17

Climate Causality

From Causation to Attribution

Petra Minnerop[*]

17.1 INTRODUCTION: OBJECTIVES AND CONTEXT

Climate law and governance structures evolve through different instruments, in international, regional, and domestic law and policy. A significant mode of development is jurisprudential. Courts often make authoritative statements not only about the law on climate change but also about the underlying scientific evidence. At the heart of this growing field of climate jurisprudence are almost always legal concepts that were neither designed nor intended for the application in the context of a collective action problem. Therefore, judicial pronouncements on law's core concepts reveal how the law is challenged by, and grapples with, climate change, especially where clarifying legislation is absent. Apart from filling legislative gaps and developing the law, courts also influence the societal perception of climate change, including its causes, impacts, urgency, and legal implications. Analysing these judgments structures, consolidates, and develops the law on climate change.

This chapter provides a thorough analysis of some of the most significant cases on causation and attribution in a rapidly growing field of global climate jurisprudence. To structure the analysis, I situate the legal notion of attribution within an overarching concept of *climate causality* that comprises general causation, specific causation, and attribution as a sequence of analytical steps. While general and specific causation are primarily concerned with identifying the factual relations between cause(s) and event(s), attribution adds a distinct normative dimension.[1]

The approach in this chapter addresses the interdisciplinary challenge of applying law in the context of climate change, connects attribution in law with event attribution, and explains the inductive and deductive approaches used in scientific studies. The case law is selected from a range of different legal orders, for its contribution to advancing the concept of climate causality. To structure the vast number of relevant cases, the chapter offers a novel system based on thematic areas where jurisprudence emerges that shapes the normative context for causal explanations and attribution.

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[1] The definition will be elaborated in Section 17.2.1.

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Four areas of judicial engagement with climate change are identified as main sources for transferable arguments that could inform the reasoning on attribution: the determination of the scope of relevant emissions, the review of national climate targets and measures, the permissibility of emissions-intensive infrastructure projects or activities, and courts' readiness to use and review general (environmental) law concepts to develop climate litigation, thus expanding the normative lens.

17.1.1 *Objective of This Chapter*

Given that so far only a limited number of cases explicitly discuss attribution directly, the approach in this chapter is to emphasise the *emerging* nature of the judicial treatment of attribution with regard to climate change. Courts have made authoritative statements about the reality of climate change,[2] they have used reports of the Intergovernmental Panel on Climate Change (IPCC) as expert evidence,[3] and they have shaped the wider normative context in which causal explanations in the field of climate change are embedded.[4] Yet to date, attributing a specific climate-related impact to a defined emitting geographical region or an individual major emitter has been a difficult task in the court room.[5] Compensatory claims against individual emitters remain at risk of failing the legal tests for causation and attribution across jurisdictions.[6] Only prospectively have courts found a causal link

[2] *State of the Netherlands (Ministry of Economic Affairs and Climate Policy) v Stichting Urgenda* [2019] ECLI:NL:HR:2019:2007 (Supreme Court of the Netherlands) (*Urgenda Supreme Court*) [4.6]; Liz Fisher, 'Climate Change Litigation, Obsession and Expertise: Reflecting on the Scholarly Response to Massachusetts v EPA' (2003) 35 Law and Policy 236, 239; cf. Maria Lee, 'The Sources and Challenges of Norm Generation in Tort Law' (2018) 9(1) European Journal of Risk Regulation 34.

[3] *Urgenda Supreme Court* (n 2), where the Court defined States obligations in the light of the IPCC reports [6.1]–[7.3.6]; *Neubauer and Others v Germany* [2021] 1 BvR 2656/18, 1 BvR 96/20, 1 BvR 78/20, 1 BvR 288/20, 1 BvR 96/20, 1 BvR 78/20 (German Federal Constitutional Court) (*Neubauer*) [36], [160]–[161]. For a discussion of the case see Petra Minnerop, 'Climate Targets: Fundamental Rights, Intergenerational Equity and the German Federal Constitutional Court' (2022) 34 JEL 135; Christoph Möllers and Nils Weinberg, 'Die Klimaschutzentscheidung des Bundesverfassungsgerichts' (2021) 76 Juristen Zeitung 1069, 1072. See also *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7 (*Gloucester Resources*) [431]–[435]; *Mathur v Ontario* [2023] ONSC 2316 (*Mathur Merits*) [19].

[4] *Neubauer* (n 3) [143]–[151]; *Family Farmers and Greenpeace v Germany* [2018] 00271/17/R/SP (Administrative Court of Berlin) (*Family Farmers and Greenpeace*) 21, noted that the threshold for causality should not be overstated; *Neubauer* (n 3) [116], [202]. [229]; *Gloucester Resources* (n 3) [515]–[516]; *Mathur Merits* (n 3) [149].

[5] One case where this could be considered as part of the scientific evidence is *Lliuya v RWE* [2017] I-5 U 15/17 (Higher Court of Appeal in Hamm). Other courts have established the causal connection between certain activities and concrete amounts of GHG emissions, *Minister of Environment v PT Selatnasik Indokwarsa and PT Simpang Pesak Indokwarsa*, Decision No 105/Pdt/G/2009/PN.JKT.UT (North Jakarta District Court).

[6] Cf United Nations Environment Programme and Sabin Center for Climate Change, 'Global Climate Litigation Report: 2023 Status Review' (2023) <https://wedocs.unep.org/20.500.11822/43008> 65 accessed 24 February 2024. The 'but for' test in the common law is similar to the *conditio since qua non* formula that is regularly applied in civil law jurisdictions, see Marta Infantino and Eleni

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between planned major infrastructure projects and their anticipated contributions to global emissions and to further adverse climate change impacts – as discussed in the preceding chapter.[7]

Meanwhile, a thorough analysis reveals that even a dismissed case can shed light on legal criteria for causation and attribution while pointing to the need for further legal and scientific research. An example is *Comer v Murphy Oil USA, Inc*, where the Court dismissed the case but alluded to the defendants' memorandum and stated that the plaintiffs would need to demonstrate the following:

(1) what would the strength of Hurricane Katrina have been absent global warming;
(2) how much of each plaintiff's damages would have been attributable to Hurricane Katrina if it had come ashore at a lower strength; and
(3) how much of each plaintiff's damages was attributable to failures by others, such as the Federal Emergency Management Agency (FEMA) and other governmental agencies, to prevent additional injury.[8]

This list of criteria merits critical evaluation. The Court's three points may indeed not set forth a conclusive selection that fully reflects the causally relevant contribution of climate change to Hurricane Katrina. Climate change may not only have contributed to the strength of the hurricane and the resulting damages, it may also have exacerbated the failures by others, thereby amplifying existing vulnerabilities. These interdependencies between existing vulnerabilities, administrative failures, and climate change deserve attention from a scientific and from a legal point of view, to make clearer statements about causation and attribution. Exploring these factual connections should not be limited through a constricted set of criteria.

An increased focus on the intersection of science and law, where scientific research is informed by a better understanding of legal criteria for attribution, is certainly timely. Attribution-based cases represent a key trend in litigation, albeit one that is moving more slowly than originally anticipated.[9] This may be due to the fact that the legal analysis of 'attribution' incorporates a normative operation: it is never

Zervogianni (eds), *Causation in European Tort Law* (Cambridge University Press 2017) 4, 590; Walter van Gerven, Jeremy Lever, and Pierre Larouche, *Cases, Materials and Text on National, Supranational and International Tort Law* (Hart 2000) 395.

7 *Gloucester Resources* (n 3) [525]–[528]; *Save Lamu et al v National Environmental Management Authority and Amu Power Co Ltd* [2016] Tribunal Appeal No Net 196 of 2016 (Kenya Environmental Tribunal) [151]; *Earthlife Africa Johannesburg v Minister of Environmental Affairs and Others* [2017] 65662/16 <http://climatecasechart.com/wp-content/uploads/sites/16/non-us-case-documents/2017/20170306_Case-no.-6566216_judgment-1.pdf> accessed 24 February 2024.

8 *Comer v Murphy Oil USA, Inc* No 1:11-cv-00220 (Federal District Court of Mississippi) 23.

9 United Nations Environment Programme and Sabin Center for Climate Change, 'Global Climate Litigation Report: 2020 Status Review' (2020) 4, 22, 27, and 31 <https://wedocs.unep.org/bitstream/handle/20.500.11822/34818/GCLR.pdf?sequence=1&isAllowed=y> accessed 24 February 2024. See for an update, Global Climate Litigation Report: 2023 Status Review (n 6) 65.

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purely scientific or merely counterfactual but entails the judicial determination of a factual, social, and legal reality.[10] This determination will be case-specific and dependent on the relevant law. However, it can be informed by filing cases into categories derived from environmental case law beyond climate change, such as the differentiation between 'look back' and 'in the moment' cases.[11] The respective category defines the applicable standard for judicial intervention so that protective measures can be adopted before harm occurs, despite remaining scientific uncertainties. Therefore, and with an emphasis on the *status nascendi*, emerging best practices in this chapter are derived from judicial pronouncements that prune the normative context and pave the way for a rigorous and comprehensive causal analysis in future cases.

17.1.2 *Climate Science and Attribution Studies as a Matter for Courts*

Climate science has already become a matter for courts. Courts across a number of jurisdictions have established a causal link between increasing greenhouse gas (GHG) emissions[12] and an increasing risk of climate-related extreme events and slow-onset events.[13] The relevant available scientific evidence is often directly derived from the reports of the IPCC, such as in *Milieudefensie v Royal Dutch Shell*,[14] or indirectly, from national scientific advisory committees that provide independent advice and devise national carbon budget calculations based on IPCC reports.[15] The Administrative Court of Berlin in *German Farmers v Germany* argued that there 'is much to be said for at least an equal global per capita distribution of the remaining global CO_2 budget'.[16]

The physical science on climate change, and, in particular, detection and attribution studies, provides important and steadily evolving information for the causal

[10] Christian von Bar, *The Common European Law of Torts*, vol 2 (Clarendon Press 2000) 435, 440, 461; van Gerven, Lever and Larouche (n 6); Christian Grüneberg, 'Vorb v § 249' in *Palandt, Bürgerliches Gesetzbuch* (77th ed, Beck 2018) [26]–[28]; see further Will Frank, 'Klimahaftung und Kausalität' (2013) Zeitschrift für Umweltrecht 23. For international law see ILC, 'Draft Articles on Responsibility of States for Internationally Wrongful Acts, with commentaries' (2001) UN Doc A/RES/56/83 (2001), 53 UN GAOR Supp (No 10) at 43, Supp (No 10) A/56/10 (IV.E.1) (ILC Draft Articles) 35 [6].

[11] This differentiation will be explained under Section 17.2.2.

[12] For legibility, the term 'emissions' will be used synonymously with 'GHG emissions'.

