RETHINKING SECURITIZATION: WATER SCARCITY AND ENERGY SECURITY IN CHINA

by

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Abstract

This thesis explores the seriousness of the impact of water resource scarcity on China's energy It starts from the premise that water resources are necessary for coal-fired energy security. production, which is itself crucial for maintaining China's required power generation, and shows how increasing coal-energy demands and diminishing water resources have combined to threaten China's energy security. To assess the seriousness of the threat it employs the securitization analysis frameworks proposed by the Copenhagen School and Mely Caballero-Anthony and Ralf Emmers, arguing that water resources were securitized in relation to energy in China's 'Three Red Lines' Number One Document in 2011. Subsequently it analyses whether and to what degree securitization resulted in policy action and policy success with respect to two important topic areas: (i) geographical distribution of water resources vis-a-vis coal-fired energy production; and, (ii) efficiency of water resource use. It argues that consideration of such factors makes for a better understanding of the empirical situation and finds that securitization resulted in significant and degrees of policy action in both topic areas, and moderate and insignificant degrees of policy success in geographical distribution of water resources vis-a-vis coal-fired energy production and efficiency of water resource use respectively. In light of this, it argues that China is very concerned about the impact of water resource scarcity on its energy security. Moreover, in order to explain the discrepancies between securitization and degrees of policy success, it introduces new additions to the aforementioned securitization frameworks - potential constraints, structural feasibility issues, timeframes, and uncertainty - which the paper argues helps explain such discrepancies as well as improve understanding of the empirical landscape. As a result of this, it argues that these additions to the theoretical frameworks should be used in future studies of securitization.

Preface

This thesis is original, unpublished, independent work by the author, Peter O'Boyle.

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Dedication

To my parents, for all their love and support.

1. Introduction

It has become increasingly clear in recent years that China is facing a water shortage problem. One important area affected by this is China's energy supply, which uses water at many stages of the production chain. This is particularly true for energy from coal, which produces a huge amount of China's energy and requires much water. To have enough energy to be 'energy secure' is important for China for obvious reasons, and thus the availability of water becomes an important issue as long as coal continues to produce most of China's energy.

The seriousness of the issue has not, however, been systematically explored in the academic literature. This thesis looks to have both an empirical and also theoretical purchase on this important issue.

Regarding the former, it asks whether water resources have become 'securitized' in relation to energy by the Chinese state. Securitization analysis is chosen because it is the most systematic theoretical framework available for assessing whether an issue has become a matter of critical importance to a relevant actor. Due to developments in the formal academic 'securitization framework' in recent years, the paper goes onto assess whether securitization, if it has occurred, has resulted in policy action and implementation. An understanding of water resource securitization in relation to energy security in China, and consequent policy action and success constitute the core empirical gains of the study. Ultimately the paper argues that China has securitized water resources in relation to energy security, and that this has resulted and is reflected in a significant degree of policy action and a moderate ranging to insignificant-yet-promising degree of policy success respectively.

With regard to the latter, the paper explores the differences in degree of securitization in the water resource issue landscape portrayed by the Copenhagen School Framework and Caballero-Anthony and Emmers's revised framework (which includes policy action and policy success). It also proposes new additions to securitization analysis frameworks. Acknowledging such differences, it makes two arguments. First, Caballero-Anthony and Emmers's theoretical framework provides scholars of securitization with a more accurate understanding of empirical situation and dynamics of securitization than the Copenhagen School framework, highlighting both areas where securitization has had the effect one might expect on policy action and success, and, conversely, discrepancies between securitization discourse and these two areas. Second, it argues that such discrepancies can be explained in part incorporating the proposed additions to the framework detailed above into securitization analysis. Inasmuch as this increases theoretical sophistication and improves understanding of specific cases, it argues that such additions should be used in future securitization analyses.

Chapters 2-4 discuss the issues of energy security and water resources scarcity in China and introduce the framework for analysis. Chapters 5-8 analyze, evaluate, and conclude.

2. National Security, Economic Security and Energy Security in the Contemporary Context

Buzan, Waever and de Wilde have argued that the field of security studies has undergone much development in the last two decades, reflecting a rapidly changing international context. Whilst scholars such as Stephen Walt once argued that security studies was about war and peace defined as 'the study of the threat, use, and control of military force', Buzan, Waever and de Wilde acknowledge that there has been a 'widening' of the field to include economic and environmental agendas, and thereby

argue against the view that the core of security studies is war and force and that other issues are relevant only if they relate to war and force...instead we want to construct a more radical view of security studies by exploring threats to referent objects, and the securitization of those threats, that are non-military as well as military....¹

To this end, Buzan, Weaver and de Wilde adopt a 'more diversified agenda' by examining sectors, which identify 'specific types of interaction'.² Sectors can be military, political, economic and environmental (amongst others), such that:

military security concerns the two-level interplay of the armed offensive and defensive capabilities of states, and states perceptions of each other's intentions. Political security concerns the organizational abilities of states, systems of government and the ideologies that give them legitimacy. Economic security concerns access to the resources, finance and markets necessary to sustain acceptable levels of state power...Environmental security concerns the maintenance of local and the planetary biosphere as the essential support system on which all other human enterprises depend.³

This emphasis on sectors is important for security studies in the twenty-first century

context, where the threat of 'traditional' interstate war is less viable than it once was. In light of

this, the economic sector has taken on greater importance. Buzan's definition's emphasis on

¹ B.Buzan, O.Waever and J.de Wilde, *Security: A New Framework for Analysis*, (Lynne Rienner Publishers, Colorado), (1998), pp.2-4; S.M.Walt, 'The Renaissance of Security Studies', *International Studies Quarterly*, 35:2, (1991), pp.212-3, quoted in B.Buzan, O.Waever and J.de Wilde, *Security: A New Framework for Analysis*, pp.3-4.

² B.Buzan et. al, Security: A New Framework for Analysis, p.7.

³ B.Buzan, *People, States and Fear: An Agenda for International Security Studies in the Post-Cold War Era*, 2e, (Lynne Rienner, Boulder), (1991), pp.19-20, quoted in B.Buzan et al., *Security: A New Framework for Analysis*, p.8.

economic security being necessary to sustain 'acceptable levels of *state power*' is important as it enables one to link 'non-traditional sectors' to the capabilities and thus influence of a state in the international system.⁴

The importance of economic power for the future of state power relations has long been noted. In 1945 Albert Hirschman wrote that "the power to interrupt commercial or financial relations with any country...is the root cause of the influence or power position which a country acquires in other countries".⁵ Richard Nixon's statement on the future of states and power in 1971 is also instructive : "These are the five [western Europe, Japan, and China as well as the USSR and the United States] that will determine the economic future and, *because economic power will be the key to other kinds of power*, the future of the world in other ways in the last third of this century".⁶

In academic scholarship this is laid out most clearly via the theoretical lens of economic nationalism or mercantilism, as articulated by Jacob Viner:

I believe that practically all mercantilists, whatever the period, country, or status of the particular individual, would have subscribed to all of the following propositions: (1) wealth is an absolutely essential means to power, whether for security or for aggression; (2) power is essential or valuable as a means to the acquisition or retention of wealth; (3) wealth and power are each proper ultimate ends of national policy; (4) there is a long-run harmony between these ends, although in particular circumstances it may be necessary for a time to make economic sacrifices in the interest of military security and therefore also of long-run prosperity.⁷

⁶ P.Kennedy, *The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500-2000* (Unwin Hyman Limited, London), (1988), p.413, emphasis in the original.

⁷ J.Viner, *The Long View and the Short: Studies in Economic Theory and Policy*, (Free Press, New York), (1958), p. 286, quoted in R.Gilpin, *The Political Economy of International Relations*, p.32.

⁴ *Ibid.*, pp.19-20.

⁵ A.O.Hirschman, *National Power and the Structure of Foreign Trade* (University of California Press, Berkeley), (1945), p.16, quoted in R.Gilpin, *The Political Economy of International Relations*, (Princeton University Press, New Jersey), (1987), p.23.

Clearly the unit of analysis in the mercantilist ideology is the state, which is seen 'as both embodying the social and political purposes for which wealth is generated and providing the security necessary for the operation of firms and markets' such that 'economic security is simply part of a wider priority given to state or "national" security'.⁸ The emphasis on the state in the mercantilist position is echoed in the Copenhagen School's discussion of economic security as it relates to their securitization framework. According to Buzan et al, states remain 'the principal reference objects of economic security'⁹, having 'the qualities necessary for securitization', most importantly because they can be "existentially threatened".¹⁰ Moreover, 'to the extent that clear existential threats arise from economic issues, they do so because of their impact in other sectors rather than their impact within the economics sector itself', including (but not limited to) states' ability to 'maintain independent capability for military production in a global market' or 'more broadly, the relationship of the economy to the capability for state military modernization', and for the possibility that 'economic dependencies within the global market...will be exploited for political ends'.11

Necessarily it is important to determine what these 'economic issues' (that impact 'other sectors') are. It has been argued that the 'foremost objective of [economic] nationalists is *industrialization*'.¹² Robert Gilpin states that:

⁸ B.Buzan et al., Security: A New Framework for Analysis, p.95.

⁹ Ibid., p.103.

¹⁰ Ibid., pp.101 and 104.

¹¹ *Ibid.*, pp.98 and 105.

¹² G.Sen, *The Military Origins of Industrialization and International Trade Rivalry*, (St Martin's Press, New York), (1984), emphasis added.

nationalists believe that industry has spillover effects (externalities) throughout the economy and leads to its overall development. Second, they associate the possession of industry with economic self-sufficiency and political autonomy. Third, and most important, industry is prized because it is the basis of military power and central to national security in the modern world.¹³

As state power is closely connected to economic security, which itself is dependent in large part on industry, a reliable and secure supply of energy needed for industrial processes - *energy security* - becomes very important. Indeed, in the case of China, 'President Hu Jintao and Premier Wen Jiabao [when coming to office in 2002] decided that securing reliable supplies of petroleum and other scarce resources was not only crucial to sustained economic development, but also integral to China's national security'.¹⁴

Christian Winzer has provided a useful and up-to-date discussion of the concept of 'energy security'. Acknowledging that competing definitions all include the idea of 'avoiding sudden changes in the availability of energy relative to demand', he argues that one can distinguish three groups of definitions. The first defines security as the continuity of energy commodity supplies.¹⁵ A definition which sums up the view of this group is provided by the UK *Department of Energy and Climate Change* which argues that: "Secure energy means that the risks of interruption to energy supply, are low"¹⁶ The second group introduces price into the equation, such that 'apart from supply interruptions security is only impaired if the scarcity of

¹³ R.Gilpin, The Political Economy of International Relations, p.33.

