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ARTICLE

Carbon Leakage and International Climate Change Law

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Abstract
Carbon leakage – the increase of greenhouse gas emissions in foreign jurisdictions following the introduction of domestic or regional climate mitigation measures – raises key questions in the climate change debate. This includes whether carbon leakage constitutes a threat to the environmental integrity of climate policies and, if so, how this could be mitigated. Through the use of four hypothetical models of international climate change regime, this article argues that international climate change law is a key factor in answering this two-part question. Firstly, the article demonstrates that the architecture of international climate change law affects whether carbon leakage can be considered as undermining the mitigation objective of climate policies. Secondly, it draws attention to the interaction – and potential tension – between carbon leakage prevention measures and international climate change law.

Keywords: Carbon leakage; Carbon border adjustment measures; Global carbon price; Paris Agreement; Common but differentiated responsibilities and respective capabilities

1. Introduction

The concept of carbon leakage refers to the increase of greenhouse gas (GHG) emissions abroad following the introduction of domestic or regional climate mitigation policies, such as carbon taxes and emissions trading schemes.[1] Because emissions have the same negative effect on the climate regardless of the location where they are

[1] Carbon leakage affects all types of mitigation policy, but so far leakage risks have been discussed primarily in the context of carbon pricing policies, and specifically in the context of the European Union (EU) emissions trading system; see S. Ambec, F. Esposito & A. Pacelli, 'The Economics of Carbon Leakage Mitigation Policies', Toulouse School of Economics Working Paper No. 1408, Sept. 2023, available at: https://www.tse-fr.eu/sites/default/files/TSE/documents/doc/wp/2023/wp_tse_1408.pdf; M. Grubb et al., 'Carbon Leakage, Consumption and Trade' (2022) 47 *Annual Review of Environmental Resources*, pp. 753–95, at 767; F. Misch & P. Wingender, 'Revisiting Carbon Leakage', International Monetary Fund (IMF) Working Paper, No. WP/21/207, 6 Aug. 2021, p. 3, available at: https://www.imf.org/en/Publications/WP/Issues/2021/08/06/Revisiting-Carbon-Leakage-462148; J. Ward et al., 'Carbon Leakage, Theory, Evidence and Policy Design', *Partnership for Market Readiness*, Technical Note 11, Oct. 2015, pp. 11–3, available at: https://openknowledge.worldbank.org/bitstream/handle/10986/22785/K8516.pdf?sequence=1&isAllowed=y. See also N.K. Dubasch et al., 'National and Sub-National Policies and Institutions', in Intergovernmental Panel on Climate Change (IPCC) (P.R. Shukla et al. (eds)), *Climate Change 2022: Mitigation of Climate Change. Contribution of*

generated, policymakers traditionally consider carbon leakage an environmental and economic risk.[2] Carbon leakage is seen as a threat to the 'environmental integrity' of domestic mitigation policies, as it could undermine, or even reverse, the effects of such policies.[3] Moreover, carbon leakage is associated with a loss of competitiveness for domestic enterprises. Domestic and regional mitigation policies have thus been designed to reduce, or eliminate, the risk of carbon leakage.[4] For example, countries that have introduced a carbon price traditionally grant tax exemptions, free allowances or subsidies to energy-intensive enterprises at risk of carbon leakage.[5] More recently, the policy debate has shifted to carbon border adjustment measures (CBAMs), which, in the European Union (EU), will gradually replace the system of free allowances as of 2026, while ensuring that 'the EU's climate objectives are not undermined'.[6]

In this article I bring a novel perspective on carbon leakage and carbon leakage prevention measures by providing a detailed analysis of their interaction with international climate change law. So far, the analysis of carbon leakage and carbon leakage prevention measures through the lens of international climate change law has been rather superficial. This can be explained by the limited engagement of legal scholars with the topic, which has been discussed primarily by economists. Most legal scholars make only passing reference to carbon leakage, which they often take as a given, in their work on climate change law.[7] They generally describe carbon leakage as a problem

Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge University Press, 2022), pp. 1354–450, at 1393.

2 A. Coste, M. Cali & D. Heine, 'Staying Competitive: Productivity Effects of Environmental Taxes', in M.A. Pigato (ed.), *Fiscal Policies for Development and Climate Action* (World Bank Group, 2019), pp. 65–114, at 74. See also C. Haywood, 'Carbon Leakage: The First Mover Disadvantage: Australia's Trade-Related Assistance Measures for Emissions-Intensive, Trade-Exposed Industries' (2011) 20(1) *Review of European, Comparative and International Environmental Law*, pp. 78–90.

3 C. Voigt, 'Security in a "Warming World": Competences of the UN Security Council for Preventing Dangerous Climate Change', in C.M. Bailliet (ed.), *Security: A Multidisciplinary Normative Approach* (Brill/Nijhoff, 2009), pp. 289–312, at 304.

4 I. Juergens, J. Barreiro-Hurlé & A. Vasa, 'Identifying Carbon Leakage Sectors in the EU ETS and Implications of Results' (2013) 13(1) *Climate Policy*, pp. 89–109, at 90. See also Grubb et al., n. 1 above, p. 755; T. Falcao, *A Proposition for a Multilateral Carbon Tax Treaty* (International Bureau of Fiscal Documentation (IBFD), 2019), pp. 141–80, at 142–3.

5 See United Nations (UN), *Handbook on Carbon Taxation for Developing Countries* (UN, 2021), pp. 113–4, available at: https://www.un.org/development/desa/financing/document/un-handbook-carbon-taxation-developing-countries-2021.

6 European Commission, Taxation and Customs Union, 'Carbon Border Adjustment Measures', available at: https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en. See also Regulation (EU) 2023/956 Establishing a Carbon Border Adjustment Mechanism [2023] OJ L 130/52, Recitals 9 and 12.

7 Some legal scholars have discussed the concept in more detail, but they do not engage explicitly with how international climate change law shapes the perception of carbon leakage risks as an environmental problem. See D.A. Farber, 'Carbon Leakage versus Policy Diffusion: The Perils and Promise of Subglobal Climate Action' (2013) 13(2) *Chicago Journal of International Law*, pp. 359–79; D.A. Farber, 'Climate Policy and the United States System of Divided Powers: Dealing with Carbon Leakage and Regulatory Linkage' (2014) 3(1) *Transnational Environmental Law*, pp. 31–55; B.G. Janzen, 'International Trade Law and the "Carbon Leakage" Problem: Are Unilateral U.S. Import Restrictions the Solution?' (2008) 8(2) *Sustainable Development Law & Policy*, pp. 22–6, endnotes at pp. 84–5; A. Shoyer, J. Sul & C. van der Ven, 'Carbon Leakage and the Migration of Private CO_2 Emitters to Other Jurisdictions', in K.R. Gray, R. Tarasofksy & C. Carlarne (eds), *The Oxford Handbook of International Climate Change Law* (Oxford University Press, 2016), pp. 285–312, at 286; F. Sindico,

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that international law can either create or eliminate, arguing, in particular, that carbon leakage risks exist because of the absence of international climate change agreements that impose uniform mitigation obligations on all countries.[8] Given the political hurdles to adopting and implementing such comprehensive international agreements, countries are encouraged to adopt carbon leakage prevention measures. Most of the literature analyzes these measures under international trade law, and only rarely discusses how they interact with the international climate change regime.[9] For example, Mehling and his co-authors view carbon leakage as a problem that 'threatens to undermine aggregate emission reductions and the effectiveness of collective climate action'.[10] In their view, this justifies the adoption of CBAMs, the design features of which should comply with the law of the World Trade Organization (WTO).[11]

My first argument is that international climate change law cannot fully eliminate carbon leakage risks. Rather, it can neutralize their environmental effects, even under a differentiated approach to climate mitigation. To that end, I analyze carbon leakage risks under four models of hypothetical international climate change regime, each characterized by a different architecture. I use the term 'architecture' to refer to the building blocks that serve as the foundation of international climate change agreements.[12] The four models that I analyze are based on building blocks that are

'Why Comply when Others Are Not Bound? Emissions Trading, Carbon Leakage and Trade Measures', in S. Maljean-Dubois & L. Rajamani (eds), *Implementation of International Environmental Law* (Brill/Nijhoff, 2011), pp. 209–50, at 225; Y. Spassov, 'EU ETS: Upholding the Carbon Price without Incidence of Carbon Leakage' (2012) 24(2) *Journal of Environmental Law*, pp. 311–44, at 316–8.

[8] See R. Quick, 'Border Tax Adjustments to Combat Carbon Leakage: A Myth' (2009) 4(11–12) *Global Trade and Customs Journal*, pp. 353–7, at 357; K. Kulovesi, 'EU Emissions Trading Scheme: Preventing Carbon Leakage Before and After the Paris Agreement', in R. Leal-Arcas & J. Wouters (eds), *Research Handbook of EU Energy Law and Policy* (Edward Elgar, 2017), pp 417–31, at 428; Voigt, n. 3 above, p. 304.

[9] See, however, G. Marín Durán, 'Securing Compatibility of Carbon Border Adjustments with the Multilateral Climate and Trade Regimes' (2023) 72(1) *International & Comparative Law Quarterly*, pp. 73–103; I. Espa, J. François & H. van Asselt, 'The EU Proposal for a Carbon Border Adjustment Mechanism (CBAM): An Analysis under WTO and Climate Change Law', World Trade Institute (WTI) Working Paper No. 06/2022, available at: https://www.wti.org/media/filer_public/ee/61/ee6171fd-a68d-4829-875e-d9b0c32298b5/wti_working_paper_06_2022.pdf; I. Ozai, 'Designing an Equitable Border Carbon Adjustment Mechanism' (2022) 70(1) *Canadian Tax Journal*, pp. 1–33; I. Venzke & G. Vidigal, 'Are Trade Measures to Tackle the Climate Crisis the End of Differentiated Responsibilities? The Case of the EU Carbon Border Adjustment Mechanism (CBAM)' (2020) 51 *Netherlands Yearbook of International Law*, pp. 187–225.

