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MARKET-BASED SOLUTIONS FOR VEHICLE EMISSIONS IN THE UNITED STATES AND CHINA

By Brian Marshall (Vermont Law School)
Dong Po (China University of Political Science and Law)

INTRODUCTION

China's unprecedented economic growth in the last 20 years has launched millions of Chinese citizens out of poverty. With higher living standards and more disposable income, a rapidly increasing number of Chinese are purchasing their own cars. In the last two years, China has been the largest market for new vehicles in the world.[1] Yet with per capita vehicle ownership only a fraction of that in the United States, the ceiling for growth in private vehicle consumption in China remains far out of sight.[2] Motor vehicles in China not only present a traffic nightmare in cities like Beijing,[3] but collectively, they are already a major source of greenhouse gas emissions and air pollution.

Although the private vehicle model is not inevitable for China, especially given China's historic investments into high-speed rail and subway systems,[4] recent trends suggest that Chinese citizens appear as eager to own personal automobiles as their American counterparts.[5] Despite

[1] U.S. ENERGY INFO. ADMIN., INTERNATIONAL ENERGY OUTLOOK 2011 126 (2011).
[2] *Id.*
[3] *Id.* at 127.
[4] *Id.* ("From 2009 to 2012, the government plans to invest $303.7 billion in rail construction, with plans to extend the rail network by 24,900 miles to a total of 74,600 miles by 2020.").
[5] *See id.* at 126 ("In 2010, China was the world's largest vehicle market for the second year in a row, registering 32-percent annual growth.").

record growth in China's automobile industry, as of 2010 average car ownership in China was just 38 cars per 1000 people compared to 815 cars per 1000 people in the United States.[6]

Car ownership varies widely across China, however, and more developed cities, such as Beijing and Shanghai, have much higher rates of private vehicle ownership than the national average.[7] According to the Economic and Social Development Statistical Report of 2011, there were approximately 5 million vehicles registered in Beijing at the end of the year, including 3.9 million private cars.[8] This figure represents an increase in 174,000 registrations over 2010.[9] In Guangzhou, the capital city of Guangdong Province, there were 26 vehicles for per 100 households as of 2011, an increase of over 23% from 2010.[10] Finally, in Wuhan, the capital city of Hubei Province, there were 954,100 registered vehicles in 2011, including 619,600 private cars, an increase of 23.5% over 2010.[11]If China's trend towards private vehicle ownership continues to reach levels seen in developed countries, it is imperative for China to implement smart policies to manage the type of vehicles that will be on the road.

In this paper, we analyze the environmental benefits of market-based approaches to managing vehicle fleets in the United States and China. By doing so, we in no way suggest that market-based approaches should be adopted in lieu of traditional regulation. In many ways, market-based approaches work best in tandem with traditional regulations. For instance, a car

[6] Yimin Liu, et al., *Energy Challenges the Automobile Industry Faces in China*, INT'L ASS'N FOR ENERGY ECON. 17, 17-18 (2010).
[7] Han Hao, et al., *Comparison of Policies on Vehicle Ownership and Use Between Beijing and Shanghai and Their Impacts on Fuel Consumption by Passenger Vehicles*, 39 ENERGY POL'Y 1016, 1016 (2011) ("Vehicle ownerships in Beijing and Shanghai have reached 212 and 77 vehicles per 1000 capita in 2009.").
[8] *Beijing 2011 Economic and Social Development Statistical Report*, BEIJING STATISTICAL INFORMATION NET (Mar. 4, 2012), http://www.bjstats.gov.cn/sjjd/jjxs/201203/t20120304_221901.htm.
[9] *Id.*
[10] *Guangzhou 2011 Economic and Social Development Statistical Report*, ENORTH (Mar. 30, 2012), http://news.enorth.com.cn/system/2012/03/30/008952793.shtml.
[11] *Wuhan 2011 Economic and Social Development Statistical Report*, CHINA ECONOMIC NET (Feb. 29, 2012), http://www.ce.cn/macro/more/201202/29/t20120229_23117038_3.shtml.

