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Petrochemical transition narratives: Selling fossil fuel solutions in a decarbonizing world

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ABSTRACT

Being integral to the fossil-based energy order and as a key driver of multiple and intersecting ecological crises, the petrochemical industry faces increasing pressures to transform. This paper examines how major petrochemical companies navigate these pressures. Drawing from literatures on discursive power, narratives, and neoGramscian political economy, we introduce the concept of narrative realignment as a nuanced iteration of corporate discursive power that reframes problems of and solutions to green transitions. Specifically, we identify and explore common transition-related narratives, analysing climate and sustainability communications from the largest producers in the petrochemical sector. We argue that these strategic narratives portray the petrochemical industry as key to a successful transition and fend off criticisms by reducing them to misunderstandings. This framing works to reduce pressures for deep mitigation while repositioning the industry as part of the solution. Building on these findings, we demonstrate how petrochemical transition narratives relate to but also diverge from the position of fossil fuel extractors. Despite relying on fossil feedstock and being solidly placed in the fossil economy, petrochemical majors increasingly focus on repositioning themselves proactively as transition enablers. The argument illustrates the work of downstream actors to legitimize the existing energy order.

1. Introduction

In view of climate emergency and global efforts to accelerate a transition to cleaner energy, fossil fuel-dependent industries face increasing pressure to transform. Energy and emission intensive sectors, which have historically been protected from climate policy, need to decarbonize [1]. In this context, incumbent firms seek to shape opportunity structures through active participation in public discourse [2–4]. This includes strategies of accommodation and resistance aimed at absorbing pressures and preventing disruption of institutionalized socio-technical configurations that benefit existing business models and vested interests. For example, it is by now well established that the oil and gas majors have spread misinformation and systematically used public relation activities to delay a transition away from fossil fuels [5–9]. Moreover, recent analyses document that, despite lofty pledges, fossil-based energy companies are not pursuing transformative change.

Rather, their strategies remain limited to hedging against or resisting a green energy transition [10,11]. Yet while much of the academic literature on fossil fuel incumbents focuses on their shared corporate interests and strategies, relatively little attention has been paid to distinctions between different industry sectors. The critical political economy scholarship, exploring the role of corporate actors in the orchestration and (re)structuring of the global energy order (e.g., [12–15]), has mainly focused on fossil fuel incumbents. Given the structural importance of the energy intensive processing industries in the fossil energy order, however, the political economy of decarbonization in these sectors is an important area for research. This paper examines how petrochemical incumbents navigate and shape the transition through proactive forms of discursive power, which threaten to undermine global climate action in subtle yet significant ways.

The petrochemical industry is the largest industrial energy consumer [16,17] but has long been “a key blindspot” [16] in climate and energy

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policy debates. Relying on fossil fuels as sources of both feedstock and energy, the petrochemical industry produces a wide variety of products that permeate modern society [18]. Global production of chemicals and the associated use of fossil energy¹ have grown rapidly over the past century [16,19] despite environmental concerns. The decade 2010–2019 alone saw global chemical sales increase by approximately 7.5 % per year [20]. A key driver is the seemingly never-ending use of plastics, which alongside fertilizers constitute the most important product categories [18]. Plastics are used for a wide-range of purposes – as packaging for all types of goods, fibres for textiles, as structural components in cars and vehicles, and for pipes and cables in buildings and infrastructure [21]. Not surprisingly, GHG emissions from plastic production have sky-rocketed, not least because expansion has primarily occurred in coal-dependent regions such as China [22,23].

Since its emergence in the early-to-mid twentieth century, the petrochemical industry has been closely connected to the fossil fuel energy regime.² Initially primarily reliant on coal, petrochemical production shifted towards petroleum in the post-war era while recent decades have seen another shift towards natural gas and natural gas liquids [26]. The dependence on fossil fuels for chemical production is not set to change any time soon. Banking on predictions that the “future of oil is in chemicals” [27], leading firms in the industry have invested massively in new fossil-based production in recent years [28]. Projections indicate that global production capacity is expected to increase by 40 % from 2020 to 2030, primarily in the Middle East, United States and Asia [29]. Once operational, these facilities can continue operations for decades – well beyond 2050 – with limited opportunities for retrofits and modifications. Accordingly, chemicals have been identified as the single most important segment for new oil demand this decade [16,30,31], demonstrating the undeniable importance of petrochemicals in climate change and energy debates.

At the same time that the sector is continuously expanding production, it is increasingly being called into question. Due to its role in the climate, toxic pollution, and plastic crises, policymakers, civil society, and academics have made calls for more stringent regulation and caps to production [32–34]. Accordingly, the petrochemical industry is subject to multiple environmental pressures and conflicts [35,36]. Corporate actors' historical response to ecological concerns has been to accommodate emerging pressures without disrupting the industry [37]. Innovation efforts have concentrated on efficiency improvements and process intensification [38], and economic motivations have dominated conflicting commitments towards lower-carbon, technology-led reorientation [39]. Moreover, many major industry players (especially the vertically integrated oil, gas, and chemical corporations) have adopted deceptive tactics of climate-change denial, while maintaining a corporate sustainability discourse that plastics and petrochemicals play an important role in green technological solutions [40,41]. In relation to toxicity and plastics, the industry has a track record of “deceit and denial” [42] of toxic risks, deflecting and co-opting criticisms and objections [35,37,41].

Recent theoretical contributions to the political economy of transitions demonstrate the relevance of neo-Gramscian perspectives and the concept of “trasformismo” in theorizing how corporate incumbents (re) produce favourable social and economic structures [43–45]. Building on this theorization in relation to the rather contradictory situation of petrochemical incumbents, we introduce the concept of narrative

¹ According to the International Energy Agency, chemicals derived from oil and gas account for around 90 % of feedstock demand in chemical production today [16].

² This “special relationship” [24] is not only material (through the integrated nature of petroleum refining and petrochemicals production) but also organizational (through vertically integrated companies) and institutional (through the shared knowledge base of chemical engineering that underlies oil refining, gas processing, and petrochemical production) [19,25].

realignment. Narrative realignment describes the strategic use of specific storylines that work to affiliate current activities and plans with calls for change through reframing problems and solutions. In this way, we focus on the employment of discursive power to not only accommodate transition pressures and resist change, but also to position industry proactively as a vital “provider” of solutions [46]. We do so mainly by analysing dominant strategic transition-related narratives employed by petrochemical incumbents, examining the puzzle of how the petrochemical sector seeks to retain its status through an energy transition despite being a fossil-based industry. These narratives are important because they reveal forms of discursive power that have material consequences in shaping industrial decarbonization pathways. By examining sustainability reports from the ten largest transnational firms in the sector triangulated with other data, we identify three strategic narratives namely *realizers of sustainability*, *breakthrough technology pioneers* and *already well underway* and explore their implications.

Engaging with a neo-Gramscian perspective, we argue that incumbent firms in the petrochemical industry advance the three identified narratives to accommodate disruptive pressures and position themselves as transition enablers that are key to successfully achieving decarbonization and circularity. By forwarding the notion that petrochemical production – competently guided by industry – (will) help achieve sustainability both now and in the future alongside the idea that modern life is owed to the wonders of chemicals, industry actors frame themselves as the essential foundation for any desirable future. In the words of the American Fuel and Petrochemical Manufacturers, petrochemicals are “the building blocks that make modern life possible” [47]. By taking this approach, petrochemical incumbents differ from their upstream fossil fuel counterparts, as fossil fuel extraction is surrendered to eventually decrease on a global scale through an energy transition. In making this argument, the paper contributes to an emerging literature on the political economy of petrochemicals and decarbonization in the energy-intensive industries [26,28,35,36]. The paper also contributes to the use of narrative analysis and the role of discursive strategies in shaping decarbonization in the petrochemical industry. More broadly, the notion of narrative realignment helps shed light on subtle, diverse, and evolving corporate tactics of *trasformismo* by describing how pressures for change are reframed as to align with existing developments.

The paper proceeds as follows. First, we elaborate on the concept of *trasformismo*, expanding on the role and use of discourses and narratives and introducing the concept of narrative realignment. We then describe the methods, materials, and analytical approach. Third, we analyse key recurring storylines that petrochemical majors invoke, mapping strategic narratives around transition pressures and the discursive strategy they constitute. We end with a discussion relating to non-discursive aspects of *trasformismo* and the position of fossil fuel majors.

2. Shaping transition pathways

2.1. *Trasformismo* and stability through change

To analyse the political economy of transitions, recent contributions have highlighted the relevance of neo-Gramscian analysis and, in particular, the notion of “*trasformismo*” [43–45]. Defining it as a capacity, Newell [44] refers to *trasformismo* as

the ability to accommodate pressures for more radical and disruptive change and to employ combinations of material, institutional and discursive power to ensure that shifts which do occur in socio-technical configurations do not disrupt prevailing social relations and distributions of political power.

This definition highlights the tension between different orders of change, i.e., incremental vis-à-vis transformative change, as associated with disparate ecopolitical projects [48]. In a more recent definition, Ford and Newell [43] define *trasformismo* as a process “by which

potentially counter-hegemonic ideas and activities are neutralised by being brought within hegemonic frameworks.” *Trasformismo* is thus not about impeding change as such but rather that change, through a process of co-optation, takes forms that align with the interests of dominant incumbents [44,49]. It thus differs from resistance by focusing on adaptation and absorption rather than on inhibition [43,50]. This is not to say that incumbents do not seek to inhibit change but rather to point out that strategies for maintaining incumbency differ. When dominant actors are under pressure, *trasformismo* is arguably particularly relevant [50].

Trasformismo is akin to another Gramscian concept, namely the notion of passive revolution. The difference is that, while *trasformismo* is about aligning counter-hegemonic ideas and activities with the hegemonic framework (thereby neutralising them), passive revolution refers to adopting reformist change to withstand opposing pressures [51]. Passive revolution thus entails incremental change but not necessarily co-optation and is in this sense a broader concept. Accordingly, *trasformismo* has been understood as a strategy of passive revolution [43,49]. In this paper, we follow this line of thinking and understand *trasformismo* to involve accommodating ideas of change through adopting for instance new discursive strategies (while such actions are not required for passive revolution). Still, we see both as forms of accommodation [12] – a process of ensuring stability through change – which arguably brings the two concepts very close to each other [43].

From a Gramscian perspective, strategies of accommodation take place within “wars of position” [52] where both hegemonic and counter-hegemonic actors and movements seek to gain influence. This process of social contestation is “endlessly unfolding” [53] and while hegemony³ might appear stable it is hardly absolute. Like dominant groups, counter-hegemonic movements can build coalitions, win support, gain influence and challenge the “social licence to operate” of incumbent firms [43,54]. In response, incumbents can seek to accommodate criticisms through strategies of *trasformismo* and/or passive revolution, which thus take form in opposition to counter-movements. For example, petrochemical companies adopted circular economy strategies to respond to the marine plastic crisis when their position on plastics was challenged [35]. The historical moment thus bears great importance for the potential for change [44,55].

That emerging ideas can be adopted to the advantage of business interest resonates with the concept of green capital accumulation, which describes how lead firms utilize the sustainability agenda to enhance profitability [56]. This phenomenon goes beyond managing brand reputation, improving information, and externalising risk by recognising sustainability management as a key capitalist dynamic. Green capital accumulation relates to *trasformismo* in that it is enabled through “specific operationalisations” of sustainability [56]. Similarly, Mah [35] describes the acceleration into new plastics markets under the guise of circular economy discourse as “proliferation”. Common to both the ideas of green capital accumulation and proliferation is that corporate incumbents do not only accommodate potential change pressures – they also seek to utilize them to their benefit to strengthen their (dominant) position. But how do corporate actors engage in such processes?