¹⁴ S.Zhao, 'China's Global Search for Energy Security: cooperation and competition in the Asia-Pacific', *The Asia-Pacific Journal: Japan Focus*, 6, 12, (2008), <<u>http://japanfocus.org/-Suisheng-Zhao/2978</u>> [accessed 6th March 2015].

¹⁵ C.Winzer, 'Conceptualizing Energy Security', *Electricity Policy Research Group Working Paper 1123, Cambridge Working Paper in Economics 1151*, (August, 2011), p.4.

¹⁶ Department of Energy & Climate Change (DECC), Energy Markets Outlook, (2009), <http://www.officialdocuments.gov.uk/document/hc0910/hc01/0176/0176.pdf>, quoted in C.Winzer, 'Conceptualizing Energy Security', p.4.

energy leads to prices above a certain threshold'.¹⁷ According to the International Energy Agency (IEA): "Energy security is defined in terms of the physical availability of supplies to satisfy demand at a given price".¹⁸ The third group widens the scope of the impact of energy security: 'instead of measuring the continuity of prices and quantities on the commodity market, they extend the impact measure to the price and continuity of services, the impacts on the economy and in some cases the environment'.¹⁹ A useful definition here is provided by Grubb, Butler and Twomey who state that "security of supply...can be defined as a system's ability to provide a flow of energy to meet demand in an economy in a manner and price that does not disrupt the course of an economy"'.²⁰ Finally, Winzer also consider the notion that 'security is concerned with risks', meaning it is 'the condition of being protected from or not exposed to danger'. In this sense, energy security can be described as "the absence of, protection from or adaptability to threats that are caused by or have an impact on the energy supply chain'.²¹

A combination of this definition and the overall impact on the economy as in the third group above seems an appropriate way to go about defining energy security in light of this paper's subject matter. To define energy security just in terms of supply seems too thin on the ground - especially in light of the emphasis placed above by IPE scholars on energy security and wider notions of economic security - whereas the third category includes the price category of

²¹ Ibid., p.9.

¹⁷ C.Winzer, 'Conceptualizing Energy Security', p.4.

¹⁸ International Energy Agency (IEA), Towards a Sustainable Energy Future, (2001), <<u>http://www.iea.org/textbase/nppdf/free/2000/future2001.pdf.</u>>, quoted in C.Winzer, 'Conceptualizing Energy Security', p.4.

¹⁹ C.Winzer, 'Conceptualizing Energy Security', p.5.

²⁰ *Ibid.*, p.6.

the second group and focuses on the bigger picture - the 'course of an economy'. Coupling this with Winzer's extra focus on security allows a better incorporation of the 'threat'/'risk element', and thus on factors, such as water, affecting energy security. Bringing the definitions together, the paper uses the following definition of energy security: 'the absence of, protection from or adaptability to threats that are caused by or have an impact on the system's ability to provide a flow of energy to meet demand in an economy in a manner and price that does not disrupt the course of an economy'.

It follows that anything that threatens this condition can be perceived to be a threat to a state's energy security. Moreover, it implies a clear link between energy security and economic security - the threat must be one to an energy resource whose absence could 'disrupt the course of an economy'. Working through the logic, this would seem to imply that threats to energy security can quickly become threats to economic and national security. Whilst this may be true in some cases, it is not necessarily so because some threats to energy security can be anticipated in advance and thus may not be recognized immediately as threat to energy or economic or national security. The issue of time is therefore important. It may be that because an issue poses a quite real existential threat in the medium-to-long term that it can be considered of upmost importance and potentially 'securitized' (as in the case discussed in this paper) long before it constitutes an emergency. Moreover, it may be that factors affecting an issue are likely to change a lot over time, and thus the issue may become 'de-securitized' before it becomes immediately existential. This implies a degree of caution when linking energy threats specifically to wider economic or national security. It may be in the interests of securitizing actors to frame issues as such for threats which are in all probability existential in the medium-to-long term, but the extended

timeframe could mean that an issue is not immediately existentially threatening, and this could be reflected in a state's policy-making and implementation, even after successful 'securitization'.

In light of this, this paper does not try to explicitly link an issue - water resources - to a state's national security. Rather it asks whether water resources have been securitized as a result of China's energy security concerns, recognizing that the energy security issue is connected to wider notions of economic and national security which may be drawn on in order to 'securitize' the issue. If securitization has occurred, it asks to what extent it is reflected in (and by implication driven forward) related policy-making and implementation, and also considers the issue of timeframes presented above. Before discussing the framework within which to carry out this analysis, it discusses the links between water resources and energy security in China.

3. Energy Security and Water Resources in Contemporary China

Water is an important resource for many reasons. At its most basic, 'clean water is a human right...[,]closely tied to human security' and necessary for the welfare and health of a human population. More broadly, it is integral to the functioning of ecological systems, and for agriculture and thus food security.²² Scarcity in each of these respective areas can result in major political problems at the state level, such as: water refugee crises; rivers running dry (such as China's Yellow River at times of the year); desertification (twenty-seven percent of China's total area has been turned to desert as a result of human activity); and the movement of farmland development into arid areas with negative effects on production.²³

Whilst each of these are important issues, one can argue that it should be industrial water use, particular for energy, that is the most important in shaping government water-related policy. As argued above, energy is the most important sector to be affected by water resource scarcity, because of its necessity to the overall 'course of an economy' and links to economic and national security. The other big candidate is agriculture, but whilst it accounted for roughly thirty-seven percent more of China's water consumption than industry in 2011²⁴, it is less crucial to the overall 'course of the economy' because it is set to 'lose out' to the industrial sector regarding water use going forward; indeed, according to the Arlington Institute, 'industrial output is increasingly much more profitable than agriculture...a thousand tons of water can produce one

²² M.Merviö, 'Water Security in Northeast Asia: Coping with Global Water Issues', in I-T.Hyun and M.A.Schreurs (eds.), *The Environmental Dimension of Asian Security: Conflict and Cooperation over Energy, Resources, and Pollution*, (United States Institute of Peace, Washington DC), (2007), pp.144-6.

²³ *Ibid.*, pp.146 and 149.

²⁴ E.Economy, 'China's Growing Water Crisis', *World Politics Review*, (2011), <<u>http://</u> www.worldpoliticsreview.com/articles/9684/chinas-growing-water-crisis> [accessed 4th Feb. 2016].

ton of wheat worth \$200, whereas the same amount of water used in industry yields an estimated \$14,000 of output'.²⁵ The impact on industry (and thus energy) is thus the most important issue area when considering water resource shortage.²⁶

Despite this, the seriousness and overall effects of limited water resources on China's energy security has not received systematic attention in the academic literature, even though there is much recognition of the serious of the topic from Chinese officials and academic scholars. Li Junfeng, the Director General of the National Center of Climate Change Strategy Research at the National Development and Reform Commission has argued that whilst 'water security and energy security are both important and closely related...water security is more important'.²⁷ In addition, Elizabeth Economy, a top scholar of Chinese domestic policy and global environmental issues has stated that 'water used for energy is a *singularly important drain* on China's scarce resources.'²⁸ This paper attempts to fill this gap, exploring the seriousness of water resources shortage for China's energy security.

There is a specific mechanism by which water resources threaten China's energy security, and it concerns the link between energy from coal and water resources. The logic is simple: *coal is crucial for China's energy security, and water is needed in energy production from coal.*

²⁵ N.Brooks, 'Impending Water Crisis in China', *Arlington Institute*, <<u>http://www.arlingtoninstitute.org/wbp/global-water-crisis/457</u>> [accessed 29th Feb. 2016].

²⁶ Whilst industry seems logically of primary importance, a more detailed consideration of water resource securitization could be carried out in the future to ascertain in systematic fashion which sector or issue (industry, agriculture, pollution etc.) has had the greatest impact on water securitization. Unfortunately this is beyond the scope of this paper.

²⁷ L.Junfeng, 'Water Over Energy Security': Interview with Li Junfeng', *China Water Risk*, (October 2014), <<u>http://</u>chinawaterrisk.org/interviews/water-over-energy-security/> [accessed 29th Feb. 2016].

²⁸ E.Economy, 'China's Growing Water Crisis', emphasis added.

Moreover, in the present context coal-fired energy production is set to increase, and water resources are becoming ever scarcer. Both points are discussed below.

Regarding the first point, it is clear that energy from coal is necessary for the absence of, protection from, or adaptability to threats that are caused by or have an impact on the system's ability to provide a flow of energy to meet demand in an economy in a manner and price that does not disrupt the course of an economy. The IEA stated in 2009 that 'coal is seen as crucial to China's energy supply security'²⁹ and according to their 2010 World Energy Outlook report, it accounted for sixty-six percent of total primary energy consumption in 2008.³⁰ Some scholars have argued that China's energy structure is over-reliant coal³¹, and it is clear that economic growth and rapid development will drive coal-energy demand for the foreseeable future. This is well documented by data from China Water Risk's 2015 *Towards a Water and Energy Secure China*, which argues that 'coal remains the vanguard as China's vast coal reserves provide the nation with energy security', and that forecast economic growth is set to demand even further power generation, which itself will continue to 'drive coal consumption'.³² Indeed, power generation accounted for just under fifty-one percent of total coal consumption in 2012³³, and whilst weak industrial demand and aggressive energy savings caused a temporary drop in coal

²⁹ International Energy Agency, 'Cleaner Coal in China', International Energy Agency, (Stedi Media, Paris), (2009), p.71.

³⁰ International Energy Agency, 'Cleaner Coal in China', p.71; International Energy Agency, 'World Energy Outlook 2010', International Energy Agency, (Soregraph, Paris), (2010), p.604.

³¹ Institute of Defence and Strategic Studies, 'China and Non-Traditional Security: Global Quest for Resources and its International Implications', *Event Report*, (Institute of Defence and Strategic Studies, S. Rajaratnam School of International Studies), (October, 2014), p.6.

³² D.Tan, F.Hu, H.Thieriot, D.McGregor, 'Towards a Water and Energy Secure China: Tough Choices Ahead in Power Expansion with Limited Water Resources' *China Water Risk*, (April, 2015), pp.95 and 98.

production and consumption from 2013 to 2014 (by 3.87 million tonnes and 3.51 billion tonnes respectively), if the State Council's 'Energy Development Strategic Action Plan' coal consumption target of 4.2 billion tonnes announced in November 2014 is accurate, then that allows for another 690 millions tonnes in coal consumption by 2020.³⁴ This increase alone is more than the total coal production of India (605 million tonnes in 2013), itself the third largest coal producer worldwide.³⁵ This will involve the expansion of China's coal-fired fleet, and will mean that power generation is set to rise by sixty-percent to approximately 1.2TW by 2020.³⁶ Whilst this constitutes a reduction of coal's share in the primary energy consumption mix from 66% in 2014 to 62% by 2020, it still means that more coal will be consumed in absolute terms in China in the coming years.³⁷ Moreover, whilst this has been taken to indicate that coal consumption will peak in 2020, other believe that even this is not beyond re-evaluation. Professor Xie Kechang, the Vice President of the Chinese Academy of Engineering, argued in 2015 that:

It's still too early for China to cut off coal....At the moment it is not realistic for China. The reason that meteorologists are calling for "moving away from coal" is that coal is the main contributor of greenhouse gas. I agree. But we will still use lots of coal in the near future...If we want China to move away from coal, then what will China replace coal with?...This is why President Xi has mentioned many times that coal is and will remain China's primary energy source; therefore he expects us to more focus on its better utilization.³⁸

³⁵ *Ibid.*, p.100.