[10] M.A. Mehling et al., 'Designing Border Carbon Adjustments for Enhanced Climate Action' (2019) 113(3) *American Journal of International Law*, pp. 433–81, at 440. See also J. Pauwelyn, 'Carbon Leakage Measures and Border Tax Adjustments under WTO Law', in G. van Calster & D. Prévost (eds), *Research Handbook on Environment, Health and the WTO* (Edward Elgar, 2013), pp. 448–506.

[11] Mehling et al., ibid. See also L. Rubini & I. Jegou, 'Who'll Stop the Rain? Allocating Emissions Allowances for Free: Environmental Policy, Economics and WTO Subsidy Law' (2012) 1(2) *Transnational Environmental Law*, pp. 325–54; F. Sindico, 'National Measures and WTO Consistency: Border Measures and Other Instruments to Prevent Carbon Leakage and Level the Carbon Playing Field', in Gray, Tarasofksy & Carlarne (eds), n. 7 above, pp. 313–32.

[12] Thus, I use the terms 'building blocks' in a slightly different fashion from Falkner, Stephan and Vogler; see R. Falkner, H. Stephan & J. Vogler, 'International Climate Policy after Copenhagen: Towards a "Building Blocks" Approach' (2010) 1(3) *Global Policy*, pp. 252–62.

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Table 1 Four Hypothetical Models of International Climate Change Regime

	First Model	Second Model	Third Model	Fourth Model
Building blocks	Heterogeneous and open by default	Heterogeneous and open by design*	Heterogeneous and closed	Homogeneous (closed or open)
Carbon leakage risks	Uncontained	Uncontained	Contained	Contained

Note
*The distinction between the first and second model is explained in Sections 3.1 and 3.2.

relevant for determining whether carbon leakage risks arise and, if so, whether they have the potential to undermine the mitigation objective of the climate change regime.

I distinguish between the hypothetical models based on whether they are homogeneous or heterogeneous, and whether they are open or closed (Table 1).[13] Homogeneous international regimes require countries to adopt mitigation strategies that lead to equivalent emissions reduction efforts or uniform mitigation policies. By contrast, heterogeneous regimes allow for differentiation in emissions reduction efforts and mitigation strategy. Open international regimes do not establish a legally binding ceiling on global emissions, whereas the existence of such a ceiling characterizes closed regimes. This feature implies that carbon leakage risks are contained under closed regimes: emissions will remain below the global ceiling.[14] Thus, closed regimes are able to neutralize the environmental effects associated with carbon leakage risks. This makes carbon leakage prevention measures unnecessary for protecting the mitigation objective of climate policies that fall within closed regimes. By applying this conceptual framework to the Kyoto Protocol[15] and the Paris Agreement,[16] both under the United Nations Framework Convention on Climate Change (UNFCCC),[17] I am able to show that they are both based on a heterogeneous approach to mitigation, and that they both contain characteristics of open and closed regimes. This implies that they both entail uncontained carbon leakage risks.[18]

Against this background, my second argument concerns the mutual influence between carbon leakage prevention measures and international climate change law. I frame that discussion in the context of carbon pricing instruments, as carbon leakage prevention measures have traditionally been adopted and analyzed in that

[13] The reference to 'closed' regimes is borrowed from A. Gosseries, 'What's Wrong with Trading Emission Rights?', in J. Moss (ed.), *Climate Change and Justice* (Cambridge University Press, 2015), pp. 89–106, at 98. Note that Gosseries defines the concept differently and uses it in a different context.

[14] Sections 2.2 and 3.3 below.

[15] Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto (Japan), 11 Dec. 1997, in force 16 Feb. 2005, available at: http://unfccc.int/resource/docs/convkp/kpeng.pdf.

[16] Paris (France), 12 Dec. 2015, in force 4 Nov. 2016, available at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

[17] New York, NY (US), 9 May 1992, in force 21 Mar. 1994, available at: https://unfccc.int/resource/docs/convkp/conveng.pdf.

[18] See Section 5 below.

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context.[19] I contrast the use of free allowances, exemptions, and direct subsidies – which constitute a logical strategy for countries to mitigate carbon leakage risks under heterogeneous climate change regimes – with the use of CBAMs. Specifically, I contend that CBAMs are hard to reconcile with the architecture of international climate change agreements that rely on a differentiated approach to climate mitigation.[20] On that basis, I explain that their adoption in the EU suggests that the EU views the current international climate change regime as defective and tries to steer it into a new direction based on a homogeneous approach.

This article is structured as follows. Section 2 lays the foundation by outlining the relevant – mostly economic – literature on carbon leakage. Section 3 analyzes carbon leakage risks under the architecture of four models of hypothetical climate change regimes. Section 4 examines the mutual influence that exists between carbon leakage prevention measures and international climate change law. Section 5 applies the conceptual framework developed in Section 3 and the reasoning applied in Section 4 to the Kyoto Protocol and the Paris Agreement. It draws attention to the legal features within these agreements that make them prone to carbon leakage risks and explain countries' reaction to such risks. Section 6 concludes.

2. Traditional Views on Carbon Leakage

Traditional approaches to carbon leakage risks generally describe such risks as inherent in heterogeneous international climate change regimes (Section 2.1). They also recognize that carbon leakage taking place within closed *regional* climate change regimes do not undermine the mitigation objective of such regional regimes (Section 2.2). Whereas the same should be true under closed *international* climate change regimes, most of the policy and legal debate still largely ignores the role of international climate change law in containing the environmental risk posed by carbon leakage (Section 2.3).

2.1. Carbon Leakage Risks as a Consequence of Heterogeneous Regimes

The usual assumption underlying studies on carbon leakage risks is that large asymmetries exist between countries' mitigation strategies as a result of the absence of a homogeneous international climate change regime.[21] According to this assumption, economists consider that the adoption of relatively more stringent climate policies in some countries or regions can lead to carbon leakage, namely 'an increase in GHG

[19] See M. Grubb et al., 'Introduction and Framing', in IPCC, n. 1 above, pp. 151–213, at 167, and Dubasch et al., n. 1 above, p. 1393; F. Rey & T. Madiès, 'Addressing the Concerns about Carbon Leakage in the Implementation of Carbon Pricing Policies: A Focus on the Issue of Competitiveness' (2021) 48 *Journal of Industrial and Business Economics*, pp. 53–75.

[20] Section 4.2 below.

[21] Economic studies on the impact of international climate change agreements (e.g., the Kyoto Protocol) on carbon leakage often start from the observation that these agreements do not impose uniform climate mitigation measures on countries; see, e.g., R. Aichele & G. Felbermayr, 'Kyoto and Carbon Leakage: An Empirical Analysis of the Carbon Content of Bilateral Trade' (2015) 97(1) *The Review of Economics and Statistics*, pp. 104–15; M.H. Babiker, 'Climate Change Policy, Market Structure, and Carbon Leakage' (2005) 65(2) *Journal of International Economics*, pp. 421–45.

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emissions in foreign jurisdictions'.[22] More precisely, carbon leakage refers to an increase in GHG emissions *generated over the territory* of foreign jurisdictions rather than an increase in emissions embedded in manufactured products consumed over the territory of foreign jurisdictions.[23]

This increase in GHG emissions can happen through two main channels.[24] The first channel is called the 'fossil fuel price channel': the adoption of domestic mitigation policies leads to lower domestic consumption of fossil fuels, which reduces their price at the global level, and encourages an increase in consumption in foreign countries.[25] This is considered problematic from an environmental point of view: if the reduction efforts undertaken in some countries are partially offset by a rise in emissions in others, this will make domestic mitigation policies less effective.[26] Yet, carbon leakage prevention measures do not aim at mitigating this type of leakage. This can be explained by three main reasons. Firstly, carbon leakage through the fossil fuel price channel is unlikely to lead to an absolute increase in GHG emissions at the global level: as soon as consumption levels rise in foreign jurisdictions, fossil fuel prices will go up again, which will encourage a reduction in fossil fuel consumption and limit the increase in GHG emissions. Secondly, the fossil fuel channel is difficult to mitigate because of the complexity of the factors that influence global fossil fuel prices.[27] Thirdly, contrary to the 'competitiveness channel' discussed below, the fossil fuel price channel does not directly affect economic activities.[28]

The 'competitiveness channel' – namely, the second channel for carbon leakage and main focus of the legal and policy debate – is linked to the pollution haven hypothesis.[29] According to this hypothesis, the introduction of more restrictive environmental policies leads to higher production costs, which either incentivizes the relocation of pollution-intensive firms to jurisdictions with no or less restrictive environmental policies, or encourages existing firms in those jurisdictions to increase their production levels.[30]

[22] A. Cosbey et al., 'A Guide for the Concerned: Guidance on the Elaboration and Implementation of Border Carbon Adjustment', *Entwined*, Policy Report No. 3, Nov. 2012, p. 6, available at: https://www.iisd.org/system/files/publications/bca_guidance.pdf. See also M. Fowlie & M. Reguant, 'Climate Policy and Trade: Challenges in the Measurement of Leakage Risk' (2018) 108 *American Economic Association Papers and Proceedings*, pp. 124–9, at 124; B. Görlach & E. Zelljadt, 'Forms and Channels of Carbon Leakage', *UmweltBundesamt*, Climate Change No. 16/2018, Feb. 2018, available at: https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2018-06-21_climate-change_16-2018_carbon-leakage_2020_0.pdf.