Trasformismo points to the wide-ranging and multiple sources of influence that incumbents can draw upon, including material, institutional, and discursive forms of power. Material power stems from economic importance and the role of a given (set of) actor(s) in securing economic growth by means of command over finance and production [43]. State dependence on growth for, e.g., legitimacy, employment, and revenue creates reliance upon the actors that structure that process, granting them material power [14]. An industry that is structurally

³ Hegemony is here understood as “the persistence of social and economic structures that systematically advantage certain groups” [12] including for example privileged access, tax breaks, subsidies and legal frameworks that benefit incumbent actors [43].

important in enabling capital accumulation, as in the case of energy, can thus claim to represent interests beyond that sector, i.e., those of “capital-in-general”, and is thereby advantageously positioned [14,43]. For example, concerns about international competitiveness and carbon leakage have led to persistent watering down of the stringency of production-based climate policies [57]. Institutional power, in turn, builds on material power and relates to the role of business in formal and informal political processes. Institutional power is exercised through both taking official part in decision-making as well as through lobbying and network relations [43]. Finally, discursive power captures how incumbents seek to build consent around “hegemonic projects” through shaping public and political discourse [43]. This form of power is exercised through a variety of public relation activities including direct (e.g., advertising, social media) and indirect forms of engagement (e.g., through media and civil society organizations). Seeking to elaborate on discursive power, the following draws on a range of literature extending well beyond explicitly neo-Gramscian contributions.

2.2. Discursive strategies and narrative realignment

In efforts to invoke discursive power, corporate incumbents decide on certain discursive strategies. Discursive strategies can be built around multiple arguments that relate to different discourses that fit well together [5]. Depending on what incumbents perceive as threats, such strategies are subject to change over time [4,43] while not necessarily neatly orchestrated among actors; they also arise out of “pragmatic, incidental alliances that shape up around specific story-lines” [58]. Coalitions (including non-business actors) can be built around agreed upon storylines as with the British pro-gas coalition analysed by Lowes et al. [59]. In this paper, we distinguish between the overall discursive strategy of corporate incumbents and specific strategic narratives invoked by industry actors. We draw upon Hajer’s [60] definition of discourses as an “ensemble of ideas, concepts, notions and categorizations that are produced, and transformed in a particular set of practices and through which meaning is given to physical and social realities”. In relation to discourses, narratives act both as “building blocks” out of which larger discourses are constructed and as “indicators” used to identify them. Narratives connect actors, through their statements, to broader discourses, while also providing a site that reveals their elementary components [61]. We here understand narratives as a particular account of a given predicament (for example the carbon-intensity of petrochemicals) pre-empting a certain solution to this problem framing [62].

Discourse can play a critical role in facilitating and breaking path dependency and lock-in [65]. In that regard, Buschmann and Oels highlight discursive carbon lock-in, defining it as “institutionalized mechanisms of discursive reproduction includ[ing] mechanisms of reproduction related to a mental map (or discourse) based on increasing returns” [65]. In other words, a discursive lock in happens when a discourse is institutionalized and becomes self-reinforcing. Breaking discursive lock-in therefore requires disrupting the processes that reproduce the dominant discourse. By constraining choice options, the struggle for discursive hegemony is a critical aspect of industry transformation. For instance, in mapping the “possibility space” and functioning as a narrative for focusing capital, hegemonic visions help decide future trajectories [66]. Emphasising discourse, however, does not preclude other dimensions of change. Reminiscent of how *trasformismo* stresses material and institutional power as well as discursive power, discursive lock-in underlines and reinforces other forms of lock-in (technological, institutional, and behavioural) [65].

Historically, the domains of climate and energy policy have been influenced by discourses of climate denial. Both think tanks [67] and specific key scientists [68] have worked to establish contrarian discourse and have successfully influenced the confidence of the scientific community in relation to climate change [69]. However, discursive strategies go beyond the efforts to spread and sustain denial of humanly

induced climate change. In this vein, Lamb et al. [70] created a typology of "discourses of climate delay" and grouped various discourses into four categories namely "push non-transformative solutions", "emphasise the downsides", "surrender" and "redirect responsibility". Discourses of delay are more difficult to "call out" in that they build on legitimate concerns and as such have compelling elements to them. However, when they misrepresent, redirect responsibility and downplay the need for action, they function as mechanisms of delay [70].

To bring together the above lines of argument and advance existing analysis, we introduce the idea of narrative realignment, which refers to discursively bringing practises and activities of incumbents (back) into line with transition pressures and calls for system-level change. This entails advancing specific narratives in which problem-framings necessitate solutions enabled by incumbents, typically in reference to progressive forms of change. The notion of narrative realignment captures how narratives are set up in a way that "twist" or reorient identified problems so that the solution entails dependency upon incumbents. Thus, industry action is part of and often integral to the solution. For example, insofar as actors and industries are criticised for lack of action, corporate actors help outsiders "understand" how incumbents are in fact addressing grand sustainability challenges. To the extent that industries are critiqued for unsustainable production, the use and essentialness of their products and output to sustainability are emphasised. Narrative realignment operates in this sense as a strategy of *trasformismo* but on a discursive scale. It is not an instance of co-optation of grander counter-hegemonic narratives. Instead, it aligns current practises, operations, and plans with potentially disruptive discourses that – at least in their formation – emerged as disruptive to business as usual (such as decarbonization, energy transition and circular economy). Narrative realignment thus resonates with discourses of climate delay in that it facilitates misrepresentation, redirects responsibility, and downplay calls for action, relying on "particular interpretations" of sustainability [56]. To the extent that specific "twists" are employed and shared across the industry, they can facilitate discursive lock-in, as actors mirror discursive practises seeking to align their existing operations with calls for change and ease regulatory, investor and civil society pressures.

The relevance and novelty of the concept of narrative realignment lies in nuancing and expanding our understanding of how discursive power is employed under *trasformismo*. The phrase helps unpack the function of and dynamics behind certain narratives and the way they are constructed and employed in response to change pressures which is particularly relevant in relation to transitions. Placed within a neo-Gramscian conceptualisation of wider processes of change and dimensions of power, we see this theoretical contribution as a way of nuancing theory to respond to the complexities of social and economic phenomena. These ideas follows Stuart Hall's interpretation of Gramscian theory as an evolving practice that is responsive to context, in which the "process of theorising" is "the sign of a living body of thought, capable still of engaging and grasping something of the truth about new historical realities" [71]. Homing in on (but not being limited to) the discursive scale, the concept of narrative realignment should thus be understood in relation to other neo-Gramscian concepts, although in principle it could be linked to other frameworks as well. For example, while we focus on the purpose and implications on industry narratives, institutionalist approaches could help conceptualise how and why these narratives might spread [72].

We start from the understanding that discursive struggles play an important role in shaping transition pathways. To accommodate pressures for change, incumbents can employ discursive power, relying on strategies that align with tactics of *trasformismo*. In practise, accommodation happens through a variety of activities including pushing certain storylines and narratives that bring potentially counter-hegemonic ideas and activities in line with the practises of incumbents. If successful, such dynamics can lead to or maintain discursive carbon lock-in, underpinning other forms of lock-in and maintaining prevailing distributions of power. One way to bring engage

in *trasformismo* is through narrative realignment, which help reframe calls for change, associating them with current and future activities and practises of incumbents. Discursive power is employed happens in a war of position in which both subordinate and dominant groups take part. Social contestation is here constantly unfolding, involving multiple sources of power, and the strategies of incumbents should be understood in relation to counter-hegemonic resistance. We focus here on the exercise of discursive power and explore how it plays into material and institutional dimensions of power in the petrochemical industry.

3. Methods and materials

3.1. Data material

To study narrative realignment in the petrochemical industry, we analyse publicly available statements and arguments on sustainability published by petrochemical majors. Specifically, our empirical analysis focuses on the ten largest firms in the sector as measured by reported chemical sales (Table 1). The industry is and has been dominated by a rather small number of large multi-national firms [73] which hold important positions in and carry the potential to influence the global petrochemical regime [74,75]. Limiting our focus to the largest producers is relevant given our theoretical framework and its attention to dominant actors, which we take these firms to be among. In that regard, the firms we analyse capture the variety and changing dynamics in the sector. Until the turn of the millennium, the dominating firms were primarily enterprises that emerged either in the early days of the industry in Europe (e.g., BASF, Linde), or with the advent of the petroleum-based era in the US (e.g., ExxonMobil, Dow, LyondellBasell). In recent decades, global competition in the industry has increased with the rapid growth of especially state-owned and state supported firms from Asia (e.g., Sinopec, Formosa, Mitsubishi) and the Middle East (e.g., Sabic) [26]. Several of these firms are vertically integrated across petroleum extraction/refining (downstream) and petrochemicals (e.g., ExxonMobile, INEOS, Sabic), while other are more chemicals-focused companies (BASF, Linde, Formosa). Certainly, the sales growth and yearly investments of the top ten are substantial (Table 1), and not surprisingly, the firms we analyse are responsible for immense volumes of GHG emissions (even given that inconsistencies and incompleteness of emission disclosure are prominent in the industry, especially for indirect scope 3 emissions⁴ [23]). For example, if the nine companies that have a net zero pledge (Table 1) genuinely realised that goal across scopes for their reported emissions, it would approximately be equivalent of abating the current annual emissions from all international transport [78].

Through web search we found the most recently available sustainability reports (as of September–October 2021) from the companies above, which we complemented with data from the companies' websites. This totalled 11 reports (two from Formosa⁵ and one for each other company) and 10 website sections on sustainability (each with a varying number of subsections). For triangulation, we also made use of corporate responses to CDP (formerly the Carbon Disclosure Project), the leading global platform on voluntary corporate environmental disclosures whose questionnaire includes several open questions that allows for longer comments. Observations and field notes were also made at four industry conferences in the period 2019–2021.

The relevance of sustainability reports as core documents used to

⁴ Scope 1 refers to direct emissions from sources that are owned or controlled, scope 2 to GHG emissions associated with purchased electricity, and scope 3 refers to indirect emissions outside of scope 2 [76]. In the case of petrochemicals, scope 3 includes emissions from e.g. oil and gas extraction or incineration of plastic, which are associated with substantial climate impact [77].

⁵ One from Formosa Petrochemical Corporation and one from Formosa Plastics Corporation.

Table 1
Overview of petrochemical producers analyzed for this paper ranked by chemical sales.