rebate program that gives consumers a credit towards the purchase of a new vehicle works precisely because new vehicles are subject to more stringent fuel economy and air emissions standards. The Chinese government is dedicated to developing market-based approaches in laws and regulations and stresses the relationship between markets and macro-control of the government.[12]

Our analysis of market-based programs is limited to analyzing reductions in carbon dioxide (CO_2) and nitrogen oxide (NOx) emissions from vehicles. These two pollutants represent the sum of environmental hazards associated with motor vehicles. Carbon dioxide is a greenhouse gas that contributes to global climate change while nitrogen oxides are harmful to human health both by themselves and as their role in forming ground-level ozone.[13] Nitrogen oxides also serve as a proxy for other pollutants such as sulfur dioxide and particulate matter.[14]

The United States serves as a valuable comparison for several reasons. First, the United States has a much longer history of vehicle emissions and fuel economy regulations. Second, more data are available for United States programs, from which it is possible to extrapolate to China's regulatory counterpart. Finally, the United States and China are the two largest vehicle

[12] Qiche Chanye Fazhan Zhengce (汽车产业发展政策) [Policy on the Development of the Automotive Industry] (Promulgated by the National Development Reform Commission on May 21, 2004) (Article 1) (expressing the government's support for the principle of combining the fundamental role of market allocation of resources with macro-control of the government); Zhonghua Renmin Gonghe Guomin Jingji he Shehui Fazhan Di Shier ge Wu Nian Guihua Gangyao (国务院关于落实《中华人民共和国民经济和社会发展第十二个五年规划纲要》主要目标和任务工作分工的通知) [Notice of the State Council on the Implementation of the Main Objectives and Tasks Division of the "Twelfth Five-Year Plan" (Promulgated by the State Council on Oct. 11, 2011).

[13] *Nitrogen Dioxide: Health*, U.S. ENVTL. PROT. AGENCY (Mar. 22, 2011), http://www.epa.gov/air/nitrogenoxides/health.html ("NOx react with ammonia, moisture and other compounds to form small particles. These small particles penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory disease, such as emphysema and bronchitis, and can aggravate existing heart disease, leading to increased hospital admission and premature death.").

[14] Ravi Maheswaran et al., *Outdoor Air Pollution, Mortality, and Hospital Admissions From Coronary Heart Disease in Sheffield, UK: A Small-Area Level Ecological Study*, 26 EUR. HEART J. 2543, 2548 (2005) (using NOx as "a proxy for traffic-related pollution").

markets in the world, and both countries are struggling to control traditional pollution and greenhouse gas emissions from automobiles.

The Chinese government has ambitious goals for limiting greenhouse gas pollution and reducing NOx emissions countrywide. China's 12th Five Year Plan (2011-2015) calls for a 17% reduction in carbon intensity and a 10% reduction in total NOx emissions.[15] Reforming China's transportation sector will be a major component of meeting these goals. Many studies of air pollution in Beijing, for example, have shown that as much as 74% of ground NOx emissions are directly attributable to motor vehicles.[16] In 2009, CO_2 emission from motor vehicles in China reached 40.2 million tons, an increase of 1.7% compared with 2008, while NOx emissions reached 5.8 million tons, an increase of 5.4% compared with 2008.[17] Likewise, China's motor vehicles are projected to collectively emit up to 3 billion tons of CO_2 by 2050.[18] To put this figure in perspective, in 2009 the United States' total emissions from all sectors were estimated at 5.4 billion tons of CO_2.[19]

In Section I we analyze car exchange rebate programs where old vehicles are scrapped for a credit towards the purchase of a new vehicle. First we analyze the environmental impacts of the 2009 Cash for Clunkers program in the United States. Next, we discuss the history of China's vehicle emissions regulations to evaluate the potential for China's vehicle exchange rebate program. By analyzing vehicle types on the road in China, we can estimate the environmental