³⁶ *Ibid.*, p.95.

³⁷ *Ibid.*, p.96. Also, see Y.Yang, 'China carbon dioxide emissions may be falling, says LSE study', *Financial Times*, (March, 2016), <<u>http://www.ft.com/cms/s/0/446b9636-e354-11e5-a09b-1f8b0d268c39.html#axzz45uuYFwNS</u>> [accessed 15th April 2016] for more on dynamics in the coal sector.

³⁸ X.Kechang, 'China: Not ready to move away from Coal: Interview with Xie Kechang', *China Water Risk*, (April 2015), <<u>http://chinawaterrisk.org/interviews/china-not-ready-to-move-away-from-coal/</u>> [accessed 21st Feb. 2016].

³⁴ *Ibid.*, p.95.

In sum, China is both currently very reliant on coal for its energy security and also almost certain to need even more coal for energy production in the future, as per the State Council's 'Energy Development Strategic Action Plan'.

Overall China is set to increase coal consumption and consequentially its water use will increase in order to maintain its power generation requirements for energy security. It is worth noting that the timeframes cited within which coal use increases extends up to 2020 according to the reports, meaning water requirements will gradually increase over that time too. The threat posed by water resources to energy security is thus a medium rather than short-term threat, (especially considering the issue was first securitized in 2011, as will be argued below). In addition, there is still uncertainty over the extent to which those targets will be revised.

Regarding the second point, China's total water resources have 'dropped thirteen percent since the start of the century'- a loss of 350 billion cubic metres.³⁹ Furthermore there is a huge discrepancy in coal reserves and water resources, as illustrated in Figure 1 below. Coal is prevalent in the west and north, whilst water is relatively abundant in the south and limited in the north.⁴⁰ This mismatch in coal and water resource reserves thus poses a significant risk for China's energy security.

³⁹ K.Schneider, 'Chokepoint: China - Confronting Water Scarcity and Energy Demand in the World's Largest Country', *Circle of Blue and Wilson Centre*, (2011), <<u>http://www.circleofblue.org/2011/world/choke-point-</u>chinaconfronting-water-scarcity-and-energy-demand-in-the-worlds-largest-country/> [accessed 24th Feb. 2016].

⁴⁰ *Natural Resources Defense Council*, 'Water Resources Red Lines Ask for Coal Production and Use Control' <<u>http://www.nrdc.cn/coalcap/index.php/English/project_content/id/542</u>> [accessed 24th Feb. 2016].

Figure 1: Water Resources per Province in China



Source: D.Tan, et al., 'Towards a Water and Energy Secure China', p.108.

China's water use in energy production is also affected by how efficiently water is used.

Whilst a small amount of water is used in the coal mining process, water use in coal-fired energy

bases is 'significantly higher'⁴¹, a good account of which is provided in the World Bank's *Thirsty*

Energy Report:

Water is heated and turned into steam. The steam spins a turbine which drives an electric generator. After passing through the turbine steam is cooled down and condensed to start the cycle again (closing the so-called steam cycle). In other words, all the heat put into the plant that is not converted into electricity is "waste heat" and has to be dissipated into the environment. Most of this heat... is rejected to the environment through the cooling system, which usually uses water as the heat transfer mechanism.⁴²

The part of the process that uses the most water is the cooling system, accounting for ninety percent of total water use (with steam generation, ash handling and flue gas desulfurization accounting for the other ten percent). Consequently, the cooling system used has

⁴¹ D.Tan, et al., 'Towards a Water and Energy Secure China', p.117.

⁴² D.J.Rodriguez, A.Delgado, P.DeLaquil, and A.Sohns, 'Thirsty Energy', *Water Papers, World Bank*, (Washington), (2013), p.11.

a large effect on the efficiency - here the cooling requirements per kWh produced - of water resource use.⁴³ Generally there are four types of cooling systems available for thermal power plants which determine the amount of water withdrawn and water consumed: once-through cooling systems; closed-loop or wet-recirculating systems; dry cooling systems, and hybrid cooling systems.⁴⁴ Closed-loop and dry cooling systems are most important for our purposes.

Closed-loop or wet recirculating systems are the most common type of system used in thermal power generation, and have a much higher water consumption rate than once-through cooling systems - approximately eighty-five percent - due to much evaporation.⁴⁵ Dry cooling systems use air rather than water to cool steam exiting the turbine, meaning water consumption can be decreased by over ninety percent. They are, however, both far more expensive than closed-loop systems and also environmentally unfriendly, and are therefore used in 'extreme situations of water scarcity'.⁴⁶ Overall, the report concludes that 'the cooling system employed by the power plant has an impact on power plant efficiency, capital and operation costs, water consumption, water withdrawn, and total environmental impacts'.⁴⁷ Cooling system efficiency plays the largest role in the energy production process on water resource requirements and thus more efficient cooling systems can lead to greater energy security when water resources are limited.

In sum, economic growth and rapid development is driving coal-energy production demand. This is putting an increasing strain on China's water resources, two key issues

⁴⁷ *Ibid.*, p.12.

⁴³ *Ibid.*, p.10.

⁴⁴ *Ibid.*, p.11.

⁴⁵ *Ibid.*, p.11.

⁴⁶ *Ibid.*, p.11.

concerning which are the geographical mismatch between coal reserves and water resources, and the need to install more air-cooling technology in thermal power plants. It follows that how China tackles these two issues is very important in guaranteeing its energy security.

4. The Importance of Securitization and Securitization Analysis Frameworks

Water resource availability affects energy security in China because energy from coal is crucial for China's energy security, and water is key for energy production from coal. The next section undertakes a systematic inquiry into this topic, using the Copenhagen School's securitization framework and its development as proposed by Mely Caballero-Anthony and Ralf Emmers, as well as some new additions proposed to improve securitization analysis frameworks.

Buzan, Weaver and de Wilde stress that 'security is about survival', arguing that something becomes an international security issue when it 'is presented as posing an existential threat to a referent object', such that the 'special nature' of the threat 'justifies the use of extraordinary [or 'emergency'] measures' to deal with it.⁴⁸ They argue that to securitize an issue 'takes politics beyond the established rules of the game and frames the issue as either as a special kind of politics or as above politics'.⁴⁹ Thus,

if one can argue that something overflows the normal political logic of weighing issues against each other this must be the case because it can upset the entire process of weighing as such: "If we do not tackle this problem, everything else will be irrelevant (because we will not be here or will not be free to deal with it in our own way)."⁵⁰

As such "security" is a self-referential practice, because it is in the practice that the issue becomes a security issue - not necessarily because a real existential threat exists but because the issue is presented as such a threat'.⁵¹ They advocate three key criteria for securitization analysis: (i) *referent objects* - 'things that are seen to be existentially threatened and that have a legitimate

⁴⁹ *Ibid.*, p.23.

50 Ibid., p.24.

⁵¹ *Ibid.*, p.24.

⁴⁸ B.Buzan et al., *Security: A New Framework for Analysis*, p.21.

claim to survival⁵²; (2) *securitizing actors*, 'who securitize an issue by articulating the existence of threat(s) to the survival of specific referent objects'⁵³; (3) the completion of the process of securitization, requiring a '*speech act*' by securitizing actors which convinces 'a specific *audience* of the existential nature of the threat'.⁵⁴

Mely Caballero-Anthony and Ralf Emmers argue that the Copenhagen School's securitization framework should be more comprehensive. The key ways to achieve fuller comprehension are by considering two further key question: (1) Why securitize? And (2) What effect did securitizing have on the handling of the issue?

With regards to the first question, they argue that the Copenhagen School fails to account for motivations behind the securitization of an issue. Thus, when asking who the securitizing actors are regarding an issue area it is necessary to explain why a securitizing actor has securitized the issue and whose interests it represents. This has implications for the seriousness of the issue that has been securitized - if the issue has genuinely been securitized for the reasons given, the process is indicative of real concern by the securitizing actor about that issue - for this case it would be the importance of water for maintaining China's energy security. Empirically, this could help better understanding of its behaviour concerning water and energy from coal and its stance on its potential future energy mix. Unfortunately, due to space constraints, this paper does not investigate this premise, but instead chooses to focus more deeply on the second question, with the paper showing how important it is in bettering understanding of securitization.

⁵² *Ibid.*, p.36.

⁵³ M.Caballero-Anthony and R.Emmers, 'The Dynamics of Securitization in Asia', in M.Caballero-Anthony, R.Emmers and A.Acharya (eds.) *Studying Non-Traditional Security in Asia: Trends and Issues* (Marshall Cavendish Academic, Singapore), (2006), p.24.

Regarding the second question, Caballero-Anthony and Emmers criticize the Copenhagen School for not assessing the policy effectiveness of securitization.⁵⁵ They split policy effectiveness into two areas, the 'degree of securitization' and 'the impact on the threat'.⁵⁶

The 'degree of securitization' is largely analogous to *policy action* as a result of securitization, assessing whether and to what degree securitization has taken place by examining policy indicators, such as 'resource allocation trends, military involvement, legislation, and institutionalization' appropriate for tackling the securitized issue.⁵⁷ If (observable) policy action prescriptions tackle an issue in such a way as to stop the issue posing an existential threat to the referent object then securitization has occurred.⁵⁸ In contrast, if policy action did not target the existential threat issue area, one would be more likely to conclude that securitization had not occurred (and thus had no causal effect).

Such policy action measures are discussed in relation to the two key topic areas described above. The first concerns geographical distribution of water relative to coal mining and coal power plants. The appropriate indicator therefore, is whether and to what degree policy action aims to reduce the chances of the geographical distribution of water resources threatening energy security. The second concerns the efficiency of water use in the energy production chain. The appropriate indicator is thus whether and to what degree policies are introduced which prescribe more efficient use of water resources in energy production in order to reduce threats to energy

⁵⁵ Ibid., p.27.

⁵⁶ Ibid., p.29.

⁵⁷ Ibid., p.29.

⁵⁸ Here the new framework moves beyond the speech act being enough to determine securitization's occurrence, suggesting that the latter's presence is also reflected by policy action.

security. The degree to which policy action suggests securitization occurred (or the effect securitization had on the policy action) will be assessed as 'very insignificant', insignificant, moderate, significant, or very significant for purposes of clarity, the criteria for which are detailed in Table 1 below.