Company	HQ	2019 sales (m USD)	Avg. sales growth 2010–2019	2019 emissions disclosed through CDP (Mt CO ₂ eq)			Net zero target
				Scope 1	Scope 2	Scope 3	
BASF	Germany (private)	66.4	4.8 %	17.3	3.6	99.7	2050
Sinopec	China (state)	61.6	9.1 %	170.1	45	NA	2050
Dow	USA (private)	43.0	0.7 %	27.5	5.1	91.4	2050
Sabic	Saudi Arabia (state)	34.4	5.8 %	37.4	17.5	107.6	2050
INEOS	UK (private)	32.0	6.1 %	NA	NA	NA	2050
Formosa	Taiwan (private)	31.4	2.3 %	36.4	8.4	136.7	No net zero target identified
ExxonMobil	USA (private)	27.4	1.5 %	NA	NA	NA	2050
Mitsubishi Chemical	Japan (private)	27.4	8.2 %	8.5	8.2	51.8	2050
LyondellBasell Industries	USA (private)	27.1	4.4 %	14.6	8.6	31.3	2050
Linde	UK (private)	25.4	13.0 %	16.5	19.9	13.7	2050

Sources: Chemical & Engineering News [79], CDP disclosure data and company sustainability reports. Note: Net zero targets differ widely in scope and how “carbon neutrality” is accounted for (see also Section 4.1), NA – not available through CDP due to lack of disclosure. The GHG emission figures for Formosa count responses to CDP questionnaires from Formosa Chemicals & Fibre Corporation, Formosa Petrochemical, Formosa Plastics Corp, and Formosa Taffeta Co.

identify narratives is that these reports are linked to companies' strategies for stakeholder engagement [80]. Because sustainability reports are central tools of maintaining legitimacy and are used strategically as part of positive image creation [81], they are suitable for our purposes. In the words of Megura and Gunderson [82], these reports constitute a “window into [the] ideal green self-image” of corporations. The relevance of sustainability reporting relates to its historical emergence as a response from corporate actors that have increasingly come under pressure to put environmental concerns more firmly on the agenda [81]. Moreover, sustainability reports are directed towards stakeholders like investors whose decisions can have direct financial consequences for companies [82]. These reports convey a comprehensive and detailed one-way form of communication under the control of a given firm as compared to shorter statements on interactive social media where claims of sustainability can be questioned and potentially backfire [83].

3.2. Analytical approach

To identify and construct the narratives we used both an inductive and iterative approach. First, guided by the notion of narratives described in Section 2.2, we coded the data according to key problem definitions and solutions on decarbonization that are used by the industry. From this coding, we could identify recurring arguments, concepts, and rhetorical commonalities. We used these elements to construct idealised narratives and then revisited the empirical material to see whether these narratives were representative of the main arguments and central statements. If key arguments were not represented in the narratives, we modified them to better represent the main statements and logics. We consolidated the number of narratives to a few that were used (though to differing extents) by most companies. This process was repeated until three ideal type narratives emerged that were mutually exclusive and collectively exhausted our body of data. We then drew on participant observations and field notes from industry conferences and CDP disclosures to triangulate and qualify this material and confirm the relevance of the identified narratives. To guide the analysis, we focused on the key issue of climate change. Because of the range and geography of other socio-ecological concerns related to the industry,⁶ we made this choice in order to be able to compare narratives more directly across companies as well as juxtapose the findings with the rhetoric employed by fossil fuel incumbents. Still, in light of the interdependence and entanglement of the different issues, we considered all of the material including sections not focused on climate change. The

⁶ Including local air and water pollution, occupational health and safety, diffusion of Polyfluoroalkyl Substances, plastic pollution, nutrient (mis)management, and so forth.

findings therefore point to domains other than GHG emissions to the extent that similarities in rhetoric were evident.

4. Transition-related narratives in the petrochemical industry

4.1. Realizers of sustainability

The “realizers of sustainability” narrative highlights what are seen as inherently positive aspects of petrochemicals and downstream products. Prominently, the narrative challenges the negative framing of plastics as problematic, instead stressing the supposed benefits. In this framing, the problem is lack of acknowledgement of the merits of petrochemicals for green purposes. To the proponents of this narrative, the focus on negative issues (plastic pollution, emissions from production, reliance on fossil feedstock, etc.) disregard benefits such as reduced food waste, reduced vehicle weight, or that plastic production is less carbon intensive than substitutes, e.g., metal or glass for packaging [84]. The solution is thus to recognise the advantages of petrochemicals particularly in achieving emission reductions. Arguments aligning with this narrative are typically made by selectively pointing further down the value chain, asserting for instance that petrochemicals enable emission reductions in other industries. Proponents often account for “avoided emissions” that arise from product applications (such as improvements in energy efficiency). Dow, for example, includes “product benefits” in their 2050 target of being “carbon neutral” [85]. In a broader perspective, proponents frequently also reference the use of petrochemicals for other purposes that purportedly relate to sustainability such as fertilizer (food security), wind turbine blades (renewable energy) and pharmaceuticals (health).

Illustrative examples:

- “In 2020, a subset of Linde applications enabled more than twice the GHG benefit than was emitted in all [of Linde's] global operations.” [86]
- “We offer our customers solutions that help prevent greenhouse gas emissions and improve energy and resource efficiency.” [87]
- “While ExxonMobil agrees there is no place for plastic waste in the environment, the environmental benefits of plastic are clear.” [88]

To reinforce this narrative, proponents often reference life cycle assessment studies that promote the embedded emissions benefits of plastics compared to alternatives [84,89]. For example, a report sponsored by the American Chemistry Council [90] finds that emissions related to plastic packaging could increase significantly if all plastic packaging in the US was replaced by alternative materials. Claiming benefits by referencing a benchmark with higher emissions is a relative rather than absolute assessment, meaning that the chosen benchmark

matters a great deal to this line of reasoning (for example, one could imagine “reduced use” reference scenario). Moreover, this argument does not say anything about whether the unit of analysis performs “well enough” given ecological limits [91], a tendency that is mirrored in corporate sustainability reporting more generally [92]. Quantifying “avoided emissions” requires consistency, or else it results in incoherence [93]. For example, in the quote above, Linde makes it accounting in reference to a hypothetical scenario in which customers do not apply Linde products, seemingly assuming that no relevant substitutes exist. In attributing these reductions to Linde, double counting occurs when their customers report lower direct emissions. Use of “creative accounting” is not unique but rather a widespread tendency in the industry, especially in relation to life cycle assessment [41].

Looking beyond method-oriented critiques, the narrative arguably ignores how accounting is constructed and its political and normative elements [94–98]. The “realizers of sustainability” narrative presents criticisms of the industry as an information-type problem (which corporate actors try to alleviate). Relating to discourses of climate delay, the practise of flagging ostensibly “objective” assessments of avoided emissions as way to alleviate pressure resonates with “whataboutism” [70]. Whataboutism also redirects responsibility, often by deploying and cherry-picking seemingly favourable statistics. While whataboutism typically reorients the focus to blame others, however, petrochemical producers also selectively redirect focus towards themselves in claiming sustainability achievements.

4.2. Breakthrough technology pioneers

According to the strategic narrative “breakthrough technology pioneers”, future low-carbon technologies pave the road towards decarbonization; technologies that the petrochemical sector will play an essential role in developing and deploying. The role of industry in ensuring these developments is framed so as to naturally follow from its track record of innovation and technological breakthroughs. In essence, the problem in this narrative is greenhouse gas emissions and plastic waste arising from petrochemical production. While acknowledging sustainability issues, the industry at the same time avoids taking responsibility, passing the blame to consumers for littering and low rates of recycling and highlighting the value of plastics as sustainable materials [41]. The solution lies in changing production processes through innovation by increasing efficiency and pioneering break-through technologies. Rather than being facilitators of carbon lock-in, the petrochemical sector is thought of as playing pivotal role in developing and scaling up what are presented as key technologies. These key technologies include carbon capture (utilization) and storage (CCS/CCUS), hydrogen (both feedstock and power generation) and electrifying the steam cracking process [99]. In addition, several companies promote chemical recycling (also known as advanced recycling, which involves breaking plastics down into their component molecules) as a means to increase circularity and, by extension, emissions reductions, although the ecological desirability of these approaches remain contested [35,100–102]. Many environmental activists, for example, argue that chemical recycling is simply another word for “incineration” [103,104]. Similar for these various means of decarbonization and increasing circularity is that, although their development may take time once they reach maturity (the narrative suggests), they will result in massive emissions reductions. Thus, the existing petrochemical infrastructure, and the expansions of (and further investments in) high-carbon complexes that continue production of virgin plastic are cast as non-problematic. Similarly, the narratives sustain the notion that existing demand patterns are locked-in and that transformative lifestyle changes are not needed. In other words, production volumes of petrochemicals and plastics should not be problematized, we just need to produce plastics with “green” technologies.

Illustrative examples:

- “(...) we are pioneering nearly carbon-free production processes, especially for emission-intensive basic chemicals”. [105]
- “Dow delivers breakthrough sustainable chemistry innovations that advance the well-being of humanity.” [106]
- “Leveraging our expertise in research and development and molecule management, we are developing options for integrating advanced recycling solutions at our petrochemical facilities.” [88]

This narrative is also found in other heavy industries that rely on development and deployment of “key technologies” to decarbonize [107] and, more generally, it aligns with the discourse of “technological optimism” [70]. Although such thinking can be found in several variations, the underlying focus is a steadfast belief in technological progress frequently backed by unsupported claims that lead to other forms of delay (e.g., regulation as damaging or breakthroughs as certain). Especially relevant for the case at hand is the continuous and repeated promotion of technological “myths” that are not manifested within the assured timeframe [108]. Among the sampled companies, most have indicated an interest in low-carbon technologies, but there have not been significant leaps towards realisation. Financing and deployment are still niche, and in several cases, have been so for several decades already [23,109]. Consequently, these technologies may well represent an essential part of the paths to decarbonization, but without significant investment, commitment, and technological development they run the risk of not materialising this potential. Seeing the timeline for uptake of new production processes and limited options for retrofitting, there is a serious lack in investment and commitments if the companies hope to achieve net-zero targets via such pathways. Such criticism is pertinent given that recent research highlights the industry as a facilitator of (an accelerating) carbon lock-in [28,110], questioning the premise of the narrative, namely that industry are pioneers of low-carbon technology.

4.3. Already well underway

In the narrative “already well underway”, the climate actions of petrochemical majors are portrayed as ambitious, bold, and inspiring. Therefore, it is important to showcase the commitment and efforts of the industry to stave off critics who misconstrue or have not realised how well individual companies are *actually* doing in terms of their sustainability efforts. The problem in this narrative is that the world is unaware or lack understanding of ongoing initiatives and previous successes. The solution is thus to promote the “many” cases of concrete action and companies’ continual progress, including demonstrating (for example) that companies have paid attention to climate change for years, are investing in research and development (R&D) and decarbonization projects, or are retrofitting existing plants. These efforts are often framed as part of a journey or path towards “carbon neutrality” with the company in question as the protagonists. The narrative also extends to plastic waste management and the notion that companies are well on their way to achieving circularity.

Illustrative examples:

- “[The blue hydrogen plant] builds on the significant CO₂ reductions we’ve already made.” [111]
- “The new photovoltaic plant will deliver an 80kt annual reduction in indirect CO₂ emissions and reinforces our support for and contribution to wider climate change initiatives.” [112]
- “(...) we are taking [concrete steps], such as the establishment of the Circular Economy Department and the implementation of initiatives to tackle the issues of waste plastic and climate change.” [113]

A feature of this narrative is that companies are framed as the drivers of change. Here, corporate action cannot be attributed to outside pressures – rather, these actions are a natural part of the corporate DNA. This feature is manifested when, for instance, corporations re-label an action that they would have undertaken in any case (due e.g. to economic

factors, new legislation or court rulings), as actions that illustrate their climate ambition. To illustrate, LyondellBasell promotes reduced flaring as part of their climate ambition. However, in October 2021, Lyondell-Basell agreed to cut flaring as part of a US court settlement [114]. In fact, their target of 0.08 Mt. CO₂ from reduced flaring matches the reductions they were forced to comply with under the court settlement. Looking beyond examples of re-labelling, the industry has ignored or fought against climate change action for decades [115] and is still lobbying opportunistically to facilitate accumulation and shape or hinder regulation [116]. From this perspective, petrochemical majors are only reluctantly engaging in decarbonization and other sustainability efforts to please stakeholders following massive pressure from multiple actors [35].

