, 55(4), 2074-2084.
10. Pérez-Fortes, M., Schöneberger, J. C., Boulamanti, A., & Tzimas, E. (2016). Methanol synthesis using captured CO2 as raw material: Techno-economic and environmental assessment. Applied Energy, 161, 718-732.
11. European Commission (2021). NER 300 programme. Retrieved from https://ec.europa.eu/clima/policies/lowcarbon/ner300_en
12. BASF (2021). BASF and Linde develop ground-breaking process technology for electrically heated steam cracker furnaces. Retrieved from https://www.basf.com/global/en/media/news-releases/2021/
13. International Energy Agency. (2019). Energy Efficiency 2019. Retrieved from https://www.iea.org/reports/energy-efficiency-2019
14. Global CCS Institute. (2021). The Role of CCS in the Chemical Sector. Retrieved from https://www.globalccsinstitute.com/news-media/insights/the-role-of-ccs-in-the-chemical-sector/
15. European Chemical Industry Council. (2018). Chemical Industry's Contribution to a Circular Economy. Retrieved from https://cefic.org/app/uploads/2019/03/Cefic-Facts-and-Figures-2018.pdf
16. Ellen MacArthur Foundation. (2017). The New Plastics Economy: Rethinking the Future of Plastics & Catalysing Action. Retrieved from https://www.ellenmacarthurfoundation.org/assets/downloads/publications/NPEC-Hybrid_English_22-11-17_Digital.pdf
17. United Nations Global Compact. (2021). Business Ambition for 1.5°C. Retrieved from https://www.unglobalcompact.org/take-action/1_5C_business_ambition
18. Oxford Analytical Services. (2022). Our sustainability journey. Retrieved from https://www.oxford-analytical.co.uk/our-sustainability-journey
19. Oxford Analytical Services. (2022). Our 5 year plan for refurbishment. Changes. Retrieved from https://www.oxford-analytical.co.uk/our-5-year-plan-for-refurbishment
20. Oxford Analytical Services. Our values at Oxford Analytical. Retrieved from https://www.oxford-analytical.co.uk/our-values
21. Oxford Analytical Services. Biocides, plant protection, and bio-stimulants. Retrieved from https://www.oxford-analytical.co.uk/biocides-biostimulants-plant-protection