Amy Ward

Legal implications for the US in transferring CCS technology to China

Contents

Introduction

Carbon Capture and Sequestration (CCS) is considered, in many circles, a critical technological development that may make a significant contribution to future climate change mitigation efforts, by reducing carbon emissions from coal-fired power plants. CCS is the 'combination of three separate technologies that are relatively mature but that have not yet been integrated at a commercial scale'[1]. As the name suggests, there are three processes involved in the deployment of CCS technology – the separation and capture of carbon dioxide (CO_2) from industrial facilities and power plants either before or after combustion, the compression and transportation of CO_2 from plants to storage sites, and injection of the CO_2 into deep geological formations for permanent storage[2]. Current CCS demonstration projects in China are focused on the initial 'capture' phase of the CCS technological process, which involves a choice of pre or post-combustion capture technology[3].

China is focusing on implementation of 'demonstration plants' that will be able to demonstrate the safety and effectiveness of the various components of CCS technology in reducing CO_2 emissions, and the projected costs of CCS deployment, before it proceeds to commercial scale demonstration at either new or existing coal-fired power plants[4]. Section I of this paper will provide an overview of the rationale for the increasing involvement of United States (US) public and private sector entities in CCS demonstration project development in China. This will be followed by an analysis of some of the significant legal

[1] The Climate Group, TOWARDS MARKET TRANSFORMATION IN CHINA, Briefing Paper (July 2010) at 2, available at http://www.theclimategroup.org/publications/2010/7/23/ccs-towards-market-transformation-in-china/

[2] Asia Society, A ROADMAP FOR US-CHINA COLLABORATION ON CARBON CAPTURE AND SEQUESTRATION, (November 2009) at 17, available at http://asiasociety.org/files/pdf/AS_CCS_TaskForceReport.pdf

[3] Integrated Coal Gasification Combined Cycle technology (ICGCC) is a pre-combustion capture technology deployed at coal-fired power plants. It is the focus of much of the current CCS project development in China: Asia Society, *id.,* at 17.

[4] Asia Society, *supra* note 2, at 17.

and related political and economic implications for US public and private sector investors, and US CCS technological proprietors, in participating in CCS demonstration projects in China through the provision of investment and technology transfers[5]. Section II will consider Chinese intellectual property rights (IPR) enforcement issues. Section III will examine existing and potential financing mechanisms for the expansion of the Chinese CCS sector, and Section IV will provide an overview of potential US and international concerns in collaborating with China in the current Chinese regulatory context, which is still developing in response to the expansion of CCS demonstration projects.

I Rationale for US transfer of CCS technology to China

In light of the substantial coal reserves distributed across the US[6], the increasing use of CO_2 in domestic Enhanced Oil Recovery operations (EOR)[7], and the economic importance of the coal industry and influence of the 'coal states' in US politics[8], the US government has set a goal of developing 5–10 domestic commercial CCS demonstration projects by 2016[9]. Nevertheless, despite US expertise in the area of sequestration technology, there remain certain barriers to the implementation of large-scale CCS demonstration projects in the US, relative to China. These include the lack of domestic economic incentives for private sector

[5] "Technology transfer' may be defined as a 'broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders'. 'Transfer' encompasses diffusion of technologies and technology cooperation across and within countries...it comprises the process of learning to understand, utilize and replicate the technology, including the capacity to choose it and adapt it to local conditions and integrate it with indigenous technologies": IPCC, IPCC SPECIAL REPORT – METHODOLOGICAL AND TECHNOLOGICAL ISSUES IN TECHNOLOGY TRANSFER – SUMMARY FOR POLICYMAKERS (IPCC, Geneva, Switzerland) at 3, available at http://www.ipcc.ch/ipccreports/sres/tectran/index.php?idp=0
[6] Large coal reserves are located in Wyoming, West Virginia, Kentucky, Illinois, North Dakota, Montana, Texas and Pennsylvania. Coal production is also dispersed; University College London (UCL) Carbon Capture Legal Programme, FINANCIAL STRATEGIES TO INCENTIVISE CCS IN THE UNITED STATES – WHY PAY FOR CCS? (webpage), accessed March 2011, available at http://www.ucl.ac.uk/cclp/ccsfinancing-usa.php
[7] UCL, *id.*
[8] UCL, *supra,* note 6.
[9] US EPA, REPORT OF THE INTERAGENCY TASK FORCE ON CARBON CAPTURE AND STORAGE, (August 2010), available at http://www.epa.gov/climatechange/downloads/CCS-Task-Force-Report-2010.pdf, as cited in UCL, *supra* note 6.

CCS investment in the US (in the absence of a carbon price), and the 'uncertain' domestic CCS legal framework, including the lack of clarity concerning long-term liabilities for CO_2 storage and related property rights[10].

Although China shares some of these US domestic barriers to large-scale CCS development, including in particular, the absence of a comprehensive domestic CCS regulatory framework, the balance of circumstances favor the initial development of CCS demonstration technology in China, from the perspective of the US Government and private sector investors. This section will examine the rationale for US investors and CCS technology proprietors in collaborating with the emerging Chinese CCS sector, including the relatively lower cost and more rapid deployment of CCS demonstration projects in China, the favourable siting conditions for CCS projects and related economic and political benefits for the US in facilitating China's efforts to engage in domestic emissions reductions.

A Lower cost and accelerated deployment of Chinese CCS projects

The deployment of CCS demonstration projects, assisted by US technology, is presently less expensive in China, in terms of the relative cost of necessary CCS project components, including steel, cement, and labor[11], and the avoided costs from expedited project implementation in China due to a lack of regulatory obstacles[12]. In addition, over one hundred coal gasifiers, fitted to many existing Chinese commercial power plants, produce

[10] UCL, *supra* note 6. A recent example of the extent of barriers to CCS deployment in the US has been the failure of the initial design for the US Government-financed 'FutureGen' coal-gasification project with a CCS component, in Illinois. The project was cancelled in 2008 due to substantial cost over-runs and high labor costs. The US Department of Energy (DOE) has recently re-launched the project as 'FutureGen 2.0': Stephen Power, *U.S. Drops Coal Project*, THE WALL STREET JOURNAL, (January 31, 2008), available at http://online.wsj.com/article/SB120175397548831345.html and US DOE Press Release, SECRETARY CHU ANNOUNCES FUTUREGEN 2.0, (August 5, 2010), available at http://www.energy.gov/news/9309.htm

[11] NRDC, IDENTIFYING NEAR-TERM OPPORTUNITIES FOR CARBON CAPTURE AND SEQUESTRATION (CCS) IN CHINA, (NRDC, October 2009) at 2, available at http://china.nrdc.org/library/identifying-near-term-opportunities-carbon-capture-and-sequestration-ccs-china

[12] Asia Society, *supra* note 2, at 10.

residual pure streams of CO_2[13]. These emissions are easier and therefore less expensive to capture, relative to emissions from combustion plants[14]. In broad terms, China's projected construction costs for ICGCC power plants are approximately one third to one half the estimated costs of similar US and European projects[15], providing a strong incentive for US financing and CCS technology transfer to China in the short term.