The “already well underway” narrative resonates with the delay discourse “all talk little action” identified by Lamb et al. [70], pointing to advancements that downplay the need for further action or more stringent regulatory measures [117]. Such discourse can be supported by setting seemingly ambitious but voluntary targets (cf. the adoption of net zero targets referenced in Section 3) and by promoting specific statistics without contextualising them, since doing so could entail undermining claims of sustainability [94]. Many loopholes exist both in terms of methods for setting and meeting targets, which demands scepticism and scrutiny [118]. Although companies should arguably be credited for committing to action, if the cumulative effect of corporate projects have a relatively small effect on overall emissions, this narrative divert attention and downplay the necessity for structural change. Similarly, “green” R&D spending should be related to overall capital expenditures into fossil-based infrastructure that further carbon lock-in. Certainly, all of these companies have recently announced substantial investments into expanding fossil-based production facilities [28]. Insofar as “green” spending is used to signal a new direction but remains dwarfed by “brown” investments [119], such commitments help legitimize the carbon lock-in that current investment patterns facilitate.

4.4. Narrative realignment in the petrochemical industry

Fig. 1 and Table 2 illustrate and present an overview of the strategic transition-related narratives employed by the sampled petrochemical majors. These various ideal type storylines are not independent, but rather, they relate to and mutually reinforce each other. Together, they constitute a discursive strategy, portraying the petrochemical industry as of unquestionable societal importance, promoting the idea that stringent regulation is not needed, and implying that criticisms against the industry are based on misunderstandings. Across narratives, the industry is portrayed as a transition enabler (rather than an originator of carbon lock-in) facilitating a transition free of contestation which, however difficult, is pleasingly under control. Not only are incumbents realising sustainability now – they are also key for future pathways, fulfilling this role in a constantly improving manner.

Despite reinforcing each other, the different strategic narratives are arguably not entirely internally consistent. For example, if industry actors are indeed “well underway” on a journey towards low-carbon production, there should be little need to appreciate that they enable “avoided” emissions elsewhere. Additionally, the “realizers of sustainability” narrative proudly points to the need for petrochemicals to produce renewables, lending support to the need for an energy transition. Yet the narratives do not necessarily entail abandoning the current energy order, instead lending themselves to continuous extraction, refining and cracking of hydrocarbons on massive scales. Lastly, the “breakthrough technology pioneers” narrative acknowledges problems while passing blame onto consumers. As for the benefits of plastics, though, “realizers of sustainability” take full responsibility. In effect, these apparent contradictions work to consolidate the narratives and fend off storylines that run counter by covering potential blind spots. By invoking these narratives, proponents can dismiss criticisms that target inadequate or lack of action as these have not considered how the

industry enables emission reductions; similarly, criticizing the industry for being fossil-based and enhancing carbon lock-in does not appreciate the role of petrochemicals in energy transitions. Strategic ambiguity remains around the framing of the agency of incumbent actors. Across narratives, firms are the main protagonists, downplaying the importance of, e.g., other actors in the global innovation system [120]. Yet the premise that current demand trends are completely fixed goes unquestioned. Taken together, these narratives narrow down climate futures and frames an incumbent-led, technology-oriented transition as the only game in town. As put rather bluntly by the industry organization Petrochemicals Europe: “We build the future!”⁷ [122].

The three strategic narratives entail narrative realignment albeit in different ways (see Table 2). Common to all narratives, however, is that they bring ideas and practices of decarbonization in line with existing strategies and current industrial developments within the sector. Narrative realignment is essential to “realizers of sustainability” in that the narrative frames existing petrochemical production as climate friendly and thereby important to decarbonization. Moreover, incumbents often highlight the importance of petrochemicals in enabling transitions to renewable energy systems (e.g., solvents to manufacture solar panels, chemicals needed to produce wind turbine blades, etc.) [73]. In doing so, the industry positions itself as critical to not only decarbonization but also to renewable energy transitions. As such, it aligns fossil-based chemical production with fossil-free energy. The narrative thereby casts current (and increasing) levels of production as legitimate and beneficial implying that the position of petrochemical incumbents in the social order should not be tampered with. Production of and investments into petrochemicals are here not primarily commercially-informed decisions that enrich capital owners but rather sources of sustainability benefits. Thereby, in framing existing and potential new products as sustainable, “realizers of sustainability” point towards options for green capital accumulation.

Encapsulating narrative realignment, the narrative of “breakthrough technology pioneers” seeks to align incumbents’ investment patterns and R&D focus with decarbonization and a circular economy. In the analyzed material, multiple companies emphasise CCUS, green hydrogen and chemical recycling – key technologies legitimized by the pathways set out by among others the International Energy Agency, in which particularly the two former hold significant potential for decarbonizing the sector [16,109,123]. Understanding the industry to be a pioneer of key technologies implies that production facilities will be decarbonized once low-carbon processes have been developed and rolled out. As such, regulating the industry amounts to misunderstanding the logics of technological innovation. If anything, public support is warranted, since the industry is uniquely positioned to develop key technologies, thereby opening for avenues of green capital accumulation.

Lastly, “already well underway” tries to cast current sustainability efforts in a positive light. Narrative realignment is here evident in how this narrative aligns previous and current actions taken by petrochemical majors with decarbonization. For example, petrochemical majors highlight energy efficiency improvements as part of their decarbonization efforts, signalling that the industry is in control and steadily following a pathway towards decarbonization. Yet energy efficiency measures have been a long-term trend in the industry [19] as these have clear economic benefits (feedstock dominating production costs). Energy efficiency improvements thereby provide a double dividend, both lowering costs and recasting industry efforts as green through lowering emission intensity, thereby fending off pressures for more transformative visions for the industry [36]. At the same time, however,

⁷ This bears noticeable resemblance to the rhetoric of the American Fuel and Petrochemical Manufacturers quoted in Section 1, who referred to petrochemicals “the building blocks of modern life”, a terminology also used by individual companies such as ExxonMobil [121].

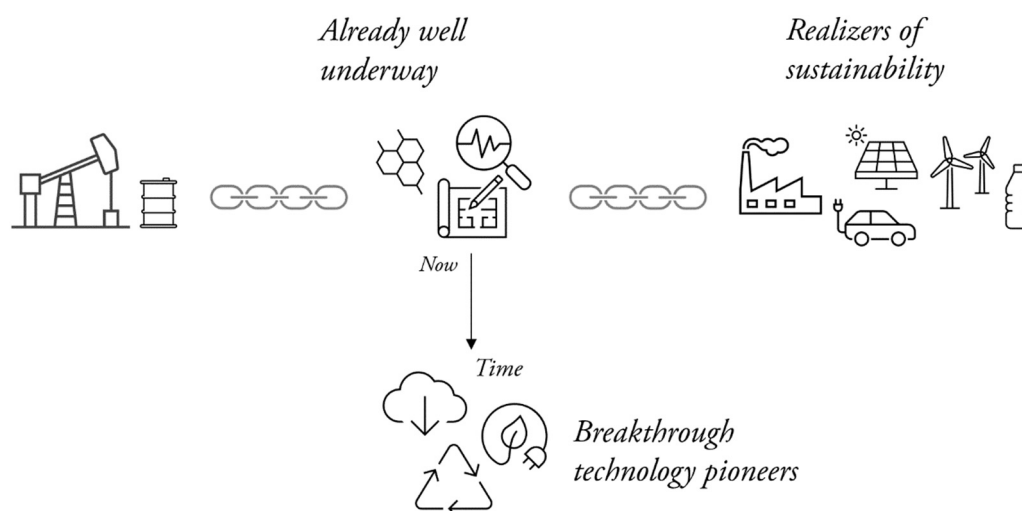


Fig. 1. Schematic representation of strategic transition-related narratives in the petrochemical sector.

Table 2
Overview of the identified narratives.

Strategic narrative	Problem	Solution	Role of industry	Narrative realignment	Resonates with
Realizers of sustainability	Lack of acknowledgement of the role petrochemical products play for various sustainability issues	Acknowledging the benefits of petrochemical products, e.g., emission reductions made possibly by plastics	Delivers tangible and substantial sustainability benefits such as emission reductions. Trying to combat misunderstandings.	Aligns ideas of decarbonization and energy transitions away from fossil fuels with current production patterns of the petrochemical industry.	Whataboutism
Breakthrough technology pioneers	Carbon emissions and plastic pollution from petrochemical production	Innovation facilitated by the industry. Increasing energy efficiency and long-term decarbonization.	Transition enablers and innovative pioneers of new technology.	Aligns decarbonization and circular economy with existing investment and R&D strategy, contending that decarbonization is best facilitated in the hands of industry.	Technological optimism
Already well underway	Unawareness of the existing efforts and transformative success of the petrochemical sector	Promoting the “many” cases of concrete action and initiatives that companies (and the sector at large) are working on in line with previous successes.	In control with high ambition and substantial action.	Aligns decarbonization and circularity with current sustainability efforts in the industry. Elements of passive revolution.	All talk little action

improvements in energy efficiency risk strengthening carbon lock-in by furthering integration of existing production processes [143,144]. This example illustrates a link between narrative realignment and passive revolution in that “already well underway” foregrounds reformist or incremental changes to neutralise criticism while recasting these developments as progressive. By presenting the industry as being on a path towards decarbonization, with key incumbent actors eagerly trotting along, the narrative positions the industry as unproblematic – also from an investor perspective. Thereby, “already well underway” downplays the sector’s exposure to climate-related financial risks arising from fossil-based production (e.g., in the form of capital stranding cascades [124]).

On the whole, the three strategic narratives portray the industry as part of the solution rather than as part of the problem. Beyond preempting regulation by deflecting or redirecting responsibility and easing pressure, these narratives play into strategies of proliferation and green capital accumulation, framing incumbent actors as integral to decarbonized futures. Dependence on petrochemicals is here both current (as realizers of sustainability) and continuous (as pioneers of breakthrough technology), making transitions possible and driving needed technological innovation. Running against pressures for change, these narratives work to “future-proof” the industry [35] based on narrative realignment, legitimating and thereby reinforcing current patterns of lock-in. In essence, this discursive strategy answers the

question posed to industry actors by a senior manager at a global consultancy for companies in the chemical sector: “[How] can you negate or convert threats, and position to capture opportunities?”⁸

5. Perspectives on petrochemical transitions

Seeing the calls to end fossil fuels [125] and cut global plastic production [32] alongside unfolding socio-ecological crises, the petrochemical industry appears to be subject to unprecedented pressure. Yet – at least if their public announcements are to be trusted – industry actors do not seem that worried. In engaging with stakeholders, the discursive strategy presented above seeks to take the disruptive and potentially counter-hegemonic ideas of decarbonization, energy transition, and circular economy, and align them with current petrochemical production and investments patterns. In this section, we discuss this discursive strategy and relate it to other forms of power required for trasformismo. To add perspective, we then consider the unique position of petrochemicals in energy transitions by contrasting the findings above with the rhetoric utilised by oil and gas majors as mapped in recent studies.

