

LESSONS FROM CHINA'S CARBON MARKETS FOR U.S. CLIMATE CHANGE POLICY

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INTRODUCTION

"I thought it was snowing. . . . Then I realized it wasn't snow. I have not seen the sun for a long time." Wu Kai, a Chinese citizen in Harbin, described the heavy smog that enveloped parts of northeast China in October 2013.¹ Harbin, the capital of Heilongjiang province, closed all primary and middle schools, as well as its airport.² Heilongjiang province shut down major highways because the smog reduced visibility to less than fifty meters.³ Concentrations of fine particulate matter in the air reached one thousand micrograms per cubic meter, and were classified as hazardous to human health.⁴

At more than forty times the recommended limit,⁵ the Harbin smog represents a deadly air pollution problem that is symptomatic of China's larger environmental crisis. Sixteen of the twenty most polluted cities in the world are located in China.⁶ Citywide shutdowns due to smog are becoming routine in the country, where its capital Beijing saw PM_{2.5} concentrations of nine hundred micrograms per cubic meter in January 2013.⁷ That smog shutdown was dubbed both "Airmageddon"

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¹ Louise Watt, *Super Smog Hits Chinese City as Air Pollution Soars to 40 Times Higher than International Safety Standard*, HUFFINGTONPOST (Oct. 21, 2013, 12:47 a.m.), http://www.huffingtonpost.com/2013/10/21/super-smog-beijing-china_n_4134226.html, archived at <http://perma.cc/S9HE-EZ8C>.

² *Id.*

³ *Id.*

⁴ *Id.*

⁵ *Id.*

⁶ Keith Wagstaff, *China's Massive Pollution Problem*, THE WEEK (Nov. 9, 2013), <https://puttingcanadafirst.ca/site/chinas-massive-pollution-problem>, archived at <http://perma.cc/3G5B-BARU>.

⁷ Tania Branigan, *Beijing Smog Continues as Chinese State Media Urge More Action*, GUARDIAN (Jan. 14, 2013), <http://www.theguardian.com/world/2013/jan/14/beijing-smog-continues-media-action>, archived at <http://perma.cc/QL9P-6ERF>.

and the “Airpocalypse,” and described as “the worst January smog since 1954.”⁸

Fine particulate matter originates primarily from combustion sources.⁹ The October 2013 smog shutdown was caused because Harbin turned on its heating system and people began burning more coal to stay warm.¹⁰ Coal combustion emits fine particulate matter, as well as greenhouse gases like carbon dioxide.¹¹ The smog shutdowns plaguing China indicate that greenhouse gas emissions are reaching dangerous new levels, along with air pollutants. Air pollution is perhaps the most visible symptom of China’s environmental crisis, but projected changes in global temperatures due to climate change will have more permanent and global reach than smog shutdowns.

Due in large part to the increasing frustration over deadly air pollution,¹² the Chinese government has recently put an unprecedented focus on its environmental policy.¹³ Starting with its 11th Five Year Plan in 2006, the Chinese government elevated its environmental targets to the highest level of priority previously reserved for only the most important state objectives, namely economic growth and stability.¹⁴ China’s 12th Five Year Plan, released in 2011, set even more ambitious environmental goals, chief among them the implementation of a national carbon trading scheme by 2015 to reduce carbon intensity (the amount of carbon dioxide emissions per unit GDP) by 17% by 2015.¹⁵ Since then, the Chinese

⁸ Damian Grammaticas, ‘*Airmageddon: China Smog Raises Modernisation Doubts*, BBC NEWS (Jan. 31, 2013, 7:43 a.m.), <http://www.bbc.co.uk/news/world-asia-china-21272328>, archived at <http://perma.cc/XD73-X8S5>.

⁹ WORLD HEALTH ORG., WHO AIR QUALITY GUIDELINES FOR PARTICULATE MATTER, OZONE, NITROGEN DIOXIDE AND SULFUR DIOXIDE 10 (2005).

¹⁰ Watt, *supra* note 1.

¹¹ *Air Emissions*, U.S. ENVTL. PROT. AGENCY, <http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html> (last updated Sept. 25, 2013), archived at <http://perma.cc/9X2G-3NRC>.

¹² Edward Wong, *Outrage Grows over Air Pollution and China’s Response*, N.Y. TIMES (Dec. 6, 2011), <http://www.nytimes.com/2011/12/07/world/asia/beijing-journal-anger-grows-over-air-pollution-in-china.html>, archived at <http://perma.cc/HU8U-AAUB>.

¹³ Chris Buckley, *Silver Lining in China’s Smog as it Puts Focus on Emissions*, N.Y. TIMES (Aug. 31, 2013), <http://www.nytimes.com/2013/09/01/world/asia/silver-lining-in-chinas-smog-as-it-puts-focus-on-emissions.html>, archived at <http://perma.cc/DUC5-HY3R>.

¹⁴ Alex L. Wang, *The Search for Sustainable Legitimacy: Environmental Law and Bureaucracy In China*, 37 HARV. ENVTL. L. REV. 365, 368 (2013).

¹⁵ GUOYI HAN ET AL., CHINA’S CARBON EMISSION TRADING: AN OVERVIEW OF CURRENT DEVELOPMENT (2012), available at <http://www.sei-international.org/mediamanager/Documents/Publications/china-cluster/SEI-FORES-2012-China-Carbon-Emissions.pdf>; Deborah Seligsohn & Angel Hsu, *How Does China’s 12th Five-Year Plan Address Energy and the Environment?*, WORLD RES. INST., (Mar. 7, 2011), <http://www.wri.org/blog/how>

government has taken even more progressive steps, aiming to reduce carbon intensity by 40–45% below 2005 levels by 2020.¹⁶ Officials have even announced that they expect to launch a nationwide emissions trading scheme as early as 2018.¹⁷

Although not compelled by apocalyptic smog shutdowns, the United States has also set carbon reduction goals, pledging to reduce carbon dioxide emissions by 17% below 2005 levels by 2020.¹⁸ The United States government has elected to focus on using more renewable energy and setting higher energy efficiency standards, rather than a national carbon market.¹⁹ In order to reach this goal, the Environmental Protection Agency has proposed a Clean Power Plan that specifically targets the energy sector.²⁰ This plan seeks to cut carbon emission from power plants by 30% below 2005 levels by 2030.²¹ It does so by setting state-specific emissions reduction goals for all states with fossil fuel powered plants.²² While EPA sets the state's reduction goal, each state is free to choose the methods it will use to reduce the carbon intensity of its energy sector, and even to collaborate with other states in multistate plans.²³

This Note proposes that the most effective way to meet the United States' carbon emissions reduction goals for 2020 and beyond is to learn from China's new policy of linking environmental, public health, and economic goals, specifically by implementing a national carbon market. Part I of this Note explores carbon policies in China and the United States. Part II analyzes the urgent need for China and the United States

-does-china%E2%80%99s-12th-five-year-plan-address-energy-and-environment, *archived at* <http://perma.cc/X88Z-2UTN>.

¹⁶ Wang Shu, *Recent Developments of Chinese ETC*, P'SHIP FOR MKT. READINESS (Mar. 5, 2014), https://www.thepmr.org/system/files/documents/China_Recent%20Development%20of%20China%27s%20ETS%20%28PMR%20in%20Mexico%2920140305.pdf.

¹⁷ *Id.*

¹⁸ EXECUTIVE OFFICE OF THE PRESIDENT, THE PRESIDENT'S CLIMATE ACTION PLAN 4 (2013), *available at* <http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>.

¹⁹ *FACT SHEET: President Obama's Climate Action Plan*, WHITE HOUSE OFFICE OF THE PRESS SEC'Y (June 25, 2013), <http://www.whitehouse.gov/the-press-office/2013/06/25/fact-sheet-president-obama-s-climate-action-plan>, *archived at* <http://perma.cc/SXR7-XLJY>.

²⁰ *FACT SHEET: Clean Power Plan Overview*, U.S. ENVTL. PROT. AGENCY, <http://www2.epa.gov/carbon-pollution-standards/fact-sheet-clean-power-plan-overview> (last updated June 13, 2014), *archived at* <http://perma.cc/EF39-MVH7>.