The 'impact on the threat' is essentially analogous to 'policy success' and considers the 'impact securitization has had on the handling of the problem or existential threat', including 'rising or declining levels of the existential threat'.⁵⁹ For this paper, assessing policy success will involve determining whether and to what degree the 'policy action' proposed as a result of securitization (if it occurs) is implemented or simply if there is evidence of appropriate measures being implemented to reduce the threat. The degree to which policy success occurred in each topic area will be assessed on the same matrix as policy action, and is also detailed in Table 1 below.⁶⁰

In addition, this paper hopes to contribute theoretically to securitization analysis and extend Caballero-Anthony and Emmers's framework by advocating *consideration of the potential constraints or structural feasibility issues limiting degrees of policy success.* It is argued that this should be added to the revamped securitization framework to allow for more nuanced judgements of degrees of policy success in securitization analysis. For example, if policies are implemented to some degree despite unforeseen, tricky or even unavoidable constraints or structural feasibility issues causing problems to the securitizing actor, one might be

⁵⁹ *Ibid.*, p.29.

⁶⁰ As described in Table 1, the degree to which policy action and policy success is deemed to have occurred (if at all) considers the magnitude of threat reduction, but also makes reference to other issues. This is no accident and is designed to reflect the fact that Buzan et al. emphasis that securitization results in 'something overflow[ing] the normal political logic of weighing issues against each other' - see p.25.

	Policy Action	Policy Success
Very Significant	Prescribes policies that aim at full de-securitization of the issue area in a short time period, such that they take priority over other serious competing issues.	Implements measures that result in full de- securitization of the issue area in a short time period, such that implementation takes priority over other serious competing issues.
Significant	Prescribes policies that aim to considerably reduce the threat, but are balanced against trade-offs with other serious competing issues.	Implements policies that result in considerable reduction of the threat, but leaves room for compromise with other serious competing issues.
Moderate	Prescribes policies that aim to reduce the threat, but not at the expense of other serious competing issues.	Implements policies that result in reduction of the threat, but not at the expense of other serious competing issues.
Insignificant	Some limited policy prescription that aims to reduce the threat, but that is nearly always subordinate to other competing issues.	Some limited policy implementation that results in reduction of the threat, but nearly always subordinate to other competing issues if clashes arise.
Very Insignificant	No policy prescriptions to reduce the threat made.	No implementation of measures to reduce threat made.

Table 1: Typology of Degrees of Policy Action and Policy Success

more justified in conferring a moderate-significant degree of policy success than if there was little implementation under conditions of few constraints and/or high structural feasibility. First, this should allow securitization analysis to be more closely connected to empirical contexts (and thus aid in empirical understanding). Second, it should also help resolve tensions between the Copenhagen School Framework and Caballero-Anthony and Emmers' revisions. Securitization inherently implies that a problem must be dealt with as a matter of perceived extreme importance, so in a case where policy success occurs to less than a moderate degree despite the occurrence of securitization (as found below), one might be forced to question the usefulness of the initial securitization analysis (and in part the usefulness of the Copenhagen School framework). However, an exploration of potential constraints and structural feasibility may resolve this tension, by showing genuineness of securitization discourse and moderateinsignificant policy success to be possible simultaneously.

This paper also goes beyond Caballero-Anthony and Emmers' framework by considering questions of timeframes and uncertainty in securitization analysis. It argues that certain issues can still be considered existential threats, but which threaten security in the medium-to-long term rather than the immediate/short-term. By their very nature such issues (climate change is one example) imply a longer *timeframe* with which to deal with a problem that is still considered as an existential threat. Logically, an extended timeframe may imply that a securitizing actor does not immediately successfully deal with an existential threat (such that it becomes de-securitized) In other words, policy action and policy success may despite securitization occurring. incrementally rather than immediately work to de-securitize a securitized issue. This is compounded by any *uncertainty* pertaining to the issue area itself or the timeframe within which to deal with the threat posed. Uncertainty in the extent to which tackling an issue area is a problem, perhaps due to reasons of the potential constraints and structural feasibility issues described above, or in exactly when the threat will 'hit' (i.e. starts becoming or becomes an emergency) could result in over- or under-estimation of necessary policy action and implementation and consequent delays or stalling. This could also result in uncertainty in trajectories of current policy action or in future policy action. In the case of underestimation securitizing actors may presume (based on reliable projections and statistics available) that if the issue starts becoming immediately existentially threatening quicker than the initial timeframe might have suggested, then appropriate policy action could prescribed and implemented. In such instances, one would expect to see degrees of policy action and (especially) policy success

approach the very significant level and potential constraints and issues related to structural feasibility to be solved with increasing urgency.⁶¹ As such, extended timeframes and uncertainty can also help to explain discrepancies in cases where the degrees of policy action and policy success articulated are inconsistent (i.e. insignificant or very insignificant degrees) with securitization discourse.⁶²

In sum, this thesis argues that Caballero-Anthony and Emmers' notion of 'degree of securitization' (policy action) and 'impact on the threat' (policy success) improve the Copenhagen School's securitization framework and should be used in securitization analysis. But whilst improving understanding of an empirical case, exploration of policy action and policy success could also result in tension with securitization discourse analysis, inasmuch as they *may* suggest an issue is not as serious as its securitization implies, (even if one is confident that securitization has in fact occurred). However in such cases adding to the theoretical framework consideration of potential constraints and structural feasibility issues, as well as timeframes and uncertainty, may help resolve this tension in the framework and thereby improve it. It should also further improve understanding of the empirical case under investigation.

⁶¹ By this logic, under conditions of no potential constraints, high structural feasibility, an immediate or short-term timeframe and no uncertainty, one would expect policy action and policy success to occur to a 'very significant' following securitization. It is also worth noting that whilst it is relatively easy to prescribe policy action measures, policy success can be much harder and is more likely to be hampered by constraints and structural feasibility.

⁶² I must note that Caballero-Anthony and Emmers advocate asking a question about timeframes for both the 'degree of securitization' and the 'impact on the threat': (1) 'what is an appropriate timeframe within which success or failure' of securitization or reducing threat levels can be measured or assessed? Somewhat differently by implication, this paper instead argues that issues can become immediately existentially threatening (or 'hit') in the medium term, meaning that one might be dealing with securitizing actors who have not carried out all necessary policy action and implementation (to de-securitize the issue) and are uncertain about the timeframe in which they must do so. This discussion of timeframe may imply (at the time of analysis) that there is not a recognized appropriate timeframe within which reducing threat levels can be measured, and thus is both different in meaning to, and also partly undermines the premise of, Caballero-Anthony and Emmers's question.

5. The Securitization of Water in Relation to Energy in China

The second half of the paper investigates whether water resources have been securitized in relation to energy security in China, and to what extent this is reflected in policy action and policy success. Potential constraints, timeframes and uncertainty are also explored and analyzed, and the overall empirical and theoretical gains of the thesis are discussed in the conclusion.

One of the oldest state documents concerning water resources in China is the 'Water Law of the People's Republic of China', adopted at the twenty-fourth Meeting of the Standing Committee of the Sixth National People's Congress on January 21st and revised and promulgated by China's President on 29th August 2002. Article 1 states that: 'the law is enacted for the purposes of rationally developing, utilizing, conserving and protecting water resources,... bringing about sustainable utilization of water resources, and meeting the need of national economic and social development.'⁶³ Article 8 states that 'the state encourages strict economy on the use of water, greatly promotes water-conserving measures, spreads the use of new technologies and technique for water-conserving, [and] develops water conserving industries, agriculture and services'.⁶⁴ Taken together, the Articles make both the connection between water resources and wider economic development, and also emphasize water conservation. But there is no clear securitization discourse suggesting a state of emergency or existential threat.

This is also much the case for another major document produced by the Chinese state regarding water resources - the China Water Conservation Technology Policy Outline of 2005. The strongest position taken by the document is in section 1.2, which states that:

⁶³ *Water Law of the People's Republic of China*, Decree No.74 of the President of the People's Republic of China, (August, 2002),<<u>http://www.mwr.gov.cn/english/01.pdf</u>>[accessed 2nd March 2012], pp.1-2.

⁶⁴ Ibid., p.29.

the tension between supply of and demand for water resources is obvious..the water crisis has seriously impeded socioeconomic development in China...in some parts of the country rivers have dried up...urban water scarcity *shows a tendency of evolving from a regional to a national problem*.⁶⁵

Whilst some of the language used is relatively extreme - 'the water crisis has seriously impeded socioeconomic development' - and the link between water and wider economic position is hinted at, there is no strong emphasis on this continuing to become an existential threat or framed as a security issue as in the subsequent document discussed below. This lack of emphasis is reiterated when the document states that 'water scarcity *shows a tendency of evolving* from a regional to a national problem', implying both that it is not at present and also ambiguity in its potential to become one such.

Rather, it is the Three Red Lines Document issued on January 29th 2011 that marks a clear shift towards securitization of water resources in relation to energy security. Each year China releases a "Number 1 (No.1) Central Document", which constitutes a 'speech act' and refers to the first major policy document of each year released by the Central Committee of the Communist Party of China and the State Council and is 'historically...the most important policy for that year and beyond'.⁶⁶ That the 2011 No.1 "Three Red Lines" Document is concerned with water resources is evidence of their considerable importance to the Chinese government, the increasing severity of which is reflected by the fact that 2011 was 'the first and only year the No. 1 Document did not refer to agriculture'.⁶⁷ This is significant in itself, and a closer systematic

⁶⁵ *China Water Conservation Technology Policy Outline*, National Development and Reform Commission (NDRC), People's Republic of China, (April 2005), <<u>http://en.ndrc.gov.cn/policyrelease/200506/t20050621_8427.html</u>> [accessed 25th Feb. 2016].

⁶⁶ J.Liu, C.Zang, S.Tian, J.Liu, H.Yang, S.Jia, L.You, B.Liu and M.Zhang, 'Water conservancy projects in China: Achievements, challenges and way forward', *Global Environmental Change*, 23, (2013), p.634.

⁶⁷ D.Tan, et al., 'Towards a Water and Energy Secure China', p.12.

assessment of the document supports this and makes clear that water resources were scrutinized in relation to energy.

Unfortunately, an original copy of the Three Red Lines is very difficult to acquire and thus conditions the following analysis of securitization of water resources. As such, secondary sources' remarks on and direct quotes from the Three Red Lines No.1 Document are used, as well as summary details of a follow-up document, the 'Opinions on the Practice of the Strictest System for the Management of Water Resources'. Published 12th January 2012, it is 'the overall layout and specific arrangements that the State Council has made since the 2011 No.1 Document...[,] a principal document guiding water related efforts in China at present and for a period to come' and 'mainly about [the] setting of the "Three Red Lines"'.⁶⁸ As such, it provides an ample opportunity to examine the reasons behind the document's existence and gives one the best opportunity of assessing securitization regarding it. Key details of this document (and further details on the Three Red Lines document) are described in a speech by H.E Mr. HU Siyi, the Vice Minister of Water Resources of the People's Republic of China at the Press Conference of the State Council Information Office on 16th February 2012.

