CHAPTER 8

From Bilateral Science Diplomacy to Wider Black Carbon Governance?

Norwegian-Chinese and Finnish-Russian Initiatives

Pami Aalto, Gørild Heggelund, Anna Claydon and Minna Hanhijärvi

1 Introduction

In this chapter, we will examine Norwegian-Chinese and Finnish-Russian science diplomacy to mitigate SLCPs, in particular focusing on black carbon emissions. The Norwegian and Finnish science diplomacy initiatives towards China and Russia, respectively, involve various combinations of governmental actors alongside a plethora of public and private sector actors in research, development and innovation (RDI) sectors. These initiatives are of interest for several reasons.

First, the black carbon initiatives of the sender countries Norway and Finland stand out in the international context since initiatives by individual states on black carbon specifically are rare. Second, the target countries, China and Russia, are globally significant emitters of black carbon and other SLCPs, especially so for the Arctic, which forms an important context for Norwegian and Finnish diplomatic practices and foreign policies in general. Third, large and multiple mitigation benefits could be gained domestically in China and Russia. Fourth, the two target countries are differently attuned to bi- or multilateral cooperation with Western countries. Fifth, as the cases also have different outcomes, they can very usefully illuminate the wider multilateral prospects of black carbon and SLCP mitigation.

In the Norwegian-Chinese case, a bilateral project was launched to bolster the science basis of mitigation and support public policies in both countries. In the Finnish-Russian case, bilateral high-level diplomacy led by the Finnish president was combined with similar initiatives in Arctic regional and more global arenas alongside scientific research with Finnish and Russian participants in the multilateral Arctic framework. However, in the Finnish-Russian case, the governmental, science and RDI tracks remained less than optimally integrated. Combined with how Russian domestic structures and foreign policy hampered the Finnish efforts, the outcomes in this case remained unclear.

We seek to shed light on the diverging outcomes and assess lessons learned for wider governance on SLCPs and black carbon. For this end, we first discuss the concept of science diplomacy, situating it into the context of Norwegian-Chinese and Finnish-Russian relations alongside wider structural change in international relations at the turn of the 2020s. In conditions where overall agreement among major actors is increasingly in question, with ramifications for international diplomacy, cooperation and security, we propose an analytical framework wherein the interests and problem definitions of actors assume centrality. In other words, with major tensions and uncertainties prevalent, the conduct of science diplomacy depends on what actors are after in the first place and what problems they identify as calling for attention. This framework is then used to scrutinise the Norwegian-Chinese and Finnish-Russian cases before discussing the implications for wider governance.

2 Science Diplomacy on Black Carbon and SLCPs: Analytical Framework

Science diplomacy is conventionally accepted to involve two aspects. First, the 'science in diplomacy' aspect refers to how scientific knowledge on complex problems such as mitigation of black carbon and SLCPs is needed for diplomacy in these areas to target adept solutions and hence potentially be effective. Second, the 'science for diplomacy' aspect refers to how international scientific cooperation can help to improve interstate relations and by extension, serve the soft power interests of states, that is, being able to exercise subtle influence.[1] Building on this last aspect, some studies suggest that science content can serve trust-building in international relations by means of initiating practices and opening channels for communication through the focus on knowledge production.[2]

We will focus here mostly on the more traditional science in diplomacy aspect while the science for diplomacy aspect will play a secondary role in our scrutiny. In other words, we remain somewhat cautious regarding what the Norwegian and Finnish-initiated science diplomacy can deliver in terms

1 Tim Flink and Nicholas Ruffin, "The Current State of the 'Art' of Science Diplomacy", in Simon, D., Kuhlmann, S. (eds.) *Handbook of Science and Public Policy* (Edward Elgar 2019), 104–121.

2 Ping Su and Maximilian Mayer, 'Science Diplomacy and Trust Building: "Science China" in the Arctic' (2018) 9 Global Policy 23 <https://doi.org/10.1111/1758-5899.12576> accessed 19 September 2022.

of potential soft power gains or mutual trust-building, acknowledging how knowledge production and diffusion do not take place in a neutral territory. Addressing seemingly technical issues such as black carbon can lead parties to fundamental political questions with deep-seated socio-economic path-dependencies involved as the Finnish-Russian case study will also indicate. Such domestic-political constraints can amplify any reservations governments may hold vis-à-vis international cooperation.

Despite this cautious approach, we expect the sender country to seek engagement in 'structured government attempts in initiating or governing the cooperation toward specific ends such as collaborative research, technology transfer, and co-production of technology'.[3] Such outcomes would serve Norwegian and Finnish soft power interests even if the exact results for mitigation would remain uneasily ascertainable or more limited than the science involved would prescribe. In other words, even somewhat limited advances can be highly welcome interim outcomes in international diplomacy.

The Norwegian and Finnish science diplomacies build on both multilateral and bilateral tracks. The chief multilateral track comprises Arctic research institutions. Like Norway and Finland, Russia is a full member in the Arctic Council where China is also an active permanent observer since 2013. However, the Council's full potential all but evaporated when Russia as then its chair country (2021–23) escalated its war in Ukraine in February 2022, after first starting it in 2014. This led to several rounds of sanctions set on Russia by other Arctic Council member states, the EU and other Western states, and to Russia's own countersanctions, resulting in the immediate freezing of Arctic cooperation involving Russia. In these conditions, the other multilateral contexts wherein black carbon mitigation has been prominently pursued, such as the Climate and Clean Air Coalition are of almost equally limited use for engaging Russia even though Russia is a member. China for its part is not a member, despite its participation in the Coalition's scientific work that largely focuses on emission sources in Asia (see Chapter 6).

The bilateral track builds on strong legacies. Finland has a long history of scientific, technological, economic and environmental cooperation with the Soviet Union and Russia. In 2006, Finland initiated the Northern Dimension Environmental Partnership between the EU, Russia, Iceland and Norway.[4]

3 Elif Özkaragöz Doğan, Zafer Uygun and İbrahim Semih Akçomak, 'Can Science Diplomacy Address the Global Climate Change Challenge?' (2021) 31 Environmental Policy & Governance 31, 34 <http://libproxy.tuni.fi/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,uid&db=bsu&AN=148477343&site=ehost-live&scope=site>.

4 Pami Aalto, Helge Blakkisrud and Hanna Smith, *The New Northern Dimension of the European Neighbourhood* (Centre for European Policy Studies 2008).

Notably, this track survived all major tensions seen in the relations throughout the 2000s between the EU, western states and Russia, until Russia's serious escalation of its war in Ukraine in 2022. Norway's knowledge-based cooperation with China for its part paved the way for China to sign the Minamata Convention in 2013.[5] Overall, the Norwegian activities benefit from China's general tendency of involving scientific cooperation into its foreign relations, as is evident for example in China's ties with developing countries.[6]

Regarding the results the Norwegian and Finnish efforts can yield, the shallow nature of trust in international relations since the late 2010s must be acknowledged. This not only follows from the Russian-initiated war in Ukraine and rounds of mutual sanctions. At issue are also the anxieties held by many powers regarding China's foreign policy ambitions and its quest for leadership in several RDI sectors,[7] and related debates on greater strategic autonomy in connection to Europe's Green Deal agenda, raising questions for multilateralism.[8] On top of these, uncertainties persist on the more generic commitment of major powers to international cooperation, particularly the USA, and their ability to agree on the purposes of global environmental governance. Challenges also emerge questioning their leadership and the hierarchy of states.[9]

While constraints for multilateralism persist, it is important to note how bilateral cooperation can be effective for mitigating black carbon and SLCP emissions.[10] 'Minilateral' or 'club' type arrangements may also work.[11] Bi-or

5 Rosendal, GK, Andresen, S, Heggelund, G, Stensdal, EH, 'The Minamata Convention and Mercury Policy in China: The Role of Science' (2020) 44 Asian Perspective 435.

6 Malgorzata Smieszek, Timo Koivurova, and Egill Thor Nielsson, 'China's Arctic Policy', in Koivurova T and Kopra S, *Chinese Policy and Presence in the Arctic* (BRILL 2020). Pavel Devyatkin 'Russian and Chinese Scientists to Establish Arctic Research Center'. The High North News, April 15 (2019) <https://www.highnorthnews.com/en/russian-and-chinese-scientists-establish-arctic-research-center> accessed 11 December 2022.

7 Andrew B Kennedy and Darren J Lim, 'The Innovation Imperative: Technology and US–China Rivalry in the Twenty-First Century' (2018) International Affairs (London) 94 (3).

8 Eric Van den Abeele, 'Towards a New Paradigm in Open Strategic Autonomy' (2021), ETUI Research Paper 2021.3 <http://dx.doi.org/10.2139/ssrn.3873798> accessed 2 December 2022.

9 E.g. Gabriele Abbondanza and Thomas S Wilkins, *Awkward Powers: Escaping Traditional Great Power and Middle Power Theory* (Springer 2022).

10 Stine Aakre and others, 'Incentives for Small Clubs of Arctic Countries to Limit Black Carbon and Methane Emissions' (2018) 8 Nature Climate Change 85.

11 Seita Romppanen, 'Arctic Climate Governance via EU Law on Black Carbon?' (2018) 27 Review of European Community & International Environmental Law 45; M Sand and others, 'Response of Arctic Temperature to Changes in Emissions of Short-Lived Climate Forcers' (2016) 6 Nature Climate Change 286; Charlotte Unger, Kathleen A Mar and Konrad Gürtler, 'A Club's Contribution to Global Climate Governance: The Case of the Climate and Clean Air Coalition' (2020) 6 Palgrave Communications.

minilateral diplomacies feature potent tools vis-a-vis black carbon, since pairs and clusters of countries continue cross-polluting each other. Because they are affected by each other's emissions, countries in such pairs and regional clusters should have a strong self-interest in mitigation, regardless of how they relate to bi-or minilateral diplomacy in general. When looking at black carbon emissions affecting the Arctic, 90% of abatement can be achieved on grounds of the main polluters acting in self-interest, that is India, China, the EU area, the USA and Russia, in this order. Among them, China would have the largest self-benefits, chiefly for public health and crop yield. The Nordic countries would have the clearest self-benefits in terms of climate, while the collective benefits would relate mostly to climate as well.[12] For black carbon and SLCPs, bilateralism may work much better than in the case of CO_2 or chemical pollution that are more global problems by nature.

The case for bilateralism must also be seen in the context of how summit-based multilateral and global mitigation efforts have proved, as a rule, relatively inefficient.[13] The Paris Agreement of 2015 is a landmark exception, but it is a political agreement outlining overall global targets. Actual mitigation targets are defined nationally and then submitted to the Paris Agreement as part of Nationally Determined Contributions. The Paris agenda furthermore remains inconclusive regarding SLCPs and black carbon that are traditionally treated as 'environmental problems' pertaining to air quality, with ambiguous ramifications on climate politics. SLCPs and black carbon can, however, be reported in Nationally Determined Contributions if the country so wishes (see Chapter 3). With this state of affairs, global governance on SLCPs has consequently remained relatively fragmented and weak, mostly consisting of soft law.[14]

Since multilateralism remains hampered by persisting and possibly deepening constraints for diplomacy, and while the record of global environmental governance remains thin, we propose that it is imperative to look at the problem definitions of actors which are crucial for the take-up and adoption of mitigation actions vis-à-vis black carbon and SLCPs. In short, in the absence of shared understandings of which problems merit most attention, especially as prospects of resolution appear weak, it is unlikely for cooperation to enhance

12 Aakre and others (n 10).

13 Hailey Stevenson, *Global Environmental Politics: Problems, Policy and Practice* (Cambridge University Press 2017).

14 Yulia Yamineva and Seita Romppanen, 'Is Law Failing to Address Air Pollution? Reflections on International and EU Developments' (2017) 26 Review of European Community & International Environmental Law 189.

dramatically. Here we build on Rosendal et al.,[15] postulating that the extent to which the sender country can affect the problem definitions in the target country depends on whether the message is held to be from a *credible* source; whether the underlying knowledge-production is considered *legitimate*, for example co-produced in regional or wider cooperation with the target country's participation; and whether the science communicated is *relevant* in view of the set of target country's national interests.

Our theoretical contribution here pertains to specifying the involved interests. Black carbon mitigation solutions and technologies can serve both public and private sector interests. Following institutional literature, we suggest that such interests are multiple.[16] Here we would mention promotion of *climate neutrality*; *public health interest* of actors responsible for air quality, in cities in particular; *profits* for involved technology and service companies; *fiscal interests* of public sector actors in terms of tax income from both polluting and environmental technology industries; the associated *RDI competence* development and possible *export income*, alongside *wider socio-economic interests* for job creation and taxes paid by industries, not to forget the respective interests of the agricultural sector actors in *crop yield* that can be affected by pollution. Naturally, interests in *foreign policy influence* through science diplomacy are expected to exist.

