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REACHing for divergence?—UK chemical regulation post-Brexit

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Abstract

On 1 January 2021, the United Kingdom formally exited the European Union (EU; Brexit) and ceased to be subject to EU chemical regulation requirements. Before Brexit, UK chemical policy was regulated largely by the EU. With its large internal market, sophisticated regulatory capability, and stringent regulatory framework, the EU has become the world's leading regulatory state, regularly influencing global industrial decisions and practices. At the time of writing, there has been limited academic analysis of the implications of Brexit for UK chemical regulation. More than two years post-Brexit, we have the opportunity to assess UK chemical regulation and revisit early expectations about regulatory divergence. This article takes the EU's Regulation on the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) as a case study to analyze patterns of post-Brexit regulatory divergence, thereby providing one of the first analyses of the implications of Brexit on UK chemical regulation. Through the analysis and review of key documents and reports ($n = 99$), this article assesses the extent to which UK and EU regulatory (REACH) regimes are beginning to diverge and discusses the potential implications of any divergence for the United Kingdom. We find that the UK and EU chemical regulatory regimes are now evolving independently and provide clear, empirical evidence of an emerging divergence in regulatory decisions, ambitions, and approaches. The evidence suggests that the United Kingdom is currently unable to keep pace with EU developments, lacking the capacity, expertise, and capability of its EU counterparts, raising the prospect of further divergence in the future. *Integr Environ Assess Manag* 2024;00:1–10. © 2024 The Authors. *Integrated Environmental Assessment and Management* published by Wiley Periodicals LLC on behalf of Society of Environmental Toxicology & Chemistry (SETAC).

KEYWORDS: Brexit; Brussels Effect; Chemical regulation; Regulatory divergence; Risk assessment

INTRODUCTION

On 1 January 2021, the United Kingdom formally exited the European Union (EU; i.e., Brexit) and ceased to be subject to EU chemical regulation requirements. Before leaving the EU, UK environmental policy had been controlled largely by the EU. For example, in 2023, more than 40 pieces of legislation (regulations and directives) across chemical groups and products (e.g., industrial chemicals, pesticides, pharmaceuticals, etc.) were in effect in the EU. The (EU) Registration, Evaluation, Authorisation, and Restriction of Chemical (REACH) regime regulates the manufacture, import, and placement of industrial chemical substances on the market, placing the burden of proof (for chemical safety) on manufacturers and importers (Scott, 2009). The enactment of REACH (in 2007) was a watershed moment in the regulation of harmful chemical products and substances across the globe (Rudén & Hansson, 2010).

With Brexit, the United Kingdom had chosen to withdraw its membership in and formal influence over policymaking and decisions in the EU and pursue its own agenda of divergence (e.g., "nonalignment") and deregulation (e.g., "cutting red tape" to remove or reduce regulatory, bureaucratic, and/or administrative barriers; HM Government, 2018b, 2021a, 2022a; Phinnemore, 2022). For chemicals, this includes a departure from the well-established REACH regime. Brexit presents a significant challenge to the UK government in terms of the regulation of traded goods and services, including chemical mixtures and substances (Bradford, 2020; Burns et al., 2022).

Described by Bradford as the "Brussels Effect" (Bradford, 2015), it is well documented that EU regulatory standards influence industrial decisions and practices across the globe (Bradford, 2020; Vogel, 1995), particularly in highly regulated areas such as chemicals. The EU single market is an important global destination, prompting many chemical manufacturers to export at an EU standard to avoid exclusion from the largest single market in the world (Bradford, 2020). Inconsistent standards can hinder cross-border trade (European Commission, 2009; Smith, 2010), whereas producing a single product for various markets is less expensive than producing numerous market-specific versions. Therefore, it is advantageous for foreign companies to apply EU rules to their

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production. This (voluntary) take-up of EU norms by multinational firms and companies is referred to as the "de facto Brussels Effect" (Bradford, 2020).

REACH has also triggered the "de jure Brussels Effect"—where non-EU or external governments, polities, and/or jurisdictions adopt EU standards through legislative change (Bradford, 2020). For instance, high EU standards have prompted state-level regulatory reforms across the globe (Bradford, 2020; EUPHOR, 2017). States such as South Korea, China, Turkey, and Japan have all implemented legislation that has been modeled, to varying degrees, on EU chemical regulations (Bradford, 2020; EUPHOR, 2017). Some (South Korea, Turkey, Switzerland) have implemented legislation closely modeled on REACH (e.g., K-REACH; TCCA, 2010) whereas others (China, Japan, India; CMSR, 2020; ENCS, 2009; Inventory of Existing Chemical Substances in China IECSC, 2013) have borrowed certain aspects of EU REACH. The REACH regulation takes a precautionary approach to chemical risk where, in the absence of certainty, a chemical is considered hazardous until proven safe. Historically, the United States has taken an alternative approach to regulation, presenting the narrative that a chemical is safe until proven otherwise. However, the US administration now acknowledges the need for US companies to align with EU REACH—particularly regarding safety data information (Bradford, 2020).