The No.1 Document for 2011 is explicitly concerned with the lack of water resources, and establishes Three Red Lines of water management - (i) controlling water use, (ii) improving water efficiency, and (iii) preventing and controlling pollution (see below for further details) from which 'various policies, laws and regulations have been issued and implemented to ensure

⁶⁸ Speech at the Press Conference of the State Council Information Office by H. E. Mr. HU Siyi, Vice Minister of Water Resources, (Feb. 2012), <<u>http://www.china.org.cn/china/2012-02/17/content_24664293.htm</u>> [accessed 27th Jan. 2016].

the "most stringent" management of water'.⁶⁹ The document clearly situates the importance of water resources in their wider context, stating that "water conservancy not only relates to security of flood control, water supply and food, but *also relates to economic security, ecological security and national security*".⁷⁰ As such, the Three Red Lines Document makes a very pointed statement which immediately jumps the logic chain and connects water resources to national security, thereby presenting an immediate and clear-cut case for securitization where the issue area is water resources, the state is the referent object, and the government is the securitizing actor. Moreover, there is also a clear sense that previous efforts in this area have been insufficient:

Since China's reform and opening up...the reform on water conservancy has been under solid progress in an orderly manner...[but] although water conservancy reform has made significant headway...compared with the requirements of the national administrative system and the market economy reform, and compared with the requirements of safeguarding a sound and rapid development of water conservancy undertakings, the problems regarding [the] development system...and overall outdated reform still exist.⁷¹

This statement implies that water resources require more serious attention than they had previously been given, and there is a clear link to the impact on the 'national administrative system', citing the state as the referent object in a way that the 2005 document's focus 'on the issue being a 'regional problem' and only a possibly a national one, did not. This also supports the explicit mention of links to economic and national security that suggest a shift in thinking about water resources. In sum, the Three Red Lines Document is a *speech act* which marks a

⁶⁹ D.Tan, et al., 'Towards a Water and Energy Secure China', p.12.

⁷⁰ J.Hai and L.Dengwei, 'Overview and Interpretation of 2011 No.1 Policy Document Issue by the CPC Central Committee', <<u>http://file.eu-chinapdsf.org/Internet/PUB/Overview_and_Interpretation_of_2011_No.</u> <u>1_Policy_Document_JinHai,LiuDengwei,pdf</u>> [accessed 18th Feb. 2016], p.1, emphasis added.

⁷¹ *Ibid.*, pp.5-6, emphasis added.

clear shift from previous documents that focused on the issue, and securitizes the *issue area* of water resources in which the state is the *securitizing actor* and *referent object*.⁷²

More supporting evidence can be found in the State Council's January 2012 'Opinions on the Practice of the Strictest System for the Management of Water Resources' described by H.E Mr. HU Siyi, and also in the *Briefings on the Opinions of the State Council on Implementing the Strictest Water Resources Management System* (hereafter *Briefings*) also published by the Ministry of Water Resources in February 2012 and which provides more detail on the issues raised in the speech.⁷³

In this speech, Mr Siyi begins by stating that whilst

water is the source of life, key to production and basis of ecology...we must be aware that a large population, limited water resources and uneven temporal and spatial distribution of water resources remain the basic national situation and water regime of China, which, coupled with prominent issues such as water shortage, severe water pollution and deterioration of water ecology, have become major bottlenecks constraining sustainable socio-economic development in China.⁷⁴

Here it is clear that the issue of water resources is linked specifically to the Chinese nation-state's

wider 'socio-economic development' in such a way that they have become 'major bottlenecks' to

⁷² It is worth noting that there is no mention of audience here (as per the discussion above), because the No.1 Documents are part of policymaking 'behind closed doors' and are published without convincing a specific audience of the threat, as per the securitization criteria. Inasmuch as there is no evidence of significant pushback to the securitization of the issue from any audience subsequently (that this author is aware of) the issue can still be considered securitized in this case - indeed, all the other securitization criteria are met and this may be the best one can do in this case. It is worth noting that securitization based on policy documents compiled and produced in the inner circles of government do produce a problem for the securitization criteria, and this should be explored in future studies on the topic.

⁷³ Speech at the Press Conference of the State Council Information Office; Briefings on the Opinions of the State Council on Implementing the Strictest Water Resources Management System, (Feb. 2012), <<u>http://www.china.org.cn/china/2012-02/17/content_24664350.htm</u>> [accessed 1st Feb. 2016]. Mr Siyi's talk is itself a 'speech act' concerning the securitization of water, where the issue area is 'water resources', the securitizing actor is the state (as it is published by the State Council) and the referent object is state (as indicated in the following analysis). Like the Three Red Lines Document, it also fits the securitization criteria of the Copenhagen School's framework, though initial securitization is deemed to have occurred with the Three Red Lines publication as per the analysis above. Inasmuch as there was an audience to Mr Siyi's speech, this may be considered an acceptance by an audience regarding securitization, even if it occurred later than the presentation of the securitizing document. Whilst not perfect, this instance of apparent acceptance by this audience appears to support the argument that the issue was securitized in 2011 (especially as there was no pushback to initial securitization (to this author's knowledge)).

⁷⁴ Speech at the Press Conference of the State Council Information Office.

it, both implying a link between water resources and economic security and also a degree of severity as required by the securitization framework. It was stated above that a major aspect of economic security is energy security, and the link in the document is made even more specific in the Briefings, where it is stated that whilst 'GDP output per 1m³ in China only accounts for one third of the world average...water consumption per RMB10,000 industrial value added reaches 120m³...which is three to four times the figure in developed countries⁷⁵ Here there is a clear link to industrialization - as per the theoretical discussion above - as being a major problem for management of Chinese water resources, and whilst in the China Technology Document of 2005 the issue had 'impeded' socio-economic development, here it is fully 'constrained' by the issue. Moreover, inserting industrialization as the middle point between water resources and the wider economy echoes well the connection made above between industrialization and economic security. As also noted above, industrialization requires energy and thus there is a clear link between water resources and energy security whilst situating them in the wider context of economic security and development where the state is the referent object. This is made extremely clear when it is stated that 'along with in-depth industrialization and urbanization, the demand for water resources will keep growing...[for] a fairly long time to come, giving rise to more intensive conflict between water supply and demand and accordingly an ever more severe situation of water resources in China', implying that this is set to continue unless something is done, unlike in the previous two documents.⁷⁶ This reinforces the link between water resources, industrialization and economic security of the nation state and the language used - 'intensive

⁷⁵ Briefings on the Opinions of the State Council.

⁷⁶ Briefings on the Opinions of the State Council, emphasis added.

conflict', 'ever more severe situation', 'major bottleneck' - supports the original statement in the 2011 Document itself regarding the link between water resources and national security in framing the issue as 'a special kind of politics' as per the requirement of the Copenhagen School.

In sum, the Three Red Lines document, issued in January 2011, marked a turning point in Chinese ideas about water resources. Not only was it the first No.1 Document not to focus on agriculture, which itself indicates that water resource management had become an extremely important issue, but there is a clear indication of lack of water resources threatening industrialization and China's socio-economic development such that it is reasonable to suppose that the issue poses a clear threat to 'the absence of, protection from or adaptability to threats that are caused by or have an impact on the system's ability to provide a flow of energy to meet demand in an economy in a manner and price that does not disrupt the course of an economy'. As per the Copenhagen School analysis, water resources (issue area) have been securitized in approximately early 2011 by the Chinese State (securitizing actors), with respect to the State (referent object) via the Three Red Line Document, Opinions on the Practice of the Strictest System for the Management of Water Resources, Briefings of the Ministry of Water Resources and speech by H.E Mr. HU Siyi regarding both (speech acts).

Following the concerns regarding the thoroughness of the Copenhagen School framework discussed in Chapter Three, the next section considers the effectiveness of 'securitization' by looking at policy action and policy success. It is worth noting briefly what the Three Red Lines themselves are in a little more detail:

⁽¹⁾ The Red Lines for control of development and utilization of water resources, with the target of controlling total quantity of water consumption nationwide below 700 billion m³ by 2030; (2) The Red Line for control of water use efficiency, with the targets of attaining or approaching the world advanced level of water use efficiency, reducing water consumption per RMB10,000 industrial value added to below 40 m³

and raising effective water use coefficiency of farmland irrigation to above 0.6 by 2030; and (3) The Red Line for restriction of water pollutants in water function areas, with the targets of controlling total quantity of major pollutants discharged into rivers and lakes within the pollutant absorption capacity of the water function areas and raising water quality compliance rate in such areas to higher than ninety-five percent.⁷⁷

This is important because two of the three 'Red Lines' are concerned with overall water consumption and water use efficiency, which are directly connected to the two topics - (1) concentration and geographical distribution and (2) efficiency - that are discussed below in relation to policy action and policy success. The topics discussed below are thus directly related to the Three Red Lines and thereby very appropriate for assessing the degree and impact of securitization advocated by Caballero-Anthony and Emmers.

⁷⁷ Speech at the Press Conference of the State Council Information Office.

6. Policy Action, Policy Success and Potential Constraints

Determining policy action and policy success of the securitization of water resources for energy security can be broadly split into two topic areas: (i) The geographical distribution of coal-fired energy bases vis-à-vis water resources; and (ii), the efficiency with which water is used in the energy production process.

6.1 Geographical Distribution - Policy Action

There is one major piece of government policy action concerned with the geographical distribution of coal-fired energy bases and water resources: the Ministry of Water Resources' Water-for-Coal Plan issued in December 2013. This policy was made soon after the Three Red Lines Document and is thereby appropriate for analyzing the extent to which securitization is reflected by and resulted in policy action.

The Water-for-Coal Plan issued in December 2013 makes direct reference to the Three Red Lines No.1 Document, stressing that 'breaking the control indicators of the "Three Red Lines" of water resources of water management is not permitted'. Moreover, Article 1 specifically discusses the construction of the large coal energy bases in relation to water resources in order to concentrate energy production from coal and thereby increase efficiency:

large scale coal-power bases construction shall be implemented completely based on the strictest water resource management system and condition of the regional water resources. The decision of construction layout and scale shall be reasonable. It shall be targeted at obtaining a win-win outcome of social and economic development and sustainable use and protection of water resources.⁷⁸

⁷⁸ *Water-for-Coal Plan*, Ministry of Water Resources of the People's Republic of China, trans. Y.Kuang and M.Zhang, (December 2013), <<u>http://www.mwr.gov.cn/zwzc/tzgg/tzgs/201312/t20131217_520799.html</u>> [accessed 26th January 2016].

