Implementing the Minamata Convention on Mercury: Will China Deliver?

Gørild Heggelund, Kristin Rosendal, Steinar Andresen, Eirik Hovland Steindal, Yan, Lin, Shuxiao Wang and Haibin Zhang

Abstract

China has undertaken a major shift in its position on mercury as an environmental problem over the last decade and a half. It ratified the Minamata Convention (MC) in 2016 and by doing so has committed to implement the treaty objectives. This article asks: how do we explain China's will and ability to implement its MC obligations? There is little systematic knowledge about the main factors underlying implementation of international mercury objectives in China, hence this article contributes new research on this important topic. We examine the implementation process, focusing on the coal sector and differentiate between indirect effects from other policies and direct efforts to implement obligations. We find that China has moved toward stricter regulation of mercury emissions and direct implementation of the Minamata Convention in the coal sector. However, our study shows that local implementation capacity needs improvement.

Key words

China, mercury, Minamata Convention, environmental policies, policy implementation

Abbreviations

CFPP	Coal-fired power plants
CFIB	Coal-Fired Industrial Boilers
EEB	Ecology and environment bureaus
FYP	Five-Year Plan
GDP	Gross domestic product
MC	Minamata Convention
MEE	Ministry of Ecology and Environment
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NIP	National Implementation Plan

Mercury (Hg) is a naturally occurring element that is used in certain products and industrial processes, as well as emitted unintentionally to air by industrial activities such as coal combustion. To deal with global mercury pollution, the Minamata Convention (MC) was adopted on October 10, 2013, entering into force on August 16, 2017. The Convention bans new mercury mines, requires phasing out existing mercury mines, and contains measures to control air emissions and releases[1] to land and water. On April 28, 2016, the Standing Committee of the National People's Congress of the

[1] The MC consistently distinguishes between *emissions* (to air) and *releases* (to land and water); we employ the same terminology.

People's Republic of China decided to ratify the Minamata Convention on Mercury,[2] making China among the earlier ratifiers.

China accounts for 29–40 percent of global mercury emissions, and approximately 75 percent of total mercury emissions in East and South Asia (UNEP 2013; Lin et al. 2017; Zhang et al. 2018; Wu et al. 2018a). According to UNEP (2013) estimates, China was the world's largest producer of mined mercury in 2009, amounting to 73 percent of global production (1,400 of 1,920 tonnes); the corresponding UNEP mercury report from 2018 found similar patterns (UNEP 2018). Mercury emissions derive from a wide range of activities. In China, the single most significant source is the coal sector. Coal combustion accounts for some 47 percent of China's national total emissions (Zhang Lei et al. 2015); of this, coal-fired power plants accounted for 40 percent and industry boilers for 47 percent (Zhang et al. 2015; Zhang et al. 2018, p.798). (See Figure 1 for an overview of coal related mercury emissions.)

Over the last decade and a half, China has undertaken a major shift in its position on mercury as an environmental problem. After virtually ignoring the issue 15 years ago, it became an active player in the Minamata negotiations, and the issue of mercury pollution has continued to climb on the domestic environmental agenda (Rosendal et al. 2020; Stokes et al. 2016). With ratification, China has committed to implementing the treaty's objectives, with some time-limited (5 + 5 years) exemptions for one of the MC regulated product groups (Steindal et al. forthcoming)[3].

[2] China was a *signatory* to the Minamata Convention on Mercury in October 2013.

[3] Exemptions are time limited flexibility mechanism of the Minamata Convention that allows for parties to submit applications to extend the phase-out date for certain substances. For instance, China

There is little systematic knowledge about the main factors driving implementation of international mercury objectives in China. Existing literature largely emphasizes the technical and scientific aspects of China's mercury situation (Selin and Wang et al. 2014; Karplus 2015; Wu et al. 2018ab; Wen et al. 2020) and political studies focus on China's role in international negotiations on mercury pollution (Selin 2014; Stokes et al. 2016). We seek to contribute novel research on the important topic of China's implementation of the Minamata Convention's objectives to understand the sources of China's political will and ability to implement its MC obligations. We do so for reasons explained further below by focusing our research on the implementation process. In order to assess political will and ability to implement, we will also discuss the difference between deliberate implementation and indirect implementation or compliance.

Our study is structured in the following way: after presenting our analytical approach, we move on to developments in environmental policy implementation in China. We then narrow our focus to the state of implementation of the MC in China. This in turn provides the foundation for understanding mercury policy implementation in the coal sector in China. Finally, we conclude our analysis with an assessment of China's willingness and ability to implement the MC.

Employing qualitative methods to examine mercury-policy implementation in China, we draw our evidence from official statements and policy documents as well as

---

submitted an application to extend the phase-out date for manufacture of mercury-containing clinical thermometers to 2025 (UNEP 2017).

journal articles (both Chinese and international). These materials are supplemented by several rounds of interviews with key actors, including with government officials with responsibilities for the mercury issue in China, experts from China, and external, collaborating academics. The uncertainties introduced by the COVID-19-induced recession may either reinforce or counteract possible changes in China's mercury policies, but it is still too early to say.

Analytical Approach

Given our focus on both the sources of China's political will and its ability to implement its MC obligations, we draw heavily on the literature on policy implementation, principally by van Meter and van Horn (1975). Our dependent variable is *implementation*, defined by van Meter and van Horn (1975) as *deliberate efforts by national authorities to follow up on commitments, by enacting policies that actively go in the same direction as the agreed obligations*. This is a common starting point for political science studies of implementation; including those that involves interaction between international and national policy levels (Miles et al., 2002). A country may fulfil its international obligations through deliberate policymaking, in which case it is correct to talk about implementation. However, the obligations (e.g. emission reductions) could also come about due not to deliberate will, but to other factors, in which case compliance or indirect implementation are more applicable. Compliance might for instance come about due to economic recession, or indirect implementation could come about as the result of other policies. In our analysis we

discuss whether the achievement of goals is due to deliberate or indirect implementation or compliance (Miles et al., 2002).

In contrast to the *deliberate* element inherent in the standard definition of implementation, *compliance* or *indirect implementation* implies that a country may have achieved the agreed international objectives (e.g. emission reductions), but that this might be due to other factors. Indirect effects from other policy areas (such as reduced emissions from air pollution policies) or economic recessions may result in perfect compliance or indirect implementation despite a lack of *deliberate* effort to implement the international obligations. Hence, indirect implementation says less about a country's will and ability to implement an international policy, and thus it offers fewer insights into China's (deliberate) implementation efforts (here regarding the MC).

Obligations can be envisaged as specific targets and emission levels, but we also examine the broader policy objectives that parties to an international agreement seek to achieve by solving environmental problems. In assessing implementation of mercury obligations and goals under the MC, we look for changes to China's mercury policies that are "moving in the right direction" (Levy et al. 1995), in line with the obligations and objectives of the MC. Deliberate implementation measures may also precede the MC itself, as China had agreed in 2009 to a legally binding convention prior to ratification of the MC and may have enacted anticipatory policies. Such policies may be referred to as *output implementation* (Easton 1965) and are identified

with reference to institutional or legislative changes. We consider also the level of *outcome implementation*, conceived of as corresponding behavioral changes among stakeholders and other target groups; however, we include but pay less attention to examining the *impact*, i.e. actual environmental problem-solving on the ground (Miles et al. 2002).