Since 2016, successive UK governments have frequently presented the narrative that the United Kingdom's departure from the EU creates a "unique opportunity" to "take back control" (Gove, 2017; HM Government, 2018b), review the laws that govern the nation (HM Government, 2021a), break away from EU rule, and amend regulations to best support the needs and interests of the United Kingdom (Gove, 2017; HM Government, 2022a, 2022b). For the most part, the United Kingdom has not made any major changes to chemical regulations post-Brexit. Instead, it has made minor amendments and tweaks to existing rules and legislation, ensuring that they made sense in a post-Brexit United Kingdom (HM Government, 2021b; House of Commons, 2021). Generally, this has involved technical changes to remove references to EU institutions that no longer play a role in UK legislation or tweaks for consistency with other domestic laws (HM Government, 2019, 2021b). In essence, this allows Great Britain to develop its own regulatory regime.

Over time, regulatory divergence is likely because UK REACH need not follow developments in the EU (UK in a Changing Europe, 2021). The term regulatory divergence can be conceptualized as the opposite of regulatory alignment (Baldock & Nicholson, 2022; Jordan, 2019). For UK and EU policy, regulatory alignment is where the UK government chooses to adopt the same environmental measures as the EU, on broadly the same timetable (Baldock & Nicholson, 2022; Jordan, 2019). Although regulatory divergence is considered anything other than alignment, Baldock and Nicholson (2022) have suggested that divergence exists on a continuum (Figure 1), where a UK government might take an ad hoc approach to alignment, electing to follow EU law where it is more convenient, cost-effective, and/or in the UK interest; a "passive" approach (i.e., divergence by default), whereby some amendments to EU law are adopted in the United Kingdom; or an "active" approach (i.e., "divergence by design"), where a UK government enacts its own domestic policies (different than EU), prompted by a desire to do things differently (Baldock & Nicholson, 2022). Divergence might not only occur in the decisions or issues being addressed. It might also take the form of divergence in regulatory principles and philosophy, policy design, timeliness, and enforcement, as well as in the transparency and reporting of decision-making processes. There are concerns that if UK regulating agencies fail to keep pace—or in fact actively choose to diverge from restrictions adopted by the EU—the United Kingdom will become a "dumping ground" for surplus material restricted in the EU (or elsewhere) that can no longer be traded or produced (Green Alliance, 2018; Peake, 2018).

Discussion on UK environmental policy post-Brexit has focused primarily on totemic issues such as fisheries and agriculture (Churchill, 2022; Dwyer, 2018; Hubbard et al., 2018; Stewart et al., 2022), with both having gained significant support to deliver radically changed arrangements and control outside the EU during the referendum campaign (House of Lords, 2017). However, there has been limited academic analysis of the implications of Brexit for UK chemical regulation. Any attempts thus far have been largely hypothetical, speculating on the risks (Burns et al., 2018; Scheidmann & Kottmann, 2018) and challenges (Dereskeviciute & Rabitti, 2021; Wright & Doukas, 2021) of an independent UK chemical regime outside the sophisticated regulatory institutions of the EU. We are now at a stage where the United Kingdom has left the EU and has taken control of independent, post-Brexit environmental policies and regulations, including UK REACH. Therefore, it is the right time to review the regulation of chemical risk and begin to assess the impact of Brexit on UK chemical regulation and policy.

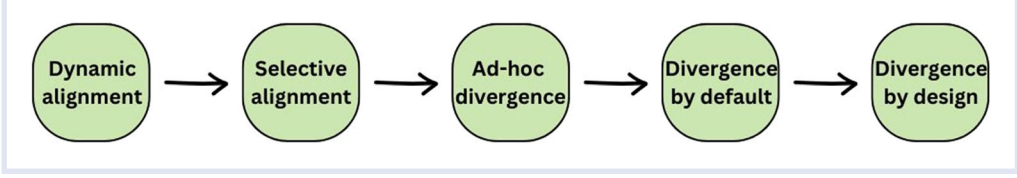

FIGURE 1 Continuum of regulatory divergence as theorized by Baldock and Nicholson (2022)

Aims and research questions

Drawing on existing work on regulatory divergence (Baldock & Nicholson, 2022; Lydgate & Anthony, 2022) and the context of environmental regulation and policy post-Brexit (Burns et al., 2019; Churchill, 2022; Stewart et al., 2022; Wright & Doukas, 2021), the following questions have been developed:

i. To what extent has UK chemical regulation diverged from EU chemical regulation since its departure?
ii. What are the potential implications of UK–EU divergence for UK chemical regulation?

This article offers one of the first analyses of the implications of Brexit on UK chemical regulation, using the REACH regulation as a case study.