[15] China's 12th Five-Year Plan, *available at* http://news.xinhuanet.com/politics/2011-03/16/c_121193916_32.htm.
[16] C.K. Chan, et al., *Air Pollution in Mega Cities in China*, 42 Atmospheric Environment 9 (2008) (citing J. Hao, et al., *Improving Urban Air Quality in China: A Beijing Case Study*, 55 J. OF THE AIR AND WASTE MANAGEMENT (2005)).
[17] MINISTRY OF ENVTL. PROT. OF THE PEOPLE'S REPUBLIC OF CHINA, Zhongguo Jidong Che Wuran Fangzhi Nianbao (中国机动车污染防治年报) [China Vehicle Emission Control Annual Report] 8 (2010).
[18] M. WANG, ET AL., UNITED STATES DEP'T OF ENERGY, PROJECTION OF CHINESE MOTOR VEHICLE GROWTH, OIL DEMAND AND CO_2 EMISSIONS THROUGH 2050, 46 (2006).
[19] Simon Rogers & Lisa Evans, *World Carbon Dioxide Emissions Data by Country: China Speeds Ahead of the Rest*, THE GUARDIAN, Jan. 31, 2011, http://www.guardian.co.uk/news/datablog/2011/jan/31/world-carbon-dioxide-emissions-country-data-co2.

benefits of removing the highest emitting vehicles. We conclude Section I by recommending how car exchange rebate programs could be improved in both countries by making environmental goals explicit and targeting the worst-offending vehicles.

In Section II, we compare vehicle purchase taxes in both countries. We analyze the "gas guzzler" tax in the United States and the overall tax structure for new vehicle purchases in China. While the gas guzzler tax may have been successful in reducing demand for large sedans, SUVs are not subject to the tax and it therefore fails to address the most inefficient swath of vehicles in the United States. Other aspects of the tax code in the United States also favor large SUVs. These tax policies had the perverse effect of allowing and encouraging significant growth in SUV numbers leading to a dirtier and more inefficient vehicle fleet. China has a more comprehensive vehicle purchase tax scheme with various rates based on a vehicle's engine size. By increasing the tax rate on vehicles with larger engines and decreasing the tax rate on smaller vehicles, the Chinese government is attempting to encourage consumers to buy energy-saving, low-emission cars.

Section III analyzes subsidies for plug-in electric and gasoline hybrid-electric vehicles in the United States and China. We conclude that electric vehicles may offer some environmental benefits in the United States in terms of both CO_2 and NOx emissions reductions. However, because of China's heavy reliance on coal to generate electricity, plug-in electric vehicles offer scant emissions benefits in China. According to the China Statistical Yearbook 2010, coal accounts for more than 70% of China's energy consumption today.[20] As long as China remains

[20] NAT'L BUREAU OF STATISTICS OF CHINA, CHINA STATISTICAL YEARBOOK 2010, *available at* http://www.stats.gov.cn/tjsj/ndsj/2010/indexch.htm.

dependent on coal, we recommend that China support gasoline-hybrid technology to reduce the CO_2 and NOx emissions from its vehicle fleet.

I. VEHICLE SCRAPPAGE & REBATE PROGRAMS

A. The "Cash for Clunkers" Program in the United States

In the midst of the global economic crisis in 2008-2009, Congress enacted the Cash for Clunkers program as part of a supplemental appropriations bill that primarily included additional funding for the wars in Iraq and Afghanistan.[21] Under the Consumer Assistance to Recycle and Save Program (CARS), its official name, Congress earmarked $1 billion for the program including $50 million to the Department of Transportation's National Highway Traffic Safety Administration (NHSTA) for its implementation.[22] On July 1, 2009, car dealers began accepting electronic rebate applications for the program, but the Department of Transportation did not officially begin accepting the vouchers until July 24.[23] Within one week, the Department instructed dealers to stop accepting applications because the funds were already gone.[24] Meanwhile, the White House pushed for additional funding for the program and Congress responded by reallocating $2 billion from a clean energy loan guarantee program included in the massive American Reinvestment and Recovery Act of 2009 stimulus bill.[25] The additional

[21] Supplemental Appropriations Act, 2009 [hereinafter CARS], Pub. L. No. 111-32, 123 Stat. 1858.
[22] *Id.*
[23] Matthew L. Wald, *"Cash for Clunkers" Car Rebate Plan Sells Out in Days*, N.Y. TIMES, July 31, 2011, at A1, *available at* http://www.nytimes.com/2009/07/31/business/31clunkers.html.
[24] *Id.*
[25] Consumer Assistance to Recycle and Save Program—Supplemental Appropriations, Pub. L. No. 111-47, 123 Stat. 1972.

