Master Thesis 2022-2023

Yara, Green Synthetic Nitrogen Fertilizers and the Self-Perpetuation of Corporate Authority.

05/06/2023

Wageningen | Wageningen University & Research

Master Thesis - RSO – 80436

Master Organic Agriculture (MOA)

2022-2023

Supervisor: Kees Jansen

Justine Cannivé – 970807154070

Abstract

This study aims to investigate the use of green fertilizers by Yara as a means to perpetuate their corporate authority in the current climate crisis. Using a critical discourse analysis and three-dimensional approach to corporate power, the study identifies how Yara uses green fertilizers to reframes themselves as part of the solution to climate change and dependency on gas. The research identifies Yara's use of knowledge to present green fertilizers as a perfect solution. By hiding and keeping certain information vague Yara is making themselves indispensable and ensuring a continued production of fertilizers. The research also shows how Yara influences regulations directly and indirectly, framing debates and securing access to resources. The study reveals how Yara uses the materiality of green fertilizers to place themselves as part of the hydrogen economy, ensuring the expansion of their influence and production to new sectors. The study aims to contribute to the understanding of how corporations mobilize their corporate power to implement technologies and use technologies to perpetuate their corporate authority.

Keywords: Corporate authority • Critical Discourse Analysis • Energy transition • Green fertilizers • Hydrogen economy • Political ecology • Power

Table of Content

List of Acronyms

AEA : Ammonia Energy Association
CBAM : Carbon Border Adjustment Mechanism
CCS : Carbon Capture and Storage
CDA : Critical Discourse Analysis
Cefic : European Chemical Industry Council
CHA: European Clean Hydrogen Alliance
CO2 : Carbon dioxide
CO_2e : CO_2 equivalent
EU : European Union
ETS : European Trading Scheme
GHG : Green-house gas
GRI : Global Reporting Initiative
H2 : Hydrogen
IFA : International Fertilizer Industry Association
IPCEI : Important Project of Common European Interest
IRA : Inflation Reduction Act
kT : Kilo tons
MoU : Memorandum of Understanding
NGO: Non-Governmental Organisation
mT : Million tons
NH_3 : Ammonia
p.a. : per annum
PEM : Proton Exchange Membrane
RFNBO : Renewable Fuels of Non-Biological Origin
T : Tonne
TFI : The Fertilizer Institute
YCA : Yara Clean Ammonia

List of Figures and Tables

Note on Terminology

During my research I noticed that some terms may indicate a different element or process depending on when and by whom they are used. Here, I use the terminologies as used by Yara, as I mainly refer to their work and statements. This terminology links the hydrogen type to the ammonia and fertilizers produced with it.

I will use the terms of blue – hydrogen / ammonia / fertilizer to describe hydrogen / ammonia / fertilizer produced with natural gas coupled with Carbon Capture and Storage (CCS).
I will use the terms of green – hydrogen / ammonia / fertilizer to describe hydrogen / ammonia / fertilizer produced with electrolysis powered by renewable energies.
I will use the terms of clean – hydrogen / ammonia / fertilizer to indicate both blue and green hydrogen / ammonia / fertilizer.

I- Introduction

In 2023, Yara International ASA, the largest synthetic nitrogen fertilizer producer, should start commercializing the first fossil free fertilizers (Yara & Lantmännen, 2022). These fertilizers will be produced with green hydrogen, the molecule which could decarbonize the energy sector. Green fertilizer thus brings new hope for the development of a low carbon agriculture. This announcement comes on the table after Yara has been criticized multiple times for their poor environmental performance and after recent protests during which the impact of the synthetic nitrogen fertilizer industry and the practices of this fertilizer giant were denounced (Burwood-Taylor, 2022; Food systems 4 people, 2021; Free the Soil, 2018). Synthetic fertilizers account for 2.1% of global Green-house gas (GHG) emissions and come with negative social impacts, relations of dependence and control with agro-industries, leading farmers to be vulnerable to price volatility (Drugmand et al., 2022; Ritchie, 2020).

Corporations sometimes have their corporate authority challenged. Corporate authority has been defined by Aguiton et al. (2021) as their ability to influence and transform the world around them through powers gained and legitimized. Corporate authority can be questioned by actors who may have different interests such as the State or civil society. Corporations develop various tools to perpetuate corporate authority. Through this thesis, I want to analyse how Yara uses green fertilizers to reproduce their corporate authority in the context of tensions linked to the environmental and social crisis.

1- Yara and Synthetic Nitrogen Fertilizers

Yara International ASA, a Norwegian chemical multinational created in 1905 as Norsk Hydra, was the first mineral fertilizer producer. Yara is the largest synthetic nitrogen fertilizer producer and second biggest fertilizer company overall after the Canadian multinational Nutrient and before The Mosaic Company from the US. It now employs around 17.000 people and operates in more than 150 countries. Yara is very active in North-West Europe; Sluiskil, in the Netherlands being its largest ammonia and nitrate fertilizer production plant. The Norwegian government is the largest shareholder, with 36,2 % of the shares. The biggest sales of Yara are synthetic nitrogen fertilizers (Yara, 2021b). In 2021, Yara produced 7.8 million tons (Mt) of ammonia as well as 21.8 Mt of finished fertilizers and had a revenue of USD 16.6 billion. Most of their production comes from ammonia-based products (Yara,

2021b). The production of synthetic nitrogen fertilizer was made possible by the discovery of the Haber-Bosch process at the start of the 20th century. These fertilizers led to a 50% crop production increase (Erisman et al., 2008). Their usage was especially popularized in the 60s at the start of the Green Revolution, along with the use of high yielding varieties, pesticides, and irrigation methods, which led to the intensification of agriculture. The economic model of agriculture changed, from a predominantly subsistence farming model to an economic model depending on agrochemical companies and subjected to market fluctuations (Mies & Shiva, 2014). Moreover, the concentration of the means of production in the hands of a small amount of big agrobusinesses, giving them an almost monopoly over the fertilizer industry, also increases price volatility (Bellamy Foster & Magdoff, 2011). Indeed, the 33% of the global synthetic nitrogen fertilizer market is controlled by just four companies (GRAIN & IATP, 2022). Likewise, synthetic nitrogen fertilizer production requires a lot of natural gas, which has unstable prices; 3-5% of all natural gas produced, and around 1-2% of the global energy supply is used just for ammonia production (Hammond & Gadanakis, 2022; Lu et al., 2018). Yara is the biggest European gas buyer, which is why for them, *"increased exposure to low-cost gas remains a key priority"* (Yara, 2017). Dependence on gas is one of the reasons why synthetic nitrogen fertilizers have an important environmental impact.

According to Menegat et al. (2022), 38.8% of the total synthetic nitrogen fertilizer-associated emissions are linked to their production, while their application to land accounts for 58.7%, and the remaining 2.6% are linked to transportation. The emissions linked to the production process of synthetic nitrogen fertilizers come mainly from two sources. The first one is the production of hydrogen, used to synthesize ammonia through a steam-reforming process which uses natural gas as a feedstock. The second is the Haber-Bosch process needed to create ammonia from hydrogen and atmospheric nitrogen (Menegat et al., 2022). According to Menegat et al. (2022), only around 20-30% of the synthetic nitrogen fertilizers applied to fields are actually converted to food, leading to further pollution. Soils get acidified, a process that slowly kills life in the soil by making it a hostile environment. In the long term, this makes absorption of nitrogen by plants harder, as bacteria that help to assimilate nitrogen disappear. The increased loose nitrogen in the soil will then leak and end up in rivers and groundwater, leading to the proliferation of algae and polluted drinking water as well as the creation of dead zones. Part of what is not absorbed by plants is also lost in the atmosphere through volatilization and denitrification (Robertson & Vitousek, 2009). As assimilation becomes harder, more

and more synthetic nitrogen fertilizers need to be applied to create the same effect, leading to a dependency on fertilizers (Drugmand et al., 2022).[1]

Yara has a particular interest in decreasing their carbon emissions linked to the production of fertilizers. According to their annual report of 2021, they are planning on cutting 30% of their market-based emissions. One of the main products they are developing to serve this purpose is green fertilizers (Yara, 2021b).

2- Green Fertilizers and the Hydrogen Economy

Green fertilizers are made out of green ammonia (see Figure *1*). Different colours of ammonia correspond to different hydrogen sources that are used to synthesise it. Grey and blue hydrogen are sourced from natural gas. In the case of blue hydrogen, the production is complemented by carbon capture and storage (CCS), helping to capture GHG that would be otherwise emitted in the air. Green hydrogen is sourced from water and isolated through electrolyse, which is powered by renewable electricity (Collett et al., 2022). In each case, hydrogen is used to produce ammonia thanks to the Haber-Bosch process. Both blue and green hydrogen are considered "clean hydrogen", and likewise clean ammonia is produced out of blue or green hydrogen. However, blue hydrogen is still reliant on fossil fuels and the CCS has been proven multiple times to be inefficient (Howarth & Jacobson, 2021; Stephens & Markusson, 2018).

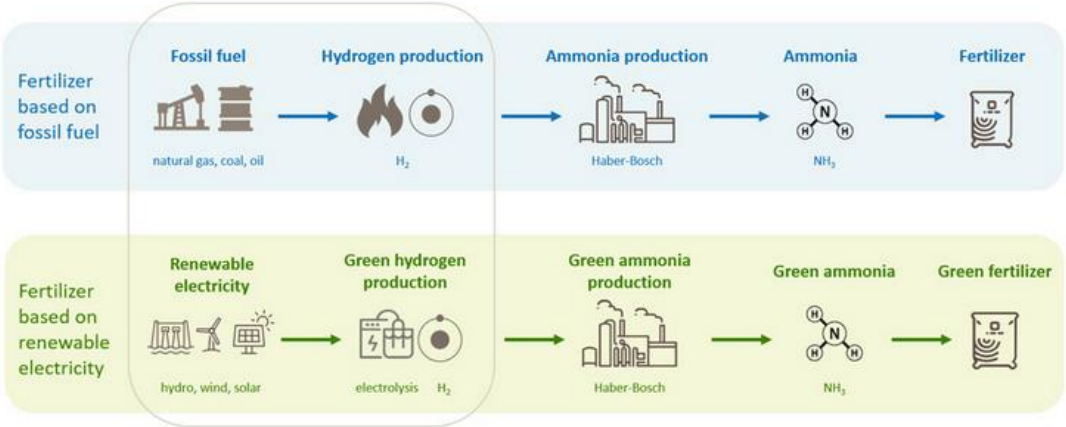

Figure 1 - Production of Green fertilizers by Yara. (Yara, n.d.-a)

[1] As the soil food-web gets damaged, it becomes harder for plants to be self-sufficient and absorb nitrogen, as well as other minerals that are naturally present in the soil. Indeed, microorganisms are responsible for fixing atmospheric nitrogen and degrading dead organic matter to transform organic and atmospheric nitrogen into nitrate, a form which plants can assimilate. Therefore, plants need a regular input of nitrogen fertilizers (Al-Kazafy H, 2015).

The production of green fertilizers and clean ammonia by Yara will be developed by the new Yara Clean Ammonia (YCA) unit, created in 2022, which focuses on clean ammonia business (Naida, 2021). YCA already has "*17 production units, operates 11 ships and 18 ammonia terminals across the world*" and is developing clean ammonia projects in Norway, Australia, and the Netherlands (Yara, n.d.-c). Clean ammonia is expected to have an important role in the hydrogen economy, and to become the future feedstock to decarbonize fertilizer production. Until 2022, half of the global hydrogen production was used for ammonia production, most of which was meant for fertilizer production. Green hydrogen has allowed the development of new applications for hydrogen, in order to decarbonize sectors which are hard to electrify and can hence not decarbonize their production with renewable electricity. A particular interest has arisen for the use of green hydrogen in the transportation, energy storage, and power generation sectors (World Energy Council, 2019).

The hydrogen industry is pushing for an economy based on decarbonized hydrogen as the main energy source, creating a hydrogen hype (Belén et al., 2020). This hype has been criticized by various organizations such as the Corporate Europe Observatory, International rivers, and Earth justice (Belén et al., 2020; International rivers, 2022; Saadat & Gersen, 2021). Among other things, critics point to the high demand in renewable energies that this economy would represent, the role of the gas lobby who is advocating for it, the continuous gas extraction to which this economy will probably lead, and its neo-colonial dimension (Belén et al., 2020). These debates, however, are mainly about the use of green hydrogen as an energy carrier and source, rather than as a feedstock for chemical production.

The study of the role of the fertilizer industry in the hydrogen hype as well as the use of green hydrogen for fertilizer production are thus particularly interesting to focus on. Moreover, as the European Union is planning on reducing the use of synthetic fertilizers, and political campaigns are demanding a fossil free agriculture, it is valuable to look into fossil free fertilizers and whether they respond to the current concerns about industrial agriculture. Fossil free fertilizers are especially relevant in a context in which the link between food production and gas became highly visible to the public through the food price increase linked to the war in Ukraine (Hammond & Gadanakis, 2022). Expectations from the EU and citizens are challenging Yara's actions and their legitimacy. Corporations use different tactics to perpetuate their authority when it is questioned, such as counter-argumentation, violence, or appropriation of the discourse (Aguiton et al., 2021). In the context of the environmental crisis, transnational companies participate in the debate around sustainable development to shape discourse and policies around it (Kolleck, 2013). According to Aguiton et al., (2021) there is an important need to study the various

instruments that corporations use to self-perpetuate their corporate authority. Indeed, when their powers are legitimized, corporations acquire an authority that allows them to influence governance as well as norms, and through this the world around them, by combining with or taking over the powers of the State. However, this authority has to be maintained and fought for, which is done through the utilization of various tools and strategies. Aguiton et al., (2021) call for more research to "*examine corporations and industries on the basis of the technologies that structure the deployment of their production systems*". Therefore, it would be interesting to study the diverse methods that Yara uses to self-perpetuate its authority, having a closer look at the role and use of green fertilizers as well as clean ammonia production, the base material for nitrogen fertilizer production, for that purpose.

The research question is the following question:

How does Yara use green fertilizers as part of their repertoire of action to self-perpetuate their corporate authority in the current social and environmental crisis?

Sub-questions are:

- *How is Yara using their corporate power to develop green fertilizers?*
- *How is Yara using green fertilizers to maintain their corporate power?*
- *How are green fertilizers limiting and embodying power?*
- *How are Yara's powers legitimized through green fertilizers?*

These research questions will be answered through a critical discourse analysis, using a three-dimensional understanding of power, which will be further explained in my theoretical framework.

II- Theoretical Framework and Methodology

In order to analyse the use of green fertilizers by Yara to self-perpetuate their corporate authority. I will first locate my research in 1) a political ecology framework 2) a critical discourse analysis base on the Foucauldian approach of power. The concepts of corporate power and corporate authority helped me to analyse the use of green fertilizers by Yara. I will review the literature on tools used by corporations to self-reproduce their powers. I will then present the and reflect on the limitations of this research.

1- Political Ecology

Political ecology is an interdisciplinary approach that connects the socio-economic and political context to environmental degradation, and studies how one influences the other. This field understands that environmental damages do not have a mere biophysical origin, but also have socio-political roots to their causes and impacts. The way that the environment is managed will have consequences over the biophysical world, leading to potential environmental changes. The latter originate from and affect different socio-economic groups disproportionally. Indeed, the socio-political context will impact how resources are used, who has access to them and under which terms. Various political ecology studies make the link between capitalism, resource accumulation and extractivism (Tilzey, 2017). Current economic structures benefit powerful actors and give them access to energy and resources. Moreover, changes may be perceived and experienced differently according to where people live, the connection between people and their environment, as well as material resources available to them to mitigate and adapt to that change. The socio-political conditions can affect the understanding and framing of the consequences and with it, the solution that may be found and enforced. This can create responses that will impact various groups in uneven manners and may not respond adequately to the biological or social aspect of the problem (Forsyth, 2004). Power dynamics are playing a major role in the framing, as various actors can have different interests, leading to some solutions being prioritized and put forward. Some actors will have a disproportionate access to governance tools and decision-making structures, which will impact the management of resources and through it, the material world. It is therefore important to understand and explicitly study the underlying power dynamics at play in environmental degradation and management (Forsyth, 2004). Some political ecologists draw on Foucault's understanding of power, developed in his work on governmentality and biopower (Fletcher, 2017; Forsyth, 2004; Robbins, 2012). This line of thinking theorizes power not only as

creating submission through physical violence, but also taking more subtle forms. Power is also seen as productive, through the making of knowledge, used to sustain itself and regulate bodies. Reciprocally, knowledge produces and reproduces power dynamics and social inequalities through discourse. Discourse is a set of statements that creates and disseminates knowledge. Discourse is not mere sentences; it is influenced by and influences the social reality and understanding (Bischoping & Gazso, 2021). Hence, discourses create frameworks to understand and interpret environmental degradations, allowing society to respond to them. As power influences discourses, allowing the over-representation of some of them, the discourse which is used will influence the solution. It is therefore relevant to study discourses in order to understand the power dynamics at play in environmental management and degradation.

2- Critical Discourse Analysis

A common approach to study power through discourse is Critical Discourse Analysis (CDA). In order to analyse how Yara uses green fertilizers to preserve their corporate authority, the discourse of Yara around green fertilizers can be analysed and compared to their concrete actions, in order to understand its material and legal impact.

Discourse analysis usually studies statements in order to identify underlying discourses and examine the assumptions on which they are based. This can help to understand the foundations of worldviews and the actors which may use their power to influence certain discourses (Benjaminsen & Svarstad, 2021). A common framework used to analyse discourse in the light of power dynamics is CDA. CDA regroups various approaches and methods. It has been used to study the effects of language use and discourse construction on social and political structures. The socio-political structures and process in which these discourses emerge and that impact their meaning construction (Wodak, 2001). It focuses on the creation and usage of specific discourses to reproduce inequalities (Megura & Gunderson, 2022). CDA aims at formulating a critique of discourse and the social reality that it creates. It deals with notions such as power, ideology, and inequalities by placing discourse in a social context (Fairclough, 2003). When practicing critical discourse analysis, one shifts the focus between the discourse and the material aspects of social reality, studying the relation between both.

> *"CDA oscillates as I have indicated between a focus on structures (especially the intermediate level of structuring of social practices) and a focus on the strategies of social agents, i.e. the ways in which they try to achieve outcomes or objectives within existing structures and practices, or to change them in particular ways"* (Fairclough, 2009).

CDA is critical in that it contributes to a more accurate understanding of social reality, the problems that are associated with it, and an identification and analysis of their causes. By gaining a better understanding of the link between discourse and social reality, an appropriate resistance can be identified and adopted. By showing the link between environmental degradation and discourse, Forsyth (2004) argues that CDA should be used to study ecological problems together with the power dynamics involved. The importance of studying the link between the two has also been shown by Alexander (2017), who uses CDA to understand how corporations build their narrative around sustainability and to unpack the actions they take to respond and adapt to it. CDA is thus a relevant approach to study the role of green fertilizers in Yara's sustainability narrative.

I will conduct a critical discourse analysis to understand how Yara creates the discourse around green fertilizers, as well as the context in which this discourse arises and the social reality it creates. This analysis was undertaken by using the concepts of corporate authority, repertoire of actions, and a tridimensional approach to corporate power.

3- Corporate Power and Repertoire of Action

This section explores the various dimensions of corporate power and the tools that allow corporations to defend their interests.

Corporations are regulated through various norms, regulations, and institutions, but also participate in and influence the formulation of those very same things. (Clapp & Fuchs, 2009). Through their corporate power they can influence and create them in order to promote their interests and favourable conditions for their activities. Various dimensions of corporate power have been identified. Clapp & Fuchs (2009) classifies them as being part of structural, instrumental or discursive power.