For insights into the prospects for Chinese output and outcome implementation of the MC, we examine how interacting domestic and international factors represent either barriers or opportunities for implementation. We take our point of departure in a multilevel governance approach, which enables the study of policymaking and implementation at various levels and incorporates the growing participation of non-state actors (Schreurs 2017).

The study of implementation of international environmental agreements often combines rational choice and normative approaches; including a variation of independent key factors like interests, norms, knowledge and institutional design (Levy et al,. 1995; Haas et al., 1993; Miles et al., 2002). A common analytical division in explaining the degree of implementation distinguishes among norm-based factors (changes in ideas or principles), cognitive factors (greater learning, role of science and knowledge), and interest-based factor (changes in cost/benefit perceptions). To these we add institutional factors, since the design of policymaking processes may hamper or hinder the further achievement of environmental policy goals. Institutional factors are of a dual nature: First, institutional change may constitute part of the implementation output as a response to obligations; thus it is included in our dependent variable (see

section 3 and Table 1). Second, institutional design is a factor that may itself influence further implementation outcomes: see section 4.3.1.

Regarding *norm-based* factors, we assume that the obligations stemming from an international convention are more easily implemented when perceived as legitimate on the national level. Legitimacy may stem from states' general commitment to adhere to their international obligations—*pacta sunt servanda* (Frank, 1990). Further, domestic implementation is more likely when international obligations concur with evolving national norms and public demands, for instance, greater attention to environmental politics among the central authorities (top-down).

Most of the approaches and findings concerning domestic politics (i.e. domestic policymaking and implementation) have drawn on research on democracies in the Organisation for Economic Co-operation and Development (OECD) region. China is de facto a one-party state, yet scholars have shown that the policy process in China includes bargaining to obtain consensus or some form of agreement between the interests of provinces and the central government, different industries and ministries, and probably also of individuals (Li 2017; Lieberthal & Oksenberg 1988; Lampton 1992). Adjusting our expectations to Chinese politics, we see public demands as a potential channel through which the Chinese public may exert a bottom–up normative push affecting policy decisions and subsequent implementation. Regarding local levels, a related assumption is that successful test cases at the local level may enhance learning and bolster environmental norms, both of which may strengthen implementation (Schreurs 2017). This could be due to correspondence between national and

international ideals/norms. Norm- and knowledge-based factors may be closely linked; but here we make a division for analytical purposes.

Implementation may also be affected by changes in *cognitive/ knowledge-based* factors. A common assumption is that consensual scientific information is more likely to affect policymaking and enhance implementation (Underdal 2000). Part of our analytical endeavor in this study is to examine how this plays out in a more authoritarian setting. Multilevel governance can be a challenge, as policies from the central authorities may simply not be taken up or be hindered during implementation at lower levels of government. However, there may also be factors enhancing implementation. Concerning *cognitive* aspects, policies that are sought implemented at local levels may be hampered if policies are not well understood and helped through increased learning and scientific knowledge (Schreurs 2017, 164). Domestic ownership of knowledge is assumed to strengthen the legitimacy and relevance of scientific environmental advice in policymaking (Mitchell et al. 2006).

The *interest-based* perspective assumes that implementation is more likely when countries have fulfilled and incorporated their domestic interests into the treaty text (Young 1993). Similarly, implementation may be enhanced when international obligations are not perceived as too demanding, e.g. in terms of economic costs. Concerning local-level interests, mercury policies may be hampered if insufficiently funded, while implementation may be helped by local capacity building (Schreurs, 2017).

To this perspective we add *institutional* factors (which along with the other three factors are summed up in Table 1). A central assumption is that implementation may be hampered by poor design and institutional fragmentation, or helped by policy coherence and a clear division of labor among implementing agencies. This involves examining changes in the vertical (across administrative levels) and horizontal (across ministries/sectors) institutional design relating to a policy area. The multilevel governance framework recognizes the increasing complexity of actor networks in the public and private sectors, which may force state actors to develop new strategies of policy coordination across and between levels. We discuss change in institutional design as part of the interest-based factors.

Table 1: Summary of assumptions of how various factors may boost implementation:

	Normative	Cognitive	Interests and institutional design
Interaction between	Given high level of	Given • credible,	Given high level of • correspondence between

international & national factors	• correspondence between national and international ideals/norms. • public demand for environmental policies (bottom–up)	legitimate, and relevant science and • high level of concurring international and domestic knowledge producers.	international obligations and domestic & local interests. • Given coherent (not fragmented) design of implementing agencies.

Implementation of environmental policy in China

To better understand the potential for implementing the MC we present an update of academic findings on implementing environmental policies in China. Economic development remains an urgent concern for ensuring economic growth and social stability. Compared to a decade ago, however, a *normative* transformation has taken place in China's environmental governance, with growing attention to energy and environmental issues (Kostka and Zhang 2018, 770; Heggelund and Nadin 2017, 98–101). Central here is the concept of *ecological civilization* (and beautiful China) that constitutes the national policy umbrella committed to in 2007 at the 17th Party Congress. This concept is followed by policy objectives prioritizing resource efficiency, environmental protection, and ecosystem restoration, with "a green, circular and low-carbon development trajectory" (CCICED 2011, 15). There is a clear consensus that environmental protection must be given greater attention than before (Kostka and Zhang 2018, 778).

At the state (horizontal) level, developing and implementing policy requires cooperation and understanding between numerous divergent ministries and agendas (Heggelund and Nadin 2017, 100). Decisionmaking processes are complex and have been described as highly fragmented in China, with bureaucratic bargaining; recently, additional stakeholders (media, NGOs) have been playing a greater role (Lampton 1987; Lieberthal and Oksenberg 1988; Heggelund 2004; Brødsgaard 2016). The central government receives inputs and pressure from many stakeholders, including line ministries, provinces, and cities (Lieberthal and Oksenberg 1990; Schreurs 2017, 164). Non-state stakeholders and think-tanks are increasingly important in the policymaking process (Wübbeke 2013; Li 2017, vii & 11), providing advice that is fed into government-led research projects, policy discussions, and reports that reach and are sometimes taken up by policymakers.

The local levels are expected to implement the policies set by the central government, and targets are divided among the provinces (Schreurs 2017, 164; Heggelund and Nadin 2017, 128).[4] The provinces in turn distribute decisionmaking targets within their jurisdictions, prefectures, counties, and cities (Gilley 2012, 291). However, the multi-tiered (vertical) system can be an obstacle to efficient implementation, for several reasons (Schreurs 2017, 163–164).

[4] Chinese local government' consists of four components that reflect the central government: the party committee *(dangwei),* the administration *(zhengfu)*, the local people's congress *(renda)*, and the local political consultation conference *(zhengxie)* (Qi and Zhang 2014, 198).

First, policy implementation at provincial and local levels may suffer from low institutional capacity (Heggelund and Nadin, 2017, 101; Kostka 2014, 7), which may be due to "insufficient implementation capacities of local agencies in charge of policy implementation" (Schreurs 2017, 163). Indeed, Schreurs holds that "one of China's largest governance challenges is improving implementation of policies at the local level" (2017, 164).

Second**,** the short time-horizons for local officials represent a challenge, given the focus on career promotion, reputation, personal income, employment, citizens' welfare issues, and lack of incentives to make the changes from a "growth-at-any-cost model to a resource-efficient and sustainable path" (Qi and Zhang 2014, 206; Van Rooij 2017, 200–201; Eaton and Kostka 2014, 360).