This article is based on a comprehensive review of primary and secondary documentary sources (see Materials and Methods in Supporting Information) published since the Brexit referendum (June 2016), thereby contributing to a burgeoning literature on the impacts of Brexit (see inter alia, Burns et al., 2019; Copeland, 2016; Gravey & Jordan, 2023; Wolff & Piquet, 2022).

To answer these research questions, this article first establishes the regulatory landscape and basic legal framework that governs the manufacture, import, and use of industrial chemicals in the United Kingdom post-Brexit. Next, we examine developments in the now independent UK and EU REACH regimes to analyze the extent of UK–EU divergence before discussing the potential consequences and/or opportunities of UK–EU divergence for UK chemical regulation. The article concludes by discussing the overall findings in relation to the two research questions outlined above.

REGULATORY LANDSCAPE AND BASIC LEGAL FRAMEWORK FOR POST-BREXIT UK CHEMICAL REGULATION

On 31 January 2020, the United Kingdom formally left the EU. Before its departure, the UK government confirmed that it would not seek "associate membership" and/or participation in EU regulations (e.g., EU REACH) and institutions (e.g., the European Chemicals Agency [ECHA]; Merrick, 2020; Pow, 2020), thereby maintaining the ability to diverge. Although the Trade and Cooperation Agreement (TCA) set out the framework for cooperation on specific regulatory arrangements (European Commission, 2020b) for chemicals, it failed to include the competency and responsibility of EU institutions (e.g., ECHA, European Food Safety Authority [EFSA], European Medicines Agency [EMA]). Crucially, there was no provision in the UK's withdrawal from the EU for UK access to the EU REACH database—a detailed database containing information on the intrinsic properties of chemical products and substances for the purposes of human and environmental safety (House of Commons, 2021). Although the database itself is publicly available, only EU Member States have access to the complete registration dossier containing detailed information on the hazard of a substance, risk, and relevant control measures used to register a substance (European Commission, 2006).

At the point of departure, the United Kingdom's previously existing Health and Safety Executive (HSE), with the help of the Environment Agency (EA), assumed the regulatory responsibilities of the ECHA to become the United Kingdom's only chemical regulatory division (HM Government, 2019; House of Commons, 2021). The Department for the Environment, Food and Rural Affairs (Defra) assumed the executive responsibility of the Commission to lead on UK policy. For the sake of simplicity and to maintain trade and market access, the UK government simply copied pre-Brexit EU rules and regulations into its own domestic law book—commonly referred to as "Retained EU Law" (REUL; European Commission, 2020b). For ease, EU REACH (among other regulatory frameworks) was preserved in domestic legislation to become UK REACH, relating to chemical products and substances imported, distributed, or sold in Great Britain (HM Government, 2021b). Under the Northern Ireland Protocol (NIP; HM Government, 2018c), Northern Ireland must remain aligned with the EU and therefore continue to follow EU REACH.

The legislation states that the UK version of REACH will remain "pretty much aligned" to EU REACH, maintaining the same level of health and environmental standards while replicating its function "as closely as possible" (House of Commons, 2021). The House of Commons Environmental Audit Committee recommended in 2019 that the United Kingdom remain aligned to the EU and that any deregulation or divergence from EU rule "should only happen where the intention is to increase safety standards" (House of Commons, 2019). Lord Goldsmith (Minister for International Environment 2020–2022) stated in 2020 that the United Kingdom "will not diverge simply for the sake of it" but that any decision on an independent UK chemicals regime "would be consistent with the fundamental aims and principles of REACH" and use scientific evidence (Goldsmith, 2020).

In choosing to depart from EU REACH, the United Kingdom is no longer able to use the best and most robust source of evidence when assessing chemical safety (Greener, UK., 2021). Only countries that align with EU REACH can access and/or use REACH data for registering substances. The absence of this provision has required the development of, and registration to, a UK-only database, costing the United Kingdom an estimated £13 million per year (Coffey, 2019). It is not possible for the United Kingdom to simply copy the EU REACH database—largely because of its centralized nature, time required to develop it, expense, and legal complexity. Commentators have suggested that maintaining alignment with the EU, and therefore ensuring access to the REACH database, would have been more cost-effective, preventing unnecessary expenditure (and time) on system duplication and testing (Greener, UK, 2020; House of Commons, 2021). Under EU membership, the UK chemical industry is predicted to have spent more than £500 million (since 2006) complying with EU REACH. An impact assessment by the UK government undertaken in mid-2022 estimated the average total

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cost of registering substances (previously registered in the EU) under UK REACH to be between £1.5 and £3.5 billion (Defra, 2022b). These costs are primarily the result of UK companies having to buy access to existing data through commercial data sharing agreements (with the EU) and administration, rather than the duplication of necessary testing procedures for registration.