⁸ Authors’ notes, Europe Chemicals and Polymers Conference, September 2021

5.1. *Trasformismo and petrochemicals*

In the process of *trasformismo*, the employment of discursive power happens in combination with material and institutional forms of power. As for material power, the dependence on petrochemicals in enabling capital accumulation confers certain advantages to the industry. Not unlike the structurally important energy industries, the petrochemical sector has arguably played a substantial role in facilitating growth in the 20th century [126]. The petrochemical industry provides input to a host of different industrial processes and has many forward-linkages to other sectors [127]. In the words of the industry, “petrochemicals make things happen” [128], which (similar to the energy industries [14]) allows petrochemical incumbents to claim to represent general interests. The ubiquity and apparent entrenchment of chemicals and plastics in modern life thus grant material power, providing a platform from which to stave off disruptive change. As emphasised in the opening keynote by the sustainability manager from the chemicals section of a large vertically integrated company at a petrochemical conference: “Without our industry, essentially everything in modern life [that] society takes for granted would not exist in the form it is today”.⁹

The material power of the industry underpins the discursive strategy of incumbents. The basis of the industry’s material power, i.e., the widespread use of petrochemicals across industrial processes, also means that a range of petrochemicals are used for sustainability-related purposes (as incumbents are quick to highlight). As we have shown above, such applications enable the realizers of sustainability narrative. More broadly, the notion of petrochemicals as “building blocks” seeks to make visible the structural importance of the sector and render practically all applications of petrochemicals essential by characterising them as prerequisites of “modern life”. As long as we desire the comforts of today – it follows – petrochemicals are indispensable. This perspective speaks to wider imaginaries of green growth and ecological modernisation, which take political and economic structures as given and envision economic growth and ecological sustainability as harmonious [94,129]. Conceived as a modified version of today, green growth might entail restructuring, but the essentiality of petrochemicals remains, i.e., things still need to “happen”. Resting on the structural importance of petrochemicals, petrochemical companies can thus position themselves as integral to hegemonic visions of the future.

Linkages between different forms of power are also pertinent in relation to institutional power. The petrochemical industry has a long history of trying to influence political decision-making, both through formal and informal forms of participation including lobbying for and against certain policies, contributing millions to political campaigns and as part of the US’s climate change counter-movement, funding climate-denial efforts [115,130–132]. A relevant and coordinated form of institutional power is the wielding of influence by industry lobbying groups, which use the three narratives analysed above in their effort to position the industry as integral to combatting climate change, and evoke the sector’s economic importance, both to influence policy [39,133]. Invoking these narratives and backed by structurally dependent material power, the employment of institutional power relates to and depends on other forms of power.

In various ways, the issue of scale is central to discursive, material, and institutional power. On a fundamental level, different socio-ecological crises are fuelled by the massive and increasing scale of petrochemical production [41,134]. In the run-up to the UN Environment Assembly resolution initializing the process of negotiating a global plastics treaty, petrochemical producers lobbied to keep the focus on waste management only and thereby disregard the role of production [135,136]. In this ongoing war of position, the industry seeks to convince stakeholders that plastics are part of the solution rather than

the root of the problem. As for discursive power, industry actors seek to tone down issues of scale through realigning plastics and sustainability. Yet it is scale that both facilitates growth and underpins the structural importance of the industry and industry actors have sought to ensure continued upscaling by fending off potential limiting threats. The identified strategic narratives should thus be seen in this broader perspective where narrative realignment and discursive efforts are part of a wider set of activities and practises seeking (through the process of *trasformismo*) to accommodate transition pressures so that they will not disrupt prevailing social and economic relations. For plastic and petrochemicals, reduced production and consumption is clearly a critically important mitigation pathway [110]. Looking forward, the degree to which incumbents will be successful in ensuring *trasformismo* will help decide whether this pathway will be pursued.

5.2. *Petro-chemicals vis-à-vis petro-extraction*

Despite relying on fossil feedstock and being solidly placed in the fossil-based energy order (with strong historical, knowledge-based, and economic linkages to oil, gas, and coal, as reflected by the multiple integrated fossil fuel and chemical companies), the petrochemical industry occupies a different position in an energy transition than do extractors of oil, gas, and coal. As explained above, petrochemicals are framed as integral to ecomodernist futures, despite being fossil-based. How does this position differ from that of fossil fuel extractors?

The oil and gas majors do not have the same platform as petrochemical producers. The “fossil fuel saviour” frame identified by Supran and Oreskes [5] builds on discourses of fossil fuel solutionism [70], positioning the fossil fuel industry as an essential part of the solution to climate change and fossil fuels as critical and necessary for meeting energy demand (which is taken as given). However, this holds only for the foreseeable future. To exemplify, fossil gas is portrayed as a “bridge” towards cleaner energy production and an increasing share of renewables is acknowledged to be necessary (at least at some point) [137]. Even if ideas of technological fixes in the form of large-scale negative emission technologies and “cleaner” fuels underpin the fossil fuel solutionism discourse [82], fossil extraction has to eventually decrease or, at the very least, energy production has to change composition. Ultimately, oil and gas firms face an existential threat, and operate with the fundamental options of either not remaining oil and gas firms or not remaining in business [10]. This means that the battleground is set up around the extent and pace of decreased production and the role of negative emission technologies herein. The contrary is the case for petrochemicals, as contextualised in the introduction: increased production is instead the starting point. Insofar as incumbents successfully manage to present themselves as critical to climate mitigation, and insofar as ecological modernisation remains the dominant imaginary, more “building blocks” are called for.

An important aspect of the fossil fuel saviour frame is the “technological shell game” discourse which, relying on strategic ambiguity, spreads doubt around feasibility, costs and implementation of energy alternatives [5]. Given that the potential of renewables appears increasingly evident (as renewables costs go down and deployment unfolds), a clear outside threat has materialised, arguably increasing the resistance from incumbents standing to loose rents [138,139]. Along these lines, the technological shell game discourse has played an obvious function for fossil fuel companies namely that of questioning the validity of renewables. But what alternatives exist to the “building blocks of modern life”? Technological alternatives for petrochemicals (e.g. bio-based feedstocks, carbon capture, and green hydrogen) focus on complementing or improving existing production processes [110], and are framed to emerge from within, with niche technologies being promoted by petrochemical majors (breakthrough technology pioneers).

Despite the above differences, similarities in rhetoric are also apparent across the value chain including discourses of climate delay such as “technological optimism”, “whataboutism”, “no sticks just

⁹ Authors’ notes, European Petrochemicals Virtual Conference, November 22, 2021.

carrots”, and “all talk, little action” [70]. A prominent example is the tendency to diminish responsibility by taking production growth as a given, “casting itself as a kind of neutral innocent, buffeted by the forces of consumer demand”, a manoeuvre used by both the fossil fuel and the tobacco industry [140,141]. Moreover, various civil society actors have worked to lump together petrochemicals, fossil fuels and plastics. For instance, Greenpeace successfully led a campaign for LEGO to end their partnership with the vertically integrated oil, gas, and petrochemicals company Shell, presenting Shell as fundamentally problematic and mobilising action against the use of fossil-based plastics for LEGO products [142]. However, unlike fossil fuel extractors who combat clear substitutes, petrochemical majors are positioned to pursue strategic narratives premised on the inevitability of “modern” society in which chemicals and plastics are ubiquitous.

With the agreed-upon resolution at the UN Environment Assembly (UNEA-5) requiring a global plastics treaty, stepping up international plastic governance across the value chain in spite of counter-efforts by industry lobbyists [32], transition pressures appear to be increasing. The three narratives discussed above that proactively frame industry as imperative to sustainability are likely to come into play as the war of position continues to unfold and hegemony is challenged. What the consequences will be and whether new narratives will emerge as the landscape changes remain open questions.

6. Conclusion

Because of their involvement in various socio-ecological crises and conflicts, petrochemical producers are subject to a multitude of change pressures. In seeking to navigate such pressures, they promote a number of strategic narratives that align current and planned activities with ideas of sustainability, decarbonization and circularity. This promotion happens through efforts of narrative realignment positioning petrochemical industry actors as central to ecomodernist futures as pioneers of technology and enablers of transitions. This position differs from that of fossil fuel extractors in petrochemicals not being a bridge to but rather the fundament for modern sustainable future(s). Instances of narrative realignment constitute examples of the use of discursive power and play into wider processes of *trasformismo* and wars of position. The processes we have described here are not only a matter of accountability, deflection and avoiding responsibility, but also about positioning and power, seeking to maintain favourable socio-technical configurations and rendering “unlimited” plastic futures more likely [41].

The concept of narrative realignment adds to our understanding of the employment of discursive power by illustrating how its concrete manifestations can mimic and feed into larger-scale processes of *trasformismo*. In this way, we have sought to illustrate *trasformismo* “in practice”. Mapping narrative realignment is thus one helpful way of tracing efforts of *trasformismo* as the process unfolds whether these efforts will be successful or not. Future research can fruitfully compare the employment of discursive power across energy intensive processing sectors and see how discursive efforts relate to central conflicts about the potential for reduced production and use as part of industry transformation. Which narratives do actors promote across industries, how are they related and what is the role of narrative realignment? For example, to what extent do incumbents push the notion of output from the steel and cement industries as essential and ubiquitous? Future research could also assess dynamics internal to the petrochemicals industry, exploring how, why, and to what extent various narratives travel and become institutionalized on a global scale. Exploring such questions will help shed further light on the material implications for industrial transformations of narratives and discursive forms of power.

With calls to cap the global production of (virgin) plastics in the upcoming global plastic treaty [32,33], the war of position concerning continued upscaling (and locking-in) of the already colossal petrochemical production will likely intensify. Accordingly, efforts of narrative realignment are set to continue as incumbent actors emphasise

petrochemicals as necessary and essential and seek, once again, to make plastic “fantastic”. If the socio-ecological consequences of continued growth of petrochemical production are to be avoided, these efforts have to be counter-balanced and the crucial role of chemicals in upholding the fossil energy order must be made visible. Yet undoing petrochemicals growth also raises questions around the vast array of processes and products that depend on synthetic petroleum derivatives. The struggle over the future of petrochemicals is thus also a struggle over the future of consumerism. To challenge petrochemical growth while meeting the needs of all therefore requires confronting existing inequalities in material and (embodied) energy consumption in conjunction with the unequal distribution of power and resources upon which these inequalities are predicated.

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CRediT authorship contribution statement

Joachim Peter Tilsted: Conceptualization, Methodology, Investigation, Writing - Original draft preparation, Writing - Reviewing and Editing. **Alice Mah:** Conceptualization, Writing - Reviewing and Editing. **Tobias Dan Nielsen:** Methodology, Investigation, Writing - Reviewing and Editing, Funding acquisition. **Guy Finkill:** Investigation, Writing - Reviewing and Editing. **Fredric Bauer:** Conceptualization, Writing - Reviewing and Editing, Supervision, Project administration, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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References

- [1] M. Åhman, L.J. Nilsson, B. Johansson, Global climate policy and deep decarbonization of energy-intensive industries, *Clim. Pol.* 17 (2017) 634–649, <https://doi.org/10.1080/14693062.2016.1167009>.
- [2] B. Turnheim, B.K. Sovacool, Forever stuck in old ways? Pluralising incumbencies in sustainability transitions, *Environ. Innov. Soc. Trans.* 35 (2020) 180–184, <https://doi.org/10.1016/j.eist.2019.10.012>.
- [3] A. van Mossel, F.J. van Rijnsoever, M.P. Hekkert, Navigators through the storm: a review of organization theories and the behavior of incumbent firms during transitions, *Environ. Innov. Soc. Transit.* 26 (2018) 44–63, <https://doi.org/10.1016/j.eist.2017.07.001>.
- [4] D. Lee, D.J. Hess, Incumbent resistance and the solar transition: changing opportunity structures and framing strategies, *Environ. Innov. Soc. Transit.* 33 (2019) 183–195, <https://doi.org/10.1016/j.eist.2019.05.005>.
- [5] G. Supran, N. Oreskes, Rhetoric and frame analysis of ExxonMobil's climate change communications, *One Earth* 4 (2021) 696–719, <https://doi.org/10.1016/j.oneear.2021.04.014>.