There is certainly local variation in development, commitment, and capacity. The revised Environmental Protection Law (NPC 2014; Arts. 6 & 68) makes local governments directly responsible for meeting environmental targets; local officials are held responsible, and in grave instances they may be removed from office (NPC 2014; Heggelund and Nadin 2017, 101; Reuters 2015). However, in China's more economically advanced provinces, local governments may also be proactive and push for more stringent regulations (van Rooij 2017, 197). In some instances, local levels and cities have been proactive, developing local standards and incentives that go beyond national requirements as to energy and the environment (Khanna et al. 2014).

Thus, while the central level seems more coherent in its environmental attention, in examining the scope for implementation we should be aware of how

normative, knowledge, interest-based, and institutional design factors play out at the local level.

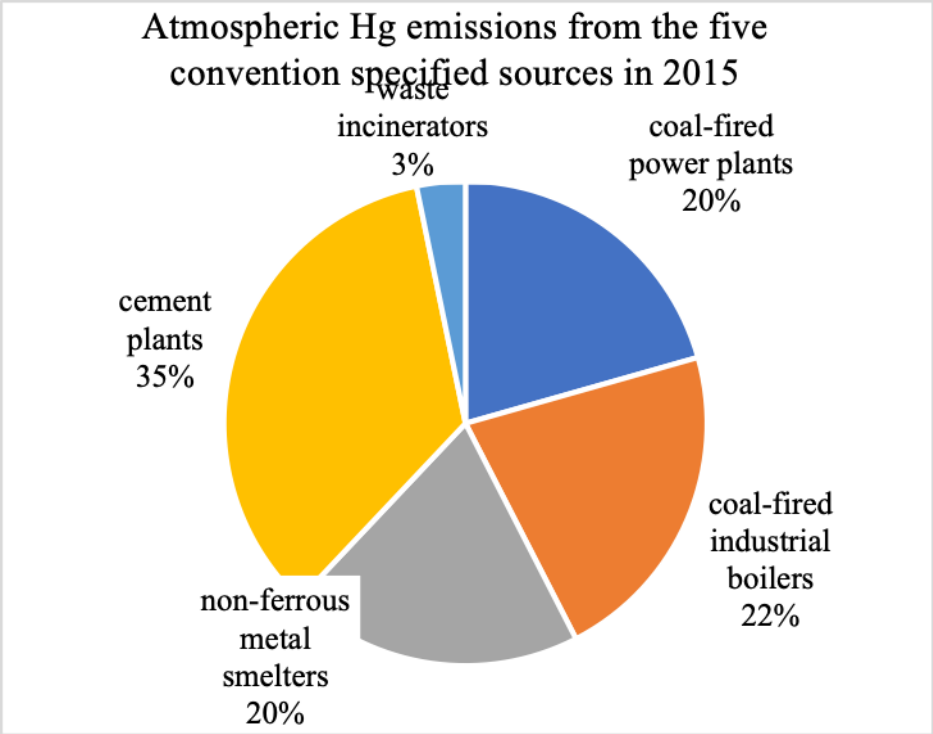
State of Implementation--Legislative and Institutional Changes

In 2016, China became the 30th Party to the MC. The MC's Articles 3 to 12 concern specific operational obligations for parties (MC 2017, 16–33). Additionally, there are five annexes, two of which (Annex A and B) specify phase-down provisions and phase-out dates for industrial processes and mercury-containing products. In Table 3, we sum up the MC obligations that are most relevant for China and how these have been implemented.

We start out with assessing changes in China's mercury-emissions reductions (implementation outcome). First, we need to know how fast emissions increased prior to any policy measures. China's mercury emissions grew from 356 t in 2000 to 538 t in 2010, an average annual increase of 4.2 percent (Zhang Lei et al. 2015; Liu K et al. 2019). Since then, China has focused on emissions-control measures, bringing the total atmospheric mercury emissions down from 571 tons in 2013 to 444 tons in 2017—a 22 percent reduction (Liu K et al. 2019). Moreover, the Air Pollution Action Plan 2013–2017 seems to have had a positive effect on emissions from coal-fired industrial boilers: down 80 mill tonnes with the shift from coal to gas and the closure of smaller boilers (Zhang Q. et al. 2019). Mercury emissions decreased from 90 tonnes to 66 tonnes in the same period. For coal-fired power plants, mercury-emissions intensity decreased from 26g/GWh in 2013 to 16 g/GWh in 2017

(Wu et al. 2018, 11091). Further, since 2014, coal-fired power plants have been made subject to China's toughest-ever emissions standards (Chen 2020). These figures indicate significant achievements in terms of implementation *outcomes*.

Fig. 1 Atmospheric Hg emission from the five convention specified sources in 2015



Source: Compiled by Tsinghua team

The MC provision on emissions to air (Article 8) is highly relevant for China's coal sector, as it concerns emissions of mercury and mercury compounds from five key industrial sectors, two of which are coal-fired power plants and industrial boilers. Convention Article 8 concerns "controlling and, where feasible, reducing emissions of mercury and mercury compounds" from five categories of point sources (UNEP 2017 Annex D, 61; Wu et al. 2018a). Article 8 sets control measures and timeframes for

existing and new sources (industrial plants) of mercury emissions. For new sources, China must apply best available techniques (BAT) and best environmental practices (BEP) within five years of the MC entry into force; for existing sources, BAT and BEP must be put in place within ten years.

We now turn to *output* implementation in terms of legislative and institutional changes.

Legislative changes

China's 12th and 13th national Five-Year plans accord greater space to *ecological civilization* and the environment, but specific regulations regarding mercury have also been introduced. The 12th FYP for National Environmental Protection (2011–2015) included the first mercury reduction targets (Ancora et al. 2016). A greater shift came with the 13th FYP (2016–2020) for Ecological and Environmental Protection (State Council 2016), with strengthened control of mercury. The 13th FYP stepped up the prevention and control of heavy-metal pollution (Section 2) and sought to improve the level of hazardous waste disposal (Section 3). It also proposed strengthening mercury pollution control of coal-fired power plants, prohibiting the construction of new primary mercury mines, and phasing out primary mercury mining.

Second, the announcement of China's ratification of the MC gave directions as to prohibiting new primary mercury mines and phasing out primary mercury mining, as well as mercury emission from coal, strengthening the control of mercury pollution emissions in key industries such as coal-fired power plants. For implementation of the

Convention, BAT/BEP guidelines for coal-fired power plants were released in 2016 (MEP 2017).

Third, atmospheric emissions standards have been strengthened since 2010, and mercury was added as a target in the general control measures (Lin et al. 2017, p. 2). Notably, the Air Pollution Action Plan (AP, 2013–2017) was far more detailed than the 13th FYP as to specific air-pollution issues.[5] The AP required that the provinces issue detailed implementation plans including timetables and action plans for limiting coal consumption.