At the point of departure, authorization under EU REACH could be transferred to UK REACH on the basis that a company interested in using a previously authorized substance submit registration data to the United Kingdom's HSE over the course of a transition period. Initially, this was set to run to October 2023 (depending on tonnage band); however, in November 2022, the UK government announced that, after public consultation, it would extend the deadlines for registration by a further three years (HM Government., 2022f). This means the first deadline (i.e., substances manufactured or imported in quantities >1000 t per year) is now set for October 2026, with further deadlines (i.e., substances manufactured or imported in quantities >100 t per year; and >1 t per year) delayed until 2028 and 2030, respectively.

The UK government also committed to exploring an alternative transitional registration model (ATRm) with the aim of reducing costs to businesses transitioning to UK REACH (Eustice, 2021b). After a review of the implementation of UK REACH and the current regulatory framework, Defra published a policy paper in November 2023 (Defra, 2023) outlining the policy direction of the ATRm. The UK government confirmed that it would not explore a "Swiss approach" where full registration data for chemicals registered in EU REACH are not required (Defra, 2022b). Such an approach would reduce costs for duplication; however, it would require alignment of the UK regime with the EU (Northern Ireland already is under the NIP), something the UK government has firmly rejected (Eustice, 2021a). Instead, the UK government stated that UK regulators "do not need to hold a complete replica of all the registration data on all chemical substances under EU REACH in order for UK REACH to undertake its regulatory work" (Defra, 2023). Defra suggested adopting a more targeted approach to regulation under UK REACH using available information to identify areas of emerging risk and regulatory priority from work done elsewhere in Europe and across the globe (Defra, 2023). Defra intended to consult (in early 2024) on matters relating to the ATRm, including proposals on refining information on "hazard" and "use and exposure," reducing costs to business associated with accessing existing EU data, improving Regulator powers, and reviewing existing fee structures (Defra, 2023); however, no public consultation on this had emerged by March 2024.

EVIDENCE OF REGULATORY DIVERGENCE

Divergence in oversight and capacity

Burns et al. (2019) identified capacity as a crucial mediating factor in the extent to which the United Kingdom might de-Europeanize and thus diverge from the EU. Following Brexit, UK authorities have struggled to keep pace with new EU REACH regulations. A report published in May 2022 by the National Audit Office (NAO, 2022) stated that, although budgets have increased, UK regulators have faced operational challenges since EU Exit, including staff recruitment and expertise, access to data, risk assessment, and approval (Burns et al., 2022; NAO, 2022). A dedicated UK REACH helpline and service desk was established in HSE to support companies in their transition to a UK-only system. However, the HSE has a staff of only 40 and an expected annual budget of £13 million (Coffey, 2019)—as compared with the ECHA, which has an annual budget of €100 million and a staff of 400. Consequently, UK authorities face the challenge of reduced regulatory capacity, capability, and oversight compared with their EU counterparts (Green Alliance, 2019; Wright, 2022), due to their inability to replicate the correct and efficient functioning of EU institutions (European Policy Centre EPC, 2019; NAO, 2021).

Divergence in regulatory decision

The comparative lack of regulatory capacity and resources to assess risk in the United Kingdom since its departure from the EU has resulted in the United Kingdom considering far fewer protective controls, hazardous substances, or restrictions than that of the EU. As Table 1a illustrates, UK regulators (i.e., HSE) have been unable to regulate the same number of substances (as the EU) under a UK REACH regime since the United Kingdom's departure from the EU on 31 December 2020. For instance, in March 2021, Defra announced the start of an official review period for two initial substances of restrictions under UK REACH—lead ammunition and per- and polyfluoroalkyl substances (PFAS) used in tattoo inks (Defra, 2022b). At the same time, EU REACH was considering more than a dozen hazardous chemical substances that have either been adopted or are in the final

TABLE 1 Number of chemical restrictions submitted (as of October 2023) under the United Kingdom and European Union (EU) Registration, Evaluation, Authorisation, and Restriction of Chemical (REACH) regulatory regimes since (a) the end of the Brexit transition (1 January 2021) and (b) the United Kingdom left the EU (31 January 2020)

	UK	EU
(a) End of Brexit transition (1 January 2021)		
Intention for restriction	2	26
Candidate (SVHC) list	0	15
Authorization list	0	5
(b) United Kingdom left the EU (31 January 2020)		
Intention for restriction	6	30
Candidate (SVHC) list	4	19
Authorization list	11	16

Notes: Chemical restrictions submitted as an "Intention for restriction;" or inclusion on the Candidate (SVHC) list or Authorization list.
Abbreviation: SVHC, substances considered to be of very hazardous concern.

stages of restriction since the end of the Brexit transition process (see Table 1b).