As discussed in Section IV, the Chinese regulatory environment also enables rapid implementation of CCS demonstration projects, relative to the US, expediting the necessary research and development phase for CCS technology[16]. The assurance of rapid deployment reduces overall project costs and facilitates a shorter period between initial capital expenditure and eventual return on investment, attracting substantial private and public investment in Chinese CCS projects[17]. US-Chinese collaboration is also expected to bring forward the deployment of US CCS facilities by five to ten years, with associated benefits for the US in meeting its future international greenhouse gas reduction commitments[18].

B Favorable siting conditions

Initial studies of China's geology indicate that it is particularly well suited to the deployment of CCS demonstration projects, relative to the US. This is due to the number of sub-surface geological sinks or 'pore space' potentially available for CO_2 storage, and the location of existing substantial point sources of CO_2 pollution (coal-fired power plants)

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[13] Asia Society, *supra* note 2, at 7.
[14] Asia Society, *supra* note 2, at 7. The NRDC cites an (IRSM-PNNL) joint study that estimates that the cost of deploying CCS technology for high-purity CO_2 streams from certain Chinese point sources, located for the most part within 80km of suitable geologic sinks, would be in the realm of $10 to 20 per tonne of CO_2; NRDC, *supra* note 11, at 2.
[15] Craig Hart and Hengwei Liu, *Advancing Carbon Capture and Sequestration in China: a Global Learning Laboratory*, WOODROW WILSON INTERNATIONAL CENTER FOR SCHOLARS, (CHINA ENVIRONMENT SERIES 2010/2011), available at http://wilsoncenter.org/index.cfm?fuseaction=topics.publications&topic_id=1421&imageField.x=11&imageField.y=12 at 119.
[16] Asia Society, *supra* note 2, at 9.
[17] Asia Society, *supra* note 2, at 9.
[18] Asia Society, *supra* note 2, at 9.

adjacent to many of these potential geological storage sites[19]. The location of point sources of pollution next to potential geological sinks reduces the need for CO_2 transportation infrastructure, and the potential regulatory risks and costs associated with transportation[20].

In terms of the number of potential sites available for CO_2 sequestration, initial assessments[21] indicate that China has enough deep saline formations (considered potentially suitable for CO_2 storage), to sequester up to 3,066 $GtCO_2$, equivalent to more than 450 times China's total CO_2 emissions in 2005[22]. Over half of the large point sources of Chinese CO_2 emissions are positioned (fortuitously) directly above potential geological sinks, with over 80% of large point sources located within 80 kilometers of a potential geological site[23].

C Chinese collaboration addresses US competitiveness concerns

An additional motivation for the US in engaging in collaborative CCS initiatives with China concerns the US position in the continuing multilateral climate negotiations. The US has consistently maintained that it is not willing to implement comprehensive domestic climate legislation without equivalent domestic action by the largest developing nations, including China. In collaborating with China in the deployment of large-scale CCS demonstration projects using advanced US technology, the US is facilitating Chinese domestic efforts to engage in substantial domestic emissions reductions, which may address

[19] NRDC, *supra* note 11, at 2.
[20] NRDC, *supra* note 11, at 2
[21] China has not yet conducted a comprehensive geological survey for the purposes of identifying suitable sites for CO_2 sequestration; Craig Hart and Hengwei Liu, *supra* note 15, at 113.
[22] Study conducted by Li and Wei of the Chinese Institute of Rock and Soil Mechanics (IRSM) with the Pacific Northwest National Laboratory (PNNL), as cited in NRDC, *supra* note 11, at 2.
[23] The NRDC cites 1,623 large point sources of CO_2 emissions in China, which each emit more than 100,000 tCO_2 every year; NRDC, *supra* note 11, at 2. Other studies have concluded that China has enough capacity to store over 100 years of its CO_2 emissions from large point sources, and that over 90% of the country's large CO_2 point sources (emitting over 100,000 tonnes of CO2 per year) are within 100 miles of onshore sequestration reservoirs: (Dahowski et al., 2009) as cited in Craig Hart and Hengwei Liu, *supra* note 15, at 114.

(to some extent) US economic competitiveness reasons for deferring domestic regulation of greenhouse gas emissions[24].

However, as the recent United Steelworkers Petition to the US Government[25] (the Petition) and subsequent US–Chinese WTO dispute[26] regarding Chinese renewable energy subsidies indicates, the US and Chinese economies are competing vigorously to become the leading 'green' or low-carbon economy of the future. The Petition refers to President Obama's 2010 State of the Union Address, in which the President argued that 'the nation that leads the clean energy economy will be the nation that leads the global economy. And America must be that nation'[27]. As such, the US Government recognizes that its collaboration with China in the transfer of CCS technology will ultimately benefit China in the race to become the leading nation in the emerging global 'clean energy economy'. For this reason, intellectual property protection remains a critical concern for US stakeholders in the transfer of US proprietary CCS technology to China.

II Intellectual property implications – protection for US and joint intellectual property

One of the more widespread concerns for US stakeholders in providing Chinese access to US proprietary CCS technology is ensuring sufficient protection of the underlying IPR in that technology. The US and Chinese governments have entered into a multitude of bilateral agreements and memoranda of understanding involving IPR since 1979, and China has

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[24] Asia Society, *supra* note 2, at 12.