Although the self-interested calculus of costs and gains should ultimately be in favour of mitigation for most actors, especially in the longer run, the outcomes can also be minuscule. This can be explained by referring to the domestic structural contexts where path-dependencies and lock-ins to existing technologies, infrastructures, institutions and behavioural patterns typically inhibit mitigation initiatives.[17] In summary, our analytical framework postulates that a crucial precondition for science diplomacy to shape black carbon and SLCP mitigation is its capacity to aggregate the various interests involved in sender and receiver countries and support the formation of shared problem definitions. The domestic structural context can furthermore either enable or inhibit shared problem definitions (see Figure 8.1). This framework will be used to examine actors, interests and problem definitions in our two

15 Rosendal and others (n 5).

16 Llewelyn Hughes and Phillip Y Lipscy, 'The Politics of Energy' (2013) 16 Annual Review of Political Science 449.

17 Kirsi Kotilainen and others, 'From Path Dependence to Policy Mixes for Nordic Electric Mobility: Lessons for Accelerating Future Transport Transitions' (2019) 52 Policy Sciences 573.

case studies, with references made to the domestic context in the target countries to account for relative successes or failures in science diplomacy.

At the time of writing, shared problem definitions are more limited in the case of black carbon and SLCP mitigation compared to the situation prevailing with CO_2 where a firm epistemic community has formed on mitigation. Therefore, it matters how much or how little the interests of actors meet and to what extent that can facilitate the formation of more congruent problem-definitions internationally. To address this research agenda, we will ask: 1) What are the problem definitions vis-à-vis SLCPs and black carbon characterising the science diplomacy actions of Norwegian and Finnish actors, and which interests shape those problem definitions? 2) What are the respective problem definitions and underpinning interests of their Chinese and Russian counterparts? 3) How do domestic structural contexts shape the prospects of science diplomacy in the target countries; and 4) What are the wider implications for multilateral governance?

The next two sections introduce our case studies. The main bulk of the material comprises previous literature, reports and documents from Norway, Finland, China and Russia. In addition, we benefited from informal communication with Norwegian environmental officials cooperating with Chinese actors. We also used semi-structured interviews conducted with 22 representatives from the Finnish RDI cluster with expertise on black carbon (see Section 4 below). The interview data is anonymised and consists primarily of

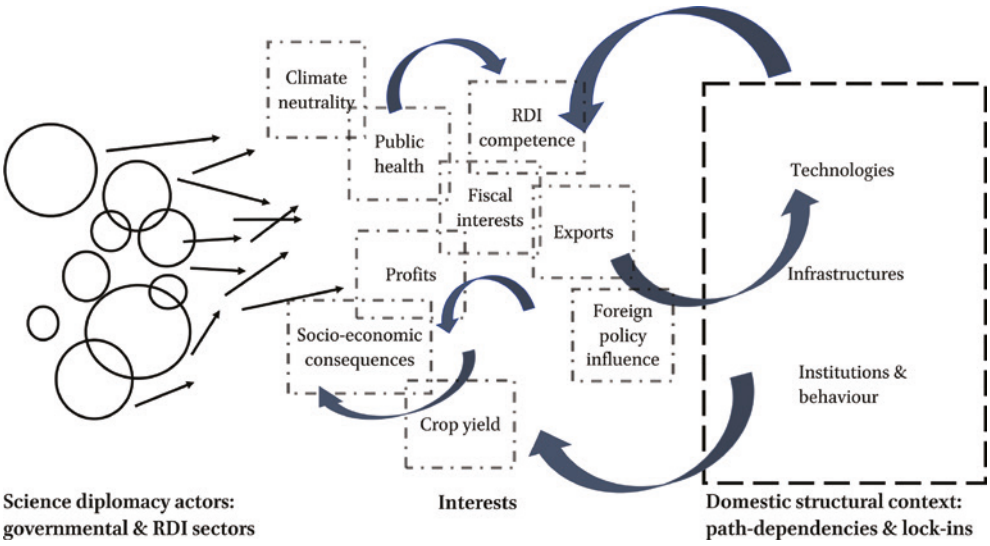

FIGURE 8.1 Problem definition in science diplomacy (developed by authors)

interviews in Finland, as we sought to cover well the Finnish RDI sector that is strong on development, innovation and commercialisation whereas Norway's main strength is the integration of scientific research into diplomacy. The Finnish interviews were fully transcribed, content analysed and coded with atlas.ti software.

3 Norwegian Science Diplomacy towards China

Norwegian interests in global climate and environmental diplomacy spring from several sources since the 1980s. First, Norway suffers from transboundary air pollution from Russia. Second, through diplomacy focusing on global problems, small countries like Norway can increase their power.[18] Third, research in the natural, environmental and social sciences, alongside the expertise and policy continuity of Norwegian environmental authorities lend support for Norway's diplomatic activities in this sphere.[19] Hence, it is natural that Norway was a first runner ratifier of protocols under the Convention on Long-range Transboundary Air Pollution (CRLTAP). As a member of the European Economic Area, Norway participates in the EU's emissions trading scheme that covers about half of the country's emissions and implements several EU directives on climate and air pollution. Overall, Norway's closest partner in these matters is the EU.

Norway implements the national actions of the Paris agenda. The country's Environment Agency produced a report on SLCP reduction in 2014, but neither Norway's updated NDC submission as of 2022 nor any of the country's official policies or targets specifically mention SLCPs or black carbon.[20] Yet, its air pollution and climate change legislation has contributed to large reductions in black carbon and organic carbon emissions since 1990. This is not an entirely atypical situation for advanced countries.[21] Norway has also pushed

18 G Kristin Rosendal, 'Norway in UN Environmental Policies: Ambitions and Influence' (2007) 7 International Environmental Agreements: Politics, Law and Economics 439.

19 ibid.

20 Norwegian Environment Agency, Summary of proposed action plan for Norwegian emissions of short-lived climate forcers (2014). M135/2014. <https://www.miljodirektoratet.no/globalassets/publikasjoner/m135/m135.pdf>; Government of Norway, Update of Norway's nationally determined contribution (2022), <https://unfccc.int/sites/default/files/NDC/2022-06/Norway_updatedNDC_2020%20%28Updated%20submission%29.pdf>.

21 See H Christopher Frey, 'Trends in Onroad Transportation Energy and Emissions' (2018) 68 Journal of the Air & Waste Management Association 514 <https://doi.org/10.1080/10962247.2018.1454357>.; M Cheng et al. 'Review of BC/OC emissions and control measures in China and Norway' (2021) ChiNorBC1.

for more guidance and methodology to the related IPCC's work. Moreover, the country is a very active member of the CCAC and the Arctic Council (see also Chapters 6 and 7).

We propose that this global, European and Arctic posture leads to a problem definition whereby particle emissions nearby the Arctic significantly affect the country's environment and have global multiplier effects of grave concern to Norwegian diplomacy given its ambitions regarding climate neutrality, air quality, as well as RDI exports, with consequences for foreign policy interests.[22] Simultaneously Norway's ambitions must come to terms with the country's oil and natural gas exports, not forgetting the corporate interest in continued profits from these sectors. The profits also serve the fiscal interests of the state and municipalities owing to taxes paid to them and dividends obtained from companies, the flagship being the majority state-owned Equinor. As Norway exports emissions, the industry has consistently sought to reduce its domestic emissions. The government for its part has used part of the proceeds incurred for ambitious climate and energy transition policies, including electrification of transport, assisted by the large-scale availability of hydropower.[23]

The Norwegian scientific community has sought to interlink the climate, air quality and health interests, somewhat distinctively from the EU context where climate neutrality most significantly targets CO_2 mitigation, leaving SLCPS to be treated mostly under air quality and health policies.[24] Norwegian scientists have developed bottom-up emission models for measuring black carbon, organic carbon and particulate matter for different sectors, utilised by the Government in the national reporting to the monitoring mechanisms of the Arctic Council and CLRTAP. Several domestic problems have been identified in this respect: 1) combustion of wood mostly in stoves for heating in residential buildings (in 2019, the 'other combustion' category accounted for 37% of Norway's black carbon emissions, of which 75% from domestic combustion); 2) the maritime transport sector (the transport sector overall accounted for 34% of black carbon emissions, of which 57% from coastal navigation); and

22 Government of Norway, 'Better growth, lower emissions – the Norwegian government's strategy for green competitiveness' (Strategy T-1562 E, 2017); Norwegian Ministry of Climate and Environment, *Norway's Climate Action Plan for 2021–2030* (White Paper, Cm 13, 2021); Norwegian Environment Agency, 'Climate mitigation measures up to 2030: Short term climate effects and health effects' (2016).

23 Aalto, Blakkisrud and Smith (n 4); Kotilainen and others (n 17).

24 Nils Hooftman and others, 'A Review of the European Passenger Car Regulations – Real Driving Emissions vs Local Air Quality' (2018) 86 Renewable & Sustainable Energy Reviews 1.

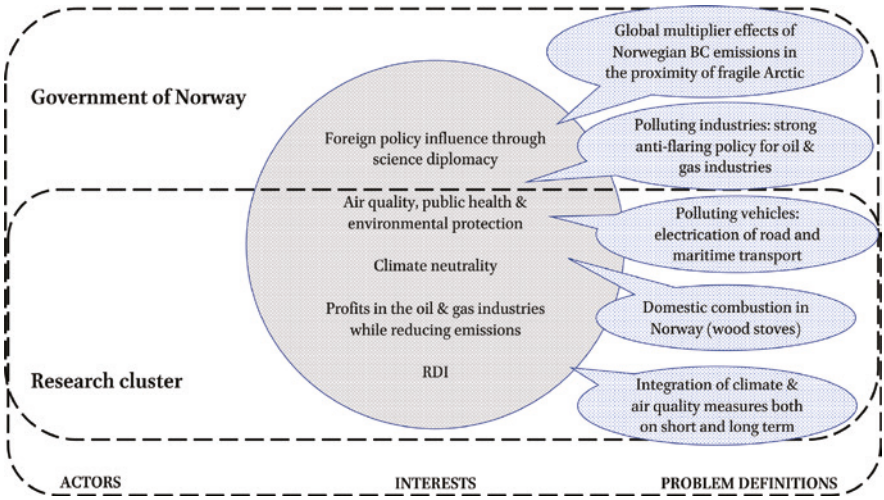

FIGURE 8.2 Norwegian actors, interests and problem definitions

3) the oil and natural gas sectors;[25] here gas flaring is, however, allowed only for safety purposes while methane emissions remain considerably lower than for example those from the production in the UK's continental shelf.[26]

Norway's well-developed research competences in measurement and monitoring practices may be transferable through science diplomacy (see Figure 8.2). Such demand for knowhow can be expected in the Chinese case, given the relatively scarce information on projected black carbon emissions in China.[27]

China's contribution to global and Arctic emissions makes it a natural target for Norway's science diplomacy. East Asia accounts for approximately 30% of the global anthropogenic black carbon emissions annually.[28] China is not

25 M Cheng et al., 'Review of BC/OC emissions and control measures in China and Norway' (2021) ChiNorBC1.

26 Marshall Hall, 'Net Zero Targets and GHG Emission Reduction in the UK and Norwegian Upstream Oil and Gas Industry: A Comparative Assessment' (2020) <https://www.oxfordenergy.org/publications/net-zero-targets-and-ghg-emission-reduction-in-the-uk-and-norwegian-upstream-oil-and-gas-industry-a-comparative-assessment> accessed 2 December 2022.

27 Yulia Yamineva and Zhe Liu, 'Cleaning the Air, Protecting the Climate: Policy, Legal and Institutional Nexus to Reduce Black Carbon Emissions in China' (2019) 95 Environmental Science & Policy 1.

28 Kohei Ikeda and others, 'Evaluation of Anthropogenic Emissions of Black Carbon from East Asia in Six Inventories: Constraints from Model Simulations and Surface Observations on Fukue Island, Japan' (2022) 2 Environmental Science: Atmospheres 416.

only the main polluter here but also an increasingly proactive actor in global environmental diplomacy. However, black carbon remains a recent item on the Chinese policy agenda.[29] The Norwegian science diplomacy addresses this situation, comprising both the science in diplomacy and science for diplomacy aspects.

In 2019, following joint preparation, the Norwegian Ministry of Foreign Affairs granted funding to a Chinese-Norwegian Project on 'Emission, Impact, and Control Policy for Black Carbon and its Co-benefits in Northern China'. The main partners were the Chinese Research Academy of Environmental Sciences, which is affiliated with the Ministry of Ecology and Environment; and the Norwegian Environment Agency, working closely with the Ministry of Climate and Environment. The Chinese Academy of Environmental Planning, the Norwegian Institute of Public Health and CICERO – Centre for International Climate Research also participated.