In total, the EU has restricted (or is in the process of restricting) 30 substances since the end of (the UK's) EU membership, whereas as of January 2023, the United Kingdom has restricted only six (20%; Table 1a). Crucially, all six of these substances were proposed for restriction when the United Kingdom was still a member of the EU, with the United Kingdom having initiated (as of October 2023) no restrictions of its own since the end of the transition period (1 January 2021). Similarly, only four (21%) chemical substances have been added to the UK REACH Candidate list (listing substances considered to be of very hazardous concern [SVHC]) compared with 19 in the EU, and 11 (69%) for authorization in the United Kingdom compared with 16 under EU REACH (Table 1a). Only two substances have been recommended for inclusion in the authorization list under UK REACH—dicyclohexyl phthalate (DCHP) and disodium octaborate (see consultation response; HM Government, 2022c, 2022d). There have been no UK-initiated substances added to the candidate or authorization list since the end of transition (1 January 2021).

Divergence in regulatory ambition

Divergence is also seen in UK–EU regulatory ambition. In June 2022, the UK HSE published its 2022/2023 work program for UK REACH (HSE, 2022). This set out five priority areas of focus; however, it failed to set out any formal restriction or authorization process. The five priority areas of focus listed chemical groups and/or substances where the United Kingdom intends to reassess the evidence base (e.g., flame retardants, intentionally added microplastics) or subject substances to a regulatory management option analysis (RMOA; e.g., PFAS; formaldehyde, and formaldehyde releasers in articles, and bisphenols in thermal paper) for potential restriction; HSE, 2022). The work program also highlights 10 chemical substances that have been restricted in the EU (since EU Exit) that the United Kingdom will not take forward for assessment (including calcium cyanide; polycyclic aromatic hydrocarbons [PAH] and undecafluorohexanoic acid [PFHxA], its salts and related substances)—considering these "not a priority for action this year" (Defra, 2022b). When questioned on the time frame for initiating restrictions on each of the 10 hazardous substances adopted by ECHA, Defra Minister Rebecca Pow stated that the United Kingdom "will continue to identify further measures to safeguard human health and the environment based on robust science and the best available evidence," including that developed by ECHA (Pow, 2022). However, she also noted that "future work programmes will address issues that we consider to be most pressing in Great Britain" (Pow, 2022). The UK government continues to state that its "approach to substance selection will seek to complement, rather than replicate, evaluation work performed by other regulatory regimes (e.g., EU REACH)" to increase understanding of the hazard and risk profiles of GB-relevant substances for restriction (Defra, 2022a; HSE, 2022).

Divergence in regulatory approach

Setting policy goals in line with its ambition for a "toxic-free environment" (European Commission, 2019, 2021), the EU published its Chemical Strategy for Sustainability (CSS; European Commission, 2020a) in October 2020. The CSS set out proposals for more than eight new regulatory measures and introduced concepts such as "essential use," "Safe and Sustainable by Design", and "nonregrettable substitution," as well as a mixture assessment factor to address harmful chemical mixtures. Crucially, the CSS set out its ambition to revise the REACH regulation (European Commission, 2020a). This includes a revision of registration requirements to better facilitate the identification and restriction of substances with critical hazard properties (e.g., carcinogenic, endocrine disruption), while simplifying communication within the supply chain.

In line with its ambition for a "toxic-free environment" (European Commission, 2019), the European Commission published its Restriction Roadmap in 2022 (European Commission, 2022; the "Roadmap"). Dubbed the "largest ever ban of toxic chemicals" (European Environmental Bureau EEB, 2022b), the Roadmap has been designed to prioritize the most harmful substances (i.e., carcinogenic, mutagenic, and reprotoxic substances [CMRs]; endocrine disrupting compounds [EDCs]; persistent, bioaccumulative, and toxic [PBT] substances; very persistent, very bioaccumulative [vPvB] substances; immunotoxicants; neurotoxicants; respiratory sensitizers; and substances toxic to specific organs) for restriction under EU REACH. The Roadmap could see up to 12 000 new restrictions on chemicals where there are concerns for human and environmental health. Seen as reflecting the precautionary principle—that is, where the inconclusive or imprecise nature of chemical substances makes it impossible to assess risk with sufficient certainty (Scott et al., 1999)—this "generic" approach to risk management seeks to regulate chemicals for all uses (not just industrial processes) and in groups, based on chemical structure, property, or function. If the United Kingdom chooses to ignore developments in the EU and maintain a predominantly risk-based approach to chemical regulation (i.e., considering the exposure of a substance alongside its hazard) rather than the EU's hazard-based approach, there is significant scope for divergence (potentially 10 000s of substances).

Divergence in timeliness and scope of policy commitments

In 2018, in its 25 Year Plan for the Environment, the UK government committed to publish a new, overarching chemical strategy, setting out its approach to chemical regulation post-Brexit (HM Government, 2018a). Although light on detail, the plan hints at the United Kingdom exploring actions around the early warning and identification of emerging chemical issues (specific to the United Kingdom), the combination effect of chemicals, the recycling and reuse of chemicals already in the supply chain,

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and tracking chemicals across their entire life cycle (HM Government, 2018a). Broadly, the strategy will set out the United Kingdom's approach to tackling (UK) chemicals of concern and reduce, through a series of immediate priorities and actions within its own domestic regulations, the quantity of harmful chemicals entering the (UK) environment.