[25] United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union, AFL-CIO CLC (USW), *China's Policies Affecting Trade and Investment in Green Technology*, PETITION FOR RELIEF UNDER SECTION 301 OF THE TRADE ACT OF 1974, AS AMENDED, Executive Summary -Public Version, Volume 1 of 9, (September 9 2010)(PETITION), at 1, as cited in M Gerrard, L6038, CLIMATE CHANGE LAW, (Columbia Law School Course Materials Vol.3, Spring 2011), at 186.

[26] Office of the United States Trade Representative, UNITED STATES REQUESTS WTO DISPUTE SETTLEMENT CONSULTATIONS ON CHINA'S SUBSIDIES FOR WIND POWER EQUIPMENT MANUFACTURERS, (Press Release, December 2010), available at http://www.ustr.gov/about-us/press-office/press-releases/2010/december/united-states-requests-wto-dispute-settlement-con

[27] PETITION; *supra* note 25, at 1.

accepted additional IPR–related obligations in joining the World Trade Organization (WTO) in 2001. However, uncertainty remains regarding the extent to which US IPR in CCS technology will be recognized and enforced in China, in terms of both existing US IPR associated with technology transfers for CCS projects, and future IPR that will be developed through collaboration with Chinese counterparts on Chinese CCS demonstration projects. This section will provide a brief overview of China's existing bilateral agreements with the US and Chinese WTO obligations to protect foreign intellectual property associated with imported technology, the nature of US concerns about inadequate recognition or enforcement of IPR in China, and recent developments that may provide greater flexibility and encourage closer collaboration in the future development of CCS technology.

A China's existing IP obligations – international and domestic

The Science and Technology Cooperation Agreement of 1979[28] after the resumption of US-Chinese trade relations, and the 1991 Amending Agreement established an initial IPR framework to govern the parties' collaboration on joint technological initiatives. The 1991 Annex on the Protection of Intellectual Property (Annex I) provides that the parties 'shall ensure adequate and effective protection of intellectual property created or furnished under this Agreement'. The IP Annex addresses the allocation of rights, interests and royalties between the parties in respect of the covered IP, and provides for dispute resolution through binding arbitration[29].

[28] AGREEMENT BETWEEN THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF CHINA ON COOPERATION IN SCIENCE AND TECHNOLOGY, (January 31 1979), available at http://www.us-china-cerc.org/pdfs/US_China_Scientific_Technological_31_Jan_1979.pdf

[29] AGREEMENT TO EXTEND AND AMEND THE AGREEMENT BETWEEN THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF CHINA ON COOPERATION IN SCIENCE AND TECHNOLOGY, (May 22 1991), available at http://www.us-china-cerc.org/pdfs/US_China_Scientific_Technological_22_May_1991.pdf

In 1992, the US and China entered into an MOU on the Protection of Intellectual Property, which imposed certain obligations on the Chinese government to both expand Chinese IP law and accede to certain multilateral IP agreements. The provisions implicated by CCS technology transfer, included Chinese patent[30] and 'trade secret' protections[31] for foreign IPR, and enforcement[32] obligations. This was followed by China's accession to the World Trade Organization (WTO) in 2001[33], and the establishment in 2004 of the US-China Intellectual Property Working Group of the Joint Commission of Commerce and Trade (JCCT)[34]. Most recently, in November 2009, the US and China established a bilateral $150 million joint research and development program in the U.S. – China Clean Energy Research Center (CERC)[35]. Through the CERC framework[36], the US and China have entered into Joint Work Plans in relation to Energy Efficiency, Clean Vehicles and a five-year Joint Work Plan for Advanced Coal, which focuses on the joint development of CCS technology in both China and the US[37].

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[30] This includes compulsory licensing under certain specified conditions: MEMORANDUM OF UNDERSTANDING BETWEEN THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF CHINA ON THE PROTECTION OF INTELLECTUAL PROPERTY, (MOU) (January 17 1992), Article 1, available at http://untreaty.un.org/unts/144078_158780/4/4/12279.pdf

[31] MOU*, id.,* Article 4.

[32] MOU, *supra* note 30, Article 5.

[33] The Protocol governing China's accession included a commitment to bring Chinese domestic IP laws into full compliance with the TRIPS Agreement and other multilateral trade agreements annexed to the WTO Agreement; WTO, ACCESSION OF THE PEOPLE'S REPUBLIC OF CHINA- DECISION OF 10 NOVEMBER 2001, WT/L/432 (23 November 2011), Article 2(A), available at http://www.worldtradelaw.net/misc/ChinaAccessionProtocol.pdf

[34] US Trade Representative, 2004 SPECIAL 301 REPORT – EXECUTIVE SUMMARY, available at http://www.ustraderep.gov/assets/Document_Library/Reports_Publications/2004/2004_Special_301/asset_upload_file963_5996.pdf

[35] PROTOCOL BETWEEN THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA AND THE MINISTRY OF SCIENCE AND TECHNOLOGY AND THE NATIONAL ENERGY ADMINISTRATION OF THE PEOPLE'S REPUBLIC OF CHINA FOR COOPERATION ON A CLEAN ENERGY RESEARCH CENTER (17 November 2009)(CERC PROTOCOL) and ANNEX I – INTELLECTUAL PROPERTY (CERC ANNEX I), available at http://www.us-china-cerc.org/pdfs/protocol.pdf

[36] CERC PROTOCOL, *id.*

[37] U.S.-China Clean Energy Research Center (CERC), JOINT WORK PLAN FOR RESEARCH ON CLEAN COAL INCLUDING CARBON CAPTURE AND STORAGE, (January 18 2011) at 1, available at http://www.us-china-cerc.org/pdfs/US/CERC-Coal_JWP_english_OCR_18_Jan_2011.pdf

In addition to China's extensive bilateral and multilateral IPR commitments, the Chinese government has embarked on a series of reforms to its domestic IP regime, particularly following the economic reforms involving the opening of domestic markets to international trade from 1978–1979[38]. The domestic Chinese legal regime includes a Trademark Law (1982), a Patent Law (1984), Copyright Law (1990), and consolidated Software regulations (1991), which were modified to align with WTO commitments after Chinese accession in 2001[39].