- [6] C. Bonneuil, P.L. Choquet, B. Franta, Early warnings and emerging accountability: Total's responses to global warming, 1971–2021, *Glob. Environ. Chang.* 71 (2021), 102386, <https://doi.org/10.1016/j.gloenvcha.2021.102386>.
- [7] B. Franta, Early oil industry disinformation on global warming, *Environ. Politics* 30 (2021) 663–668, <https://doi.org/10.1080/09644016.2020.1863703>.
- [8] G. Supran, N. Oreskes, Addendum to 'Assessing ExxonMobil's climate change communications (1977–2014)' Supran and Oreskes (2017 *Environ. Res. Lett.* 12 084019), *Environmental Research Letters* 15 (2020) 119401, <https://doi.org/10.1088/1748-9326/ab89d5>.
- [9] B. Franta, Weaponizing economics: big oil, economic consultants, and climate policy delay, *Environ. Politics* 00 (2021) 1–21, <https://doi.org/10.1080/09644016.2021.1947636>.
- [10] J. Green, J. Hadden, T. Hale, P. Mahdavi, Transition, hedge, or resist? Understanding political and economic behavior toward decarbonization in the oil and gas industry, *Rev. Int. Polit. Econ.* (2021) 1–28, <https://doi.org/10.1080/09692290.2021.1946708>.
- [11] M. Li, G. Trencher, J. Asuka, The clean energy claims of BP, Chevron, ExxonMobil and Shell: a mismatch between discourse, actions and investments, *PLoS ONE* 17 (2022), e0263596, <https://doi.org/10.1371/journal.pone.0263596>.
- [12] D.L. Levy, P.J. Newell, Business strategy and international environmental governance: toward a neo-Gramscian synthesis, *Glob. Environ. Politics* 2 (2002) 84–101, <https://doi.org/10.1162/152638002320980632>.
- [13] P. Newell, P. Johnstone, *The political economy of incumbency fossil fuel subsidies in global and historical context*, in: J. Skovgaard, H. van Asselt (Eds.), *The Politics of Fossil Fuel Subsidies and Their Reform*, Cambridge University Press, 2018.
- [14] P. Newell, M. Paterson, A climate for business: global warming, the state and capital, *Rev. Int. Polit. Econ.* 5 (1998) 679–703, <https://doi.org/10.1080/096922998347426>.
- [15] P. Newell, M. Paterson, *Climate Capitalism: Global Warming and the Transformation of the Global Economy*, Cambridge University Press, Cambridge, 2010, <https://doi.org/10.1017/CBO9780511761850>.
- [16] IEA, *The Future of Petrochemicals: Towards More Sustainable Plastics and Fertilisers*, International Energy Agency, Paris, 2018, <https://doi.org/10.1787/9789264307414-en>.
- [17] IEA, *Energy Technology Perspectives 2020*, International Energy Agency, Paris, 2020, <https://doi.org/10.1787/9789264109834-en>.
- [18] P.G. Levi, J.M. Cullen, Mapping global flows of chemicals: from fossil fuel feedstocks to chemical products, *Environ. Sci. Technol.* 52 (2018) 1725–1734, <https://doi.org/10.1021/acs.est.7b04573>.
- [19] S.J. Bennett, Implications of climate change for the petrochemical industry: mitigation measures and feedstock transitions, in: *Handbook of Climate Change Mitigation*, Springer, US, 2012, pp. 319–357, https://doi.org/10.1007/978-1-4419-7991-9_10.
- [20] Cefic, *Facts and Figures of the European Chemical Industry 2021*, Cefic, Brussels, 2021.
- [21] R. Geyer, J.R. Jambeck, K.L. Law, Production, use, and fate of all plastics ever made, *Sci. Adv.* 3 (2017) 5, <https://doi.org/10.1126/sciadv.1700782>.
- [22] L. Cabernard, S. Pfister, C. Oberschelp, S. Hellweg, Growing environmental footprint of plastics driven by coal combustion, *Nat. Sustain.* 2021 (2021) 1–10, <https://doi.org/10.1038/s41893-021-00807-2>.
- [23] F. Bauer, V. Kulionis, C. Oberschelp, S. Pfister, J.P. Tilsted, G. Finkill, *Petrochemicals and Climate Change - Tracing Globally Growing Emissions and Key Blind Spots in a Fossil-Based Industry*, 2022.
- [24] S.J. Bennett, Chemistry's special relationship, *Chem. World* 4 (2007) 66–69.
- [25] N. Rosenberg, Chemical engineering as a general purpose technology, in: *Schumpeter and the Endogeneity of Technology: Some American Perspectives*, Routledge, London, 2000, pp. 79–104, https://doi.org/10.1142/9789814273596_0015.
- [26] A. Hanieh, *Petrochemical empire*, *New Left Rev.* 25–51 (2021).
- [27] A.H. Tullio, in: *The Future of Oil Is in Chemicals, Not Fuels 97*, C&EN Global Enterprise, 2019, pp. 26–29, <https://doi.org/10.1021/cen-09708-feature2>.
- [28] F. Bauer, G. Fontenit, Plastic dinosaurs – digging deep into the accelerating carbon lock-in of plastics, *Energy Policy* 156 (2021), 112418, <https://doi.org/10.1016/j.enpol.2021.112418>.
- [29] Global Data, *Global Petrochemicals Capacity and Capital Expenditure Outlook, 2021–2030 – Asia Leads Global Petrochemical Capacity Additions*, Global Data, 2021.
- [30] IEA, *Oil 2021*, 2021.
- [31] BP, in: *Energy Outlook 2022*, 2022, p. 109.
- [32] M. Bergmann, B.C. Alroth, S.M. Brander, T. Dey, D.S. Green, S. Gundogdu, A. Krieger, M. Wagner, T.R. Walker, A global plastic treaty must cap production, *Science* 376 (2022) 469–470, <https://doi.org/10.1126/science.abq0082>.
- [33] N. Simon, K. Raubenheimer, N. Urho, S. Unger, D. Azoulay, T. Farrelly, J. Sousa, H. van Asselt, G. Carlini, C. Sekomo, M.L. Schulte, P.-O. Busch, N. Wienrich, L. Weiland, A binding global agreement to address the life cycle of plastics, *Science* 373 (2021) 43–47, <https://doi.org/10.1126/science.abi9010>.
- [34] J. Tickner, K. Geiser, S. Baima, Transitioning the chemical industry: the case for addressing the climate, toxics, and plastics crises, *Environ. Sci. Policy Sustain. Dev.* 63 (2021) 4–15, <https://doi.org/10.1080/00139157.2021.1979857>.
- [35] A. Mah, Future-proofing capitalism: the paradox of the circular economy for plastics, *Glob. Environ. Politics* 21 (2021) 121–142, https://doi.org/10.1162/glep_a_00594.
- [36] A. Mah, Ecological crisis, decarbonisation, and degrowth : the dilemmas of just petrochemical transformations, *Stato e Mercato XLI* (2021) 51–78, <https://doi.org/10.1425/10144>.
- [37] A.J. Hoffman, Institutional evolution and change: environmentalism and the U.S. chemical industry, *Acad. Manag. J.* 42 (1999) 351–371, <https://doi.org/10.2307/257008>.
- [38] T. Ren, Barriers and drivers for process innovation in the petrochemical industry: a case study, *J. Eng. Technol. Manag.* 26 (2009) 285–304, <https://doi.org/10.1016/j.jengtecman.2009.10.004>.
- [39] F.W. Geels, Conflicts between economic and low-carbon reorientation processes: insights from a contextual analysis of evolving company strategies in the United Kingdom petrochemical industry (1970–2021), *Energy Res. Soc. Sci.* 91 (2022), 102729, <https://doi.org/10.1016/j.erss.2022.102729>.
- [40] L.A. Hamilton, S. Feit, *Plastic & Climate: The Hidden Costs of a Plastic Planet*, Center for International Environmental Law, 2019 (accessed September 12, 2022), <https://www.ciel.org/plasticandclimate/>.
- [41] A. Mah, *Plastic Unlimited: How Corporations Are Fuelling the Ecological Crisis and What We Can Do About It*, 1st ed., Polity Press, 2022.
- [42] G. Markowitz, D. Rosner, *Deceit and Denial*, University of California Press, 2013, <https://doi.org/10.1525/9780520954960>.
- [43] A. Ford, P. Newell, Regime resistance and accommodation: toward a neo-Gramscian perspective on energy transitions, *Energy Res. Soc. Sci.* 79 (2021), 102163, <https://doi.org/10.1016/j.erss.2021.102163>.
- [44] P. Newell, Transformismo or transformation? The global political economy of energy transitions, *Rev. Int. Polit. Econ.* 26 (2019) 25–48, <https://doi.org/10.1080/09692290.2018.1511448>.
- [45] J. Szabo, Energy transition or transformation? Power and politics in the European natural gas industry's trasformismo, *Energy Res. Soc. Sci.* 84 (2022) 102391, <https://doi.org/10.1016/j.erss.2021.102391>.
- [46] T. Bartley, Transnational corporations and global governance, *Annu. Rev. Sociol.* 44 (2018) 145–165, <https://doi.org/10.1146/annurev-soc-060116-053540>.
- [47] American Fuel and Petrochemical Manufacturers, *What are petrochemicals?* (n.d.), <https://empower.afpm.org/products/what-are-petrochemicals> (accessed April 7, 2022).
- [48] H. Buch-Hansen, M.B. Carstensen, Paradigms and the political economy of ecopolitical projects: Green growth and degrowth compared, *Competition & Change* 25 (2021) 308–327, <https://doi.org/10.1177/1024529420987528>.
- [49] R.W. Cox, Gramsci, hegemony and international relations: an essay in method, *Millennium* 12 (1983) 162–175, <https://doi.org/10.1177/03058298830120020701>.
- [50] J. Bates, The domestication of open government data advocacy in the United Kingdom: A neo-Gramscian analysis, *Policy Internet* 5 (2013) 118–137, <https://doi.org/10.1002/POI3.25>.
- [51] D.L. Levy, A. Spicer, Contested imaginaries and the cultural political economy of climate change, *Organization* 20 (2013) 659–678, <https://doi.org/10.1177/1350508413489816>.
- [52] A. Gramsci, Notes on Italian history, in: Q. Hoarse, Q. Hoare, G. Nowell Smith (Eds.), *Selections From the Prison Notebooks of Antonia Gramsci*, International, New York, 1971, pp. 52–118.
- [53] D.L. Levy, D. Egan, A neo-Gramscian approach to corporate political strategy: conflict and accommodation in the climate change negotiations*, *J. Manag. Stud.* 40 (2003) 803–829, <https://doi.org/10.1111/1467-6486.00361>.
- [54] M. Blondeel, Toward a neo-Gramscian interpretation of "social licence", in: G. Wood, J. Gorski, G. Mete (Eds.), *The Palgrave Handbook of Social License to Operate and Energy Transitions*, Springer International Publishing, Cham, 2022, pp. 1–24, https://doi.org/10.1007/978-3-030-74725-1_10-1.
- [55] A.D. Morton, *Unravelling Gramsci*, Pluto Press (2007), <https://doi.org/10.2307/j.ctt18dzstb>.
- [56] S. Ponte, Green capital accumulation: business and sustainability management in a world of global value chains, *New Polit. Econ.* 25 (2020) 72–84, <https://doi.org/10.1080/13563467.2019.1581152>.
- [57] R. Wood, K. Neuhooff, D. Moran, M. Simas, M. Grubb, K. Stadler, The structure, drivers and policy implications of the European carbon footprint, *Clim. Pol.* (2019) 1–19, <https://doi.org/10.1080/14693062.2019.1639489>.
- [58] M.A. Hajer, Acid rain in Great Britain: environmental discourse and the hidden politics of institutional practice, in: *Greening Environmental Policy*, Palgrave Macmillan, US, New York, 1995, pp. 145–164, https://doi.org/10.1007/978-1-137-08357-9_9.
- [59] R. Lowes, B. Woodman, J. Speirs, Heating in Great Britain: An incumbent discourse coalition resists an electrifying future, *Environ. Innov. Soc. Transit.* 37 (2020) 1–17, <https://doi.org/10.1016/j.eist.2020.07.007>.
- [60] M.A. Hajer, Discourse coalitions and the institutionalization of practice: the case of acid rain in Great Britain, in: F. Fischer, J. Forester (Eds.), *The Argumentative Turn in Policy Analysis and Planning*, Duke University Press, 1993, pp. 43–76, <https://doi.org/10.1515/9780822381815-003>.
- [61] E. Palm, J. Hasselbalch, K. Holmberg, T.D. Nielsen, Narrating Plastics Governance: Policy Narratives in the European Plastics Strategy, 2021, <https://doi.org/10.1080/09644016.2021.1915020>.
- [62] F. Fischer, *Reframing Public Policy: Discursive Politics and Deliberative Practices*, Oxford University Press, 2003, <https://doi.org/10.1093/019924264X.001.0001>.
- [63] P. Buschmann, A. Oels, The overlooked role of discourse in breaking carbon lock-in: the case of the German energy transition, *Wiley Interdiscip. Rev. Clim. Chang.* 10 (2019), e574, <https://doi.org/10.1002/WCC.574>.
- [64] A. Smith, A. Stirling, F. Berkhout, The governance of sustainable socio-technical transitions, *Res. Policy* 34 (2005) 1491–1510, <https://doi.org/10.1016/j.respol.2005.07.005>.