²¹ *FACT SHEET: Clean Power Plan Framework*, U.S. ENVTL. PROT. AGENCY, <http://www2.epa.gov/carbon-pollution-standards/fact-sheet-clean-power-plan-framework> (last updated June 13, 2014), *archived at* <http://perma.cc/ZR44-P64G>.

²² *Id.*

²³ *Id.* at 1–3.

to take drastic action to cut their carbon emissions. Part III of this Note argues that emissions trading schemes are the best solution to reducing global greenhouse gas emissions.

Part IV of this Note provides general background on how carbon markets work. Part V of this Note evaluates the progress of China's carbon markets. Part VI of this Note analyzes the lessons that the United States can learn from China's carbon market attempts.

I. CHINESE AND AMERICAN CLIMATE CHANGE POLICIES

The United States continues to be the world's second largest producer of carbon dioxide emissions, despite its recent reduction efforts.²⁴ Recently, carbon dioxide emissions have fallen more rapidly than experts have predicted.²⁵ The United States emitted 1.4 billion tons of carbon dioxide in 2012, the lowest amount since 1994.²⁶ After peaking at over 1.6 billion tons in 2007, the United States has reduced its carbon dioxide emissions every year since then, except for 2010.²⁷

These drops, however, have been fueled in part by temporary or unpredictable factors, such as unusually warm winters and economic recession.²⁸ For a more permanent and ambitious solution, the United States' best course of action is a mandatory, legally binding national carbon market.

Although there is no current national carbon exchange framework, multiple regions within the United States have taken the initiative to form their own regional carbon markets. The Northeast Regional Greenhouse Gas Initiative ("RGGI") covers carbon emissions from power plants in ten states in the United States Northeast.²⁹ Launched in 2009, the RGGI's goal is to reduce emissions by 10% below 2009 levels by

²⁴ *Overview Data for United States: Carbon Dioxide Emissions*, U.S. ENERGY INFO. ADMIN., <http://www.eia.gov/countries/country-data.cfm?fips=US&trk=m> (last updated May. 30, 2013), *archived at* <http://perma.cc/FL4C-YMHL>.

²⁵ See Wendy Koch, *U.S. Carbon Emissions Hit Lowest Level Since 1994*, USA TODAY (Oct. 21, 2013, 6:04 p.m.), <http://www.usatoday.com/story/news/nation/2013/10/21/us-carbon-emissions-energy-lowest-1994/3146123/>, *archived at* <http://perma.cc/D3EJ-F6FW>.

²⁶ *Id.*; *Energy-Related Carbon Dioxide Emissions Declined in 2012*, U.S. ENERGY INFO. ADMIN. (Apr. 5, 2013), <http://www.eia.gov/todayinenergy/detail.cfm?id=10691>, *archived at* <http://perma.cc/9DYU-WJFZ>; Emily E. Adams, *U.S. Carbon Dioxide Emissions Down 11 Percent Since 2007*, EARTH POLICY INST. (Oct. 2, 2013), http://www.earth-policy.org/data_highlights/2013/highlights41, *archived at* <http://perma.cc/G24Z-QUD7>.

²⁷ U.S. ENERGY INFO. ADMIN., *supra* note 26; Adams, *supra* note 26.

²⁸ Koch, *supra* note 25; U.S. ENERGY INFO. ADMIN., *supra* note 26; Adams, *supra* note 26.

²⁹ HAN ET AL., *supra* note 15, at 10.

2018.³⁰ The RGGI is associated with five offset programs, which include capturing methane from landfills and livestock manure.³¹

Two recent regional carbon markets in the United States both center on California. The California Climate Change Law Exchange launched on January 1, 2013 with a goal of cutting emissions to 1990 levels by 2020.³² The California Exchange covers 85% of the state's carbon emitters, making it one of the largest carbon markets in the world, second only to the European Union's.³³ The market's first five quarterly auctions were widely considered successful, resulting in plans to double the cap in 2015 to include transportation fuels and natural gas distributors.³⁴ California formally linked its cap-and-trade program with Quebec's similar program on January 1, 2014.³⁵

The only nationwide carbon exchange in United States history was the voluntary Chicago Carbon Exchange ("CCX"), which lasted from 2003 to 2010.³⁶ At its height, the CCX included 450 power companies, manufacturers, cities, and universities.³⁷ Its commitments were legally binding upon members and, despite its voluntary status, it attracted a number of influential parties, such as Ford, Motorola, DuPont, and International Paper.³⁸ After eight years, CCX's market collapsed due to an inflated number of credits from offset programs, cutting the permit prices to a nickel per unit.³⁹

The CCX experiment was not a total loss, however, as it resulted in a reduction of 700 million metric tons of carbon dioxide since 2003.⁴⁰

³⁰ *Id.*

³¹ *Id.*

³² KATHERINE HSRA-KIUNG ET AL., CARBON MARKET CALIFORNIA: A COMPREHENSIVE ANALYSIS OF THE GOLDEN STATE'S CAP-AND-TRADE PROGRAM, ENVTL. DEF. FUND vi (2014), available at http://www.edf.org/sites/default/files/content/executive_summary_v2.pdf.

³³ *Id.*

³⁴ *Id.* at vi–vii.

³⁵ *Id.* at viii.

³⁶ Marianne Lavelle, *A U.S. Cap-and-Trade Experiment to End*, NAT'L GEOGRAPHIC NEWS (Nov. 3, 2010), <http://news.nationalgeographic.com/news/news/energy/2010/11/101103-chicago-climate-exchange-cap-and-trade-election/>, archived at <http://perma.cc/5WZQ-UASJ>.

³⁷ *Id.*

³⁸ *Id.*

³⁹ Nathaniel Gronewold, *Chicago Climate Exchange Closes Nation's First Cap-and-Trade System but Keeps Eye to the Future*, N.Y. TIMES (Jan. 3, 2011), <http://www.nytimes.com/cwire/2011/01/03/03climatewire-chicago-climate-exchange-closes-but-keeps-ey-78598.html?pagewanted=all>, archived at <http://perma.cc/RM96-V9TG>.

⁴⁰ Lavelle, *supra* note 36.

Eighty-eight percent of those cuts came from industrial emission reductions, while 12% came from offset programs such as tree planting.⁴¹

CCX's existence also indicates that companies and industries are not as opposed to carbon exchanges as the current divisive political climate might suggest.⁴² As one representative for a former party to the CCX said, "Many of us were doing this not only to make voluntary commitments, but as a way that we could get prepared for a mandatory future. . . . We were learning the ropes, learning about trading and trying to become more proficient in reducing our carbon footprint over time."⁴³ This suggests that not only can companies and industries learn to adapt to mandatory carbon markets, but that a number are eager to do so.

CCX's demise may have been tied to the failure of another national cap-and-trade effort in 2009. The American Clean Energy and Security Act of 2009 ("ACESA") is the origin of the 17% reduction by 2020 goal for carbon dioxide emissions.⁴⁴ The bill would have implemented a mandatory, national carbon market by 2016, with emissions cuts starting in 2012.⁴⁵ The bill extended emissions goals to 42% below 2005 levels by 2030, and to more than 80% below 2005 levels by 2050.⁴⁶ The ACESA market would have started with 85% of the permits being "grandfathered in" or distributed for free.⁴⁷ Most of those free permits would have gone to local electricity distribution companies, as well as energy-intensive industries like iron, steel, cement, and paper.⁴⁸

The carbon market would have allowed up to two billion tons of total emissions reductions to be achieved using offsets.⁴⁹ Approximately half of these offset programs would have taken place in the United States, and half would have been international.⁵⁰ The bill also included stricter energy efficiency standards, investments in energy technology, and a

⁴¹ *Id.*

⁴² *See id.*

⁴³ *Id.*

⁴⁴ Kate Sheppard, *Everything You Always Wanted to Know About the Waxman-Markey Energy/Climate Bill—In Bullet Points*, GRIST (June 4, 2009, 6:43 a.m.), <http://grist.org/article/2009-06-03-waxman-markey-bill-breakdown/>, archived at <http://perma.cc/ZUA4-BXR9>.

⁴⁵ *Id.*

⁴⁶ *Id.*

⁴⁷ *Id.*

⁴⁸ *Id.*

⁴⁹ *Id.*

⁵⁰ Sheppard, *supra* note 44.