B Areas of concern for the US regarding IPR in technology transfer

Two areas of critical concern for the US are firstly, ensuring sufficient enforcement of existing US IPR brought to China in the transfer of CCS technology following the implementation of the Chinese Anti-Monopoly Law, and secondly, the interaction of the Chinese IP regime with its 'technology for markets' strategy. The US IPR concerns in relation to CCS technology stem from historical tensions between the US and Chinese governments in the context of trade disputes in the 1990s, which came 'close to a full-scale trade war'[40] over US concerns about inadequate Chinese enforcement of counterfeited US products, particularly in relation to software and films[41]. Although various forms of IPR are implicated by CCS technology, including patents, trademarks, and trade secrets or 'knowhow', the primary concern for IPR holders in the context of CCS technology concerns the enforcement of foreign patents[42].

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[38] Paul Crookes, INTELLECTUAL PROPERTY REGIME EVOLUTION IN CHINA AND INDIA-TECHNOLOGICAL, POLITICAL AND SOCIAL DRIVERS OF CHANGE, (Brill, The Netherlands, 2010), at 148.
[39] Paul Crookes*, id.,* at 149.
[40] Paul Crookes, *supra* note 38, at 151.
[41] Paul Crookes, *supra* note 38, at 151.
[42] Antony Taubman and Jayashree Watal, THE WTO TRIPS AGREEMENT – A PRACTICAL OVERVIEW FOR CLIMATE CHANGE POLICYMAKERS, 11.xii.2009. (Initial Consultation Draft, Intellectual Property Division of the WTO Secretariat, 2009), available at www.wto.org/english/tratop_e/trips.../trips_climat_change09_e.doc at 1.

From the perspective of US CCS technological proprietors holding IPR, the enforcement of the Chinese Anti-Monopoly Law (AML), introduced in 2007, may potentially weaken Chinese IPR enforcement efforts. The AML provides that the Chinese IP regime will distinguish between legitimate uses of IPR by business operators in accordance with Chinese IP laws and administrative regulations, and "abuses" of IPR[43]. The stated purposes of the AML are to protect the public interest and promote the Chinese socialist market economy[44]. In light of the ambiguous language used in the IPR provision of the AML concerning IPR 'abuses', and the AML's stated objectives, multinational corporations have raised concerns that Chinese antitrust regulators would have a basis for restraining foreign IPR holders from enforcing their IPR against domestic Chinese firms[45], despite China's extensive WTO commitments relating to IPR.

A second area of concern for US technological proprietors in the CCS context has been the Chinese practice of negotiating for technology transfer as a condition of foreign investment approval (providing access to the substantial and potentially lucrative Chinese market), which has been described as a 'technology for market' strategy[46]. Although technology transfer is not inherently problematic from an IPR perspective[47], the cumulative effect of China's 'technology for markets' strategy, combined with the perceived insufficient

[43] Anti-Monopoly Law (AML); Article 55, as cited in: Jones Day, NEW CHINESE ANTI-MONOPOLY LAW, (October 2007), available at http://www.jonesday.com/newsknowledge/publicationdetail.aspx?publication=4662
[44] The AML took effect on August 1, 2008: Jones Day, *id.*
[45] Jones Day, *supra* note 43.
[46] This argument formed a part of the recent USW petition to the USTR about Chinese WTO violations in the context of the Chinese renewable energy industry, and particularly wind farm subsidies: see PETITION, *supra* note 25, at 4.
[47] In fact, an objective of TRIPs is to *facilitate* technology transfer through ensuring minimum standards of IPR protection. Article 7 provides that the "protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology"; TRIPS: AGREEMENT ON TRADE-RELATED ASPECTS OF INTELLECTUAL PROPERTY RIGHTS, (April 15, 1994), Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, THE LEGAL TEXTS: THE RESULTS OF THE URUGUAY ROUND OF MULTILATERAL TRADE NEGOTIATIONS 320 (1999), 33 I.L.M. 1197 (1994), as cited in Sigrid Sterckx, *The WTO-TRIPs Patent Regime after Doha: promises and realities,* in Paul Torremans, Hailing Shan and Johan Erauw (Eds), INTELLECTUAL PROPERTY AND TRIPS COMPLIANCE IN CHINA, (Edward Elgar Publishing, UK 2007), at 208.

enforcement of foreign IPR in China[48] and implementation of the AML, have made some multinational technological proprietors (including US-based corporations) hesitant to enter into commercial agreements involving Chinese technology transfer[49]. The requirement for technology transfer without assurance of US-equivalent IPR protection has been, for several US companies in the renewable energy industry, an unattractive business proposition, particularly when the proprietary technology represents their commercial 'crown jewels' and the basis for their competitive market position[50].

C Recent developments

An emerging IPR issue in the context of greater collaboration between the US and China on a bilateral level and in the commercial sector on CCS deployment will be ensuring adequate protection of jointly developed IPR. If one of China's policy priorities in pursuing domestic CCS demonstration projects is developing an opportunity for future export growth[51], China will be interested in obtaining control over, or access to, emerging IPR jointly developed through Chinese CCS demonstration projects[52]. However, China's investment and technology partners, including the US, will expect equal access to that IPR as a condition of their involvement.

[48] Jingzhou Tao cites weak enforcement teams and poor coordination, local protectionism, non-deterrent administrative penalties and the prohibitive cost of enforcement as some of the problems encountered by the civil IP enforcement regime in China; Jingzhou Tao, *Problems and new developments in the enforcement of intellectual property rights in China*, in Paul Torremans, Hailing Shan and Johan Erauw (Eds), *id.*, at 108–110.
[49] Jones Day, *supra* note 43.
[50] The USW petition refers to public complaints made by GE and Siemens AG, and the required licensing of Evergreen Solar's solar wafer technology as a condition of Chinese investment in Evergreen's Chinese manufacturing plant pursuant to a joint venture agreement in 2009: PETITION, *supra* note 25, at 4.
[51] Richard Morse, Varun Rai and Gang He, *Digging In Deep*, BUSINESS FORUM CHINA, (February 2010) at 31, available at http://sprie.stanford.edu/publications/digging_in_deep_carbon_capture_and_storage_technology_in_china_is_driven_by_energy_security_concerns/
[52] Richard K. Morse, Varun Rai and Gang He, THE REAL DRIVERS OF CARBON CAPTURE AND STORAGE IN CHINA AND IMPLICATIONS FOR CLIMATE POLICY, (Working Paper 88, August 2009, Stanford Program on Energy and Sustainable Development (PESD), at 11, available at http://pesd.stanford.edu/publications/the_real_drivers_of_carbon_capture_and_storage_in_china_and_implications_for_climate_policy/