The project was tasked to 'develop improved emission inventories for black carbon-and OC-emissions in China using the most recent, best available national statistics and measurements obtained in the project'.[30] This information was intended to inform Chinese policy makers of possible policy solutions, in order to maximize co-benefits,[31] and potentially shape Chinese black carbon policies. While Norway's main interest in the project pertains to climate change and China's – to air pollution, finding a common ground is possible, especially given the potency of bilateralism in black carbon mitigation. During 2020, the project was affected by COVID-19. However, since 2021 monthly (digital) meetings were held in good dialogue, with project reports issued.[32] The final report was expected by the end of 2022.[33]

The project was initiated within a favourable structural context on the Chinese side. Chinese policymaking is characterized by a long-term perspective and input from different ministries expressing their interests. That China is governed by the principle of 'Scientific Outlook on Development', equated with Marxist-Leninist thinking in the Communist Party, translates to demand for knowledge-based policy.[34] The research cluster's close association with high-level policymakers supports knowledge dissemination.

29 Yamineva and Liu (n 27).
30 Cheng et al. (n 25).
31 ibid.
32 Jost Wubbeke, 'China's Climate Change Expert Community-Principles, Mechanisms and Influence' (2013) 22 The Journal of Contemporary China 712.
33 Informal communication with Norway's Environment Agency 2022.
34 Li Cheng, *The Power of Ideas: The Rising Influence of Thinkers and Think Tanks in China* (World Scientific Publishing Co Pte Ltd 2017); Wubbeke (n 34).

Mitigation and adaptation vis-à-vis climate warming are of Chinese interest at least since the 2007 National Climate Change Programme.[35] The government and scientific community unequivocally view warming as a threat to socio-economic development. China Meteorological Administration's annual report from 2022 on climate change found China's warming to exceed the global average.[36] Since 2013, Chinese scientists have participated in Arctic cooperation on SLCPs and black carbon, including the widely cited work of the Arctic Contaminants Action Programme.[37] China's Arctic expeditions have expanded from natural scientific research into wider research, development and policy formation exercises. In 2015, a task force was set by a high-level policy advisory body China Council for International Cooperation for Environment and Development to address SLCPs and black carbon.[38] Moreover, scientists involved in the AC's work on black carbon have prominent roles in the Chinese-Norwegian project.

China's governmental problem definition conforms to that of the World Health Organisation, proceeding more generally from $PM_{2.5}$ rather than from specific pollutants, as is evident in the 13th Five-Year Plan (2016–2021). The coal burning power sector, transport and industrial sectors remain priority areas as they were in the 2013–2017 Ambient Air Pollution Prevention and Control Action Plan.[39] In the transport sector, size of the vehicle fleet, technology and standard upgrades featured among the more precise problem definitions in the 2013 Plan, and in the industrial sector, improved emission indicators and tightened entry requirements for new production units.[40] The successor to this

35 National Development and Reform Commission, *China's National Climate Change Programme* (National Development and Reform Commission, June 2007).

36 Gov.cn., 'China Meteorological Administration released the "China Climate Change Blue Book"' (in Chinese, 10 August 2022) <http://www.gov.cn/xinwen/2022-08/10/content_5704792.htm>; Reuters, 'China warns that its temperatures are rising faster than global average' (4 August 2022) <https://www.reuters.com/world/china/china-warns-that-its-temperatures-are-rising-faster-than-global-average-2022-08-04/#:~:text=SHANGHAI%2C%20Aug%204%20(Reuters),mount%2C%20a%20government%20official%20said>.

37 Peoples' Republic of China [PRC], Observer Review Report 2017–2019, Arctic Council (2019), available at: https://oaarchive.arctic-council.org/handle/11374/2251; Peoples' Republic of China [PRC], Observer Review Report 2019–2021, Arctic Council (2021), available at: https://oaarchive.arctic-council.org/handle/11374/2717.

38 Gørild M Heggelund, 'China's Climate and Energy Policy: At a Turning Point?' (2021) 21 International Environmental Agreements: Politics, Law and Economics 9.

39 ibid.

40 State Council, 'Notice of the State Council Distributing the Action Plan for the Prevention and Control of Air Pollution'(10 September 2013) <http://www.gov.cn/zwgk/2013-09/12/content_2486773.htm> retrieved in Chinese 12 May 2022.

Plan, the Action Plan for Winning the Blue Sky War (2018–2020) offered more detail but retained similar problem definition. Largely comparable problem definitions have been transferred into key laws through several amendments while regional level implementation and measures in emission hotspots remain concerning (see Figure 8.3).[41] President Xi has announced that coal use is set to peak in 2025 during the 14th Five-Year plan (2021–2025), to be reduced thereafter.[42] China's '30.60' dual decarbonization goals foresee peaking carbon emissions before 2030 and carbon neutrality by 2060, likely affecting Chinese black carbon emissions. The Chinese-Norwegian project supports this goal by developing emission inventories.

Like in Norway, $PM_{2.5}$ emissions in China are on a decreasing trend even though no major national policy explicitly targets black carbon. At the same time, environmental enforcement remains decentralised to the regions in China, while regional authorities encounter serious path dependencies in transferring the policies and laws into action as they are also responsible for local socio-economic development.[43] Some regions must simultaneously deal with the most polluting form of coal consumption (i.e., coal used in rural heating and small industry), shift away from a coal-based economy, manage job changes for hundreds of thousands of coal-workers, whilst maintaining economic growth. The institutional and behavioural lock-ins of the coal-oriented industry weigh heavily for local authorities, who are supposed to implement the central government's policy targets that are divided among the provinces.[44]

In sum, Norway's bilateral effort led to increased attention and capacity to address the black carbon and SLCP challenges in China. Bilateral scientific collaboration was established on equitable terms with joint implementation of the project. As such, Norway and China's long-term collaboration on environmental and climate issues has enhanced trust between scientific institutions and in that way strengthened diplomatic relationships. Hence the Norwegian-Chinese project illustrates in part also the science for diplomacy aspect in the environmental sector. Importantly, while China is emerging as a central actor

41 Yamineva and Liu (n 27).

42 State Council, 'The People's Republic of China's 14th Five-Year Plan of National Economic and Social Development and Outline of Vision Goals for 2035' <http://www.gov.cn/zhengce/2020-11/03/content_5556991.htm> accessed 16 July 2021, in Chinese; David Stanway & Cate Cadell 'President Xi says China will start cutting coal consumption from 2026' (Reuters, April 22, 2021) <https://www.reuters.com/world/china/chinas-xi-says-china-will-phase-down-coal-consumption-over-2026-2030-2021-04-22/> accessed 9 December 2022.

43 Yamineva and Liu (n 27).

44 Miranda Schreurs, 'Multi-Level Climate Governance in China' (2017) 27 Environmental Policy and Governance 163 <https://doi.org/10.1002/eet.1751> accessed 19 September 2022.

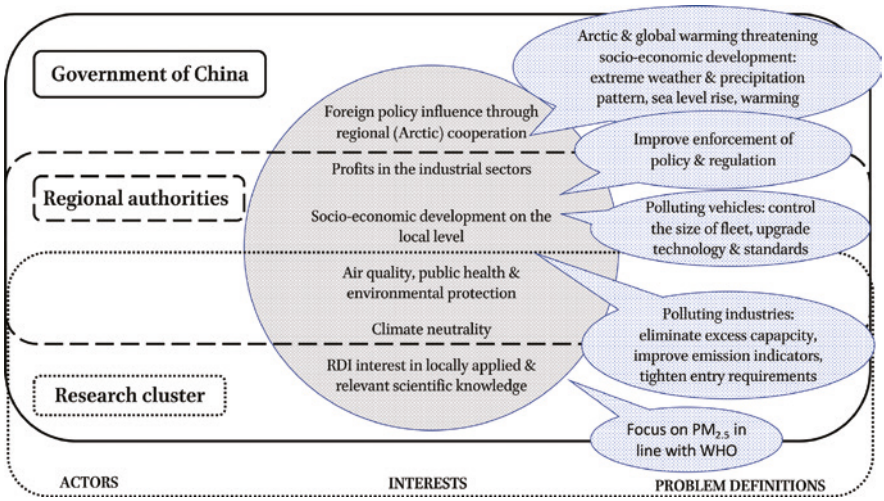

FIGURE 8.3 Chinese actors, interests and problem definitions

in global environmental governance, cooperation with it in these matters can shape the country's efforts and commitments vis-à-vis global agreements.

4 Finnish Science Diplomacy towards Russia

Finnish interests in climate and environmental diplomacy rely, first, on the country's strong climate and environmental policies nationally (see Appendix 1), and as part of the EU. Finland seeks accelerated transition away from black carbon and SLCP emitting fossil fuels, being politically committed to climate neutrality by 2035. Second, Finland has advanced research in meteorology, aerosol physics, and further natural scientific and engineering competences supporting such diplomacy. The Finnish RDI cluster on black carbon comprises publicly funded research institutions, municipal authorities experienced in air quality monitoring and private environmental technology companies ranging from small and mid-size enterprises to stock market listed firms.

Third, an important background factor for Finnish science diplomacy is the country's extensive use of biofuels. Their use raises questions of managing the associated black carbon emissions.[45] Solid and liquid biofuels accounted for

45 Carl Muth, Pami Aalto, Fanni Mylläri, Topi Rönkkö, and Pirkko Harsia, 'Globally and Locally Applicable Technologies to Accelerate Electrification' in Aalto, P. (ed.), *Electrification: Accelerating the Energy Transition* (Academic Press/Elsevier 2021), 25–55.

29.7% of total final energy consumption during 2021.[46] Owing to their availability and capacity for energy storage, biofuels will remain integral for Finland's energy transition. In the power sector, fossil fuels are replaced primarily by weather-dependent wind power that is so far difficult to store, unlike biofuels. In the transport sector, liquid biofuels represent a major transition fuel in national policies.[47] In the residential heating sector, combustion of wood materials is important, being the main source of black carbon emissions as in Norway.[48] Hence, the Finnish RDI cluster will have a domestic market in addition to that emerging globally. Fourth, like Norway, Finland is a net importer of black carbon emissions just like the Nordic countries and most of western Europe.[49]

Despite Finland's global gaze, Russia remains a major source of those imported emissions,[50] and is traditionally a crucial target of Finnish diplomacy. Here the country's president is the main actor. This is so despite the prime minister being responsible for EU affairs and formally the main national actor in the EU's Russia relations. However, the practical legacy of heavily personalised Finnish-Soviet/Russian relations is strong while Finland's semi-presidential system lends the presidency strong rights of foreign policy initiative.[51] Consequently, the initiator of Finnish black carbon diplomacy vis-à-vis Russia is President Sauli Niinistö (2012–), well known of his regular contacts with President Vladimir Putin (2000–2008; 2012–), until Russia's intensified war in Ukraine. Niinistö started the black carbon diplomacy during his first term in office (2012–18); it became particularly intense during Finland's chairmanship of the Arctic Council (2017–19) and continued until Russia's full-scale invasion of Ukraine. In the Arctic Council context, Niinistö reiterates the Arctic-specific climate warming effects of black carbon that were prominent in the IPCC's fifth report:

46 Tilastokeskus, 'Energian kokonaiskulutus energialähteittäin (kaikki luokat), 1970–2021' <https://pxweb2.stat.fi/PxWeb/pxweb/fi/StatFin/StatFin__ehk/statfin_ehk_pxt_12vq.px/>.

47 Pasi Toivanen and others, 'Finland's Energy System for 2030 as Envisaged by Expert Stakeholders' (2017) 18 Energy Strategy Reviews 150.

48 Nordic Council of Ministers, 'Policy Brief: Emissions of Short-Lived Climate Pollutants (SLCPs): emission factors, scenarios and reduction potentials' (Nordic Council of Ministers 2019) <http://dx.doi.org/10.6027/Nord2019-013>.

49 Aakre and others (n10).

50 Ibid.

51 Tapio Raunio, 'Semi-Presidentialism and European Integration: Lessons from Finland for Constitutional Design' (2012) 19 Journal of European Public Policy 567; Tapio Raunio and Thomas Sedelius, 'Presidents and Cabinets: Coordinating Executive Leadership in Premier-Presidential Regimes' (2020) 18 Political Studies Review 53.

> Beyond CO_2, however, there are also other factors contributing to climate change. One of them is black carbon, which is particularly relevant for the fate of the Arctic Sea ice. When black carbon falls on the white ice, it immediately accelerates the melting. Yet reducing black carbon emissions has an equally immediate, positive impact.[52]

The Finnish Arctic Council chairmanship also proposed the AC's scientific work on black carbon and methane to be integrated with that of the UNFCCC and IPCC.[53] The more detailed problem definition features Arctic-and Russia-specific emission sources: gas flaring (widespread practice in the Russian oil industry; see Box 1), energy production and Arctic shipping (large part of which relates to Russian energy projects). The related problems are to be tackled with cleaner technologies and processes where Finland has expertise.