[23] Embedded emissions are those that are 'generated in the production of goods and services regardless of the location and timing of those emissions'; see R. van Diemen et al., 'Annex I: Glossary', in IPCC, n. 1 above, pp. 1793–820, at 1800.

[24] Ward et al., n. 1 above, pp. 14–5. Note that they discuss more than two channels of carbon leakage as they distinguish between the short-term and long-term competitiveness channels.

[25] Ibid. See also S. Dröge et al., 'Tackling Leakage in a World of Unequal Carbon Prices', *Climate Strategies*, 1 Sept. 2009, available at: https://climatestrategies.org/wp-content/uploads/2009/10/cs-leakage-final-230909.pdf.

[26] Ward et al., n. 1 above, p. 16.

[27] Ibid., pp. 15–6.

[28] Ibid.

[29] Aichele & Felbermayr, n. 21 above, p. 104.

[30] A. Dechezleprêtre & M. Sato, 'The Impacts of Environmental Regulations on Competitiveness' (2017) 11(2) *Review of Environmental Economics and Policy*, pp. 183–206, at 201.

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These jurisdictions, called pollution havens, are known for their low environmental standards, which attract polluting firms, leading to 'policy-induced pollution leakage'.[31] The pollution haven hypothesis has been criticized by the proponents of the Porter hypothesis who believe that more stringent environmental policies can encourage innovation and, in that way, strengthen the competitive position of domestic firms.[32]

Under the assumption that the pollution haven hypothesis prevails over the Porter hypothesis, the consequences of the competitiveness channel of carbon leakage are generally considered problematic for two main reasons.[33] The first is economic: the relocation of enterprises leads to less economic activity in the implementing country and hence, for example, fewer jobs. The second is environmental: carbon leakage means that the reduction of carbon emissions at home can be offset by an increase in carbon emissions abroad. Economists use the term 'leakage rates' to determine the extent of the environmental problem associated with carbon leakage.[34] Leakage rates measure the 'increase in foreign emissions as a share of reductions in domestic emissions'.[35] According to the traditional understanding of carbon leakage risks, a leakage rate of 100% would fully cancel the environmental effects of a domestic mitigation measure and a leakage rate of more than 100% would be actively detrimental to the climate because the increase in emissions abroad would be higher than the decrease in emissions at home.[36]

Such a high carbon leakage rate would provide an environmental justification for *not* introducing domestic mitigation measures.[37] This argument was used (unsuccessfully) in a 2019 Australian case concerning the refusal of development consent for a project aimed at the construction and operation of a mine close to the Australian town of Gloucester:[38]

> GHG emissions could actually increase if coal mining were to be moved from Australia to other countries. … Australian coal mines operate to some of the highest environmental standards in the world and regulations ensure a strict recognition and accounting of

[31] Ibid., p. 183.

[32] Ibid., p. 184 (referring to M.E. Porter & C. van der Linde, 'Towards a New Conception of the Environment: Competitiveness Relationship' (1995) 9(4) *Journal of Economic Perspectives*, pp. 97–118). See also C. Di Maria & E. van der Werf, 'Carbon Leakage Revisited: Unilateral Climate Policy with Directed Technical Change' (2008) 39 *Environmental and Resource Economics*, pp. 55–74.

[33] A. Cosbey et al., 'Developing Guidance for Implementing Border Carbon Adjustments: Lessons, Cautions, and Research Needs from the Literature' (2019) 13(1) *Review of Environmental Economics and Policy*, pp. 3–22, at 5.

[34] Ibid., p. 6.

[35] Ibid.

[36] S. Kortum & D.A. Weisbach, 'Optimal Unilateral Carbon Policy', *Cowles Foundation*, Discussion Paper No. 2311, 8 Nov. 2021, p. 4, available at: https://elischolar.library.yale.edu/cgi/viewcontent.cgi?article=3658&context=cowles-discussion-paper-series.

[37] See *References re Greenhouse Gas Pollution Pricing Act*, Supreme Court of Canada, 25 Mar. 2021, 2021 SCC 11, para. 186, available at: https://decisions.scc-csc.ca/scc-csc/scc-csc/en/item/18781/index.do. Contra, ibid., para. 385 (dissenting opinion of Brown J.).

[38] *Gloucester Resources Ltd* v. *Minister for Planning*, New South Wales Land and Environment Court, 2 Feb. 2019, [2019] NSWLEC 7, available at: https://climatecasechart.com/wp-content/uploads/non-us-case-documents/2019/20190208_2019-NSWLEC-7-234-LEGRA-257_decision.pdf.

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> GHG emissions, but this is not the case in all countries where coal mining occurs …. This situation is sometimes referred to as 'carbon leakage' where, as a result of more stringent climate policies or more stringent application of climate policies in a country, businesses move their production from that country to other countries with less ambitious climate policies or less ambitious application of climate policies, which can lead to a rise in global GHG emissions.[39]

So far, *ex post* empirical economic analysis indicates that evidence for the existence of carbon leakage remains limited.[40] Indeed, carbon leakage has sometimes been described as a 'myth' rather than a risk.[41] Interestingly, the Court of Appeal of The Hague (The Netherlands) relied on this argument in the *Urgenda* case to reject the Dutch government's claim that its unambitious emissions pledge was justified by the risk of carbon leakage: 'The State has failed to substantiate that this [carbon leakage] risk will actually occur if the Netherlands were to increase its efforts to reduce greenhouse gas emissions before 2020'.[42] However, a lack of empirical evidence of carbon leakage does not necessarily imply that carbon leakage is a myth. Instead, it suggests that mitigation policies have so far been too weak to lead to carbon leakage risks.[43] *Ex ante* studies estimating the effects of future and more ambitious policies indicate that carbon leakage would arise.[44]

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[39] Ibid., para. 535.

[40] For an overview of economic studies see Ward et al., n. 1 above, pp. 24–5.

[41] Carbon Market Watch, 'Carbon Leakage Myth Buster', *Carbon Market Watch*, Policy Briefing, Oct. 2015, available at: https://carbonmarketwatch.org/wp-content/uploads/2015/10/CMW-Carbon-leakage-myth-buster-WEB-single-final.pdf. See also A. Dechezleprêtre, D. Nachtigall & F. Venmans, 'The Joint Impact of the European Union Emissions Trading System on Carbon Emissions and Economic Performance', Organisation for Economic Co-operation and Development (OECD), Economics Department Working Paper No. 1515, ECO/WKP(2018)63, 14 Dec. 2018, available at: https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ECO/WKP(2018)63&docLanguage=En; Dechezleprêtre & Sato, n. 30 above.

[42] *Stichting Urgenda* v. *Government of the Netherlands (Ministry of Infrastructure and the Environment)*, Gerechtshof Den Haag [Court of Appeal, The Hague], Case No. 200.178.245/01, 9 Oct. 2018, ECLI:NL:GHDHA:2018:2610 (unofficial English translation), para. 57 (*Urgenda)*. For comment see B. Mayer, '*The State of the Netherlands* v. *Urgenda Foundation*: Ruling of the Court of Appeal of The Hague (9 October 2018)' (2019) 8(1) *Transnational Environmental Law*, pp. 167–92. Note that in Cassation the state did not lodge any complaint about the 'rejection of the State's reliance on the carbon leakage phenomenon' (see *Staat der Nederlanden* v. *Stichting Urgenda* ECLI:NL:HR:2019:2006 (unofficial English translation), 13 Sept. 2019, Parket bij de Hoge Raad [Procurator General of the Supreme Court of the Netherlands], para. 4.209). A similar point was made by Brown J. (dissenting reasons) in *References re Greenhouse Gas Pollution Pricing Act*, n. 37 above, para. 385 ('the evidence on this record of the harms of interprovincial carbon leakage is equivocal at best. Indeed, it tends to suggest that, in most sectors and for most provincial economic activity, such concerns are insignificant'). See also *Gloucester Resources Ltd* v. *Minister for Planning*, n. 38 above, paras 536–7. For comment on the Supreme Court's decision in the *Urgenda* case see M. Meguro, '*State of the Netherlands* v. *Urgenda Foundation*. ECLI:NL:HR:2019:2007. Judgment. Supreme Court of the Netherlands' (2020) 114(4) *American Journal of International Law*, pp. 729–35.

[43] Dechezleprêtre & Sato, n. 30 above, pp. 201–2; Cosbey et al., n. 33 above; Ward et al., n. 1 above, pp. 17–27.

[44] Ward et al., ibid., pp. 18–23; OECD, 'Climate Policy Leadership in an Interconnected World: What Role for Border Carbon Adjustments' (OECD, 2020), available at: https://www.oecd-ilibrary.org/environment/climate-policy-leadership-in-an-interconnected-world_8008e7f4-en.

2.2. Internal Carbon Leakage

Importantly, carbon leakage remains contained if it takes place between jurisdictions that are part of a closed system: namely, a system that introduces a legally binding ceiling on emissions generated (by certain sectors) within those jurisdictions. Economists have studied this phenomenon in the context of regional emissions trading schemes that establish a region-wide cap on the emissions of energy-intensive sectors. Such systems usually impose uniform carbon pricing obligations on energy-intensive sectors across regional partners. Yet, some regional partners might decide unilaterally to adopt additional mitigation measures on the sectors covered by the regional scheme.[45] Economists warn that such unilateral measures might have no impact on emissions: the additional reduction in emissions achieved unilaterally at the domestic level might lead to an increase in emissions in other regional partners.[46]

Perino, Ritz and Van Benthem call this type of carbon leakage 'internal carbon leakage' because 'emissions displacement' happens within a closed scheme.[47] Like 'external carbon leakage' (meaning carbon leakage that takes place outside a closed system), internal carbon leakage reduces the environmental impact of the domestic mitigation policy in absolute terms: without leakage, the domestic climate policy would have led to a higher decrease in regional emissions. However, unlike 'external' carbon leakage, the increase in emissions remains within the limit of the emissions reduction goal jointly defined by the members of the closed scheme. Carbon leakage risks are contained by the closed scheme thanks to the regional ceiling on emissions and, from that point of view, do not undermine the achievement of the regional climate reduction target. Emissions flow from one country to another as water would flow between parts of a waterbed upon application of pressure, which explains why this phenomenon has been called the 'waterbed effect'.[48] The waterbed effect implies that carbon leakage has no negative impact on the reduction in aggregate emissions at the regional level: without carbon leakage, emissions would not have been capped further.