[13] *Massachusetts v EPA* 549 US 497 (2007). For a comprehensive analysis of this case see Richard J. Lazarus, *The Rule of Five* (HUP 2020); *Thomson v Minister for Climate Change Issues* [2017] NZHC 733 (High Court) (*Thomson*); *Notre Affaire à Tous and Others v France* [2021] No 1904967, 1904968, 1904972 1904976/4-1 21, 22; *Neubauer* (n 3) [36], [160], [161].

[14] *Milieudefensie v Royal Dutch Shell* [2021] ECLR:NL: RBDHA:2021:5339 (District Court of the Hague) [4.4.29]–[4.4.30].

[15] *Neubauer* (n 3) [160]–[161]; *R (on the application of Friends of the Earth Ltd) v Secretary of State for Business, Energy and Industrial Strategy* [2022] EWHC 1841 (Admin) [175].

[16] *Family Farmers and Greenpeace* (n 4) 21.

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analysis generally and for the specific criteria of legal attribution.[17] Relevant studies can deliver expert evidence in court and they also more generally improve our understanding of the human contribution to extreme events,[18] such as floods,[19] hurricanes,[20] heatwaves,[21] or slow-onset events and impacts on vulnerable ecosystems.[22] The conventional approach of probabilistic event attribution uses inductive reasoning to establish a quantifiable fraction of the magnitude or probability of risk or harm that can scientifically be attributed to climate change or even localised regional emissions.[23] Studies that claim to evidence the link between a concrete climate-related impact and an individualised amount of emissions carry the potential to change the outcome of litigation.[24] However, only reliable, unbiased, and carefully reviewed studies can produce the legally relevant evidence through assessing observed changes in weather extremes and climate-related impacts, their attribution to causes, and their future trajectories and return periods.[25]

The IPCC has acknowledged that case-specific studies provide evidence in addition to the 'established fact that human-induced greenhouse gas emissions have led to an increased frequency and/or intensity of some weather and climate extremes since pre-industrial time, in particular for temperature extremes'.[26] The IPCC stated in its Sixth Assessment Report (AR6), Working Group I, that since the 2018 IPCC

[17] The concerns finding the factor that is a necessary or a sufficient condition for the event, see Petra Minnerop and Friederike Otto, 'Climate change and causation: Joining law and climate science on the basis of formal logic' (2020) 27 Buffalo Environmental Law Journal 49, 56, 68.

[18] Working Group I of the Intergovernmental Panel on Climate Change (IPCC) in its Sixth Assessment Report of 2021 defines an extreme weather event as 'an event that is rare at a particular place and time of year' and an extreme climate event as 'a pattern of extreme weather that persists for some time, such as a season', Valerie Masson-Delmotte and others (eds), *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press 2021) 11.1.2, [11].

[19] Sarah F. Kew and others, 'Impact of precipitation and increasing temperatures on drought trends in eastern Africa' (2021) 12 Earth System Dynamics 17.

[20] Kevin A. Reed, Michael F. Wehner, and Colin M. Zarzycki, 'Attribution of 2020 hurricane season extreme rainfall to human-induced climate change' (2022) 13 Nature Communications 1905.

[21] Andrew Ciavarella and others, 'Prolonged Siberian heat of 2020 almost impossible without human influence' (2021) 166 Climatic Change 9; Mariam Zachariah and others, 'Climate Change made devastating early heat in India and Pakistan 30 times more likely' (*World Weather Attribution*) <www.worldweatherattribution.org/wp-content/uploads/India_Pak-Heatwave-scientific-report.pdf> accessed 24 February 2024.

[22] Caroline Taylor and others, 'Glacial lake outburst floods threaten millions globally' (2023) 14 Nature Communications 487.

[23] Tobias Pfrommer and others, 'Establishing causation in climate litigation: Admissibility and reliability' (2019) 152 Climatic Change 67, 68.

[24] Rupert Stuart-Smith and others, 'Filling the evidentiary gap in climate litigation' (2021) 11 Nature Climate Change 651. Rupert Stuart-Smith and others, 'Attribution science and litigation: Facilitating effective legal arguments and strategies to manage climate change damages' (*Smith School of Enterprise and the Environment*, 2021).

[25] Masson-Delmotte and others (n 18) 11, with projections for three global warming levels 1.5°C, 2°C, 4°C.

[26] ibid Chapter 11 [6].

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Special Report on Global Warming of 1.5°C was published, new evidence has emerged that:

> [E]ven relatively small incremental increases in global warming (+0.5°C) cause statistically significant changes in extremes on the global scale and for large regions (high confidence). In particular, this is the case for temperature extremes (very likely), the intensification of heavy precipitation (high confidence) including that associated with tropical cyclones (medium confidence), and the worsening of droughts in some regions (high confidence).[27]

The legal evaluation of these scientific insights requires judicial engagement with general and case-specific scientific evidence on climate change[28] and climate literacy.[29] The relevant scientific knowledge and the law evolve often at different time scales, and this poses challenges to the science/law intersection. A continuous, mutually informing interdisciplinary discourse is necessary. An illustrative example is *Native Village of Kivalina v ExxonMobil Corp*, where the link between the defendant's emissions and the erosion of the coastal line as a result of climate change at the time of the decision was too indirect to fulfil the criteria of 'fair traceability' (a requirement to establish standing).[30] Scientists nowadays claim that it would be possible to establish a causal link between the losses claimed and the defendant's GHG emissions.[31]

Challenges and constraints in accessing the most relevant, recent, and unbiased scientific evidence in the court of law persist.[32] Any limited availability of scientific evidence in court, or the actual lack of data, cannot simply be interpreted as implying that no relevant trends exist, or that anthropogenic climate change has not contributed to the intensity and frequency of a studied event.[33] Data limitations may only indicate that either the quality or the temporal length of the case-specific data collection, or both, are not suited to provide a full and specific account for

[27] ibid.

[28] Commission on Human Rights of the Philippines, 'National Inquiry on Climate Change Report' (CHRP December 2022) <https://chr.gov.ph/nicc-2/> last accessed 3 April 2025.

[29] The importance of climate education is already acknowledged in the work on 'Action for Climate Empowerment' under Paris Agreement (entered into force 4 November 2016) 3156 UNTS 79 (Paris Agreement) art 12 and United Nations Framework Convention on Climate Change (entered into force 21 March 1994) 1771 UNTS 107 (UNFCCC) art 6.

[30] *Native Village of Kivalina v ExxonMobil Corp Kivalina* 663 F.Supp.2d 863 (District Court of Northern District of California 2009).

[31] Rupert Stuart-Smith and others, 'Increased outburst flood hazard from Lake Palcacocha due to human-induced glacier retreat' (2021) 14 Nature Geoscience 14, 85, 86.

[32] ibid; Pfrommer and others (n 23) 80, explaining that different outcomes can sometimes be explained based on whether a study focuses on magnitude of the event or its frequency.

[33] Friederike Otto and others, 'Climate change increased rainfall associated with tropical cyclones hitting highly vulnerable communities in Madagascar, Mozambique & Malawi' (*World Weather Attribution*, 2022) <www.worldweatherattribution.org/wp-content/uploads/WWA-MMM-TS-scientific-report.pdf> last accessed 24 February 2024.

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attribution.[34] Even then, it remains possible and necessary to analyse the factual circumstances of a case in light of the already available and steadily growing body of climate science.

Given the significant and increasing importance of climate science for legal developments, both in legislation and in litigation, Section 17.2 defines the analytical steps of climate causality and explains how attribution studies can be used for legal attribution. It then explains the potential role of normative correctives[35] to soften the outcome of a strict causal analysis, and points to the critical function of three, instead of just two, logical fundamentals for a coherent legal analysis. Section 17.3 identifies emerging best practices of judicial engagement with climate change that could inform legal attribution. Section 17.4 discusses the potential for replicability of these arguments and Section 17.5 concludes.

17.2 CAUSATION AND ATTRIBUTION AS INTERTWINED LEGAL CONCEPTS AND ATTRIBUTION STUDIES

The differences between general and specific causation and attribution are not always clearly articulated, and the terminology varies between science (discussed in Chapter 3) and law. Furthermore, some statements about causation in law imply attribution, and there are different approaches to distinguish 'event' and 'source' attribution in scientific studies.[36] In human rights-based cases, a general causal link between a country's projected GHG emissions, increasing global mean temperatures, and expected impacts of climate change that risk interfering with individual rights may be sufficient to argue that national climate targets are inadequate (see Chapter 7).[37] By contrast, in cases that seek to establish individual liability for a climate-related event, specific causation, and attribution of the harm or increased risk of harm, to the action or omission of the defendant must be demonstrated. It

[34] ibid.

[35] Normative Correctives are understood here as case-specific consideration of fairness and justice, as expressed by *Fairchild v Glenhaven Funeral Services* [2002] UKHL 22 [36]: 'Any other outcome would be deeply offensive to instinctive notions of what justice requires and fairness demands' (Lord Nicholls).

[36] Cf Michael Burger, Jessica Wentz, and Radley Horton, 'The law and science of climate change attribution' (2020) 45 Columbia Journal of Environmental Law 57, 67. See Chapter 3 on Attribution Science. See further the differentiation of climate change attribution, extreme event attribution, impact attribution, and source attribution at https://climateattribution.org/.

[37] In *Klimatická žaloba ČR v Czech Republic* [2022] No 14A 101/2021 (Prague Municipal Court), the Court noted that 'there is no doubt that human activity is the central cause of climate change' [283] and that insufficient national measures constituted a violation of the Paris Agreement [280]. This caused an unlawful interference with rights [322]. See, for comparison, the first human rights case of Inuit Circumpolar Council Canada, Petition to the Inter-American Commission on Human Rights Seeking Relief from Violations Resulting from Global Warming Caused by Acts and Omissions of the United States, [2005] Inter-American Commission on Human Rights 1413-05. See further Jacqueline Peel and Hari M. Osofsky, 'A rights turn in climate change litigation?' (2018) 7 TEL 37, 42.

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has been noted in 2018 that, for the first time, attribution science opens the door to establishing 'the evidence of specific and quantifiable loss and damage arising out of atmospheric levels of anthropogenic GHGs that can be linked to specific regions and individuals'.[38]

17.2.1 *Attribution as a Scientific and Legal Field of Study*

Event attribution as a field of scientific study is defined as 'the process of evaluating the relative contributions of multiple causal factors to a change or event with an assignment of statistical confidence'.[39] A number of different analytical tools are employed, spanning climate observations, modelling, and statistical (re-)analyses.[40] These attribution studies provide the 'human contribution assessment' for observed changes in ecosystems,[41] such as ocean heat content increase or arctic sea ice loss – cases where since 1970 anthropogenic emissions have become the main drivers for those changes.[42] Scientists identify changes in characteristics of the climate system, such as trends and variations in single extreme events, including their frequency, intensity, and duration.[43]

[38] Sophie Marjanac and Lindene Patton, 'Extreme weather event attribution science and climate change litigation: An essential step in the causal chain?' (2018) 36 Journal of Energy and Natural Resources Law 265, 279.