BOX 1 The Gas Flaring Problem in Russia's Arctic

The flaring of associated petroleum gas is a side-product of oil extraction, contributing 42% to the annual mean black carbon surface concentrations in the Arctic.[54] Despite commitment to the World Bank's Zero Routine Flaring by 2030 initiative, Russia has for long been the world's largest emitter of these gases.[55]

The respective Russian regulation comprises the pollution fees system. Corporations with activities harmful to the environment must obtain an environmental permit issued by the Russian public

52 President of Finland, 'Speech by the President of the Republic of Finland, Mr. Sauli Niinistö, at the Arctic Forum in St. Petersburg, 9 April 2019' (2019) <presidentti.fi/en/speeches/speech-by-the-president-of-the-republic-of-finland-mr-sauli-niinisto-at-the-arctic-forum- in-st-petersburg-9-april-2019/>.

53 Government of Finland, 'Finland's Chairmanship program for the Arctic Council 2017 – 2019' (Ministry for Foreign Affairs of Finland 2017) <https://oaarchive.arctic-council.org/server/api/core/bitstreams/cd14f8d1-cba1-4802-ab3e-67ac12b9e544/content>.

54 A Stohl and others, 'Black Carbon in the Arctic: The Underestimated Role of Gas Flaring and Residential Combustion Emissions' (2013) 13 Atmospheric Chemistry and Physics 8833.

55 World Bank, *Global Gas Flaring Tracker Report 2021 – Global Gas Flaring Partnership* (2021) <https://thedocs.worldbank.org/en/doc/1f7221545bf1b7c89b850dd85cb409b0-0400072021/original/WB-GGFR-Report-Design-05a.pdf>; World Bank, *Global Gas Flaring Tracker Report 2022 – Global Gas Flaring Partnership* (2022) <https://thedocs.worldbank.org/en/doc/1692f2ba2bd6408db82db9eb3894a789-0400072022/original/2022-Global-Gas-Flaring-Tracker-Report.pdf>.

authority Rosprirodnadzor, the Russian Federal Service supervising natural resources. Since 2009, Russian oil companies must utilize 95% of their produce of associated petroleum gases. The pollution fee is set for the exceeding 5 percent and for non-metered flaring. For methane emission, 4.5 times the standard environmental fine applies. However, strong institutional lock-ins inhibit enforcement and inspection, combined with technological and infrastructural lock-ins on the part of Russian fossil fuel companies that also have strong lobbying powers. In practice, the industry is obliged to protect the environment only insofar as this does not harm its activities.[56]

Black carbon emissions and volumes of flared gas are correlated.[57] Best Available Technologies and Best Environmental Practices such as reinjection technologies of associated petroleum gases are applicable in at least five oil and gas fields in Russia's Arctic; six further fields have high potential.[58] For example Gazprom Neft uses associated petroleum gas reinjection in its Novoportovskoye field since 2019. By 2025, best available techniques and best environmental practices could reduce SLCP emissions in Russia's Arctic from 25 to 7 million tons of CO_2 equivalents, with significant economic co-benefits. The challenges for scaling up include the geology of the oil and gas fields and lack of incentives in Russia's regulatory system after the 95% utilization target is met for associated petroleum gases.

56 Anna Korppoo, 'Russian Associated Petroleum Gas Flaring Limits: Interplay of Formal and Informal Institutions' (2018) 116 Energy Policy 232 <https://www.sciencedirect.com/science/article/pii/S0301421518300752>.

57 Kristin Böttcher and others, 'Black Carbon Emissions from Flaring in Russia in the Period 2012–2017' (2021) 254 Atmospheric Environment 118390 <https://www.sciencedirect.com/science/article/pii/S1352231021002090>.

58 Arctic Contaminants Action Program (ACAP), 'Mitigation of Short-Lived Climate Pollutants from APG-Flaring. Project: Phase 2 – The Use of New Methodology to Reduce APG Flaring at Remote Fields' (2021) <https://oaarchive.arctic-council.org/handle/11374/2607>; 'Black Carbon and Methane from the Oil and Gas Sector: Webinar Report with Recommendations' (2021) <https://oaarchive.arctic-council.org/bitstream/handle/11374/2605/MMIS12_2021_REYKJAVIK_ACAP_Black-Carbon-Webinar.pdf?sequence=1&isAllowed=y>; 'Mitigation of Short-Lived Climate Pollutants from AGP-Flaring Project: Final report. Phase 1A – Evaluation of potential impact of AÅG flaring on Arctic zone environment by Vygon Consulting' (2018) <https://oaarchive.arctic-council.org/bitstream/handle/11374/2450/FinalReport_APG-flaring-Phase-1A.pdf?sequence=1&isAllowed=y>.

In the UN context, the set of interests expressed by Niinistö expands from climate towards health, wider environmental and socio-economic issues: 'Issues like sustainability, climate change and migration are not only about development and human rights. They are also essential questions of peace and security.'[59] Black carbon becomes a multifaceted security problem, linking climate change with forced migration and famine, raising a need for international cooperation to fill persisting knowledge gaps.

Importantly, these knowledge gaps connect the interests of public and private actors. To shape the market, in the EU context, the Finnish actors participate in industrial lobbies and RDI consortia wherein governmental, university and company funding are combined. This includes for example working groups of the European Committee for Standardisation and the European Commission-initiated information exchange procedures, on areas such as BAT solutions, best available techniques reference documents, and the Industrial Emissions Directive. Direct contacts exist with national and EU level policymakers, and the World Health Organisation. The Finnish cluster specialises on monitoring and measurement devices, and filtering and low-emission solutions for example in engines. The cluster's problem definition highlights less climate neutrality and more air quality and health, covering issues like how scientific knowledge and RDI competence can be transferred to policies, how technological modernization and modification in individual behaviour is required for example in small-scale residential combustion for black carbon-relevant business to emerge.

The knowledge gaps reiterate the calls of the World Health Organisation and concern the measurement and monitoring of relevant parameters (e.g., black carbon, elemental carbon, particle number, ultra-fine particles), in addition to the parameters used in regulation (at the time of the interviews, $PM_{2.5}$; see Chapter 1). The industry foresees a need for medium-priced, durable and reliable measurement technologies to complement standard high-end devices applicable for long-term monitoring needs and more low-end devices. Since the technology market is driven by regulation, only regulation can create a market for such middle-range devices applicable to high-emitting economies such as Russia or China.

59 President of Finland, 'Statement by President of the Republic of Finland Sauli Niinistö at the United Nations General Assembly 73rd General Debate on 25th September 2018' (2018) <presidentti.fi/en/speeches/statement-by-president-of-the-republic-of-finland-sauli-niinisto-at-the-united-nations-general-assembly-73rd-general-debate-on-25th-september-2018/>.

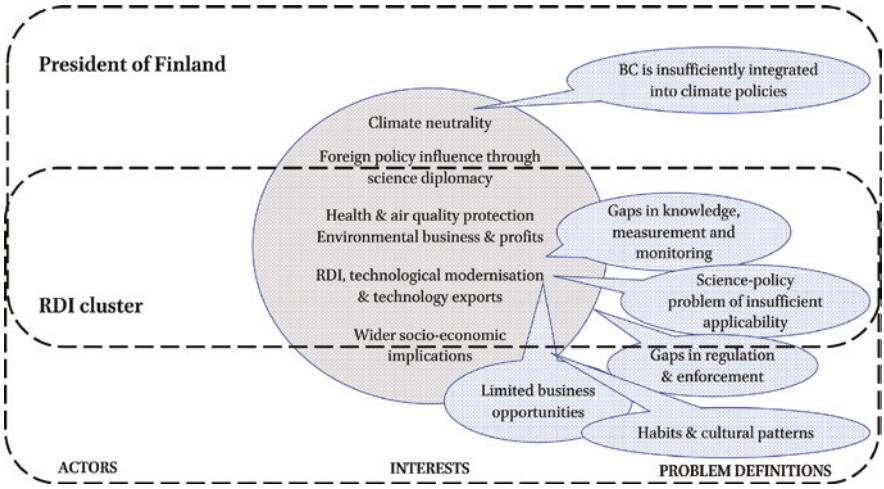

FIGURE 8.4 Finnish actors, interests and problem definitions

The profit interests of the Finnish RDI cluster concern most prominently the EU and Chinese markets. The Indian market is potentially emerging, yet considered a difficult environment. Despite the mentioned, potentially high Russian self-interest in black carbon mitigation, the Finnish RDI cluster expressed at best indifferent, if not outrightly negative, views on the Russian market already well before the 2022 full-scale invasion of Ukraine:

> maybe environmental issues are not as high a priority for policy and decision-makers [in Africa, Russia, Middle East, and India] as they are elsewhere. Sure, the problems there are as big, but they have many other problems there too than those connected to the environment.[60]

The Finnish RDI actors identify a problem of measurement leading to monitoring and mitigation problems. The yet wider problem concerns the interface between science and policy. Taken that the RDI cluster deems health impact the primary area of black carbon mitigation, with the climatic effects remaining uncertain, the lack of respective scientific data becomes problematic. Its availability could be boosted by regulatory means (see Figure 8.4).

In other words, the Finnish RDI actors call for regulation to oblige the take-up and adoption of low black carbon emitting technologies and services. While

60 Interview with a measurement technology manufacturer, 11.9.2019.

BOX 2 Finnish-Russian Bilateral Black Carbon Diplomacy

Monitoring and mitigation of black carbon emissions, and climate change in the Arctic were discussed in May 2019 between the Finnish Ministry of Foreign Affairs and the Russian Ministry for Natural Resources and Ecology. The Russian ministry's Director of the Department of International Cooperation, Nuritdin Inamov reiterated Russia's commitment to the Paris Agreement, referring to the ongoing introduction of BAT practices, for example in the transport, forestry, energy and industry sectors, and indicating interests in public health and environmental protection. The national environmental project 'Ekologiya' (Ecology) was set to reduce the total volume of air pollution in large industrial centres and the most polluted cities by at least 20%. However, the credibility of knowledge formed in the Arctic Council context was questioned by an expert of the Voeikov Main Geophysical Observatory, disputing the global effects of black carbon emissions, instead alleging only rather some (insignificant) regional effects.[61]

During his visit to Finland in August 2019, President Putin acknowledged the agreed intensification of Russian-Finnish environmental cooperation. President Niinistö welcomed the Russian plans to combat black carbon emissions.[62] When meeting the Prime Minister of Russia Dmitry Medvedev in November 2019, Prime Minister of Finland Antti Rinne took up black carbon emissions in the context of the Paris Agreement.[63]

61 Russian Ministry for Natural Resources and Ecology, 'Working meeting between representatives of the Finnish foreign ministry and the embassy of Finland in Russia and the Russian ministry for natural resources and ecology' (Press release, 21 May 2019) <https://www.mnr.gov.ru/press/news/predstaviteli_minprirody_rossii_i_mida_finlyandii_obsudili_voprosy_sokrashcheniya_vybrosov_chernogo_/?sphrase_id=405786> accessed 12 May 2022.

62 President of Finland, 'President of Russia Vladimir Putin visited Finland' (Press release, 21 August 2019), <https://www.presidentti.fi/en/news/president-of-russia-to-make-working-visit-to-finland-3/> accessed 11 July 2022; President of Russia, 'Joint news conference with President of Finland Sauli Niinistö – Vladimir Putin and Sauli Niinistö made press statements and answered media questions following Russian-Finnish talks' (Presidential Executive Office, Press release 21 August 2019) <http://en.kremlin.ru/events/president/news/61349> accessed 11 July 2022.

63 Government of Finland, 'Prime Ministers Rinne and Medvedev met in Moscow' (Press release, 25 November 2019) <https://valtioneuvosto.fi/-/10616/paaministerit-rinne-ja-medvedev-tapasivat-moskovassa?languageId=en_US> accessed 11 July 2022.

science diplomacy is unlikely to achieve such regulatory change, it can affect the knowledge spurring on reform, to the extent that knowledge-based policy-making practices prevail in the target country. In this respect, Russia poses a stern test for Finnish science diplomacy. Despite the legacy of cooperation, and bilateral track (see Box 2) utilised alongside the regional one, no similar project or other institutionalised result has emerged as in the Norwegian-Chinese case.

On the Arctic track, Russian and Finnish experts have jointly contributed to policy-relevant knowledge, as part of the Arctic Contaminants Action Programme and its Expert Group on SLCPs.[64] Russia has moreover signed the 2015 approved Arctic Council Framework for Action on Enhanced Black Carbon and Methane Emissions, which is a soft law document that politically commits Parties to either national action plans or mitigation strategies with a two-year iterative reporting process. However, Russia's only such report is from 2015.[65] Broadly in agreement with Finnish diplomacy, the report identifies the extraction of mineral resources (80%), electricity production, manufacturing industries and transport, as the major sources of black carbon emissions in Russia's Arctic (see Box 1). Yet, the report hints how climate change coupled with the fossil fuels industry's technological development enables it to pursue profits by accessing Arctic resources.