The US-Chinese bilateral approach under the CERC Protocol should provide a useful model for US-Chinese private sector collaboration going forward. This approach requires the negotiation and agreement *ex ante* of a 'Technology Management Plan' for the proper recognition and allocation of ownership and access to joint IPR (through licensing) and the respective obligations of the parties to a collaborative CCS project, without which a project cannot commence[53]. Addressing IPR obligations upfront will provide the maximum degree of certainty for investors and make the most of the leverage available to technological proprietors, before capital is committed to CCS project implementation. A detailed treatment of IPR in future collaborative CCS development efforts in China will be a necessary precondition to the 'scaling up'[54] of CCS technology to a commercial scale.

III Financing of Chinese CCS projects using US technology

Chinese CCS demonstration projects are being financed through a variety of domestic and international legal mechanisms that reflect the public or private nature of the investment. This section will provide a brief overview of the main sources of international financing for Chinese CCS demonstration projects, including international institutions, recent multilateral climate financing commitments, and existing sources of domestic Chinese and US investment. This will be followed by an assessment of present barriers to the growth of private sector investment in Chinese CCS projects, and the legal viability of additional potential investment mechanisms, including recognition under the Clean Development Mechanism (CDM) and a US coal export tariff on coal exports to China.

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[53] CERC ANNEX I, *supra* note 35, at Article II B. (2)(e).

[54] Fred Wellington, Rob Bradley, Britt Childs Staley, Clay Rigdon, Jonathan Pershing, SCALING UP: GLOBAL TECHNOLOGY DEPLOYMENT TO STABILIZE EMISSIONS, (World Resources Institute with the Goldman Sachs Center for Environmental Markets, April 2007) at 3, available at http://www.wri.org/publication/scaling-up

A International financing of Chinese CCS demonstration projects

In the short-term, financing through international institutions and multilateral fora will be critical in overcoming the uncertainty and substantial capital investment costs involved in developing initial CCS demonstration projects, particularly in developing countries such as China[55]. Recent examples from 2009 include the Carbon Capture and Storage Fund (valued at $21.5 million AUD) arising from a trust fund agreement between the Australian Government (through funding for the Global CCS Institute) and the Asian Development Bank, to support deployment of CCS demonstration projects in Asia (with priority being given to Chinese projects[56]). The Norwegian Government has also partnered with the Global CCS Institute to initiate a Carbon Capture and Storage Trust Fund (valued at $8 million USD), administered by the World Bank as a multi-donor trust fund for CCS deployment in developing countries. This fund will be administered through World Bank legal mechanisms, which include the provision of investment loans, credit and guarantees[57].

B Chinese and US financing of Chinese CCS demonstration projects

Despite historically falling behind the US in terms of research and development funding for CCS technology[58], the Chinese government and major Chinese corporations in the energy sector, including the Huaneng Group (China's largest power producer) and Shenhua Group (China's largest coal company) are increasingly involved in financing initial domestic CCS

[55] Richard Morse, Varun Rai and Gang He, *supra* note 52, at 4.
[56] UCL Carbon Capture Legal Programme, FINANCING CCS - OVERVIEW, available at http://www.ucl.ac.uk/cclp/ccsfinancing-overview.php
[57] UCL Carbon Capture Legal Programme*, id.*
[58] Kelly Sims Gallagher, KEY OPPORTUNITIES FOR U.S.-CHINA COOPERATION ON COAL AND CCS, (The John L. Thornton China Center at Brookings, December 2009), at 7, available at http://www.brookings.edu/papers/2009/12_us_china_coal_gallagher.aspx

demonstration projects, either unilaterally, or in conjunction with US or other international investors (in light of the high implementation costs of CCS demonstration projects)[59].

The Chinese National Development and Reform Commission (NDRC), the Ministry of Science and Technology (MOST) and the Chinese Academy of Sciences have provided some public research funding for domestic CCS technology development, predominantly in the area of pre-combustion capture technology, where CO_2 capture is less complicated and expensive relative to post-combustion technology[60]. Some of the more high-profile CCS demonstration projects led by domestic industry and receiving government funding include the Huaneng Group-led 'GreenGen' ICGCC plant project in Tianjin[61], the sequestration component of the Shenhua-led joint US-China coal-to-synfuels project in Ordos, Inner Mongolia[62] (involving West Virginia University), and the Thermal Power Research Institute/Huaneng post-combustion capture demonstration projects in Beijing and Shanghai[63]. The Huaneng Group and the ENN Group (a Chinese energy corporation) have also developed their own proprietary coal gasification technologies in the CCS sector[64].

US investment has come from both the US Government and major multinational and US corporations. The primary focus for US Government investment at the bilateral level (separate from its international and multilateral financial commitments), has been the CERC, as discussed in Section II. The US and Chinese Governments have made a joint commitment to a total of $150 million in financing, with the US Department of Energy (DOE) funding research performed exclusively by US research participants, and MOST and the NEA

[59] Kelly Sims Gallagher, *id.,* at 7.
[60] Kelly Sims Gallagher, *supra* note 58, at 7.
[61] The 'GreenGen' project is expected to cost approximately 7 billion Yuan, with 'start up' funding from MOST and construction loans and grants from the Asian Development Bank: Craig Hart and Hengwei Liu, *supra* note 15, at 109.
[62] This project is valued at approximately $1.46 billion (presumably USD), and has also received support from the Chinese NDRC and the US Department of Energy: Craig Hart and Hengwei Liu, *supra* note 15, at 111.
[63] Asia Society, *supra* note 2, at 39.
[64] NRDC, *supra* note 11, at 3.

funding only research performed by Chinese research participants, in collaborative research activities[65]. Funding has also been provided directly from several US universities. In 2009, for example, the Stanford Global Climate and Energy Project provided almost $2 million (USD) in funding for a three-year, international collaboration with Peking University, the China University of Geosciences at Wuhan and the University of Southern California to research issues arising from large-scale geological sequestration[66].