Instrumental power is exercised by one actor over another, with a direct influence over the outcome. Some tools of instrumental power include lobbying or financing of political campaigns. Corporations can use this to frame political debates to their advantage. By examining the relationships between states and businesses,

instrumental power can be studied (Jansen, 2017). Structural power takes into account the structures that provide space for influence and give decision-making power to certain actors. This can be linked to the corporation's role in the economy. It is also more and more available to corporations through their right to make regulations with tools such as labels, property rights and CSR. Through this, they can determine the focus and content of those rules (Clapp & Fuchs, 2009). Structural power can be related to the complexity of certain issues that require the expertise of certain economic actors for governance (Jansen, 2017). The existing material structures influence the various degrees of acceptance of different solutions, restricting the examined alternatives. Corporations use their power in the discursive process to frame problems and societal norms. They try to shape *"perceptions, identities and interpretations"* and through it influence social practices and the political agenda (Kolleck, 2009). By creating corporation friendly framing to understand problems and the state of affairs, corporations can influence which solutions are considered valid. These different types of power should not be considered independently but rather as being interconnected. Some strategies may be associated with different types of power. They may overleap and can interact as well as reinforce each other. However, an analytical distinction between different types of power helps to understand the various aspects in which corporations influence social reality and to *"identify and distinguish a variety of forms of business influence and how they may shift over time"* (Jansen, 2017).

Due to the *"dynamic and multi-sited*" as well as systemic nature of these powers, they create what Aguiton et al. (2021), calls *'pervasive powers'*. They have a direct impact on their environment, through regulations and discourses as well as materiality. Indeed, industrial production affects the environment in irreversible manners. This can be the case through the space it occupies with infrastructure, for transport, production, marketing, as well as through the production of residues as Boudia et al. (2021) describes. Moreover, they can influence the technological perspectives of a society (Aguiton et al., 2021). Ahlborg & Nightingale, (2018) also identify power in technologies and artefacts. Although they may often be perceived as passive objects, they are productive and dynamic and have a central role to the exercise and (re)production of power by corporations. This understanding of technology indicates the importance of studying the role of green fertilizers not only as a tool but also as an object that holds power and thus has a central role in the exercise of power by Yara.

Corporate power can become institutionalized, which gives corporations an authority. This institutionalisation relies on the legitimacy that society and state give them, through their recognition and acceptance of these powers (Sikor & Lund, 2010). This legitimacy is especially important in the exercise of discursive power, as

it relies on listening and trusting, but also creates it. According to Clapp & Fuchs (2009),

> *"Actors can also obtain political legitimacy from the trust the public places in their expertise and capacities as well as in their intentions. These latter sources of political legitimacy apply primarily to nonstate actors."*

They base legitimacy on three aspects, namely trust in a corporation's expertise, capacities, and intentions. These three criteria will guide the analysis of the perpetuation of Yara's corporate authority.

Corporate authority gives corporations a major influence over the global governance of economic production and hence, the possibility to transform the world around them and secure their access to resources (Aguiton et al., 2021). However, it is not indefinitely acquired, and can be put through difficulties by human and non-human actors. This is the case with grassroot movements that publicly criticise and resist some practices and corporations, governments which have divergent goals, as well as the limits of production due to a lack of soil fertility or the toxicity of residues (Boudia et al., 2021; Puig de la Bellacasa, 2015). Multinational corporations need to fight to self-reproduce corporate authority, and maintain their power over institutions, norms and rules and influence the distribution of cost and benefits (Levy & Egan, 2003).

In order to self-perpetuate corporate authority, corporations mobilize various strategies and invest in technological innovations. The variety of tools and tactics through which they defend their self-interests has been theorised under the term of repertoire of action (Déplaude & Marc-Olivier, 2014). It encompasses methods such as lobbying, recruitment of researchers and academics, diversion, blame-shifting, as well as discrediting or threatening opponents (Déplaude & Marc-Olivier, 2014). This can be done by corporations themselves or by related actors.

Aguiton et al. (2021) describe five dimensions to this repertoire. This distinction between various strategies will provide an analytical guideline to identify the strategies used by Yara to develop green fertilizers and the ones in which green fertilizers plays a role for the preservation of Yara's self-interests.

The first strategy corresponds to the methods used by corporations to make themselves indispensable to other actors. This can be achieved by acquiring a certain structural power due to their economic position that allows them to impose rules and standards. The development of infrastructures as well as the creation of knowledge can lead to dependencies of other actors. Strategies of development of technologies are also deployed, which creates a need when adopted by the broader society. Corporations can also take advantage of various aspects of knowledge production,

such as knowledge expertise and ignorance of other actors. Some data may be hidden, kept vague or only partly communicated. They can use the law, as well as its loopholes and failures as part of their repertoire of actions. Legal as well as illegal means can be used, such as lobbying practices and corruption. Violence in various degrees and forms is also an important aspect. Finally, the visibility of the corporation's actions can played with and used to various degrees to their advantage. Indeed, their views may be highly mediatized and communicated about, while some aspects of production or decision-making processes are hidden to the public, keeping affected populations out of the democratic process. This study pays a particular attention to strategies developed by corporations to make themselves indispensable, as those can be closely linked to the use of technologies in defending their interest. Some attention is also be paid to the use of knowledge, visibility and law. The dimension of violence, as well as the illegal means, will not be studied here, due to the lack of access to data.

4- Methodology

The analysis of the role of green fertilizers in Yara's strategy was realised by undertaking a critical discourse analysis The data were collected through a literature review of public documents. I analysed various reports, position papers, corporate releases, YouTube videos, and conference recordings of Yara and lobby groups they are part of. I also reviewed various EU legislations which were of particular interest. Some key critical documents written by NGOs and campaigning groups were also studied in order to put into perspective some of the information given by Yara.

I started by identifying the main narratives around fertilizers and green fertilizers pushed by Yara. The main documents used for that purpose were the integrated and sustainability reports of the past 10 years, with a specific attention to the ones of 2021 and 2022. Presentations and advertisement videos where also studied for that purpose. As a second step I made a map of the lobby groups and organizations that Yara is part of in Europe. I used the tool Lobbyfacts, which is made by Corporate Europe Observatory (Corporate Europe Observatory & Lobby Control, n.d.-a). This platform is based on knowledge from the EU corporate watch, but keeps a trace of past years, which is not possible with the EU tool. This platform gives information on the amount of money declared by Yara for lobbying purposes. Moreover, Yara announces the various topics of interests they are lobbying for. This tool also keeps a trace of the different accreditations that Yara and their lobby groups have at the European council. I could map the organizations that Yara is affiliated to, and their lobbying firms. The different official meetings that Yara took part in are also indicated, as well as the roadmaps and public consultations that Yara participated in. With this information collected from Yara, as well as their affiliated partners, I could draw a mind map on domains of influence and interests of Yara in European policy making. Following these indications, I read the key position papers of Yara, as well as those of various lobby groups and associations they are affiliated with. Likewise, I read various policy briefs of the EU that Yara is engaging with.
Finally, I dived into the practices of Yara. For that purpose I read into the documentation of Yara Clean Ammonia (YCA), especially of the Capital Market Day presentation which was the most complete source of information I could find. I also read various corporate releases of the past 10 years and project feasibility studies to get a clearer overview of the projects and plans of Yara. I compare this information with the goals set by Yara in their integrated and sustainability reports, as well as information from local reports, with a focus on France and the Netherlands.

In order to verify and complete some information and know more about Yara's actions and their narrative, I got in contact with them. A first email was sent to YCA in order to have more information about projects developed by Yara in the United States. A second email was sent the following week to Yara International to request an interview. Both these emails remained unanswered. In order to hear from more critical sources I reached out to the Corporate Europe Observatory, who did research on the hydrogen economy and on Yara, to request an interview. The person who had the most knowledge on the topic was unavailable, but I received some valuable information from them. I also went at the *Salon de l'Agriculture* in Paris in order to meet someone working at Yara, and try to establish a first contact. I had the chance to talk to someone on the stand, but I was never contacted by that person again.

The information collected was then studied using the concepts of power, corporate authority, and repertoire of action. I identified different tools which are used by Yara to implement green fertilizers and the ones used thanks to green fertilizers to renew their corporate authority. I also identified the various powers which Yara uses and which are reinforced through the development of green fertilizers. The legitimization of their powers was studied in the light of concepts defined by Clapp & Fuchs (2009).

5- Limitations

This research has various limitations which are linked to the time available to conduct the research, external factors, and the methodology chosen.

First, the absence of interviews, made it difficult to verify some information and hear some personal views of people working for Yara and why they use a certain discourse. Furthermore, I could only collect publicly available data as I had no access to closed or informal meetings and conversations. Moreover, I only had access to official data regarding the financial links of Yara with other actors, and without means to verify that information. Hence, I could not draw any conclusions on the potential use of violence or illegal means, as well as on undocumented decision-making processes.

Another limitation is the scope of the study in terms of space, time and actors, due to limited time. I decided to focus on the European legal context as I know and understand it better and to study some specificities linked to local contexts. This was the case especially in France thanks to my visit to the *Salon de l'Agriculture*, and to my understanding of the language. The lack of a long term perspective, as recommended by Aguiton et al. (2021), due to the recent development of green hydrogen make some claims tentative only. However, within the context of a critical

discourse analysis, the focus on the current situation may allow my research to have an impact on the current debate, as a better response to the use of green fertilizers can be formulated through a better understanding of the complex situation. Moreover, the absence of research about Yara's involvement in the academic world, again due to time reasons, limits the understanding of researcher's role in the self-perpetuation of corporate authority.

My personal bias is the last limitation that I identified. Indeed, CDA has been criticized for being prone to biased interpretations (Meyer, 2001). This was limited by the triangulation of data, with the use of various data sources such as corporate reports, videos, legal documents and corporate releases. However, no triangulation through interviews could be conducted. The combining of sources of different actors such as Yara, their lobbying groups, and reports of NGOs allowed limit my biases. Moreover, by doing CDA, I am also open about my intentions and position (Meyer, 2001).

III- Results

In order to study the use of green fertilizers by Yara, it is important to look at both how green fertilizers are present in Yara's narrative as well as what Yara is advocating for and how they are influencing the regulatory framework. This can be made concrete and become relevant by analysing and comparing it to what Yara is doing and planning to do with green fertilizers. Through this analysis, I hope to develop a better understanding of the role which fertilizers play in Yara's strategy and business model.

1- Yara's Narrative

A- The Need for Synthetic Fertilizers

'The need for synthetic fertilizers' is at the core of the justification for the existence of the fertilizer industry and Yara. The fact that mineral fertilizers allow the production of half of all crops in the world is present in various key Yara documents (Erisman et al., 2008). This claim, used to demonstrate the need for synthetic fertilizers, is often reformulated and states that half the world population is fed thanks to mineral fertilizers and in consequence, without synthetic fertilizers, half the population would be lacking food.

> *"Did you know that without mineral fertilizers, half of the people in the world wouldn't have food on their table"* (Yara, 2022h).

Through this statement, Yara makes mineral fertilizers necessary to ensure food security for a growing population. The necessity for synthetic fertilizers is also present in the fertilizer industry's broader narrative. Fertilizers Europe - the largest association representing the fertilizer industry - wants *"to raise public awareness of the complexity of food production and how vital fertilizers are to Europe's food security"* (Fertilizers Europe, 2021a).

Nowadays, Yara is connecting the issue of food insecurity with climate change in their communication and sustainability strategies. Yara acknowledges that climate change is both driven by agriculture, and a threat to it. They recognize the role played by the fertilizer industry in GHG emissions and the need to reduce emissions.

> *"Connecting the issues of food security and climate change is a key approach when responding to global environmental issues. A major global challenge is to create green growth in a low-carbon economy, with a*

> *reduced carbon footprint. Today, agriculture causes about one quarter of global greenhouse gas emissions, with land use change originating from agricultural expansion being the main culprit. The manufacturing of mineral fertilizers contributes to GHG emissions, but they are also vital in limiting the need to expand farmland"* (Yara, 2018).

Yara identifies the double pressure of a growing world population, which will require an increase in food production, and climate change, which is partly driven by land use change for agricultural purposes. According to Yara, the intensification of agriculture is needed in order to reduce the impact of land use change. This will help produce more food on less land and will help deal with both climate change and a growing world population at the same time. This allows Yara to affirm that fertilizers have to be part of the solution for climate change and environmental degradation.

> *"Fertilisers are a key piece of the puzzle to keep up with the EU's ambition to produce food in a more sustainable way"* (Yara, 2021a).

Yara affirms that fertilizers have to be part of the solution for sustainable food systems, which respect the environment while feeding people. Through this, the problem becomes about the way in which synthetic fertilizers are used and produced, rather than about the fertilizer industry and fertilizers as such.

Yara positions itself as a key stakeholder to respond to this challenge. Their identity and intensions are presented as key arguments to their presence in the decarbonization of the fertilizer sector.

> *"Sustainability is fully embedded and integrated into Yara's strategy and decision-making processes. We firmly believe that our knowledge and purpose give us a competitive advantage in a market that values sustainability, and our Sustainability Governance structure ensures that we meet our commitments and deliver on our ambition of Growing a Nature-Positive Food Future"* (Yara, 2023a).

Yara is presenting sustainability as being central to their activity and identity, which is seen in their sustainability goals and the strategies developed to meet them. This mission statement of *'growing a nature-positive future'* is defined more precisely by Yara in this statement :

> *"This (strategy) encompasses our expertise in crop nutrition solutions and our goal of climate-neutrality, but also goes further. We will expand our*

> *knowledge-sharing to create measurable, positive global impact in order to help feed the world and contribute to a responsible food system while protecting nature, reducing emissions, and improving livelihoods"* (Yara, 2023b).

This clarifies that central to their ambition is the wish to reduce their emissions and enable a climate neutral food system. Furthermore, it also shows how Yara is presenting their expertise and experience as a very needed advantage for the development of a sustainable food system. By bringing forward arguments of expertise, experience, and ambition, Yara becomes a central stakeholder for the development of a sustainable and climate neutral food system.

Looking at the narrative around synthetic fertilizers, it becomes visible that Yara is justifying the need for mineral fertilizers in the future food system, to ensure food security while reducing the environmental impact of food production through the intensification of agriculture and the reduction of land use change. The problem lays in the way fertilizers are produced and used, which results in GHG emissions. According to Yara, they are the right stakeholders to meet this challenge, as they have experience and expertise in fertilizer production, as well as the right intensions.

B- Green Fertilizers as the Solution – Timeline and Narrative

Yara identified clean ammonia and green fertilizers as a solution to decarbonize the fertilizer industry, and through it, agriculture. The interest in green fertilizers grew after the Paris Agreements. The first time that Yara mentioned green fertilizers was briefly in their 2017 GRI report, as a response to climate change and to improve resource management (Yara, 2018). It was specified that the technology would still need considerable improvements. In the 2018 GRI report, Yara mentions green ammonia, as well as potential production projects, for the first time (Yara, 2019). In 2019, the first goal for climate neutrality in 2050 is set, and the 30% emission reduction by 2030 goal appears one year later in the 2020 report (Yara, 2020a, 2021c). In Yara's 2020 sustainability report, they express their ambition to extend the use of clean ammonia to new applications which are being developed in the context of the emergence of the hydrogen economy (Yara, 2021c). The 2021 report is the first mention of CCS as part of their clean ammonia strategy (Yara, 2022b). It is important to highlight that Yara's ambition to produce clean ammonia and green fertilizers is recent, and follows European climate regulations and the development of the hydrogen lobby. Moreover, it is noticeable that Yara is setting their goal of climate neutrality after the Paris Agreements and after having identified green fertilizers as a potential technology to achieve it.

Green fertilizers are now present in most information sources from Yara that address climate change, as well as the future of the company and food production. They were an integral part of Yara's narrative at the *Salon de l'Agriculture*, through a model representing the various routes that Yara uses to decarbonize their fertilizer production. The first step of the model presented the production of hydrogen with renewable energies or natural gas that was coupled with CCS. It also presented the NO_2 abatement technologies that Yara already developed, as well as the digital tools that would help reduce the nutrient losses on the field (Yara France, 2023b). Moreover, green fertilizers were Yara's main talking point at the COP27 in the panel discussion about decarbonizing food production (Food Systems Pavilion at COP27, 2022). Green fertilizers and clean ammonia are also the 2nd fast track solution mentioned in the roadmap to put the Farm to Fork strategy into actions (Yara, 2021d). Likewise, they are part of the roadmap for decarbonization of various ammonia production plants of Yara, such as Sluiskil and Le Havre (Yara France, 2023a; Yara Netherlands, 2022b). The production of clean ammonia is not only part of Yara's plan to decarbonize their production, but also of some states' plan; Norway for example is counting on the electrification of Porsgrunn to reduce their emissions by 800,000 t/year (Yara, 2021f). Clean ammonia and green fertilizers are also promoted by the broader fertilizer sector as part of the future of the fertilizer industry, with actors such as Fertilizer Europe. This can be seen in magazines such as the World Fertilizer Magazine issue of February 2023 which has various articles that document on green fertilizers and entails numerous advertisements for different companies, products and production technologies (World Fertilizer, 2023).

After the Paris agreements, green fertilizers gained in importance in Yara's communication. This shift is recent and was followed by the setting of sustainability goals which rely on this technology to be achieved. Green fertilizers are now present in most communication from Yara concerning the future of nitrogen fertilizer production

C- Green Fertilizers as a Perfect Solution

Yara uses various arguments to justify the importance of green fertilizers. According to them, this technology is now ready to implement, which would respond to the urgency of the climate crisis.

> *"Low carbon, fossil free fertilizer is not a distant fantasy but reality. A global solution that requires local implementation"* (Food Systems Pavilion at COP27, 2022).

This statement claims that at this stage green fertilizers only require implementation. Furthermore, this technology can be a response to environmental challenges everywhere. Yara identifies three further benefits to green fertilizers, namely that they are an *effortless, fossil free* and *impactful* solution (Yara, 2023b).

First of all, according to Yara, green fertilizers allow an easy transition.

> *"Green fertilizers are a simple way for food companies and farmers using nitrate-based fertilizers to reduce the carbon footprint of their crops and food products without needing to change their operations, agricultural practices, or processes"* (Yara, 2023b).

This statements underlines that the value chain, infrastructures, and production processes for fertilizers are the same regardless of the hydrogen source. This allows the maintaining of most of the current fertilizer production structure, simplifying the transition.

Secondly, Yara considers green fertilizers to be a breakthrough technology that will allow the decarbonization of the fertilizer sector by moving away from fossil fuels. Indeed, the main source of emissions linked to synthetic nitrogen fertilizer production comes from the natural gas used for the production of ammonia.

> *"Our core processes, including the production of nitrogen fertilizers and industrial chemicals, rely heavily on natural gas as the primary energy source and feedstock. However, our use of natural gas in the ammonia process generates significant CO_2 emissions, making ammonia production responsible for almost 80% of our direct greenhouse gas (GHG) emissions. As a result, reducing GHG emissions from our ammonia production is a critical priority for us"* (Yara, 2023b).

According to Yara, changing the ammonia production process is key to reducing the emissions linked to nitrogen fertilizers. Fertilizer production which uses green ammonia as feedstock would thus allow them to move away from natural gas and help their decarbonization. This argument was especially used by Yara after the start of the war in Ukraine. Indeed, these recent events heavily influenced the gas industry and the fertilizer sector. The dependency on Russian gas led to an increase in gas prices and hindered access to this resource. According to Yara,

> *"One of the most powerful responses (to the Russian invasion) is therefore to continue to reduce our Russian energy and food dependency. A key lever*

> *is to produce ammonia and fertilizers based on renewables instead of fossil energy. This will have the dual impact of decarbonizing large sectors such as agriculture, shipping, and power production, as well as limiting the influence and importance of Russian carbon-intense energy"* (Yara, 2023a).

In this remarkable statement, Yara is arguing that this crisis shows the need to divest from of Russian gas through the development of the hydrogen economy. By increasing the production and availability of renewable energies, both climate change and dependency on Russian gas can be addressed. Furthermore, access to gas which does not come from unstable areas should be secured and the energy transition accelerated.

Lastly, Yara is stating that the shift to green fertilizers would have a strong impact on current emissions.

> *"Green fertilizers will significantly lower the carbon footprint across the food value chain, from fertilizers to food. Green fertilizers can cut the carbon footprint of crops by up to 30% and of certain food items by as much as 20%"* (Yara, 2023b).

They are showing the impact of this technological shift by emphasising the emissions avoided by the implementation of green fertilizers. It is important to highlight that no indication is given on the agricultural practices used to grow the products they are comparing themselves to. Indeed, by showing the reduction rate, Yara gives the impression that only one type of agriculture exists.