Renewable Electricity Standard requiring utility companies to increase their use of renewable energy.⁵¹

According to a 2009 EPA study, the bill would have delayed energy consumption levels that the United States is currently scheduled to reach in 2015 until 2040.⁵² The bill would have also increased the market share of low carbon energy (including renewables and nuclear) to 18% by 2020, 26% by 2030, and 30% by 2050.⁵³ Without the bill, the market share is projected to remain steady at 14%.⁵⁴

ACESA passed in the Democrat-controlled House of Representatives by a narrow margin of 219–212.⁵⁵ The vote largely proceeded along party lines, with 43 Democrats voting against it, and only 8 Republicans voting for it.⁵⁶ The Senate never brought the bill to a vote, effectively killing the legislation.⁵⁷ A similar bill is unlikely to pass the current Republican-controlled House of Representatives, though many of the energy efficiency standards and investments in renewable energy technology have been resurrected in President Obama's 2013 Climate Action Plan, and later in EPA's Clean Power Plan.⁵⁸

The Clean Power Plan sets rate-based goals for each state to reduce the carbon intensity of its fuel-powered power plants.⁵⁹ While EPA sets states' goals, it allows each state the flexibility to implement whichever methods it chooses to meet the goal.⁶⁰ EPA does, however, provide four "building blocks" for the state to choose from in order to construct its reduction strategy.⁶¹ These building blocks include: (1) improving the efficiency of fossil fuel plants; (2) using low-emitting power sources more frequently;

⁵¹ *Id.*

⁵² OFFICE OF ATMOSPHERIC PROGRAMS, EPA ANALYSIS OF THE AMERICAN CLEAN ENERGY AND SECURITY ACT OF 2009: H.R. 2454 IN THE 111TH CONGRESS, U.S. ENVTL. PROT. AGENCY 3 (2009), available at http://www.epa.gov/climatechange/Downloads/EPAactivities/HR2454_Analysis.pdf.

⁵³ *Id.*

⁵⁴ *Id.*

⁵⁵ *H.R. 2454 (111th): American Clean Energy and Security Act of 2009*, GOVTRACK.US, <https://www.govtrack.us/congress/votes/111-2009/h477> (last visited Jan. 15, 2015), archived at <http://perma.cc/3LQ4-P94H>.

⁵⁶ *Id.*

⁵⁷ *Id.*

⁵⁸ *FACT SHEET: President Obama's Climate Action Plan*, *supra* note 19.

⁵⁹ *FACT SHEET: Clean Power Plan Framework*, *supra* note 21, at 1.

⁶⁰ *Id.* at 2.

⁶¹ *Id.*

(3) using more low-emitting power sources; and (4) making more efficient use of electricity.⁶²

However, these state-specific standards alone may not result in the 17% reduction in United States emissions by 2020 needed to slow the rise of global temperatures.⁶³ China has reacted to its environmental and public health crisis with ambitious goals that utilize the power of carbon markets, an option that EPA needs to consider.

II. CHINA MAKES ITS MOVE TO ADDRESS A GLOBAL CRISIS

In 1990, China was responsible for 10% of the world's greenhouse gas emissions.⁶⁴ By 2013, it was responsible for 30%.⁶⁵ China has been the largest producer of carbon dioxide emissions since 2006, and its emissions more than doubled between 2000 and 2011.⁶⁶ This is largely due to China's heavy reliance on coal, which comprises 70% of its total energy consumption.⁶⁷ China is the world's largest coal consumer, burning through nearly as much coal as every other country in the world combined.⁶⁸

This heavy coal consumption has serious implications beyond hazardous air pollution because coal combustion releases 30% more carbon dioxide than petroleum and 78% more carbon dioxide than natural

⁶² *Id.* at 2–3.

⁶³ NICHOLAS M. BIANCO ET AL., CAN THE US GET THERE FROM HERE?: SUMMARY FOR POLICY MAKERS 1 (2013), available at http://www.wri.org/sites/default/files/pdf/can_us_get_there_from_here_summary.pdf.

⁶⁴ *The East is Grey*, ECONOMIST, Aug. 10, 2013, available at <http://www.economist.com/news/briefing/21583245-china-worlds-worst-polluter-largest-investor-green-energy-its-rise-will-have>, archived at <http://perma.cc/C39X-KWCB>.

⁶⁵ *Id.*

⁶⁶ *International Energy Statistics: China, United States*, U.S. ENERGY INFO. ADMIN., <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=90&pid=44&aid=8&cid=CH,US,&syid=2000&eyid=2011&unit=MMTCD> (last visited Jan. 15, 2015), archived at <http://perma.cc/V227-894S>; *China Leads World to a Higher Carbon Pollution*, U.S. NEWS AND WORLD REPORT (Nov. 17, 2009), <http://www.usnews.com/science/articles/2009/11/17/china-leads-world-to-higher-carbon-pollution>, archived at <http://perma.cc/39GK-EMSK>.

⁶⁷ Christina Nunez, *Harbin Smog Crisis Highlights China's Coal Problem*, NAT'L GEOGRAPHIC (Oct. 22, 2013), <http://news.nationalgeographic.com/news/energy/2013/10/131022-harbin-ice-city-smog-crisis-china-coal/>, archived at <http://perma.cc/ZN2Y-A8AT>.

⁶⁸ *China Consumes Nearly as Much Coal as the Rest of the World Combined*, U.S. ENERGY INFO. ADMIN. (Jan. 29, 2013), <http://www.eia.gov/todayinenergy/detail.cfm?id=9751>, archived at <http://perma.cc/6NNE-9HFZ>.

gas.⁶⁹ While China's air pollution certainly takes a toll on its population's health,⁷⁰ the impacts of climate change are projected to have even greater long-term costs to global human health. In 2012, the international humanitarian organization DARA released its second Climate Vulnerability Monitor, which found that climate change currently contributes to 400,000 deaths worldwide, primarily from hunger and communicable diseases.⁷¹ The report estimates that if countries continue to emit greenhouse gases at their current rate, climate change could cause up to 700,000 deaths per year by 2030.⁷²

In an attempt to reduce the short-term health impacts of coal combustion, China has banned new coal plants in three industrial regions because of air quality problems.⁷³ This is certainly a step in the right direction, but some of the other efforts China has made to fight air pollution will actually worsen the long-term impacts of climate change. In 2013, China approved several large-scale projects to turn coal into synthetic natural gas.⁷⁴ While this will improve air quality, synthetic natural gas actually creates seven times more greenhouse gas emissions than natural gas, negating the environmental benefits of these projects.⁷⁵

The synthetic natural gas project exemplifies the way China's local, short-term actions affect long-term, global climate change. Since 2000, China has been responsible for two-thirds of the world's increase in carbon dioxide emissions.⁷⁶ According to current projections, China's emissions between 1990 and 2050 will equal 500 billion tons, the same amount that the entire world emitted between the industrial revolution and 1970.⁷⁷

⁶⁹ Bill Chameides, *Climate Change: China Puts Kibosh on New Coal Plants*, NAT'L GEOGRAPHIC (Sept. 13, 2013), <http://energyblog.nationalgeographic.com/2013/09/13/climate-change-china-puts-kibosh-on-new-coal-plants/>, archived at <http://perma.cc/Z936-GFXN>.

⁷⁰ See Wagstaff, *supra* note 6. Studies indicate that air pollution contributed to 1.2 million premature Chinese deaths in 2010 alone, lung cancer rates in China have spiked 465% over the last thirty years, and 500 million people's lives have been shortened by an average of 5.5 years. *Id.*

⁷¹ DARA, CLIMATE VULNERABILITY MONITOR: A GUIDE TO THE COLD CALCULUS OF A HOT PLANET 17 (2012), available at <http://www.daraint.org/wp-content/uploads/2012/09/EXECUTIVE-AND-TECHNICAL-SUMMARY.pdf>.

⁷² *Id.*

⁷³ Nunez, *supra* note 67.

⁷⁴ *Id.*

⁷⁵ *Id.*

⁷⁶ *The East is Grey*, *supra* note 64.

⁷⁷ *Id.*

As previously noted, China has changed its environmental policies in the last five years. First, the government established a Ministry for Environmental Protection in 2008.⁷⁸ In 2012, the National Congress of the Communist Party of China (“CPC”) added the principle of “Ecological Civilization” to its constitution.⁷⁹ For the first time since 1989, the government proposed amendments to its Environmental Protection Law, the main framework for China’s legal environmental approach.⁸⁰ These legal changes signify the government’s changing attitudes toward the environment and environmental health.