Thus, countries that are part of a closed regional scheme should be aware that, by being part of such a scheme, the environmental impact of their domestic policies is affected by – and to some extent limited to – the environmental objective of the scheme, which is defined by the common ceiling on emissions. Domestic climate policies that fall within the scope of a closed regional scheme do not exist on their own; their mitigation objective is necessarily tied to the scheme's emissions reduction target. Therefore, as noted by the Dutch government in *Urgenda*, it might appear 'pointless' to adopt '[additional]

[45] E.g., when the United Kingdom (UK) was still part of the EU ETS, it adopted a carbon price floor on its electricity sector; see D.M. Newbery, D.M. Reiner & R.A. Ritz, 'The Political Economy of a Carbon Price Floor for Power Generation' (2019) 40(1) *The Energy Journal*, pp. 1–24.

[46] S. Fankhauser, C. Hepburn & J. Park, 'Combining Multiple Climate Policy Instruments: How Not To Do It' (2010) 1(3) *Climate Change Economics*, pp. 209–25.

[47] G. Perino, R.A. Ritz & A. van Benthem, 'Understanding Overlapping Policies: Internal Carbon Leakage and the Punctured Waterbed', *National Bureau of Economic Research* (NBER), Working Paper 25643, Mar. 2019, available at: https://www.nber.org/system/files/working_papers/w25643/revisions/w25643.rev0.pdf.

[48] Ibid.

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national measures to reduce greenhouse gas emissions within the framework of [a regional scheme such as] the ETS [European Emissions Trading System]'.[49]

To achieve a higher level of aggregate emissions reduction than requested by the regional scheme, more ambitious regional partners have no choice other than to try to lower the ceiling. A first option is to convince other members of the scheme that the ceiling needs to be lowered. A second option is to reduce the ceiling through the use of unilateral measures. This option is available only when the ceiling is not fully regulated at the regional level. For example, under the EU emissions trading system (EU ETS), the Union-wide cap is defined by a quantity of allowances. These allowances are allocated between Member States, which are then responsible to auction them or grant them for free to industries at risk of carbon leakage. Each Member State could thus, at least in theory, cancel its allowances, which would reduce the Union-wide cap by the number of allowances cancelled.[50] Finally, a third option is to introduce a mechanism within the closed scheme, which allows the automatic reduction of the ceiling in specific circumstances. For example, under the EU ETS, a mechanism, known as the 'market stability reserve', allows the EU to transfer allowances to a reserve and, hence, reduce the annual emissions cap set by the scheme.[51] The Dutch Court underlined this feature of the European scheme in *Urgenda* to reject the argument of the Dutch government that additional mitigation measures were 'pointless', noting that 'it is impossible for a waterbed effect to occur before 2050' because of the 'dampening effect over time of the "market stability reserve"'.[52]

2.3. Internal Carbon Leakage and International Climate Change Law

The concepts of internal carbon leakage and the waterbed effect – which economists have studied in the context of closed regional (rather than international) climate change regimes – illustrate that the establishment of a common emissions cap has an impact on carbon leakage. Importantly, internal carbon leakage does not undermine the mitigation objective set at the regional level even if individual regional partners still view it as undermining the mitigation objective of their unilateral climate policies. From this, it follows logically that internal carbon leakage does not threaten to 'undermine aggregate emission reductions and the effectiveness of collective climate action'.[53] Thus, carbon leakage risks would not affect the mitigation objective of an international climate change agreement establishing a ceiling on global emissions.

[49] See *Urgenda*, n. 42 above, paras 55–6.

[50] See Art. 12 of Directive 2003/87/EC Establishing a Scheme for Greenhouse Gas Emission Allowance Trading within the Community and Amending Council Directive 96/61/EC (Consolidated Version) [2003] OJ L 275/25 (EU ETS Directive). For an economic discussion of this option see C. Böhringer & C. Fischer, 'Tax, Kill or Bill: An Analysis of Unilateral CO_2 Price Floor Options in Multilateral Emissions Trading Systems' (2023) 119 *Journal of Environmental Economics and Management*, article 102816.

[51] Decision (EU) 2015/1814 concerning the Establishment and Operation of a Market Stability Reserve for the Union Greenhouse Gas Emission Trading Scheme and Amending Directive 2003/87/EC (Consolidated Version) [2015] OJ L 264/1.

[52] *Urgenda*, n. 42 above, para. 55.

[53] See Mehling et al., n. 10 above, p. 440.

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Yet, so far, the impact of international climate change law on the environmental effects of carbon leakage risks has been largely ignored in the literature and policy debate.[54] Most of the discussions have focused on the need to fully eliminate carbon leakage risks rather than to contain them and neutralize their environmental effects. For example, many economic studies start from the observation that the Paris Agreement causes carbon leakage risks because it does not establish a fully harmonized mitigation policy and, on that basis, call for truly global policies such as through the adoption of a global carbon price.[55] This premise implicitly assumes that there are no other international ways to fix the Paris Agreement than to move to homogeneous solutions. The next section explains why such a premise is incorrect by analyzing four models of hypothetical climate change regime, among which are three models that are based on a heterogeneous approach.

3. Carbon Leakage Risks under Four Hypothetical Climate Change Regimes

Before analyzing each model separately, I should clarify that all models rely on a territorial approach to climate mitigation. Emissions are apportioned to the country in which they are generated. For productive activities, this translates into a production-based approach to climate mitigation. Such an approach differs from a consumption-based approach to climate mitigation, under which countries are responsible for the emissions embedded in all the goods *consumed* on their national territory.

Two main reasons justify this choice. Firstly, international climate change law relies almost exclusively on a territorial, production-based approach to climate mitigation.[56] As the largest share of global emissions historically originated as a result of economic

[54] See E. Lanzi, J. Chateau & R. Dellink, 'Alternative Approaches for Levelling Carbon Prices in a World with Fragmented Carbon Markets' (2012) 34 *Energy Economics*, pp. S240–50. One exception is the study by F. Murphy & K. McDonnell, 'Investigation of the Potential Impact of the Paris Agreement on National Mitigation Policies and the Risk of Carbon Leakage: An Analysis of the Irish Bioenergy Industry' (2017) 104 *Energy Policy*, pp. 80–8.

[55] L.C. King & J.C.J.M. van den Bergh, 'Potential Carbon Leakage under the Paris Agreement' (2021) 165(3) *Climatic Change*, pp. 1–19. See also L. Wu, Y. Zhou & H. Qian, 'Global Actions under the Paris Agreement: Tracing the Carbon Leakage Flow and Pursuing Countermeasures' (2022) 106 *Energy Economics*, article 105804; M. González-Eguino et al., 'Industrial and Terrestrial Carbon Leakage under Climate Policy Fragmentation' (2017) 17(Sup1) *Climate Policy*, pp. S148–69.

[56] J. Scott, 'The Geographical Scope of the EU's Climate Responsibilities' (2015) 17 *Cambridge Yearbook of European Legal Studies*, pp. 92–120, at 100–2. Note, however, the distinction made by Mayer and Ding on 'the procedural obligation to communicate national GHG emissions inventories', which relies on a territorial approach, and 'the substantive obligation' to mitigate climate change, which under the UNFCCC is not necessarily limited to territorial emissions: B. Mayer & Z. Ding, 'Climate Change Mitigation in the Aviation Sector: A Critical Overview of National and International Initiatives' (2023) 12(1) *Transnational Environmental Law*, pp. 14–41, at 20. See also IPCC, *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 1996), available at: https://www.ipcc-nggip.iges.or.jp/public/gl/invs4.html; and IPCC, *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 2006), available at: https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol1.html. Note that the 2006 Guidelines (ibid.) are used under Decision 18/CMA.1, 'Modalities, Procedures and Guidelines for the Transparency Framework for Action and Support referred to in Article 13 of the Paris Agreement', 19 Mar. 2019, UN Doc. FCCC/PA/CMA/2018/3/Add.2, Annex, paras 17, 20–4, available at: https://unfccc.int/resource/tet/0/00mpg.pdf.

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activities in developed countries, it made sense, from an economic development perspective, to account for emissions on a production basis.[57] Moreover, a production-based approach makes practical sense as it is easier to account for emissions where they are generated rather than to track the carbon footprints of all the products consumed in a country. Secondly, under a climate change regime based on a consumption-based approach, countries' mitigation policies would target consumption rather than production, which implies that carbon leakage would no longer arise through the competitiveness channel.[58] As this article focuses on carbon leakage prevention measures designed to mitigate carbon leakage risks through the competitiveness channel, it is justified to limit our analysis to models of climate change regimes that rely on a production-based approach. These models are also relevant for the analysis of CBAMs. Although CBAMs are imposed on emissions embedded in imported products, they are designed to operate in a system that is predominantly production-based. In the EU, for example, the CBAM regulation is complementary to the EU ETS, which targets emissions generated by energy-intensive activities, such as the production of aluminium, cement, iron and steel.[59] Thus, its objective is not to replace the EU production-based approach to climate mitigation but rather to address the carbon leakage risks that are associated with it.[60]

3.1. First Model: Absence of Agreement

This first model corresponds to a situation where no consensus exists on the architecture of the international climate change regime. There is neither an agreement on how the responsibility to mitigate climate change should be shared among countries nor on the level of emissions reduction needed to maintain the rise of global average temperature below an acceptable limit. This model includes two scenarios: (i) a scenario under which no international climate change agreement exists (leaving the adoption of mitigation measures to the discretion of individual countries), and (ii) a scenario under which an international climate change agreement exists but is ignored (leaving countries to behave as if the international climate change regime did not exist).