Yara is presenting green fertilizers as a perfect solution which is ready to be applied and will provide an easy and impactful alternative to fossil-based fertilizers. This can be further studied by looking into the terminology used by Yara to designate fertilizers as well as ammonia and hydrogen.

D- Nomenclature to Designate Fertilizers and Hydrogen, and what it says about Yara

Throughout this research, the existence of a multitude of terms used to designate the different types of fertilizers, ammonia, and hydrogen became visible. By looking more into Yara's terminology to describe green fertilizers (presented in Table 1), it is noticeable that they use designations with positive overtones to refer to this technology. They get called *"zero-emission fertilizers"*, *"carbon-free fertilizers"*, *"climate-neutral fertilizers"* and *"decarbonized fertilizers"*. All of these terms

emphasize the environmentally sustainable side of green fertilizers. This allows a rebranding of synthetic fertilizers, hiding the consequence of their usage by focusing on the positive side of their production method.

By looking at the terms, it is important to highlight that Yara is mainly naming *green fertilizers*, but does not have a clear designation for or narrative around *blue fertilizers*. Yara only refers to the use of blue hydrogen in the case of the production of blue ammonia. Yara has two pages of their website dedicated to green fertilizers: *"What you need to know about green fertilizers"* and "*Transforming the food system, green fertilizers, a key piece to the climate puzzle"* (Yara, n.d.-b, n.d.-a). None of these mentions the (potential) existence of blue fertilizers. One page of their website is dedicated to Yara Clean Ammonia (YCA), which expands on their clean ammonia business. On this page, Yara clearly mentions the concept of green ammonia: *"Furthermore, producing ammonia with renewable energy results in zero or minimal greenhouse gas emissions"* (Yara, n.d.-c). This sentence is followed by an indication to a video which names, without defining, blue ammonia: *"Watch the video to learn more about clean (blue and green) ammonia"* (Yara, n.d.-c). In these sentences, Yara talks about both blue and green ammonia, giving more visibility to green ammonia and highlighting the use of renewable energies. By having no clear designation or description, it seems like blue fertilizers do not exist.

Table 1 – Variation in nomenclature of the various terms used to define hydrogen, ammonia and fertilizers

Term	Used by	Meaning	Quote	Source
Clean hydrogen	EU	Green hydrogen	"Renewable hydrogen (sometimes referred to as clean hydrogen)"	European Commission, 2020a
Clean hydrogen	Hydrogen Europe	Blue and green hydrogen	"The subsidy works on a sliding scale, so that the cleaner the end product, the bigger the tax credit it receives, starting at 60c/kg. That means support for a variety of clean hydrogen technologies, including blue, which is made by capturing the carbon dioxide produced during traditional production."	Hydrogen Europe, 2022b
Low carbon hydrogen	EU	Hydrogen with lower carbon footprint – independent of energy source	"defined by the amount of GHG emissions it produces and is neutral to the method used. As a result, low-carbon hydrogen can come from a variety of energy sources such as natural gas with CCS or electrolysers running on nuclear electricity."	Erbach & Svensson, 2023
Renewable hydrogen	EU	Green hydrogen	"Hydrogen produced through the electrolysis of water (in an electrolyser, powered by electricity),	European Commission, 2020a

			and with the electricity stemming from renewable sources"	
Climate Neutral hydrogen	Austrian govern-ment	Blue and turquoise hydrogen with 100% carbon capture and excluding nuclear power at every step of the production.	"The Austrian strategy introduces the concept of "climate-neutral hydrogen"	Hydrogen Europe, 2022a
Clean ammonia	Yara	Blue and green ammonia	"Watch the video to learn more about clean (blue and green) ammonia."	Hydrogen Europe, 2022b
Clean ammonia	Fertilizer Europe	Blue and green ammonia	"Fertilizers Europe calls on EU co-legislators to ensure that clean fertilizer and ammonia production continue to be produced in Europe. To keep this key element of food security, the legislators should include low carbon hydrogen in the RFNBOs industry target."	Fertilizers Europe, 2023
Blue ammonia	Yara	Blue ammonia	"is produced in a conventional process using natural gas, but with the addition of a carbon capture and storage (CCS) process to capture and permanently store CO_2 emissions. »	Yara, 2021c
Green ammonia	Yara	Green ammonia	"is generated by using 100% renewable energy and feedstock sources, resulting in zero or minimal GHG emissions. One example is using hydrogen from water electrolysis based on renewable energy, and nitrogen separated from the air."	Yara, 2021c
Low carbon ammonia	Yara	Unclear	"We focus on developing markets and demand for zero or low carbon ammonia in fertilizer production"	Yara, 2021c
Zero carbon ammonia	Yara	Unclear	"We focus on developing markets and demand for zero or low carbon ammonia in fertilizer production"	Yara, 2021c
Renewable ammonia	Yara	Green ammonia	"ENGIE-YARA Renewable Hydrogen and Ammonia Deployment in Pilbara"	Yara & Engie, 2020
Reduced carbon ammonia	Yara	Unclear	"Yara pledges to source and/or produce a minimum of 3 million tons of reduced-carbon ammonia (equivalent of 530 kilotons of reduced-carbon hydrogen) by 2030, of which a minimum of 50% will be low-carbon or ultra-low carbon."	Yara, 2022b
Clean fertilizer	Yara	Blue or green fertilizers	"Yara clean fertilizer sales"	YCA, 2022a
Green fertilizer	Yara	Synthetic fertilizers	"Green and Low Carbon Fertilizer Solutions"	Yara, 2022b

		based on renewable energies		
Low carbon fertilizer	Yara	Unclear	"The production facility will be capable of supplying low-carbon ammonia to meet growing global demand, with an expected capacity of 1.2 –1.4 million tpy. Approximately 95% of the carbon dioxide (CO_2) generated from the production process is anticipated to be captured and transported"	Yara, 2023c
Fossil free fertilizer	Yara	Green fertilizers	"Lantmännen and Yara are now taking a pioneering role in the transformation of the food system by launching a pilot project to introduce a certified fossil free fertilizer. The collaboration builds on Yara's efforts to produce mineral fertilizer from renewable energy"	Yara, 2020a
Zero emission fertilizer	Yara	Unclear	"We are also exploring renewable energy sources and step change technologies to deliver zero-emission fertilizer and clean ammonia"	Yara, 2021c
Decarbon-ized fertilizer	Yara	Unclear	"It demonstrates how the combination of decarbonized fertilizers, precision tools, and selection of the right nitrogen forms can reduce GHG emissions"	Yara, 2021c
Climate neutral fertilizer	Yara	Synthetic fertilizers based on renewable energies	"On the road to providing climate-neutral fertilizers: Yara is investing in green ammonia and hydrogen with the goal to offer carbon-free fertilizers"	Yara, 2021a
Carbon free fertilizer	Yara	Synthetic fertilizers based on renewable energies	"On the road to providing climate-neutral fertilizers: Yara is investing in green ammonia and hydrogen with the goal to offer carbon-free fertilizers"	Yara, 2021d
Carbon free fertilizer	Yara	Unclear	"Yara recently established a new Clean Ammonia unit to capture growth opportunities in emission-free fuel for shipping and power, carbon-free fertilizers and ammonia for industrial applications."	Yara Clean Ammonia & JERA, 2023

In Yara's communication, it can be observed that the formulations they use are often unclear in what they refer to, making it hard to understand their vision (See Table *1*). In their 2022 sustainability report, Yara claim that it:

> *"pledges to source and/or produce a minimum of 3 million tons of reduced-carbon ammonia (equivalent of 530 kilotons of reduced-carbon hydrogen) by 2030, of which a minimum of 50% will be low-carbon or ultra-low carbon"* (Yara, 2023b).

In this statement, Yara is using three different terms for ammonia, namely *'reduced carbon ammonia'*, *'low carbon ammonia'* and *'ultra-low carbon ammonia'*. None of these terms are defined in the report. All of them have a positive connotation, but the overall statement remains unprecise and cannot be evaluated. Indeed, although in some documents the EU gives a clear definition of the terms used, such terminology schemes are not present in documents written by other actors (Erbach & Svensson, 2023; European Commission, 2020a). Hence, in reports by Yara or Hydrogen Europe – the largest hydrogen lobby association –, some information remains unclear due to the lack of defined and unified terminology. This is reinforced by the fact that some key terms are used differently by various actors. This is the case with *'clean hydrogen'*, which is used by Yara and the European Clean Hydrogen Alliance (CHA) to define *'renewable and low-carbon hydrogen'*, but used by the EU to define *'hydrogen produced through the electrolysis of water'* (European Commission, 2020a; The European clean hydrogen alliance, 2021). Moreover, these definitions may vary over time, as it is mentioned in the EU rules for renewable hydrogen, in which the European parliament state that they are moving away from a colour scheme which classifies hydrogen according to the energy source and towards a more complex definition (Erbach & Svensson, 2023).

Upon closer examination, it is noticeable that Yara and other actors in the hydrogen and fertilizer industry are only using positive designations to refer to green fertilizers, which highlight their reduced impact on the environment. Furthermore, no clear term was identified to designate fertilizers produced with blue ammonia, which gives the impression that those will not be produced. Lastly, the denominations are often unclear and may be used differently by various actors, which makes the understanding difficult.

E- The Role of Yara and their Perspective on the Development of the Hydrogen Economy

Through the development of green ammonia for the production of green fertilizers, Yara is taking a role in the development of the hydrogen economy. Similar to the justification for their role in fertilizer production, Yara argues that they are the right actors to develop clean ammonia because of their experience and expertise.

> *"Clean technologies and the quest for decarbonization have broadened our business model and are shaping our operations and markets. Building on a*

> *century of ammonia production, we are well positioned to lead the development of clean ammonia as a means to decarbonize crop production, and the shipping and power sectors"* (Yara, 2022b).

In this statement, Yara draws on their long-term experience in ammonia production to demonstrate their ability to produce clean ammonia and expand its use to further sectors. The fertilizer industry is also using their economic position and their production processes to justify the role of the fertilizer industry in the development of the hydrogen economy.

> *"As one of the biggest producers and users of hydrogen in Europe, fertilizer producers have all it takes to be front-runners in scaling up the production of renewable hydrogen"* (Fertilizers Europe, 2021a).

The central role of the fertilizer industry in the current production of hydrogen meant for fertilizer production positions them as front-runners to develop the green hydrogen sector. This argument was also used by Yara, when presenting their new Yara Clean Ammonia (YCA) unit, meant to develop their clean ammonia projects.

> *"Asset-backed and active across the value chain from sourcing to sales, YCA has >20% market share in traded ammonia"* (YCA, 2022a).

The infrastructures already in place and their current position in the ammonia market is used in this statement to justify the relevance of Yara in the development of a clean ammonia and hydrogen market. By using these arguments, Yara position themselves as sustainability enablers. Moreover, it is essential to highlight that by focusing on their role in developing a solution to environmentally damaging synthetic fertilizers, Yara are hiding their own responsibility in the climate crisis and their current harmful practices and products.

According to Yara, they are ready to develop the clean hydrogen business, but appropriate regulations and economic incentives are the missing pieces to upscale this solution.

> *"Due to the limited availability of renewable power and high electrolyser technology costs, large-scale green ammonia projects require incentives and public support schemes to become economically viable. Yara will continue to lead the technology development, advocate for incentive mechanisms, and develop clean ammonia certifications"* (Yara, 2023b).

Through this affirmation, Yara is reshaping the problem. Rather than being about the production of synthetic nitrogen fertilizers, the problem lies in the renewable energy availability and price, as well as the regulations which are not favourable to the production of renewable energies. According to Yara, these aspects hinder the development of the hydrogen economy and the production of green fertilizers. By claiming so, Yara is shifting responsibility onto the state.

Looking at Yara's narrative, it becomes visible that they are presenting fertilizers as necessary to the climate crisis as they ensure food security while reducing emissions thanks to agricultural intensification. However, the production of synthetic fertilizers leads to the consumption of gas and the emissions of GHG. Yara claims to have the solution with green fertilizers that are fossil free, effortless, and impactful. This is enhanced by the various terms used by Yara to designate fertilizers, which always highlight the reduction of emissions but often remain unclear unto what they designate. Moreover, Yara is the perfect partner for the development of the hydrogen economy and the decarbonization of agriculture as they have good intentions, expertise, experience, a strong market position, and infrastructures. Although they are ready to further develop the clean ammonia market, the right regulatory framework is missing. It is therefore relevant to look at what Yara is advocating for, taking the example of the European Union.

2- Lobbying and Regulations

A- Presence of Yara in European Institutions

Following the Paris Agreements in 2015, various laws and strategies were adopted by the EU. First of all, the Green Deal, a set of policies that aim to make the EU carbon neutral by 2050, was adopted in 2020. In order to meet this goal, the Fit for 55 package, a set of proposals to update EU legislations, was adopted in 2021. Its goal is to meet an intermediary target of a 55% emission reduction by 2030 from a 1990 baseline (Fertilizers Europe, 2021b). Part of this package are the European Trading Scheme (ETS) and Carbon Boarder Adjustment Mechanism (CBAM) regulations. The ETS is a carbon pricing mechanism, which makes products with a high carbon footprint more expensive in order to encourage investments and purchases of environmentally friendlier products. The CBAM imposes a tax on products which are imported according to their carbon footprint in order to compensate the ETS. The goal is for European goods to remain competitive on the European market. It is meant to reduce carbon leakage, which corresponds to industries moving to countries where environmental regulations are less restrictive, leading to an overall increase in emissions. In 2020, the EU launched their Hydrogen strategy, which aims to *"shift away from fossil fuels, create a clean hydrogen market and reduce greenhouse gas emissions"* (European Commission, n.d.). Following the war in Ukraine, the EU revaluated their hydrogen ambition, and adopted in 2022 the RePowerEU plan, meant to reduce the dependency on Russian gas by accelerating the energy transition and diversifying their energy sourcing (European commission, 2022). The increase of the 2030 renewable energy production target from 40% to 45%, is at the core of this plan. Furthermore, the renewable hydrogen target was raised to 10 mT renewable hydrogen production in the EU, and an import of 10 mT renewable hydrogen by 2030 (European Commission, 2022). The EU also plans to accelerate the development of necessary infrastructures, especially the pipeline network. Part of the Green Deal is also the Farm to Fork strategy, which is setting targets for a sustainable food system (European Commission, 2020c). These regulations show the interest of the EU in reducing their emissions in measurable ways, and become climate neutral by 2050, as well as reducing their dependency on (Russian) gas.

Those interests are shared by Yara, who is a signatory of the letter of the We Move Business Coalition which states that:

> *"As business and civil society leaders, and representatives of science and communities around the world, we are committed to doing everything in our power to limit global warming to 1.5 °C and avoid dangerous tipping points. […] The science remains unchanged: 1.5 °C is a limit, not a target"* (We Mean Business Coalition, n.d.).

This statement makes visible the common interest that Yara has with other actors of society and their will to participate in limiting climate change, as recommended by science. Yara and the EU share this goal, but do not necessary align on the means to meet it. The measures adopted by the EU in order to achieve this ambition will influence the functioning of Yara and the fertilizer industry, who need to deliver on the EU targets and adapt their business model to the regulations. Fertilizers Europe is communicating over the Fit for 55 package, saying that:

> *"[The fertilizer] sector definitely has part of the solution but, at the same time, we have to remain realistic and make sure that the fertilizer sector can remain competitive and continue to invest in this very challenging transition to decarbonize the economy. Together with our members, Fertilizers Europe will play an active role and engage with policy makers and wider stakeholders to support the development of EU policies and regulation"* (Fertilizers Europe, 2021b).

In this statement, Fertilizers Europe expresses their intention, and the one from their members, which includes Yara, to engage with the development of the European climate strategy. Most importantly, they are communicating the main goal which they will defend, namely, to remain competitive. This highlights the tension that may arise between the EU and the fertilizer industry when constructing climate policies.

Looking at Yara's presence in the formulation of European policies, it is noticeable that they invested a lot of money in lobbying, especially regarding the development of the hydrogen economy. Yara's lobbying investments in particular grew from €350,000 in 2019, to €2,500,000 – €2,749,999 in 2021.[2] In 2019 Yara had 1.5 full time lobbyists and 0 accreditations (Corporate Europe Observatory & Lobby Control, n.d.-b). In 2021 and 2022, they had 5 full time lobbyists among which 4 had accreditations, which shows the quick change. On Figure *3*, which presents information on Yara's lobbyists in the EU and the meetings they joined, it can be seen that since 2021, they joined 13 meetings with the European Commission. No information on (potential) meetings before that date could be found. Various

[2] No data could be found for 2020.

meetings that Yara – and lobby groups they are part of – joined were linked to the Green Deal. This is the case for meetings about the Fit for 55, the Farm to Fork strategy, and the RePowerEU, as well as more specific meetings about the CBAM and ETS (Cefic et al., 2022; Hydrogen Europe, 2022a; YCA, 2022b). This shows the interest of Yara in investing in the hydrogen economy by supporting favourable policies for the development of clean hydrogen and ammonia.

In order to do so, Yara is engaging lobby firms such as FTI consulting and joining associations such as Fertilizers Europe, as visible on Figure *2* and 3 which respectively show the organisations they are affiliated with and the lobby firms they hired. Furthermore, Yara is associating with companies such as Unilever, Nestle and Danone in the We Move Business Coalition, as well as NGOs such as Greenpeace in the Hydrogen Coalition. Those partnerships strengthen their vision, as it is supported by a variety of key actors. In Figure *3* and 4, we can see that they are using various tools to communicate, such as lobbying in meetings with the European Commission thanks to accredited members, participating in public consultations, and writing position papers. This indicates that Yara is investing in influencing the goals and implementation of the various regulations that constitute the EU climate strategy.