However, the real evidence that Chinese leaders are starting to take climate change seriously lies in changes to the country’s cadre evaluation system.⁸¹ The cadre system is China’s structure for bureaucratic personnel evaluation, essentially deciding which local party members and leaders receive promotions.⁸² Lower-level bureaucrats that meet the state’s targets are rewarded with financial bonuses, prizes, and promotions, while those that fail to meet their goals are penalized with transfers, financial punishments, or worse.⁸³ The state’s overall goals are established through successive five-year plans, which set economic and social development targets.⁸⁴ Targets are given differing levels of importance, which signal to mayors and other local leaders which goals must be met at all costs, and which are given only nominal significance.⁸⁵

These goals can be labeled as soft targets, hard targets, or “targets with veto power” (veto targets).⁸⁶ Soft targets have the lowest priority, and previously included environmental goals.⁸⁷ Hard targets are mandatory, and traditionally include economic development goals.⁸⁸ Veto targets have the highest priority, with automatic penalties attached to any failures.⁸⁹ Veto targets historically included social stability and the

⁷⁸ *Id.*

⁷⁹ Guizhen He et al., *Revising China’s Environmental Law*, 341 *SCIENCE* 133 (2013).

⁸⁰ Michael Standaert, *China’s Proposed Revisions to Environmental Protection Law Draw Mixed Reviews*, *BLOOMBERG BNA* (July 31, 2013), <http://www.bna.com/chinas-proposed-revisions-n17179875568/>, archived at <http://perma.cc/4PFE-C5HB>.

⁸¹ See Wang, *supra* note 14, at 368.

⁸² *Id.* at 378.

⁸³ *Id.* at 379–80.

⁸⁴ *Id.* at 379.

⁸⁵ *Id.* at 380.

⁸⁶ *Id.*

⁸⁷ Wang, *supra* note 14, at 380–81.

⁸⁸ *Id.* at 380.

⁸⁹ *Id.*

one-child policy.⁹⁰ The hypercompetitive nature of the cadre system, in which success is always judged relative to others' performance,⁹¹ often means that soft targets are sacrificed in order to meet veto targets.⁹² Thus, in line with past five-year plans, local leaders chose to ignore environmental goals in order to meet the more important economic development and industrialization targets.⁹³

This is why 2006's 11th Five-Year Plan represented such a stark change for China's climate change policies and broader environmental attitude. Environmental targets—specifically goals for climate change mitigation, energy efficiency, and pollution—were raised to hard target and even veto status.⁹⁴ Environmental targets were considered “binding” key indicators for the first time.⁹⁵ To give some perspective, the 11th Five-Year Plan contained twenty-two key indicators, eight of which were designated binding.⁹⁶ Four of these eight binding key indicators were environmentally focused.⁹⁷ One of the most ambitious key indicators was the goal to reduce energy intensity (energy consumption per \$1 GDP) by 20%, which China narrowly missed, instead achieving a 19.1% reduction.⁹⁸

The 12th Five-Year Plan includes even more aggressive climate change and environmental targets. It sets goals to increase non-fossil fuels to 11.4% of primary energy consumption, increase forest cover by 12.5 million hectares, further reduce energy intensity by 16%, and reduce carbon intensity by 17%, all by 2015.⁹⁹ These goals are part of the larger framework wherein China is working to reduce carbon intensity by 40–45% below 2005 levels by 2020, as part of its COP-15 commitments.¹⁰⁰ In recognition that these ambitious goals require more fundamental policy changes than rolling blackouts will achieve, China has implemented seven

⁹⁰ *Id.*

⁹¹ *Id.* at 379–80.

⁹² *Id.* at 380–81.

⁹³ *The East is Grey*, *supra* note 64; Wang, *supra* note 14, at 381.

⁹⁴ Wang, *supra* note 14, at 381.

⁹⁵ *Id.* at 399.

⁹⁶ *Id.*

⁹⁷ *Id.*

⁹⁸ *Id.* at 414. The success and sustainability of the energy intensity reduction is debatable, as local governments had to resort to week-long blackouts of cities and industries to meet the goal. Jim Bai & Tom Miles, *China County Institutes Blackouts to Save Energy—Media*, REUTERS (Sept. 6, 2010, 1:42 a.m.), <http://www.reuters.com/article/2010/09/06/china-power-idAFTOE68502L20100906>, archived at <http://perma.cc/5UZL-8T62>.

⁹⁹ Seligsohn & Hsu, *supra* note 15.

¹⁰⁰ HAN ET AL., *supra* note 15, at 13–14.

experimental local carbon markets to theoretically pave the way for a national carbon market by 2018. As will be discussed below, the carbon market is an effective step in lowering carbon intensity and overall carbon emissions, which should be studied and followed by the United States.

A. *Why Climate Change Requires Serious Action*

In the long term, unregulated greenhouse gases like carbon dioxide will result in a far more disastrous outcome than smog.¹⁰¹ One of the lessons that the U.S. can learn from China's new environmental policy is recognizing the link between environmental health and public health. The World Health Organization ("WHO") reports that "[c]limate change affects social and environmental determinants of health—clean air, safe drinking water, sufficient food and secure shelter."¹⁰²

1. Public Health Crisis

WHO estimates that climate change had already cost over 140,000 excess deaths per year by 2004.¹⁰³ WHO also estimates that climate change's direct damage cost to health will exceed two billion dollars by 2030.¹⁰⁴ Rising temperatures contribute to deaths from cardiovascular and respiratory disease in the elderly, and increase the levels of ozone and other pollutants in the air.¹⁰⁵ Air pollution already contributes to 1.2 billion deaths every year, and the number is expected to increase as temperatures rise.¹⁰⁶

The number of weather-related natural disasters reported each year has tripled since the 1960s.¹⁰⁷ These natural disasters cause over

¹⁰¹ See Kevin Bullis, *Averting Disastrous Climate Change Could Depend on Unproven Technologies*, MITTECH. REVIEW (Apr. 14, 2014), <http://www.technologyreview.com/news/526411/averting-disastrous-climate-change-could-depend-on-unproven-technologies/>, archived at <http://perma.cc/4JYR-EKTK>.

¹⁰² *Climate Change and Health*, WORLD HEALTH ORG., <http://www.who.int/mediacentre/factsheets/fs266/en/> (last modified Nov. 2013), archived at <http://perma.cc/GG73-4ZRC>.

¹⁰³ *Climate Change is a Health Issue*, CLIMATE HEALTH ALLIANCE, http://caha.org.au/wp-content/uploads/2011/03/CAHA-Briefing-Paper-1_Climate-change-is-a-health-issue1.pdf (last visited Jan. 15, 2015).

¹⁰⁴ *Climate Change and Health*, *supra* note 102.

¹⁰⁵ *Id.*

¹⁰⁶ *Id.*

¹⁰⁷ *Id.*

60,000 deaths each year, primarily in developing nations.¹⁰⁸ WHO estimates that by the end of the century, droughts will occur twice as often and last six times longer.¹⁰⁹ Higher temperatures and lower rainfall are likely to result in decreased food production of up to 50% in some regions of Africa.¹¹⁰ This will exacerbate malnutrition and under-nutrition, which already claim more than 3.1 million lives each year.¹¹¹

Climate change is also expected to change the way diseases are spread and transmitted. Vector-borne diseases are anticipated to experience an increased transmission season, as well as an increased geographic range.¹¹² Malaria already kills almost 800,000 people every year, and this is expected to increase as temperatures rise and mosquitos are active for longer periods of time throughout the year.¹¹³ Dengue fever is also spread by mosquitos in tropical countries, and WHO estimates that climate change could expose more than 2 billion people to dengue fever by 2080.¹¹⁴ In the United States, West Nile Virus rates have sharply increased over the last few decades.¹¹⁵ A study published in the *American Journal of Tropical Medicine and Hygiene* reported that hospitalizations from West Nile have cost the United States approximately \$780 million since 1999.¹¹⁶

WHO summarizes that “[a]ll populations will be affected by climate change, but some are more vulnerable than others.”¹¹⁷ These more vulnerable groups include children, the elderly, and those with pre-existing medical conditions such as asthma.¹¹⁸

2. Unprecedented Environmental Degradation & Global Conflict

In addition to numerous detriments to public health, climate change is expected to have devastating environmental and social costs.