- [67] A.M. McCright, R.E. Dunlap, Defeating Kyoto: the conservative movement's impact on U.S. climate change policy, *Soc. Probl.* 50 (2003) 348–373, <https://doi.org/10.1525/sp.2003.50.3.348>.
- [68] M. Lahsen, Experiences of modernity in the greenhouse: a cultural analysis of a physicist "trio" supporting the backlash against global warming, *Glob. Environ. Chang.* 18 (2008) 204–219, <https://doi.org/10.1016/j.gloenvcha.2007.10.001>.
- [69] S. Lewandowsky, N. Oreskes, J.S. Risbey, B.R. Newell, M. Smithson, Seepage: climate change denial and its effect on the scientific community, *Glob. Environ. Chang.* 33 (2015) 1–13, <https://doi.org/10.1016/j.gloenvcha.2015.02.013>.
- [70] W.F. Lamb, G. Mattioli, S. Levi, J. Timmons Roberts, S. Capstick, F. Creutzig, J. C. Minx, F. Müller-Hansen, T. Culhane, J.K. Steinberger, Discourses of climate delay, *Glob. Sustain.* 3 (2020), <https://doi.org/10.1017/sus.2020.13>.
- [71] S. Hall, The problem of ideology-Marxism without guarantees, *J. Commun. Inq.* 10 (1986) 28–44, <https://doi.org/10.1177/01968598601000203>.
- [72] L. Fuenschilling, An institutional perspective on sustainability transitions, in: *Handbook of Sustainable Innovation*, 2019, pp. 219–236, <https://doi.org/10.4337/9781788112574.00020>.
- [73] F. Bauer, L. Fuenschilling, Local initiatives and global regimes – multi-scalar transition dynamics in the chemical industry, *J. Clean. Prod.* 216 (2019) 172–183, <https://doi.org/10.1016/j.jclepro.2019.01.140>.
- [74] J.P. Tilsted, F. Bauer, *Networks in Global Socio-technical Systems: Lead Firm Ties in the Petrochemical Industry*, 2021. Karlsruhe, Germany.
- [75] L. Fuenschilling, C. Binz, Global socio-technical regimes, *Res. Policy* 47 (2018) 735–749, <https://doi.org/10.1016/j.respol.2018.02.003>.
- [76] WBCSD/WRI, *The Greenhouse Gas Protocol - A Corporate Accounting and Reporting Standard*, World Resources Institute/World Business Council for Sustainable Development, Washington, DC, 2004.
- [77] J. Zheng, S. Suh, Strategies to reduce the global carbon footprint of plastics, *Nature Climate Change.* 9 (2019) 374–378, <https://doi.org/10.1038/s41558-019-0459-z>.
- [78] Global Carbon Project, Supplemental data of Global Carbon Budget 2021 (Version 1.0) [Data set]. Global Carbon Project, 2021, <https://doi.org/10.18160/gcp-2021>.
- [79] A.H. Tullio, in: *C&EN's Global Top 50*, *C&EN Global Enterprise* 98, 2020, pp. 30–36, <https://doi.org/10.1021/cen-09829-cover>.
- [80] I.M. Herremans, J.A. Nazari, F. Mahmoudian, Stakeholder relationships, engagement, and sustainability reporting, *J. Bus. Ethics* 138 (2016) 417–435, <https://doi.org/10.1007/s10551-015-2634-0>.
- [81] S. Jaworska, Change but no climate change: discourses of climate change in corporate social responsibility reporting in the oil industry, *international, J. Bus. Commun.* 55 (2018) 194–219, <https://doi.org/10.1177/2329488417753951>.
- [82] M. Megura, R. Gunderson, Better poison is the cure? Critically examining fossil fuel companies, climate change framing, and corporate sustainability reports, *Energy Res. Soc. Sci.* 85 (2022), 102388, <https://doi.org/10.1016/j.erss.2021.102388>.
- [83] A.H. Reilly, N. Larya, External communication about sustainability: corporate social responsibility reports and social media activity, *Environ. Commun.* 12 (2018) 621–637, <https://doi.org/10.1080/17524032.2018.1424009>.
- [84] J. Clapp, The rising tide against plastic waste: unpacking industry attempts to influence the debate, in: S. Foote, E. Mazzolini (Eds.), *Histories of the Dustheap: Waste, Material Cultures, Social Justice*, MIT Press, Cambridge, MA, 2012, pp. 199–226.
- [85] Dow, *Sustainability Targets*, (n.d.). <https://corporate.dow.com/en-us/science-and-sustainability/commits-to-reduce-emissions-and-waste.html> (accessed August 17, 2022).
- [86] Linde, *Linde Applications Enable 2.3x Carbon Productivity*, (n.d.). <https://www.linde.com/-/media/linde/emrger/documents/sustainable-development/carbon-productivity-chart.pdf?la=en> (accessed May 30, 2022).
- [87] BASF, *Sustainability*, (n.d.). <https://www.basf.com/global/en/investors/calendar-and-publications/factbook/basf-group/strategy/sustainability.html> (accessed May 19, 2022).
- [88] ExxonMobil, *ExxonMobil Sustainability Report*. <https://corporate.exxonmobil.com/-/media/Global/Files/sustainability-report/publication/Sustainability-Report.pdf>, 2021 (accessed September 4, 2022).
- [89] J. Clapp, L. Swanston, Doing away with plastic shopping bags: International patterns of norm emergence and policy implementation, *Environ. Politics* 18 (2009) 315–332, <https://doi.org/10.1080/09644010902823717>.
- [90] Franklin Associates, in: *Life Cycle Impacts of Plastic Packaging Compared to Substitutes in the United States and Canada*, 2018, pp. 1–160.
- [91] A. Bjørn, C. Chandrakumar, A.M. Boulay, G. Doka, K. Fang, N. Gondran, M. Z. Hauschild, A. Kerkhof, H. King, M. Margni, S. McLaren, C. Mueller, M. Owsianiak, G. Peters, S. Roos, S. Sala, G. Sandin, S. Sim, M. Vargas-Gonzalez, M. Ryberg, Review of life-cycle based methods for absolute environmental sustainability assessment and their applications, *Environ. Res. Lett.* 15 (2020), 083001, <https://doi.org/10.1088/1748-9326/AB89D7>.
- [92] A. Bjørn, N. Bey, S. Georg, I. Røpke, M.Z. Hauschild, Is Earth recognized as a finite system in corporate responsibility reporting? *J. Clean. Prod.* 163 (2017) 106–117, <https://doi.org/10.1016/j.jclepro.2015.12.095>.
- [93] M. Brander, Transposing lessons between different forms of consequential greenhouse gas accounting: Lessons for consequential life cycle assessment, project-level accounting, and policy-level accounting, *J. Clean. Prod.* 112 (2016) 4247–4256, <https://doi.org/10.1016/j.jclepro.2015.05.101>.
- [94] J.P. Tilsted, A. Bjørn, G. Majeau-Bettez, J.F. Lund, Accounting matters: Revisiting claims of decoupling and genuine green growth in Nordic countries, *Ecol. Econ.* 187 (2021), 107101, <https://doi.org/10.1016/j.ecolecon.2021.107101>.
- [95] J. Walenta, The making of the corporate carbon footprint: the politics behind emission scoping, *J. Cult. Econ.* 14 (2021) 533–548, <https://doi.org/10.1080/17530350.2021.1935297>.
- [96] F. Ascui, H. Lovell, As frames collide: making sense of carbon accounting, *Account. Audit. Account. J.* 24 (2011) 978–999, <https://doi.org/10.1108/095135711111184724>.
- [97] F. Ascui, H. Lovell, Carbon accounting and the construction of competence, *J. Clean. Prod.* 36 (2012) 48–59, <https://doi.org/10.1016/j.jclepro.2011.12.015>.
- [98] D. MacKenzie, Making things the same: gases, emission rights and the politics of carbon markets, *Acc. Organ. Soc.* 34 (2009) 440–455, <https://doi.org/10.1016/j.aos.2008.02.004>.
- [99] BASF, SABIC, Linde, BASF, SABIC and Linde join forces to realize the world's first electrically heated steam cracker furnace, Press Release. <https://www.basf.com/global/en/media/news-releases/2021/03/p-21-165.html>, 2021 (accessed May 20, 2022).
- [100] F. Koopmans, K. Doorselaer, C. Velis, B.De Wilde, A. Ritschkoff, M. Crippa, J. Leysens, M. Wagner, J. Muncke, *A Circular Economy for Plastics: Insights From Research and Innovation to Inform Policy and Funding Decisions*, Publications Office, 2019, <https://doi.org/10.2777/269031>.
- [101] CIEL, *GAIA, Plastic Is Carbon - Unwrapping the "Net Zero" Myth*, 2021.
- [102] Á. Galán-Martín, V. Tulus, I. Díaz, C. Pozo, J. Pérez-Ramírez, G. Guillén-Gosálbez, Sustainability footprints of a renewable carbon transition for the petrochemical sector within planetary boundaries, *One Earth* 4 (2021) 565–583, <https://doi.org/10.1016/j.oneear.2021.04.001>.
- [103] G. Hamilton, EPA: Regulate "chemical recycling" for what it is – incineration, Break Free From Plastic. <https://www.breakfreefromplastic.org/2022/03/09/epa-regulate-chemical-recycling-for-what-it-is-incineration/>, 2022 (accessed September 12, 2022).
- [104] V. Singla, T. Wardle, Recycling Lies: "Chemical Recycling" of Plastic Is Just Greenwashing Incineration, NRDC. <https://www.nrdc.org/resources/recycling-lies-chemical-recycling-plastic-just-greenwashing-incineration>, 2022 (accessed September 12, 2022).
- [105] BASF, *Sustainability*. <https://www.basf.com/global/en/investors/calendar-and-publications/factbook/basf-group/strategy/sustainability.html>, 2022 (accessed September 3, 2022).
- [106] Dow, *2025 Sustainability Goals*, (n.d.). <https://corporate.dow.com/en-us/science-and-sustainability/2025-goals.html> (accessed September 1, 2022).
- [107] L.J. Nilsson, F. Bauer, M. Åhman, F.N.G. Andersson, C. Bataille, S. de la Rue, K. du Can, T. Ericsson, B. Hansen, S. Johansson, M. van Lechtenböhmer, V. Vogl Sluisveld, An industrial policy framework for transforming energy and emissions intensive industries towards zero emissions, *Clim. Pol.* 21 (2021) 1053–1065, <https://doi.org/10.1080/14693062.2021.1957665>.
- [108] P. Peeters, J. Higham, D. Kutzner, S. Cohen, S. Gössling, Are technology myths stalling aviation climate policy? *Transp. Res. Part D: Transp. Environ.* 44 (2016) 30–42, <https://doi.org/10.1016/j.trd.2016.02.004>.
- [109] D. Saygin, D. Gielen, Zero-emission pathway for the global chemical and petrochemical sector, *Energies* 14 (2021) 3772, <https://doi.org/10.3390/en14133772>.
- [110] F. Bauer, T.D. Nielsen, L.J. Nilsson, E. Palm, K. Ericsson, A. Fråne, J. Cullen, Plastics and climate change—breaking carbon lock-ins through three mitigation pathways, *One Earth* 5 (2022) 361–376, <https://doi.org/10.1016/j.oneear.2022.03.007>.
- [111] INEOS, *INEOS at Grangemouth announces plans to construct a Low-Carbon Hydrogen Manufacturing Plant*, (n.d.). <https://www.ineos.com/news/shared-news/ineos-at-grangemouth-announces-plans-to-construct-a-low-carbon-hydrogen-manufacturing-plant/> (accessed May 19, 2022).
- [112] Iberdrola will build and operate the world's largest on site photovoltaic self-consumption system for SABIC, Iberdrola. (n.d.). <https://www.iberdrola.com/press-room/news/detail/iberdrola-will-build-operate-world-s-largest-site-photovoltaic-self-consumption-system-sabic> (accessed May 19, 2022).
- [113] Mitsubishi Chemical, *Sustainability Report 2020*. https://www.m-chemical.co.jp/en/csr/pdf/sr_mcc_2020.pdf, 2021.
- [114] US Environmental Protection Agency, L.P. Equistar Chemicals, L.C.C. collab <collab> LyondellBasell Acetyls, Lyondell Chemical Company Clean Air Act Settlement. <https://www.epa.gov/enforcement/equistar-chemicals-lp-lyondellbasell-acetyls-llc-and-lyondell-chemical-company-clean>, 2021 (accessed February 17, 2022).
- [115] D.M. Sicotte, From cheap ethane to a plastic planet: regulating an industrial global production network, *Energy Res. Soc. Sci.* 66 (2020), 101479, <https://doi.org/10.1016/j.erss.2020.101479>.
- [116] I. Schlegel, C. Gibson, *The Making of an Echo Chamber: How the Plastic Industry Exploited Anxiety About COVID-19 to Attack Reusable Bags*, 2020.
- [117] R. Gillard, Unravelling the United Kingdom's climate policy consensus: the power of ideas, discourse and institutions, *Glob. Environ. Chang.* 40 (2016) 26–36, <https://doi.org/10.1016/J.GLOENVCHA.2016.06.012>.
- [118] A. Bjørn, J.P. Tilsted, A. Addas, S.M. Lloyd, Can science-based targets make the private sector paris-aligned? A review of the emerging evidence, *Curr. Clim. Chang. Rep.* (2022), <https://doi.org/10.1007/s40641-022-00182-w>.
- [119] D. Barrowclough, G. Finkill, *Banks, Bonds and Petrochemicals - Greening the Path From the Copenhagen Agreement, Through Covid and Beyond* 69, UNCTAD Research Paper, 2021. UNCTAD/SER.RP/2021/12.
- [120] C. Binz, B. Truffer, Global innovation systems—a conceptual framework for innovation dynamics in transnational contexts, *Res. Policy* 46 (2017) 1284–1298, <https://doi.org/10.1016/j.respol.2017.05.012>.