funding lasted less than one month so that by August 24, CARS came to a halt more than two months earlier than planned.[26]

The law provided consumers with two different voucher options for trading in eligible vehicles. To qualify for either option consumers must have had a drivable vehicle between one and 25 years old with a combined fuel economy less than 25 mpg.[27] Under the first option, consumers received $3,500 toward the purchase of a new passenger vehicle or qualifying truck by trading in an eligible vehicle.[28] This credit required the new passenger car to have an average fuel economy of at least 4 mpg higher than the trade-in car.[29] In the case of new trucks, based on the type of vehicle, the truck must be either larger in size than the trade-in or have 1-2 mpg higher average fuel economy.[30]

The other option provided a $4,500 credit for consumers to purchase even more fuel-efficient vehicles.[31] The same conditions applied to this voucher except that consumers must have purchased a new vehicle with a 10 mpg higher average fuel economy.[32] Truck trade-ins require a 5 mpg or 2 mpg increase in average fuel economy based on the type of truck.[33]

In total, vouchers were applied to 690,114 transactions amounting to a total of $2.85 billion.[34] According to the NHTSA's report to Congress, 86% of trade-in vehicles were trucks, which include SUVs under the Department of Transportation's definitions.[35] However, passenger

[26] Nick Bunkley, *Government Will End Clunker Program Early*, N.Y. TIMES, Aug. 21, 2009, at B3, *available at* http://www.nytimes.com/2009/08/21/business/21clunkers.html.
[27] CARS, *supra* note 21, at Title XIII Section 1302(i)(7).
[28] CARS, *supra* note 21, at Title XIII Section 1302(b)(1).
[29] *Id.*
[30] *Id.*
[31] CARS, *supra* note 21, Title XIII Section 1302(b)(2).
[32] *Id.*
[33] *Id.*
[34] Marianne Tyrrell & John C. Dernbach, *The "Cash for Clunkers" Program: A Sustainability Evaluation*, 42 U. TOL. L. REV. 467, 480 (2011).
[35] NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., REPORT TO CONGRESS ON CARS PROGRAM 20 (2009) (Table 3).

vehicles accounted for almost 60% of new vehicle purchases.[36] This asymmetry partly explains why the fuel-efficiency of trade-in vehicles was only 15.7 mpg, while the new vehicles averaged 24.9 mpg.[37] While the economic stimulus aspects of the program are hotly debated,[38] this paper will focus exclusively on the environmental impacts of CARS.

At the outset, it is important to understand that CARS was based entirely on fuel economy and not on greenhouse gas or conventional pollution emissions. While there is a strong correlation between fuel economy and emissions, the alignment is not a perfect match.[39] Using fuel economy expressed as mpg is flawed for two reasons. First, because expressing the value in terms of miles per gallon of fuel conceals the true benefits in terms of fuel consumption.[40] Second, because fuel consumption is not a perfect proxy for CO_2 or conventional air pollutant emissions.[41]