Fourth, the State Council (2018) follow-up action plan (2018–2020) repeats some of the goals in the 13th FYP for energy development on non-fossil energy, natural gas and coal proportions, setting specific objectives as to coal-fired power plants and coal-fired industrial boilers. Of particular relevance to mercury emissions, it aims to reduce total SO_2 and NO_x emissions by more than 15 percent from 2015 by 2020, to get "blue skies" back again; and to reduce the concentration of PM2.5[6] in cities by more than 18 percent compared with 2015 (State Council 2018, section 1.2). Air pollution control has introduced more stringent regulations on SO_2 and NO_x particle emissions, and mercury emissions are captured and reduced in this abatement process (Wang et al. 2014; Ancora et al. 2016; Cai et al 2017). Thus, mercury emissions are likely to have decreased significantly as a co-benefit of other

[5] *Air Pollution Action Plan* (2013-2017) had concrete objectives to improve air quality in the Beijing-Tianjin-Hebei area, the Yangtze River Delta and the Pearl River Delta (State Council 2013).

[6] *A*tmospheric particulate matter (PM) less than 2.5 micrometers in diameter

air-pollution control measures, in addition to the mercury emissions limits themselves (Mulvaney et al. 2020).[7]

Institutional changes

A major change in the institutional set-up, coordination and division of labor is that China has established a specific coordination group for MC implementation; it has representatives from 17 ministries and administrations and is led by the environmental authorities (MEP 2017). The Ministry of Ecology and Environment (MEE) is the key ministry in charge of the MC work and heads the coordination group (see Table 2 on stakeholders and roles). The National Development and Reform Commission (NDRC) on overarching economic policies, including energy and mercury; China's energy is still largely fossil-based, with coal constituting approximately 57 percent of energy consumption (NBS 2020). The diverging interests and responsibilities of the 17 ministries constitute an implementation challenge, requiring firm coordination. The development of a Chinese National Implementation Plan (NIP) for the Minamata Convention is coordinated by the Department of Solid Waste and Chemical Management under the MEE.

Thus, China has initiated a range of legislative and institutional changes aimed at implementing its MC obligations for the coal sector. The emissions reductions achieved indicate high achievement on outcome implementation; they seem to have

[7] Personal communication, October 2019, Thorjørn Larssen, research director at NIVA and central to all phases of the SINOMER project.

come about partly as a co-benefit from other policies on air pollution. That in turn clearly indicates rather high achievement in terms of indirect implementation, although it does not provide solid evidence of direct implementation. However, the MC allows parties to choose among a selection of control measures on air emissions, including co-benefit mitigation and "alternative measures" (MC, Art. 8, para 5d, 30). Interestingly, this design reflects the view that it is not the means (*direct* or *indirect*) that are important: what matters is achieving the *aim* of the Convention—mercury reduction.

Explaining China's Mercury Policies on Coal

Evolving environmental norms, top-down and bottom–up

The main assumption within the normative perspective is that domestic implementation is more likely when international obligations concur with evolving national norms and public demands. Kuhn notes the development of collaborative governance in the field of sustainable development, bringing together public and private stakeholders, "promoting and implementing an ambitious agenda for sustainable development"' (Kuhn 2016, p. 450). The 18th Communist Party Congress (2012) included the construction of an *ecological civilization* in the Party Constitution (Deng 2012), reflecting the shift at China's central-level toward more environmental protection in domestic policies. Importantly, the meeting in 2017 of China's Communist Party's highest body and main annual political event, its Communist Party Congress (the 19th), emphasized this further: "Taking a driving seat in international cooperation to respond to climate change, China has become an

important participant, contributor, and torchbearer in the global endeavor for ecological civilization" (Xinhua, 2017).

Moreover, public opinion is achieving greater impact on decisionmakers and responsiveness to public demand (Aamodt and Stensdal, 2017; Kostka and Zhang 2018, 778). Thus, we assume that *public demand* for improved environmental policies may exert a normative push, affecting political decisions in China.

As noted, other policy areas may indirectly impact the state of mercury emissions. Air pollution, smog, and its health impacts are major concerns of the Chinese public and these issues rank high on the policymaking agenda (Ahlers et al. 2018, p. 302). Air-pollution incidents and regulations concerning disclosure of environmental information (based on the State Council regulations issued in 2007) require ecology and environment bureaus (EEBs) to disclose environmental laws, regulations, and data on environmental quality (Wang 2018). Environmental regulators were the first to set about implementing rules pursuant to the State Council 2007 Regulation on Open Government Information (Wang 2018, 879)—a signal of support for disclosure. This has resulted in enhanced environmental awareness among the public, the urban population in particular. Creating public pressure by exposing the role of polluting companies or backward provinces is becoming more common.[8] Despite high public pressure due to the damage to the local environment and health

[8] Hundreds protest chemical plant in southern China: https://www.reuters.com/article/us-china-protests-petrochemicals/hundreds-protest-chemical-plant-in-southern-china-idUSBREA2U0KS20140331paraxylene

caused by coal combustion, awareness about mercury pollution remains generally low. Mercury levels in fish tend to be low, and cases of rice contamination concern a few hotspot areas (Zhang, Feng, Larssen, Qiu and Vogt 2010; Cheng and Hu 2012; Selin and Karplus, 2015).

In sum, the Chinese authorities display increased attention to environmental norms, as implied by the construction of *ecological civilization*. The smog issue and air pollution have brought increased bottom–up public attention to the coal problem. Public demands for "blue skies" and a better environment may have strengthened indirect implementation—but, as far as we can ascertain, normative factors have not been central in accounting for direct implementation of mercury policies.

Scientific Knowledge and Domestic Ownership

Our central assumption here is that domestic ownership of knowledge strengthens the legitimacy and relevance of scientific environmental advice. China's scientific community plays an increasingly important role in bringing information and knowledge to policymakers; and inputs to the policymaking process are frequently provided by think-tanks, research institutes, and universities (Wübbeke 2013; Rosendal et al. 2020). China has recently developed a significantly stronger domestic knowledge base for assessing the domestic situation and needs concerning the mercury pollution problem (Rosendal et al. 2020).

The role of science in mercury changed during the MC negotiations. At the beginning of the global talks about a possible mercury convention, the G77 and China

were skeptical, arguing the existing chemicals regime and voluntary measures were sufficient. They argued against a binding convention, noting that the developing countries knew little about mercury and had insufficient capacity for addressing the problem (Stokes et al. 2016, 15–16). In the course of a few years, China's stance changed, due partly to greater domestic knowledge on the mercury issue, and to its growing ownership of the knowledge about mercury (Stokes et al. 2016, 17; Rosendal et al. 2020). For instance, mapping of mercury pollution in fish and rice yielded data that showed lower concentration levels of mercury than anticipated from on international data (UNEP, 2013; Rosendal et al. 2020; Zhang, Feng, Larssen, Qiu and Vogt 2010; Cheng and Hu 2012; Selin and Karplus, 2015). Domestic data indicated that the mercury pollution issue seemed potentially controllable, which in turn may have fostered greater support for mercury policies in China and abroad (Rosendal et al. 2020). Domestic experts and scholars conducted mercury research and published widely in Chinese and international scientific journals, contributing to greater understanding and ownership of the issue among Chinese policymakers (Zhang et al. 2010a; Zhang et al. 2010b; Zhang Lei et al. 2015; Lin et al. 2016). Moreover, scientific experts who conducted research on domestic mercury issues took part in the negotiations to give scientific support, thereby providing a scientific basis for China's negotiations stance.

Chinese researchers are also heavily involved in international cooperative projects on mercury, central in strengthening agreement of scientific knowledge about the mercury issue in China. Between 2006 and 2017, Norway supported a ten-year

mercury project, SINOMER, aimed at building capacity in China for reducing mercury pollution.