Under this model, given that countries unilaterally define how and to what degree they want to contribute to climate change mitigation, their mitigation policies are likely to be characterized by large heterogeneity in terms of their emissions reduction efforts and strategy. Some countries are likely to introduce ambitious mitigation measures, by which I mean policies that aim to achieve climate neutrality within the shortest time frame. Importantly, I do not refer to the parameter of ambitiousness to make a simplistic value judgement about less ambitious countries, as these might have good reasons (for example, linked to their economic development) to be less ambitious. However, such a

[57] See UNFCCC, n. 17 above, Recital 3.

[58] Such a consumption-based approach, however, could still lead to the displacement of embedded GHG emissions across jurisdictions if *consumers* relocate to countries with less ambitious climate mitigation policies.

[59] Regulation (EU) 2023/956, n. 6 above, Arts 1–2, Annex I.

[60] See A. Pirlot, 'Carbon Border Adjustment Measures: A Straightforward Multi-Purpose Climate Change Instrument?' (2022) 34(1) *Journal of Environmental Law*, pp. 25–52, at 46–7.

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heterogeneous and open approach to climate mitigation entails carbon leakage risks, which in turn undermine the emissions reduction efforts of ambitious countries. As, under this model, reduction in aggregate emissions is achieved through the combination of unilateral climate policies, carbon leakage risks constitute a threat to the mitigation of climate change at the global level.

3.2. Second Model: Open and Heterogeneous Climate Change Regimes

This second model corresponds to a situation where an international agreement exists on the architecture of the international climate change regime, and such regime is open and heterogeneous. Like the first model, this model is characterized by the absence of agreement on a legally binding ceiling on global emissions. Unlike the first model, however, this second model is heterogeneous by design rather than by default: some countries are asked to take more ambitious mitigation action than others for reducing GHG emissions generated over their territory. Heterogeneity is the outcome of an international consensus rather than the result of a lack of coordinated action. An example of this model is an agreement that requires large emitting countries to impose a carbon price of either US$ 25, 50 or 75 per tonne of carbon dioxide (CO_2), depending on their level of development.[61] Another example of this model is an agreement that establishes emissions reduction targets only for advanced economies.

To achieve its climate mitigation objective, this model relies on the combined efforts of countries with emissions reduction targets. One can thus assume that the reduction in aggregate emissions that this model hopes to achieve consists of the sum of emissions reduction targets (in absolute terms) imposed by the model on some countries. Carbon leakage risks are inherent in this model because it is based on a heterogeneous approach. Moreover, its open nature implies that carbon leakage risks are not contained. Carbon leakage risks could thus undermine the efforts of countries with mitigation policies, and thus the ability of the international climate change regime to contribute effectively to climate change mitigation.

If carbon leakage takes place, the reduction in aggregate emissions will be less than the sum of domestic emissions reduction targets. To illustrate this with an example, let us imagine an international agreement under which advanced economies are required to reduce their emissions levels by a certain percentage. Country X falls within the category of 'advanced economies' and has to reduce its emissions by 50 million tonnes to meet its reduction target. Country X adopts a mitigation policy to achieve this goal. Importantly, given that climate change is a global problem, the environmental objective of Country X's mitigation policy, as determined under the open and heterogeneous climate change regime, should be to contribute to the reduction of global – and not only domestic – GHG emissions by 50 million tonnes. Carbon leakage would undermine this objective, as the domestic reduction of 50 million tonnes achieved by Country X

[61] I. Parry, S. Black & J. Roaf, 'Proposal for an International Carbon Price Floor among Large Emitters', *International Monetary Fund*, Staff Climate Note 2021/01, 18 June 2021, available at: https://www.imf.org/en/Publications/staff-climate-notes/Issues/2021/06/15/Proposal-for-an-International-Carbon-Price-Floor-Among-Large-Emitters-460468.

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would be compensated by an increase in emissions in non-advanced economies. Overall, global emissions reductions would be less than 50 million tonnes. It thus makes sense for Country X to mitigate carbon leakage risks.

3.3. Third Model: Closed and Heterogeneous Climate Change Regimes

This third model corresponds to a regime that sets a legally binding ceiling on global emissions and imposes different ambitious mitigation obligations on different countries, for example, on the ground that developed countries should achieve climate neutrality more quickly. An example of this model would be a regime under which *all* countries are obliged to achieve national economy-wide emissions reduction targets, which are more or less ambitious depending on each country's level of economic development. Taken together, legally binding domestic emissions reduction targets amount to a legally binding global target establishing a ceiling on global emissions, which constitutes the mitigation objective of the international climate change regime. This model is heterogeneous by design, which means that domestic climate policies will be characterized by varied levels of ambition. This model, therefore, differs from the regional schemes described above in that such regional schemes are designed as homogeneous regimes, although they might become heterogeneous because of the unilateral measures adopted by some of the regional partners who view the regional scheme as insufficiently ambitious.[62] These unilateral policies imply a disconnection between the objective of the regional scheme and the objective of unilateral policies of more ambitious partners. In contrast, under the model described in this section, all domestic climate policies – either more or less ambitious – pursue the same objective – namely, contributing to achieving the global emissions reduction target established by the international climate change regime.

Carbon leakage risks are the natural consequence of heterogeneous climate change regimes. However, the closed character of this model modifies the nature of such risks: the displacement of emissions from countries with more to less stringent mitigation policies does not undermine the mitigation objective of closed regimes nor of the domestic climate policies that fall within their scope. Carbon leakage risks – both through the fossil fuel price and competitiveness channels – are contained. Such internal carbon leakage risks cannot, assuming compliance, lead to an increase in emissions above the global ceiling because all countries – less and more ambitious – are obliged to comply with their specific emissions reduction targets, regardless of carbon leakage.

To illustrate this point, let us imagine an international agreement that requires advanced economies to reach climate neutrality immediately while allowing that small amounts of GHG emissions are still emitted in other countries over a period of 10 years. Country X falls within the category of advanced economies and has to reduce its total emissions by 50 million tonnes to zero in order to meet the objective of climate neutrality. Country Y is a small developing state where 5 million tons of emissions can

[62] Another difference between this model and the regional schemes discussed above (Section 2.2) is that they could be sector-specific (e.g., EU ETS), whereas this model is intended to apply to economy-wide emissions.

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be emitted per year over the next 10 years. As a result of carbon leakage, emissions in energy-intensive sectors might rise in Country Y. However, Country Y should ensure that this rise in emissions does not lead to an overshooting of its allowances of 5 million tonnes of emissions, for example, by introducing more stringent policies for other sectors. Thanks to the economy-wide reduction targets that apply to the emissions of both countries, carbon leakage does not undermine the mitigation objective of the international climate change regime. Importantly, this outcome holds true only if countries comply with their mitigation obligations. In the case of non-compliance, the regime cannot remain closed. Carbon leakage risks will no longer be contained, and the environmental integrity of the regime can no longer be guaranteed. To alleviate such risks, countries might prefer to adopt measures targeted at non-compliant members, rather than indiscriminate carbon leakage prevention measures.

One should nevertheless acknowledge that contained carbon leakage risks might lead to uncontained carbon leakage risks by triggering non-compliance. Under a closed and heterogeneous international climate change regime, countries with the most ambitious climate mitigation policies are likely to continue to be concerned by contained carbon leakage risks because of their potential impact on the competitiveness of their domestic enterprises. These economic concerns might have environmental consequences if, in order to preserve the competitiveness of their economy, ambitious countries weaken their level of ambition and, hence, no longer comply with their mitigation obligations under the closed and heterogeneous climate change regime. Yet, it is important to underline that contained carbon leakage risks do not, as such, undermine the mitigation objective of closed regimes. Instead, it is the economic consequences associated with contained carbon leakage risks that might undermine the regime by encouraging countries with ambitious emissions reduction targets to not comply with their mitigation obligations. Thus, under this model, the primary objective of carbon leakage prevention measures is to help ambitious countries to bear the economic consequences of their emissions reduction commitments rather than protect the mitigation objective of the international climate change regime, as is the case under open and heterogeneous climate change regimes.

3.4. Fourth Model: Homogeneous Regimes

This fourth model includes regimes that require countries to commit to the same emissions reduction level or adopt uniform mitigation measures for all sectors of the economy. In the rest of this article I refer to regimes that are homogeneous with regard to countries' emissions reduction efforts as 'homogeneous reduction regimes'. Such regimes entail an element of heterogeneity in that they allow countries to adopt different climate mitigation strategies as long as they lead to equivalent emissions reduction outcomes across jurisdictions. Regimes can also be homogeneous with regard to countries' mitigation policies. I refer to those as 'homogeneous policy regimes' as they harmonize mitigation strategies across countries. Such regimes might also entail an element of heterogeneity as uniform mitigation policies can lead to different emissions reduction efforts across countries.

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Homogeneous reduction regimes are necessarily closed regimes: taken together, the domestic emissions reduction targets constitute the mitigation objective of the regime by establishing a ceiling on global emissions. Homogeneous policy regimes may be closed or open depending on whether they establish a legally binding ceiling on global emissions. An example of an open and homogeneous policy regime is an international regime requiring all countries to adopt a carbon tax of US$ 100. Under such an open regime, there is no certainty as to the exact level of emissions reduction that will be achieved. An example of a closed and homogeneous policy regime is an economy-wide international cap-and-trade system that requires whoever generates GHG emissions to buy emissions allowances for a price determined by global supply and demand. The closed nature of such a regime provides certainty as to the maximum amount of emissions generated at the international level.