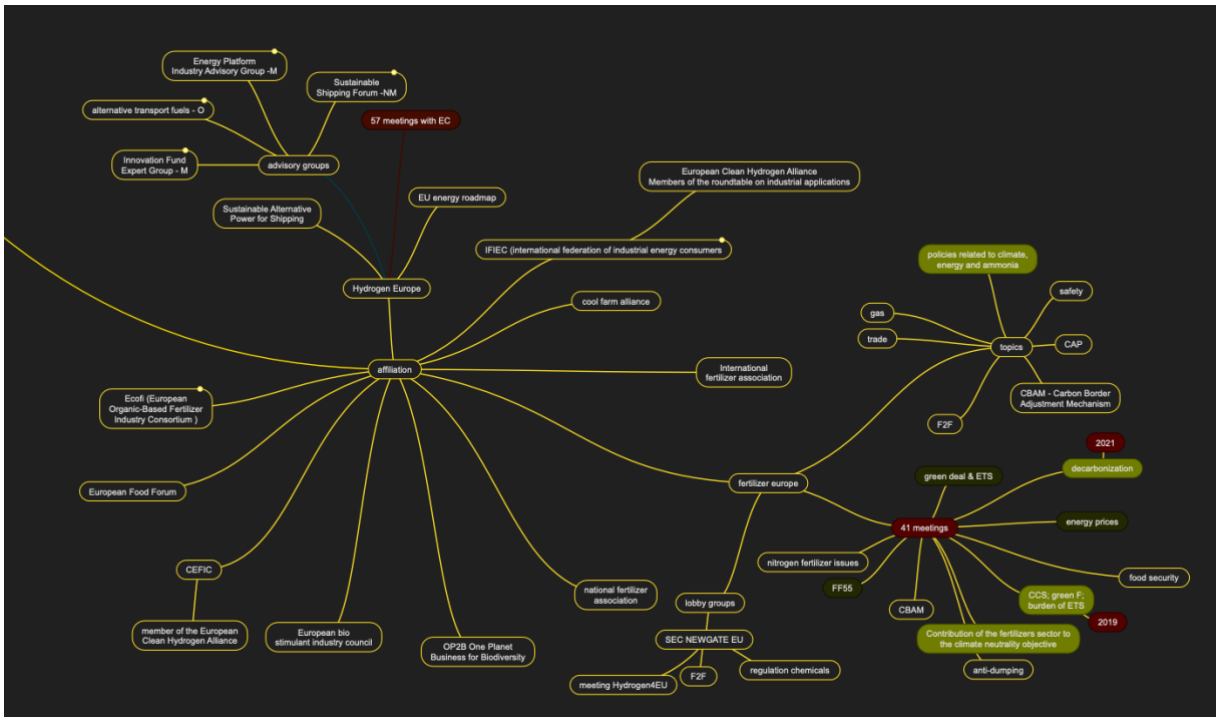

Figure 2 – Yara's affiliations to organisations *(Corporate Europe Observatory & Lobby Control, n.d.-b)*

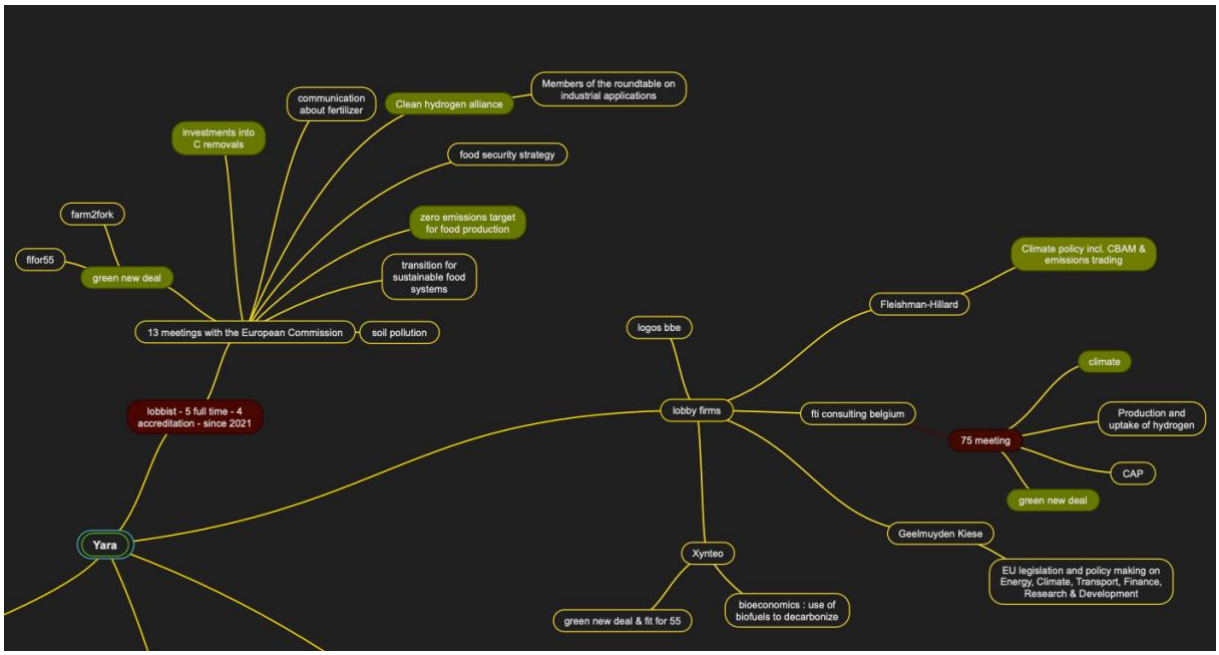

Figure 3 – Yara's lobbyists and lobby firms *(Corporate Europe Observatory & Lobby Control, n.d.-b)*

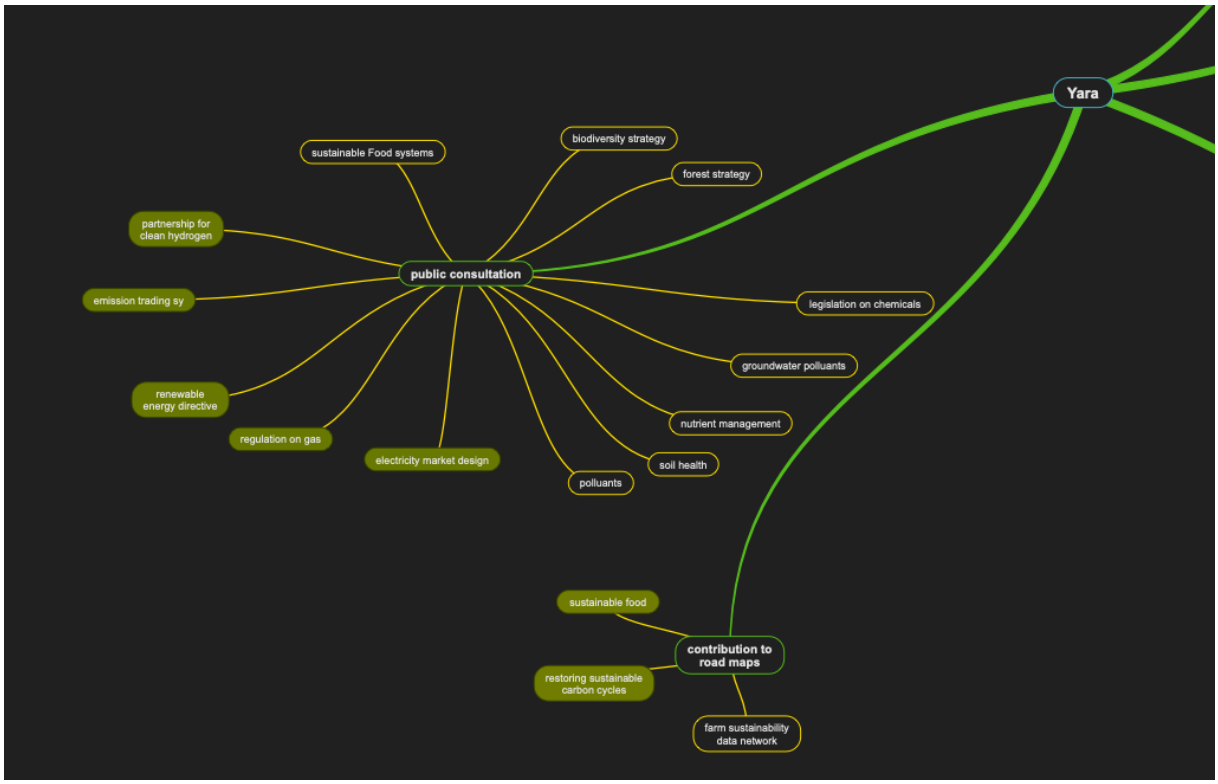

Figure 4 – Yara's participation in public consultations and roadmaps *(Corporate Europe Observatory & Lobby Control, n.d.-b)*

Yara is also part of the European industrial strategy group from the European Clean Hydrogen Alliance (CHA) (Corporate Europe Observatory & Lobby Control, n.d.-b). This group was created by the EU and aims to formulate an investment agenda to meet the objectives set in the European Hydrogen strategy. The members of this

alliance are NGOs, industrial actors, and scholars, and are active in the deployment and consumption of clean hydrogen. This group is working on reports about barriers, opportunities, and viable projects for the development of clean hydrogen in Europe. These reports are used to support their policy recommendations for the European Commission. This shows how the EU gives space to corporations, due to their expertise and economic position, as part of regulation-making and strategy implementation.

To conclude, the EU is adopting various regulations, strategies, and goals in order to reduce their dependency on (Russian) gas, as well as their emissions, in order to achieve climate neutrality. This can conflict with the interests of the fertilizer industry that wants to remain competitive above all. These interests are defended on multiple levels by Yara and the fertilizer sector through various associations and a close connection to European institutions. Two controversial aspects of the climate legislations, namely certification schemes and economic incentives for hydrogen production, will be further explored.

B- Certification Schemes for Hydrogen

As stated in the CHA, there is a *"Lack of clear terminology, as well as a comprehensive certification and verification framework for clean hydrogen."* (The European Clean Hydrogen Alliance, 2021). Indeed, looking at the variety of terms used to define hydrogen, it becomes visible that hydrogen terminology cannot be reduced to a distinction between blue, green and grey hydrogen (See Table 1). This makes visible the complexity of the certification scheme and further debates within the European hydrogen strategy goals. The use of electrolysis to produce hydrogen does not give indications on the electricity used to power the process. Electricity can be taken off-grid, from the grid or by a mix of both. In the off-grid case, it is directly sourced from a power plant which is located on site. It is hence easy to label, as the hydrogen type depends on the energy source and carbon footprint. In the case of on-grid electricity, the energy source and the carbon footprint, depends on the electricity mix, making the labelling harder. As a response to the demand from various actors of the hydrogen industry for a clear certification scheme for clean hydrogen, the EU developed a delegated act for Renewable Fuels of Non-Biological Origin (RFNBO)[3], which selected various criteria that had to be met in order for hydrogen to be considered as coming from a renewable origin (Erbach & Svensson, 2023). These

[3] RFNBOs refer to fuels produced with renewable energies other than biomass. They mainly include hydrogen and e-fuels.

criteria take into account aspects such as the average proportion of renewables in the grid and electricity consumption variations (Hydrogen Europe, 2022a). Various actors such as Yara, Fertilizers Europe and Hydrogen Europe gave feedback on the draft version of the delegated act. Yara is recommending that the grid hydrogen production from countries who have a proportion of renewable energies in the grid which is higher than 70% be considered as completely renewable, rather than 90% as announced in the draft. This should simplify and encourage the transition. (Yara, 2022c). In the case of on-grid production the EU identified the additional criteria of origin, geographic proximity, and temporal correlation. The first criterion indicates that the construction of a new renewable energy plant, whose power will be added to the grid when the electrolyser starts functioning, is required. The second criterion determines a maximal geographic zone that the renewable energy source can come from, in order to facilitate the management of the demand and access. The temporal correlation criterion limits the use of renewable electricity to times in which it is produced. (Erbach & Svensson, 2023). In the case of the temporal correlation, a transition period is planned until 2027, until which this criteria does not need to be met. Hydrogen Europe and various industry actors are advising for this transition phase to be extended to at least 2030, ideally 2038 (Cefic et al., 2022; Erbach & Svensson, 2023). They also request an extension of the geographical zone and temporal correlation. Likewise, Yara expresses the need for loser regulations regarding these additionality criteria (Yara, 2022c). When comparing the draft version released by the EU in June 2022 with the one adopted in 2023, a few changes become visible. This is the case among other things for the transition phase of the temporal correlation, which has been extended to 2030 as requested by Fertilizers Europe.

Hydrogen which does not fall under the certification of RFNBOs may be considered by the EU as low-carbon hydrogen if it has a minimum of 70% lower carbon footprint than grey hydrogen. This definition includes hydrogen produced with nuclear power[4] as well as blue hydrogen. In the case of blue hydrogen, the difference in carbon

[4] The use of nuclear energy in the hydrogen economy is a source of debate. Indeed, legislations regarding this energy source are different according to the country. This may become relevant, especially in France where nuclear power is the main energy source in the grid and is expected to play a role in the energy transition until 2050. It may be pertinent to look at whether hydrogen produced with nuclear power should or will be used to produce fertilizers, and how they will be labelled. Until now, nuclear power has been excluded by Yara, but this could change if European regulations evolve (Cicero, 2022).

capture rate may vary between 95% and a 60%, greatly influencing the final carbon footprint. The EU is developing methods to determine the carbon footprint, however those should not be available until 2025. Furthermore, the certifications are for now limited to hydrogen. Yara is therefore currently working with industry associations to develop their own labelling methods for clean ammonia (Yara, 2023b).

Debates around the certification of hydrogen show the tensions between the EU and Yara, as the latter agree with the EU on reducing their emissions insofar as their competitiveness is not compromised. Indeed, Yara are lobbying for lower restrictions regarding the certification of green hydrogen in order to facilitate its production and reduce the first mover's risk. Furthermore, Yara are complementing the lack of certification for ammonia by creating their own certification schemes.

C- Economic Incentives

Besides the certification scheme, other obstacles to the upscaling of the hydrogen economy and the decarbonisation of the ammonia sector have been identified. Yara and the industry sector indicated in a CHA report that for large scale green ammonia production, abundant and cheap renewable energy is required for the industry (The European Clean Hydrogen Alliance, 2021). According to Yara, the Fit for 55 package does not sufficiently address this challenge. Fertilizers Europe is sharing stating that:

> *"the frontrunners have stated that public funds and a supportive regulatory framework are needed to upscale this technology"* (Fertilizers Europe, 2021a).

This statement communicates that there is a need for state intervention, through substantial investments and favourable regulations, in order to meet the targets set by the EU (The European Clean Hydrogen Alliance, 2021). Moreover, Yara wants the binding target of 50% of renewable energy used for RFNBO production to be conditional and dependent on the renewable energy available in different zones. Yara and the industry sector are particularly interested in implementing regulatory frameworks that will ensure favourable market conditions for import and export, such as the ETS and CBAM (Fertilizers Europe, 2021b; Yara, 2022c, 2022d). Various lobby groups and associations that Yara is affiliated to, such as Cefic, Fertilizers Europe, Hydrogen Europe and, Xyntheo, are also positioning themselves on this

question. (Cefic, 2021, 2022; Fertilizers Europe, 2021a; Hydrogen Europe, 2022a; Xynteo & BioAdvantage Europe, 2022). They are requesting taxes on imported products as well as ways to have compensation for European low carbon products, in order to be competitive in a less environmentally friendly international market. Overall, Yara supports the EU ETS system, if implemented gradually, as well as the CBAM. They are often claiming to produce fertilizer with a lower carbon footprint than non-EU actors. These regulations would hence represent a comparative advantage for Yara. Yara is concerned about the lack of CBAM meant to allow competitiveness of exported European products on the global markets. Moreover, according to them, there is a lake of consideration of the downstream value chain in these regulations, to be understood here as final agricultural products. Yara is thus requesting further regulations to protect their competitiveness.

In the debate around hydrogen regulations, the US Inflation Reduction Act (IRA), which plans tax credits for clean hydrogen production[5], is often praised by stakeholders of the hydrogen economy.

> *"The US Inflation Reduction Act of 2022 provides tax incentives, which can attract large investments in domestic clean energy, spurring talk of future trade barriers from uneven pricing of the most important enabler of the green transition: renewable energy"* (Yara, 2023b).

In this statement, we can see that Yara considers tax credits to be a highly effective way of attracting companies and developing the hydrogen economy. Yara as well as other actors of the energy and industrial sector are worried that this may impact European production, and use this to push for European subsidises on clean hydrogen.

> *"The Inflation Reduction Act in the US, which was approved in 2022, is expected to create a decarbonization momentum and to make the US a highly attractive location for clean ammonia investments. The cost of producing blue ammonia in the US after the introduction of IRA will be significantly lower than in Europe, especially if Europe does not introduce additional incentives for its own industry"* (Yara, 2023a).

Through this declaration, Yara is warning the EU of the risk of delocalisation of industries if no stronger economic incentives are created to favour clean hydrogen production. This can be understood as a threat formulated by Yara to the EU, in which

[5] Clean hydrogen is defined by the US government as hydrogen emitting less than 4kg CO_2e/ H kg

they evoke a jeopardization of European competitiveness and of the achievement of their climate goals.

Furthermore, the previous statement shows that Yara is recommending incentivising blue hydrogen production, as done by the IRA. Yara repeatedly expresses the need for blue hydrogen in the transition to green hydrogen. At the European hydrogen forum, Luc Haustermans – Yara's head of EU Public Affairs and Industry Relations - expressed that:

> *"An all-out transformation of the European fertiliser industry towards renewables in seven years is a massive sprint. Green hydrogen is preferable, but blue hydrogen is a faster route to decarbonise"* (European Commission, 2022b).

This declaration illustrates that Yara perceives blue hydrogen as indispensable to meet the European hydrogen production goals. This is also supported by Fertilizers Europe who published a call to include blue hydrogen in the European plan.

> *"Fertilizers Europe calls on EU co-legislators to ensure that clean fertilizer and ammonia production continue to be produced in Europe. To keep this key element of food security, the legislators should include low carbon hydrogen in the RFNBOs industry target"* (Fertilizers Europe, 2023).

According to them, the 20 mT hydrogen production and import target for 2030 should include blue hydrogen. A similar element of threat can be found in this statement, in which they warn the EU that food security could be jeopardized if blue hydrogen is not included in the EU targets and hence eligible for financial support.

Looking at the EU subsidiary scheme, it is noticeable that they have been increasingly subsidising clean hydrogen research, production, and infrastructures. In April 2022, €1.1 billion, funded by revenues from the ETS, were distributed to 7 innovative clean tech projects, including clean hydrogen and CCS projects (European Commission, 2022c). In July 2022, a further €1.8 billion were given to 17 clean tech projects (European Commission, 2022a). A third call was made in November 2022, with a budget that increased to €3 billion in the context of the RepowerEU plan (European Commission, 2023c). Most of the hydrogen projects selected are part of the viable projects identified by the CHA in their project pipeline (European Commission, 2023b). Further public funds were made available in the context of two Important Project of Common European Interest (IPCEI) approved specifically for clean Hydrogen projects. The first one, approved in July 2022, made €5.4 billion

available for the development of 41 projects with 35 companies (European Commission, 2022d). A second one, approved in September 2022, will financially support 35 projects of 29 companies with €5.2 billion public fund (European Commission, 2022e). Most of the companies receiving funding are part of Hydrogen Europe (Hydrogen Europe, 2022c). One green ammonia project by Yara will be financed by the Dutch government through this fund (Smart Delta Resources, 2022). Furthermore, the European Hydrogen Bank, which will invest in green hydrogen projects, was launched in March 2023 and will provide a first granting of €800 million in autumn of 2023 (European Commission, 2023a). Through these fundings, we can see that the EU and EU members have been increasingly investing in clean hydrogen projects as wished by actors of the European hydrogen economy. Furthermore, members of the CHA, as well as the important hydrogen lobby association Hydrogen Europe, have a key position in receiving grants for developing clean hydrogen projects. This shows the close link between corporations and the EU in constructing the European hydrogen economy[6].

The presence of Yara in the European institutions, in order to create favourable regulations for the development of green fertilizers and clean ammonia, is happening on a variety of levels. They are forming partnerships with various actors such as corporations, NGOs as well as associations in order to strengthen their position, and using a multitude of lobbying tools. Yara is also granted a position by the EU as experts and key economic actors, giving them a direct influence over European regulations. Yara wants looser regulations regarding certification of clean and green hydrogen. On the contrary they are pushing for more state interventions regarding carbon taxes and border regulations. This shows the tensions between the EU and Yara's interests. Although carbon taxes ensure competitiveness of the European fertilizer industry while incentivising emission reduction, certification recommendations are securing low emissions while creating barriers to the first movers, hindering competitiveness. The success of Yara and the fertilizer industry in lobbying can be especially seen when looking at the recent increase in grants provided by the EU for hydrogen projects as well as the partners chosen for its development.

[6] An extended analysis of the influence of Hydrogen Europe in the European policy making previous to 2022, the year in which Yara joined the association, can be found in the research done by Corporate Europe Observatory

3- Yara's Ambition

A- General Climate Goals

In order to respond to the climate crisis, Yara set goals which are aligned with the Paris Agreements and with European policies.

> *"Yara has voiced support for the Paris Agreements since its inauguration, and based on the partnership effort, we are ready to put the next stake in the ground: defining emission reduction targets which will deliver on the Paris Agreements goals"* (Yara, 2020b).

The obvious ambition and importance for Yara to stay below the 1.5°C, as recommended by the Paris Agreements, is highlighted in this declaration. This is translated into the voluntary emission reduction goals they are setting. Those are often legitimized by Yara's expertise, by stating that these targets are '*science-based'*. According to various reports published by Yara, they aim to be climate neutral by 2050, reduce scope 1 and 2 of emissions[7] by 30% in 2030 from a 2019 baseline, and want to achieve the European Fit for 55 ambition[8]. The IPCC, states a 43% GHG emissions reduction by 2030 from a 2019 baseline and net-zero carbon emissions by 2050 are needed to have a chance to stay at 1.5 °C. It is first of all important to highlight that the IPCC target is higher than the 30% reduction target set by Yara for scope 1 and 2. (Hoesung Lee et al., 2023). Furthermore, Yara does not take into account scope 3 of emissions in their 2030 target, which represents the majority of their emissions. The 2023 Integrated report announces an ambition of a 11.1% reduction in the downstream part of scope 3 emissions by 2030 from a 2021 baseline. A target for the entire scope 3 is not yet established (Yara, 2023a). The choice for a 2021 baseline is not explained, however it is noticeable that 2021 corresponds to the year with the highest downstream scope 3 emissions between 2017 and 2022. If taking a 2019 baseline as recommended by the Paris Agreements, it would correspond to a 5.5% reduction of the downstream part of scope 3 emissions. By taking an advantageous baseline year to set their emission reduction target, Yara is giving the impression to have higher targets for downstream scope 3 of emissions than they actually do. Taking into account all scopes of emissions, 7.9 mT CO_2e

[7] Different types of carbon emissions are classified as scope 1, 2 and 3. Scope 1 of emissions corresponds to the direct emissions through production. Scope 2 of emissions corresponds indirect emissions linked to purchased energy. Scope 3 of emotions coming from the upstream and downstream part of the value chain.