On the one hand, the document not only makes specific reference to the document where water was securitized (Three Red Lines), but also directly connects the geographical construction of coal energy bases to geographical water resources, showing that policy action aims to ensure that there is enough water for the production of energy in a given geographical area and thereby reduce the threat of water resources to China's energy security. Moreover, that 'large scale coalpower base construction shall be *implemented completely based on the strictest water resource* management and conditional of regional water resources' initially implies that water resource issues take priority over other competing issues and thereby suggests a very significant degree of policy action. On the other hand, there is also a clear trade-off here. Whilst decisions on construction are phrased as 'win-win', to suggest that construction layout and scale should be 'reasonable', and also to place emphasis on social and economic development (ahead of concerns regarding water resource availability) as well as sustainable use and protection of water resources does not necessarily suggest that lack of water resources takes priority over other serious issues or that it constitutes an impending, short-term 'existential threat'. For this reason one must conclude that securitization occurred to a significant rather than very significant degree, as there is clear recognition of the issue and its importance to China's energy security, but not such that it takes full priority over concerns over continued social and economic development, even if they deplete water resources.

In sum, the extent to which policy action aims to ensure that there is enough water for the production of energy in a given geographical area can be considered relatively strong. The Water-for-Coal Plan references the Three Red Lines document, and also clearly states that construction of coal energy bases should be considered in relation to water resources. Framing

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the decision on construction as 'reasonable' however, does leave room for doubt as to whether water is really being considered, despite securitization, as posing an immediate short-term threat to energy security or taking precedent over other important issues, such as economic development.

6.2 Geographical Distribution - Policy Success

A key indicator of policy success is if government's plans adhere to the aforementioned Water-for-Coal Plan's statement that 'large scale coal-power base construction shall be implemented completely based on the strictest water resource management system and condition of the regional water resources'. Whether this is the case can be analyzed well using China Water Risk's analysis of China's coal-fired energy bases and water capabilities of China's provinces, which are classified on the following scale: extreme water scarce, water scare, water stressed and water rich, where all but the last classification count as 'water challenged' provinces.⁷⁹

'Due to the anticipated rise in electricity needs' (as described above), the Chinese government commissioned the construction of 16 large coal-fired energy bases in its 12th Five Year Plan 2011-15, to be completed within these dates.⁸⁰ Seven⁸¹ bases exist at the time of the report's publication and the government is currently 'expanding' these to reach the 16 base-target

⁷⁹ D.Tan, et al., 'Towards a Water and Energy Secure China', p.108.

⁸⁰ *Greenpeace*, 'Thirsty Coal: A Water Crisis Exacerbated by China's New Mega Coal Power Bases', *Greenpeace*, (Beijing), (2012), <<u>http://www.greenpeace.org/eastasia/publications/reports/climate-energy/2012/thirsty-coal-water-crisis/</u>> [accessed 24th March 2016], p.2.

⁸¹ This is often quoted as 'nine' due to Shanxi's bases being counted as one (as per Table 2).

as shown in Table 2 below.⁸² Of the added bases all are in the same provinces as the original nine, and of the added bases, two are in water challenged provinces, Heilongjiang and Gansu, and only one is in a water rich province, Guizhou. This leaves thirteen out of the sixteen bases in water challenged provinces.

9 Existing Large Coal-Fired Energy Bases		12FYP Planned 16 Large Coal-Fired Bases			
No.	Coal Bases	Provinces	No.	Coal Bases	Provinces
1	Ordos	Inner Mongolia	1	Ordos	Inner Mongolia
2	Xilingol League	Inner Mongolia	2	Xilingol League	Inner Mongolia
3	Jinbei	Shanxi	3	Shanxi (Jinbei, Jinzhong & Jindongnan)	Shanxi
4	Jinzhong	Shanxi	4	Shaanbei	Shaanxi
5	Jindong	Shanxi	5	Ningdong	Ningxia
6	Shaanbei	Shaanxi	6	Hami	Xinjiang
7	Ningdong	Ningxia	7	Huaidong	Anhui
8	Hami	Xinjiang	8	Binchang	Shaanxi
9	Huaidong	Anhui	9	Zhungeer	Inner Mongolia
			10	Hulunbuir	Inner Mongolia
			11	Huolin River	Inner Mongolia
			12	Baoqing	Heilongjiang
			13	lli	Xinjiang
			14	Huainan	Anhui
			15	Longdong	Gansu
			16	Guizhou	Guizhou

Table 2: Proposed Geographical Locations of Coal-Fired Energy Bases

Source: State Council, NEA

Source: D.Tan, et al., 'Towards a Water and Energy Secure China', p.107.

In the case of coal-fired energy bases, one could perhaps make a stronger case for a lack of policy success following policy action, especially concerning the Water-for-Coal Plan's statement quoted above. Indeed, as per the table, twelve of the coal-fired energy bases are in water challenged regions, and thirteen of the sixteen coal fired energy bases in water challenged

⁸² D.Tan, et al., 'Towards a Water and Energy Secure China', p.95. Currently seven (nine) of the 16 bases have been completed, but whilst sources (D.Tan, et al., 'Towards a Water and Energy Secure China', p.95;) state that 'the government is expanding the [current] nine large coal fired energy bases to 16' and that 'the government intends to expand the energy bases to form 16 large coal-fired energy bases by the end of [the] 12FYP' it has proved extremely deficit to get any up-to-date information about how close the other bases are to completion. (Hopefully future studies on the topic would be able to acquire the information (if and) when it becomes available). Completing seven (nine) of the sixteen bases is still an impressive feat, and this thesis analyses all 16 bases in relation to policy success, on the grounds that they are in the process of being built (which is enough to qualify as 'implementation'), even if they have not all individually been constructed yet.

regions, as above, meaning that implementation seems subordinate to the issue of location of coal reserves.⁸³

However, this may be too harsh. As China Water Risk points out, 'it is difficult to scaledown coal production in the major coal-producing provinces as it is not possible to 'shift' coal reserves'⁸⁴, implying practical problems of moving coal as well as the huge disruption this would cause to energy production, which could itself threaten energy security. In other words, despite securitization of water resources for energy security as indicated in the policy action, the Chinese government's hands may be tied regarding both the feasibility of moving energy production out of water challenged provinces and due to a potential decrease in energy security caused by threatening disruption of energy sources in the short term. In this sense, whilst one might argue that there is a low degree of policy success, because there is some limited implementation that results in reduction of the threat but which is largely subordinate to a competing issue - coal reserve location - it may be fairer to conclude that there is a moderate degree of policy success. Essentially, as per the addition to the theoretical framework, this represents an instance where water resource problems are being taken very seriously as per securitization, but also where implementation is hampered by structural feasibility issues faced by the government. This 'moderate' classification is bolstered by acknowledging that coal-fired energy bases are being spread out to three provinces in which they were not before, indicating the state spread the stress on China's water resources, and also to partly alleviate it by having a coal-fired energy base in water-rich Guizhou. As such, one could argue that there has been a moderate degree of policy

⁸³ The coal bases were meant to be finished by the end of the 12 Five-Year Plan (see China Water Risk, p.X). Currently nine are complete and available sources suggest

⁸⁴ Ibid., p.110.

success in this issue area, suggesting that securitization has resulted in reaction of the threat, but not necessarily at the expense of other 'competing issues'. Moreover, the example also illustrates that the addition of a new criteria - practical constraints and structural feasibility - helps explain the potential discrepancy between securitization and policy action on the one hand, and policy success on the other in this case.⁸⁵

In sum, supplementing the discussion of securitization in Chapter Four with consideration of policy action and success as they relate to geographic distribution of water resources allows one to understand the dynamics of securitization in greater depth. Whereas the Copenhagen School's framework suggested pretty unequivocally that water had been securitized, an investigation of policy action and success suggested that the extent to which this occurred was less clear-cut. With respect to the Water-for-Coal Plan, a close reading of the key points on policy action suggests a significant degree of securitization, but not such that other constraints here the geographical location of coal reserves vis-a-vis water resources - can be completely circumvented during implementation, suggesting a moderate degree of policy success. In addition, this illustrates the usefulness of adding consideration of structural feasibility issues to the theoretical framework.

6.3 Efficiency of Water Resource Use - Policy Action

The second area of policy action with which this paper is concerned is that of efficiency of water use inside power plants. Policy action on installation of air-cooling systems dates back to the mid-2000s, specifically to the 'Requirements on the planning and construction of coal

⁸⁵ A higher degree of policy success (significant or very significant) could be argued for, if for example, more coalfired energy bases had been built in water rich provinces and coal transported there as necessary.

power plants' and the 'China Water Conservation Technology Policy Outline', both published by the National Development and Reform Commission (NDRC) in 2004 and 2005 respectively.86 The policies are concerned with coal-fired energy production and 'promote air-cooling technology as a main measure to relieve the pressures on water resources posed by the expansion of coal power production in northwest regions since the mid-2000s'.⁸⁷ This is clear in Section 3.2.4 of the China Water Conservation Technology Policy Outline, which says to 'develop aircooling techniques...In areas that lack water and have proper climate condiments, popularize aircooling techniques...Encourage research and development into highly effective, economic aircooling techniques and equipment'.⁸⁸ Additional policy action in this area after securitization is to be found in the 'Notice of the State Council on Issuing the 12th Five-Year Plan on Energy Development', issued, January 2013, which states that 'advanced water-saving technology shall be used' specifically in the aforementioned large-scale coal power bases.⁸⁹ Information regarding policy action is also found in the Water-for-Coal Plan, issued December 2013, and as before, is stated specifically after reiterating the importance of the Three Red Lines. The Waterfor-Coal Plan states in Article 1 (i) that 'provincial water administrative departments shall work out plans of controlling or reducing total water usage, clarify the plan and strategies of reducing total water usage, and [improve] the potential of water resources by increasing efficiency of

⁸⁶ C.Zhang, L.D.Anadon, H.Mo, Z.Zhao, and Z.Liu, 'Water-Carbon Trade-off in China's Coal Power Industry', *Environmental Science and Technology*, 48, (2014), pp.11083, 11088 and 11089. This thesis examines only the latter of the two documents, as the former is only available (so far as I can determine) in Chinese, and I have not been able to obtain an English translation.

⁸⁷ *Ibid.*, p.11087.

⁸⁸ China Water Conservation Technology Policy Outline.

⁸⁹ Notice of the State Council on Issuing the 12th Five-Year Plan on Energy Development, (January, 2013), trans. M.Zhang, <<u>http://www.gov.cn/zwgk/2013-01/23/content_2318554.htm</u>> [accessed 4th Feb. 2016].

water resource usage and water right transfer', thereby placing emphasis on the efficiency of water resource use.⁹⁰ In addition, Article 1 (iv) states that the 'planning of power bases shall stick to the principle of "save water first, and then use water"...Water-deficient areas shall use air cooling units and dry ash handling systems...project construction shall practically enhance protection of water resources'⁹¹, and thus forcefully prescribes use of air-cooling systems.