The domestic and international aspects of the cognitive explanatory perspective indicate increased potential for will and ability for China to implement its MC obligations. But has the implementation potential been fully utilized? And are these same factors likely to help promote implementation on the local levels?

Domestic Interests

The interest-based perspective assumed that implementation is more likely when a country has had a breakthrough for its *domestic interests* in international negotiations; further, that implementation may be enhanced when international obligations are not perceived as too demanding. One general indication of this is how China (with other countries) has gained acceptance for exemptions and other specific flexibility mechanisms in the MC (Steindal et al. forthcoming). Below, we examine how economic and industrial interests play out in the coal sector. The change of perspective among top leaders as to China's national interests and climate change has much to do with Chinese performance in implementing the MC. When meeting with then US State Secretary John Kerry, Xi said, "Addressing climate change and implementation of sustainable development is not what we are asked to do, but what we really want to do and we will do well" (*People's Daily,* 2014).

Non-state stakeholders have become important sources of advice in China's policymaking processes (Wübbeke 2013; Li 2017, vii & 11). In section 4.2 we saw how scientific advice is increasingly being fed into government-led research projects, policy discussions, and reports that reach central-level policymakers. It is, however, difficult to measure this impact at the local level. In section 4.3.2 we examine how implementation fares with local-level government.

The Role of the Coal Industry

Rosendal et al. (2020) found evidence that the MC objectives were not seen as a major threat to Chinese industry interests in general, and that industry was open for somewhat stricter control measures. In contrast to China's coal-fired power plants (CFPP), represented in the negotiations by the China Electricity Council, the CFPP and Coal-Fired Industrial Boilers (CFIB) used in a range of industries has no association, and consequently did not take part in the MC negotiations. The CFPP industry has been generally positive to the government's evolving mercury policies, seeing itself as being in the international forefront of pollution-abatement technology and controlling almost 90 percent of China's mercury emissions (Rosendal et al. 2020). There is also evidence that mercury targets could be achieved by shutting down or modernizing small, inefficient coal-combustion plants (Bergsager and Korppoo 2012). This restructuring policy led to a phase-out of small, heavy polluters, with the larger companies likely to profit from the general modernization process (Rosendal et al. 2020). On the other hand, many new coal-combustion plants are still

being established; it is mostly the smaller plants that are closing. Although the new plants are far more technologically advanced, there is uncertainty regarding future mercury emissions (Rosendal et al. 2020). As of this writing, the 14th FYP is being developed; there are indications that the industry is pushing for increased capacity (Chen 2020), although a final decision has not been made. There are also important concerns regarding mercury from coal-combustion by-products such as fly ash, potentially increasing mercury release to water and land (Wen et al. 2020).

The domestic-interest perspective seems to point in two directions: rather high implementation achievements in the short term, but greater uncertainty regarding the willingness to implement in the longer term.

Local Governments: Will and Ability to Implement?

A central analytical assumption was that *implementation may be hampered by poor design or institutional fragmentation and helped by policy coherence and a clear division of labor among implementing agencies*. Despite China's centralized political system, significant levels of vertical and horizontal fragmentation have inspired the concept of "fragmented authoritarianism" to describe the system (Lieberthal and Lampton 1992).

For many years, GDP growth has been the most important indicator for promotion of local leaders (Qi and Zhang 2014, p.207). Given the Chinese environmental planning system, with economic and political incentives provided to local implementers, public and private participation and interests, as well as financial,

technical, and political capacities of implementing agencies, there is often insufficient motivation for effective environmental governance (Kostka 2014, p. 43; Schreurs 2017). As described in section 2.1, local governments may be less willing to implement environmental policies than to reduce growth, even with the growing central attention to the environment.

The 13th FYP for Ecological and Environmental Protection (2016–2020) proposed strengthening mercury-pollution control of coal-fired power plants. However, the major challenges to implementation lie in the coal-producing and coal-consuming areas. The top five *provinces* for mercury emissions in the power industry sector are Shandong, Henan, Guizhou, Inner Mongolia, and Shanxi, together accounting for 40 percent China's total emissions (Zhang et al. 2018, 799). This is due to high coal consumption in provinces such as Shandong and Henan, and high mercury content in the coal in Guizhou. Shandong has the highest coal consumption, 402 million tonnes in 2015 (National Bureau of Statistics), due largely to its aluminum production, which requires massive amounts of electricity. Shandong faces a major challenge in controlling its total coal consumption, and failed to achieve the targets of the province-level Air Pollution Action Plan (2013–2017; interview 2017).

As noted, the Air Pollution Action Plan (2013–2017) had a positive effect on reducing emissions from coal-fired industrial boilers and from coal-fired power plants (Cai et al 2017). Again, there is notable regional variation: coal-fired power plants in the region 2+26 cities are expected to have installed multi-pollutant control technologies end 2020 (Wu et al. 2018, p.11091). Also, although mercury has been

added as a targeted control element in most industrial emission standards, the MEP request (2007) for high-polluting coal-fired plants to install Continuous Emissions Monitoring Systems has had varying degrees of success at the local level (Karplus et al. 2018, 1).

Recent trends indicate a future increase in mercury emissions from coal combustion. In 2018, an increase in coal consumption was driven by energy demand from industrial growth (Myllyvirta and Howard 2018). This is seen in relation to the central government's recently shifting the responsibility to local from central officials in making decisions on industrial output that concern coal consumption (Feng 2018). This decentralization, coupled with greater emphasis on economic growth at local levels, could weaken implementation of centrally adopted mercury policies. Differing degrees of development at the local level could also be a challenge to implementing the MC. Capacity-building is needed in many smaller municipalities, as there is general pressure for economic development and poverty reduction to achieve the goals of *xiaokang shehui* (a "moderately prosperous society") (Moody 2020).

By contrast, large municipalities have the capacity and funding to be proactive. Shanghai recently launched its Clean Air Action Plan, focused on energy, coal and PM 2.5. Realizing the need to adjust key industries, Shanghai focuses explicitly on mercury (MEE 2018)[9]. This could be an instance of collaborative governance in the field of sustainable development—or an example of authoritarian environmentalism (Kuhn 2016; Ahlers et al. 2018).

9 Largely related to medical devices and lamps (liquid mercury fluorescent lamp; mercury sphygmomanometer; mercury-containing batteries)

The recent strengthening of the Ministry of Ecology and Environment (MEE) is among the greatest policy-related shifts announced at the National People's Congress (NPC) (Ma and Liu 2018), likely to have an immediate and long-term bearing on MC implementation in China. Moreover, the MEE (with direct responsibility for mercury) has experience and the policy tools to regulate emitters (SO_2 and NO_x), so the recent change in its status could be expected to contribute to better enforcement of mercury policies in the coal sector. Dealing with energy-related carbon emissions, and mercury emissions resulting from coal combustion requires close and effective coordination between MEE and NDRC, in charge of the energy portfolio.

Regarding the institutional set-up, the strengthening of MEE and establishing the 17-ministry coordination group indicate increased potential for effective implementation of the MC in China. We lack the data necessary for ascertaining whether this coordination has effectively reduced the 'silo-mentality' approach to pollution, and key tasks in MC implementation are still spread of various ministries. Moreover, MEE changes have not yet been fully implemented at the local levels, in turn adding to the challenges.