¹⁰⁸ *Id.*

¹⁰⁹ *Id.*

¹¹⁰ *Climate Change and Health*, *supra* note 102.

¹¹¹ *Id.*

¹¹² *Id.*

¹¹³ *Id.*

¹¹⁴ *Id.*

¹¹⁵ *West Nile Virus Has Cost U.S. Nearly \$800 Million: CDC*, DRUGS.COM (Feb. 10, 2014), <http://www.drugs.com/news/west-nile-virus-has-cost-u-s-nearly-800-million-cdc-50344.html>, archived at <http://perma.cc/T5UP-6YEH>.

¹¹⁶ *Id.*

¹¹⁷ *Climate Change and Health*, *supra* note 102.

¹¹⁸ *Id.*

The frequency of severe floods across Europe is expected to double before 2050, with accompanying costs increasing five-fold.¹¹⁹ The United States government estimates that climate change impacts—including more extreme droughts and floods, crop losses, and sea level rise—are costing Americans \$37 per ton of carbon dioxide emitted.¹²⁰ This represents an increase from the last figure in 2010, when the government estimated that the impacts of climate change cost Americans \$21 dollars per ton of carbon dioxide emitted.¹²¹ However, this estimated cost is likely wildly insufficient because it does not factor in all the myriad effects of climate change. Experts warned that this figure did not take into account increased damage from forest fires or damage to crops from the increased risk of pest problems.¹²²

Unregulated greenhouse gas emissions could lead to warming of 4 °C or higher by the end of the century.¹²³ The last time the planet was that warm, global sea levels were five meters higher than current levels.¹²⁴ Sea level rise of this magnitude would lead to mass migrations away from coastlines and low-lying islands.¹²⁵

Experts have recently begun exploring the unpredictable social costs of climate change. Because violent crime rates increase during higher temperatures, researchers now theorize that climate change could lead to increased criminal activity.¹²⁶ A study published in the *Journal of Environmental Economics and Management* predicts that by the end of the century, higher temperatures due to climate change will cause an additional 22,000 murders, 180,000 rapes, and 2.4 million assaults.¹²⁷

¹¹⁹ Steve Connor, *Frequency of Severe Flooding Across Europe “to Double by 2050”*, INDEPENDENT (Mar. 2, 2014), <http://www.independent.co.uk/environment/climate-change/frequency-of-severe-flooding-across-europe-to-double-by-2050-9163852.html>, archived at <http://perma.cc/VV56-7MXX>.

¹²⁰ Laurie Goering, “Social Cost” of Carbon Emissions Rising But Still Underestimated, *Experts Warn*, THOMPSON REUTERS FOUND. (Feb. 27, 2014, 12:31 p.m.), <http://www.trust.org/item/20140227123121-0pfu2>, archived at <http://perma.cc/6359-2ACZ>.

¹²¹ *Id.*

¹²² *Id.*

¹²³ Nicholas Stern, *Climate Change is Here Now and It Could Lead to Global Conflict*, GUARDIAN (Feb. 13, 2014), <http://www.theguardian.com/environment/2014/feb/13/storms-floods-climate-change-upon-us-lord-stern>, archived at <http://perma.cc/8K33-X4C8>.

¹²⁴ *Id.*

¹²⁵ *See id.*

¹²⁶ Louis Sahagun, *Climate Change Brings More Crime*, L.A. TIMES (Feb. 19, 2014), <http://www.latimes.com/science/sciencenow/la-sci-sn-climate-change-crime-20140219,0,2765136.story#axzz2uxlAWkK9>, archived at <http://perma.cc/93A8-73SQ>.

¹²⁷ *Id.*

The social costs of these higher crime rates could reach as high as \$115 billion.¹²⁸ The author of the study said that “[t]he broader context here is that climate change will influence our lives in a variety of ways beyond how much water we can spare for such things as farming.”¹²⁹

III. CARBON MARKETS: THE BEST “BUILDING BLOCK” FOR STATES

A. *Background on Carbon Markets*

Carbon “cap-and-trade” markets work by setting an overall emissions cap limiting the total amount of carbon dioxide emissions that can be produced by the body in question, usually a country, or region, or trade union.¹³⁰ Operating under that cap, allowances or permits are distributed to the parties involved, including companies, industries, and other stakeholders.¹³¹ Each individual party is allowed to produce emissions based on the number of permits or allowances it holds.¹³² Pollution permits are typically sold at auction, though sometimes they are “grandfathered” or distributed to parties at no cost.¹³³

Parties who emit less than their current permits allow are able to sell their remaining permits to other parties to make a profit.¹³⁴ Parties who wish to emit more than their current permits allow are able to purchase permits from other parties, or if none are available, purchase reductions from an offset program.¹³⁵ When emissions are high, permits become scarcer and more expensive, which in theory will incentivize parties to pursue a more cost-effective method of emissions reduction rather than purchasing more permits or offsets.¹³⁶ Some carbon markets, such as the European Union Emissions Trading Scheme (“EU ETS”), allow non-emitting parties to purchase permits, thus reducing the number of permits in circulation and increasing the price, further incentivizing other parties to reduce emissions.¹³⁷

¹²⁸ *Id.*

¹²⁹ *Id.*

¹³⁰ See HAN ET AL., *supra* note 15, at 7–9.

¹³¹ *Id.* at 7.

¹³² *Id.* at 7–8.

¹³³ *Id.* at 7.

¹³⁴ *Id.*

¹³⁵ *Id.*

¹³⁶ See HAN ET AL., *supra* note 15, at 7–9.

¹³⁷ *Id.* at 7–8.

A successful carbon trading market requires five administrative and monitoring conditions to function properly in limiting emissions: (1) setting the total emissions limit or cap; (2) a fair method of allocating the quota of permits or allowances among the parties; (3) credible verification and accounting rules to monitor the emissions; (4) a free trading infrastructure, such as exchanges or registries; and (5) a strict accountability system in case of noncompliance.¹³⁸

These conditions are vulnerable, especially in corruption-prone countries such as China.¹³⁹ Misuse of the system will render the trading scheme ineffective.¹⁴⁰ The success of a carbon market is measured by several metrics. Effectiveness is measured by the resultant emissions reduction,¹⁴¹ while the cost-effectiveness or efficiency is measured by the emission reduction cost.¹⁴² Other metrics include innovation and investment in clean technology, and whether carbon leakage has occurred (whether one country increases emissions due to the decrease in the country with the trading market).¹⁴³

B. *Successful Carbon Markets*

The Kyoto Protocol established an international carbon trading market among thirty-seven countries in 2005, with the goal of reducing emissions by 5% below 1990 levels by 2012.¹⁴⁴ The Kyoto Protocol is linked with the Clean Development Mechanism, an offset program wherein investors from developed countries obtain carbon credits by implementing projects in developing countries that will reduce global emissions overall.¹⁴⁵

The EU ETS established a trading scheme among the twenty-seven members of the European Union in 2005, with the goal of reducing emissions by 21% below 2005 levels by 2020.¹⁴⁶ Since 2005, regional and national carbon markets have spread rapidly.¹⁴⁷ In 2011, the global carbon market was worth \$142 billion.¹⁴⁸

¹³⁸ *Id.* at 8.

¹³⁹ See *Corruption Perceptions Index 2012*, TRANSPARENCY INT'L, <http://cpi.transparency.org/cpi2012/results/> (last visited Jan. 15, 2015), *archived at* <http://perma.cc/P8TC-5D6R>.

¹⁴⁰ HAN ET AL., *supra* note 15, at 8.

¹⁴¹ *Id.*

¹⁴² *Id.*

¹⁴³ *Id.*

¹⁴⁴ *Id.* at 10.

¹⁴⁵ *Id.*

¹⁴⁶ HAN ET AL., *supra* note 15, at 10.

¹⁴⁷ *Id.* at 9.