[36] *Id.*
[37] *Id.* at 26.
[38] *Cash for Clunkers Results Finally In: Taxpayers Paid $24,000 per Vehicle Sold*, EDMUNDS.COM (Oct. 19, 2009), http://www.edmunds.com/about/press/cash-for-clunkers-results-finally-in-taxpayers-paid-24000-per-vehicle-sold-reports-edmundscom.html?articleid=159446& (concluding that the economic impacts of the CARS program were very limited); *but see* Macon Phillips, *Busy Covering Car Sales on Mars, Edmunds.com Gets it Wrong (Again) on Cash for Clunkers*, WHITEHOUSE.GOV BLOG (Oct. 29, 2009), http://www.whitehouse.gov/blog/2009/10/29/busy-covering-car-sales-mars-edmundscom-gets-it-wrong-again-cash-clunkers (disputing Edmunds.com's methodology).
[39] INT'L TRANSP. FORUM, CAR FLEET RENEWAL SCHEMES: ENVIRONMENTAL AND SAFETY IMPACTS 21 (2011) ("CARS saw positive results from targeted incentives, even if these were imperfectly aligned with the most effective scheme objectives (the criteria to award the transactions were based on fuel economy rather than fuel consumption or, more importantly, pollutant emissions like NOx).").
[40] *See* Mike Allen, POPULAR MECHANICS, *Why We Should Measure by Gallons per Mile Not Miles per Gallon* (2009), http://www.popularmechanics.com/cars/news/4324986 (demonstrating that replacing an 18 mpg with a 28 mpg vehicle offers double the fuel consumption reduction compared to replacing a 34 mpg with 50 mpg vehicle).
[41] This is especially true when different fuel vehicles, such as diesel, are directly compared with gasoline vehicles. *See* FENG AN ET AL., GLOBAL OVERVIEW ON FUEL EFFICIENCY AND MOTOR VEHICLE EMISSION STANDARDS: POLICY OPTIONS AND PERSPECTIVES FOR INTERNATIONAL COOPERATION 2 (2011) ("Diesel fuel contains about 10 percent more carbon and more energy than gasoline. As a result, the fuel economy of diesel vehicles is augmented by both the energy efficiency and the greater energy content of the fuel when measured using miles per gallon. However, when considered under a GHG-basis, the higher carbon content of the fuel is taken into account and offsets the fuel-related improvement found on a mpg-basis.").

CARS achieved limited success in reducing CO_2 emissions. One problem with fleet renewal schemes such as CARS is the rebound effect.[42] These programs have the unavoidable side effect of increasing the total vehicle miles travelled between the trade-in and the new car because older cars are gradually driven fewer miles over time while new cars are driven more miles per year.[43] Thus, while the new vehicles are emitting less pollution per mile they travel, they also travel more total miles, cancelling out some of the CO_2 benefit. Nevertheless, CARS achieved an average per vehicle lifetime emissions reduction of 0.15 metric tons.[44] In total, about 1,000 metric tons of CO_2 emissions were avoided by the scheme.[45]

While the CO_2 reduction benefits of CARS are modest at best, the NOx reductions are surprisingly strong. Despite the rebound effect, CARS will significantly reduce total NOx emissions between 2010-2025 from the vehicle fleet.[46] Per vehicle NOx emissions have decreased substantially since the mid-1990s, thus "the distribution of avoided NOx emissions shows that the impact comes mostly from very old (pre-1990) and 14-18 year old (1992-1996) vehicles."[47] Replacing these old, high-polluting vehicles with newer models that must comply with stricter air emissions standards results in a total reduction of 64,000 metric tons of NOx.[48]

[42] INT'L TRANSP. FORUM, *supra* note 39, at 23.
[43] *Id.* at 23-24 ("Although the new vehicles are initially (in 2010) assumed to cover the same yearly distances as the ones they replace, the fleet turnover introduced by the schemes increases the total distance travelled by the combination of the 2 vehicles—since the scrapped vehicles would keep getting older and thus travel progressively less, and the new vehicles carry on being driven with a usage decrease in line with their age . . . there is more total 'lifetime' in the new fleet versus the scrapped one.").
[44] *Id.* at 25.
[45] *Id.* at 39.
[46] *Id.* ("In the US, our analysis indicates that the average scrapped vehicle transaction avoided 94 kg of NO_X emissions . . . .").
[47] *Id.* at 31.
[48] *Id.* at 39.

This reduction accounts for the largest monetized benefit of the program at approximately $700 million.[49]

B. China's Car Scrappage & Rebate Program

1. Background: China's Vehicle Emissions and Fuel Economy Standards

To understand how China's vehicle scrappage and rebate program is designed, it is necessary to understand the basics of China's vehicle emissions standards. China's vehicle emission standards have developed fairly recently. The legal basis for motor vehicle emissions standards in China is the Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution.[50] Chapter IV of the act provides that "[n]o unit or individual may manufacture, sell or import motor-driven vehicles and vessels that discharge atmospheric pollutants in excess of the prescribed discharge standards."[51] China's vehicle emission standards date back to 1992, but the regulations did not get serious until China's environmental protection agency[52] required all new vehicles to comply with Guo I (equivalent to Euro I) standards in 2000.[53] In 2004, the standards were raised to Guo II (Euro II), in 2007 to Guo III (Euro III), and this year to Guo IV (Euro IV).[54] Some of China's largest cities have implemented the Guo standards on a more aggressive timetable with Beijing leading the way by adopting Guo IV