Although barriers to international private sector investment in the Chinese CCS sector persist, several multinational and US corporations (including Shell, Duke Energy and Peabody Energy) are becoming involved in Chinese CCS demonstration projects, predominantly through CCS technology transfer. Duke Energy signed an MOU with Huaneng in August 2009 for the development of renewable and clean energy technologies[67], and Peabody Energy has contributed CCS technology to the Chinese 'GreenGen' project[68]. Peabody also announced in January this year, its involvement with the China Huaneng Group and Calera Corporation (a Californian energy company) in developing a 'green coal energy campus' in the Xilinguole Region of Inner Mongolia. The energy project would include a 1,200 megawatt supercritical power plant that would capture a portion of carbon dioxide (CO_2) and convert it into green building materials, advancing carbon capture technology. The extent of Peabody's (presumed) financial investment has not been publicly disclosed[69].

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[65] CERC PROTOCOL, *supra* note 35, Article VI (2).
[66] Craig Hart and Hengwei Liu, *supra* note 15, at 114.
[67] Kelly Sims Gallagher, *supra* note 58, at 7.
[68] Kelly Sims Gallagher, *supra* note 58, at 7.
[69] Peabody Energy, CHINA HUANENG, PEABODY AND CALERA AGREE TO PURSUE DEVELOPMENT OF LOW-CARBON EMISSIONS CLEAN COAL PROJECT IN INNER MONGOLIA, (Press Release, January 20, 2011), available at http://phx.corporate-ir.net/phoenix.zhtml?c=129849&p=irol-newsArticle&ID=1518085&highlight=

C Barriers to additional private sector investment in Chinese CCS projects

There are many private multinational and US corporations that will have a vested interest in the future development of CCS technology, including GE, ConocoPhillips and Siemens (for combustion technology), Alstom, Praxair and Fluor (regarding carbon-capture technology) and the major oil companies (for sequestration technology)[70] – in light of the utility of CO_2 in Enhanced Oil Recovery (EOR)[71] operations. Although there is substantial commercial interest in the future successful deployment of CCS technology at a commercial scale, there are presently several barriers, specific to the CCS sector, to facilitating greater private sector investment in developing countries such as China.

Sources of concern identified by CCS industry stakeholders, including investors, are the lack of a carbon price signal, the fact that the introduction of a carbon price may not provide sufficient incentives for CCS project development without additional government financing[72], the untested nature of CCS technology, the lack of national regulatory frameworks for CCS project implementation, the need for more financial information about expected upfront capital investment costs and expected rates of return, and the need for sufficient certainty regarding specialized CCS-related insurance[73] or a governmental commitment to assume the long-term liability for potential leakage of sequestered carbon[74].

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[70] Varun Rai, David Victor and Mark Thurber, CARBON CAPTURE AND STORAGE AT SCALE: LESSONS FROM THE GROWTH OF ANALOGOUS ENERGY TECHNOLOGIES, (Stanford University Program on Energy and Sustainable Development, Working Paper 81, February 2009), at 15, available at http://irps.ucsd.edu/dgvictor/publications/Working%20Papers/WP81%20Carbon%20Capture%20&%20Storage.pdf

[71] CO_2 is injected into almost depleted oil wells to facilitate oil recovery. In this way, CO_2 is a valuable resource that can be used in EOR processes to offset the cost of CCS project implementation: Craig Hart and Hengwei Liu, *supra* note 15, at 108.

[72] UCL Carbon Capture Legal Programme, *supra* note 56.

[73] John Kessels and Brendan Beck, *Financing Carbon Capture and Storage Projects- the Results of Two Expert Meetings*, ENERGY PROCEDIA I (2009: 4475-4479) at 4477.

[74] The Climate Group, CARBON CAPTURE AND STORAGE: MOBILISING PRIVATE SECTOR FINANCE, (September 20, 2010), available at http://www.theclimategroup.org/publications/2010/9/20/ccs-mobilising-private-sector-finance/

The introduction of CCS technology in coal-fired power plants also involves an 'energy penalty' that has adverse economic implications for private sector investors. The carbon capture aspect of CCS technology reduces power generation efficiency by 20-30 per cent, which in turn requires an increase in coal consumption by approximately 20-25 per cent to generate the same amount of electricity, placing increasing pressure on constrained global coal supply chains[75]. Other considerations for private sector investors include the extensive water demands of CCS technology and the regulation of adverse environmental impacts of coal extraction.

D Options for facilitating additional financing

In addition to addressing some of the identified barriers to attracting further private sector financing from multinational and US-based corporations, other proposals have been made to facilitate additional CCS financing in China. These include the recognition of CCS as an eligible 'project activity' under the CDM, and US proposals to levy a targeted coal export tariff on exports to China to finance CCS project development.

(i) Recognition of CCS demonstration projects in the CDM

In light of the obligation of all Annex I parties to the United Nations Framework Convention on Climate Change (UNFCCC) in Article 4.5[76] to finance and promote technology transfer to developing countries, the Kyoto Protocol's Clean Development Mechanism (CDM) may provide a future source of additional financing for CCS demonstration projects in China, if the CDM is retained in any post-Kyoto multilateral agreement. The declaration issued at the seventh Conference of the Parties (COP 7) in 2001

[75] Richard Morse, Varun Rai and Gang He, *supra* note 51, at 32.
[76] Article 4.5 requires all Annex I countries to take "All practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other parties, particularly developing countries, to enable them to implement provisions of the convention": UN FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC), May 9, 1992, 1771 UNTS 108, 31 ILM 849 (1992).

indicated that the Article 4.5 obligation applied to the financing and deployment of CCS technology equally with other climate change mitigation options[77].

At the sixth meeting of the parties to the Kyoto Protocol (CMP.6) in Cancun in December 2010, the parties determined that CCS "is eligible as project activities under the CDM"[78], provided that certain issues identified in the fifth meeting of the parties (CMP.5)[79] were "addressed and resolved in a satisfactory manner". CMP.6 also requested the Subsidiary Body for Scientific and Technological Advice to the UNFCCC to prepare modalities and procedures for the future inclusion of CCS within the CDM[80]. As a result, although CCS technology has now been given conditional approval for CDM project registration, it will not be an eligible project activity in the CDM in the immediate future.