¹⁴⁸ *Id.*

Although various countries and regions have found relative success in reducing carbon emissions through carbon exchanges, China and the United States have been conspicuously absent from the Kyoto Protocol and any sort of mandatory, legally binding national carbon market.¹⁴⁹ Their absence is especially counter-productive because they are by far the world's two largest emitters of carbon dioxide.¹⁵⁰ In 2008, China surpassed the United States as the largest producer of carbon dioxide emissions in the world.¹⁵¹ Together, these two countries were responsible for 42% of the total global carbon dioxide emissions in 2008.¹⁵²

After establishing that the United States and China are undoubtedly the two most powerful economic and political forces in mitigating climate change, this Note will next examine the reasons that these two countries have yet to enact any meaningful emissions reduction mechanisms.

C. *China's Emerging Carbon Markets*

The concept of carbon permit trading in China first began under the Clean Development Mechanism of the Kyoto Protocol.¹⁵³ The National Development and Reform Commission (NDRC) first endorsed the CDM in 2004, with formal trading implemented in 2005.¹⁵⁴ While the CDM has been successful in reducing global carbon dioxide emissions by about one billion tons since its inception, this success is tempered somewhat by the fact that this amount is roughly equivalent to China's increase in emissions from 2009 to 2010.¹⁵⁵

In 2008, the NDRC established several environment and carbon exchanges—the Tianjin Climate Exchange, the China Beijing Environment Exchange, and the Shanghai Environment and Energy Exchanges.¹⁵⁶ However, to date these exchanges have focused exclusively on facilitating

¹⁴⁹ See *id.* at 10; *The World's Carbon Markets*, INT'L EMISSIONS TRADING ASS'N., <http://www.ieta.org/worldscarbonmarkets> (last visited Jan. 15, 2015), *archived at* <http://perma.cc/3C9P-776B>.

¹⁵⁰ See *Global Greenhouse Gas Emissions Data*, U.S. ENVTL. PROT. AGENCY, <http://www.epa.gov/climatechange/ghgemissions/global.html#four> (last updated Sept. 9, 2013), *archived at* <http://perma.cc/8UEJ-98DW>.

¹⁵¹ *International Energy Statistics: China, United States*, *supra* note 66.

¹⁵² *Global Greenhouse Gas Emissions Data*, *supra* note 150.

¹⁵³ HAN ET AL., *supra* note 15, at 13.

¹⁵⁴ *Id.*

¹⁵⁵ *Id.* at 17.

¹⁵⁶ *Id.* at 18.

CDM transactions and Voluntary Emissions Reductions (“VER”).¹⁵⁷ Although there have been some efforts at standardizing measurements, benchmarks, etc., there has been no actual voluntary trading.¹⁵⁸

The 12th Five-Year Plan specifically included carbon markets as a key measure to reduce carbon intensity.¹⁵⁹ In 2011, the NDRC officially approved carbon trading pilots in seven cities and provinces.¹⁶⁰ The seven pilot carbon-trading schemes began in the summer of 2013, with two more approved for launch in November 2013.¹⁶¹

By late 2013, China had officially launched five carbon dioxide markets: Tianjin, Shenzhen, Shanghai, Beijing, and Guangdong.¹⁶² Although few of these exchanges have released information about the size of their market caps,¹⁶³ some have already expressed concern about the over-allocation of permits.¹⁶⁴ This over-allocation is caused by the markets’ reliance on self-reported emissions data from companies and industries, which creates an incentive for companies to over-report past emissions levels in order to claim more permits.¹⁶⁵ While the official launch of five carbon markets before 2014 is encouraging, if the market caps are set too high, permit-holders have no incentive to restrict their emissions and depart from their “business-as-usual” behavior.¹⁶⁶ Over-allocation will result in artificially low permit prices, which provides no motivation for industries to innovate or invest in more low-carbon technologies.¹⁶⁷

¹⁵⁷ *Id.* at 19.

¹⁵⁸ *Id.*

¹⁵⁹ HAN ET AL., *supra* note 15, at xix–xx.

¹⁶⁰ *Id.* at 14.

¹⁶¹ Ranping Song, *Inside China’s Emissions Trading Scheme: First Steps and the Road Ahead*, WORLD RES. INST. (Aug. 28, 2013), <http://www.wri.org/blog/inside-china%E2%80%99s-emissions-trading-scheme-first-steps-and-road-ahead>, archived at <http://perma.cc/K9XQ-A9AE>; David Stanway, *China to Launch Two New Carbon Trading Exchanges*, REUTERS (Nov. 25, 2013), <http://www.reuters.com/article/2013/11/25/us-china-carbon-idUSBRE9A007E20131125>, archived at <http://perma.cc/NPN8-78PN>.

¹⁶² Kathy Chen & Stian Reklef, *Tianjin Launches China’s Latest Carbon Market*, REUTERS (Dec. 25, 2013), <http://www.reuters.com/article/2013/12/26/china-tianjin-carbon-idUSL3N0K50AS20131226>, archived at <http://perma.cc/8WBW-2CDQ>.

¹⁶³ *See id.*

¹⁶⁴ Reuters, *China’s Carbon Markets “to Face Surplus”*, CLIMATE SPECTATOR (Jan. 20, 2014, 12:35 p.m.), <http://www.businessspectator.com.au/news/2014/1/20/carbon-markets/chinas-carbon-markets-face-surplus>, archived at <http://perma.cc/YB6T-BYMJ>.

¹⁶⁵ *Id.*

¹⁶⁶ *Id.*

¹⁶⁷ ORG. FOR ECON. CO-OPERATION & DEV., CLIMATE AND CARBON: ALIGNING PRICES AND POLICIES 16 (2013), available at http://www.oecd-ilibrary.org/environment-and-sustainable-development/climate-and-carbon_5k3z11hjg6r7-en, archived at <http://perma.cc/C2P3-W2WE>.

One carbon market that has provided information regarding its total carbon dioxide cap is the Shenzhen carbon exchange.¹⁶⁸ The Shenzhen exchange aims to reduce its carbon intensity by 21% below 2010 levels, using a cap of 32 million tons of carbon dioxide.¹⁶⁹ It applies to all companies that emit more than 20,000 tons of carbon dioxide over twenty-six industries, including electricity, natural gas, water supply, and industrial manufacturing.¹⁷⁰ While the total market cap is appropriately set, the Shenzhen pilot market is disappointing in that it only covers approximately 40% of total emissions, which leaves the region vulnerable to carbon leakage and no actual reduction of emissions.¹⁷¹

Although all seven carbon exchange pilots were implemented by mid-2014, China remains in danger of missing its carbon-intensity reduction goals.¹⁷² The country's progress has been superficially impressive, cutting its carbon intensity for nine consecutive years leading up to 2014.¹⁷³ In 2013, it reduced its economy's carbon intensity by 3.5%, which was its largest reduction since the financial crisis of 2008.¹⁷⁴ However, to meet the 40–45% reduction goal by 2020 would require at least a 3.9% reduction every year for the rest of the decade.¹⁷⁵

Although China has not released national data reporting its carbon emissions since 2005, British Petroleum's annual energy statistics are considered a fairly accurate substitute.¹⁷⁶ Based on these figures, the country has no hope of meeting its 17% reduction goal by 2015.¹⁷⁷ While China likely will not meet all of its ambitious goals, there are still numerous lessons to be learned from its embrace of carbon markets.

D. Lessons From China's Carbon Markets

China's carbon markets can teach the United States which pitfalls to avoid in successfully implementing a national carbon market.

¹⁶⁸ See *id.* at 17.

¹⁶⁹ *Id.*

¹⁷⁰ *Id.*

¹⁷¹ See *id.* at 17, 43.

¹⁷² Gerard Wynn, *China off Course for 2020 Carbon Emissions Target*, RESPONDING TO CLIMATE CHANGE, <http://www.rtcc.org/2014/06/17/china-off-course-for-2020-carbon-emissions-target/> (last updated June 17, 2014), archived at <http://perma.cc/52Z7-T4WV>.