[39] See Chapter 3 on Attribution Science. Gabriele Hegerl and others, 'Good practice guidance paper on detection and attribution related to anthropogenic climate change', in IPCC, *Meeting report of the Intergovernmental Panel on Climate Change expert meeting on detection and attribution of anthropogenic climate change*; confirmed again in Priyadarshi Shukla and others, 'Summary for Policymakers' in *Climate Change 2022: Mitigation of Climate Change* <https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf> accessed 24 February 2024. See further National Academy of Sciences, *Attribution of Extreme Weather Events in the Context of Climate Change* xvii; Alexis Hannart and others, 'Causal counterfactual theory for the attribution of weather and climate related events' (2016) 97 Bulletin of the American Meteorological Society 99, 104.

[40] ibid. See further Geert Jan van Oldenborgh and others, 'Attribution of extreme rainfall from Hurricane Harvey' (2017) 12 Environment Research Letters 124009.

[41] Intergovernmental Panel on Climate Change, *AR6 Synthesis Report: Climate Change 2023* 43 <www.ipcc.ch/report/sixth-assessment-report-cycle/> accessed 24 February 2024 (IPCC 2023, AR6 SYR). See e.g. Mariam Zachariah and others, 'Without human-caused climate change temperatures of 40°C in the UK would have been extremely unlikely' (*World Weather Attribution*) <www.worldweatherattribution.org/wp-content/uploads/UK-heat-scientific-report.pdf> accessed 24 February 2024.

[42] ibid IPCC 2023, AR6 SYR. For more extreme weather and attribution studies see 'Attributing extreme weather to climate change' (*Met Office*) <www.metoffice.gov.uk/research/climate/understanding-climate/attributing-extreme-weather-to-climate-change#:~:text=This%20page%20explains%20how%20we,impact%20all%20levels%20of%20society> accessed 24 February 2024.

[43] ibid IPCC 2023, AR6 SYR 42; Christopher W. Callahan and Justin S. Mankin, 'National attribution of historical climate damages' (2022) 172 Climatic Change 40; Maria L. Banda, 'Climate Science in the Courts: A Review of US and International Judicial Pronouncements' (*Environmental Law Institute*, 2020) <www.eli.org/sites/default/files/eli-pubs/banda-final-4-21-2020.pdf> accessed 24 February 2024; Friederike Otto and others, 'The attribution question' (2016) 6 Nature Climate Change 813, 814.

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As a scientific field of study, attribution science is relatively young. One of the first attribution studies concerned the human contribution to the European heatwave of 2003.[44] The study found that it was very likely (confidence level >90%) that human influence had at least doubled the risk of a heatwave exceeding a threshold for mean summer temperatures in Europe.[45] The IPCC recognised for the first time in its Fourth Assessment Report (AR4) of 2007 the relevance of the data of formal detection and attribution studies as a further source for the understanding of the physical science basis of climate change, in addition to climate records and observational data.[46] Since then, evidence of observed changes in weather extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, 'and in particular their attribution to human influence', has been significantly strengthened; most recently in AR6.[47]

As introduced in Chapter 3 on Attribution Science, two main methodological approaches can be differentiated: probabilistic event attribution studies and the so-called storyline approach. Probabilistic attribution studies employ inductive reasoning and ask two main questions.[48] First, whether the likelihood or strength of an event has changed in the observational record, and second, whether this change is consistent with the anthropogenic influence as found in one or more climate models.[49] These climate models compare the world *with* climate change with the counterfactual world where *no* climate change exists, thereby assessing the fraction of the attributable risk that can be assigned (quantitatively and qualitatively) to anthropogenic climate change.[50]

The so-called storyline approach is mainly deductive. Studies using this approach do not assess the change of likelihood in a specific event's occurrence (they take that change as a given), but ask whether the impact of the particular event was affected by

[44] Peter A. Stott, Daniel A. Stone, and Myles R. Allen, 'Human contribution to the European heatwave of 2003' (2004) 432 Nature 610, 613.

[45] ibid 613.

[46] Susan Solomon and others, 'Technical summary' in *Climate Change 2007: The Physical Science Basis* 22, 53. Furthermore, a distinction was made between attribution based on expert judgment and attribution through formal studies. The Report added accordingly the terms 'extremely likely', 'extremely unlikely', and 'more likely than not' in order to provide a more specific assessment <www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-ts-1.pdf> accessed 24 February 2024.

[47] IPCC 2023, AR6 SYR (n 41) 12, 17.

[48] Stephanie D. Herring and others, 'Introduction to explaining extreme events of 2014 from a climate perspective' (2015) 96(12) Bulletin of the American Meteorological Society 1; Daniel E. Horton and others, 'Contribution of changes in atmospheric circulation patterns to extreme temperature trends' (2015) 522 Nature 465, 466.

[49] Sarah Sparrow and others, 'The use of very large atmospheric model ensembles to assess potential anthropogenic influence on the UK summer 2012 high rainfall totals' (2013) 94(9) Bulletin of the American Meteorological Society Supplement Explaining Extreme Events of 2012 from a Climate Perspective S36–S38; Fraser Lott and others, 'Can the 2011 East African drought be attributed to human-induced climate change?' (2013) 40 Geophysics Research Letters 1177.

[50] Friederike Otto and others, 'Assigning historic responsibility for extreme weather events' (2017) 7 Nature Climate Change 757, 758.

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known changes (induced by climate change) in the climate system's thermodynamic conditions.[51] Thus, the focus rests primarily on specific qualitative changes in the studied event that can be attributed to climate change.[52] From a legal perspective, both approaches can provide complementary evidence for causation and attribution.[53]

A further layer is added by differentiating between event attribution and source attribution. Source attribution concerns the nexus between a certain activity, a project, or another defined source of emissions, and the additional and quantifiable amounts of emissions.[54] An example are wetland emissions and atmospheric sink changes that explain the growth of methane.[55]

For the purpose of this chapter, and with a view to capture the relevant scientific findings of event attribution studies, the meaning of legal attribution is defined within the broader concept of climate causality that involves general causation and specific causation as a sequence of analytical steps. *General causation* means that a factor has altered the probability of the occurrence of a certain class of events in a statistically significant way.[56] This could encompass the general link between human-caused climate change that is affecting many weather and climate extremes in every region across the globe,[57] or between increasing human-caused climate change and heavy precipitation associated with tropical cyclones.[58] *Specific causation* describes the factual finding that a factor (e.g. increasing GHG emissions, increasing mean temperatures) has altered the specific characteristics of a concrete event (e.g. the duration, frequency, and/or intensity of a heatwave in a certain region and year) in a statistically significant way.[59] In the legal assessment, general and specific causation rely on counterfactual inquiries that seek to identify if, and to what extent, the factor was either necessary or sufficient for the studied event(s).[60] Neither general nor specific causation stipulates that the factor, i.e. the amount of

[51] Kevin E. Trenberth, John T. Fasullo, and Theodore G. Shepherd, 'Attribution of climate extreme events' (2015) 5 Nature Climate Change 725, 727.

[52] 'For example, given a heatwave, how was that influenced by drought changes in precipitation and extra heat from global warming?', ibid 726.

[53] Elisabeth A. Lloyd and Theodore G. Shepherd, 'Climate change attribution and legal contexts: Evidence and the role of storylines' (2021) 167 Climatic Change 28.

[54] The Sabin Center for Climate Change Law distinguishes the literature on source attribution, impact attribution, and extreme event attribution, see <https://climateattribution.org/> accessed 24 February 2024.

[55] Shushi Peng and others, 'Wetland emission and atmospheric sink changes explain methane growth in 2020' (2022) 612 Nature 477–482; Krishnakant Budhavant and others, 'Black carbon aerosols over Indian Ocean have unique source fingerprint and optical characteristics during monsoon season' 120(8) PNAS e2210005120.

[56] HLA Hart and Tony Honore, *Causation in the Law* (Oxford University Press 1985) 100, 108, 431; Desmond M. Clarke, 'Causation and Liability in Tort Law' (2014) 5 Jurisprudence 217; van Gerven (n 6).

[57] IPCC 2023, AR6 SYR (n 41) 46.

[58] ibid 17.

[59] Minnerop and Otto (n 17) 49, 56; Mariam Zachariah and others, 'Extreme heat in North America, Europe and China in July 2023 made much more likely by climate change' (*Imperial College London*, 2023) <https://spiral.imperial.ac.uk/handle/10044/1/105549> accessed 24 February 2024.

[60] Minnerop and Otto (n 17) 49, 55.

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emissions over a certain period of time, must be the only cause. There can be a set of factors that act as concurrent causes.[61] It is a related but different question to measure and objectively quantify the contribution of each cause.

On that basis, *attribution* in law is understood as the final step that describes the adequate and quantifiable contribution of an individualised factor or activity to the studied event (impact or damage), in a specific normative context.[62] It asks, for example, if the changed characteristics of a concrete event (increased outburst flood hazard of a glacial lake) have not only been caused by human-induced glacier retreat (i.e. specific causation between glacier retreat and increased risk)[63] but can be *adequately* assigned to a concrete human contribution. Attribution spans the nexus between the human activity and the concrete adverse impact. The term 'adequate' has its roots in the 'theory of adequate causation'[64] and indicates that there can be causal chains that – for various reasons – cannot or no longer be linked to a particular source.[65]

The normative considerations that are relevant to establish legal attribution will depend on the circumstances of each case and relevant scientific and legal determinations such as the role of natural variabilities, the distribution of risk spheres, and provisions concerning the onus of proof.[66] Absolute certainty is not required to prove either causation or attribution in law.[67]

Within the normative evaluation of 'adequacy', the law – and courts in interpreting and applying legal criteria – can attribute climate-related impacts to human-controlled emissions and thereby (re-)allocate responsibilities, potentially beyond the strict 'but for' analysis albeit within the rule of law. However, these legal determinations can work in both ways: they can either interrupt or expand the causal chain, that is, exclude or include certain factors as causes.