Overall, a dual picture emerges whereby the fossil fuel industry's profit interests co-exist with interest expressed in reducing black carbon emissions from associated petroleum gases, right until the full-scale invasion of Ukraine. For example, the Russian Ministry for Natural Resources and Ecology[66] referred to Arctic Contaminants Action Programme's study that proposed unified national methodologies for identifying, measuring and estimating emissions alongside appropriate reporting. In an Arctic Council plenary meeting in June 2021, the Minister for Natural Resources and Ecology Alexander Kozlov reported on

64 Arctic Council Secretariat, Expert group on Black carbon and methane 3rd Summary of Progress and Recommendations Report (2021) <MMIS12_2021_REYKJAVIK_EGBCM_Summary-Report-2021.pdf>; also see Chapter 7.

65 Ministry of Natural Resources and Environment of the Russian Federation, 'National report on the actions on black carbon and methane emissions reduction in accordance with the Framework for Action on Enhanced Black Carbon and Methane reductions' (Report, 24 April 2015) <https://oaarchive.arctic-council.org/handle/11374/1168>.

66 Russian Ministry for Natural Resources and Ecology, 'Video webinar arranged 29 October 2020 in connection of the forthcoming Russian chairmanship of the Arctic Council' (Press release, 29 October 2020) <https://www.mnr.gov.ru/press/news/sokrashchenie_vybrosov_chernogo_ugleroda_i_metana_v_atmosferu_arktiki_rossiya_otkryta_dlya_sotrudnich/?special_version=N> accessed 12 May 2022.

Russian plans for a black carbon emissions monitoring system. This system would include best available techniques practices and would expand and modernise Roshydromet's network of 240 monitoring stations including 172 meteorological stations. Voluntary monitoring of emissions from shipping and installation of meteorological stations was planned for the Arctic Ocean. The minister himself sought to assure that the Russian parties 'will definitely do it'.[67]

Similar duality characterises Russia's wider climate and environmental policies. black carbon and SLCP issues surface here too in the context of air quality and environmental protection rather than climate change. This problem definition is inseparable from the structure of Russian government and society. In Russia's heavily presidential system, science institutions exercise advisory and variable functions in knowledge production. The most influential ones in climate modelling are the Institute of Numerical Mathematics of the Russian Academy of Sciences and Roshydromet, the Russian Federal Service for Hydrometeorology and Environmental Monitoring, which has reported on climate change for the Russian government since 2008 and contributed to IPCC's reports.[68] However, such knowledge is secondary to the profit interests of Russia's fossil fuel industries and other heavy industries, and the socio-economic and foreign policy interests they serve.[69] At the same time, the Russian society features little awareness, if not outright scepticism of the anthropogenic sources of climate change (see Figure 8.5).[70]

67 Ibid. (2021).

68 Igor Makarov, 'Does Resource Abundance Require Special Approaches to Climate Policies? The Case of Russia' (2022) 170 Climatic change; Katja Doose, 'Modelling the Future: Climate Change Research in Russia during the Late Cold War and beyond, 1970s–2000' (2022) 171 Climatic Change 6 <https://doi.org/10.1007/s10584-022-03315-0>; Elana Wilson Rowe, 'Climate Science, Russian Politics, and the Framing of Climate Change' (2013) 4 WIREs Climate Change 457 <https://doi.org/10.1002/wcc.235> accessed 19 September 2022.

69 Pami Aalto and Anna Lowry, *Modernization of the Russian Economy: Fossil Fuels, Diversification and the Shackles of International Political Economy* (Routledge 2020); Lada V Kochtcheeva, 'Foreign Policy, National Interests, and Environmental Positioning: Russia's Post Paris Climate Change Actions, Discourse, and Engagement' (2021) ahead-of-print Problems of post-communism 1; Ellen Martus, 'Contested Policymaking in Russia: Industry, Environment, and the "Best Available Technology" Debate' (2017) 33 Post-Soviet Affairs 276.

70 See e.g. Veli-Pekka Tynkkynen and Nina Tynkkynen, 'Climate Denial Revisited: (Re) Contextualising Russian Public Discourse on Climate Change during Putin 2.0' (2018) 70 Europe-Asia Studies 1103; Tatiana Mitrova and Yuriy Melnikov, 'Energy Transition in Russia' (2019) 3 Energy Transitions 73.; Marianna Poberezhskaya, "Russian Climate Change Policy: Increasing Ambitions" (2021), Russian Analytical Digest, 72, 2–5 <https://doi.org/10.3929/ethz-b-000511730>.

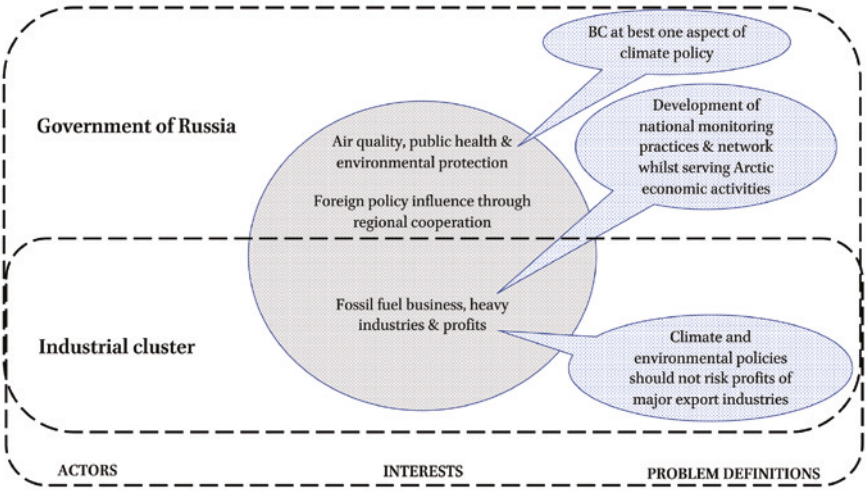

FIGURE 8.5 Russian actors, interests and problem definitions

The same duality applies to Russian companies. They need to demonstrate awareness of the climate and air quality problems of gas flaring to their customers in Western markets. The share of Russian export volumes to such environmentally sensitive markets continued to be decisive until summer 2022. Sanctions, combined with a poor outlook for Russia-West relations and ongoing energy transition in Europe, may well mean such air quality disclosure loses its stature. This can support the simultaneously existing, widespread non-compliance of Russian companies with the respective Russian domestic regulation. This in turn may protect the industry's competitive advantage in those markets that remain accessible for Russian producers.[71] For example, Russia's four largest energy and mineral extraction companies failed to reduce emissions despite declaring environmental safety measures and ambitious climate change targets during 2015–2019 (see Table 8.1). This is so because the fines for violation of environmental legislation are significantly lower than the costs of developing and implementing emission-reducing innovation.[72]

Overall, Russia's domestic structures comprise major technological, infrastructural and institutional-behavioural lock-ins to the fossil fuels economy.

71 Korppoo (n 54).

72 VA Tsukerman and SV Ivanov, 'Problems of Reducing Air Pollution from Industrial Enterprises in the Arctic Regions' (2022) 988 IOP Conference Series: Earth and Environmental Science 32006.

TABLE 8.1 Volume of air and greenhouse gas emissions in million tons of CO_2, 2015–2019

Company	2015	2016	2017	2018	2019
PJSC MMC Norilsk Nickel	2064	1963.4	1846.8	1926.6	1952.7
PJSC Severstal (Division Severstal Resources)	214.9	220.8	204.7	219.7	213.3
Arctic PJSC NOVATEK	66.2	121.2	92	70.3	75.6
PJSC ALROSA	9.4	8.9	7.5	9.8	8

SOURCE: MODIFIED FROM VA TSUKERMAN AND SV IVANOV, 'PROBLEMS OF REDUCING AIR POLLUTION FROM INDUSTRIAL ENTERPRISES IN THE ARCTIC REGIONS' (2022) 988 IOP CONFERENCE SERIES: EARTH AND ENVIRONMENTAL SCIENCE 32006

These lock-ins make mitigation a relatively low priority. Adaptation is a timelier goal as the Russian fossil fuel industry is shifting production to the Arctic with the large western Siberian fields depleting, and having to adapt to the rapidly changing Arctic conditions (e.g. permafrost melting, depreciating sea ice cover, heavier storms).[73] In this situation, despite adopting several climate and environmental documents pertaining to the Paris commitments, Russia's emission reduction commitments remain modest (see Table 8.2). At the same time, it is party to several international agreements and a member of transnational partnerships relevant for black carbon and SLCP mitigation (see Appendix 1).

Following the full-scale attack on Ukraine, this late, albeit unimpressive surge in climate policy was followed by depreciating economy with extensive sanctions, withdrawing foreign investment and strengthened anti-Western rhetoric domestically, with significant effects on the communicated decarbonisation plans and technological modernization. During 2022, debates in the Duma called for withdrawing from the Paris Agreement while companies asked for easing of environmental regulation. Russian climate scientists lost access to international research networks and data, thus endangering the future of measuring systems crucial for Arctic climate modelling.

In summary, the Finnish bilateral efforts and Arctic cooperation at best co-contributed, alongside more global pressure, to Russia's adoption of global climate and environmental regulation with relevance for black carbon and SLCP. China's commitment to climate neutrality during Autumn 2021 is significant

73 Michael Bradshaw "Russian energy dilemmas: energy security, globalisation and climate change", in P. Aalto (ed.), *Russia's energy policies: national, interregional and global levels* (Edward Elgar 2012), 206–229.

TABLE 8.2 Russian policies and regulations relevant for BC and SLCP mitigation

Document	Summary
Long-term climate strategy with emissions projections until 2050[a]	Target for net emissions reduction by 80% compared to the 1990 level by 2050, primarily through increasing the absorptive capacity of forests; yet no implementation plan[b]
Federal law on limiting GHG emissions[c]	Mandatory disclosure of information on GHG emissions by companies emitting the equivalent of 150,000 tons of CO_2 a year or more, from 2025 at the latest; legal framework for carbon trading & climate projects; carbon footprint concept; register of GHG emissions incl. methods for quantifying and determining emissions & sequestrations
Climate adaptation action plan until 2022[d]	Framework for adaptation vis-à-vis climate change; yet no sector-specific measures[e]
Energy strategy until 2035[f]	Reducing the environmental impact of the energy system and industry and their adaptation to climate change; Russia presented as one the most ecologically friendly (low carbon) leading economies owing to nuclear power, hydropower and natural gas resources
Regulations regarding BAT[g]	Incentives for companies to modernize; removal of environmental penalties for fully BAT compliant enterprises; investment credits; sanctions for negative environmental impact. Enterprises exceeding BAT regulations required to develop an environmental effectiveness programme and modernized production processes[h]
Decree on limiting atmospheric emissions from flaring and APG with introduction of a 5% limit on flaring of gas as a proportion of total production in 2012[i]	The regulation is based partly on the pollution fees system, set for exceeding the allowed 5 percent, for non-metered flaring and 4.5 times the standard environmental fine for methane emissions[j]