¹⁷³ *Id.*

¹⁷⁴ *Id.*

¹⁷⁵ *Id.*

¹⁷⁶ *Id.*

¹⁷⁷ *Id.*

The first lesson is in avoiding carbon leakage. Unlike the Shenzhen carbon market, emissions trading schemes have to be “geographically and industrially comprehensive” in order to effectively reduce net emissions.¹⁷⁸ If the trading scheme does not target all regions or industries, it runs the risk of shifting demand to sectors not covered by the cap, and the ineffective market does not result in a net emissions reduction.¹⁷⁹ The problem of domestic carbon leakage increases with the number and size of industries that are not included in the carbon market.¹⁸⁰

The second lesson that the United States can learn from China’s carbon markets is that caps should be set low enough to actually incentivize lower emissions, rather than encouraging reductions in name only. In fact, one of the regional American carbon markets can also provide lessons about setting emissions caps. The paradox inherent in emissions trading schemes is that as the market drives innovation and lower-carbon technology, the demand for emissions permits drops. According to some analysts, this means that drops in permit prices are actually a signal of success, and not debilitating instability.¹⁸¹ These analysts argue that the price of carbon permits most accurately reflects the cost of reducing emissions.¹⁸² Therefore, unexpectedly low permit prices mean that industries have found it easier than anticipated to reduce their emissions.¹⁸³

Some markets have been able to adapt to decreased demand and lower prices with flexible emissions caps.¹⁸⁴ The Regional Greenhouse Gas Initiative (“RGGI”) responded to permit price fluctuations by progressively lowering the total market cap.¹⁸⁵ Members of the RGGI agreed to cut the program’s cap by 45% starting in 2014, and by another 2.5% every year after that until 2020.¹⁸⁶ The RGGI responded with rebounding permit prices.¹⁸⁷ This illustrates the necessity of setting appropriately

¹⁷⁸ See ORG. FOR ECON. CO-OPERATION & DEV., *supra* note 167, at 42–43.

¹⁷⁹ *Id.* at 42–43.

¹⁸⁰ *Id.* at 43.

¹⁸¹ See Tim Worstall, *Low Carbon Credit Prices Are a Sign of Success, Not Failure*, FORBES (Feb. 18, 2012, 6:38 a.m.), <http://www.forbes.com/sites/timworstall/2012/02/18/low-carbon-credit-prices-are-a-sign-of-success-not-failure/>, archived at <http://perma.cc/3EZY-4R9L>.

¹⁸² See *id.*

¹⁸³ See *id.*

¹⁸⁴ See Silvio Marcacci, *Latest RGGI Auction: Time To Reconsider “Success” In Carbon Markets?*, CLEANTECHNICA (Sept. 15, 2013), <http://cleantechnica.com/2013/09/15/latest-rggi-auction-time-to-reconsider-success-in-carbon-markets/>, archived at <http://perma.cc/8NYK-V2KU>.

¹⁸⁵ *Id.*

¹⁸⁶ *Id.*

¹⁸⁷ *Id.*

low emissions caps, and in lowering them in response to changing technology and market conditions.

The third lesson is the importance of linking economic and environmental achievement, as the Chinese government has successfully accomplished with their 11th and 12th Five-Year Plans. China set its ambitious environmental goals partially in response to economic stagnation.¹⁸⁸ This environmental focus is part of an effort to transform China's economic growth model from high-polluting local industries into more efficient "corporate powerhouses capable of competing on the global stage,"¹⁸⁹ all while opening new opportunities for investing in environmental and energy industries.¹⁹⁰ If the United States is serious about reducing greenhouse gas emissions, it needs to emphasize the accompanying economic growth opportunities possible.

The RGGI has already raised \$1.4 billion, and is projected to raise another \$0.6 billion by 2020.¹⁹¹ The Organisation for Economic Co-operation and Development ("OECD"), an international economic organization, calculated that if countries were to use explicit carbon pricing mechanisms such as carbon markets to meet their respective reduction targets, they would raise up to \$250 billion per year by 2020.¹⁹² Carbon markets have the potential to raise valuable revenue for the United States and other countries, while reducing emissions and encouraging investment in lower-carbon technology.

Another lesson to be learned from China's carbon market experiment is the necessity of transparency in emissions data. As previously discussed, the over-reporting of emissions data in the Tianjin carbon market has possibly resulted in over-allocation, which negates the effectiveness of any emissions trading scheme.¹⁹³ In order to avoid similar problems, an efficient carbon market needs to verify actual emissions data when calculating appropriate total caps.

E. Why Carbon Markets?

While the mixed success of China's carbon markets illustrates the potential pitfalls of emissions trading, it is still the most efficient option

¹⁸⁸ Wang, *supra* note 14, at 393.

¹⁸⁹ *Id.*

¹⁹⁰ *Id.*

¹⁹¹ Marcacci, *supra* note 184.

¹⁹² ORG. FOR ECON. CO-OPERATION & DEV., *supra* note 167, at 41.

¹⁹³ See Reuters, *supra* note 164.

to reduce global carbon dioxide emissions. A 2013 policy paper from the OECD found that explicit carbon pricing mechanisms are more cost-effective than implicit carbon pricing mechanisms.¹⁹⁴ OECD reported that carbon markets are approximately 94% cheaper than subsidies paid for renewable energy, and just as effective at reducing emissions.¹⁹⁵

Explicit carbon pricing refers to carbon taxes and emissions trading systems, which put a price on each ton of carbon dioxide emitted.¹⁹⁶ Implicit carbon pricing refers to policy methods such as standards, regulations, and product taxes based on fuel content or volume rather than carbon dioxide emissions.¹⁹⁷ These methods put an implicit price on carbon, which places the cost of reducing emissions on consumers and producers.¹⁹⁸

Explicit carbon pricing works by incentivizing investment in low-carbon technology and increased energy efficiency.¹⁹⁹ The OECD study found that carbon markets and carbon taxes were more cost-effective at reaching the global community's ultimate goal of low-carbon economies.²⁰⁰

In order to reach the 2 °C goal agreed to by the global community, the concentration of greenhouse gases in the atmosphere must be stabilized at 450 parts per million ("ppm").²⁰¹ All of the possible paths to stabilize global emissions would require zero net greenhouse gas emissions during the second half of the twenty-first century.²⁰²

The likeliest scenario for decreasing greenhouse gas emissions will be the one that has the lowest cost to society.²⁰³ In its study, the OECD calculated that annual emissions would need to be limited to forty-five gigatons of carbon dioxide by 2020, and twenty-four gigatons by 2050.²⁰⁴ If emissions continue at the current "business as usual" rate, annual emissions are projected to reach fifty-one gigatons by 2020 and

¹⁹⁴ ORG. FOR ECON. CO-OPERATION & DEV., *supra* note 167, at 4.

¹⁹⁵ Matthew Carr, *Carbon Markets 94% Cheaper than Renewable Support, OECD Says*, BLOOMBERG NEWS (Oct. 9, 2013), <http://www.bloomberg.com/news/2013-10-09/carbon-markets-16-times-cheaper-than-renewable-aid-oecd-says.html>, *archived at* <http://perma.cc/N5FP-UU6P>.

¹⁹⁶ ORG. FOR ECON. CO-OPERATION & DEV., *supra* note 167, at 4.

¹⁹⁷ *Id.* at 23.

¹⁹⁸ *Id.*

¹⁹⁹ *Id.* at 11.

²⁰⁰ *Id.* at 4.

²⁰¹ *Id.* at 7.

²⁰² ORG. FOR ECON. CO-OPERATION & DEV., *supra* note 167, at 7.

²⁰³ *See id.*

²⁰⁴ *Id.* at 8.

eighty-two gigatons by 2050.²⁰⁵ Delaying comprehensive global action until 2020 will make any eventual action much more expensive. If annual emissions reach more than forty-five gigatons by 2020, they will need to be sharply reduced to nineteen gigatons by 2050 in order to meet the goal of 450 ppm.²⁰⁶

Of the explicit carbon pricing choices, emissions exchanges are the best way to guarantee the resulting level of maximum emissions, as opposed to carbon taxes which discourage emissions but do not set any concrete limits.²⁰⁷ In addition, OECD found that carbon markets were the most cost-efficient method of reducing carbon dioxide emissions, with a carbon price of approximately 10 EUR per ton of carbon dioxide.²⁰⁸ By comparison, the cost of other implicit and explicit carbon pricing mechanisms cost an average of 170 EUR per ton of carbon dioxide.²⁰⁹ Carbon markets can also inadvertently reduce other greenhouse gases because carbon dioxide emissions are largely linked to the same economic activities responsible for many other greenhouse gases.²¹⁰

F. Lessons from Acid Rain

More than mere projection, cap-and-trade programs have had actual success in solving other environmental problems in the United States. In 1990, Congress amended the Clean Air Act to include Title IV, the Acid Rain Program.²¹¹ The Acid Rain Program was the first large scale cap-and-trade system intended to reduce environmental pollution in the world.²¹² The goal of this program was to reduce sulfur dioxide emissions by ten million tons below 1980 levels.²¹³

²⁰⁵ *Id.*

²⁰⁶ *Id.*

²⁰⁷ *Id.*

²⁰⁸ ORG. FOR ECON. CO-OPERATION & DEV., *supra* note 167, at 30–31. The cost efficiency of reducing carbon emissions was calculated by examining the economies of Australia, Brazil, Chile, China, Denmark, Estonia, France, Germany, Japan, South Korea, New Zealand, South Africa, Spain, the UK, and the US. *Id.* at 30.