Contrary to what is often assumed in the scholarly and policy debate, a homogeneous approach to climate mitigation would not fully eliminate carbon leakage risks. It is true, however, that homogeneous regimes neutralize the environmental risks associated with carbon leakage.[63] Yet, countries are likely to continue to view the displacement of emissions from their territory to other countries' territory as an economic risk. Such leakage risks would no longer be caused by differences in emissions reduction efforts or mitigation policy but by differences in abatement costs.

Under homogeneous reduction regimes, two main factors explain that carbon leakage remains an economic risk. Firstly, countries could decide to achieve their emissions reduction target by prioritizing decarbonization in specific sectors, which could lead to leakage across sectors: companies would relocate to jurisdictions where decarbonization policies focus on sectors other than theirs.[64] Secondly, carbon leakage would remain an economic risk even when decarbonization policies apply equally across sectors, as homogeneous reduction regimes allow for differences in mitigation strategies across countries.

To illustrate why, it is helpful to compare the cost of two different mitigation policies with an equivalent emissions reduction target: (i) a regulation that forces energy-intensive companies to limit their emissions per unit of production to a maximum amount of X tonnes of emissions per unit of production, and (ii) a carbon tax with a sufficiently high rate to incentivize companies to achieve the same maximum amount of X tonnes of emissions per unit of production.[65] The cost of the regulation corresponds to the abatement costs – namely, the costs of the adjustments that energy-intensive companies need to make to their processes and production methods to achieve the required reduction in emissions per unit of production. In comparison, the cost of the carbon tax is higher. This is because it includes the abatement costs,

[63] This is either thanks to the fact that they function as closed regimes (homogeneous reduction regimes) or because they are based on uniform mitigation strategies across countries (homogeneous policy regimes).

[64] See K. Baylis, D. Fullerton & D.H. Karney, 'Leakage, Welfare and Cost-Effectiveness of Carbon Policy' (2013) 103(3) *American Economic Review*, pp. 332–7.

[65] This example and reasoning are inspired by M. Keen, I. Parry & J. Roaf, 'Border Carbon Adjustments: Rationale Design and Impact' (2022) 43(3) *Fiscal Studies*, pp. 209–34. See also Keen, Parry & Roaf, ibid., Online Appendices A, available at: https://onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1111%2F1475-5890.12307&file=fisc12307-sup-0001-OnlineAppendix.pdf.

which are the same as those under the regulatory scenario, given that companies prefer to abate their emissions to the extent that it is less costly than paying the carbon tax, but also the costs of the carbon tax itself on the remaining emissions generated by the company (X tonnes of emissions per unit of production). Under an international climate change regime that requires countries to achieve equivalent emissions reduction levels, one could thus assume that energy-intensive companies would relocate from jurisdictions imposing a carbon tax to those with regulatory standards. This assumption might appear counter-intuitive, as carbon taxes are usually presented as the most cost-effective option to mitigate climate change. Yet, rather than making carbon taxation cost-ineffective, it underlines that carbon leakage prevention measures would remain necessary under a homogeneous reduction international climate change regime.[66]

Under homogeneous policy regimes, the main factor explaining the possibility of carbon leakage risks is the existence of differences in the emissions intensity of economic activities across countries, for example, because of differences in energy mix or weather. Energy-intensive companies would be incentivized to relocate from jurisdictions where production methods are more emissions-intensive to jurisdictions where production methods are less emissions-intensive or even climate neutral, as this would translate into lower carbon mitigation costs. From a worldwide perspective, such relocation would be beneficial from both an environmental and economic perspective: it is most efficient for economic activities to take place where it is the least costly and polluting. The displacement of economic activities from a more emissions-intensive to a less emissions-intensive jurisdiction would result in a decrease in GHG emissions at the global level. Yet, countries where production methods are more emissions-intensive would be likely to view this as problematic from an economic (domestic) viewpoint as it would lead to less economic activity on their territory. As under the closed and heterogeneous model (Section 3.3 above), the economic effects associated with the relocation of emissions across jurisdictions could translate into negative environmental effects if they discourage affected countries from meeting their obligations under the homogeneous regime. In that hypothesis, as under the third model, non-compliance would open the door to environmentally problematic carbon leakage risks: a regime cannot remain homogeneous when some countries violate their mitigation obligations.

4. Carbon Leakage Prevention Measures

As the previous section has shown, the architecture of the international climate change regime determines whether carbon leakage risks have the potential to undermine the mitigation objective of climate policies. Against this background, the question arises as to the type of carbon leakage prevention measures that countries should introduce. Different methods and types of measure have been used and proposed to mitigate carbon leakage risks arising from carbon pricing policies: exemptions and free

[66] Ibid., p. 212 ('a country implementing aggressive carbon pricing that adopts a BCA [border carbon adjustment] could well choose to apply it to imports from a country achieving equivalent emissions reductions through regulations').

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allowances, direct subsidies, and CBAMs. These measures differ in how costly they are and the extent to which they help the implementing country to reduce the GHG emissions generated over its territory (Section 4.1). They also differ in how they interact with different international climate change models (Section 4.2).

4.1. Typology

The first method to mitigate carbon leakage risks consists of ensuring that enterprises at risk of carbon leakage are not or are only partially subject to climate mitigation policies. In the context of carbon pricing policies, this can be achieved by means of exemptions or free allowances. Enterprises at risk generally benefit from a full or partial exemption when a carbon price is set via a carbon tax.[67] Full exemptions completely mute the carbon price, which implies that enterprises that benefit from them do not contribute to the mitigation of climate change at the domestic level (unless other mechanisms are put in place to encourage them to do so). Partial and full exemptions constitute an indirect cost for governments as enterprises at risk do not pay the carbon tax (or pay only part of it). When the carbon price is established through an emissions trading scheme, enterprises at risk will usually benefit from free allowances, which fully or partially cover the costs associated with the emissions allowances that they are supposed to surrender under the scheme in proportion to the emissions they generate. As such, they also constitute an indirect cost on the governmental budget. For example, in the EU, sectors deemed to be exposed to a risk of carbon leakage receive free allowances against a benchmark which is based on the most efficient 10% of installations of the sector concerned.[68] The use of such a benchmark implies that installations that are less efficient need to surrender more allowances than those they receive for free. For this reason, the European system of free allowances does not fully mute the carbon price signal for less efficient installations. The sectors at risk are still encouraged to reduce their emissions to benefit from additional free allowances. A similar mechanism, known as the 'output-based pricing system', is used in Canada for energy-intensive and trade-exposed enterprises.[69] This system significantly reduces the carbon price for sectors at risk of carbon leakage, but it does not fully mute it.[70]

Instead of partially or fully exempting enterprises at risk of carbon leakage from the carbon price, countries can give them direct subsidies, such as a cash transfer, a grant or a loan aimed at covering (some of) the costs linked to a carbon tax or emissions

[67] E.g., in the EU context, the Energy Taxation Directive allows Member States to grant tax reductions to energy-intensive businesses: Directive 2003/96/EC Restructuring the Community Framework for the Taxation of Energy Products and Electricity (Consolidated Version) [2003] OJ L 283/51, Art. 17.

[68] In the European context see EU ETS Directive, n. 50 above, Art. 10a. For a critical view of this regime see M. Carevic, 'Carbon Leakage in the EU in the Light of the Paris Climate Agreement' (2015) 11 *Croatian Yearbook of European Law and Policy*, pp. 47–71; Rubini & Jegou, n. 11 above. Note that the EU plans to gradually replace free allowances by CBAMs.

[69] Government of Canada, 'Output-Based Pricing System Regulations', 28 June 2019, SOR/2019-266, available at: https://laws-lois.justice.gc.ca/eng/regulations/SOR-2019-266/index.html.

[70] On this point see *References re Greenhouse Gas Pollution Pricing Act*, n. 37 above, para. 338.

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allowances.[71] Such measures could also be adopted in addition to tax exemptions and other preferential treatment in the form of free allowances.[72] The transfer of funds could be made conditional on the adoption of emissions reduction measures, for example, by requiring energy-intensive and trade-exposed industries to invest in less carbon-intensive processes and production methods, or in carbon capture and storage technologies. Conditional subsidies would help countries to reach climate neutrality, though possibly at a very high cost.

Finally, the third way of mitigating leakage risks is to introduce CBAMs, which impose a carbon price equivalent to that imposed on domestic products on imported products from jurisdictions with no or a comparatively lower carbon price (the so-called 'adjustment on imports').[73] CBAMs can also be used to relieve exported products from the carbon price (the so-called 'adjustment on exports'). In comparison with free allowances and tax exemptions, CBAMs allow the carbon price signal to be maintained to a greater extent as it applies to both domestic and imported products from countries with no or comparatively lower carbon prices.[74] This feature has been presented as 'creating incentives for the reduction of emissions' by foreign producers and encouraging third countries to adopt more ambitious carbon pricing policies.[75] Compared with free allowances, tax exemptions, and direct subsidies, CBAMs impose less of a cost on a government's budget. Indeed, the cost of adjustments on exports is comparable with exemption measures and free allowances, but adjustments on imports raise revenue by requiring importers of energy-intensive products to pay a carbon price.

4.2. Interaction with the International Climate Change Models

All types of carbon leakage prevention measure fit within the first model, characterized by an absence of coordination: the lack of international agreement on the building blocks of the regime implies that countries are free to act as they deem appropriate. Yet, countries interested in maximizing the impact of their climate mitigation policies might prefer CBAMs as they have the advantage that they might incentivize other

[71] The adjective 'direct' is used to distinguish these measures from free allowances and exemptions, which can be viewed as indirect subsidies.