TABLE 8.2 Russian policies and regulations relevant for BC and SLCP mitigation (*cont.*)

a Government of Russia, *Strategiya sotsialno-ekonomicheskogo razvitiya Rossiyskoy Federatsii s nizkim urovnem vybrosov parnikovyh gazov do 2050 goda, ot 29 oktyabrya 2021 g. № 3052-r* (Decree № 3052-r., 2021a) <http://static.government.ru/media/files/ADKkCzp3fWO32e2yAoBhtIpyzWfHaiUa.pdf> accessed 28 March 2022.
b Makarov (n 67).
c Government of Russia, *Federalnyi zakon ot 02.07.2021 № 296-FZ "Ob ogranicsenii vybrosov parnikovyh gazov"* (Federal Law, No 296-FZ., 2021b) <https://legalacts.ru/doc/federalnyi-zakon-ot-02072021-n-296-fz-ob-ogranichenii-vybrosov/> accessed 6 July 2022.
d Government of Russia, *Rasporyazhenie ot 25 dekabrya 2019 goda №3183-r. "Natsionalnyi plan meropriyatiya perbogo etapa adaptatsii k izmeneniyam klimata na period do 2022 goda"* (Decree № 3183-r, 25 December 2019a) <http://government.ru/docs/38739/> accessed 6 July 2022.
e Igor Yakovlev, Kabir, L. S. & Nikulina, S. I. "Climate policy of Russian Federation: international cooperation and national approach" (2020) ("Klimaticheskaya politika Rossiyskoy Federatsii: mezhdunarodnoe sotrudnitsestvo i natsionalniy podhod."), Financial Journal (Financovyi zhurnal) Vol 12 (4), 26–36 (in Russian).
f Government of Russia, *Rasporyazhenie Pravitelstva Rossiyskoy Federatsii ot 9 iyunya 2020 g. № 1523-r "Energeticheskaya strategiya Rossiyskoy Federatsii na period do 2035 goda"* (Decree No 1523-r., 2020) <http://static.government.ru/media/files/w4sigFOiDjGVDYT4IgsApssm6mZRb7wx.pdf> accessed 6 July 2022.
g Government of Russia, *Federalnyi zakon ot 21 iyulja 2014 g. № 219-FZ "O vnesenii izmeneniy v Federalnyi zakon "Ob ohrane okruzhajushchey sredy" I otdelnye zakonodatelnye akty Rossiyskoy Federatsii"* (Federal Law № 219-FZ, 21 July 2014a) <http://base.garant.ru/70700466/> accessed 11 July 2022; Government of Russia, *Postanovlenie Pravitelstva RF ot 8 dekabrya 2014 g. № 1458 "O poryadke opredeleniya tehnologii v kachestve nailyshey dostupnpoy tehnologii, a takzhe razrabotki, akualizatsii i opublikovaniya informatsionno-tehnitseskih spravochnikov po nailushym dostunym tehnologiyam"* (Decree № 1458, 8 December 2014b) <http://base.garant.ru/70829288/> accessed 11 July 2022.
h Martus (n 70); PV Roslyakov and others, 'Optimal Choice of the Best Available Technologies for Russian Thermal Power Plants' (2019) 66 Thermal Engineering 268.
i Government of Russia (2009).
j Korppoo (n 54).

here as the country was among the last to do so of the major customers of Russian fossil fuel industry. However, it is possible to propose that for example further joint RDI actions in the Arctic context would be considered relevant nationally, to the extent they could reduce the costs of environmental innovation in Russia. Yet, Russia's war in Ukraine has long-standing repercussions to such a regional cooperation path which earlier would have represented natural continuation to bi-and multilateral projects.

5 Conclusion

In this chapter, we compared the science diplomacies of Norway and Finland towards China and Russia, respectively, on black carbon and SLCP mitigation. In the Norwegian-Chinese case, the diplomacy led to a tangible result in the form of a Norwegian-Chinese project intended to bolster the science basis of mitigation. In the Finnish-Russian case, bilateral high-level diplomacy led by the Finnish president was combined with similar initiatives in Arctic regional and more global arenas as well as scientific work as part of multilateral Arctic cooperation. Despite greater political capital invested, the results in this latter case are not as well ascertainable. It is true that Russia has adopted several black carbon and SLCP relevant regulatory acts. Yet, underpinning these actions are Russia's own modernisation interests while they also represent its long-standing aim to be recognised as one of great powers and contributor to major international processes, even if such processes were taking place in a low-priority-area for Russian foreign policy like environmental governance. At the same time, bilateral and regional cooperation may have played their own role in preparing the ground for these actions. In science diplomacy, and in wider global environmental governance which such diplomacy sustains and seeks to shape, numerous reasons usually underpin outcomes. This applies also to the cases examined here. Our theoretical starting points help to explain some of these reasons.

In the Norwegian-Chinese case, the bilateral scientific project was complemented by the regional track wherein Chinese scientists participated in similar Arctic scientific cooperation until Russia's war in Ukraine froze that track. Together, scientific work along these two tracks can help to improve the credibility of knowledge in this area. This is crucial given the uncertainties of knowledge pertaining to black carbon mitigation in general and more specifically on black carbon emissions in China. The legitimacy of knowledge produced can also improve with the involvement of Chinese science institutions on the two tracks, given their strong links with the Chinese government and its preference for science-based policy in climate and environmental policy. The relevance of the knowledge produced is strong as it responds to the central government's interest in improving air quality as evinced in successive Chinese policy documents. Chinese actors also acknowledge how Arctic air pollution shapes the region's climate system, with effects extending to China. This has repercussions to strengthening Chinese interests in climate change mitigation and adaptation.[74] The links to Norwegian interests in air quality and climate policy

74 Gørild Heggelund and Cheng, H. "China's climate policy: does an Arctic dimension exist?", in Rottem, S.V., Soltvedt, I. (eds) *Arctic Governance III: Norway, Russia and Asian states* (I.B. Tauris 2019), 281–298.

are evident. The main lock-ins standing on the way in China's case concern the way in which the implementation of air quality issues rests with regional authorities that also need to mind the considerable socio-economic interests associated with local polluting industries.

In some contrast to the Norwegian-Chinese case, Finland's high-level black carbon initiative never as decisively shaped knowledge production processes in Russia. The Arctic track for its part was not fully sustained by Russian parties as the country only reported on its black carbon emissions in 2015 and then failed to follow up, as agreed within the Arctic Council Framework for enhanced black carbon and methane emission reductions. It is possible to propose that the bilateral and regional processes did not decisively enough strengthen the credibility of the knowledge the Finnish parties sought to disseminate. Yet, on balance, in this case, the change that needed to be achieved was greater than that in the Norwegian-Chinese case.

For the Finnish official diplomacy, the major interest pertained to climate, and perhaps to some extent the sometimes nationally debated air pollution from Russian fossil fuel production and other industrial sites to Finland. For Russian parties, the credibility of the climate argument vis-à-vis black carbon was never widely enough accepted. Russia's interests in this area mostly pertained to adaptation rather than to mitigation sought by Finnish parties. For improving the legitimacy of knowledge, the work within the two tracks utilised remained inconclusive. No notable bilateral knowledge production process occurred despite the interests of Finnish scientists on cooperation with Russia.[75] No new joint research project or programme was launched by the authorities or science funders despite long-standing scientific and technical cooperation. The official diplomacy track could have integrated science and RDI actors more decisively into the activities, especially considering the RDI cluster's more global approach at the outset that was sceptical of the Russian market. Now that task was largely left to the Arctic multilateral track.

Here one must, however, return to how Russia's system of climate and environmental policy formation is not as open nor transparent for knowledge-based diplomacy and policy as is the Chinese one. It is furthermore crucial to note that very strong lock-ins in terms of fossil fuel technologies, infrastructures, institutions and behaviour persist in Russia, eroding the relevance of Finnish diplomacy's message. This means that in Russia, powerful national interests persist in continued fossil fuel economy and exports – to those markets and

75 Hanna Lappalainen et al., Pan-Eurasian Experiment (PEEX): Towards a holistic understanding of the feedbacks and interactions in the land-Atmosphere-ocean-society continuum in the northern Eurasian region, Atmospheric Chemistry and Physics 16(22): 14421–14461.

product segments remaining outside of the sanctions that were reinforced since Russia's escalation of war in Ukraine and not (yet) subject to efforts to diversify away from Russian suppliers. Such interests easily override potential Finnish interests in exports of environmental technologies and devices. It is furthermore well known that Russian interests in economic diversification are limited, as commodities and products in potential sectors of the economy are bound to be less competitive than those of the fossil fuels industry.[76] In other words, no decisive enough breakthrough took place to sufficiently integrate Finnish and Russian interests.

The lessons for the global governance of black carbon and SLCPs concern the role of knowledge in science diplomacy. Bilateralism can work with congruent enough interests and investment in joint knowledge production that can bolster the credibility and legitimacy of the knowledge. High-level science diplomacy without enough science cooperation created may not have the same effect for knowledge, especially if powerful lock-ins exist in the target country and knowledge-based policy tradition is limited. In terms of interests involved, the sender country should plan its approach carefully. If health and socio-economic health bill are likely to be the primary self-interests for the target country as far air pollution is concerned, focusing the science diplomacy on climate policy may not be helpful, particularly if we assume actors in the target country to know those benefits to be of global nature from their perspective, and think global benefits to weigh less than national ones.

In other words, the diplomatic practice must be tailor-made for each target country to maximise its chances while a mechanism must exist for adapting and learning along the way. Learning by doing has been the actual practice of Arctic cooperation for a long time,[77] but this requires opportunities for such doing. At the time of writing, such opportunities involving Russian parties are becoming fewer than during the Cold War. Overall, the long-term consequences of the Russian offensive in Ukraine will hamper the diffusion of climate and environmental policies and adoption of mitigation technologies that would normally be sought by science diplomacy. Without doubt this development will be instructive to Chinese foreign policy makers as well as Chinese scientists who likely do not want to witness the same while their western

76 Clifford Gaddy and Barry Ickes, *Bear Traps on Russia's Road to Modernization* (Routledge 2013); Aalto and Lowry (n 68).

77 Sigve R Leland and Alf Håkon Hoel, "Learning by doing: The Barents cooperation and development of regional collaboration in the north", in Aalto, P., Blakkisrud, H. and Smith, H. (eds) *The New Northern Dimension of the European Neighbourhood* (Centre for European Policy Studies 2009), 36–53.

counterparts cannot afford it. This all should make science diplomacy actors in Norway, Finland and beyond acutely aware of how their sphere of activity depends on international order. As for China, we expect China's science-based energy and environmental policies to make the domestically expected benefits of mitigation more likely to be reaped than in the case of Russia, with more positive outlook for continued international cooperation. Should China instead embark on similar geopolitical adventures like Russia, the outlook for international science diplomacy may be dark.

Appendix 1: Membership in Key International Agreements, Frameworks, and Partnerships Relevant to SLCPs

TABLE 8.3 Membership in key international agreements, frameworks, and partnerships relevant to SLCPs

Binding international agreements	Membership, year of ratification/ joining				
	FI	NO	RUS	CHI	SLCPs concerned
UNFCCC (1992)	1994	1993	1994	1993	CH_4 & HFCs
Kyoto Protocol (1997)	2002	2002	2004	2002	CH_4 & HFCs
Paris Agreement (2015)	2016	2016	2019	2016	Unspecified[a]
UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP) (1979)	1979	1979	1979	N/A	AP
UNECE CLRTAP (1979) Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (1999), Geneva Amendment (2012)	2017	2019	-	N/A	$PM_{2.5}$, BC
Vienna Convention for the Protection of the Ozone Layer (1985) Montreal Protocol on Substances that Deplete the Ozone Layer (1987) Kigali Amendment (2016)	2017	2017	2020	2021	HFCs

TABLE 8.3 Membership in key international agreements, frameworks (*cont.*)

Binding international agreements	Membership, year of ratification/ joining				
International Convention for the Prevention of Pollution from ships (MARPOL 73/78) (1973, 1978)[b]	1983	1983	1984	1983	PM
MARPOL 73/78 (1973, 1978) Protocol of 1997 Annex VI Prevention of Air Pollution from Ships[c]	2005	2005	2011	2006	PM
Voluntary inter-governmental frameworks					
The North-East Asia Clean Air Partnership (NEACAP)[d]	N/A	N/A	2018	2018	$PM_{2.5}$, BC
North-East Asian Subregional Program for Environmental Cooperation (NEASPEC)	N/A	N/A	1993	1993	AP
Arctic Council	1996	1996	1996	2013	BC, CH_4
Arctic Council Framework "Enhanced Black Carbon and Methane Emissions Reductions: An Arctic Council Framework for Action" (2015)[e]	2015, 2017, 2020	2015, 2017, 2020	2015	-	BC, CH_4
Tripartite Environment Ministers Meeting (TEMM) (1990), Tripartite Policy Dialogue on Air Pollution (TPDAP) (2013)	N/A	N/A	N/A	2013	AP, $PM_{2.5}$
Acid Deposition Monitoring Network in East Asia (EANET) (2001)	N/A	N/A	2001	2001	PM
UNEP Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Northwest Pacific Region (NOWPAP) (1994)	N/A	N/A	1994	1994	AP, PM_{10}, CH_4
East Asia Summit (EAS) (2005)	N/A	N/A	2011	2005	env. coop.
Asia-Pacific Economic Cooperation (APEC) (1989)	N/A	N/A	(1998) 2014	(1991) 2014	env. coop.
Green Supply Chain Cooperation Network (2014)					

TABLE 8.3 Membership in key international agreements, frameworks (*cont.*)

Binding international agreements	**Membership, year of ratification/ joining**				
EU-Russia Permanent Partnership Council (2003), PPC on Environment (formal EU-Russia environmental dialogue) (2006)	N/A	N/A	(2003) 2006	N/A	env. coop.
Voluntary public-private/multi-stakeholder partnerships					
Climate and Clean Air Coalition (CCAC) to reduce short-lived climate pollutants (2012)	2012	2012	2014	-	BC, CH_4, TO, HFCS
Global Methane Initiative (GMI) (2004)	2008	2011	2004	2004	CH_4
Asia Pacific Clean Air Partnership (APCAP) (2015)[f] Joint Forum	N/A	N/A	N/A	-	$PM_{2.5}$, O3
Political and economic unions					
European Union (EU) (1992)[g]	1995	-	-	N/A	$PM_{2.5}$, BC
Association of Southeast Asian Nations (ASEAN) (1967) (through Non-ASEAN Ambassadors)[h]	2011	2015	1991	1991	AP, haze
ASEAN + 3 Environment Ministers Meeting (2002)	N/A	N/A	N/A	2002	AP, haze
Inter-governmental organisations					
International Civic Aviation organisation (ICAO) (1947)[i]	1949	1947	1970	1946	AP, PM, nvPM
UN Economic and Social Commission for Asia and the Pacific (ESCAP)	N/A	N/A	1947	1947	AP
Baltic Marine Environment Protection Commission (Helsinki Commission – HELCOM) (1974, 1992)	1974, 1992	N/A	(1974) 1992	N/A	env. coop.
Northern Dimension Environmental Partnership (NDEP) (2001)	2001	2001	2001	N/A	env. coop.
Barents Euro-Arctic Council (BEAC) (1993)	1993	1993	1993	N/A	env. coop.