Following a ministerial roundtable at the end of April 2022, work began on a series of external stakeholder workshops for a future UK chemical strategy (HM Government, 2018a; Stringer, 2022). Workshops were held by Defra throughout summer 2022 to help inform the strategy across six major themes: (1) Vision and principles, (2) Innovation, (3) International, (4) Priority chemical issues and future chemical risks, (5) Managing chemicals throughout their life cycle, and (6) Effective regulation. The strategy must also reflect the United Kingdom's future relationship with the EU, after the failure to negotiate an arrangement for data sharing or association with EU regulations (i.e., REACH) and institutions (i.e., ECHA) within a UK–EU trade deal.

Despite first being promised in 2018 and having deadline after deadline delayed—the most recent being a commitment to publish the strategy in 2023 (HM Government, 2023)—Defra confirmed in a regulation and policy update to the UK Chemical Stakeholder Forum (October 2023) that the strategy will now be published in 2024 (Adie, 2023). It states that this agrees with "stakeholder feedback to consult further in the development of the strategy" and anticipates publishing the strategy in early 2024 (Adie, 2023). At the time of writing (March 2024), no details or requests for stakeholder consultation and feedback have emerged.

It is not yet clear whether the development of the UK strategy will lead to divergence between UK–EU REACH regimes. However, further delay (by the United Kingdom) will only provide a greater opportunity for divergence as the European Commission moves forward with delivering more than 70 actions in its Green Deal commitment to reach zero pollution by 2050 (European Commission, 2019).

POTENTIAL IMPLICATIONS OF UK–EU DIVERGENCE FOR UK CHEMICAL REGULATION

It is critically important, in the context and functioning of trade agreements and market access, for regulatory styles and approaches to be maintained (Heyen, 2013; Smith, 2010). Regulation and construction of the Single European Market have created significant economic advantages in and across EU Member States, eliminating barriers to trade, capital, and labor, while ensuring the efficient flow of goods and services (Bradford, 2020; Smith, 2010). For chemical risk, EU regulation ensures the establishment of market-wide environmental and human health standards while encouraging competitive advantage and industrial innovation in a global setting (Bradford, 2020; Scott, 2009; Smith, 2010; Vogel, 1995). It is particularly important for the United Kingdom to consider how decisions to diverge from the EU could interact with its ability to trade with other jurisdictions and trade market bodies—not only the EU but also at a global scale.

If the United Kingdom fails to strengthen UK regulation in line with EU control, any divergence from EU REACH could result in significant cost (in the form of tariff and/or checks) to UK businesses trading with the EU, as they comply with two separate regulatory systems (House of Commons, 2021; Vogel, 1995). A core, underpinning principle of REACH is "one substance, one registration" (European Commission, 2006), meaning that companies must submit joint registrations when manufacturing and/or importing the same substance. This includes sharing access to test data (European Commission, 2006). With UK REACH diverging from EU REACH in both its process and restrictions, for the United Kingdom it is now "one substance, two registrations." This is already the case for Northern Ireland, where under the NIP (European Commission, 2020b; HM Government, 2018c), the island of Ireland continues to align with EU REACH.

In principle, it is possible for UK producers and manufacturers to adopt two different sets of standards—one for the EU market and another for the rest of the world. However, it may soon be uneconomical for substances to be registered with both UK and EU REACH given the costs associated with registration and compliance. For products that are widely traded between the United Kingdom and EU, there is a strong case for regulatory alignment where regulations and commitments are designed to address transboundary and/or shared resources (EPC, 2019; Jordan, 2019). With the UK government's decision to diverge and pursue nonalignment to enhance competitiveness, UK businesses wishing to trade with the EU (and Northern Ireland) may experience a competitive disadvantage facing an additional layer of complexity and compliance to meet EU standards (Spisak & Britto, 2021). Furthermore, because most companies do not have the luxury (or financial ability) to conform to two separate regulatory regimes, there is a possibility that some chemicals could disappear from the GB market with companies prioritizing the larger EU market (Burns et al., 2022; Spisak & Britto, 2021). Similarly, the EU may authorize substances for use before GB, meaning that a substance may be accessible on the EU market but not in Great Britain, fundamentally reducing the United Kingdom's ability to compete at the global level.