An example of the former is the exclusion of so-called 'cruise emissions' from the consideration of an airport expansion in *Vienna-Schwechat Airport Expansion*.[68] The Austrian Constitutional Court interpreted the requirement for airline operators to comply with EU emissions monitoring and reporting schemes[69] so as to conclusively assign the responsibility to manage so-called 'cruise emissions' to airlines and not to

[61] ibid 53, 67, 83. See also explicitly *Mathur Merits* (n 3) [143].
[62] Grüneberg (n 10).
[63] Stuart-Smith and others (n 31) 85, 86.
[64] The 'Adequanztheorie' goes back to the work of Carl Ludwig von Bar, *Die Lehre vom Causalzusammenhange im Rechte, besonders im Strafrechte* (1871).
[65] ibid 27, 28.
[66] Michael S. Moore, *Causation and Responsibility: An Essay in law, Morals and Metaphysics* (Oxford University Press 2009) 118; Ernest J. Weinrib, 'Causal uncertainty' (2016) 36 OJLS 135, 140.
[67] ILC, 'Draft Articles on Responsibility of States for Internationally Wrongful Acts, with commentaries' (2001) UN Doc A/RES/56/83 (2001), 53 UN GAOR Supp (No 10) at 43, Supp (No. 10) A/56/10 (IV.E.1) 39 [9].
[68] *Vienna-Schwechat Airport Expansion* E 875/2017 E 886/2017 (Constitutional Court of Austria) 6–9 <http://climatecasechart.com/non-us-case/in-re-vienna-schwachat-airport-expansion/> accessed 24 February 2024.
[69] Council Directive 2008/101/EC of 19 November 2008 [2009] OJ L8/3 [15].

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airports or airport operators.[70] On that basis, the Court overturned an earlier decision of the Austrian Administrative Court.[71] The Administrative Court had refused to grant permission for a third runway extension with the argument that the public interest of 'no further significant increase in GHG emissions in Austria due to the construction and operation of the third runway' prevailed over the interest to expand the airport's capacity.[72] The Constitutional Court did not deny that additional emissions would occur; however, it found that these had wrongly been included in the consideration of relevant public interests by the Administrative Court, given that the majority of predicted emissions would occur as cruise emissions – thus falling within the responsibility of airline operators.[73]

The Constitutional Court's reasoning in this case demonstrates the normative operation that furnishes attribution, and it illustrates how important it is to clearly distinguish between a factual consideration of a proposed project's future emissions and assigning legal responsibility for those emissions. Specific causation captures the quantifiable emissions resulting from the expansion of the airport; these would not exist 'but for' this individual project. The next analytical step relates to the attribution of these additional emissions. It is indeed a *legal determination* to attribute cruise emissions to the airline operators. This legal attribution and the assigned responsibility that comes with it in terms of accounting and reporting, and possibly 'off-setting', are to be distinguished from specific causation, as the factual assessment of the amount of predicted emissions. According to the relevant Austrian law, the evaluation and balancing of the various 'public interests' affected by the project depend precisely on the factual consideration of the project's emissions,[74] not on the legal attribution of these emissions.

Interestingly, the Philippines Commission on Human Rights included in its National Inquiry on Climate Change Report a section on 'Recommendations for the Judiciary'.[75] Therein, it noted that 'in many jurisdictions, courts evaluate evidence linking actors to climate-related losses using the stringent standards of legal causation'.[76] According to the Commission, 'this disregards the work of climate

[70] *Vienna-Schwechat Airport Expansion* (n 68).

[71] ibid.

[72] *Vienna-Schwechat Airport Expansion* W109 2000179-1/291E (Administrative Court of Austria) (unofficial English translation). The Court found at [127] that

> As climate change is associated with severe health damage, with an increase in heat – related deaths as well as severe impairments of the Austrian economy and the agriculture and the project will lead to a significant increase in GHG emissions, the public interest in the realization of the project fall below the public interest in the protection against the negative effects of climate change and land use.

[73] *Vienna-Schwechat Airport Expansion* (n 68) at 7.

[74] Luftfahrgesetz, LFG, BGBl. Nr. 253/1957, idF. BGBl. I Nr. 80/2016 (Austria).

[75] Commission on Human Rights of the Philippines (n 28) 147.

[76] ibid.

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and attribution science, and causes more climate injustices'.[77] The Commission proceeded to define event attribution as to establish '(i) whether the likelihood or strength of a natural event has changed in the observational record, and (ii) whether this change is consistent with the anthropogenic influence as found in one or more climate models'.[78] This statement confirms that measurable changes in the likelihood of an event's occurrence or strength are *legally* relevant.[79]

It should be mentioned that in exceptional circumstances, beyond the context of climate litigation, courts have acknowledged that normative considerations can also function in the opposite direction and draw factors in as factual causes. These are cases where a mechanistic causal analysis was found to be 'in contradiction to law's function to achieve justice and fairness'.[80] For example, in asbestos litigation, courts have attributed harm to the actions or omissions of the defendant, even when the traditional causal tests of 'but for' and '*conditio sine qua non*' have failed.[81]

This interpretative approach stresses the fundamental role of the judiciary in the evolution and affirmation of so-called 'normative correctives' that form part of the legal concept of attribution.[82] However, specific normative correctives in the context of climate change are not yet widely articulated or accepted. Therefore, the attribution of a specific climate risk, damage, or loss involves not only a variety of forensic, evidentiary, and legal questions, it fundamentally still proceeds in the shadow of a yet unresolved ethical debate of global climate equity and fairness.[83]

17.2.2 *Normative Correctives v Extended Logical Fundamentals?*

As the Philippines Human Rights Commission remarked, an overly stringent application of causal tests will not easily be reconciled with the evidence produced by attribution studies.[84] Research has demonstrated that two main approaches are available to soften the outcome of a strict causal analysis in

[77] ibid. This view is based on attribution science understood as the 'storytelling' approach, see Trenberth, Fasullo, and Shepherd (n 51).

[78] Commission on Human Rights of the Philippines (n 28) 160.

[79] See Elisabeth A. Lloyd and others, 'Climate scientists set the bar of proof too high' (2021) 165 Climatic Change 55.

[80] Richard W. Wright, 'Causation in tort law' (1985) 73 California Law Review 1735, 1743.

[81] *Fairchild* (n 35) [40]: 'On occasions the threshold "but for" test of causal connection may be over exclusionary' (Lord Nicholls). See generally for the treatment of Asbestos under tort law, Maria Lee, 'The sources and challenges of norm generation in tort law' (2018) 9(1) European Journal of Risk Regulation 34, 36.

[82] Minnerop and Otto (n 17) 49.

[83] See Stephen M. Gardiner, *A Perfect Moral Storm: The Ethical Tragedy of Climate Change* (Oxford University Press 2011); Stephen M. Gardiner and David A. Weisbach, *Debating Climate Ethics* (Oxford University Press 2016).

[84] Commission on Human Rights of the Philippines (n 28).

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specific cases of alternative or hypothetical causation in multi-stage scenarios.[85] One option would be to apply in the context of climate change normative correctives, given that *factual* circumstances can make it just as difficult as in medical exposure cases to establish causation across a set of multiple factors. So far, these normative correctives in some jurisdictions have included considerations of fairness, distributive justice,[86] and the allocation of risk spheres between the claimant and the defendant.[87] Similarly, courts have used the 'material contribution to risk' test in situations where the plaintiff was unable to establish the exact contribution of a particular tortfeasor.[88] Applying these correctives has changed the outcome of the analysis in situations of alternative, hypothetical, or concurrent causation.[89]

This type of an outcome-correcting approach is, therefore, neither foreign to the law nor has it been widely rejected as conflicting with a positivist approach to the law. For some specific case categories, legal provisions across a number of jurisdictions even set aside the strict rule of the 'but for' test.[90] For example, if a tort has been committed jointly, each tortfeasor will be liable for the full damage if it cannot be established who exactly caused the injury or damage.[91] Meanwhile, normative correctives have had a lesser bearing on climate jurisprudence and the causal analysis in relation to complex climate-related extreme events that are often characterised through combined contributions of natural and human-induced factors.[92]

An alternative option to reflect the scientific evidence of attribution studies through attribution in law is therefore to extend the logical fundamentals upon which the legal analysis of the 'but for' test rests.[93] This can be achieved by using three instead of the usual two logical fundamentals to reflect the contributory

[85] These are necessity, sufficiency, and sustenance, Minnerop and Otto (n 17) 49.

[86] Weinrib (n 66) draws the attention to conceptual operations in handling causal uncertainty in accordance with corrective justice.

[87] Minnerop and Otto (n 17) 49, 60–62; Marjanac and Patton (n 38).

[88] *Clements v Clements* [2012] 2 SCR 181 (Supreme Court of Canada). This is related to the 'market share liability' approach where each defendant is liable in proportion to the market share, see *Sindell v Abbott Laboratories* 26 Cal 3d 588 (Supreme Court of California 1980).

[89] *Fairchild* (n 35) at [34] (Lord Bingham), [42] (Lord Nicholls), [47] (Lord Hoffmann), [116] (Lord Hutton), and [168] (Lord Rodger).

[90] Minnerop and Otto (n 17) 49, 56.

[91] Cf Bürgerliches Gesetzbuch, BGB (Germany) s 830 <www.gesetze-im-internet.de/englisch_bgb/englisch_bgb.html#p4227> accessed 14 July 2023. The law uses a legal presumption that reverses the burden of proof for the injured party, see Hartwig Sprau, 'Vorb v § 830' in *Palandt, Bürgerliches Gesetzbuch* (77th ed, Beck 2018). There are different constellations of multiple sufficient causal sets, *Baker v Willoughby* [1970] AC 467; *McGhee v National Coal Board* [1973] 1 WLR 1; *March v Stramare E & MH Pty Ltd* (1991) 171 CLR 506. See also American Law Institute, *Restatement of the Law Third, Torts: Liability for Physical and Emotional Harm* (American Law Publishers 2010) s 26.

[92] IPCC 2023 AR6 SYR (n 41) 62.

[93] Minnerop and Otto (n 17) 49, 78–84.

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nature of concurrent causes in a set of conditions.[94] A coherent causal analysis in these multi-factor causation scenarios over a range of factors can be based on necessity, sufficiency, and, in addition, sustenance.[95] Sustenance accounts for the capacity of a factor to produce and maintain the event, even if the factor is only one among others in a set of conditions, provided its relative contribution can be objectively measured.[96] The case-specific causal analysis on sustenance will be influenced by our general understanding of the physical science basis of climate change and the evidence for the human contribution to certain types of extreme events. This general causal knowledge is captured by the novel concept of the *distinctive causal field* that encompasses certain types of events with common characteristics (i.e. heatwaves in a specific geographical region).[97] The distinctive causal field forms the backdrop for the assessment of the case-specific evidence, for example, concerning the occurrence of a *concrete* heatwave in the specific geographical region.