TABLE 8.3 Membership in key international agreements, frameworks (*cont.*)

Year = member; - = not a member; N/A = not applicable

a The Paris Agreement does not specify mitigated pollutants. However, GHGs, CH_4 and HFC are part of the reporting system through the agreement's transparency framework. The voluntary submission of reduction plans on any SLCPs can take place as part of the nationally determined contributions (NDCs).

b The Optional Annexes III, IV, V of the Convention adopted as follows: Finland: Annex III (1992), IV (2003), and V (1988), Norway: Annex III (1992), IV (2003), and V (1988), Russia: Annex III (1992), IV (2003), and V (1988), and China: Annex III (1994), IV (2007), and V (1989)

c IMO 2020 Amendment ("IMO 2020 Sulphur regulation") is applicable to all parties having ratified MARPOL Protocol 1997 Annex VI

d NEACAP comprises science-based, policy-oriented cooperation on transboundary air pollution in North-East Asia. It has received technical support from UNECE CLRTAP

e Finland and Norway have submitted reports in 2015, 2017, and 2019, and Russia in 2015.

f China is not a member; Chinese experts are involved in the scientific panel.

g E.g., the National Emission Ceiling (NEC) Directive of the EU Clean Air Policy Package includes limits for PM2.5 and recommendations for BC. BC is also targeted indirectly through EURO6 vehicle standards.

h Finland's partnership with ASEAN is unspecified (though a partnership exists), Norway is involved as a Sectoral Dialogue Partner, and Russia and China as Dialogue Partners.

i ICAO Committee on Aviation Environmental Protection (CAEP) has introduced a PM standard (PM mass & number) and End Smoke Number Standard; both applicable in 1/2023 (included under Annex 16, Volume II, Chapter 4).

Acknowledgements

We would like to acknowledge the financial support of the 'Black Carbon Footprint (BCFp)' project (Business Finland, 2019–2022, no. 530/31/2019) and the support Pami Aalto obtained during his research visit to the Fridtjof Nansen Institute (FNI) in November 2021, including several invaluable discussions with FNI staff members.

Bibliography

Aakre S and others, 'Incentives for Small Clubs of Arctic Countries to Limit Black Carbon and Methane Emissions' (2018) 8 Nature Climate Change 85.

Aalto P and Lowry A, *Modernization of the Russian Economy : Fossil Fuels, Diversification and the Shackles of International Political Economy* (Routledge 2020).

Aalto P, Blakkisrud H and Smith H, *The New Northern Dimension of the European Neighbourhood* (Centre for European Policy Studies 2008).

Abbondanza, G and Wilkins, T S, *Awkward Powers: Escaping Traditional Great Power and Middle Power Theory* (Springer 2022).

Arctic Contaminants Action Program, *Mitigation of Short-Lived Climate Pollutants from APG-Flaring. Project: Phase 2 – the Use of New Methodology to Reduce APG Flaring at Remote Fields* (Arctic Contaminants Action Programme 2021a) <https://oaarchive.arctic-council.org/handle/11374/2607>.

Arctic Contaminants Action Program, *Black Carbon and Methane from the Oil and Gas Sector: Webinar Report with Recommendations*. (Arctic Contaminants Action Programme 2021b), <https://oaarchive.arctic-council.org/server/api/core/bitstreams/168f1e3f-a237-45d9-8092-720ce8a3fe35/content>.

Arctic Contaminants Action Program, *Mitigation of Short-Lived Climate Pollutants from AGP-Flaring Project: Final report. Phase 1A – Evaluation of potential impact of AÅG flaring on Arctic zone environment* (Final report, VYGON Consulting, 16 November 2018) <https://oaarchive.arctic-council.org/bitstream/handle/11374/2450/FinalReport_APG-flaring-Phase-1A.pdf?sequence=1&isAllowed=y>.

Arctic Council Secretariat, *Expert group on Black carbon and methane 3rd Summary of Progress and Recommendations Report* (Arctic Council Secretariat 2021) <MMIS12_2021_REYKJAVIK_EGBCM_Summary-Report-2021.pdf>.

Arctic Monitoring and Assessment Programme, *Impacts of Short-Lived Climate Forces on Arctic Climate, Air Quality and Human Health Summary for Policymakers* (Arctic Monitoring and Assessment Programme 2021) <https://www.amap.no/documents/download/6760/inline>.

Böttcher K and others, 'Black Carbon Emissions from Flaring in Russia in the Period 2012–2017' (2021) 254 Atmospheric Environment 118390 <https://www.sciencedirect.com/science/article/pii/S1352231021002090>.

Bradshaw, M. "Russian energy dilemmas: energy security, globalisation and climate change", in P. Aalto (ed.), *Russia's Energy Policies: National, Interregional and Global Levels* (Edward Elgar 2012), 206–229.

Cheng L, *The Power of Ideas: The Rising Influence of Thinkers and Think Tanks in China* (World Scientific Publishing Co Pte Ltd 2017).

Cheng, M., Meng, F., Randall, S., Rønning, I., Vestreng, V. "Review of BC/OC emissions and control measures in China and Norway" (2021) ChiNorBC1.

Devyatkin, P, 'Russian and Chinese Scientists to Establish Arctic Research Center' (The High North News, 15 April 2019) <https://www.highnorthnews.com/en/russian-and-chinese-scientists-establish-arctic-research-center> Accessed 6 September 2022.

Doose K, 'Modelling the Future: Climate Change Research in Russia during the Late Cold War and beyond, 1970s–2000' (2022) 171 Climatic Change 6 <https://doi.org/10.1007/s10584-022-03315-0>.

Flink T. and Ruffin N, 'The Current State of the 'Art' of Science Diplomacy', in Simon D and Kuhlmann S (eds.) *Handbook of Science and Public Policy* (Edward Elgar 2019), 104–121.

Frey HC, 'Trends in Onroad Transportation Energy and Emissions' (2018) 68 Journal of the Air & Waste Management Association 514 <https://doi.org/10.1080/10962247.2018.1454357>.

Gaddy C and Ickes B, *Bear Traps on Russia's Road to Modernization* (Routledge 2013).

Gov.cn., 'China Meteorological Administration released the "China Climate Change Blue Book' (in Chinese, 10 August 2022) <http://www.gov.cn/xinwen/2022-08/10/content_5704792.htm>.

Government of Finland, 'Finland's Chairmanship program for the Arctic Council 2017 – 2019' (Ministry for Foreign Affairs of Finland, 2017) <https://oaarchive.arctic-council.org/server/api/core/bitstreams/cd14f8d1-cba1-4802-ab3e-67ac12b9e544/content>.

Government of Finland, 'Prime Ministers Rinne and Medvedev met in Moscow' (Government Communications Department, Press release, 25 November 2019) <https://valtioneuvosto.fi/-/10616/paaministerit-rinne-ja-medvedev-tapasivat-moskovassa?languageId=en_US> accessed 11 July 2022.

Government of Norway, 'Update of Norway's nationally determined contribution' (2022) <https://unfccc.int/sites/default/files/NDC/2022-06/Norway_updatedNDC_2020%20%28Updated%20submission%29.pdf> accessed 2 December 2022.

Government of Norway, *Better Growth, Lower Emissions – the Norwegian Government's Strategy for Green Competitiveness* (Strategy T-1562 E, 2017).

Government of Russia, *Federalnyi zakon ot 02.07.2021 № 296-FZ "Ob ogranicsenii vybrosov parnikovyh gazov"* (Federal Law, No 296-FZ., 2021b) <https://legalacts.ru/doc/federalnyi-zakon-ot-02072021-n-296-fz-ob-ogranichenii-vybrosov/> accessed 6 July 2022.

Government of Russia, *Federalnyi zakon ot 21 iyulja 2014 g. № 219-FZ "O vnesenii izmeneniy v Federalnyi zakon "Ob ohrane okruzhajushchey sredy" I otdelnye zakonodatelnye akty Rossiyskoy Federatsii*" (Federal Law № 219-FZ, 21 July 2014a) <http://base.garant.ru/70700466/> accessed 11 July 2022.

Government of Russia, *Postanovlenie Pravitelstva RF ot 8 dekabrya 2014 z. №1458 "O poryadke opredeleniya tehnologii v kachestve nailyshey dostupnpoy tehnologii, a takzhe razrabotki, akualizatsii i opublikovaniya informatsionno-tehnitseskih spravochnikov po nailushym dostunym tehnologiyam"* (Decree № 1458, 8 December 2014b) <http://base.garant.ru/70829288/> accessed 11 July 2022.

Government of Russia, *Postanovlenie Pravitelstva RF ot 8 Yanvarya 2009 g. No 7 "O merah po stimulirovaniyu sokrasheniya atmosfernogo vozduha produktami szhiganija popytnogo neftyanogo gaza na fakelnyh ustanovkah"* (Decree № 7, 8 January 2009) <https://www.garant.ru/products/ipo/prime/doc/12064540/> accessed 6 July 2022.

Government of Russia, *Rasporyazhenie ot 25 dekabrya 2019 goda №3183-r. "Natsionalnyi plan meropriyatiya perbogo etapa adaptatsii k izmeneniyam klimata na period do 2022 goda"* (Decree № 3183-r, 25 December 2019a) <http://government.ru/docs/38739/> accessed 6 July 2022.

Government of Russia, *Rasporyazhenie Pravitelstva Rossiyskoy Federatsii ot 9 iyunya 2020 g. № 1523-r "Energeticheskaya strategiya Rossiyskoy Federatsii na period do 2035 goda"* (Decree No 1523-r., 2020) <http://static.government.ru/media/files/w4sigFOiDjGVDYT4IgsApssm6mZRb7wx.pdf> accessed 6 July 2022.

Government of Russia, *Strategiya sotsialno-ekonomicheskogo razvitiya Rossiyskoy Federatsii s nizkim urovnem vybrosov parnikovyh gazov do 2050 goda, ot 29 oktyabrya 2021 g. № 3052-r* (Decree № 3052-r., 2021a) <http://static.government.ru/media/files/ADKkCzp3fWO32e2yA0BhtIpyzWfHaiUa.pdf> accessed 28 March 2022.

Hall, M 'Net Zero Targets and GHG Emission Reduction in the UK and Norwegian Upstream Oil and Gas Industry: A Comparative Assessment' (2020) <https://www.oxfordenergy.org/publications/net-zero-targets-and-ghg-emission-reduction-in-the-uk-and-norwegian-upstream-oil-and-gas-industry-a-comparative-assessment/> accessed 2 December 2022.

Heggelund GM, 'China's Climate and Energy Policy: At a Turning Point?' (2021) 21 International Environmental Agreements: Politics, Law and Economics 9.

Heggelund, Gorild and Cheng, H. 'China's climate policy: does an Arctic dimension exist?', in Rottem, S.V., Soltvedt, I. (eds) Arctic Governance III: Norway, Russia and Asian states (I.B. Tauris 2019), 281–298.

Hooftman N and others, 'A Review of the European Passenger Car Regulations – Real Driving Emissions vs Local Air Quality' (2018) 86 Renewable & Sustainable Energy Reviews 1.

Hughes L and Lipscy PY, 'The Politics of Energy' (2013) 16 Annual Review of Political Science 449.

Ikeda K and others, 'Evaluation of Anthropogenic Emissions of Black Carbon from East Asia in Six Inventories: Constraints from Model Simulations and Surface Observations on Fukue Island, Japan' (2022) 2 Environmental Science: Atmospheres 416.

Kennedy AB and Lim DJ, 'The Innovation Imperative: Technology and US–China Rivalry in the Twenty-First Century' (2018) 94 International Affairs (London) 553.