The overall objectives agreed upon in the MC would seem to correspond broadly with China's own norms, domestic knowledge-production, and interests in dealing with the mercury issue. However, we find greater variation in how mercury policy goals and measures are followed up at the local level. The Shanghai example could indicate that the central authorities rely on resourceful municipalities to provide

"green results," while being more lenient with the poorer regions. As some of the more polluting industries remain in poor regions, this could mean reduced potential for goal achievement and implementation.

Concluding Remarks

We lack conclusive evidence as to whether China's air pollution and mercury policies add up to "deliberate" implementation of the Minamata Convention. However, the mercury emission reductions that can be traced back to co-benefits from energy policies, from side-effects of air-pollution abatement measures, and from phasing out "backward" industries through modernization policies, are all strong indications that China is taking significant steps, directly and indirectly, to meet the Convention's obligations. That indirect implementation is triggering the largest reductions is not uncommon; elsewhere, as in the EU, there are cases where "conventional pollutant regulations have resulted in steady reductions of mercury emissions from coal combustion" (Ancora et al. 2016, 486). When designing and negotiating the MC, the delegates were evidently aware of this potential, since co-benefit mitigation and alternative means were made acceptable tools for achieving compliance. In the case of indirect implementation, however, our explanatory factors are less informative as to how deliberate, direct implementation is helped or hampered.

Still, we have noted (section 3) several sets of legislation and significant changes in institutional design, all aimed at reducing mercury emissions. Mercury is targeted specifically in China's 12th and 13th FYPs, in its Air Pollution Action Plans,

and (obviously) in the ratification Announcement. Although other air-pollution measures may also have had an indirect effect in reducing mercury, the legislation indicates will and may still contribute to a positive pull toward-s achieving MC implementation.

Our explanatory factors indicate a reasonable level of *willingness* to implement the MC in China. The larger policy picture—with evolving *norms* on *ecological civilization*, environmental and energy policies and regulations, institutional set-up and strengthening of environmental authorities—pulls in a positive direction regarding indirect implementation but says little about deliberate implementation of mercury policies. Also, the *cognitive* factors have a strong potential to strengthen implementation: The increase in domestic scientific research has strengthened the knowledge base in China and may have enhanced the legitimacy of its MC obligations. Third, China's own *interests* are reflected in the MC; industry generally accepted the international objectives. However, that might also be due to lack of stringent coal measures in the Convention, and to targets that proved easier to achieve than anticipated. Finally, the *institutional* strengthening of MEE and the mercury coordination group might offer a useful platform for policy alignment, though it is still too early to draw conclusions.

Regarding the *ability* to go from implementation output to outcome, however, much depends on local authorities and stakeholders. There is less certainty as to the capacities of local agencies in charge of policy implementation. Moreover, with the economic impact of COVID-19 recession may lower environmental ambitions.

China has definitely been moving toward stricter regulation of mercury emissions. However, the need to enhance local implementation capacity, the expected increase in the use of coal, and exemptions provided by the Minamata Convention may indicate that although the process is headed in the right direction, much remains to be done.

Notes

Dr. Gørild Heggelund, Research Professor at the Fridtjof Nansen Institute (FNI), has carried out research on China's environmental, energy and climate change policy for three decades, including China's Arctic policies.

Dr Kristin Rosendal is a Research Professor at the Fridtjof Nansen Institute (FNI), where she has also served as Research Director and Deputy Director. She holds a PhD in Political Science from the University of Oslo. She can be reached at krosendal@ fni.no

Steinar Andresen is a research professor at the Fridtjof Nansen Institute. He has also been associated with the University of Oslo, Department of Political Science as well as the Pluricourt Center of Excellence, also University of Oslo. He can be reached at sandresen@fni.no.

Eirik H. Steindal is a biologist, a Senior Research Scientist at the Norwegian Institute for Water Research (NIVA) and a PhD candidate at the Department of International Environment and Development Studies, Norwegian University of Life Sciences (NMBU). He can be reached at Eirik.Steindal@niva.no.

Dr. Yan Lin is a senior researcher at Norwegian Institute for Water Research (NIVA). Lin has long experiences on bilateral cooperation between Norway and China on global environmental convention related work, such as Minamata Convention on Mercury, Stockholm Convention on POPs and Basel Convention on Hazardous Wastes. He can be reached at Yan.Lin@niva.no.

Shuxiao Wang is a full professor at School of Environment, Tsinghua University. She is also the Director of the State Environmental Protection Key Laboratory of Sources and Control of Air Pollution Complex, China. She can be reached at shxwang@mail.tsinghua.edu.cn.

Haibin Zhang, Professor and Associate Dean of the School of International Studies, Peking University, and member of China National Expert Committee on Climate Change. He can be reached at zhanghb@pku.edu.cn.

The authors are grateful to the Research Council of Norway for the funding for the project through the Miljøforsk programme (project number 268443.). We are grateful to Professor Thorjørn Larssen, Research Director and environmental chemist at the Norwegian Institute for Water Research, who has collaborated extensively with Chinese scientists and policymakers on pollution issues for more than 20 years, including on mercury for the last 10, for sharing valuable knowledge. We would also like to extend our thanks to Erik Solheim, former Executive Director of UNEP and former Norwegian Minister of the Environment, who has provided helpful insights on China's role, globally and in UN environmental policymaking. Many thanks also to the editors of *Asian Perspective* and two anonymous reviewers for helpful comments.

References

Ahlers, Anna L. and Yongdong Shen. 2018. “Breathe Easy? Local Nuances of Authoritarian Environmentalism in China’s Battle against Air Pollution.” *The China Quarterly*, 234, June 2018, pp. 299–319

Ancora, Maria Pia, Lei Zhang, Shuxiao Wang, Jeremy J. Schreifels, and Jiming Hao. 2016. “Meeting Minamata: Cost-effective compliance options for atmospheric mercury control in Chinese coal-fired power plants.” *Energy Policy*, 88(2016) 485–494

Cai, Siyi, Yangjun Wang, Bin Zhao, Shuxiao Wang, Xing Chang and Jiming Hao. 2017. “The impact of the Air Pollution Prevention and Control Action Plan on PM2.5 concentrations in Jing-Jin-Ji region during 2012–2020.” *Science of the Total Environment* 580, 197–209

Cheng, Hefa and Yuanan Hu. 2012. “Understanding the Paradox of Mercury Pollution in China: High Concentrations in Environmental Matrix yet Low Levels in Fish on the Market.” *Environmental Science and Technology.* https://pubs.acs.org/doi/pdfplus/10.1021/es3013744

CCICED 2011. Special Policy Study on Mercury Management in China, CCICED Annual General Meeting http://www.cciced.net/cciceden/POLICY/rr/prr/2011/201205/P020160810466199200238.pdf

Chen, Wang. 2020. “How is China doing with the Minamata Convention on mercury?” *Chinadialogue*. June 11, 2020.

https://chinadialogue.net/en/pollution/how-is-china-doing-with-the-minamata-convention-on-mercury/ Accessed July 5, 2020

Deng, Yuwen 2012. "18th CPC Congress Amendments reflect CPC's resolve," November 15. http://www.chinadaily.com.cn/china/2013npc/2012-11/15/content_16261593.htm. Accessed February 15, 2018.