Recent scientific research buttresses the validity if not the necessity of the distinctive causal field for assessing scientific evidence, in arguing that attribution studies often contain far more information, 'about other hazards of the same type, than is currently utilised'.[98]

The case against the German energy provider, *Lliuya v RWE*, currently pending in the Higher Court of Appeal in Hamm, Germany, could be one of the first cases to illustrate how emissions could qualify as a cause for an increased flood risk on the basis of sustenance and within the context of scientific evidence on glacier melting. Two scientific studies (one using probabilistic event attribution (inductive) and one using the storyline (deductive) approach) assessed the increased outburst flood hazard from Lake Palcacocha in the context of human-induced glacier retreat.[99] At the time of writing, the legal attribution of this flood risk to a so-called 'carbon major', the largest German energy provider RWE, is being considered at the evidentiary stage.[100] This means that the Court was convinced that the case is conclusively argued from a legal point of view.[101]

[94] ibid 56, 72.
[95] ibid.
[96] ibid.
[97] Introduced by Minnerop and Otto (n 17) 49, 77.
[98] Ben Clarke, Friederike Otto, and Richard Jones, 'When don't we need a new extreme event attribution study?' (2023) 176 Climatic Change 60.
[99] Stuart-Smith and others (n 31) 85, using a probabilistic event attribution study approach, and following a storyline approach are Christian Huggel and others, 'Anthropogenic climate change and glacier lake outburst flood risk: Local and global drivers and responsibilities for the case of lake Palcacocha, Peru' (2020) 20 Nature Hazards Earth Systems Science 2175.
[100] See below Section 17.3.3.
[101] *Lliuya* (n 5). Conclusively argued means that the Court is satisfied that the argument is legally sound (Schlüssigkeitsprüfung). The outcome of the case depends then on the evidence that is produced to prove the legal points.

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17.3 EMERGING BEST PRACTICE ON CLIMATE CAUSALITY IN GLOBAL CLIMATE JURISPRUDENCE

Climate change has undoubtedly moved from the future to the present.[102] The IPCC AR6, WG III Report underlines that the continuation of policies implemented by the end of 2020 – without further strengthening – will lead GHG emissions to continue to rise beyond 2025 and to a median global warming of around 3.2°C by 2100.[103] All government institutions, including courts, play a critical role in strengthening policies that incentivise emissions reductions, and emerging best practices of global climate jurisprudence can support States' ambition.

While there has been a sharp increase in climate cases and strategic litigation in more recent years, climate jurisprudence is not a new phenomenon. One of the earliest cases to mention carbon dioxide (CO_2) emissions as a causal factor for environmental degradation is the 1998 Minnesota Court of Appeal's opinion in *re Quantification of Environmental Costs*.[104] New litigation strategies are informed and shaped by the outcome of previous 'waves' of cases.[105]

A whole new field of global climate jurisprudence has emerged since then where boundaries between jurisdictions and traditional lines of differentiation along the public/private law divide have become less suitable to systematise case categories and to derive knowledge from judicial engagement with climate law and science. Private law norms are applied in cases against States, and, equally, private actors' duties are reconciled with States' duties that flow from the Paris Agreement's long-term goals.[106] Some cases are directly concerned with climate causality whereas others advance the normative framework in which causal explanations and attribution could evolve in the future. Therefore, the following devises an analytical structure based on four reference areas where judicial engagement with the climate challenge start to produce transferable arguments across jurisdictions. First, the determination of the scope of relevant emissions; second, the review of national climate measures and their effect on the global climate; third, the planning of emissions-intensive infrastructure projects or activities; and fourth, the use of general environmental law concepts to develop climate law.

[102] Margaret Rosso Grossman, 'Climate change and the individual' (2018) 66 American Journal of Comparative Law 345, 353; Petra Minnerop, 'Integrating the "duty of care" under the European Convention on Human Rights and the science and law of climate change: The decision of The Hague Court of Appeal in the Urgenda case' (2019) 37 Journal of Energy and Natural Resources Law 149, 160.

[103] Shukla and others (n 39).

[104] *Quantification of Environmental Costs* 578 N.W.2d 794 (Court of Appeals of Minnesota, 1998).

[105] See e.g. *Michael John Smith v Fonterra Co-Operative Group Limited and Others* CA 128/2020 [2021] NZCA 552 (*Smith Court of Appeal*) [118]; Wendy Bonython, 'Tort Law and Climate Change' (2021) 40 University of Queensland Law Journal 421; Geetanjali Ganguly, Joana Setzer, and Veerle Heyvaert, 'If at first you don't succeed: Suing corporations for climate change' (2018) 38 OJLS 841. For an overview and an analysis that includes country reports, see Wolfgang Kahl and Marc Weller (eds), *Climate Change Litigation: A Handbook* (Bloomsbury 2021) 237.

[106] Paris Agreement (n 29) art 2(1)(a). See Chapter 9 on Duty of Care.

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17.3.1 *The Determination of the Scope of Relevant Emissions*

A critical starting point is to establish which emissions, and over which periods of time, should be included in the judicial consideration. In *Urgenda*, the Supreme Court of the Netherlands confirmed that all emissions are causal for further climate change, thereby opposing the 'drop in the ocean' argument of the government.[107] The logic of a limited global carbon budget that demands full consideration of all GHG emissions has also been confirmed by the New South Wales Land and Environment Court in *Gray v The Minister for Planning*[108] and in *Gloucester*.[109]

In a similar vein, the Supreme Court of Norway stated in *Nature and Youth Norway and Greenpeace Nordic v The State* that GHG emissions from combustion of oil and gas (so-called downstream or scope 3 emissions) from exploration of the Barents Sea could interfere with the right to a healthy environment under Article 112 of the Norwegian Constitution.[110] However, the final conclusion of the Supreme Court was based on the premise that the State could nevertheless formulate its climate policy in the light of the 'division of responsibilities' enshrined in international agreements.[111] This reference to international agreements led the Supreme Court to conclude that emissions from combustion would fall within the remit of the respective State using the oil and gas,[112] a position that risks conflating factual causation with the allocation of responsibilities for emissions accounting. The normative and/or legal attribution of these emissions, including the allocation of accounting obligations and potential off-setting responsibilities of the 'end-user', should be reserved for the final step in the analysis as explained in Section 17.2.

The Court of Session (Scotland) equally confirmed that excluding emissions from fossil fuel consumption from consideration as 'direct or indirect significant effects of the relevant project' would not render the environmental impact assessment (EIA) unlawful.[113] According to the Court, these emissions stemmed from the 'use of a finished product'.[114]

[107] *Urgenda Supreme Court* (n 2) [5.6.1]–[5.8].

[108] *Gray v The Minister for Planning, Director-General of the Department of Planning and Centennial Hunter Pty Ltd* [2006] NSWLEC 720 [100], [103].

[109] *Gloucester Resources* (n 3).

[110] *Greenpeace Nordic Association v Ministry of Petroleum and Energy* (2020) Case No 20-051052SIV-HRET (Norwegian Supreme Court) (*People v Arctic Oil*) [149], [155]; *Greenpeace Nordic Association v Ministry of Petroleum and Energy* (2020) Case No 18-060499ASD-BORG/03 (Borgarting Court of Appeal) (*People v Arctic Oil Court of Appeal*); Petra Minnerop and Ida Roestgaard, 'In search of a fair share: Article 112 Norwegian constitution, international law, and an emerging inter-jurisdictional judicial discourse in climate litigation' (2021) 44(4) Fordham International Law Journal 847; Ivar Alvik, 'The first Norwegian climate litigation' (2018) 11 Journal for World Energy Law and Business 541, 544.

[111] ibid *People v Arctic Oil* [159].

[112] ibid.

[113] *Greenpeace Ltd v the Advocate General (representing the Secretary of State for Business, Energy and Industrial Strategy and the Oil and Gas Authority)* [2021] CSIH 53 XA34/20 (Court of Session (Scotland)) [64].

[114] ibid.

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Conversely, a specific case in point that illustrates a comprehensive analysis of climate causality – including attribution – is the judgment of the Rechtbank Den Haag (District Court) in *Milieudefensie v Royal Dutch Shell*, where the Court explicitly included scope 1, 2, and 3 emissions in its causal analysis and ordered Royal Dutch Shell (both directly and via its legal entities which form the Shell group) 'to limit or cause to be limited, the aggregate annual volume of all CO_2 emissions into the atmosphere (scope 1, 2 and 3 emissions) due to the business operations and sold energy-carrying products of the Shell group to such an extent that this volume will have reduced by at least net 45% at end 2030, relative to 2019 levels'.[115] In reaching this decision, the District Court not only stated that there was a causal link between GHG emissions and dangerous climate change[116] but also established a further causal link between the limitation of fossil fuel production and global emissions reductions. The Court found that there is a 'direct, linear link between man-made greenhouse gas emissions, in part caused by the burning of fossil fuels, and global warming'.[117] Thus, limiting the production of fossil fuels would result in reduction of emissions, as 'research shows that there is a causal relationship between production limitation and emission reduction' and 'studies using elasticities from the economics literature have shown that for oil, each barrel left undeveloped in one region will lead to 0.2 to 0.6 barrels not consumed globally over the longer term'.[118]

The Court's reasoning rejects the conventional 'carbon leakage' argument that the demand for fossil fuel will remain constant regardless of any changes in the supply chain. The decision stands in sharp contrast to the view held by the Court of Session in *Greenpeace Ltd v the Advocate General*, where the material effect on climate change of discontinued oil exploitation in the North Sea was seen as 'difficult to argue'.[119] In addition, *Milieudefensie* demonstrates that private actors' duties are no longer fully separate from States' duties: rather, the company's emissions reductions duties are legally intertwined with the State's commitment to the Paris Agreement and its temperature thresholds that define the global and each State's carbon budget (see Chapter 9).

Accordingly, three important insights resonate from the judgment in *Milieudefensie* and define the Court's position on attribution. The first concerns

[115] *Milieudefensie* (n 14) [5.3].
[116] ibid [4.1.3].
[117] ibid [2.3.2].
[118] ibid [4.4.50].
[119] *Greenpeace Ltd v the Advocate General* (n 113) [68]:

> […] The argument is, in any event, an academic one. It is not maintained that the exploitation of the Vorlich field would increase, or even maintain, the current level of consumption. Unless it did so, it is difficult to argue that it would have any material effect on climate change; even if it is possible to arrive at a figure for its contribution by arithmetical calculation relative to the production of oil and gas overall.

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the Court's emphasis on a scientifically supported and internationally endorsed consensus that each company must work towards achieving net zero emissions by 2050.[120] The second insight relates to the recognition of a direct and linear link between Royal Dutch Shell's GHG emissions, dangerous levels of global warming, and the imminent environmental damage in the Netherlands.[121] Finally, the Court confirmed the plaintiffs' argument that all CO_2 emissions *attributable to the Shell group* had to be reduced.[122] This means that the localised, imminent environmental damage is attributable to the individualised emissions of the Shell group.