[49] *Id.* at 39 (assuming a €7700/metric ton cost of NO_X in 2010 Euros) We assume a conversion of 1.43 dollars per Euro, in 2010 dollars.
[50] Zhonghua Renmin Gonghe Guo Daqi Wuran Fangzhi (中华人民共和国大气污染防治法）[Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution] (revised 2000).
[51] *Id.*
[52] China's state-level environmental protection agency is known today as the Ministry of Environmental Protection. Before 2008, this agency was known as the State Environmental Protection Agency. *See* Michelle Yu, *Wu Lihong, Lake Tai, and the Difficulties of Protecting China's Environment: A Case Study*, 21 GEO. INT'L ENVTL. L. REV. 639, 645-46 (2009) (discussing the evolution of China's Ministry of Environmental Protection).
[53] Ye Wu, et al., *On-Road Vehicle Emission Control in Beijing: Past, Present, and Future,* 45 ENV'T SCI. TECH. 148 (2011).
[54] FREDA FUNG, ET AL., INT'L COUNCIL ON CLEAN TRANSP., OVERVIEW OF CHINA'S VEHICLE EMISSION CONTROL PROGRAM 25 (2010).

standards in 2008.[55] To understand the differences in standards, a Guo III vehicle emits 44% less carbon dioxide per mile travelled and 70% less NOx per mile travelled than a Guo I vehicle.[56]

China also has a separate vehicle category, known as Yellow Label vehicles (*Huang Biao Che*). Yellow Label refers to gasoline vehicles that do not meet Guo I emissions standards and diesel vehicles that do not meet Guo III emissions standards.[57] The Yellow Label vehicle concept grew out of a program from the Beijing Environmental Protection Bureau whereby yellow labels were affixed to vehicles that did not meet emissions standards.[58] Since then, the term has come to apply to all vehicles that fail the Guo I, or Guo III for diesel vehicles, emissions standards.[59] These vehicles are specifically targeted by the 2009 expansion of the vehicle rebate program.

There are even greater differences between a new vehicle complying with Guo IV and vehicles produced before China's emissions standards were implemented. When China adopted the Guo I standard, passenger vehicles were permitted to emit NOx at a maximum rate of 0.49 g/km.[60] Guo IV reduces vehicle emissions by more than 90% to 0.08 g/km.[61] Assuming an average of 14,125 kilometers travelled per vehicle per year,[62] the annual per vehicle reduction in NOx emissions between Guo I and Guo IV vehicles is almost 5.8kg.[63] This is likely a significant underestimate for many vehicles in China because Yellow Label vehicles fail to meet even Guo I

[55] *Id.*
[56] MINISTRY OF ENVTL. PROT. OF THE PEOPLE'S REPUBLIC OF CHINA, Zhongguo Jidong Che Wuran Fangzhi Nianbao (中国机动车污染防治年报) [China Vehicle Emission Control Annual Report] 16 (2010).
[57] *Id.*
[58] *Id.*
[59] *Id.*
[60] APPENDIX ON RECENT EUROPEAN UNION (EU) EMISSIONS STANDARDS, VEHICLE EMISSION STANDARDS AND INSPECTION AND MAINTENANCE 35, http://www.adb.org/documents/guidelines/vehicle_emissions/im_ch07.pdf.
[61] *Id.*
[62] DEP'T OF TRANSP., *Vehicle Travel by Selected Country* (2010), http://www.fhwa.dot.gov/policyinformation/statistics/2008/pdf/in5.pdf.
[63] This example is used as an approximation to provide the reader with a sense of the scope of emissions reductions possible. It does not take into account factors such as how the age of the vehicle affects annual vehicle kilometers travelled and other considerations that would yield more accurate results.

emission standards. The benefits of replacing old diesel trucks with new trucks that meet Guo IV standards are even greater because diesel vehicles are responsible for over 90% of NOx emissions from vehicles in China.[64] Generally speaking, the emissions from a Guo IV vehicle are 1/2 those of a Guo III vehicle, 1/4 those of a Guo II vehicle, 1/12 those Guo I vehicle, and only 1/28 those of a Yellow Label vehicle.[65]