Inclusion in the CDM would provide an additional source of international financing of CCS projects in China, through the purchase of Certified Emissions Reduction (CER) offsets by UNFCCC parties to satisfy their compliance obligations. However, the projected timeframes for CCS technology to 'scale up' to the commercial implementation phase[81], the likelihood that the value of CERs will remain too low to incentivize registration of CCS

[77] Paragraph 8, item (d) states: "Cooperating in the development, diffusion and transfer (...) and/or technologies relating to fossil fuels that capture and store GHGs, and encouraging their wider use, and facilitating the participation of the least developed countries and other Parties not included in Annex I in this effort": *Matters relating to Article 3, paragraph 14, of the Kyoto Protocol*, DECISION 9/CP.7, (FCCC/CP/2001/13/Add.1), as cited in the IPCC SPECIAL REPORT ON CARBON DIOXIDE CAPTURE AND STORAGE, (2005: IPCC, Geneva, Switzerland) at 70, available at http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

[78] Article 1, DECISION 7/CMP.6, *Carbon dioxide capture and storage in geological formations as clean development mechanism project activities*, FCCC/KP/CMP/2010/12/Add.2, available at http://unfccc.int/resource/docs/2010/cmp6/eng/12a02.pdf#page=27

[79] The issues identified in DECISION 2/CMP.5 were: 'non-permanence, including long-term permanence; measuring, reporting and verification; environmental impacts; project activity boundaries; international law; liability; and the potential for perverse outcomes; safety; insurance coverage and compensation for damages caused due to seepage or leakage.

[80] Article 2, DECISION 7/CMP.6, 'Carbon dioxide capture and storage in geological formations as clean development mechanism project activities', FCCC/KP/CMP/2010/12/Add.2, (10th plenary meeting, 10–11 December 2010), available at http://unfccc.int/resource/docs/2010/cmp6/eng/12a02.pdf#page=27

[81] It has been projected that it will take years, if not decades, for 'prototypical technologies' such as CCS to be commercialized at a sufficient scale: Fred Wellington et. al, *supra* note 54, at 10.

projects under the CDM[82], and the increasing problem of establishing 'additionality' for Chinese renewable and 'clean' energy projects[83] under the CDM procedures will limit the role of CDM financing in future Chinese CCS technology development.

(ii) Linkages between US coal exports and Chinese CCS development – viability of a US coal export tariff

An additional mechanism that has been proposed in the US for financing the development of Chinese CCS demonstration projects would involve a coal export tariff or targeted fee on coal exports to China[84]. Unlike the current Chinese export tariff on 'rare earth' minerals[85], which discourages trade in these highly valued commodities, a US coal export tariff could build upon existing US CCS technology transfer initiatives, in directly financing the implementation of Chinese CCS demonstration projects. The US Government could use the US taxation system to apportion the proceeds between US and international CCS demonstration projects, with an emphasis on Chinese CCS projects. As between the US and China, the US export tax revenue could be legally committed to Chinese CCS development either through an amendment to the CERC Protocol (as a component of the Clean Coal Research and Development Work Plan), or through a separate bilateral agreement.

Despite these potential benefits, there are numerous legal, economic and political problems with the implementation of a US export-based coal tariff. Although export tariffs

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[82] Richard Morse, Varun Rai and Gang He, *supra* note 52, at 19.

[83] China has recently set ambitious domestic renewable energy and energy efficiency targets, mandated by law: Craig Hart and Hengwei Liu, *supra* note 15, at 101. The energy sector is generally heavily regulated and primarily involves state-owned entities. Together, these factors reduce the likelihood that Chinese CCS projects would satisfy the CDM Executive Board's 'additionality' requirements for eligible projects: Michael Wara, *Measuring the Clean Development Mechanism's Performance and Potential*, 55 UCLA LAW REV. 1759 (2008) at 1790. 'Additionality' refers to the requirement that the emissions reductions achieved by a CDM project are additional to those reductions that would otherwise occur in the project 'host' country.

[84] Columbia Center for Climate Change Law, *Carbon Offshoring: India, China buying U.S. coal mines, shale gas fields, LNG terminals*, CLIMATE LAW BLOG (November 18, 2010), available at http://blogs.law.columbia.edu/climatechange/2010/11/18/carbon-offshoring-indian-and-china-are-buying-u-s-coal-mines-shale-gas-fields-lng-terminals/

[85] Reuters, CHINA TO RAISE RARE EARTH EXPORT TARIFFS IN 2011, (December 14, 2010), available at http://www.reuters.com/article/2010/12/14/us-china-tariffs-idUSTRE6BD0WA20101214

are consistent with the WTO framework of multilateral agreements (with approximately one third of WTO Members imposing some form of export duty[86]) and are not prohibited as part of any current regional or bilateral US agreement with China[87], they are problematic under US law.

As a matter of US domestic law, export tariffs are unconstitutional in so far as they are characterized as a 'tax' or a 'duty laid on Articles exported from any state' under the 'Export Clause' of the US Constitution[88]. US Supreme Court jurisprudence has consistently held that the Export Clause 'categorically bars Congress from imposing any tax on exports'[89].

In addition to exposure to constitutional challenges, a US coal export tariff or dedicated fee towards investment in Chinese CCS demonstration projects would not be economically or politically viable for the US. Economically, although China is now a net importer of coal[90], China could simply substitute US coal imports with imports from other net coal exporting nations such as Australia, in response to higher US coal prices following the imposition of a US coal export tariff. If China's core strategic energy objectives are securing energy independence and security, rather than CO_2 mitigation[91], it is uncertain whether China would welcome CO_2 mitigation measures designed to increase domestic CCS investment unless those measures satisfied Chinese strategic objectives.