17.3.2 *Reviewing National Climate Targets and Measures*

Cases against governments often concern insufficient national climate targets for mitigation, but lawsuits challenging States' adaptation measures are also rising.[123] Furthermore, and as deadlines for sectoral climate targets approach, new administrative case law begins to emerge that is concerned with adequate response measures if targets are not met.[124] So far, cases against governments have often relied on a general causal link between the challenged national climate targets, further climate change in the absence of enhanced targets, and an interference with fundamental rights.[125] The focus rests on whether or not the impugned action or inaction is capable of depriving individual rights,[126] with the aim of compelling governments to

[120] *Milieudefensie* (n 14) [4.4.27], [4.4.36].
[121] ibid [2.3.2], [4.4.16], [4.4.37].
[122] ibid [4.4.34], [4.4.37].
[123] *Klimatická žaloba ČR* (n 37). *Friends of Cedra Mesa v Department of the Interior* No 1:21-cv-00971 (District Court of Utah). See further *Global Climate Litigation Report: 2023 Status Review* (n 6) 38–47.
[124] The Higher Administrative Court in Berlin-Brandenburg ordered the German government to adopt an immediate action programme ('Sofort Programm') to address the State's failure to meet the targets in the transportation and the building sectors in OVG 11 A 11/22, OVG 11 A 27/22 u. OVG 11 A 1/23.
[125] The Human Rights Council adopted a resolution on 8 October 2021 that introduces a new Special Rapporteur on the promotion and protection of human rights in the context of climate change, A/HRC/RES/48/14; see further OHCHR, Report of the Special Rapporteur on the Issue of Human Rights Obligations Relating to the Enjoyment of a Safe, Clean, Healthy and Sustainable Environment UN Doc A/HRC/37/59, annex (2018).

See Commission on Human Rights of the Philippines (n 28); Jacqueline Peel and Jolene Lin, 'Transnational climate litigation: The contribution of the Global South' (2019) 113 AJIL 679; Minnerop (n 102) 149, 160; Margaretha Wewerinke-Singh and Ashleigh McCoach, 'The State of the Netherlands v Urgenda Foundation: Distilling best practice and lessons learnt for future rights-based climate litigation' (2021) 30 RECIEL 275; Ganguly, Setzer, and Heyvaert (n 105) 841; Brian J. Preston, 'The evolving role of environmental rights in climate change litigation' (2018) 2 CJEL 131; Peel and Osofsky (n 37); Jacqueline Peel, Hari Osofsky, and Anita Foerster, 'Shaping the "next generation" of climate change litigation in Australia' (2017) 41 Melbourne University Law Review 793; Benoit Mayer, 'Climate change mitigation as an obligation under human rights treaties?' (2021) 115 AJIL 409.
[126] *Klimatická žaloba* (n 37) [162], [163].

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increase ambition levels.[127] These decisions are covered in more detail in Chapters 7, 9, and 16. The following only draws on some of the relevant case law where climate targets were challenged to point out where the reasoning could also inform the analysis on attribution.

The premise for the review of national climate measures is that the Paris Agreement's long-term temperature goal can be translated into corresponding global and national carbon budgets and modelled pathways, as in *Milieudefensie*.[128] Climate targets and corresponding measures can then be reviewed in light of domestic administrative and constitutional frameworks.[129] The scrutiny of national targets is most effective in cases where national climate targets are enshrined in law, as seen in *Urgenda*[130] and *Thomson*,[131] and where domestic law includes interim and sectoral targets as in *Neubauer*[132] and *Deutsche Umwelthilfe*.[133] Acknowledging the causal link between targets, corresponding national emissions, and their effect on the global carbon budget has indeed been critical for the intervention of courts that in turn increased the level of ambition of the defendant State. These decisions indirectly acknowledge that governments' targets and corresponding implementing policies constitute factors to which further climate change and related impacts can be attributed. This nexus is reflected in *Friends of the Earth Ltd and others v Secretary of State for Business Energy and Industrial Strategy*, where the High Court of England and Wales overturned a decision of the Secretary of State as it failed to address how the shortfall towards the national target would be addressed under statutory requirements, and for failure to provide a quantitative explanation to Parliament as required by law.[134]

Courts have an important function when adjudicating on matters such as the role of the Paris Agreement and its implications for national decision-making processes.[135] For example, the Court of Appeal of England and Wales concluded in *R. (on the application of Plan B Earth Ltd.) v Secretary of State for Transport* that the Secretary of State had wrongly omitted climate change considerations and due regard for the Paris Agreement in his decision-making on the expansion of

[127] *Friends of the Irish Environment CLG v The Government of Ireland, Ireland and the Attorney General* [2020] Appeal No 205/19 (Supreme Court of Ireland); *Asghar Leghari v Federation of Pakistan etc* PLD 2018 Lahore 364; *Family Farmers and Greenpeace* (n 4).

[128] *Milieudefensie* (n 14).

[129] An early case in that respect is *Ashgar Leghari* (n 127).

[130] *Urgenda Supreme Court* (n 2).

[131] *Thomson* (n 13). The importance of legal targets have found support in scientific analysis, see Joeri Rogelj and others, 'Three ways to improve net-zero emission targets' (2021) 591 Nature 365, 368. The difficulties that arise from a lack of climate legislation are discussed e.g. for India by Eeshan Chaturvedi, 'Climate change litigation: Indian perspective' (2021) 22 German Law Journal 1459, 1468.

[132] *Neubauer* (n 3).

[133] OVG 11 A 11/22, OVG 11 A 27/22 u. OVG 11 A 1/23 (n 124).

[134] *Friends of the Earth Ltd and others v Secretary of State for Business, Energy and Industrial Strategy* [2022] EWHC 1841 [253], [254].

[135] Instructive is *Klimatická žaloba* (n 37) [244]–[247].

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Heathrow Airport.[136] The decision was overturned on appeal, with the UK Supreme Court remarking that 'the Paris Agreement itself is not Government Policy'.[137]

A similar pattern emerges in other jurisdictions, where the lower courts afford the Paris Agreement and nationally determined contributions (NDCs) a legal valence that is not confirmed in next instance. For example, the Municipal Court in *Klimatická žaloba v Government of the Czech Republic* decided that the government was legally bound under Article 4(2) of the Paris Agreement, and also under the State's NDC, to adopt mitigation measures aimed at achieving the objective of its NDCs.[138] The Court acknowledged a direct link between the State's climate target, the adequacy of measures, and the impact on the global climate.[139] Moreover, the Court applied the rules on treaty interpretation enshrined in Article 31, paragraphs 1 and 2(a), of the Vienna Convention on the Law of Treaties,[140] which are recognised as customary international law.[141] However, on 20 February 2023, the Supreme Administrative Court overturned the decision in *Klimatická žaloba v the Government of the Czech Republic*, based on the collective nature of the EU Member States obligations to reduce GHG emissions by 55 per cent by 2030, and referred the case back to the Municipal Court.[142]

Arguments concerning ineffective mitigation measures and non-compliance with governments' own targets were also tested based on private law in two cases brought against the French government in the Paris Administrative Court and the *Conseil d'Etat*. These cases illustrate that ecological damage can be attributed to emissions that exceed the State's target.

The Paris Administrative Court applied a specific tort law provision of the French Civil Code[143] that prescribes that every person is responsible to provide reparation for ecological damage.[144] The Court thereby affirmed that exceeding the national emissions limits will lead to ecological damage; in other words, the damage is

[136] *R (on the application of Plan B Earth Ltd) v Secretary of State for Transport* [2020] EWCA (Civ) 214. The decision of the Court of Appeal was overturned by the Supreme Court, *R (on the application of Plan B Earth and others) v Heathrow Airport Ltd (Heathrow Expansion)* [2020] UKSC 52.

[137] ibid [112]. See further Joanna Bell and Elizabeth Fisher, 'The Heathrow case in the Supreme Court: Climate change legislation and administrative adjudication' (2023) 85 MLR 226.

[138] *Klimatická žaloba* (n 37) [244]–[248].

[139] ibid.

[140] ibid [247]; Vienna Convention on the Law of Treaties (entered into force 27 January 1980) 1155 UNTS 331 (VCLT).

[141] This is established international case law, *Kasikili/Sedudu Island (Botswana/Namibia)* [1999] ICJ Rep 1045, [18], already in 1971, *Legal Consequences for States of the Continued Presence of South Africa in Namibia* (Advisory Opinion) [1971] ICJ Rep 16 [94]. See further Anthony Aust and Oliver Dörr, 'Vienna Convention on the Law of Treaties', *Max Planck Encyclopedias of Public International Law* (Oxford University Press 2018).

[142] *Klimatická žaloba ČR v Czech Republic* 9 As 116/2022 – 166 (Supreme Administrative Court).

[143] *Notre Affaire à Tous* (n 13).

[144] ibid 30 [8]; art 1246 of the French Civil Code states that: 'Toute personne responsable d'un préjudice écologique est tenue de le réparer'.

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attributable to the State's excess emissions. In a second decision, the Court then decided that the 'Prime Minister and the competent Ministers are ordered to take all useful measures to repair the ecological damage and prevent it worsening for the share of greenhouse gas emissions not made good compared to the first carbon budget'.[145] In a similar vein, the Conseil d'Etat in *Grande-Synthe*[146] found that the French government was under an obligation to take additional measures by 31 March 2022 to meet the target of reducing GHG emissions by 40 per cent compared to 1990, by 2030.[147]

It should be noted that the argument that an event is attributable to climate change may serve as a defence for the Respondent. In *Burgess v Ontario Minister of Natural Resources and Forestry*, both parties to the dispute argued that the damage was *attributable* to climate change.[148] After the flooding in Houston, Texas, caused by Hurricane Harvey,[149] owners of properties upstream of the Addicks and Barker Dams brought suits against the United States. They alleged an uncompensated taking under the Fifth Amendment.[150] The government argued that it was not responsible for the harm that resulted from the flooding because the damage was attributable to Hurricane Harvey as an 'Act of God'.[151] The Court of Federal Claims joined all cases and then split them into two sub-dockets, one for the Upstream cases and one for the Downstream cases.[152] For the Upstream cases, the Court determined that the United States was liable to thirteen property owners under the Fifth Amendment of the United States Constitution for the taking of a non-categorical, permanent flowage easement on their properties.[153] These easements were the result of government-induced flooding during Hurricane Harvey and produced by the government's construction, maintenance, and operation of the Addicks and Barker Dams.[154] For the Downstream cases, the Court granted the government's motion to dismiss and denied appellant motion for summary judgment.[155] On appeal, the

[145] *Notre Affaire à Tous* (n 13).
[146] This follows the decision that was handed down in November 2020 where the *Conseil d'Etat* found that the case was admissible and found France substantially exceeded its first 'carbon budget' set for the period prior to 2020. See *Commune de Grande-Synthe v France* [2020] N°427301 (Conseil d'Etat) (*Grande-Synthe*).
[147] ibid 6.
[148] *Burgess v Minister of Natural Resources and Forestry* No 16-1325 CP, Statement of Claim (Superior Court of Ontario). The case was discontinued voluntarily.
[149] Eric S. Blake and David A. Zelinsky, 'Tropical Cyclone Report: Hurricane Harvey' (*National Hurricane Center*, 2018) <www.nhc.noaa.gov/data/tcr/AL092017_Harvey.pdf> last accessed 24 February 2024.
[150] *In re Upstream Addicks and Barker (Texas) Flood-control Reservoirs USA* No 1:2017cv09001 (Federal Claims Court).
[151] ibid 2. See also *Milton v US* Case: 21-1131 (Court of Appeals for the Federal Circuit).
[152] *In re Downstream* 147 Fed. Cl. at 570, 574 (Federal Claims Court).
[153] In *re Upstream Addicks & Barker* (n 150).
[154] ibid [264].
[155] In *re Downstream* (n 152).