²⁰⁹ *Id.* at 31.

²¹⁰ *Id.* at 43.

²¹¹ Justin Gerdes, *Cap and Trade Curbed Acid Rain: 7 Reasons Why It Can Do the Same for Climate Change*, FORBES (Feb. 13, 2012, 12:53 p.m.), <http://www.forbes.com/sites/justingerdes/2012/02/13/cap-and-trade-curbed-acid-rain-7-reasons-why-it-can-do-the-same-for-climate-change/>, archived at <http://perma.cc/ZJW5-N3MS>.

²¹² GABRIEL CHAN ET AL., THE SO₂ ALLOWANCE TRADING SYSTEM AND THE CLEAN AIR ACT AMENDMENTS OF 1990 2 (2012), available at http://www.hks.harvard.edu/m-rcbg/heap/papers/SO2-Brief_digital_final.pdf.

²¹³ Gerdes, *supra* note 211.

Acid rain is the result of sulfur dioxide emissions, primarily from coal-fueled power plants.²¹⁴ In order to reduce sulfur dioxide emissions and save the Northeast's lakes and rivers, the United States departed from previous "command-and-control" environmental regulation models.²¹⁵ The prior environmental legislation focused on uniform emission limits or uniform pollution-control technology.²¹⁶ By implementing a more flexible control scheme focused on net emissions reductions, the cap-and-trade market made it possible for plants with higher reduction costs to trade with plants that face lower reduction costs.²¹⁷

This flexibility was key to the Acid Rain Program's cost efficiency and overall environmental benefit. From 1990 to 2004, national sulfur dioxide emissions decreased 36%, from 15.9 million tons to 10.2 million tons.²¹⁸ This was achieved despite a national increase in electricity generation from coal power plants of 25% during that time.²¹⁹ The program's overall goal of reduction to 8.95 million tons was accomplished by 2007.²²⁰ By 2010, national sulfur dioxide emissions reached an even lower target of 5.1 million tons.²²¹

The Acid Rain Program also reached its goals faster than expected because many utility companies over-complied during the first phase.²²² Internal incentives, such as low-cost abatement technologies that could easily be applied to older power plants, caused emissions to fall much lower than the program's Phase I target.²²³

In addition to its cost efficiency and environmental benefits, the Acid Rain Program also achieved unexpected public health advantages.²²⁴ Reduced levels of airborne fine particles produced by sulfur dioxide emissions resulted in public health benefits of \$50 billion per year by 2010.²²⁵

Twenty years after the program's implementation, analysts with the Harvard Environmental Economics Program estimated that the cap-and-trade model for sulfur dioxide cost 15–90% less than a program that would have required uniform control technology, or uniform emissions

²¹⁴ CHAN ET AL., *supra* note 212, at 3.

²¹⁵ *Id.* at 4–5.

²¹⁶ *Id.* at 4.

²¹⁷ *Id.* at 10.

²¹⁸ *Id.* at 14.

²¹⁹ *Id.*

²²⁰ CHAN ET AL., *supra* note 212, at 15.

²²¹ *Id.*

²²² *Id.*

²²³ *Id.*

²²⁴ *Id.* at 5.

²²⁵ *Id.* at 5.

reductions from every power plant.²²⁶ In 1990, EPA estimated that the Acid Rain Program's cap-and-trade market would cost upwards of \$6.1 billion.²²⁷ In 1998, an industry-funded research company estimated the program's implementation would cost \$1.7 billion.²²⁸ That same year, an independent research company estimated the cost was even lower, at \$1.1 billion.²²⁹

The Harvard researchers ended their twenty-year reflective analysis by noting that:

Ironically, the cap-and-trade model seems especially well suited to addressing the problem of climate change, in that emitted [greenhouse gases] are evenly distributed throughout the world's atmosphere. Emissions reductions anywhere make identical contributions to helping alleviate the problem, and there are no pollutant concentration hot-spots. The sheer number and variety of [greenhouse gases] emissions sources . . . magnifies the cost savings that could be achieved by enlisting the market to find the least costly abatement options.²³⁰

CONCLUSION

China has reached a critical point in the history of its attitude toward the environment. As an effort to maintain its legitimacy, the Chinese government has recognized that it needs to cure its air pollution problem in order to keep its citizens happy and healthy. Though air pollution is the most immediate symptom of heavy industrialization, it is not the only, nor the most important, consequence of a carbon-intensive economy.

As previously discussed, climate change is forecasted to have disastrous effects on public health, society, and the environment. After decades of denial, a majority of Americans have come to realize that the government needs to take action to reduce America's greenhouse gas emissions.

A survey by the Yale Project on Climate Change and Communication and the George Mason Center for Climate Change found that 83% of Americans "say the U.S. should make an effort to reduce global warming, even if it has economic costs."²³¹ Sixty percent of Americans said the

²²⁶ Gerdes, *supra* note 211.

²²⁷ *Id.*

²²⁸ *Id.*

²²⁹ *Id.*

²³⁰ CHAN ET AL., *supra* note 212, at 32.

²³¹ *Study: 83 Percent Want Action on Global Warming, Even With "Economic Costs,"* US NEWS & WORLD REPORT (Feb. 12, 2014, 3:28 p.m.), <http://www.usnews.com/news/articles>

United States should reduce its greenhouse gas emissions, even if other countries fail to act.²³² Sixty-seven percent said that carbon dioxide should be regulated as a pollutant, and 56% of Americans said they would rather pay an extra \$100 every year for their electricity if it would result in power companies using more renewable energy sources.²³³

While Americans are finally starting to realize that climate change is a serious problem, other countries are beginning to see carbon emissions markets as the most viable solution. China has begun implementation of its carbon market pilot programs. Iran announced in February 2014 that it planned to implement a carbon market in order to reduce industrial emissions in an economy that relies heavily on oil and natural gas.²³⁴ Economic analysts predicted that the global carbon market would increase by two-thirds between 2013 and 2014.²³⁵

The consensus amongst economists is that carbon markets are the most cost-efficient solution to prevent climate change. They are more cost-efficient and provide a greater degree of flexibility than command-and-control policies, while incentivizing investment in cleaner technology. Unlike carbon taxes, carbon markets provide a guaranteed emissions reduction goal. Strict reduction targets are necessary if the United States is to become a leader in mitigating climate change.

The most important “building block” of EPA’s Clean Power Plan should be multistate carbon markets covering most, if not all, of the United States. These carbon dioxide emissions trading schemes would require progressively restrictive caps. This will ensure that as emissions reduction goals are met, the market is not inundated with excess carbon permits. The world needs the United States and China to reduce their carbon emissions if the 2 °C temperature target is to be met. China’s actions have shown that carbon markets are an integral part of any serious effort to reduce emissions. The time has come for the United States to reach the same conclusion.

/2014/02/12/study-83-percent-want-action-on-global-warming-even-with-economic-costs, archived at <http://perma.cc/SQ92-4MMU>.

²³² *Id.*

²³³ *Id.*

²³⁴ *Iran Plans Emissions Trading Scheme*, CLIMATE SPECTATOR (Feb. 17, 2014, 9:07 a.m.), <https://www.businessspectator.com.au/news/2014/2/17/carbon-markets/iran-plans-emissions-trading-scheme>, archived at <http://perma.cc/4KSQ-LH23>.

²³⁵ *Global Carbon Market to Reach Record Volumes by 2016*, CLIMATE SPECTATOR (Feb. 28, 2014, 10:08 a.m.), <http://www.businessspectator.com.au/news/2014/2/28/carbon-markets/global-carbon-market-reach-record-volumes-2016>, archived at <http://perma.cc/9RT6-2LWA>.