A UK–EU divergence could also mean different things across different parts of the United Kingdom. Brexit has seen the control and responsibility of issues related to the environment return to the United Kingdom's respective governments (i.e., England, Wales, Scotland, not including Northern Ireland, because under the NIP, Northern Ireland must align with EU standards). The UK government published a Chemicals and Pesticides Provisional Common Framework in February 2022 (HM Government, 2022e), which, although not legally binding, set out the policy responsibility and administrative arrangements of each devolved nation (England, Scotland, Wales, Northern Ireland), how the parties will work together, and operational arrangements (e.g., decision-making processes, communication, and stakeholder engagement). Although the environment is considered to be an issue of the devolved state, the Scottish and Welsh governments

do not have policy responsibility for regulatory processes and decisions related to the REACH regime (HM Government, 2022e). This is because UK REACH is a GB-wide regime, with Defra (aided by HSE and the EA) enacting regulatory decisions. For devolved matters, these decisions require the consent of Scottish and Welsh Ministers. With Scotland and Wales having stated their interest in and commitment to remaining aligned with EU law (Antoniw, 2022; Scottish Government, 2021), any significant divergence from EU rule that the UK government pursues likely risks political and/or economic tension within UK borders—affecting governance and coherence for the future of the union.

There could be good and legitimate reasons for the United Kingdom to diverge from EU rule, such as amending previous regulatory regimes to meet the needs and demands of UK domestic policy, regulatory innovation, and market competition (House of Commons, 2021; Spisak & Britto, 2021). Although EU REACH is widely considered to be the best chemical regulatory regime in the world, it is not without its flaws (European Commission, 2018; European Environmental Bureau EEB, 2022a). REACH was initially introduced to address the information gap in chemical products, but more than a decade after it started operating, it has failed to restrict the most harmful chemicals on the market (European Commission, 2018; EEB, 2022a).

With REACH placing the burden of responsibility for data provision on industry, a large proportion of chemicals (>80%) are being authorized for use while lacking adequate safety assessment or research (European Commission, 2021; European Environmental Bureau EEB, 2022a). Only 5% of dossiers must be checked for compliance (European Commission, 2006; European Environmental Bureau EEB, 2018), with (low) sanctions for noncompliance, providing no incentive for industry to abide by the rules (EEB, 2018, 2022a). Furthermore, although its aim is to accelerate the assessment and management of risk for the protection of human and environmental health (European Commission, 2006), REACH has apparently slowed them down. A 2022 report from the EEB (2022a) concluded that, even when a chemical has been identified as a substance of hazardous concern under REACH, it takes on average six years for the regulating authorities (e.g., ECHA) to restrict its use (EEB, 2022a). These delays have allowed the highly profitable chemical industry to increase the production and use of hazardous chemical substances without appropriate risk management (EEB, 2022a).

The European Commission was due to overhaul the EU REACH regulation by the end of 2022. However, as revisions were set to begin, the Commission delayed the start of the REACH reform to the last quarter of 2023, with some citing industrial pressure (Pickstone, 2022; Warhurst, 2022), the Russo–Ukrainian war (Scheuer, 2023), and the cost-of-living crisis as reasons for delay (Romano, 2022). Originally intended to increase the speed of decision-making, improve legal compliance, and support the transition to safe and sustainable chemicals, the reforms have since been postponed until 2025 (at the earliest), four years after their initial commitment. The European Environmental Bureau described the delays as effectively "game over" under the 2019–2024 EP legislature (European Environmental Bureau EEB, 2022c). Critics argue that, in scrapping bold plans against hazardous chemicals, the Commission has betrayed its own commitments to the protection of human and environmental health set out in the European Green Deal (European Commission, 2019) and Chemical Strategy for Sustainability (European Commission, 2020a; EEB, 2022c).

Although it is too early to assess the impact of divergence in UK–EU REACH regimes on businesses, human health, and/or the environment, it is important to consider likely costs and benefits. For example, if UK REACH continues to diverge and/or fall behind EU REACH, UK businesses may prioritize the EU market as trade barriers become too burdensome. While this may result in significant cost to the United Kingdom in lost value generation, reduced profits, and job loss, the adverse impacts these polluting industries have on human and environmental health may be reduced. Thus, societies and ecosystems in the United Kingdom could benefit from less chemical exposure. Alternatively, divergence may result in UK (and non-UK) businesses taking advantage of a more lenient regulatory regime if the United Kingdom fails to keep pace and falls behind. This would benefit the United Kingdom in increased value generation, industry profits, and the creation of jobs, but would negatively affect (i.e., cost) UK ecosystems and society because the adverse impacts of these polluting industries could lead to increased exposure of chemical substances to human and environmental health. The UK government has consistently stated that it has no intention of reducing environmental standards (see Carrington, 2022; HM Government, 2022a, 2022b) and is working to uphold its excellent record on issues related to the environment. However, CHEMTrust notes that this reputation has depended largely on EU membership (Warhurst, 2017, 2018).

CONCLUSION

This article has addressed two key research questions:

i. To what extent has UK chemical regulation diverged from EU chemical regulation since the UK's departure?
ii. What are the potential implications of UK–EU divergence on UK chemical regulation?