Eaton, Sarah and Genia Kostka. 2014. "Authoritarian Environmentalism Undermined? Local Leaders' Time Horizons and Environmental Policy Implementation in China." *The China Quarterly*, 218, pp 359–380 doi:10.1017/S0305741014000356

NPC 2014. Environmental Protection Law of the People's Republic of China, April 24, 2014 Environmental Protection Law of the People's Republic of China (2014 Revision) (osaka-u.ac.jp)

Feng, Emily. 2018. "Beijing axes coal and steel production curbs as economy slows." *Financial Times*, October 1, 2018. Accessed October 2, 2018 https://www.ft.com/content/3bf1dde2-c2ec-11e8-95b1-d36dfef1b89a

Gilley, Bruce. 2012. "Authoritarian environmentalism and China's response to climate change," *Environmental Politics*, 21:2, 287–307, DOI: 10.1080/09644016.2012.651904

Haas, Peter M. (1993) "Epistemic Communities and the Dynamics of International Environmental Cooperation", in V. Rittberger (ed) Regime Theory and International Relations (Oxford: Clarendon Press).

Heggelund, Gørild and Rebecca Nadin. 2017. "Climate Change Policy and

Governance," in Eva Sternfeld (ed) *Routledge Handbook of Environmental Policy in China.* New York: Routledge, pp. 97–112.

Karplus, Valerie, Shuang Zhang, and Douglas Almondc. 2018. "Quantifying coal power plant responses to tighter SO2 emissions standards in China," http://www.pnas.org/content/early/2018/06/12/1800605115 Accessed June 25, 2018

Khanna, Nina, David Fridley, and Lixuan Hong. 2014. "China's pilot low-carbon city initiative: A comparative assessment of national goals and local plans." *Sustainable Cities and Society*, 12:110–121.

Kostka, Genia 2014. *Barriers to the Implementation of Environmental Policies at the Local Level in China (August 1, 2014).* World Bank Policy Research Working Paper No. 7016. Available at SSRN: https://ssrn.com/abstract=2487614

Kostka, Genia and Chunman Zhang. 2018. "Tightening the grip: environmental governance under Xi Jinping." *Environmental Politics*, 27:5, 769-781, DOI:10.1080/09644016.2018.1491116

Kuhn, Berthold. 2016. "Collaborative Governance for Sustainable Development in China." *Open Journal of Political Science* 6(04): 433–453. DOI:10.4236/ojps.2016.64037.

Lampton, David M. 1992. A Plum for a Peach: Bargaining, Interest, and Bureaucratic Politics in China, in Lieberthal Kenneth G. and Lampton, David M. 1992. *Bureaucracy, Politics, and Decision Making in Post-Mao China*, Berkeley: University of California Press

Levy, Marc A., Oran R. Young & Michael Zürn (1995) "The study of international regimes", European Journal of International Relations, vol. 1, no. 3, pp. 267-330.

Li, Cheng. 2017. *The Power of Ideas. The Rising Influence of Thinkers and Think Tanks in China*. London: World Scientific Publishing.

Lieberthal, Kenneth and Michel Oksenberg, 1990. *Policy Making in China: Leaders, Structures, and Processes*. Princeton, NJ: Princeton University Press

Lin, Yan, Shuxiao Wang, Eirik Hovland Steindal, Hua Zhang, Huan Zhong, Yindong Tong, Zuguang Wang, Hans Fredrik Veiteberg Braaten, Qingru Wu, and Thorjørn Larssen. 2017. "Minamata Convention on Mercury: Chinese progress and perspectives." *National Science Review*, 4 (5) 2017, pp. 677–679, https://doi.org/10.1093/nsr/nwx031

Lin, Yan, Shuxiao Wang, Qingru Wu, and Thorjørn Larssen. 2016. "Material Flow for the Intentional Use of Mercury in China." *Environmental Science and Technology* 50 (5), 2337−2344. DOI: 10.1021/acs.est.5b04998

Liu, Kaiyun, Qingru Wu, Long Wang, Shuxiao Wang**,** Tonghao Liu, Dian Ding, Yi Tang, Guoliang Li, Hezhong Tian, Lei Duan, Xun Wang, Xuewu Fu, Xinbin Feng and Jiming Hao 2019. "Measure-Specific Effectiveness of Air Pollution Control on China's Atmospheric Mercury Concentration and Deposition during 2013−2017," *Environmental Science and Technology* 53 (15), 8938–8946

Ma, Tianjie and Qin Liu. 2018. "China reshapes ministries to better protect

environment”

https://chinadialogue.net/article/show/single/en/10502-China-reshapes-ministries-to-better-protect-environment *China Dialogue,* March 14. Accessed March 22, 2018

Ministry of Environmental Protection (MEP) 2017. “Announcement of the entry into force of the Minamata Convention on Mercury” 关于汞的水俣公约》生效公告 2017 年 第 38, August 15. No. 38

http://www.mep.gov.cn/gkml/hbb/bgg/201708/t20170816_419736.htm

Accessed August 29, 2018

Ministry of Ecology and Environment (MEE) 2018. “Shanghai releases ‘blueprint’ for air management in the next five years ‘Shanghai Clean Air Action Plan (2018–2022),’” 上海发布未来 5 年空气治理“蓝图”《上海市清洁空气行动计划（2018 年-2022 年）July 23, 2018

http://www.mee.gov.cn/xxgk/gzdt/201807/t20180723_447111.shtml Accessed September 10, 2018

Mitchell, Ronald B., William C. Clark, and David W. Cash. 2006. “Information and Influence.” In R.B. Mitchell, W.C. Clark, D.W. Cash, and N.M. Dickson, eds., *Global Environmental Assessments: Information and Influence.* Cambridge, MA: MIT Press.

Moody, Andrew 2020. “The most remarkable achievement of our times,” *China Daily,* August 3,

http://www.chinadaily.com.cn/a/202008/03/WS5f2772d3a31083481725dc57.h

tml

Mulvaney, Kathleen, Noelle E. Selin, Amanda Giang, Marilena Muntean, Chiao-Ting Li, Da Zhang, Hélène Angot, Colin P. Thackray, and Valerie Karplus 2020. "Mercury Benefits of Climate Policy in China: Addressing the Paris Agreement and the 'Minamata Convention Simultaneously," *Environmental Science and Technology* 54 (3), 1326–1335, https://doi.org/10.1021/acs.est.9b06741

Myllyvirta, Lauri and Emma Howard 2018. "'Globally significant': China's emissions keep on rising," *Unearthed*, September 21. https://unearthed.greenpeace.org/2018/09/21/china-emissions-rise-2018/ Accessed September 24, 2018

National Bureau of Statistics (NBS 2020). "Statistical Communiqué of the People's Republic of China on the 2019 National Economic and Social Development," February 28 (中华人民共和国 2019 年国民经济和社会发展统计公报) http://www.stats.gov.cn/tjsj/zxfb/202002/t20200228_1728913.html

People's Daily, 2014. "US State Secretary pays a visit to China and Xi Jinping asks Kerry to convey his best regards to Obama" (美国国务卿访华 习近平请克里转达对奥巴马问候), February 15, http://sc.people.com.cn/n/2014/0215/c345167-20572417-2.html

Qi, Ye and Lingyun Zhang. 2014. "Environmental Enforcement constrained by Central–Local Relations in China," *Environmental Policy and Governance* 24, 204–215. Published online March 14, 2014 in Wiley Online Library

(wileyonlinelibrary.com) DOI: 10.1002/eet.1640

Rosendal, Kristin, Steinar Andresen, Gørild Heggelund and Eirik Hovland Stensdal. 2020. “The Minamata Convention and Mercury Policy in China: The Role of Science.” *Asian Perspective*, 44(3), 435–460.