Kochtcheeva LV, 'Foreign Policy, National Interests, and Environmental Positioning: Russia's Post Paris Climate Change Actions, Discourse, and Engagement' (2021) ahead-of-print Problems of Post-communism 1.

Korppoo A, 'Russian Associated Petroleum Gas Flaring Limits: Interplay of Formal and Informal Institutions' (2018) 116 Energy Policy 232 <https://www.sciencedirect.com/science/article/pii/S0301421518300752>.

Kotilainen K and others, 'From Path Dependence to Policy Mixes for Nordic Electric Mobility: Lessons for Accelerating Future Transport Transitions' (2019) 52 Policy Sciences 573.

Lappalainen H et al., 'Pan-Eurasian Experiment (PEEX): towards a holistic understanding of the feedbacks and interactions in the land-Atmosphere-ocean-society continuum in the northern Eurasian region' (2016) Atmospheric Chemistry and Physics 16(22): 14421–14461.

Leland SL and Alf Håkon Hoel, "Learning by doing: The Barents cooperation and development of regional collaboration in the north", in Aalto, P., Blakkisrud, H. and Smith, H. (eds) *The New Northern Dimension of the European Neighbourhood* (Centre for European Policy Studies 2009), 36–53.

Li C, *The Power of Ideas: The Rising Influence of Thinkers and Think Tanks in China* (World Scientific Publishing Co Pte Ltd 2017).

Makarov I, 'Does Resource Abundance Require Special Approaches to Climate Policies? The Case of Russia' (2022) 170 Climatic Change.

Martus E, 'Contested Policymaking in Russia: Industry, Environment, and the "Best Available Technology" Debate' (2017) 33 Post-Soviet Affairs 276.

Ministry of Natural Resources and Environment of the Russian Federation, *National report on the actions on black carbon and methane emissions reduction in accordance with the Framework for Action on Enhanced Black Carbon and Methane reductions* (Government of Russia, Report, 24 April 2015) <https://oaarchive.arctic-council.org/handle/11374/1168>.

Mitrova T and Melnikov Y, 'Energy Transition in Russia' (2019) 3 Energy Transitions 73.

Muth, C, Aalto, P, Mylläri, F, Rönkkö, T, Harsia, P, "Globally and Locally Applicable Technologies to Accelerate Electrification", in Aalto, P. (ed.), *Electrification: Accelerating the Energy Transition* (Academic Press/Elsevier 2021), 25–55.

National Development and Reform Commission, *China's National Climate Change Programme* (National Development and Reform Commission, June 2007) <http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/File188.pdf>.

Nordic Council of Ministers, *Policy Brief: Emissions of Short-Lived Climate Pollutants (SLCPs): emission factors, scenarios and reduction potentials* (Nordic Council of Ministers 2019) <http://dx.doi.org/10.6027/Nord2019-013>.

Norwegian Environment Agency, *Climate Mitigation Measures up to 2030: Short Term Climate Effects and Health Effects* (Norwegian Environment Agency 2016).

Norwegian Environment Agency, *Summary of proposed action plan for Norwegian emissions of shortlived climate forcers* (M135/2014, 2014) <https://www.miljodirektoratet.no/globalassets/publikasjoner/m135/m135.pdf> accessed 2 December 2022.

Norwegian Ministry of Climate and Environment, *Norway's Climate Action Plan for 2021–2030* (White Paper, Cm 13, 2021).

Özkaragöz Doğan E, Uygun Z and Akçomak İS, 'Can Science Diplomacy Address the Global Climate Change Challenge?' (2021) 31 Environmental Policy & Governance 31 <http://libproxy.tuni.fi/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,uid&db=bsu&AN=148477343&site=ehost-live&scope=site>.

Peoples' Republic of China [PRC], *Observer Review Report 2017–2019, Arctic Council* (2019) <https://oaarchive.arctic-council.org/handle/11374/2251>.

Peoples' Republic of China [PRC], *Observer Review Report 2019–2021, Arctic Council* (2021) <https://oaarchive.arctic-council.org/handle/11374/2717>.

Poberezhskaya, M "Russian Climate Change Policy: Increasing Ambitions" (2021) Russian Analytical Digest Vol 72, 2–5. <https://doi.org/10.3929/ethz-b-000511730>.

President of Finland, 'President of Russia Vladimir Putin visited Finland' (Office of the President of the Republic of Finland, Press release, 21 August 2019) <https://www.presidentti.fi/en/news/president-of-russia-to-make-working-visit-to-finland-3/> accessed 11 July 2022.

President of Finland, *Speech by the President of the Republic of Finland, Mr. Sauli Niinistö, at the Arctic Forum in St. Petersburg, 9 April 2019* (2019) <presidentti.fi/en/speeches/speech-by-the-president-of-the-republic-of-finland-mr-sauli-niinisto-at-the-arctic-forum-in-st-petersburg-9-april-2019/>.

President of Finland, *Statement by President of the Republic of Finland Sauli Niinistö at the United Nations General Assembly 73rd General Debate on 25th September 2018*, available at: <presidentti.fi/en/speeches/statement-by-president-of-the-republic-of-finland-sauli-niinisto-at-the-united-nations-general-assembly-73rd-general-debate-on-25th-september-2018/>.

President of Russia, 'Joint news conference with President of Finland Sauli Niinistö – Vladimir Putin and Sauli Niinistö made press statements and answered media questions following Russian-Finnish talks' (Presidential Executive Office, Press release 21 August 2019) <http://en.kremlin.ru/events/president/news/61349> accessed 11 July 2022.

Raunio T, 'Semi-Presidentialism and European Integration: Lessons from Finland for Constitutional Design' (2012) 19 Journal of European Public Policy 567.

Raunio T and Sedelius T, 'Presidents and Cabinets: Coordinating Executive Leadership in Premier-Presidential Regimes' (2020) 18 Political Studies Review 53.

Reuters, 'China warns that its temperatures are rising faster than global average' (4 August, 2022) <https://www.reuters.com/world/china/china-warns-that-its-temperatures-are-rising-faster-than-global-average-2022-08-04/#:~:text=SHANGHAI%2C%20Aug%204%20(Reuters),mount%2C%20a%20government%20official%20said>.

Romppanen S, 'Arctic Climate Governance via EU Law on Black Carbon?' (2018) 27 Review of European Community & International Environmental Law 45.

Rosendal GK, 'Norway in UN Environmental Policies: Ambitions and Influence' (2007) 7 International Environmental Agreements: Politics, Law and Economics 439.

Rosendal GK and others, 'The Minamata Convention and Mercury Policy in China: The Role of Science' (2020) 44 Asian Perspective 435.

Roslyakov PV and others, 'Optimal Choice of the Best Available Technologies for Russian Thermal Power Plants' (2019) 66 Thermal Engineering 268.

Russian Ministry of Natural Resources and Ecology, 'Arctic Council plenary meeting' (Ministry of Natural Resources and Ecology, Press release, 25 June 2021) <https://www.mnr.gov.ru/press/news/aleksandr_kozlov_vazhno_uchityvat_monitoring_po_chyernomu_uglerodu_i_metanu_seychas_uzhe_obsuzhdaem_/?sphrase_id=405821> accessed 12 May 2022.

Russian Ministry for Natural Resources and Ecology, 'Video webinar arranged 29 October 2020 in connection of the forthcoming Russian chairmanship of the Arctic Council' (Ministry for Natural Resources and Ecology, Press release, 29 October 2020) <https://www.mnr.gov.ru/press/news/sokrashchenie_vybrosov_chernogo_ugleroda_i_metana_v_atmosferu_arktiki_rossiya_otkryta_dlya_sotrudnich/?special_version=N> accessed 12 May 2022.

Russian Ministry for Natural Resources and Ecology, "Working meeting between representatives of the Finnish foreign ministry and the embassy of Finland in Russia and the Russian ministry for natural resources and ecology" (Ministry for Natural Resources and Ecology, Press release, 21 May 2019) <https://www.mnr.gov.ru/press/news/predstaviteli_minprirody_rossii_i_mida_finlyandii_obsudili_voprosy_sokrashcheniya_vybrosov_chernogo_/?sphrase_id=405786> accessed 12 May 2022.

Sand M and others, 'Response of Arctic Temperature to Changes in Emissions of Short-Lived Climate Forcers' (2016) 6 Nature Climate Change 286.

Schreurs M, 'Multi-Level Climate Governance in China' (2017) 27 Environmental Policy and Governance 163 <https://doi.org/10.1002/eet.1751> accessed 19 September 2022.

Smieszek, MG, Koivurova, T, Nielsson, ET, "China's Arctic Policy", in Koivurova T and Kopra S, *Chinese Policy and Presence in the Arctic* (BRILL 2020).

Stanway, D, "President Xi says China will start cutting coal consumption from 2026" (Reuters, 22 April 2021) <https://www.reuters.com/world/china/chinas-xi-says-china-will-phase-down-coal-consumption-over-2026-2030-2021-04-22/>.

State Council, "Notice of the State Council Distributing the Action Plan for the Prevention and Control of Air Pollution" (10 September 2013) <http://www.gov.cn/zwgk/2013-09/12/content_2486773.htm> accessed 12 May 2022, in Chinese.

State Council, "The People's Republic of China's 14th Five-Year Plan of National Economic and Social Development and Outline of Vision Goals for 2035" (2021) <http://www.gov.cn/zhengce/2020-11/03/content_5556991.htm> accessed 16 July 2021, in Chinese.

Stevenson H, *Global Environmental Politics: Problems, Policy and Practice* (Cambridge University Press 2017).

Stohl A and others, 'Black Carbon in the Arctic: The Underestimated Role of Gas Flaring and Residential Combustion Emissions' (2013) 13 Atmospheric Chemistry and Physics 8833.

Su P and Mayer M, 'Science Diplomacy and Trust Building: "Science China" in the Arctic' (2018) 9 Global Policy 23 <https://doi.org/10.1111/1758-5899.12576> accessed 19 September 2022.

Tilastokeskus, 'Energian kokonaiskulutus energialähteittäin (kaikki luokat), 1970-2021' (2022) <https://pxweb2.stat.fi/PxWeb/pxweb/fi/StatFin/StatFin__ehk/statfin_ehk_pxt_12vq.px/>.

Toivanen P and others, 'Finland's Energy System for 2030 as Envisaged by Expert Stakeholders' (2017) 18 Energy Strategy Reviews 150.

Tsukerman VA and Ivanov SV, 'Problems of Reducing Air Pollution from Industrial Enterprises in the Arctic Regions' (2022) 988 IOP Conference Series: Earth and Environmental Science 32006.

Tynkkynen V-P and Tynkkynen N, 'Climate Denial Revisited: (Re)Contextualising Russian Public Discourse on Climate Change during Putin 2.0' (2018) 70 Europe-Asia Studies 1103.

Unger C, Mar KA and Gürtler K, 'A Club's Contribution to Global Climate Governance: The Case of the Climate and Clean Air Coalition' (2020) 6 Palgrave Communications.

Van den Abeele, E, 'Towards a New Paradigm in Open Strategic Autonomy' (ETUI Research Paper 2021.3, 2021) <http://dx.doi.org/10.2139/ssrn.3873798> accessed 2 December 2022.

Wilson Rowe E, 'Climate Science, Russian Politics, and the Framing of Climate Change' (2013) 4 WIREs Climate Change 457 <https://doi.org/10.1002/wcc.235> accessed 19 September 2022.

World Bank, *Global Gas Flaring Tracker Report. Global Gas Flaring Reduction Partnership* (World Bank 2021) <https://thedocs.worldbank.org/en/doc/1f7221545bf1b7c89b850dd85cb409b0-0400072021/original/WB-GGFR-Report-Design-05a.pdf>.

World Bank, *Global Gas Flaring Tracker Report. Global Gas Flaring Reduction Partnership* (World Bank 2022) <2022-Global-Gas-Flaring-Tracker-Report.pdf (worldbank.org)>.

Wubbeke J, 'China's Climate Change Expert Community-Principles, Mechanisms and Influence' (2013) 22 The Journal of Contemporary China 712.

Yakovlev, Igor, Kabir, L. S. & Nikulina, S. I. "Climate policy of Russian Federation: international cooperation and national approach" (2020) ("Klimaticheskaya politika Rossiyskoy Federatsii: mezhdunarodnoe sotrudnitsestvo i natsionalniy podhod."), Financial Journal (Financovyi zhurnal) Vol 12 (4), 26–36 (in Russian). DOI: 10.31107/2075-1990-2020-4-26-36.

Yamineva Y and Liu Z, 'Cleaning the Air, Protecting the Climate: Policy, Legal and Institutional Nexus to Reduce Black Carbon Emissions in China' (2019) 95 Environmental Science & Policy 1.

Yamineva Y and Romppanen S, 'Is Law Failing to Address Air Pollution? Reflections on International and EU Developments' (2017) 26 Review of European Community & International Environmental Law 189.