All four state policies described proscribe use of air-cooling techniques. The 2004-2013 date range initially appears problematic for the securitization argument, though a closer look at the documents suggests otherwise. First, whilst the 2005 document clearly mentions air-cooling techniques, it also discusses other types of less efficient cooling system far more in sections 3.2.1-.3.2.3, and even states to 'encourage the development of highly efficient environmentally friendly water conservation cooling towers and other cooling structures' (used in the closed loop or wet-recirculating systems described above) implying at the time of writing that these less water efficient systems were still to be used. In contrast, the Water-for-Coal Plan not only declines to mention such systems, but is also much more forceful in its prescription of the use of air-cooling systems, stating that 'water deficient areas shall use air-cooling systems' as opposed to 'popularizing' and 'encourag[ing]' their introduction as in the 2005 document. The shift indicates a clear change in emphasis in policies post-securitization and thereby indicates that securitization did play an important role in policy action in this area. That this policy was directed specifically at the large scale coal power bases as stated in the 'Notice of the State Council' document is also indicative of issue linkage; the combination of air cooling measures

⁹⁰ Water-for-Coal Plan, emphasis added.

Figure 2: Proportion of air-cooled power capacity in total thermal power capacity in China (2003-12)



Source: C.Zhang et al., 'Water-Carbon Trade-off', pp.11083.

and centralization of coal power bases post-securitization is particularly important considering the fact, as mentioned above, that constraints forced the government to put some of these power bases in water-challenged areas. The change in importance of air-cooling system policies postsecuritization such that they aim to considerably reduce the threat means policy action to combat a lack of water resources occurred as a result of securitization and should be classified as significant as opposed to moderate. Overall securitization can be said to have had a significant effect on policy action in the topic of water efficiency and cooling systems, and supports the securitization argument presented in Chapter Four.

6.4 Efficiency of Water Resource Use - Policy Success

Data on air-cooling system installation in China's coal energy industry is very sparse to my knowledge, but one study of the process has been undertaken by Chao Zhang, Laura Anadon, Hongpin Mo, Zhongnan Zhao and Zhu Liu, based on data from China Electricity Council (CEC),National Development and Reform Commission (NDRC), Ministry of Water Resources

(MWR) and Ministry of Environmental Protection (MEP).⁹² It will be used to assess to what extent securitization has resulted in policy success.

Zhang et al. analyze the proportion of of air-cooled power capacity in total thermal power capacity from 2003 to 2012, as shown in Figure 2 above. This is appropriate for this paper as it does not include thermal nuclear power (itself separately accounted for in Chinese energy statistics) and coal-fired power generation accounts for almost all - ninety-two percent - of nonnuclear thermal installed capacity in China by 2012.93 Whilst Zhang et al. state that the 'the share of air-cooled coal power capacity increased from less than one percent of national total thermal power capacity to fourteen percent of the national total', the percentage rose from one percent in 2003 to roughly eleven percent in 2010 before securitization, and only from roughly eleven to roughly fourteen percent in 2011 and 2012, after securitization. The increase in proportion of air-cooled coal power capacity over time post-securitization is therefore only very slightly higher (1.5 percent per year) than pre-securitization (~1.4 percent per year). The small difference in percentage is suggestive of limited reduction of the threat at best and thus suggests that securitization had a insignificant effect on policy success. (and in fact reflects gradual installation of units over time). The slightly steeper gradient on the graph around 2005-6 could also be reflective of the 2004 and 2005 policies, suggesting that they had an effect even though they did not securitize the issue. That fact that 'the first two 1000MW ultra-supercritical aircooled units were put into commission in the Ningxia Lingwu Power Plant' in 2011 (postsecuritization), possibly supports the very slightly higher increase in proportion of air-cooled

⁹² C.Zhang et al., 'Water-Carbon Trade-off', pp.11082-9.

⁹³ Ibid., p.11084; D.Tan, et al., 'Towards a Water and Energy Secure China', p.104.

capacity over time post-securitization, but only really aids in supporting the overall impact of securitization as insignificant rather than very insignificant (there is some evidence for limited implementation here rather than none).⁹⁴

This classification may reflect the fact that the study only provides data up to 2012, which is before the first significant policy action in this topic area post-securitization. Whilst in Chapter Three policy success did not have to strictly respond to published policy action it seems sensible to speculate that more positive results of securitization for policy success may occur in the aftermath of securitization-influenced policy action - i.e. after the Notice of the State Council and Water-for-Coal Plan. Zhang et al. make positive remarks in this regard, referencing specifically the air-cooling requirements outlined in the the Water-for-Coal Plan, and suggesting that

it is also expected that the newly installed capacity of coal power generation will amount to 265GW during the 13th five-year period (2016-2020), nearly sixty percent of which will be located in thirteen large production bases of coal mining and power generation in the north and northwest of China. If seventy percent of the new capacity in those large coal power bases adopts an air cooling system, air-cooled power plants may reach 260GW in 2020, about twenty-two percent of China's total coal-fired power generation capacity.⁹⁵

This is important as it shows that significant implementation has been forecast in the large coal bases as per Notice of the State Council document, and indicates that the imperative language of the Water-for-Coal Plan is more than just rhetoric. This is encouraging for the impact of securitization on policy success - and suggests that 'insignificant' may be a harsh classification - but cannot be determined concretely until more data becomes available.

⁹⁴ *Ibid.*, p.11084. Supercritical and ultra-supercritical power plants operate at temperatures and pressure above the critical point of water, meaning they are more efficient than conventional plants, have lower emissions, and lower fuel costs per megawatt.

⁹⁵ *Ibid.*, p.11084.

The issue of potential constraints is also present for efficiency of water resources. Whilst air-cooling has a significant water-saving benefit, it also leads to 'lower overall thermal efficiency...[as] the energy consumption and consequently carbon emissions per kilowatt hour of net electric power output of air cooled power plants are usually higher than their wet-cooling counterparts'.⁹⁶ According to Zhang et al.'s data, in 2012 whilst 'air cooling technology resulted in consumptive water use savings of 832-942 million m³ in China', it also resulted in 'an additional consumption of 8.22-10.8 million tonnes of standard coal equivalent, which resulted in 24.3-31.9 million tonnes of carbon emissions'.⁹⁷ The scholars recognize that

with the increasing dual pressures of water scarcity in north and northwest China and the national greenhouse gas (GHG) mitigation target, identifying the magnitude of the water-carbon trade-off embedded in the current technological choices should further motivate policy makers to pay more attention to alternative electricity supply options which bring both water conservation and carbon mitigation benefits.⁹⁸

It is therefore possible to draw a neat parallel between constraints the Chinese government faces with water efficiency measures and with the distribution of coal reserves vis-a-vis water resources in the discussion on geographic distribution. In this case, dealing with the water resource issue implies a trade-off with carbon emissions and constitutes another possible constraint on dealing with the issue of water resources as per the recommended additions to Caballero-Anthony and Emmers's framework. Policy success in this area has already been deemed insignificant, and this trade-off provides another example of the challenges of implementation despite an issue being securitized, accounting in part for the discrepancy between Copenhagen school-style securitization and policy success. From a theoretical

⁹⁶ *Ibid.*, p.11083.

⁹⁷ *Ibid.*, pp.11086-7.

⁹⁸ *Ibid.*, p.11088.

standpoint, this reflects the importance of the addition of practical constraints to securitization analysis frameworks, and shows how it may complicate the initial typology suggested for an analysis that used only Caballero-Anthony and Emmers' framework.

In sum, one must argue that there has been an insignificant degree of policy success since securitization in the area of water efficiency. A better understanding of the process could be increased with newer data on the issue, which may change the classification in future studies. There is an interesting parallel here with geographic distribution topic, and taken together suggest, not surprisingly, that policy success is harder to achieve than policy action, with the greenhouse gas emission factor acting as a notable potential constraint on implementation. One final point to note is the linkage between the two topic areas, reflected in air-cooling systems being forecast to go into the large coal power bases. Inasmuch as this is suggestive of an overall strategic approach to the issue, one may be more encouraged to conclude securitization has had an notable effect on the overall handling of the water resources problem. Theoretically, this linkage across issues may be something that is worth incorporating into Caballero-Anthony and Emmers's securitization framework, and may be a useful extra indicator of degrees of securitization to be used in future studies.

7. Timeframes and Uncertainty

Chapter Five demonstrated how policy success in geographical distribution and efficiency (moderate and low respectively) does not always appear consistent with policy action (significant and significant respectively) and securitization of water resources in relation to energy. It illustrated how this may have to do with structural feasibility (re. geographical distribution of coal reserves) and potential constraints (including the high greenhouse gas emission produced by air-cooling systems). This chapter aims to build on these problems such issues pose for securitization analysis by considering the issues of timeframes and uncertainty.

As stated in Chapter One, it has been recognized that water resources constitute a threat to China's energy security in the medium-term more than as an immediate/short-term threat, and that this implies a extended timeframe for dealing with the issue. This chapter argues that the medium-term timeframe involved gives China breathing space in which to deal with the issue, and along with uncertainty may account for the discrepancy in securitization and policy action, and actual policy success. It does by drawing on two studies to show how China would be able to dramatically reduce water use in coal-fired energy with the right policy action and implementation should the issue become more immediately threatening, and that this makes the situation less serious than if it was unable to dramatically reduce water use and had very little time to do so.

The first study, produced by Lingying Pan, Pei Liu, Linwei Ma, and Zheng Li, provides a comprehensive analysis of 'water issues in the entire coal industry from a supply chain

perspective'.⁹⁹ Assuming that 'coal will remain as the dominant energy reserve in China for a long time', they examine 'the interaction between the water system and the coal industry, and analyze possible scenarios of water use in China's coal supply chain in 2020 and 2030', as well as in 2008, using data from the IEA's World Energy Outlook 2010.¹⁰⁰ World Energy Outlook predicts coal demand in China base on three scenarios: the Current Policies Scenario, New Policies Scenario and 450 scenario. Pan et al.'s data focus on the Current Policies Scenario and New Policies Scenario¹⁰¹, in which the former considers 'only the energy and environmental policies that formally developed by government by the middle of 2010, are taken into account, and assumed to remain unchanged during 2010-2035', whilst the latter 'accounts for broad policy commitments and plans that have been announced to deal with the environmental and energy security problems, including those commitments with no identified or announced measures for implementation'.¹⁰² They also add in technological developments as a factor, including cooling system and ash removal improvements. Based on this they calculate four possible scenarios for water use of the coal supply chain. Their results are reproduced below in Table 3 and Figure 3.¹⁰³ As is clear from the tables, the predictions for projected water use vary quite considerably across the different scenarios. The real interest is in coal-fired power generation, improvements in which Pan et al. conclude 'would be the most effective way to

⁹⁹ L.Pan, P.Liu, L.Ma, and Z.Li, 'A supply chain based assessment of water issues in the coal industry in China', *Energy Policy*, 48, (2012), p.94.