- [121] Sustainability | ExxonMobil Product Solutions, (n.d.). <https://www.exxonmobilchemical.com/en/exxonmobil-chemical/sustainability> (accessed September 4, 2022).
- [122] Petrochemistry in Europe - Petrochemicals Europe, Petrochemicals Europe. (n.d.). <https://www.petrochemistry.eu/> (accessed August 22, 2022).
- [123] J. Rissman, C. Bataille, E. Masanet, N. Aden, W.R. Morrow, N. Zhou, N. Elliott, R. Dell, N. Heeren, B. Huckestein, J. Cresko, S.A. Miller, J. Roy, P. Fennell, B. Cremmins, T.Koch Blank, D. Hone, E.D. Williams, S. de la Rue du Can, B. Sisson, M. Williams, J. Katzenberger, D. Burtraw, G. Sethi, H. Ping, D. Danielson, H. Lu, T. Lorber, J. Dinkel, J. Helseth, Technologies and policies to decarbonize global industry: Review and assessment of mitigation drivers through 2070, *Applied Energy*. 266 (2020) 114848, <https://doi.org/10.1016/j.apenergy.2020.114848>.
- [124] L. Cahen-Fourrot, E. Campiglio, A. Godin, E. Kemp-Benedict, S. Trsek, Capital stranding cascades: The impact of decarbonisation on productive asset utilisation, *Energy Econ.* 103 (2021), 105581, <https://doi.org/10.1016/j.eneco.2021.105581>.
- [125] M. Paterson, "The end of the Fossil Fuel Age"? Discourse politics and climate change political economy, *New Political Econ.* 26 (2021) 923–936, <https://doi.org/10.1080/13563467.2020.1810218>.
- [126] A. Arora, R. Landau, N. Rosenberg, *Chemicals and Long-term Economic Growth: Insights From the Chemical Industry*, Wiley, New York, 1998.
- [127] L. Cahen-Fourrot, E. Campiglio, E. Dawkins, A. Godin, E. Kemp-Benedict, Looking for the Inverted Pyramid: An Application Using Input-Output Networks ☆, 2019, <https://doi.org/10.1016/j.ecolecon.2019.106554>.
- [128] Petrochemicals Europe, Flowchart poster, (n.d.). https://www.petrochemistry.eu/wp-content/uploads/2021/05/Petrochemistry-FlowChart_2019MC_V13-13092019-withoutFolds.pdf (accessed August 22, 2022).
- [129] J.S. Dryzek, *The Politics of the Earth*, 3rd ed., Oxford University Press, Oxford, 2017 <https://doi.org/10.1093/hepl/9780199696000.001.0001>.
- [130] M. Contiero, *TOXIC LOBBY How the Chemicals Industry Is Trying to Kill REACH*, 2006.
- [131] T.Dan Nielsen, K. Holmberg, J. Stripple, Need a bag? A review of public policies on plastic carrier bags-where, how and to what effect?, 2019, <https://doi.org/10.1016/j.wasman.2019.02.025>.
- [132] R.J. Brulle, Institutionalizing delay: foundation funding and the creation of U.S. climate change counter-movement organizations, *Clim. Chang.* 122 (2014) 681–694, <https://doi.org/10.1007/s10584-013-1018-7>.
- [133] K. Marusic, The Titans of Plastic, *EHN*. <https://www.ehn.org/the-titans-of-plastic-2657986993.html>, 2022 (accessed September 16, 2022).
- [134] L. Persson, B.M.C. Almroth, C.D. Collins, S. Cornell, C.A. de Wit, M.L. Diamond, P. Fantke, M. Hassellöv, M. MacLeod, M.W. Ryberg, P.S. Jørgensen, P. Villarrubia-Gómez, Z. Wang, M.Z. Hauschild, Outside the safe operating space of the planetary boundary for novel entities, *Environmental Science & Technology*. (2022), <https://doi.org/10.1021/ACS.EST.1C04158> acs.est.1c04158.
- [135] F. Bauer, C.Deere Birkbeck, A New International Treaty to End Plastic Pollution: From Ambition to Concrete Commitments, Meaningful Action and Effective Governance, *The Global*. <https://theglobal.blog/2022/03/04/a-new-international-treaty-to-end-plastic-pollution-next-step-is-translating-an-ambitious-mandate-in-to-meaningful-action/>, 2022 (accessed March 4, 2022).
- [136] CIEL, *Convention on Plastic Pollution: Toward a New Global Agreement to Address Plastic Pollution*, 2020.
- [137] I. Vormedal, L.H. Gulbrandsen, J.B. Skjærseth, Big oil and climate regulation: business as usual or a changing business? *Glob. Environ. Politics* 20 (2020) 143–166, https://doi.org/10.1162/GLEP_A_00565.
- [138] H. Breetz, M. Mildenerger, L. Stokes, The political logics of clean energy transitions, *Bus. Politics* 20 (2018) 492–522, <https://doi.org/10.1017/bap.2018.14>.
- [139] J.D. Colgan, J.F. Green, T.N. Hale, Asset revaluation and the existential politics of climate change, *Int. Organ.* 75 (2021) 586–610, <https://doi.org/10.1017/S0020818320000296>.
- [140] G. Supran, Fueling their own climate narrative; using techniques from big data to decode Big Oil's climate change propaganda, *Science* 374 (2021) 702, <https://doi.org/10.1126/SCIENCE.ABM3434>.
- [141] R.N. Proctor, *Golden Holocaust*, University of California Press, 2012, <https://doi.org/10.1525/9780520950436>.
- [142] D. Gladwin, *Digital Storytelling Going Viral: Using Narrative Empathy to Promote Environmental Action*, 2020, <https://doi.org/10.1080/25741136.2020.1832827>.
- [143] Z. Janipour, V. de Gooyert, M. Huijbregts, H. de Coninck, Industrial clustering as a barrier and an enabler for deep emission reduction: a case study of a Dutch chemical cluster, *Clim. Pol.* 22 (2022) 320–338, <https://doi.org/10.1080/14693062.2022.2025755>.
- [144] Z. Janipour, R. de Nooij, P. Scholten, M.A.J. Huijbregts, H. de Coninck, What are sources of carbon lock-in in energy-intensive industry? A case study into Dutch chemicals production, *Energy Res. Soc. Sci.* 60 (2020) 101320, <https://doi.org/10.1016/j.erss.2019.101320>.