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United States Court of Appeals for the Federal Circuit remanded the case back to the Court of Federal Claims to consider, inter alia, whether Appellants have established causation when considering the impact of the government actions that address the relevant risk.[156]

17.3.3 *Permissibility of Emissions-Intensive Projects or Activities*

Cases concerning the permissibility of emission-intensive projects and activities regularly involve private actors. Litigation against corporations, especially against so-called 'carbon majors',[157] is on the rise and contiguous strategies are constantly refined.[158] Cases are often initiated by non-governmental organisations to halt emissions-intensive infrastructure projects or activities. In some instances, lawsuits have also been initiated by local or State governments: for example, several States have filed suits in the United States, seeking to hold oil and gas companies liable for climate change-related harms.[159] A couple of States have also tried to challenge federal measures such as quantifying estimates for the social costs of GHG emissions.[160]

A key case for causation and attribution that is still pending in second instance before the Higher Regional Court in Hamm (Court of Appeal, 'Oberlandesgericht') at the time of writing is *Lliuya v RWE*, as mentioned earlier.[161] The case is based on German nuisance law (section 1004 Civil Code) and concerns climate adaptation measures in response to flood risks. The claimant, a Peruvian farmer from the Andes region, requests a pro-rata contribution of the energy company for protection measures against flood outburst of the glacial Lake Palcacocha, thus a contribution to adaptation costs. The claimant's calculation, which is open for the Court's own determination, is rooted in the global percentage of historic emissions contributed by RWE, amounting to 0.47 per cent according to a study of carbon-major corporations.[162] In the first instance, the Regional Court in Essen ('Landgericht')

[156] *Milton v US* (n 151) [14].

[157] Richard Heede, 'Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers 1854–2010' (2014) 122 Climatic Change 229–241.

[158] Ganguly, Setzer, and Heyvaert (n 105).

[159] *City of New York v BP plc* Case 18-2188; *City of Oakland v BP plc* Case 3:17-cv-06011-WHA.

[160] *State of Missouri v Biden* No 4:21-CV-00287-AGF, in which the President's Executive Order 13990 ('EO 13990') that establishes an Interagency Working Group on the Social Cost of Greenhouse Gases was challenged; the case was dismissed for lack of standing. The Circuit Court in *State of Louisiana v Biden* Case 22-30087 dismissed a similar claim for lack of standing, stating that 'We now dismiss this action because Plaintiffs have failed to meet their burden to prove standing. Plaintiffs' allegations of "injury in fact" rely on a chain of hypotheticals: federal agencies may (or may not) premise their actions on the Interim Estimates in a manner that may (or may not) burden the States. Such injuries do not flow from the Interim Estimates but instead from potential future regulations…'

[161] *Lliuya* (n 5). See also Section 17.2.2.

[162] Heede (n 157).

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rejected a causal link between the contributions of RWE to global climate change, due to the many contributions and contributors to climate change.[163] A mechanistic application of the '*conditio sine qua non*' (equivalent to 'but for') formula prevented the Court from engaging more closely with scientific evidence that seeks to attribute quantifiable amounts of emissions to specific major emitters. By contrast, the Higher Regional Court stated that the case was conclusively argued (meaning the legal argument *per se* is valid and the case will depend on providing pertinent evidence) and allowed it to proceed to trial. Now at the evidentiary stage, claimants must prove that there is a serious threat of an avalanche that could lead to flooding, and they must demonstrate how this would affect the property of the claimant.[164]

Cases to compel further regulatory action or to review authorities' approval for emissions-intensive infrastructure projects have been brought across jurisdictions. These include situations where authorities below the level of national government unlawfully refused to take regulatory action,[165] limited public participation, and/or insufficiently considered climate change impacts when granting permissions.[166] The latter category impliedly connects emissions attribution (e.g. the anticipated future emissions) and event attribution (the contribution of the project to further climate-related impacts). For example, in *Earthlife Johannesburg v Minister of Environmental Affairs*, the High Court of South Africa held that an assessment of climate change impacts in the environmental authorisation process will 'best be accomplished by means of a professionally researched climate change impact report'.[167] This approach was confirmed in *Sustaining the Wild Coast NPC v Minister of Mineral Resources*.[168] In *Save Lamu v National Environmental Management Authority*, the National Environment Tribunal of Kenya set aside the EIA licence, because the climate impacts of what would have been the first coal fired power plant in Kenya had not been fully evaluated given that comprehensive access to information had not been possible.[169]

The decision in *Gloucester Resources Limited v Minister for Planning* provides a causal analysis that includes an explicit statement on attribution.[170] The Court stressed the causal link between the proposed coal mine, climate change, and further impacts, stating that: '[A]ll of the direct and indirect GHG emissions of the Rocky Hill Coal Project will impact on the environment'.[171] The additional

[163] *Lliuya v RWE* [2015] Az 2 O 285/15 (Essen Regional Court) [41]–[46].
[164] *Lliuya* (n 5).
[165] *Massachusetts v EPA* (n 13).
[166] *Save Lamu* (n 7); *Gloucester Resources* (n 3).
[167] *Earthlife Johannesburg* (n 7) [91], for the procedure that NEMA contains for revocations of an authorisation see [110].
[168] *Sustaining the Wild Coast NPC v Minister of Mineral Resources* [2022] High Court of South Africa No 3491/2021.
[169] *Save Lamu* (n 7) [69].
[170] *Gloucester Resources* (n 3).
[171] ibid [514].

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emissions would be directly attributable to the project. Consequently, a measurable impact of the project on the environment would be attributable to the project and the emissions generated by it.[172]

In *Citizens for a Healthy Community v U.S. Bureau of Land Management*, the Court held that the agency had failed to comply with the National Environmental Policy Act by not taking a hard look at the reasonably foreseeable indirect impacts of authorising oil and gas developments.[173] In *Sierra Club v Federal Energy Regulatory Commission*, the US Court of Appeal for the District of Columbia Circuit found that the Federal Energy Regulatory Commission should have considered the impacts of the project's downstream carbon emissions and climate effects, or explained why such considerations were not relevant for the project.[174] All of these decisions strengthen the proposition that, from a legal point of view, measurable climate impacts could be attributed to a concrete project and its respective emissions.

A more direct attempt to attribute quantified emissions amounts to a certain activity was made in the Indonesian case *Ministry of Environment and Forestry v PT Asia Palem Lestari*, in which the Ministry challenged a private company for the illegal burning of peatland.[175] The government argued that the clearing of peatland for a palm oil plantation released 2,700 tonnes of carbon into the atmosphere and that the activities led to a loss of carbon sinks equal to 945 tonnes of carbon.[176] The District Court of North Jakarta dismissed the case because the Ministry had failed to include other landowners as concerned parties.[177] Meanwhile, the Supreme Court of Indonesia decided in a tort-based lawsuit in *Minister of Environment v PT Selatnasik Indokwarsa and PT Simpang Pesak Indokwarsa* that a quantifiable amount of emissions was attributable to illegal mining activities and awarded the Indonesian Ministry of Environment restoration costs and compensation for GHG emissions.[178]

17.3.4 *Expanding the Normative Lens*

Instantiations of emerging best practices that could change the analysis of causality often result from re-assessing legal concepts. For example, the Constitutional

[172] See also *Gray* (n 108) [100].

[173] *Citizens for a Healthy Community v US Bureau of Land Management* No 1:2017cv02519 (District Court for the District of Columbia).

[174] *Sierra Club v FERC*, 867 F.3d 1357 (District Court for the District of Columbia).

[175] *Ministry of Environment and Forestry v PT Asia Palem Lestari* Decision No 607/Pdt.G-LH/2019/PN.Jkt.Utr <http://climatecasechart.com/non-us-case/ministry-of-environment-and-forestry-v-pt-asia-palem-lestari/> last accessed 6 April 2023.

[176] ibid.

[177] ibid.

[178] *Minister of Environment v PT Selatnasik Indokwarsa and PT Simpang Pesak* Indokwarsa, Decision No 105/Pdt/G/2009/PN.JKT.UT.

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Court in *Neubauer* re-conceptualised the meaning of 'interference' with a fundamental right and developed the 'advanced interference like effect'.[179] Other courts draw from precedent outside the climate context to adjust the threshold for review. An example is *Hauraki Coromandel Climate Action Inc v Thames-Coromandel District Council*.[180] The Court opined that judicial review in the context of climate change deserves 'heightened scrutiny', as 'decisions about climate change by public decision-makers is similar to that for fundamental human rights'.[181] A key example in that respect is *Mathur v Ontario*, where seven young claimants made an application in 'solidarity with millions of youth in Ontario and around to world', to the Superior Court of Justice of Ontario (Canada), seeking, inter alia, a declaration that Ontario's climate target to reduce GHG emissions by 30 per cent below 2005 levels by 2030 violated their rights and that of future generations.[182] They asserted that Ontario had to establish a science-based target consistent with Ontario's share of the minimum level of GHG reductions to limit global warming to below 1.5°C above pre-industrial temperatures, or, in the alternative, well below 2°C.[183]

The Canadian Court first rejected the government's motion to dismiss the application,[184] stating that many of the claims were capable of scientific proof,[185] and that the applicants should be afforded the opportunity to present their full evidence.[186] In its decision on admissibility, the Court also elaborated on the standard of proof for causation, based on the jurisprudence of the Supreme Court of Canada on the more flexible 'sufficient causal connection' standard.[187]

In its decision on the merits, the Superior Court of Ontario made several important statements about causality.[188] First, it held that the government's target as the impugned action did not need to be the *dominant or the only cause* for the prejudice suffered by the claimants.[189] The Court explained that 'while Ontario's contribution to global warming may be numerically small, it is real, measurable and not speculative'.[190] Second, the Court relied on evidence stemming from event attribution science: it acknowledged that the applications had established on a *balance of probabilities* that the State action 'contributes to an increase in the risk of death or in the

[179] *Neubauer* (n 3).
[180] *Hauraki Coromandel Climate Action Inc v Thames- Coromandel District Council* [2021] 3 NZLR 280.
[181] ibid [51].
[182] *Mathur et al v Her Majesty the Queen in Right of Ontario* Application of 25 November 2019, Case No 19-00631627, quote at [6].
[183] ibid at [7], [8], see (f).
[184] *Mathur et al v Her Majesty the Queen in Right of Ontario* [2020] ONSC 6918 (Superior Court of Justice).
[185] ibid. [96], [97] with reference to the Court of Appeal for Ontario.
[186] ibid [171].
[187] ibid [168]–[171].
[188] *Mathur Merits* (n 3) [143]–[151].
[189] ibid [148], [149].
[190] ibid.