Comparing UK and EU REACH regulations (post-2016), this article provides clear evidence of an emerging divergence in UK–EU REACH regulatory decisions, ambitions, and approaches (Question i). The UK government has been unable to keep pace with EU regulation. It lacks the regulatory capacity, oversight, and capabilities of its EU counterpart, and a little more than two years after its departure, the United Kingdom is already failing to restrict the most harmful chemical substances or implement policy changes and commitments. This is a clear demonstration of divergence by default (i.e., passive divergence) in which a UK government has failed to enact all EU regulatory

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developments. The United Kingdom has remained interdependent with the EU because of the significant transposition of Retained EU Law. Thus, the purpose, aims, and scope of the REACH regulation have remained the same in the United Kingdom post-Brexit. However, the evidence that informs regulatory decisions, the institutions and departments that enact regulation and domestic priorities have all changed. This, in part, reflects the political landscape at the global scale where other urgent issues such as the COVID-19 pandemic, the Russo–Ukrainian War, and a looming economic recession have taken priority.

In departing the EU, the United Kingdom has the unique opportunity to rewrite its regulatory rulebook and amend, repeal, or replace regulations it feels are no longer necessary and/or suit the needs and demands of the nation. Such large-scale regulatory reform would likely see the United Kingdom diverge further and disengage from the EU, a process that goes against the general process of harmonization (and thus Europeanization) of global chemical regulation. Eventually, active divergence (i.e., divergence by design) could provide the United Kingdom the opportunity to make, amend, and enact regulation more effectively, at a faster pace, and to better suit the needs and demands of its own borders. However, as demonstrated in answering Question ii, any deviation or divergence between UK and EU regulatory regimes risks trade and market access, the environment, and human health. Divergence also threatens the manufacture and production of chemical goods, as industries may choose to export to a single market to reduce economic costs. This is of particular importance to issues of the devolved state where Northern Ireland (under the Northern Ireland Protocol) continues to align (i.e., engage) with the EU, whereas Scotland and (to a certain extent) Wales have pledged their desire to align (and thus reengage) with the EU.

The United Kingdom is currently at a crossroads. The extent to which the United Kingdom and EU can and/or will diverge depends largely on the decisions the UK government makes in the months and years ahead (Oziel, 2022). Alongside international treaties and conventions to which the United Kingdom is still a party (i.e., the Stockholm Convention), the Trade and Cooperation Agreement between the EU and the United Kingdom that governs their relationship could mediate the extent to which the United Kingdom can diverge from EU law. Commitments to "nonregression" and a "level playing field" constrain the parties to maintain at least the same level of standards as those prevailing at the end of the transition period. Crucially, the provisions also establish a mechanism for "rebalancing," where a party (be that the United Kingdom or EU) may implement a series of measures to rebalance standards when "significant divergences" create "material impacts on trade or investment" (European Commission, 2020b). Such provisions, along with the complexities involved in chemical regulation (i.e., trade, market access) will likely limit the extent to which the United Kingdom can or will continue to diverge from the EU (Baldock & Nicholson, 2022), particularly when the polity in which it wishes to trade and do business (i.e., the EU) is the world's largest trading bloc and a leading regulatory power (Bradford, 2020).

The development and transition from EU to UK REACH is by no means complete. The empirical contributions set out in this research are merely suggestive of the direction in which UK and EU regimes are moving, not the final result. Faced with the challenge of enacting its own independent chemical regime with limited resources, capacity, and expertise while maintaining trade and market access with the EU, the UK government must think critically about the impact of current decisions on future relationships. As the EU develops and rolls out its own Chemical Strategy in line with the commitments made in its Green Deal, the United Kingdom must decide whether it wishes to align with the priorities and targets set by the EU or follow its own path, reflecting different domestic policies, regulatory pressures, and demands (Spisak & Britto, 2021). With 2024 set to see the United Kingdom publish its eagerly awaited Chemical Strategy (at the time of writing in March 2024), alongside the (potential) reform of EU REACH in 2025, it is important that future research begins to assess the opportunities of an independent UK chemical regulatory regime.

AUTHOR CONTRIBUTION

Lowenna B. Jones: Conceptualization; formal analysis; investigation; methodology; project administration; visualization; writing—original draft; writing—review and editing. **Charlotte J. Burns**: Conceptualization; methodology; supervision; validation; writing—review and editing.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article because no new data were created or analyzed in this study. A full list of published documents analyzed for this study is available on reasonable request from the corresponding author Lowenna B Jones (lbjones3@sheffield.ac.uk).

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SUPPORTING INFORMATION

Figure S1a. Visual representation of the number and type of documents by year of publication (fig S1a) analyzed in this research.

Figure S1b. Visual representation of the number and type of documents by year of classification (fig S1b) analyzed in this research.

Figure S2. NVivo coding tree structure presented as a nodemap (fig S2) detailing primary and secondary codes.

Detailed description of the materials and methods used in this research.

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