Schreurs, Miranda. 2017. “Multi-level climate governance in China.” *Environmental Policy and Governance*, 163–174 (2017) Published online (wileyonlinelibrary.com) DOI: 10.1002/eet.1751

Selin, Noelle & Valerie Karplus. 2015. “Quantifying Mercury Contamination of Rice and its Impact on Food Security in China.” J-WAFS research paper, https://jwafs.mit.edu/research/projects/2015/quantifying-mercury-contamination-rice-and-its-impact-food-security-china

Selin, Henrik. 2014. “Global Environmental Law and Treaty-Making on Hazardous Substances: The Minamata Convention and Mercury Abatement,” *Global Environmental Politics* 14 (1): 1–19 doi:10.1162/GLEP_a_00208

State Council. 2016a. “13th Five-Year Plan for Ecological and Environmental Protection 2016” 国发〔2016〕65 号十三五”生态环境保护规划年 11 月 24 日 November 24. http://www.gov.cn/zhengce/content/2016-12/05/content_5143290.htm Accessed December 7. 2017

State Council. 2018. “State Council Notice on the three-year action plan to win the blue skies defense war” 国务院关于印发打赢蓝天保卫战三年行动计划的通知 国发〔2018〕22 号, 27 June.

http://www.legaldaily.com.cn/index_article/content/2018-07/03/content_7585363.htm Accessed July 5, 2018

Steindal, Eirik, Steinar Andresen, Gørild M. Heggelund, and G. Kristin Rosendal (forthcoming) "The use of exemptions under the Minamata Convention – Good intentions, with unforeseen consequences?"

Stokes, Leah C., Amanda Giang, and Noelle E. Selin 2016. "Splitting the South: China and India's Divergence in International Environmental Negotiations." *Global Environmental Politics* 16:4, doi:10.1162/GLEP_a_00378

UNEP. 2013. *Global Mercury Assessment 2013: Sources, Emissions, Releases and Environmental Transport.* Geneva: UNEP Chemicals Branch. http://mercuryconvention.org/Convention/tabid/3426/language/en-US/Default.aspx

Accessed March 21, 2018

UNEP. 2017. *Minamata Convention (MC) on Mercury. Text and Annexes*, Text (mercuryconvention.org) Accessed January 12, 2018

UNEP. 2018. Global Mercury Assessment 2018. Global Mercury Assessment 2018: Key Findings. United Nations Environment Programme. https://wedocs.unep.org/bitstream/handle/20.500.11822/29830/GMAKF_EN.pdf.

Van Rooij, Benjamin, Qiaoqiao Zhu, Na Li, Qiliang Wang, and Xuehua Zhang 2017. "Pollution law enforcement in China: understanding national and regional variation," in Eva Sternfeld (ed.) *Routledge Handbook of Environmental*

Policy in China. New York: Routledge, pp. 193–207.

Wang, Alex L. 2018. "Explaining Environmental Information Disclosure in China." 44: 865 *Ecology Law Quarterly* (2018). Explaining Environmental Information Disclosure in China (ecologylawquarterly.org)

Wang, Shuxiao, Lei Zhang, Long Wang, Qingru Wu, Fengyang Wang, and Jiming Hao. 2014."A review of atmospheric mercury emissions, pollution and control in China." *Frontiers of Environmental Science & Engineering* 8: 631, https://doi.org/10.1007/s11783-014-0673-x

Wen, Minneng, Qingru Wu, Guoliang Li, Shuxiao Wang, Zhijian Li, Yi Tang, Li Wenxu, Tonghao Liu 2020. "Impact of ultra-low emission technology retrofit on the mercury emissions and cross-media transfer in coal-fired power plants." *Journal of Hazardous Materials*, 396, 122729

Wu, Qingru, Li Guoliang, Wang Shuxiao, Kaiyun Liu, and Jiming Hao. 2018a. "Mitigation Options of Atmospheric Hg Emissions in China." *Environmental Science & Technology*, 10.1021/acs.est.8b03702

Wu, Qingru, Li Guoliang, Wang Shuxiao, Kaiyun Liu, and Jiming Hao. 2018b. "Emission-Limit-Oriented Strategy to Control Atmospheric Mercury Emissions in Coal-Fired Power Plants towards the Implementation of the Minamata Convention," *Environmental Science & Technology* 2, pp. 11087−11093

Wübbeke, Jost 2013. "China's Climate Change Expert Community: Principles, Mechanisms and Influence." *Journal of Contemporary China* 22 (82): 37−41.

Xinhua 2017. “Full text of Xi Jinping's report at 19th CPC National Congress October 18–November 4, 2017: Secure a Decisive Victory in Building a Moderately Prosperous Society in All Respects and Strive for the Great Success of Socialism with Chinese Characteristics for a New Era,” Address delivered at the 19th National Congress of the Communist Party of China October 18, 2017 http://www.chinadaily.com.cn/china/19thcpcnationalcongress/2017-11/04/content_34115212.htm Accessed February 15, 2018

Zhang, Hua., Xinbin Feng, Thorjørn Larssen, Guangle Qiu, and Rolf. D. Vogt. 2010. “In Inland China, Rice, rather than Fish, is the Major Pathway for Methylmercury Exposure.” *Environmental Health Perspectives* 118 (9), pp. 1183−1188. https://doi.org/10.1289/ehp.1001915

Zhang, Lei, Shuxiao Wang, Mulin Hui, Bin Zhao and Siyi Cai. 2016. “Potential of Co-benefit Mercury Control for Coal-Fired Power Plants and Industrial Boilers in China,” prepared for NRDC https://www.nrdc.org/sites/default/files/co-benefit-mercury-control-report.pdf Accessed March 21,2018

Zhang, Lei, Shuxiao Wang, Long Wang, Ye Wu, Lei Duan, Qingru Wu, Fengyang Wang, Mei Yang, Hai Yang, Jiming Hao, and Xiang Liu. 2015. “Updated Emission Inventories for Speciated Atmospheric Mercury from Anthropogenic Sources in China, 2015.” *Environmental Science & Technology* 49 (5), 3185–3194, DOI: 10.1021/es504840m

Zhang, Qiang Zhang, Yixuan Zheng, Dan Tong, Min Shao, Shuxiao Wang, Yuanhang Zhang, Xiangde Xu, Jinnan Wang, Hong He, Wenqing Liu, Yihui Ding, Yu Lei, Junhua Li, Zifa Wang, Xiaoye Zhang, Yuesi Wang, Jing Cheng, Yang Liu, Qinren Shi, Liu Yan, Guannan Geng, Chaopeng Hong, Meng Li, Fei Liu, Bo Zheng, Junji Cao, Aijun Ding, Jian Gao, Qingyan Fu, Juntao Huo, Baoxian Liu, Zirui Liu, Fumo Yang, Kebin He, and Jiming Hao (2019) "Drivers of improved PM2.5 air quality in China during 2013–2017." *Proceedings of the National Academy of Sciences of the United States of America,* 116 (49) 24463–24469

Zhang, Yue, Xuejie Ye, Tianjun Yang, Jinglin Li, Long Chen, Wei Zhang, and Xuejun Wang. 2018. "Evaluation of costs associated with atmospheric mercury emission reductions from coal combustion in China in 2010 and projections for 2020." *Science of the Total Environment* 610–611, pp 796–801.