[8] No precise information about emissions previous to 2008 could be found to evaluate the 55% potential emissions reduction from a 1990 baseline.

should be cut from a 2019 baseline, which corresponds to an overall 10.6% CO_2e reduction by 2030. This goal is far from the absolute 30% GHG emissions reduction announced by Yara, as well as from the 43% GHG emission reduction for 2030 from a 2019 baseline required by the IPCC. It is also lower than the 25% reduction for 2030 from a 2019 baseline, which is needed for a 2 °C scenario (Hoesung Lee et al., 2023). It is therefore important to highlight that by remaining unclear about the scopes and the baseline dates which are taken into account in their emission reduction targets, Yara is announcing higher targets than they actually set. Contrarily to their announced support for the Paris Agreements, Yara's goals do not align with it.

The low reduction planned for the downstream part of scope 3 of emissions and the lack of target for the entire scope 3 is also contradictory with the importance they put on reducing scope 2 and 3 emissions. Indeed, Yara affirms that:

> *"The main focus for most companies is the direct emissions. It is common to start with what is closest. However, it is not nearly enough if we are to deliver on the Paris Agreement and make sure global warming does not exceed 1.5 °C above pre-industrial levels. To succeed, we must all get serious about scope 3 emissions – emissions that are not produced by the company itself, but by those in the upstream and downstream of its value chain. For Yara, scope 2 and scope 3 account for 76 percent of its total emissions"* (Yara, 2023b).

The significance of minimizing emissions linked to the utilization of fertilizers is highlighted in this statement. As seen previously, the downstream emissions reduction goals do not translate this statement into action. This shows a lack of focus on the emissions linked to the use of fertilizers. The Farm to Fork strategy is the part of the European Green Deal which focuses on agricultural production. Yara is supportive of this strategy and established a roadmap to put it into practice, in which they set the goals of "*reducing nutrient losses, increasing yields and producing healthier crops*" (Yara, 2021d). However, Yara never sets goals to reduce the use of fertilizers, although the Farm to Fork strategy asks for a minimum reduction of 20% by 2030 (European Commission, 2020b). Yara is further lacking the ambition to seriously reduce the use of fertilizers and the emissions linked to their use. This again, shows the disparity between Yara's announced support for environmental policies, and their actual implementation strategies.

The lack of ambition in reducing the downstream part of scope 3 of emissions is further criticised by a *New Climate* report (Mooldijk et al., 2022). According to

them, it is impossible to see whether the use of technology can be aligned with the Paris Agreements if the entire scope of emissions is not taken into account. Indeed, the utilization in itself may be damaging and have emissions that cannot be cut. In some cases, the technology itself is inadequate to the objective of climate neutrality.

The last important aspect is that, as seen previously, Yara's targets are voluntarily set. As previously demonstrated, this is used by Yara to show the emphasis they put on reducing emissions. However, it also means that Yara will face no consequences if those targets are not met. This is the case with the energy efficiency target which was set at 33.3 GJ/t NH for 2021. In that year, the actual energy efficiency was 34.1 GJ/t NH, which was higher than the previous year (Yara, 2022b). Besides this being briefly justified in the report, no consequence was observed for Yara. The target was still not met in 2022, with an energy efficiency which raised to 34.3 GJ/t NH. It is noticeable that the energy efficiency target for 2022 was raised to 33.4 GJ/t NH, compared to the one set for 2021 (Yara, 2022b, 2023b). This shows that the targets are not binding and that they can be change without explanation to the public from one year to another. Those targets may be used to show Yara's ambition, but do not necessarily translate into meaningful action.

Looking into the goals which Yara set in order to meet the Paris Agreements, it became clear that although Yara is stressing the importance of staying below 1.5°C, this does not correspond to their actual ambition. Taking into account all information, the goals set by Yara are well below what is recommended by the IPCC and what Yara announces. The targets also show that contrarily to what is communicated by Yara, they are focusing on reducing emissions from the production process which hinders the examination of whether the very use of synthetic fertilizers is compatible with the 1.5°C limit. Furthermore, the targets set by Yara are not binding, which reduces their potential achievement. The potential achievement of Yara's targets will be further studied by looking closer into green fertilizers as a way to achieve climate neutrality.

B- Clean Ammonia and Green Fertilizers Projects by Yara

Clean ammonia and green fertilizers play a central role in Yara's climate goals. This can be seen in the communication of Yara Clean ammonia (YCA), Yara's unit that will be in charge of all ammonia trades and clean ammonia projects of Yara International. According to the presentation given during the Capital Market Day, clean ammonia projects should lead to a 3 mT CO_2e reduction between 2025 and 2030 (YCA, 2022a). This accounts for 54.5% of the reduction needed to meet the

2030 target set by Yara. According to Yara's climate roadmap, between 2022 and 2025, a 2mT CO_2e reduction should come from "*Catalyst installations, energy efficiency, electrification of machinery, renewable energy sourcing and expected volume effects*" (Yara, 2022b). Most of the progress that can be made on N_2O abatement will be done by 2025. Yara is currently still developing a roadmap to achieve carbon neutrality by 2050. Therefore, no specific information regarding Yara's climate actions further than 2030 were available. However, in Yara's Farm to Fork roadmap, the only project identified to reduce scope 1 and 2 of emissions is green fertilizers. From the available information it follows that green fertilizers will be the main way of decarbonizing scope 1 and 2 of the fertilizer sector from 2025 on.

In order to understand the 3 mT CO_2e emission reduction, it is necessary to take a closer look at the plan that YCA developed. During the Capital Market Day, YCA presented the six projects which will produce 2.5 mT clean ammonia in 2030 (YCA, 2022a). Information regarding these projects can be found in

Table *2*.

Table 2 - Clean ammonia projects of YCA

Project	Yuri	Skrei	Hegra	Sluiskil	Grey to blue (CCS)	New project
Due date	2025-2026	2023	2027-2030	2025-2029	2026-2029	2028-2030
Ammonia type	Green	Green	Green	Blue	Blue	Blue
Location	Australia - Pilbara	Norway - Herøya Industripark	Norway - Herøya Industripark	Sluiskil - Netherlands	North America	North America
Partner	Engie	Linde Engineering	Lost partnership from Aker Clean Hydrogen and Statkraft	Northern light (TotalEnerg-ies, Equinor, Shell).	Unknown	Unknown
Financing	A$42.5 million ARENA grant	NOK 283million grant from Enova	Unknown	Financed at 80% by Norwegian government	Unknown	Unknown
New or repurposed	New	New	Electrifica-tion	Storage of already captured CO2	New grey to blue	Unknown
Application	Fertilizers, energy for Japan	Shipping & Fertilizer	Shipping	Fuel and power production	Unknown	Unknown

Energy source	Off-grid Solar power	On-Grid Hydropower	On-Grid Hydropower	Gas + CCS	Gas + CCS	Gas + CCS
Hydrogen Production capacity	625 T/p.a.	10,000 kg/j	Unknown	Unknown	Unknown	Unknown
NH3 production capacity (kt NH3 p.a.)	3.5	20	400	400	600	1,100
Fertilizer production capacity (T)	Unknown	60,000-80,000 T	Unknown	Unknown	Unknown	Unknown
Emission abatement (t CO_2e p.a.)	- 6,500	- 41,000	-800,000	-700,000 – 800,000	Unknown	Unknown
Sources	(Yara, 2021; Yara, 2020d; Yara & Engie, 2020; YCA, 2022a, 2022c)	(Yara, 2022a; YCA, 2022a)	(Yara, 2021f; Yara et al., 2021; YCA, 2022a)	(Yara, 2022e; Yara Netherlands, 2022b; YCA, 2022a)	(YCA, 2022a)	(YCA, 2022a)

Some more projects, presented in Table *3*, have also been locally announced, but never relayed by YCA. This is the case for the green ammonia project in Sluiskil. The most recent was published in 2020, when they announced that a decision should be made by 2021 or early 2022 about a final investment decision (Yara, 2020c). This green ammonia project is still part of the climate roadmap of the factory as published in 2022 (Yara Netherlands, 2022a). It was also mentioned by Svein Tore Holsether, the CEO of Yara, during the panel discussion on "decarbonization of agriculture" at the COP27, during which he mentioned this project as the wind-powered green ammonia project (Filbert, 2022; Food Systems Pavilion at COP27, 2022). No news on the investment decisions since 2020 could be found. Another green ammonia project is announced by Yara France, of which only the due date and the location is known. No press release has been published by Yara. Yara International published in July 2021 a blue ammonia project in Normandie, in collaboration with TotalEnergies, Esso, Borealis and AirLiquide (Yara, 2021e). A Memorandum of Understanding (MoU) was signed to study the possibility of developing CCS infrastructures. No mention of it was found in YCA documents, but this information was presented to me at the *Salon de l'Agriculture* as something that was going to happen. This shows that these projects remain unclear and uncertain for some, and that their realisation may differ from the plan. This uncertainty is strengthened by the

example of Hegra, which represents the largest green ammonia project of Yara. This project was supposed to happen in partnership with Aker Clean Hydrogen and Statkraft. However, in 2022 it was announced that the partnership stopped and that Yara now had the sole ownership of the project. No explanation was given to this partnership loss (Filbert, 2022).

I identified two projects for green fertilizers commercialization. The first commercial agreement was signed in January 2022 with Lantmännen (Yara & Lantmännen, 2022). This partnership was also praised by Svein Tore Holsether during the COP27 conference and presented as a hope for the decarbonization of agriculture (Food systems pavilion at COP27, 2022). The goal is to develop a "fossil free food chain". According to Yara, green fertilizers will allow a reduction of the carbon footprint of the grain produced by 20%. No information could be found about the amount of green fertilizers which will be delivered. A second commercial agreement was signed in December 2022 with a chips producer, El Parque Papas, the biggest potato farmer in Argentina, to deliver them green fertilizers by 2023 (Yara, 2022f). No specific amount of fertilizer is mentioned, however the carbon footprint at farm level and from the chips should respectively be diminished by 28.8% and 5-10%. It is unclear whether these carbon footprints take into account all scopes. Similarly to the production projects, information is missing in the case of commercialization projects, which hinders the understanding of the reach of these projects.

Looking at commercialization projects, no partnerships for fertilizers produced with blue ammonia could be identified. From the available information, it remains unclear how they will be labelled and named. However, three of these projects are blue ammonia and represent 2.1 mT ammonia and three green ammonia projects will produce 0.4 mT ammonia in 2030. According to Yara's projects, blue ammonia will represent their largest ammonia volume in 2030, with 84% of the clean ammonia volume produced. Furthermore, recent partnerships are also allowing the development of blue ammonia projects. Yara and Northern Light, a project lead by Equinor, Shell and TotalEnergies, signed the first commercial agreement which will allow CO_2 cross-border transportation meant for carbon storage. This is a major step for the development of blue ammonia projects.

Table 3 - Clean ammonia projects announced by Yara

Project	Haddock	France	France	Texas	US golf
Due date	2024-2025	2028	Unknown	2027-2028	Ammonia sales should start in 2027
Latest Update	Final investment decision in 2021 - early 2022	Project mentioned in a report (2023)	Technical and financial feasibility study in 2021	Letter of intent signed in 2023	MoU signed in January 2023 to agree on intent to provide blue ammonia to JERA and to jointly develop a blue ammonia project
Ammonia type	Green ammonia	Green ammonia	Blue ammonia	Blue ammonia	Blue ammonia
Location	Sluiskil - Netherlands	Le Havre	Bassin de Normandie	Enbridge Ingleside Energy Center (EIEC)	US golf
Partner	Ørsted	Unknown	Esso, TotalEnergies, Air Liquide, Borealis	Enbridge Inc.	Jera
Financing	Subsidized by the Dutch government IPCEI status	Unknown	Seeking for European, French and regional subsidies	Unknown	Unknown
New or repurposed	New	Unknown	Unknown	New	New
Application	Shipping & fertilizer	Unknown	Unknown	All	500 kT of hydrogen for Co-firing
Energy source	Offshore wind and on-grid	On-grid	Gas + CCS 90%	Gas + 95% CCS	Gas + CCS
Hydrogen Production capacity	14 kT H/year (if continuous production)	Unknown	Unknown	Unknown	Unknown
Ammonia production capacity (kT NH3/year)	70	Unknown	Unknown	1,200 –1,400	1,000
Fertilizer production capacity	Unknown	Unknown	Unknown	Unknown	Unknown
Emissions abatement ($kTCO_2$/year)	100	Unknown	Unknown	Unknown	Unknown
Sources	(Yara, 2020c; Yara Netherlands, 2022b)	(Yara France, 2023)	(Yara, 2021e)	(Yara, 2023c)	(YCA & JERA, 2023)

Focusing on applications for which the clean ammonia is meant, it is noticeable that most of the projects aim to deliver clean ammonia for fertilizers as well as for new applications, especially shipping fuels (Yara, 2022e). Furthermore, Yara is expanding its ammonia terminals in Germany to a capacity of 3 mT of ammonia and created new ammonia storage spaces. This will help develop the European hydrogen economy through the transport of ammonia, which is meant to facilitate its use as shipping fuels, hydrogen carrier and power fuel (Yara, 2023d).

Yara has multiple clean production and commercialization projects which have been announced by YCA and local branches of Yara. Information regarding these projects remain oftentimes incomplete, unclear, and subject to change. This makes it hard to have a reliable overview of the clean ammonia outlook for Yara's production. However, when looking at the projects, two facts become clear. First of all, a lot of ammonia is actually meant for new applications rather than fertilizer production. Secondly, most of the clean ammonia volume produced will come from blue ammonia plants. Both these aspects will be further explored in this research.

C- Clean Ammonia for New Applications

YCA is the unit which will be in charge of developing the ammonia market for new application. The sector that should find a market and which should represent the biggest sales is clean ammonia as shipping fuel. It is estimated that this sector will have an overall demand of 3 mT clean ammonia in 2030 and 182 mT in 2050 (See Figure 5). In 2050, it should account for 39% of global clean ammonia demand, while the industrial and agricultural sector should represent 49% of market demand. The second sector to develop should be power generation, which is expected to have a smaller demand for ammonia in the long term, with 2 mT clean ammonia in 2030 and 20 mT in 2050. The last sector to emerge should be the use of ammonia as hydrogen carrier. It is projected that this sector will develop in 2040 and reach a demand of 36 mT in 2050. It is expected to grow more after 2050 (YCA, 2022a). [9]

Yara's growing interest in these sectors can be seen in their project development. Indeed, they recently signed various contracts to deliver clean

[9] Various criticisms have been emitted regarding certain applications of hydrogen and ammonia. Indeed, by converting renewable energies into hydrogen, some energy is lost. When using hydrogen for applications which could directly use renewable electricity, the use of renewable hydrogen thus constitutes a waste. Likewise the use of ammonia as a hydrogen carrier leads to energy losses due to the conversion of hydrogen to ammonia before transport and ammonia to hydrogen before usage. More on the application debate can be found in the report written by Earth Justice (Saadat & Gersen, 2021).

ammonia to be co-fired in coal plants in Japan, as well as to decarbonize the shipping sector by adding clean ammonia to the fuel mix. (YCA & JERA, 2023 ; Yara International ASA, 2022).

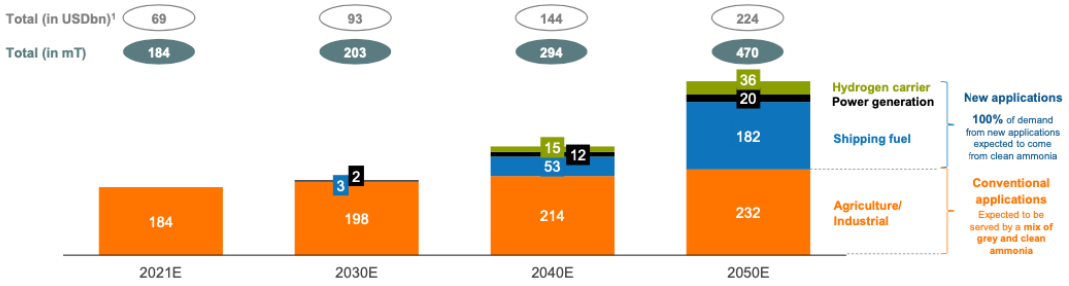

Figure 5 - Global Ammonia demand outlook per application (YCA, 2022a)

When looking more closely at the market predictions made by Arkwright market study and used by YCA, it is noticeable that by 2050, the ammonia demand should increase by 60% (See Figure 5). Most of this expansion is linked to new demand, which should consume 238 mT of ammonia by 2050. It is important to note that all ammonia used for new application will be clean. Therefore, all grey ammonia production will be left for industrial application, of which 80% accounts for synthetic nitrogen fertilizer production (YCA, 2022a).

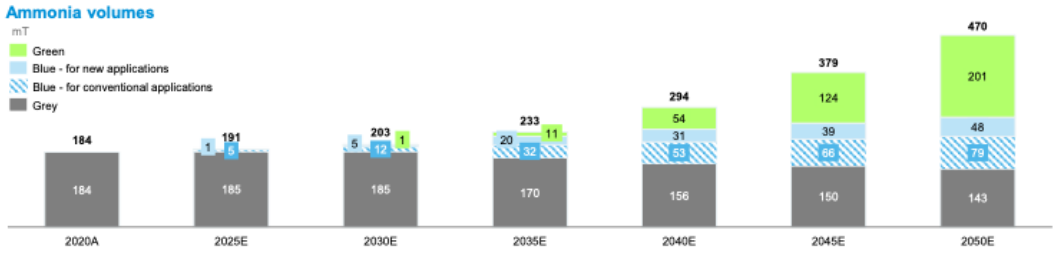

Figure 6 – Global ammonia demand outlook (YCA, 2022a)

Combining the data provided on the outlook for clean ammonia volumes and applications as presented by YCA, it becomes clear that new application such as shipping fuel, power generation and hydrogen carrying will capture most of the clean ammonia volume (See Figure 5 & 6). By 2050, 73% of clean ammonia should be used for new applications. Furthermore, 95% of the green ammonia demand should come from new applications.

A closer look at the predictions for YCA ammonia production shows that they plan to produce 2.5 mT of clean ammonia in 2030, from which 300kT are expected to be used in green and blue fertilizers. This indicates that in 2030, 12% of the clean ammonia produced by YCA will be used to produce green and blue fertilizers (YCA,

2022a).[10] This confirms the previous observation that most YCA clean ammonia projects will deliver ammonia for new applications (See Table *2* & 3).

D- Overall Clean Ammonia Production Outlook

It was previously observed that most of the clean ammonia produced by YCA in 2030 would come from blue ammonia. It is hence relevant to look more into the clean ammonia production outlook.
When looking more into the narrative of YCA, it is noticeable that blue ammonia will represent the main clean ammonia source at first, in order to then develop green ammonia.

> *"Blue ammonia will be the key immediate focus before relative competitiveness of green ammonia improves"* (YCA, 2022a).

This statement indicates that blue ammonia will be a transitional option. This will allow a *"rapid abatement of emissions"*. Green ammonia on the contrary will be the "*long-term fully renewable option*" (YCA, 2022a). According to the Arkwright market study 2021, which was used by YCA, blue ammonia is expected to achieve price competitiveness with grey ammonia by 2030-2035, while green ammonia is unlikely to achieve it before 2040. On Figure *6*, which shows the global ammonia demand outlook, it can be seen that green ammonia won't be the most important source of clean ammonia until 2045. According to YCA,

> *"Gas price will impact blue ammonia and impact price until green ammonia is competitive with blue ammonia. Which we believe, is quite far into the future"* (YCA, 2022a).