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risks faced by the Applicants with respect to the security of the person'.[191] Third, the Court found that by setting a climate target below the 'scientific consensus' of what would be required to align with 1.5°C, Ontario was 'contributing to an increase in the risk of death and in the risks faced by the Applicants and others with respect to the security of the person'.[192] Fourth, the Court acknowledged that the 'causal connection standard' was sensitive to the *context of the particular case*, explaining that a very high causal standard would serve to hinder solving global problems.[193]

The Court thus rejected the government's argument that to meet the causal connection standard, the applicants had to prove 'beyond a reasonable doubt' or 'even on the balance of probabilities' that the harm will occur. Nevertheless, the Court dismissed the case given that the rights under section 7 of the Charter had to be interpreted as a restriction on the State's ability to deprive of the rights and did not (yet) include positive obligations.[194] A further argument concerning intergenerational equity was equally rejected, based on the inability of the Court to determine a generational cohort as an analogous ground under section 15(1) of the Charter.[195] This decision is on appeal at the time of writing.

Courts have of course expressed different views on the possibility to adjust thresholds for judicial review. The Supreme Court of Norway in *Greenpeace Nordic* found that wherever the Storting (Norwegian Parliament) had considered a matter, the threshold for review must be very high.[196] In a similar vein, the concepts of heightened judicial scrutiny, or variable intensity review, were rejected in *Students for Climate Solutions Inc v Minister of Energy and Resources* where the Court explained that 'what varies is the nature and extent of the legal controls over discretions, not the intensity with which the Court undertakes its tasks'.[197]

In some cases, courts have turned to legal developments that are external to the growing body of climate law. Scholars have pointed out that in China, cases concerning air pollution begin to serve as a gateway for climate change litigation.[198] Courts have applied the 'burden shifting' doctrine under the Chinese Tort Liability Law (TLL) 2009, which operates on a legal presumption of causation and shifts the burden to prove the *absence* of a causal relation in environmental tort disputes to the defendant.[199]

Another approach for assessing causation and attribution stems from the introduction of case categories, as in *R (on the application of Richards) v Environment*

[191] ibid [150].
[192] ibid [147].
[193] ibid [149].
[194] ibid [81], [82].
[195] ibid [178]–[182].
[196] *People v Arctic Oil* (n 110) [142].
[197] *Students for Climate Solutions Inc v Minister of Energy and Resources* [2022] NZHC 2116 [40].
[198] Yue Zhao, Shuan Lyu, and Zhu Wang 'Prospects for climate change litigation in China' (2019) 8 TEL 349, 375.
[199] ibid 371.

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Agency, a case concerning unsafe levels of hydrogen sulphide from a landfill site.[200] The case was overturned on appeal.[201] However, it is interesting to note that the High Court for England and Wales had reasoned that, in some situations, courts should acknowledge a *presumed* causal chain in line with scientific knowledge, at the point where intervention was still possible and harm could be avoided. Although this case is concerned with air pollution and not climate change directly, it is nevertheless instructive as the Court made several impactful statements about causation and attribution, derived from European Court of Human Rights' jurisprudence that had also been previously endorsed by the UK Supreme Court.[202]

The Court distinguished two main categories, the so-called 'look back' and the 'in the moment' cases. The Court held that the inexorable logic of these human rights cases, especially the 'in the moment cases', is that 'public authorities – and courts – must "step up" at the time when it is still possible to prevent that the foreseeable damage will materialise'.[203] In other words, in situations where the causal chain has not yet fully materialised, the duty of 'stepping up' entails that authorities must act *before* a damage occurs and *despite* remaining uncertainties. This approach aligns with the precautionary principle.[204]

17.4 REPLICABILITY

Replicability of any of the approaches and analytical arguments related to climate causality will depend on factual circumstances and several tangible and intangible factors. Tangible factors comprise the similarity between jurisdictions (e.g. common law, civil law) and the often-nuanced approach of domestic legal frameworks towards the applicability of international treaty law (variations of monism/dualism). Intangible factors include how courts engage with scientific evidence, foreign case law, and normative considerations pertaining to case categories and thresholds for establishing causation and attribution. Furthermore, the perception of the urgency of the threat of climate change as a societal challenge, global emergency, and/or national crisis inevitably influences the balancing of interests and frames the decision-making.[205] While climate change continues to be viewed globally 'as the gravest threat to humanity', there are divergent senses of urgency and country-specific priorities across jurisdictions.[206]

[200] *Richards, R (On the Application Of) v The Environment Agency* [2021] EWHC 2501 (Admin).
[201] *Richards v Environmental Agency* [2022] EWCA Civ 26.
[202] *Rabone v Pennine Care NHS Foundation Trust* [2012] UKSC 2.
[203] *Richards v Environmental Agency* (n 200) [50].
[204] Meinhard Schröder, 'Precautionary approach/principle' in *Max Planck Encyclopaedias of International Law* (Oxford University Press 2018).
[205] Friederike Otto and others, 'Causality and the fate of climate litigation: The role of the social superstructure narrative' (2022) Global Policy 736, 740.
[206] World Economic Forum, *The Global Risks Report 2022* 18 <www.weforum.org/reports/global-risks-report-2022> accessed 24 February 2024.

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Engaging with expert evidence is critical to any consideration of climate causality and for the transfer of judicial arguments. Domestic courts using international law generally,[207] and the Paris Agreement in particular,[208] have already contributed to an inter-jurisdictional judicial discourse on climate change that gradually corroborates judicial reasoning on legal concepts.[209] Some courts have shown a tendency to adopt a comparative law approach by referencing other courts to address opposing views of their own executive branches or public authorities, especially when confronted with the task of safeguarding fundamental rights, or in ensuring compliance with administrative rules.[210]

A court that endorses the reasoning on climate causality in its own jurisprudence validates and strengthens a legal position. Applying domestic law to a global challenge can thus unfold a harmonising effect for legal concepts such as causation and attribution. The following pathways exist to replicate any of the structural arguments:

- Engaging with scientific evidence, including attribution studies, and with social sciences research.
- Including all GHG emissions into the scope of judicial scrutiny, whether reviewing national climate targets or emissions-intensive infrastructure projects and activities.
- Clearly distinguishing between general causation, specific causation, and attribution.
- Engaging with the findings of other courts in a comparative legal approach.
- Drawing from normative developments outside the climate change context to ensure coherent approaches in environmental jurisprudence.

17.5 CONCLUSION

This chapter speaks to the lawyer (or judicial officer) and to the climate scientists in its attempt to explain causation and attribution in law and science, and to systematise

[207] Eyal Benvenisti, 'Reclaiming democracy: The strategic uses of foreign and international law by national courts' (2008) 102 AJIL 241, 251; Olga Frishman and Eyal Benvenisti, 'National courts and interpretative approaches to international law' in Helmut Philipp Aust and Georg Nolte (eds), *The Interpretation of International Law by Domestic Courts: Uniformity, Diversity, Convergence* (Oxford University Press 2016) 317, 319; Jutta Brunnée, 'The rule of international (environmental) law and complex problems' in Heike Krieger, Georg Nolte, and Andreas Zimmermann (eds), *The International Rule of Law: Rise or Decline?* (Oxford University Press 2019) 215.

[208] *Klimatická žaloba* (n 37); *PSB and others v Brazil* [2022] ADPF 708 (Federal Supreme Court of Brazil) considered the 'supralegality' of the Paris Agreement; *Ruling on Modification to Ethanol Fuel Rule* 610/2019 (Supreme Court of Mexico). The diversity of views on the role of the Paris Agreement is shown in the case concerning the expansion of Heathrow Airport (n 136). See also the argument of the applicants in *Duarte Agostinho v Portugal and 32 other States* App No 39371/20 (ECtHR).

[209] Minnerop and Roestgaard (n 110) 919.

[210] ibid.

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the global case law that shapes the normative context for climate causality. Three main points resonate from the analysis. First, the chapter has filled a gap in the literature by defining general causation, specific causation, and attribution as distinct but overlapping components of climate causality, and it has explained the various approaches used by scientists in attribution studies. This instils much needed conceptual clarity in a complex area of law, including the law/science intersection. Second, it has advanced the idea of a global, inter-jurisdictional judicial discourse on climate change, by structuring the case law through four key areas of judicial engagement with climate change (the determination of the scope of relevant emissions, the review of national climate targets and measures, the permissibility of emission intensive projects or activities, and courts' willingness to use and review general (environmental) law concepts to develop climate litigation). From these four areas, transferable arguments on climate causality already emerge which could tighten the normative context in future cases on attribution. As has been discussed, it is necessary to clearly distinguish between the factual considerations that define general and specific causation, and the normative assessment that furnishes attribution. Legal attribution involves a range of normative considerations that determine 'adequacy' in the causal chain. These normative considerations can exclude or include anthropogenic emissions as causal factors.

Third, the chapter provides a foundation for further interdisciplinary research on attribution. The legal concept of attribution is well suited to trace the relevant scientific evidence, and its benefit for litigation will not only depend on science-informed law but also on law-informed scientific research. Crucially, attribution in law seeks to assign the legal responsibility for a concrete impact or damage to a specific human action or omission; it requires a qualification and a quantification of the human contribution. It is not sufficient to scientifically attribute an increased risk or a harm to human-induced climate change without further specifying the contribution of the 'human factor'. Research on the possible expansion of logical fundamentals of the causal analysis,[211] and the introduction of the 'distinctive causal field',[212] have further elaborated the logical operation that the law could use to trace attribution science.[213] So far, emerging best practice on attribution is scarce, and allowing a case to proceed to the evidentiary stage as in *Lliuya v RWE* is a significant step that signals judicial engagement with this attribution science. The growing body of case law where courts already engage with climate science and social sciences, national and international law, and with the arguments derived from the reasoning of other courts can be described as global climate jurisprudence. This global climate jurisprudence comprises pathways for the replicability of arguments. It may even serve as the basis for emerging normative parameters that carry the fairness discourse on climate change forward, within and beyond climate causality.

[211] Judea Pearl, *Causality: Models, Reasoning and Inference* (Cambridge University Press 2009).
[212] Minnerop and Otto (n 17).
[213] ibid.

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