[72] See EU ETS Directive, n. 50 above, Art. 10a(6). See also Directive 2018/410 Amending Directive 2003/87/EC to Enhance Cost-Effective Emission Reductions and Low-Carbon Investments, and Decision (EU) 2015/1814 [2018] OJ L 76/3, Preamble, para. 13.

[73] On the role of these measures in preventing leakage see F. Branger & P. Quirion, 'Would Border Carbon Adjustments Prevent Carbon Leakage and Heavy Industry Competitiveness Losses? Insights from a Meta-Analysis of Recent Economic Studies' (2014) 99(C) *Ecological Economics*, pp. 29–39. See also C. Böhringer et al., 'Potential Impacts and Challenges of Border Carbon Adjustments' (2022) 12(1) *Nature Climate Change*, pp. 22–9, at 25–7; Mehling et al., n. 10 above; J. Zhong & J. Pei, 'Carbon Border Adjustment Mechanism: A Systematic Literature Review of the Latest Developments' (2024) 24(2) *Climate Policy*, pp. 228–42, at 234–5, available at: https://doi.org/10.1080/14693062.2023.2190074.

[74] Note that adjustments on exports mute the carbon price signal on exported products.

[75] Regulation (EU) 2023/956, n. 6 above, Art. 1; European Commission, 'European Green Deal: Commission Proposes Transformation of EU Economy and Society to Meet Climate Ambitions', IP/21/3541, 14 July 2021, available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541. In the US context see Climate Leadership Council, 'The Four Pillars of Our Carbon Dividends Plan', Sept. 2019, available at: https://clcouncil.org/our-plan.

countries to adopt mitigation measures as ambitious as those that have been introduced in the more ambitious country. In comparison, exemptions, free allowances, and direct subsidies mitigate carbon leakage risks, but without encouraging other countries to act.

By contrast, all types of carbon leakage prevention measure should be an option under homogeneous policy regimes (part of the fourth model) only if they are part of the uniform mitigation strategy adopted at the international level. If such measures are not part of that strategy, their adoption will transform the homogeneous policy regime into a heterogeneous regime. For example, if an international climate change agreement introduces a global carbon tax of US$ 100, the regime will no longer be fully homogeneous if a country adopts a higher carbon tax together with CBAMs.

Under the other models (second and third models, and homogeneous reduction regimes under the fourth model), countries should adopt carbon leakage prevention measures that align with their emissions reduction obligations as well as with the model's approach to climate mitigation, at least to the extent that they value its architecture. Exemptions, free allowances, and direct subsidies are all acceptable under these models, but exemptions and free allowances should not prevent countries from meeting their emissions reduction commitments. Thus, for countries required to achieve climate neutrality, they are an option only in combination with other mitigation measures that allow them to meet their commitments, such as regulations requiring the use of clean technologies or subsidies aimed at promoting carbon-capture and storage. Otherwise, exemptions and free allowances will largely mute the carbon price signal, and sectors at risk of carbon leakage will continue to emit high levels of GHG emissions and prevent the countries in which they are located from achieving climate neutrality.

The case for CBAMs is more controversial because they are hard to reconcile with the spirit of regimes that are heterogeneous by design (second and third models) or include an element of heterogeneity with regard to a country's climate mitigation strategy (homogeneous reduction regimes under the fourth model). One of the objectives of the EU CBAM regulation is to encourage countries with no or less ambitious mitigation policies to increase their level of ambition, even if only – at least initially – in respect of a limited number of carbon-intensive sectors.[76] The regulation does not force countries into imposing a carbon price on carbon-intensive producers, but it strongly incentivizes those whose economy relies on exports to the EU to do so. In that way, those countries will be able to retain the revenue, which would otherwise have fallen under the EU budget through the CBAM regulation. Countries adopting CBAMs could thus be viewed as trying to steer heterogeneous climate change regimes into a new direction, moving away from a differentiated approach to climate mitigation in favour of a more homogeneous one.[77]

[76] On this point see Marín Durán, n. 9 above; Pirlot, n. 60 above, pp. 33–5; Zhong & Pei, n. 73 above, p. 13.

[77] See European Commission, 'Commission Staff Working Document: Impact Assessment Report Accompanying the Document, Proposal for a Regulation of the European Parliament and of the Council Establishing a Carbon Border Adjustment Mechanism', 14 July 2021, SWD(2021)643final, para. 2.4.2 ('CBAM becomes a necessary tool to mitigate the risk of carbon leakage as long as third countries do not share the same level of ambition, or in other words that they do not have a similar carbon price in place'). See also European Parliament, 'Briefing: EU Carbon Border Adjustment Mechanism: Implications for Climate and Competitiveness', 24 Mar. 2023 ('The CBAM aims to contribute to the

Such a move would not necessarily imply the end of differentiated responsibilities in international climate change law. However, heterogeneity would no longer apply to climate mitigation, and would rather focus on the other dimensions of differentiation in international climate change law, such as financial and technology transfer.[78] This change in approach to climate mitigation could weaken the consensus reached at the international level and lead countries to withdraw from the existing climate change regime and move back into a world without a coordinated mitigation regime (first model). This possibility could be disregarded by countries that deem the regime of which they are part as fully unsuitable to mitigate climate change.[79] However, countries might view that regime unsuitable, and yet prefer it to a situation characterized by an absence of coordination. Under that hypothesis, they should try to identify whether CBAMs are more likely to strengthen international efforts on climate mitigation or disrupt them (for instance, countries might decide to withdraw from the Paris Agreement).

This balancing exercise illustrates that countries need to determine how much they value the climate change regime of which they are part. This is important because any one country or region cannot adequately mitigate climate change on its own. The mitigation objective of domestic and regional climate policies does not exist in and of itself, but rather in interaction with other countries' mitigation policies, which are likely to be influenced by the architecture of the international climate change regime.

5. From Theory to Practice: Carbon Leakage under International Climate Change Law

The hypothetical models described in Section 3 and the reasoning developed in Section 4 can be used to better understand carbon leakage risks and countries' responses to such risks under past and existing international climate change agreements, specifically, the Kyoto Protocol (Section 5.1) and the Paris Agreement (Section 5.2).

5.1. The Kyoto Protocol

The Kyoto Protocol provides a concrete example of an open and heterogeneous climate change regime with some characteristics of a closed regime. The Protocol established legally binding emissions reduction targets for industrialized countries and countries with economies in transition (those included in Annex I of the UNFCCC).[80] For example, between 2008 and 2012, the emissions reduction targets, as a percentage

EU's climate neutrality objectives, and encourage partner countries to decarbonize their production processes').

[78] See Paris Agreement, n. 16 above, Recital 6, Arts 9–11. On the different dimensions of differential treatment see L. Rajamani, *Differential Treatment in International Environmental Law* (Oxford University Press, 2006), p. 93.

[79] E.g., countries could view a closed regime as unsuitable because the ceiling on global emissions has been set too low so that the increase in global average temperature will not remain below an acceptable level.

[80] Kyoto Protocol, n. 15 above, Arts 2(7), 3. For a comment on the Kyoto Protocol see C. Breidenich et al., 'The Kyoto Protocol to the United Nations Framework Convention on Climate Change' (1998) 92(2) *American Journal of International Law*, pp. 315–31.

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relative to 1990 levels,[81] varied between 0% (for countries such as Ukraine, the Russian Federation, and New Zealand) and 8% (for the European Community and some other countries).[82] Among these countries, the Kyoto Protocol served as a closed and heterogeneous regime. Consequently, carbon leakage taking place among ratifying and compliant Annex I countries should not have undermined the emissions reduction objectives to which those countries committed under the Kyoto Protocol. Assuming that the decrease in emissions in a ratifying and compliant Annex I country had led to an increase in emissions in another ratifying and compliant Annex I country, the latter country would have had to adopt additional mitigation measures to fulfil its emissions reduction commitments.

However, given that no emissions reduction targets applied to non-Annex I countries, the system established by the Kyoto Protocol was, as a whole, an open climate change regime (second model, Section 3.2 above). Carbon leakage had the potential to undermine the environmental goal of the Kyoto Protocol had it taken place between Annex I countries having ratified the Kyoto Protocol and other countries (non-Annex I and Annex I that had not ratified it), because the latter were not subject to any emissions reduction commitments. It thus made perfect sense for the ratifying Annex I countries to address these carbon leakage risks by means of exemptions and free allowances. Given the relatively unambitious emissions reduction commitments of Annex I countries, these carbon leakage prevention measures were a suitable strategy to reduce carbon leakage risks. By focusing their mitigation policies on sectors that were not at risk of carbon leakage, countries were able to achieve their reduction targets without running the risk that the global impact of their domestic mitigation policy would be reduced because of an increase of GHG emissions in non-Annex I countries.

5.2. The Paris Agreement

The Paris Agreement serves as an example of an imperfect closed and heterogeneous climate change regime (third model, Section 3.3 above). That the Paris Agreement is based on a heterogeneous approach is beyond discussion. The Paris Agreement is based on a bottom-up approach, leaving its parties largely free to determine the scope and type of measures that they consider appropriate to meet its temperature goal: keeping the increase in global average temperature below 2, or ideally 1.5 degrees Celsius (°C) above pre-industrial levels.[83] Whereas the Kyoto Protocol required industrialized countries and economies in transition only to meet specific emissions reduction targets, the Paris Agreement requires all parties to 'pursue domestic mitigation measures'.[84] Yet, the normative approach of the Paris Agreement still recognizes that the national circumstances of least-developed, developing, and developed countries are not comparable, and it explicitly acknowledges that developed countries should take 'the lead by

[81] Note, however, that a different base year could be used for some countries 'undergoing the process of transition to a market economy': Kyoto Protocol, n. 15 above, Art. 3(5), Annex B.
[82] See Kyoto Protocol, n. 15 above, Annex B.
[83] See Paris Agreement, n. 16 above, Art. 2(1)(a), Arts 3–4.
[84] Ibid., Art. 4(2).