Through this statement, YCA confirms that green ammonia will only be available in a long time. As seen previously, according to Yara, in order for green ammonia to become competitive, more advantageous regulations should be adopted to foster the hydrogen economy and renewable energies which are needed in large amounts and at a low cost. Moreover, YCA indicates that the electrolyser technology is still being developed and that further investments are needed for improvements (YCA, 2022a).

[10] The documentation available does not provide enough information to determine whether this is the only clean ammonia volume that Yara will use to produce green and blue fertilizers. Indeed, some of the clean ammonia produced by the projects presented in Table *3*, which are not mentioned by YCA, could be added to the 300kT meant for fertilizer production.

This puts into perspective the 'readiness' of the green ammonia production technology and the easiness with which it would be available, as often presented by Yara.
Blue ammonia is often presented as a transitional phase. During a presentation of the project *Haddock*, it was mentioned that:

> *"Blue ammonia is phased out when large scale green ammonia comes in from 2030-2035 onwards"* (Schlaug, 2022).

This would lead to a maximum 10-year production of blue ammonia as the expected production starting date of this project will be 2025 at the earliest. The blue ammonia projects developed by Yara are for the most part planned for the late 2020s. It is hard to believe that these blue ammonia projects will have a lifetime of 1-10 years if the transition happens in 2030-2035. Likewise, if green ammonia should become price competitive in 2040, CCS would be a technology that could be operational over 15 years. When looking at the general market expectations, the green ammonia demand should be more important than the blue ammonia demand from 2050 on. However, a blue ammonia production increase is observed until at least 2050. Furthermore, during the presentation it was affirmed that there is:

> *"still long term need for blue ammonia by 2050 to fill this (new applications) market"* (YCA, 2022a).

The need for blue ammonia in the long term as expressed in this statement, contradicts the fact that blue ammonia is only a transitional phase until green ammonia becomes price competitive. Indeed, no phase-out of blue ammonia seems expected and no clear targets are set.

The previous statement is also informing us that blue ammonia is mainly meant for new applications. However, in 2050, 62% of the blue ammonia produced should be used to respond to the blue fertilizer demand (See Figure *6*). This contradicts that blue ammonia is needed to deliver on new applications as stated by Yara as most of the blue ammonia produced will be used for fertilizers. Looking at the prospects for ammonia consumption in the fertilizer industry it is worth noting that, by 2050, green fertilizers are predicted to account for 12 % of all clean fertilizers produced (See Figure *7*). This contrasts with the general narrative of Yara around green fertilizers. Indeed, as indicated above, Yara's communications mainly refer to green fertilizers made out of renewable energy and not to blue fertilizers. However, the fertilizer

sector should have a higher blue ammonia demand than green ammonia demand until at least 2050 (YCA, 2022a).

Looking at the overall ammonia demand outlook, it becomes clear that blue ammonia will remain the main clean ammonia source until 2045. Although it is often presented as a transitional phase, no phase-out is envisioned. Green ammonia will only be price competitive in 2040. Furthermore, until at least 2050, blue ammonia will remain the most important source of clean ammonia for fertilizers and fertilizers will be the main application for blue ammonia.

E- Grey Ammonia Production Outlook

Yara is counting on the use of clean fertilizers to phase out conventional fertilizers. This shows the need to look further into the actual grey ammonia volume previsions, especially regarding the fertilizer market. According to predictions used by YCA, in 2050, 34 % of ammonia meant for industrial application should be blue ammonia, and 4.3%, should be green (See Figure *7*). Grey ammonia would thus represent 61.6% of the ammonia meant for conventional applications with a volume of 143 mT. In 2050, fertilizers would thus still be produced with a majority of grey ammonia. This can be confirmed with a statement made by YCA which affirms that:

> *"grey ammonia is expected to continue to play an important role in the agricultural and industrial market"* (YCA, 2022a).

This declaration contradicts the narrative that green fertilizers will enable a phase-out of fossil-based fertilizers and decarbonisation of the sector. It is essential to take into consideration that ammonia production for fertilizers is predicted to increase by 22% between 2020 and 2050 (See Figure *7*). With this information, it can be calculated that about half of the clean ammonia demand for conventional application will serve the increase in ammonia demand for this sector. This shows that clean ammonia volumes will mainly allow an increase in fertilizer production rather than an actual transition to clean fertilizers. Furthermore, it is important to keep in mind that the main impact of the fertilizer industry is linked to the use of fertilizers. Hence an increase in fertilizer production would lead to an increase in the scope 3 of emissions and is contradictory with the Farm to Fork goal of reducing fertilizer use by 20%. The emissions cut from producing clean ammonia over grey ammonia could be counterbalanced with emissions linked to an increase in fertilizer use.

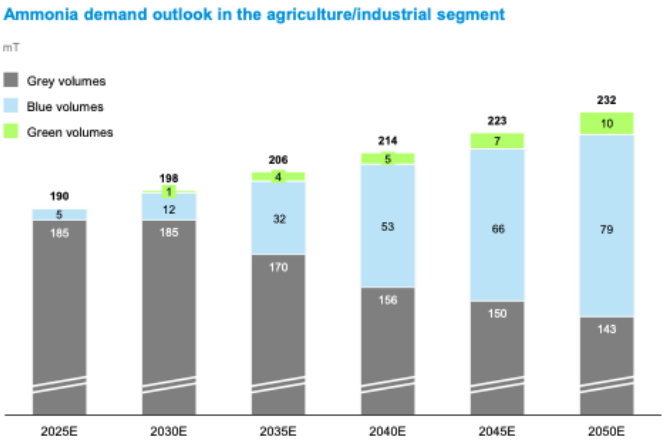

Figure 7 – Global ammonia demand outlook in the agricultural segment (YCA, 2022a)

Focusing on the changes in the demand for grey ammonia, it is essential to note that in 2050, grey ammonia demand will only be reduced by 22.3% from a 2022 baseline (See Figure *6*). Zooming into the evolution of grey ammonia demand as presented by YCA, it is visible that no reduction in grey ammonia production should be observed until 2035. As all the grey volume is used for industrial production, there should be no reduction in grey ammonia use for the fertilizer sector until 2035 (See Figure *7*). Until then, all clean ammonia production meant for industrial application is likely serve the increase in ammonia demand, rather than a phase out of grey ammonia. This would make it impossible for Yara to reduce their global and fertilizer linked emissions by 2030 thanks to clean ammonia and clean fertilizers.

As these expectations are for the entire sector, they do not indicate whether Yara will follow the overall tendency. However, when looking at Yara's projects, it is important to notice that most of Yara's clean ammonia projects are planning new ammonia plants rather than the electrification or the carbon capture of existing ones (See Table *2* & 3). This reinforces the risk of observing an increase in ammonia production rather than a decrease in grey ammonia production by Yara. Furthermore, it was mentioned during the Capital Market Day presentation that:

> *"Stable volume development in conventional applications (is) expected where YCA targets to maintain its market-leading position and replace any converted volumes (i.e. to blue or green) with additional grey volumes"* (YCA, 2022a).

This statement indicates that in the medium to long term, new clean ammonia volume produced by Yara from converted grey ammonia plants, thus reducing the amount of grey ammonia produced, will be replaced by new grey ammonia production or sourcing. This confirms that the grey ammonia volumes used by Yara should remain constant, despite the conversion of grey ammonia production plants. No estimate nor goal was set on how much ammonia and fertilizer will be produced by Yara in 2030 and 2050. Likewise, no clear goal or estimate was found for clean ammonia production in 2050 or for clean fertilizers production in 2030 and 2050. No clear goal for the proportion of clean ammonia used for fertilizer production was communicated. An indication on the decrease of the grey ammonia volume is also never given.

The lack of indication on grey ammonia production reduction is also visible in the case of the *Yuri* plant in Pilbara. Yara is indicating that in Phase I, 6-20% of the ammonia synthesis should be fed by green hydrogen. In Phase II, a new ammonia plant will be constructed and fed at 60% by green hydrogen while the other ammonia plant is fed only by grey hydrogen. In Phase 3, 80-100% of the new ammonia plant should be fed by green hydrogen while the old ammonia plant will be fed with grey hydrogen. The use of a percentage does not give any information about a potential reduction of grey ammonia (Yara & Engie, 2020).

The lack of clear data about Yara's grey ammonia volumes raises questions on whether clean ammonia production will actually cover the surplus ammonia produced and lead to a reduction or maintaining of the volume of grey ammonia produced by Yara, or whether new grey volume will be added by 2030. A report published by Yara France mentions that Yara will produce 83000 T green fertilizers in 2027 and 30% of its fertilizer production will be green by 2030 (Yara France, 2023). None of these goals can be found in communications from Yara International or YCA. Moreover, without an indication on the fertilizer production, this does not inform us about a potential reduction in grey ammonia. I was told at the *Salon the l'Agriculture* that grey ammonia would still have a role in fertilizer production, but the person could not give me more information on when green fertilizers would be predominant.

Blue and grey ammonia are production methods which both rely on natural gas. Looking at the projections, we can notice that the overall demand for blue and grey ammonia should increase from 184 mT in 2021 to 270 mT in 2050. Within the conventional sector, the demand should increase from 184 mT in 2021 to 222 in 2050 (See Figure *6*). This data indicates an overall increase of 31.9 % in gas between 2021

and 2050 and of 16.4% in the conventional sector. This is contradictory with the narrative that Yara uses to push for the use of clean ammonia in order to be less dependent on Russian gas and less impacted by the price volatility of natural gas.

Through the focus on grey ammonia volumes, it can be seen that clean ammonia will mainly serve the creation of a market for new applications and the increase in fertilizer production, rather than a transition to renewable fertilizers. No consequent reduction in grey ammonia is planned and an increase in gas consumption should be observed. Yara is not setting any goals for grey ammonia reduction, but their projects and statements indicate a tendency similar to the global ammonia demand outlook. This raises concerns about the actual purpose of clean ammonia for the fertilizer industry. Indeed, market expectations used by Yara are not aligned with a possibility of carbon neutrality in 2050 if clean ammonia is the main way to reduce their scope 1 and 2 emissions.

F- Environmental Impact of Clean Fertilizers

Yara sometime s uses terms such as *"zero-emission fertilizers"*, *"carbon-free fertilizers"*, *"climate-neutral fertilizers"* and *"decarbonized fertilizers"* to define green fertilizers. It is therefore interesting to take a closer look at the technology of green fertilizers and its environmental impact.
Yara mentions, in the context of their partnership with Lantmännen, that:

> *"(t)he fertilizers, with a 70 to 90% smaller carbon footprint, will be key to realizing the world's first food value chain practically fossil-free"* (Yara & Lantmännen, 2022).

This shows that green fertilizers are not actually emission-free and that this food chain will not be entirely fossil-free. Fossil fuels may be used for transportation or mining activities (Yara, n.d.-b). The actual amount of fossil fuels is not mentioned.

In the case of blue fertilizers, YCA indicates that the carbon reduction for blue ammonia production lies between 1.9 and 1.1 t CO_2 / tNH3. This corresponds to a 60-95%% reduction, which mainly depends on the carbon capture rate (YCA, 2022a). Besides the project in partnership with Enbridge Inc, which aims for a carbon capture rate of 95%, no other blue ammonia project realized by Yara has a clear indication of the carbon capture rate (See Figure *2* & 3). However, this greatly influences the final emissions reduction, making it hard to estimate how much CO_2

will actually be cut from the clean ammonia projects. Furthermore, criticisms have been formulated about the efficiency of CCS, and various studies have shown that the process of capturing CO_2 is highly energy intensive, which counterbalances the emissions avoided by capturing the carbon. Furthermore, leakage during production, transport and storage can be observed, leading to additional GHG emissions (Howarth & Jacobson, 2021).[11] This reinforces doubts over Yara's actual CO_2 emissions reduction capacity if no overall fertilizer and ammonia reduction as well as no significant grey ammonia and fertilizer reduction are envisioned.

After the production of hydrogen, a further energy intensive step is required for ammonia production, namely the Haber-Bosch process. The ammonia production process requires a temperature of above 400°C and a pressure of above 150 bar and is usually fuelled by natural gas. Some ammonia plants are getting electrified, but it remains unclear whether it will be the case for all green ammonia production plants. No precise information could be found on this. When the representative of Yara at the *Salon de l'Agriculture* was asked about this, after avoiding the question at first, he reoriented it by saying that the Haber-Bosch process was not the main issue. According to him, the biggest challenge was the electrification of hydrogen production. When looking at the *Yuri* project, which is the most documented project, we can see that the renewable ammonia plant will be built in the second phase, which is 5 years after the start of the production of green hydrogen (Yara & Engie, 2020; YCA, 2022a). However, YCA indicates that it will already be producing 3kT of green ammonia in 2025. Hence, Yara considers ammonia as being green in cases in which the Haber-Bosch process is not electrified.

Contrary to what Yara is saying, green fertilizers are not guaranteed to be fossil- or emission-free fertilizers as various parts of the production may still rely on fossil fuels. This confirms the need for a clear ambition to reduce the overall production of fertilizers in order to have significant emission reduction.

G- Challenges linked to Resource Use for Green Ammonia Production

Yara and the European Union are focusing their ambition on reducing carbon emissions. However, the use of resources by Yara when producing ammonia may have social impacts, be linked to further environmental damages, and be subject to

[11] Information on the impact of CCS can be found in the report written by Food and Water Watch (Food and Water Watch, 2020).

scarcity. A brief overview of some of these resource management challenges will be presented here.

Certain resources linked to clean ammonia production are barely talked about by Yara. The production of electrolysers and machinery for renewable energy production will require the mining of rare metals. This is the case for the platinum present in PEM electrolysers, used for example in the Skei project (Yara, 2022a). The mining of this rare metal has been associated with high energy use, GHG emissions, water use, and solid waste (Glaister & Mudd, 2010). Furthermore, it has been shown that this metal is present in very low amounts on Earth and the available quantity will not meet the needs of a growing electrolyzer production if the hydrogen increases and extends to new sectors (IRENA & AEA, 2022).

Another aspect is the growing demand for renewable energies. Indeed, more and more sectors are counting on renewable energies to decarbonize. Yara Netherlands stated regarding the Sluiskil ammonia production plant that:

> *"Suppose the entire site is converted to green hydrogen and Yara Sluiskil thereby uses 340,000 tons of hydrogen as at present, this would require 2.2 GW of baseload electric power. For comparison, that corresponds to 4.5 times the capacity of the Borssele nuclear power plant"* (Yara Netherlands, 2022a).

This statement shows the high energy demand for green ammonia production. However, the amount of renewable energy is not infinite due to the materials needed and the space available. Hence, there is a growing competition for access to renewable energies and the EU is counting on imports to meet this demand. According to Hydrogen Europe, the African continent has a great potential for renewable energy production and could respond to the European demand for renewable hydrogen production. Furthermore, when looking at expected production and consumption centres, it is noticeable that the Global North will be the main consumption centre of renewable hydrogen and ammonia. The production centres are mainly located in the Global South, namely in Chile, North Africa, and the Middle East. The exploitation of resources in the Global South for the purpose of the Global North's consumption raises concerns over the perpetuation of neocolonial dynamics. Frans Timmermans – the European Commission Vice-President – identified this risk in a report published by Hydrogen Europe, in which he affirms that:

> *"In the context of energy cooperation, we must acknowledge Europe's colonial past and strive to ensure the establishment of fair and equitable partnerships with our African partners"* (Hydrogen Europe, 2022).

Although in this declaration he identifies the risk of perpetuating neocolonial practices, no indication is given on how this should be done. Some concerns have been raised by multiple organizations about the exploitation of renewable energies in poorer locations to meet the needs of the European hydrogen market which do not take into account local needs and concerns (Belén et al., 2020). These worries were expressed in the case of the construction of the Inga dam in DRC, which will be exploited by Fortescue, an Australian hydrogen company, despite local concerns over the environment and local access to energy (International Rivers, 2021).[12]

A focus on Yara's resource use for clean ammonia production raises various concerns about this technology. It shows that focusing on emissions reduction is not enough, and other environmental challenges can emerge such as an water and waste. Furthermore, the scarcity of resources can undermine the scaling up of green hydrogen production and lead to the perpetuation of neocolonial dynamics.

This section made clear that Yara is supportive of the Paris Agreements, but when taking all information into account, the goals they set do not align with the 1.5°C limit. Furthermore, although Yara places all hopes in green fertilizers to decarbonize the fertilizer sector, data derived from their projections indicate that green fertilizers will be available a long time from now and will represent a minority of fertilizers produced. Despite being rarely talked about by Yara and presented as a transitional phase, blue fertilizers should remain the main clean fertilizers produced. Only a small reduction of grey fertilizer production should be observed, as most clean ammonia would go to compensate new volumes linked to the development of new applications and to the fertilizer production increase. Despite being presented as a perfect solution, clean ammonia faces multiple challenges linked to resource use and is not emission- and fossil-free. This raises questions about the unconditional subsidising of clean hydrogen.

[12] More information on the neocolonial challenges linked to the upscaling of hydrogen production can be found in the report written by Corporate Europe Observatory (Corporate Europe Observatory, 2020).

IV- Discussion

The findings from this analysis may be of interest to policy makers and grassroots organisations besides researchers due to the topicality of green hydrogen and fertilizers. For the sake of accessibility, this discussion will be separated in two parts. The first part will discuss the political implications of the empirical conclusions on the role of green fertilizers and clean ammonia in Yara's climate strategy and the EU's. This will mainly serve an audience of policy makers and activists. The second part will discuss the theoretical implications and expand on the strategies used by Yara to perpetuate their corporate authority using green fertilizers. This section will mainly be of interest to researchers.

1- Green Fertilizers in the Climate Strategy of Yara and the European Union

The collected data shows that Yara claims to be prioritising climate change by meeting the objectives of the Paris Agreements through self-imposed climate targets and the development of clean ammonia and fertilizer projects. In doing so, they claim to be sharing the ambition of the EU to reduce emissions and dependency on (Russian) gas. This alleged common interest, as well as their expertise and economic position, gives Yara a role in the shaping of EU climate regulations, such as within the Clean Hydrogen Alliance. However, looking closer at what Yara is planning and lobbying for, it becomes clear that some interests diverge with the EU, which aims to reduce its emissions and become climate neutral by 2050. Indeed, Yara mainly wants to secure competitiveness and a continued fertilizer production. This can be seen in Yara's lobbying for looser certification schemes regarding green fertilizers at the expense of their climate impact. Looking at Yara's predictions and projects, it is noticeable that ammonia production should have only decreased by 22% in 2050. Indeed, most of the green ammonia produced by Yara will be used to match the increased demand for ammonia, linked to a higher demand for fertilizers and new applications. In 2050, green fertilizers should represent an insignificant share of Yara's fertilizer production. This shows that Yara's actions and previsions do not align with their climate targets. Furthermore, when taking all information into account, even Yara's targets do not align with the 1.5°C limit.

Although Yara's communication is based on green fertilizers, blue ammonia will remain the main clean ammonia source for fertilizers. As blue and grey ammonia are dependent on gas, gas consumption should continue increase. Therefore, the EU's unconditional subsidising of clean ammonia production may be financing an ammonia production increase and a continued gas consumption, rather than the decarbonization of the fertilizer and broader energy sector. Based on this evidence,

the alleged intention of Yara to decrease emissions and their dependency over natural gas seems questionable, while the disparity between Yara's interests and the ones of the EU seems clear. Yara's presence in European policy making is thus questionable as it puts democratic functioning at risk. The increasing presence of corporations in policy making may *"transform [..] the objectives pursued by public authorities"* (Aguiton et al., 2021). Indeed, the interests of Yara are diverge from those of the citizens who elected their EU representatives. Yara's expertise cannot be considered unbiased and exempt of private interests.