¹⁰⁰ *Ibid.*, p.94.

¹⁰¹ Pan et al. imply that the targets set in the 450 scenario, which forecast coal demand in China in 2030 to be less than that in 2008, to be too uncertain to use in the study.

¹⁰² *Ibid.*, p.98.

¹⁰³ *Ibid.*, pp.99-100.

Table 3: Water Use and Projected Water Use of Coal Supply Chain in China under different scenarios

Scenario	Year	Coal mining	Coal preparation	Coal-fired power generation	Coal chemical industry	Total
Current policies & technology scenario	2008	6.5	3.5	78.6	1.9	90.6
	2020	9.7	7.9	143.6	2.5	163.7
	2030	11.1	10.9	188.2	2.5	212.8
Current policies & technical progress scenario	2008	6.5	3.5	78.6	1.9	90.6
	2020	6.7	4.7	70.5	1.9	83.9
	2030	4.8	2.2	66.1	1.4	74.5
New policies & current technology scenario	2008	6.5	3.5	78.6	1.9	90.6
	2020	9.0	7.3	131.0	2.5	149.7
	2030	9.2	9.0	144.2	2.3	164.7
New policies & technical progress scenario	2008	6.5	3.5	78.6	1.9	90.6
	2020	6.2	4.4	64.3	1.9	76.9
	2030	4.0	1.8	50.6	1.3	57.7

 Table 6

 Water use of coal supply chain in China, 2020 and 2030 (Unit: km³)

Source: L.Pan et al., 'A supply chain based assessment', p.99.

Figure 3: Projected Water Use of Coal Supply Chain by Sector in China in 2030



Fig. 5. Sectoral water use of coal supply chain in China, 2030.

Source: L.Pan et al., 'A supply chain based assessment', p.100.

reduce water use in the coal industry in China'.¹⁰⁴ As per the rest of the thesis, the study shows that water use decreases dramatically under the 'technical progress scenario', and by a small degree under implementation of policies. Whilst there is little difference under Scenarios 1 and 3, in Scenarios 2 and 4 water use is reduced by 16 and 36 percent respectively by 2030, and actually ends up falling below 2008 levels in each case.¹⁰⁵

This is important in showing the extent to which different scenarios could have very different implications for water resources posing an existential threat to China's energy security: with the right policies the threat factor goes down (and could potentially lead to de-securitization of the issue area); in the first and third scenarios, the opposite is true. This is indicative of the potential to do something about the water situation and suggests that the government would be able to enact water-saving measures (installation of air-cooling systems) dependent on forecasting of the threat. The medium-term timeframe of this issue area thus gives China time anticipate to deal with the issue, and thus *may* also account for the discrepancy in securitization and policy action and actual policy success.

Much the same sort of analysis is provided by Ying Qin, Elizabeth Curmi, Grant Kopec, Julian Allwood and Keith Richards, who analyze the energy sector's current and potential future compliance with the industrial water policy section of the Three Red Lines No.1 Document, considering how the energy sector and its water use might develop up to the 2030s, and how the

¹⁰⁴ *Ibid.*, p.101.

¹⁰⁵ *Ibid.*, pp.99-101.

answer to this is influenced by technology and policy changes.¹⁰⁶ They consider both coal, nuclear and other energy¹⁰⁷ under four different scenarios, as in the Table 4 below.

Table 4: Summary of Scenarios proposed by Ying Qin et al., (2015), 'China's energy-water nexus'.

	Scenario 1A	Scenario 1B	Scenario 1C	Scenario 2
Objective	Baseline for analysis, taking no consideration of policy chan- ges or technological improvements	Considering the impact of coal power restructuring on coal and water use	Considering the impact of dry cooling expansion on coal and water use on top of efficiency gains by coal power restructuring	Considering the impact of efficiency improvements, dry cooling expansion with policy changes (demand re- duction and further increase in non-fossil fuels) on coal and water use
Energy pathway	IEA Current policies	IEA Current policies	IEA Current policies	IEA New policies
Coal power technologies	Same mix as 2010	50% reduction in subcritical 300 MW units(increase in ul- tra-supercritical and super- critical units)	50% reduction in subcritical 300 MW units(increase in ul- tra-supercritical and super- critical plants)	50% reduction in subcritical 300 MW units(increase in ultra-supercritical and su- percritical plants)
Nuclear	50% WTC and 50% OTC	50% WTC and 50% OTC	100% WTC	100% WTC
Dry cooling (% of power generated)	12%	12%	30%	30%

Source: Y.Qin et al, 'China's energy-water nexus', p.137.

They conclude the following: in scenarios 1a and b, the energy sector would not comply with the target; and in scenarios 1c and 1d they would reduce the energy sector's water withdrawal to eighty-nine and sixty-seven percent of the industrial water target's respectively.¹⁰⁸ Again, in scenarios 1c and 1d, the effect of cooling clearly plays a big role, and illustrates that the securitizing actor would be able to reduce water use dramatically (by installation of air-cooling systems) dependent on forecasting of the threat. Again the medium-term timeframe coupled with the government's potential ability to deal with the issue pending threat forecasting

¹⁰⁶ Y.Qin, E.Curmi, G.M.Kopec, J.M.Allwood and K.S.Richards, 'China's energy-water nexus - assessment of the energy sector's compliance with the "3 Red Lines" industrial water policy', *Energy Policy*, 82, (2015), pp.131-3. Qin et al. consider technology as to do with the type of plant, coal-power technology, fuel used and cooling system employed, but say that the cooling system makes the most difference for water use (see p.138).

¹⁰⁷ Though coal-fired power generation plays by far the largest role in water use; see pp.138-9.

¹⁰⁸ *Ibid.*, pp.138-9.

(and specifically in relation to the targets set to in the Three Red Lines document), may also account for the discrepancy in securitization and policy action and actual policy success.

The cases also highlight the issue of uncertainty. For example, in Chapter Three it was noted that uncertainty in the extent to which tackling an issue area is a problem, perhaps due to reasons of the potential constraints and structural feasibility, or in the timeframe, might cause underestimation of the problem and result delays or stalling in policy action and implementation. This is an example of a case where it is uncertain when the threat will hit, and when potential constraints - greenhouse gas emission problems related to air-cooling installation - have potentially resulted in delays and stalling of policy implementation despite securitization. This may also help to explain discrepancies between securitization and degrees of policy action and implementation.

Future studies could also delve deeper into related uncertainties that may better both empirical understanding of China's water and coal-energy problem, and also securitization analysis. This might include deeper investigations into China's future energy mix, as well as of potential developments in air-cooling technology to make it greener, and anticipated future pricing.

8. Conclusion

This paper has explored the securitization of water in relation to China's energy security situation.

First, it found that water was securitized in relation to energy in the Three Red Lines Document of January 2011.

Second, it extended the analysis of securitization as per Caballero-Anthony and Emmers's Framework, considering policy action and policy success in relation to geographic distribution of water resources and water efficiency measures, specifically regarding air-cooling systems. Policy action measures proposed with regard to geographic distribution suggested a significant degree of securitization occurring. Qualifications also suggested that other factors, such as continued economic development requiring much water for coal, may be equally as important even if they were to have a detrimental effect on water resources. Policy success was deemed to have occurred to a moderate degree, as despite some moves to implement the policy action proposal practical constraints, such as the high distribution of coal resources in water challenged provinces, limited the state's ability to do this. With regard to water efficiency, securitization was shown to have had a significant effect on policy action, and a insignificant effect on policy success partly due to constraints such as the trade-off with greenhouse gas emissions. Taken together, the paper therefore concludes that securitization had a significant affect on policy action, and a moderate ranging to insignificant-yet-promising-future-potential impact on the threat, which shows that it was important overall in changing the direction of China's water resources policy in relation to energy security concerns. Overall it is clear that China is very concerned about the empirical reality of water resource shortage and consequences

of this for its energy security. At the same time, that neither policy action or policy success were deemed to have occurred to a very significant degree, as well as the relatively low degrees of policy success, is suggestive of the water resource issue being confined to the issue of energy security rather than wider notion of economic security and national security, and indicates that these concerns are limited at present.

Third, and from a more theoretical standpoint, it argues that using Caballero-Anthony and Emmers's framework paints a more nuanced picture of securitization than the Copenhagen School's framework would allow by considering consequential policy action and policy success. A good example of this was policy action for geographical distribution being balanced against factors such as economic development. In this way Caballero-Anthony and Emmers's framework both introduces, and also increases understanding of, important connected (and potentially competing) concerns in the empirical landscape, in a way that the Copenhagen School framework's focus on only the moment of securitization does not.

Fourth, it also argues that further extensions need to be made to Caballero-Anthony and Emmers's more developed framework. First, consideration of potential constraints and structural feasibility issues should be added to the framework, as these may hamper policy action and especially implementation with respect to an issue area despite securitization. This was reflected in policy action suggesting a significant rather than very significant degree of securitization (as one might expect), and policy success being deemed only moderate to insignificant, the latter obstructed by practical matters such as the geographic distribution of coal reserves, and the water-carbon trade-off inherent in air-cooling. This addition to the framework both helps explain potential discrepancies in the evidence when using the Copenhagen School framework and Caballero-Anthony and Emmers's additions, and should also result in better understanding of the empirical reality. Second, the paper also argues that consideration of timeframes and uncertainty should be added to Caballero-Anthony and Emmers's framework. It may be that the medium-term timeframe involved meant that China has not implemented proposed policy action as quickly as it could, but feels that it could reduce the threat notably should the circumstances dictate; data from available studies showed the potential for China to significantly reduce water use for coal-fired energy production below the levels laid out in the Three Red Lines. Uncertainty in precise timeframes, as well as in other issues not hitherto discussed, such as air-cooling technology development and pricing, may shed further light on this issue, and also help make sense of discrepancies between policy success and securitization. The paper argues that potential constraints and structural feasibility issues, as well as consideration of timeframes and uncertainty, should both be added to securitization analysis frameworks, and used in future empirical studies.

Finally, avenues for future research which could take this study further might include the following: more detailed consideration of linkage between topic areas (both between geographical distribution and air-cooling and also other issues); deeper investigation into China's energy mix; more research on future development and pricing of air-cooling technology; more data on known available water resources; and, more consideration of securitization of water resources in relation to factors other than energy. This study could also be improved by obtaining fuller access to the relevant documents in a language known to the researcher, as well as to officials and experts well-informed on the topic. Better data and statistics on future coal-fired energy production and its respective water requirements would also be useful.

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