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undertaking economy-wide absolute emission reduction targets'.[85] Hence, in line with the principle of common but differentiated responsibilities and respective capabilities, mitigation policies in developed countries should be more ambitious than those in developing and least-developed countries.[86]

That the Paris Agreement functions as a closed system, a 'waterbed' on a global scale, is more controversial, as it requires a number of conditions to be fulfilled. Firstly, the Paris Agreement does not establish a legally binding ceiling on global emissions. Even though the temperature goal of the Paris Agreement necessarily implies a ceiling on global emissions,[87] it would need to be made explicit and legally binding. Yet, countries are likely to have different views on what the ceiling should be. Arguably, if all countries had expressed their views publicly, one could, for example, consider that it corresponds to the lowest common denominator, and thus that it should be set according to the views of the country in favour of the highest ceiling. Yet, in the absence of explicit agreement on the level and binding nature of the ceiling, the Paris Agreement cannot serve as a closed system.

Secondly, assuming that a legally binding ceiling on global emissions were to be adopted, the closed character of the Paris Agreement would still be conditional upon recognition of legally binding domestic emissions reduction targets, which are sufficiently ambitious, taken together, to remain below the global ceiling. Although one can derive domestic emissions reduction targets from parties' nationally determined contributions (NDCs), such targets do not amount to legally binding obligations under the Paris Agreement.[88] Moreover, even though many would agree that most countries' NDCs have been insufficiently ambitious to meet the temperature goal of the Agreement,[89] there is no common understanding of what a sufficiently ambitious climate mitigation policy is. This implies that the Paris Agreement cannot properly function as a closed system. In the absence of a clear mechanism to identify countries with mitigation policies that are insufficiently ambitious under the normative approach

[85] Ibid., Art. 4(4). For a comparison of the Paris Agreement and the Kyoto Protocol in how they approach differentiation see D. Bodansky, 'The Paris Climate Change Agreement: A New Hope?' (2016) 110(2) *American Journal of International Law*, pp. 288–319, at 300; C. Voigt & F. Ferreira, '"Dynamic Differentiation": The Principles of CBDR-RC, Progression and Highest Possible Ambition in the Paris Agreement' (2016) 5(2) *Transnational Environmental Law*, pp. 285–303.

[86] See Paris Agreement, n. 16 above, Preamble, para. 3; Art. 2(2), Art. 4(3) and (19).

[87] See J. Rogelj et al., 'Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development', in IPCC (V. Masson-Delmotte et al. (eds)), *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5.°C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty* (Cambridge University Press, 2022), pp. 93–174, at 104–8.

[88] On this question see B. Mayer, 'International Law Obligations Arising in relation to Nationally Determined Contributions' (2018) 7(2) *Transnational Environmental Law*, pp. 251–75.

[89] Draft Decision -/CMA.5, 'Outcome of the First Global Stocktake, Proposal by the President', 13 Dec. 2023, UN Doc. FCCC/PA/CMA/2023/L.17, paras 18–42, available at: https://unfccc.int/documents?f%5B0%5D=body%3A4099. See also I. Parry et al., 'Carbon Pricing: What Role for Border Carbon Adjustments', *International Monetary Fund*, Staff Climate Note 2021/004, 27 Sept. 2021, p. 4, available at: https://www.imf.org/en/Publications/staff-climate-notes/Issues/2021/09/24/Carbon-Pricing-What-Role-for-Border-Carbon-Adjustments-464805. See also European Commission, n. 77 above, Introduction, para. 4.

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of the Paris Agreement, one cannot distinguish between external carbon leakage risks that undermine the mitigation objective of the Paris Agreement (when the relocation of emissions takes place outside the Paris Agreement, between countries with sufficiently ambitious mitigation policies and countries with insufficiently ambitious mitigation policies) and internal carbon leakage risks that are mainly problematic for domestic economic reasons (when the relocation of emissions takes place within the Paris Agreement, between countries with sufficiently ambitious mitigation policies).[90]

Despite its imperfect character, the closed system created by the Paris Agreement has had – albeit in rare instances – an impact on the perception of carbon leakage risks in the legal discourse.[91] One example is the case *Gloucester Resources Ltd* v. *Minister for Planning*, in which an Australian court referred to the Paris Agreement and the fact that developing countries were also bound to mitigate climate change as an argument to minimize the possibility of carbon leakage risks.[92] The Australian court stated as follows:

> If approval for the [Rocky Hill Coal] Project in the developed country of Australia were to be refused, on grounds including the adverse effects of the mine's GHG emissions on climate change, there is no inevitability that developing countries such as India or Indonesia will instead approve a new coking coal mine instead of the Project, rather than following Australia's lead to refuse a new coal mine.[93]

This reasoning can be linked to the idea that carbon leakage would remain contained if the Paris Agreement were to operate as a perfectly closed system. All parties would act so that their collective and progressive action allows them to meet the overall objective of maintaining the increase in global average temperature below 1.5 or 2°C. The increase in emissions in some jurisdictions – caused either by the fossil fuel price or competitiveness channels – would remain internal to the Paris Agreement, ensuring that carbon leakage risks do not undermine its temperature goal. Policymakers would remain concerned about the economic effects resulting from this internal carbon leakage in terms of loss of competitiveness for their domestic firms,[94] but they would have no reason to worry about the negative environmental effects that are traditionally associated with carbon leakage.

In most cases, however, countries rightly continue to see the Paris Agreement as open to carbon leakage risks that undermine its environmental integrity. To mitigate these risks, countries have used exemptions and free allowances favouring

[90] Sections 2.2 and 3.3 above.

[91] See B.J. Preston, 'The Influence of the Paris Agreement on Climate Litigation: Legal Obligations and Norms (Part I)' (2021) 33(1) *Journal of Environmental Law*, pp. 1–32.

[92] N. 38 above.

[93] Ibid., para. 539.

[94] See UK Department for Business, Energy & Industrial Strategy (BEIS), 'UK Business Competitiveness and the Role of Carbon Pricing', BEIS Research Paper No. 2020/17, Apr. 2020, p. 22, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/911247/UK_ Business_Competitiveness_and_the_Role_of_Carbon_Pricing_report.pdf.

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emissions-intensive and trade-exposed industries. For developed countries, which should be the first to reach climate neutrality under the Paris Agreement, these measures are likely to be, or quickly become, unacceptable as they largely mute the carbon price signal, and thus prevent them from achieving ambitious emissions targets unless they are combined with additional mitigation measures.[95] Developed countries are thus left with few alternatives, including direct subsidies, which are costly, and CBAMs, which are controversial as they do not fit easily into the architecture of internationally agreed heterogeneous climate change regimes.[96]

As this article has demonstrated, another path to neutralize the environmental risks associated with carbon leakage would be to modify the architecture of the Paris Agreement so as to transform it into a perfectly closed regime under which a heterogeneous approach to climate mitigation can be preserved. With such an approach, carbon leakage risks would remain, but they would no longer threaten the mitigation objective of the Agreement. In this scenario, countries willing to alleviate the economic effect of these risks would need to rely on free allowances and exemptions, as long as such measures do not prevent them from achieving their mitigation obligations, and/or direct subsidies.

6. Conclusion

This article challenges one of the most common arguments in the climate change policy debate, namely, that in the absence of an international agreement that fully harmonizes mitigation policies, carbon leakage constitutes an environmental problem and needs to be mitigated. By presenting carbon leakage risks as the logical consequence of the architecture of heterogeneous international climate change agreements, the article has explored the legal conditions required to keep such leakage under control. As the article has shown, carbon leakage does not undermine the mitigation objective of heterogeneous agreements that qualify as closed systems. Under such agreements, carbon leakage remains internal and, therefore, does not lead to higher levels of GHG emissions than the levels provided for in the agreement.

The application of this logic to the Paris Agreement suggests that carbon leakage would not threaten its success if the Agreement included clear provisions that translate its temperature goal into a legally binding ceiling on global emissions and assess whether its parties comply with its normative approach. Though the Paris Agreement might never include such provisions, this finding is important. It demonstrates that the assumption that carbon leakage is necessarily an environmental risk under heterogeneous regimes is inaccurate. Contrary to common belief, there are legal options for mitigating climate change at the global level under which carbon leakage does not

[95] For other countries, these measures will remain acceptable for a longer period as their emissions reduction pledges do not need to be as ambitious in the short and medium terms.

[96] The EU impact assessment recognizes the tension between CBAMs and the principle of common but differentiated responsibilities and respective capabilities but does not provide convincing arguments to address it; see European Commission, n. 77 above, para. 5.2.1.11. For a detailed analysis of this point see Marín Durán, n. 9 above, pp. 80–91.

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pose an environmental risk. By illuminating such options, this article encourages us to reimagine the possible policy solutions that would effectively maintain the rise in global average temperature below an acceptable level.

So far, in the literature and policy debate, the creation of a homogeneous international climate change regime based on uniform carbon mitigation policies has been presented as the best option. The EU's adoption of CBAMs plays into this narrative: such measures are presented as a necessary second-best option for as long as other countries do not adopt carbon pricing policies that are as ambitious as those in place in the EU.[97] Yet, other options exist. Importantly, to those who view differentiation between countries' mitigation policies as a key component of international climate change law, regimes that are heterogeneous and closed will be the best option to mitigate climate change at the global level.

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[97] See Regulation (EU) 2023/956, n. 6 above, Recital 9, Arts 1(3), 9; European Commission, n. 77 above, para. 2.4.2.

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