In their communication, Yara is presenting green fertilizers as a perfect solution for reducing emissions within agriculture as they are impactful, fossil free and easy to implement. They represent a simple way of reducing emissions in a measurable way, as requested by the EU. However, green fertilizers do not address fertilizer use, which represents the main source of emissions for fertilizers. Looking more into green fertilizers as well as clean ammonia, it also becomes visible that they are not necessarily fossil- and emission-free. Furthermore, they represent other challenges linked to resource access and use such as the production of waste, the high use of water and the potential perpetuation of neo-colonial practices linked to exploitation of the Global South for access to renewable energies. They also perpetuate the dependency of farmers on fertilizers and risk creating new dependencies linked to the import of renewable energies. Focusing on emissions reduction is hence not sufficient. A deeper questioning of our food system may be needed. Agricultural systems which don't use synthetic fertilizers and have a radically different and more holistic approach such as agroecology and permaculture exist, but may be overshadowed in European institutions due to the omnipresence of easily applicable technological solutions such as green fertilizers (de Tombeur et al., 2018; Via Campesina, 2020).

2- Yara, Green Fertilizers and Corporate Authority

The use of green fertilizers is an example of how companies develop strategies and use power to maintain their corporate authority. Indeed, as Yara and synthetic nitrogen fertilizers are currently challenged by social movements and environmental regulations, Yara is developing green fertilizers to respond to that challenge and secure their position. By empirically researching the role of green fertilizers in the strategies deployed by Yara and the powers they are using to perpetuate their corporate authority, a better understanding of the role of technology in maintaining the status quo can be developed. This will be done by drawing a distinction between structural power, which refers to the direct exercise of power over the outcome and the delimitation of possibilities; institutional power, which corresponds to the influence of an actor over another and discursive power, which allows the phrasing of problems and societal norms (Clapp & Fuchs, 2009).

A- Structural Power

The way Yara's structural power is used to develop technologies, and how these technologies are used to reproduce Yara's structural power, becomes visible by studying their practices and narrative (Aguiton et al., 2021).

Yara is exercising structural power by influencing what are to be considered as possible alternatives (Clapp, 2009). Starting with their narratives, Yara is claiming that green fertilizers are an effortless solution to the climate crisis. The dominant agricultural system is dependent on synthetic fertilizers. Yara is using this lock-in to promote green fertilizers as a solution to the climate crisis, as it does not require changes in the production chain. Yara proposes a technology which further extends the use of this technology and requires smaller changes. They take advantage of the power held by synthetic fertilizers, which is embodied in their materiality, which determines agricultural practices. By using the power held by technologies, as theorized by Ahlborg & Nightingale (2018), Yara is making green fertilizers the most suitable choice. Consequently, the development of that technology creates a reinforcement of the food system's dependency on synthetic fertilizers. Indeed, this leads Yara to renew their structural position within the food system, making farmers and, through this, consumers, dependent on green fertilizers. Yara is gaining a structural position by making themselves and their technology indispensable to the food system.

The materiality of (green) fertilizers is also used to justify the presence of Yara in new markets such as shipping, hydrogen carrying, and fuel. Indeed, Yara is using their experience in ammonia production linked to fertilizer production, and their capacity to produce green ammonia through green fertilizer production, as part of their narrative to develop new sectors. The use of ammonia for new applications should increase Yara's ammonia sales and diversify their production. This should be economically beneficial for Yara and expand their influence, making them indispensable to other sectors, thus reinforcing their structural power (Aguiton et al., 2021).

Yara is the largest synthetic nitrogen fertilizer producer in the world and has a large number of production plants in Europe, granting them an economic position resulting in strong structural power. Yara's position in the economic sector strengthens the demands they formulate and gives them the capacity to influence the agenda on how to shape the energy and food sector to develop the solution they are proposing. Indeed, by identifying green fertilizers as the solution, Yara is formulating demands for appropriate regulations regarding green hydrogen production by publishing a large amount of position papers and joint statements. The impact of those demands can be seen in implementations such as the Delegated Act for RFNBO, which created a certification scheme for renewable hydrogen. The need for certification was observed by actors of the hydrogen economy such as Yara and Hydrogen Europe.

Due to their economic position, Yara is also directly taking part in regulation making. This is the case for the CHA, in which they take part in discussions to determine the outlook and the relevant projects of the European hydrogen backbone. Their economic position grants them the status of experts, which gives Yara influence over policymaking, similarly to what has been observed in the pesticide industry by Jansen, (2017). Yara's expertise, to which they also lay claim in their communications, as well as the sustainability goals that they intentionally set, are legitimizing their presence in policymaking as stated by Sikor & Lund, (2010). Yara's economic position also guarantees them an access to resources, such as a privileged access to public grants for green ammonia project development through their presence in the CHA.

The need for their technology and industry is used by Yara as part of their repertoire of action to threaten the EU with delocalising their production units and jeopardizing food security if regulations are not favourable. This can be further understood by drawing on Clapp & Fuchs (2009), who affirms that:

> *"The structural power of Transnational corporations (TNCs) derives from the ability to punish and reward countries for their policy choices by relocating investments and jobs."*

From this analysis can be derived that the capacity of Yara to threaten the EU comes from their ability to punish states due to their economic position, and their green hydrogen development capacity, which is presented as an indispensable solution to decarbonize the European industry.

Yara are making themselves indispensable by using the very materiality of fertilizers to make green fertilizers a suitable solution, and through this reinforcing a technological lock-in. Yara are using their structural power, linked to their key position for green fertilizer development, combined with their self-proclaimed expertise, as arguments to legitimize their presence in direct regulation making. This gives them special advantages such as access to financial resources through grants. Furthermore, their economic presence gives them the power to threaten the EU and impose favourable regulations.

B- Institutional Power

Looking more into the regulations and their content as well as state-business interactions helps create a better understanding of how Yara is using and developing green fertilizers and clean ammonia. Yara has recently invested more money in lobbying in order to ensure favourable regulations, demonstrating that the use of official forms of lobbying is part of their repertoire of action. They are creating alliances with different members of the hydrogen economy and NGOs, strengthening the credibility of Yara and what they are advocating for. Yara is joining various lobbying events such as panel discussions at the COP27 and the European Hydrogen Forum, in which they advocate for green fertilizers and present their green fertilizer projects. By using multiple tools and state-business interactions, as well as alliances with other companies and associations, Yara is shaping the policy debate. They are pushing for state financial support of green hydrogen as the main means of reducing emissions while neglecting the goal of diminishing fertilizer use. The impact of these demands can be seen in the increased availability of EU public grants for hydrogen projects, which were requested by different actors including Yara in order to develop the hydrogen economy. Yara is advocating for loose regulation of the certification schemes for clean hydrogen and clean ammonia production targets. On the other hand, Yara is supporting strong state intervention through the use of financial mechanisms, such as carbon taxes and markets, in order to make climate-friendly solutions, such as green fertilizers, more interesting economically. This is part of a neoliberal climate capitalist project, in which corporations will bring change through innovation by being incentivised to produce climate-friendly products thanks to a

market designed appropriately by governments (Sapinski, 2016). Furthermore, this confirms that corporations may advocate for stricter regulations when it gives them an advantage over other actors (Jansen, 2017). Indeed, taxes on the carbon footprint of fertilizers gives Yara a comparative advantage over non-EU fertilizer producers.

By using lobbying tools, such as taking part in public consultation and joining lobbying events, Yara is using their institutional power to bend regulations in order to create a favourable framework for the development of clean ammonia production and placing itself in a climate capitalist project. Yara is creating various alliances in order to strengthen their position and credibility.

C- Discursive Power

My results show that in a time when synthetic fertilizers are being criticized for their social and environmental impact, Yara is defending the need for fertilizers, despite their GHGEs, to ensure food security while protecting the planet through sustainable intensification, which decreases land use change. Yara is placing the problem in the energy intensive production of fertilizers and seeing the perfect solution in green fertilizers, which will help cut the dependency on natural gas. By enforcing this narrative through report publications, investments in lobbying, and taking part in conferences, Yara positions itself as being part of the solution to the climate, food, and energy crisis and as an enabler of sustainability. Yara rephrase the problem with fertilizers in a way that suits their interests, namely, a continued fertilizer production. Through the high visibility of Yara's communication on green fertilizers and the emissions reduction that they will bring, Yara is focusing on the widely shared idea that something needs to be done in order to stay below 1.5°C. The use of viability as part of their repertoire of action, however, creates a distraction from Yara's current actions (Aguiton et al., 2021). Green fertilizers have not yet been produced, and the possibility of their production remains uncertain. In the meantime, grey ammonia production represents the entire nitrogen fertilizer production, and should remain the largest proportion in the long term. By choosing to focus their goals on the overall clean ammonia production, Yara is hiding that most clean ammonia produced will serve an increase in ammonia consumption linked to new applications and an increase in fertilizer production. Although Yara gives a lot of visibility to green fertilizers, they are keeping vague how much they will actually represent in the long term, and downplaying blue fertilizers, which will represent the majority of clean fertilizers. Furthermore, Yara can only maintain the illusion of a perfect solution by keeping some knowledge hidden, such as the availability of rare metals needed for electrolysers and renewable energy production and the impact of their extraction.

Moreover, Yara renders invisible the problem of the use of fertilizers, which represents majority of emissions. This diversion strategy allows them to avoid talking about, and envisioning, a reduction of synthetic nitrogen fertilizer production and use. Through the high visibility of green fertilizers, Yara is concealing all alternatives which produce food sustainably without synthetic fertilizers. (de Tombeur et al., 2018; Via Campesina, 2020). The concealment of alternative possibilities, based on alternative values as well as on potential social and environmental impact, has also been observed in the framing of CCS by the fossil fuel industry (Tilsted et al., 2022).

The empirical findings can also be related to several other theoretical frameworks. Yara's discursive strategy around green fertilizers resembles what Tilsted et al., (2022) identified as the *narrative realignment method* used by petrochemical companies to preserve their authority. Through the production of green fertilizers, Yara becomes a *"breakthrough technology pioneer"* which will decarbonize the fertilizer sector through its emissions reduction. Yara avoids taking responsibility for the environmental impact of synthetic fertilizers and makes the current production and the continued use of fertilizers acceptable. By seeing the solution to climate change and pollution in an energy-efficient fertilizer production, Yara places itself in the broader discourse of techno-optimism, which puts its faith in technology and science to solve the climate crisis (Tilsted et al., 2022). Technological fixes are part of the broader promise of climate capitalism, which focuses on changing the energy source without changing the economic model or questioning the power dynamics involved and the root causes of unsustainability (Sapinski, 2015). By presenting (green) fertilizers as indispensable and developing a new economics based on hydrogen which, like the fossil fuel economy, is led by multinationals, Yara overshadows all debate around which type of agriculture and energy system is desirable. Various academics argue that climate capitalism leads to a slow energy transition and mainly allows corporations to maintain their control over new energy sources. These critics put forward the need to take into account the broader socio-political environment, and push for an alternative approach that would address the inequalities around access to resources and around the impact of climate change and environmental pollution (Carroll, 2021).

The development of green fertilizers by Yara and the phrasing of this as a perfect solution strengthens the impression that they have the capacity, well-meaning intentions, and expertise to respond to the climate crisis. Yara communicates about green fertilizers in a way that ensures that society trusts in those three dimensions, by hiding some information while making other information more visible. Their discourse is thus legitimizing their corporate power (Clapp & Fuchs, 2009). This

legitimization is reinforced by the valorisation of Yara's expertise, experience, infrastructures, and purpose in their communication.

The analysis of Yara's discursive strategies reveals that they are reframing the problems linked to fertilizers in a way that is advantageous for them through the narrative realignment discursive method. This is made possible by hiding or keeping certain information vague as well as by creating a distraction from damaging practices through the highlighting of green fertilizers and their emissions reductions potential. Through the discursive creation of a perfect solution and a perfect partner, Yara is justifying the legitimacy of their power, thus reproducing their corporate authority.

V- Conclusion

The main objective of this research was to study the use by Yara of green fertilizers as a tool to perpetuate corporate authority. To do so, I looked into the strategies deployed to develop this technology, how it is instrumentalized to legitimize Yara's power and how the technology influences social reality. The method of critical discourse analysis allowed me to study the socio-political context in which green fertilizers are developed, the strategies and discourses deployed to change the current social reality and legitimize Yara's power in doing so, and finally to provide a critique to that social reality.

By doing a critical discourse analysis, I studied the socio-political context in which green fertilizers are developed, the strategies and discourse deployed to change the current social reality and a critic to the one it creates. The development of green fertilizers in light of power as defined by Clapp & Fuchs, (2009) who used a three-dimensional approach which pays attention to the instrumental, structural, and discursive dimensions of power. Moreover, I have studied how Yara uses green fertilizers as part of their tool to self-reproduce these dimensions of power and legitimize them. Although the distinction between structural, institutional and discursive power does not provide sharply delimited domains of power, it makes visible the various levels in which Yara uses this technology. The use of the concept of repertoire of action was helpful to see how a technology is used as part of and in combination with tools of the repertoire of action to reproduce corporate authority.

By studying the discourse around green fertilizers used by Yara, I identified how they are using green fertilizers to reframe themselves as part of, and as indispensable to the solution. They propose green fertilizers as a breakthrough technology to answer current challenges linked to environmental degradation, climate change, food insecurity and dependency on (Russian) gas. According to Yara, green fertilizers are effortless, fossil free and impactful and they are the perfect stakeholder to develop it thanks to their experience, expertise, intentions, and infrastructures. To create this narrative, Yara is using knowledge as part of their strategy, by hiding certain information to maintain the illusion of a perfect solution and emphasing their expertise (Aguiton et al., 2021). Furthermore, Yara is making green fertilizers highly visible by focusing on them during lobbying events and in their climate strategies. This shifts the attention away from their current grey production, and makes the future grey production seem acceptable, preventing the company from taking responsibility. This also creates a confusion around the existence of blue fertilizers, although they should represent the majority of clean fertilizer volumes. By showing their green fertilizer projects and presenting them as a perfect solution, Yara is

legitimizing their corporate power by reinforcing the trust of people in their capacity, expertise, and intentions.

Yara is using the dependency over synthetic fertilizers to place green fertilizers as a perfect solution and through it, reinforces this lock-in by maintaining the use of synthetic fertilizers. Using the materiality of green fertilizers, Yara is shaping the agriculture of the future. Through the development of green ammonia meant for fertilizers and their experience in hydrogen production, Yara is placing themselves at the centre of the hydrogen economy and developing new markets. Although the fertilizer industry has a special place in the hydrogen economy through their use of hydrogen as feedstock rather than energy, they are reframing their production systems to be able to develop new markets and increase their influence and production. Yara is becoming necessary to new sectors, and through it reinforcing their economic position and structural power. Yara's economic position allows them to directly influence regulations through their access to direct decision-making processes, also linked to their status of expertise, as well as their capacity to threaten governing bodies.

Yara also influences regulations indirectly by using the law as part of their repertoire of action, using official lobbying tools such as taking part in meetings with the European Commission, answering public consultation, writing position papers and joining working groups. Yara is pushing for favourable regulations that may be more or less strict according to their interests. They have particular interests in the legislation which concerns the hydrogen economy development, nomenclature, taxations, and funding. Through this they are framing the debates, securing access to resources such as renewable energies and money. Moreover, they are focusing the debate on developing a new energy source while sustaining the use of gas and maintaining the power structures in place in agriculture and energy sector, placing themselves at the centre of a climate capitalist project. Their influence and credibility is strengthened by various state-business, business-business and business-Ngo associations.

This study of Yara and green fertilizers aimed at identifying various tools and strategies developed as part of their repertoire of action by corporations to self-perpetuate their corporate authority when challenged by governments and organisations in the context of socio-environmental crisis and injustices. Drawing from the data analysed, Yara is playing with the visibility of green fertilizers to invisibles other aspects of Yara's activities; making themselves indispensable through narrative realignment and by using the materiality of (green) fertilizers; using knowledge in their advantage by emphasing their expertise and keeping some knowledge hidden or vague and using official lobbying methods such as joining

events, meetings with the commission and writing position papers. The focus on the role that technologies play in perpetuation corporate authority, allowed me to add to the literature on how corporations are mobilising their corporate power to implement them, and through it reinforce their powers and legitimacy. Furthermore, I intended to contribute to the understanding of the role which the very materiality of technology plays in is securing the perpetuation of corporate authority, having long term material effects. Through this, I hope to create a stronger base for identifying and resisting technologies which are deployed to maintain the status quo rather than creating a radical change that would more profoundly respond to current challenges.

Bibliography

Aguiton, S. A., Déplaude, M. O., Jas, N., Henry, E., & Thomas, V. (2021). The Pervasiveness of Corporate Authority: Repertoire of Actions, Material Effects, and Democratic Challenges. *Pervasive Powers: The Politics of Corporate Authority*, 9–32. https://doi.org/10.4324/9781003053873

Ahlborg, H., & Nightingale, A. J. (2018). Theorizing power in political ecology: The where of power in resource governance projects. *Journal of Political Ecology*, *25*(1), 381–401. https://doi.org/10.2458/V25I1.22804

Alexander, R. J. (2017). Investigating Texts about Environmental Degradation Using Critical Discourse Analysis and Corpus Linguistic Techniques. In *The Routledge Handbook of Ecolinguistics* (pp. 196–210). Routledge. https://doi.org/10.4324/9781315687391-14

Al-Kazafy H, S. (2015). Synthetic Fertilizers; Role and Hazards. *Fertilizer Technology*, *1*, 110–133. https://doi.org/10.13140/RG.2.1.2395.3366

Belén, B., Gaëtane, C., Frida, K., & Elena, Gerebizza. (2020). *The Hydrogen hype: gas industry fairy tale or climate horror story?*

Bellamy Foster, J., & Magdoff, F. (2011). *What Every Environmentalist Needs to Know about Capitalism* (NYU Press).

Benjaminsen, T. A., & Svarstad, H. (2021). Discourses and Narratives on Environment and Development: The Example of Bioprospecting. *Political Ecology*, 59–87. https://doi.org/10.1007/978-3-030-56036-2_3

Bischoping, K., & Gazso, A. (2021). Foucauldian Discourse Analysis. In *Analyzing Talk in the Social Sciences* (pp. 131–142). SAGE Publications Ltd. https://doi.org/10.4135/9781473965454.n9

Boudia, Soraya., Creager, A. N. H., Frickel, Scott., Henry, Emmanuel., Jas, Nathalie., Reinhardt, Carsten., & Roberts, J. A. (2021). Residue Properties. In *Residues : Thinking Through Chemical Environments.* (pp. 1–20). Rutgers University Press. https://doi.org/10.7351/ests2018.245

Burwood-Taylor, L. (2022). Regenerative agriculture conference faces protests in Amsterdam. *AFN*. https://agfundernews.com/regenerative-agriculture-conference-faces-protests-in-amsterdam

Carroll, K. W. (2021). Prospects for Energy Democracy in the Face of Passive Revolution. In *Regime of Obstruction: How Corporate Power Blocks Energy Democracy* (pp. 479–503). Athabasca University Press. https://doi.org/10.15215/aupress/9781771992893.01

Cefic. (2021). *Cefic position on the ETS review*.

Cefic. (2022). *The Carbon Border Adjustment Mechanism (CBAM) proposal needs upgrading for chemicals*.

Cefic, Cembureau, Cerame-Unie, CO2 Value EUrope, ECFD, e-fuel Alliance, EuLA, Eurofer, Eurogas, Euromines, Fertilizers Europe, Fuels Europe, Hydrogen Europe, & IFIEC EUrope. (2022). *Joint statement of the EU industry: Pragmatic regulatory framework necessary for hydrogen market*.

Cicero. (2022). *Yara Green Financing Second Opinion*.