Politically, it is also highly unlikely that either the Chinese Government or US coal producers would support the imposition of a targeted US coal export tariff. The Chinese

[86] Roberta Piermartini, THE ROLE OF EXPORT TAXES IN THE FIELD OF PRIMARY COMMODITIES, (WTO, Geneva, Switzerland 2004) at 2, available at http://www.wto.org/english/res_e/booksp_e/discussion_papers4_e.pdf
[87] Roberta Piermartini, *id.,* at 2.
[88] THE CONSTITUTION OF THE UNITED STATES, Article 1, Section 9, Clause 5.
[89] *United States v IBM Corporation*., 517 U.S. 843 (1996); *United States v United States Shoe Corp*., 523 U.S. 360, 363 (1998).
[90] In 2003, China exported 83 million more tons of coal than it imported, yet by 2010, it imported 140 million tons more than it shipped out: Jeffrey Tomich, *Arch, Peabody seek coal exporting deals to Asia*, STL TODAY (December 27, 2010), available at http://www.stltoday.com/business/local/article_c721c19d-55a6-5fe6-9d83-606f1926a67c.html
[91] Richard K. Morse, Varun Rai and Gang He, *supra* note 52, at 5.

Government would not accept US financing in circumstances where it would have limited control over where it would be directed. The Chinese Government would also potentially find a US export tariff objectionable in being generally inconsistent with the US Government's position in the various WTO multilateral negotiating rounds advocating reductions in international trade barriers. US coal producers would also resent any additional regulation that could potentially raise their production costs and reduce Chinese demand for US coal, rendering US coal companies uncompetitive in the international coal export market, particularly in circumstances where access to the Chinese coal market has become an increasingly important strategic priority for the major US coal companies, such as Peabody Energy and Arch[92] in light of declining US domestic demand for coal[93].

Coal export tariffs or dedicated fees are one of several potential measures that could foster linkages between US international coal exports and Chinese CCS project development. However such measures raise broader legal, political and economic problems in determining the extent to which one country should be held responsible for the carbon emissions it exports to other countries in the course of international trade. This is a more complex question that extends well beyond coal exports, and demonstrates the increasing need for the UNFCCC multilateral process to engage with the potential conflict between international climate mitigation obligations and the WTO imperative of reducing economic barriers to international trade[94].

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[92] Kelsey Volkmann, *Peabody, Arch make big bets on Asia*, ST LOUIS BUSINESS JOURNAL (January 21, 2011), available at http://www.bizjournals.com/stlouis/print-edition/2011/01/21/peabody-arch-make-big-bets-on-asia.html

[93] Washington State is one example of a US state facing the dilemma of considering the greenhouse gas implications of its exports, having set a goal of reducing its own greenhouse gas emissions to 1990 levels by 2020. It is currently considering whether to approve a new port terminal in Cowlitz County, and is under pressure from Montana to grant approval, in light of Montana's planned future coal exports to Asia from the port: see Josh Goodman, *Should a Green State Ship Coal to China?,* STATELINE (April 13, 2011), available at http://www.stateline.org/live/details/story?contentId=567104

[94] Gabrielle Marceau, *The WTO and Climate Finance- Overview of Key Issues,* at 250, in CLIMATE FINANCE, as extracted in M Gerrard, L6038, CLIMATE CHANGE LAW, (Columbia Law School Course Materials Vol.3, Spring 2011), at 138.

IV Chinese regulatory implications of US CCS technology transfer

As CCS demonstration projects are developed in China, the US Government, private sector investors and stakeholders in the CDM will increasingly expect stringent domestic Chinese regulation of the CCS industry as a condition of financing, facilitating technology transfer and the ability to earn CERs under the CDM[95]. A comprehensive Chinese CCS regulatory regime will reduce project implementation uncertainties, clarify the allocation of potential short and long term liabilities between project partners, and improve the overall environmental outcomes of CCS demonstration projects. A robust Chinese CCS regulatory regime will also serve US domestic interests in demonstrating the safety of CCS technology within a regulated environment, facilitating the earlier deployment of demonstration CCS technology in the US.

There are currently no explicit CCS regulations in China[96]. However, the NRDC has noted the existence of over a dozen different domestic laws and regulations administered by different government agencies that could impact on Chinese CCS projects. As such, NRDC recommends that China implement a regulatory framework that addresses energy policy and enforcement issues, including environmental, health and safety requirements for future Chinese CCS projects[97]. The World Resources Institute is also collaborating with Tsinghua

[95] WRI has prepared a set of recommendations on technical and regulatory issues for the UNFCCC parties to consider, in the progressive integration of CCS project activities into the CDM. Their recommendations include the need for an environmental regulatory framework that ensures long-term permanence of CO_2 storage, the need for stringent measuring, monitoring, and verification efforts, a comprehensive EIS process, safety requirements, a long-term liability framework and insurance coverage and potentially a national trust fund for long-term stewardship of geological storage sites: Sarah Forbes and Micah Ziegler, CARBON DIOXIDE CAPTURE AND STORAGE AND THE UNFCCC – RECOMMENDATIONS FOR ADDRESSING TECHNICAL ISSUES, (WRI Issue Brief, November 2010), at 3, available at http://www.wri.org/publication/carbon-dioxide-capture-and-storage-and-the-UNFCCC. A much more detailed WRI publication has also been released, providing specific technical guidelines for each step in the CCS technological process: WRI, CCS GUIDELINES: GUIDELINES FOR CARBON DIOXIDE CAPTURE, TRANSPORT AND STORAGE, (WRI, Washington DC, 2008), available at http://www.wri.org/publication/ccs-guidelines
[96] NRDC, *supra* note 11, at 3.
[97] NRDC, *supra* note 11, at 3.

through the Asia Pacific Partnership to specifically address emerging Chinese CCS regulatory and liability issues[98].

Conclusion

This paper has provided a survey of some of the legal, political and economic implications of the involvement of US public and private investors and CCS technological proprietors in Chinese CCS demonstration projects, and the legal mechanisms currently available to facilitate their involvement. Barriers to implementation of wide-scale Chinese CCS demonstration projects remain, in terms of existing Chinese regulation of intellectual property and CCS technology, which impacts upon the Chinese ability to attract additional US and other international private sector investment. However, these barriers are not insurmountable.

It remains to be seen whether, after a necessary research and development and demonstration period, the economics of CCS technology will be sufficiently attractive to secure its place in providing for future US and Chinese domestic energy security and emissions reduction commitments. Even in a future carbon-constrained regulatory environment, other renewable technologies may ultimately prove economically more attractive and environmentally sound than CCS.

[98] Kelly Sims Gallagher, *supra* note 58, at 7.