Clapp, J., & Fuchs, D. A. (2009). Corporate power in global agrifood governance. *Agribusiness*, *27*(1), 308. https://doi.org/10.1002/AGR.20271

Collett, K. A., Silva Ribeiro, C., Hayer, L., Müller, L. A., & Hirmer, S. (2022). *Green hydrogen for development - An alternative to natural gas*. https://climatecompatiblegrowth.com/green-hydrogen-for-development-an-alternative-to-natural-gas/

Corporate Europe Observatory. (2020, December 7). *The hydrogen hype: Gas industry fairy tale or climate horror story?* https://corporateeurope.org/en/hydrogen-hype

Corporate Europe Observatory, & Lobby Control. (n.d.-a). *lobbyfacts*. LobbyFacts. Retrieved May 13, 2023, from https://www.lobbyfacts.eu/

Corporate Europe Observatory, & Lobby Control. (n.d.-b). *YARA BELGIUM S.A.* Lobbyfacts. Retrieved May 13, 2023, from https://www.lobbyfacts.eu/datacard/yara--belgium-sa?rid=68208004617-79

de Tombeur, F., Sohy, V., Chenu, C., Colinet, G., & Cornelis, J.-T. (2018). in Environmental Science Soil Processes Effects of Permaculture Practices on Soil Physicochemical Properties and Organic Matter Distribution in Aggregates: A Case Study of the Bec-Hellouin Farm (France). *Frontiers in Environmental Science*, *6*. https://doi.org/10.3389/fenvs.2018.00116

Déplaude, & Marc-Olivier. (2014). Les infortunes de la vertu. Sociologie d'un répertoire d'action patronal. *Http://Journals.Openedition.Org/Sdt*, *56*(4), 411–434. https://doi.org/10.4000/SDT.1971

Drugmand, D., Feit, S., Fuhr, L., & Muffet, C. (2022). *Fossils, Fertilizers, and False Solutions How Laundering Fossil Fuels in Agrochemicals Puts the Climate and the Planet at Risk*.

Erbach, G., & Svensson, S. (2023). EU rules for renewable hydrogen Delegated regulations on a methodology for renewable fuels of non-biological origin. In *European parliament*.

Erisman, J. W., Sutton, M. A., Galloway, J., Klimont, Z., & Winiwarter, W. (2008). How a century of ammonia synthesis changed the world. *Nature Geoscience 2008 1:10*, *1*(10), 636–639. https://doi.org/10.1038/NGEO325

European Commission. (n.d.). *Key actions of the EU Hydrogen Strategy*. Retrieved May 27, 2023, from https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen/key-actions-eu-hydrogen-strategy_en

European Commission. (2020a). *A hydrogen strategy for a climate-neutral Europe*. https://www.eu2018.at/calendar-events/political-events/BMNT-

European Commission. (2020b). *Farm to Fork Strategy - For a fair, healthy and environmentally-friendly food system*.

European Commission. (2020c). *Farm to Fork Strategy*. European Commission.

European Commission. (2022a). *EU invests €1.8 billion in clean tech projects*. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4402

European Commission. (2022b). *European Hydrogen Forum*. https://ec.europa.eu/docsroom/documents/50574/attachments/1/translations/en/renditions/native

European Commission. (2022c). *Over €1 billion for the EU climate transition*. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_2163

European commission. (2022). *REPowerEU Plan*. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52022DC0230

European Commission. (2022d, July 15). *State Aid: Commission approves up to €5.4 billion of public support by fifteen Member States for an Important Project of Common European Interest in the hydrogen technology value chain*. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4544

European Commission. (2022e, September 21). *State Aid: Commission approves up to €5.2 billion of public support by thirteen Member States for the second Important Project of Common European Interest in the hydrogen value chain*. https://ec.europa.eu/commission/presscorner/detail/en/IP_22_5676

European Commission. (2023a). *Boosting hydrogen through a European hydrogen bank*. https://doi.org/10.2775/754166

European Commission. (2023b). *Innovation Fund projects*. https://climate.ec.europa.eu/eu-action/funding-climate-action/innovation-fund/innovation-fund-projects_en

European Commission. (2023c). *Third call for large-scale projects*. https://climate.ec.europa.eu/eu-action/funding-climate-action/innovation-fund/large-scale-calls_en#overview-of-the-second-call-for-large-scale-project-proposals

Fairclough, N. (2003). Analysing Discourse_ Textual Analysis for Social Research. In *Routledge* (Routledge, Issue February).

Fairclough, N. (2009). A dialectical-relational approach to critical discourse analysis in social research. In SAGE Publications Ltd (Ed.), *Methods of critical discourse analysis* (pp. 162–186). SAGE.

Fara. (2021). *Yara Pilbara Fertilisers-'Renewable' hydrogen project proposal*.

Fertilizers Europe. (2021a). *Green ammonia - the workhorse of the EU hydrogen economy*.

Fertilizers Europe. (2021b). *Fit for 55 Package: ETS & CBAM* . https://www.fertilizerseurope.com/fitfor55-ets-cbam/

Fertilizers Europe. (2023). *Fertilizers Europe calls on co-legislators to secure clean ammonia production in Europe*.

Filbert, A. (2022). Statkraft and Aker exit large-scale Norwegian ammonia project — EnergyWatch. *Energy Watch*. https://energywatch.com/EnergyNews/Renewables/article13874767.ece

Fletcher, R. (2017). Environmentality unbound: Multiple governmentalities in environmental politics. *Geoforum*, *85*, 311–315. https://doi.org/10.1016/J.GEOFORUM.2017.06.009

Food and Water Watch. (2020). *The Case Against Carbon Capture: False Claims and New Pollution*.

Food systems 4 people. (2021). *No to corporate food systems yes to food sovereignty*. https://www.foodsystems4people.org/

Food Systems Pavilion at COP27. (2022). *SCALE climate resilient agriculture* . https://www.youtube.com/watch?v=5Rzm_7hkcGA

Forsyth, T. (2004). Critical Political Ecology: The politics of environmental science. *Critical Political Ecology: The Politics of Environmental Science*, 1–320. https://doi.org/10.4324/9780203017562

Free the Soil. (2018). *Free the Soil*. https://freethesoil.org/

Glaister, B. J., & Mudd, G. M. (2010). The environmental costs of platinum–PGM mining and sustainability: Is the glass half-full or half-empty? *Minerals Engineering*, *23*(5), 438–450. https://doi.org/10.1016/J.MINENG.2009.12.007

Hammond, J., & Gadanakis, Y. (2022, March 11). *Ukraine: how the global fertiliser shortage is going to affect food*. The Conversation. https://theconversation.com/ukraine-how-the-global-fertiliser-shortage-is-going-to-affect-food-179061

Hoesung Lee, Katherine Calvin, Dipak Dasgupta, Gerhard Krinner, Aditi Mukherji, Peter Thorne, Christopher Trisos, José Romero, Paulina Aldunce, Ko Barrett, Gabriel Blanco, William W. L. Cheung, Sarah L. Connors, Fatima Denton, Aïda Diongue-Niang, David Dodman, Matthias Garschagen, & Oliver Geden. (2023). *Synthesis report of the IPCC sicth assessment report (AR6) - Summary for Policymakers*.

Howarth, R. W., & Jacobson, M. Z. (2021). How green is blue hydrogen? *Energy Science & Engineering*, *9*(10), 1676–1687. https://doi.org/10.1002/ESE3.956

Hydrogen Europe. (2022a). *Clean Hydrogen Monitor 2022*.

Hydrogen Europe. (2022b). *EU must match US H2 ambition*. https://hydrogeneurope.eu/eu-must-match-us-h2-ambition/

Hydrogen Europe. (2022c, September 22). *Important Projects of Common European Interest: Commission approves €5.2bn*. https://hydrogeneurope.eu/important-projects-of-common-european-interest-commission-approves-e5-2bn/

International Rivers. (2021). *Fortescue Metals Group's Plan to Develop Grand Inga Hydro Scheme Won't Deliver Green Energy for DRC* . https://www.internationalrivers.org/news/international-rivers-statement-on-fortescue-metals-groups-agreement-to-develop-grand-inga-hydro-scheme/

International rivers. (2022). *Seeing Green - Hydropower to "green" hydrogen the latest false climate solution*.

IRENA, & AEA. (2022). *Innovation Outlook: Renewable Ammonia*.

Jansen, K. (2017). Business Conflict and Risk Regulation: Understanding the Influence of the Pesticide Industry. *Global Environmental Politics*, *17*(4), 48–66. https://doi.org/10.1162/GLEP_A_00427

Kolleck, N. (2009). Business power for sustainable development: the role of discourses. *Revista de Gestão Social e Ambiental*, *3*(2). https://doi.org/10.5773/rgsa.v3i2.152

Kolleck, N. (2013). How Global Companies Wield Their Power: The Discursive Shaping of Sustainable Development. In *The Handbook of Global Companies* (pp. 134–152). John Wiley and Sons. https://doi.org/10.1002/9781118326152.ch8

Levy, D. L., & Egan, D. (2003). A Neo-Gramscian Approach to Corporate Political Strategy: Conflict and Accommodation in the Climate Change Negotiations*. *Journal of Management Studies*, *40*(4), 803–829. https://doi.org/10.1111/1467-6486.00361

Lu, W., Meikun, X., Hong, W., Kefeng, H., Chenxi, Q., Christos, T. M., & Geoffrey, A. O. (2018). Greening Ammonia toward the Solar Ammonia Refinery. *CellPress*, *2*(6), 1055–1074.

Megura, M., & Gunderson, R. (2022). Better poison is the cure? Critically examining fossil fuel companies, climate change framing, and corporate sustainability reports. *Energy Research & Social Science*, *85*, 102388. https://doi.org/10.1016/J.ERSS.2021.102388

Menegat, S., Ledo, A., & Tirado, R. (2022). Greenhouse gas emissions from global production and use of nitrogen synthetic fertilisers in agriculture. *Scientific Reports*, *12*(1). https://doi.org/10.1038/s41598-022-18773-w

Meyer, M. (2001). 2 Between theory, method, and politics: positioning of the approaches to CDA. *Methods of Critical Discourse Analysis*, 14–31. https://doi.org/10.4135/9780857028020.D4

Mies, M., & Shiva, V. (2014). The Need for a New Vision: the Subsistence Perspective. In *Ecofeminism* (Zed Books, pp. 297–324).

Mooldijk, S., Hans, F., Marquardt, M., Smit, S., Posada, E., Kachi, A., & Day Design, T. (2022). *Evaluating corporate target setting in the Netherlands Project number*. https://newclimate.org/sites/default/files/2022-07/

Naida, H. P. (2021, February 9). Yara creates Clean Ammonia unit - Offshore Energy. *Offshore Energy*. https://www.offshore-energy.biz/yara-establishes-clean-ammonia-unit/

Puig de la Bellacasa, M. (2015). Making time for soil: Technoscientific futurity and the pace of care. *Social Studies of Science*, *45*(5), 691–716. https://doi.org/10.1177/0306312715599851

Ritchie, H. (2020). Sector by sector: where do global greenhouse gas emissions come from? *Our World in Data*. https://ourworldindata.org/ghg-emissions-by-sector

Robbins, P. (2012). Introduction and Part I "What is political ecology?" *Political Ecology: A Critical Introduction*, 9–24.

Robertson, G. P., & Vitousek, P. M. (2009). Nitrogen in agriculture: Balancing the cost of an essential resource. *Annual Review of Environment and Resources*, *34*, 97–125. https://doi.org/10.1146/annurev.environ.032108.105046

Saadat, S., & Gersen, S. (2021). *Reclaiming Hydrogen for a Renewable Future: Distinguishing Oil & Gas Industry Spin from Zero-Emission Solutions*. Earthjustice. https://earthjustice.org/feature/green-hydrogen-renewable-zero-emission

Sapinski, J. P. (2015). Climate capitalism and the global corporate elite network. *Environmental Sociology*, *1*(4), 268–279. https://doi.org/10.1080/23251042.2015.1111490

Sapinski, J. P. (2016). Constructing climate capitalism: corporate power and the global climate policy-planning network. *Global Networks*, *16*(1), 89–111. https://doi.org/10.1111/GLOB.12099

Schlaug, M. (2022). *Clean Ammonia Blue hydrogen as first step to green*.

Sikor, T., & Lund, C. (2010). Access and property: A Question of Power and Authority. *The Politics of Possession: Property, Authority and Access to Natural Resources*, 1–22. https://doi.org/10.1002/9781444322903.CH1

Smart Delta Resources. (2022, September 27). *Regional hydrogen projects selected as project of European interest*.

https://www.smartdeltaresources.com/en/regional-hydrogen-projects-selected-project-european-interest

Stephens, J. C., & Markusson, N. (2018). Technological optimism in climate mitigation: The case of carbon capture and storage. *Oxford Handbook of Energy and Society*, 503–518. https://doi.org/10.1093/OXFORDHB/9780190633851.013.29

The European clean hydrogen alliance. (2021). *Reports of the alliance roundtables on barriers and mitigation measures*.

Tilsted, J. P., Mah, A., Nielsen, T. D., Finkill, G., & Bauer, F. (2022). Petrochemical transition narratives: Selling fossil fuel solutions in a decarbonizing world. *Energy Research & Social Science*, *94*, 102880. https://doi.org/10.1016/J.ERSS.2022.102880

Tilzey, M. (2017). Political ecology, food regimes, and food sovereignty: Crisis, resistance, and resilience. In *Political Ecology, Food Regimes, and Food Sovereignty: Crisis, Resistance, and Resilience*. Springer International Publishing. https://doi.org/10.1007/978-3-319-64556-8

Via Campesina. (2020). *Peasants in Zimbabwe revive stagnant farms through agroecology*. https://viacampesina.org/en/peasants-in-zimbabwe-revive-stagnant-farms-through-agroecology/

We Mean Business Coalition. (n.d.). *COP27: Business and Civil Society is All In for Delivery*. Retrieved May 14, 2023, from https://www.wemeanbusinesscoalition.org/cop27-all-in-for-one-point-five/

Wodak, R. (2001). What CDA is about – a summary of its history, important concepts and its developments. *Methods of Critical Discourse Analysis*, 1–13. https://doi.org/10.4135/9780857028020.N1

World Energy Council. (2019). *Innovation Insights Brief - New Hydrogen Economy - Hype or Hope?*

World Fertilizer. (2023). *World Fertilizer February 2023*. https://www.worldfertilizer.com/magazine/world-fertilizer/february-2023/

Xynteo, & BioAdvantage Europe. (2022). *The European bioeconomy and the Fit for 55 Package*.

Yara. (n.d.-a). *Fossil free green fertilizers with a low carbon footprint*. Retrieved December 17, 2022, from https://www.yara.com/sustainability/transforming-food-system/green-fertilizers/

Yara. (n.d.-b). *What are Yara green fertilizers and how are they produced?* Retrieved November 23, 2022, from https://www.yara.com/sustainability/transforming-food-system/green-fertilizers/what-you-need-to-know-about-green-fertilizers/

Yara. (n.d.-c). *Yara Clean Ammonia | Enabling the hydrogen economy* . Retrieved November 23, 2022, from https://www.yara.com/yara-clean-ammonia/

Yara. (2017). *Yara Annual Report 2017*.

Yara. (2018). *Yara sustainability GRI report 2017*.

Yara. (2019). *Yara Sustainability GRI Report 2018*.

Yara. (2020a). *Yara Sustainability GRI Report 2019*.

Yara. (2020b). *Yara to Align Emission Reduction Goals with Paris Agreement Targets*. https://www.yara.com/news-and-media/news/archive/2020/yara-to-align-emission-reduction-goals-with-paris-agreement-targets/

Yara. (2020c). *Ørsted and Yara seek to develop groundbreaking green ammonia project in the Netherlands*. https://www.yara.com/corporate-releases/orsted-and-yara-seek-to-develop-groundbreaking-green-ammonia-project-in-the-netherlands/

Yara. (2020d). *Yara at the forefront of clean ammonia in Australia* . https://www.yara.com/news-and-media/news/archive/news-2022/yara-at-the-forefront-of-clean-ammonia-in-australia/

Yara. (2021a). *Farm to Fork Strategy implementation Making every nutrient count*.

Yara. (2021b). *Yara Integrated Report 2021-Growing a Nature-Positive Food Future*.

Yara. (2021c). *Yara sustainability report 2020 - Leading with a sustainable purpose*.

Yara. (2021d). *Yara's roadmap for putting Europe's Farm to Fork Strategy into action Reducing nutrient losses, increasing yields and producing healthier crops*.

Yara. (2021e). *Air Liquide, Borealis, Esso, TotalEnergies and Yara collaborate to help decarbonize the industrial basin of Normandy in France*. https://www.yara.com/news-and-media/news/archive/2021/air-liquide-borealis-esso-totalenergies-and-yara-collaborate-to-help-decarbonize-the-industrial-basin-of-normandy-in-france/

Yara. (2021f). *Green ammonia from HEGRA to secure Norwegian competitiveness*. https://www.yara.com/corporate-releases/green-ammonia-from-hegra-to-secure-norwegian-competitiveness/

Yara. (2022a). *Yara and Linde Engineering agree to build a 24 MW green hydrogen demonstration plant in Norway. Both companies aim to achieve a significant carbon dioxide reduction in the production of fertilizers in Norway*. https://www.yara.com/corporate-releases/yara-and-linde-engineering-agree-to-build-a-24-mw-green-hydrogen-demonstration-plant-in-norway.-both-companies-aim-to-achieve-a-significant-carbon-dioxide-reduction-in-the-production-of-fertilizers-in-norway/

Yara. (2022b). *Yara Sustainability Report 2021-Growing a Nature-Positive Food Future*.

Yara. (2022c). *Yara's position on Fit for 55-Supporting Europe's low-carbon solutions*.

Yara. (2022d). *CBAM: Competitively decarbonizing Europe*. https://www.youtube.com/watch?v=y25dsb740I0

Yara. (2022e). *Major milestone for decarbonizing Europe*. https://www.yara.com/news-and-media/news/archive/news-2022/major-milestone-for-decarbonising-europe/

Yara. (2022f). *Turning potato chips climate friendly in Argentina*. https://www.yara.com/corporate-releases/turning-potato-chips-climate-friendly-in-argentina/

Yara. (2022g). *Yara Clean Ammonia and Pilbara Ports Authority team up to assess ammonia as a shipping fuel* . https://www.yara.com/news-and-media/news/archive/news-2022/yara-clean-ammonia-and-pilbara-ports-authority-team-up-to-assess-ammonia-as-a-shipping-fuel/

Yara. (2022h). *Yara is working with the food chain to bring green fertilizers to market*. https://www.youtube.com/watch?v=T30X2lv-4lU

Yara. (2023a). *Yara integrated report 2022 - On course to a nature-positive food future*.

Yara. (2023b). *Yara Sustainability Report 2022 - On course to a nature-positive food future*.

Yara. (2023c). *Yara and Enbridge to develop and construct a low-carbon blue ammonia project at Enbridge Ingleside Energy Center*. https://www.yara.com/corporate-releases/yara-and-enbridge-to-develop-and-construct-a-low-carbon-blue-ammonia-project-at-enbridge-ingleside-energy-center/

Yara. (2023d). *Yara is speeding up the hydrogen economy in Germany*. https://www.yara.com/news-and-media/news/archive/2023/yara-is-speeding-up-the-hydrogen-economy-in-germany/

Yara, Aker Clean Hydrogen, & Statkraft. (2021). *Hegra - Herøya Grønn Ammøniakk*.

Yara, & Engie. (2020). *ENGIE-YARA Renewable Hydrogen and Ammonia Deployment in Pilbara YURI Phase 0: Feasibility Study Knowledge Sharing Report*.

Yara France. (2023a). *Décarbonation, contribution, sécurité et dialogue Solution'ÈRE Des solutions pour développer et décarboner*.

Yara France. (2023b). *Une « usine » d'engrais au coeur du Salon International de l'Agriculture*.

Yara, & Lantmännen. (2022). *Yara and Lantmännen sign first commercial agreement for fossil free fertilizers*. https://www.yara.com/corporate-releases/yara-and-lantmannen-sign-first-commercial-agreement-for-fossil-free-fertilizers/

Yara Netherlands. (2022a). *Climate Roadmap 2030*.

Yara Netherlands. (2022b). *Yara Climate Roadmap 2030 Sluiskil*.

YCA. (2022a). *Capital Markets Day*.

YCA. (2022b). *Enabling the hydrogen economy*.

YCA. (2022c). *Lloyd's Register to investigate Pilbara potential for ammonia as a clean shipping fuel*. https://www.yara.com/news-and-media/news/archive/news-2022/lloyds-register-to-investigate-pilbara-potential-for-ammonia-as-a-clean-shipping-fuel/

YCA. (2022d). *Yara Clean Ammonia CMD (full length)*.

YCA, & JERA. (2023). *Yara Clean Ammonia and JERA announce a MOU for joint project development and sales & purchase of clean ammonia*. https://www.yara.com/news-and-media/news/archive/2023/yara-clean-ammonia-and-jera-announce-a-mou-for-joint-project-development-and-sales-purchase-of-clean-ammonia/