Although the vehicle rebate exchange program in China has been in place since 2002, there are still a significant minority of vehicles that do not meet even Guo I standards. As of 2009, about 17% of all motor vehicles were classified as Yellow Label.[66] These vehicles are responsible for over 50% of air pollution emissions from China's vehicles.[67] Eliminating this segment of the vehicle population would yield enormous pollution reduction benefits. In 2009, China's motor vehicles emitted 5.3 million metric tons of NOx pollution.[68] Thus, if all of China's Yellow Label vehicles were taken off the road, this would reduce annual NOx emissions by more than 2.5 million metric tons. Using European IMPACT numbers to monetize the costs of NOx pollution, China could save roughly $27 billion per year by eliminating these vehicles.[69]

Taking these vehicles off the road would also reduce CO_2 emissions because Yellow Label vehicles do not meet China's recent fuel economy standards. China's fuel economy standards, passed in 2004, included two phases for implementation. Phase I commenced on July 1, 2005 for new models and a year later for existing models.[70] Phase II began on January 1, 2008

[64] China Vehicle Emission Control Annual Report, *supra* note 56, at 19.
[65] Wo Guo Taotai Huangbiao Che Yi Jiu Huan Xin Fa Butie Da Pailiang Jiang Duo Zhengshui (我国淘汰黄标车 以旧换新发补贴 大排量将多征税), http://wfs.mep.gov.cn/dq/jdc/zh/201012/t20101206_198328.htm.
[66] *Id.* at 3.
[67] *Id.*
[68] *Id.* at 8.
[69] INT'L TRANSP. FORUM, CAR FLEET RENEWAL SCHEMES: ENVIRONMENTAL AND SAFETY IMPACTS 39 (2011) (using €7,700 per metric ton of NOx pollution in 2010 Euros per the IMPACT handbook).
[70] D.V. Wagner, et al., *Structure and Impacts of Fuel Economy Standards for Passenger Cars in China*, 37 ENERGY POL'Y 3803, 3806 (2009).

for new models and again a year later for existing models.[71] Unlike corporate average fuel economy (CAFE) standards in the United States, which allow manufacturers to use their fleet average fuel economy to comply,[72] China currently requires every vehicle to meet its standards.[73] Thus, every new vehicle purchased under the rebate scheme will have better fuel economy than the trade-in. Before China's fuel economy standards went into effect, the fleet average fuel economy in China was 9.11L/100km (25.8 mpg).[74] The current average for new vehicles is 7.7L/100km (30.5 mpg), equal to a 16% reduction.[75] Since Yellow Label vehicles are likely the worst offenders, the fuel economy improvement could be even greater than this increase suggests. The following chart shows the development of China's fuel economy standards:

Total Vehicle Weight (VW) in kilograms	Phase I (L/100km)	Phase II (L/100km)	Proposed Phase III (2015) (L/100km)
$VW \leq 750$	7.2	6.2	5.2
$750 < VW \leq 865$	7.2	6.5	5.5
$865 < VW \leq 980$	7.7	7.0	5.8
$980 < VW \leq 1090$	8.3	7.5	6.1
$1090 < VW \leq 1205$	8.9	8.1	6.5
$1205 < VW \leq 1320$	9.5	8.6	6.9

[71] *Id.*
[72] Jody Freeman, *The Obama Administration's National Auto Policy: Lessons from the "Car Deal*," 35 HARV. ENVTL. L. REV. 343, 354 (2011).
[73] D.V. Wagner, et al, *supra* note 70.
[74] *Id.*
[75] *Id.*

1320 < VW ≤ 1430	10.1	9.2	7.3
1430 < VW ≤ 1540	10.7	9.7	7.7
1540 < VW ≤ 1660	11.3	10.2	8.1
1660 < VW ≤ 1770	11.9	10.7	8.5
1770 < VW ≤ 1880	12.4	11.1	8.9
1880 < VW ≤ 2000	12.8	11.5	9.4
2000 < VW ≤ 2110	13.2	11.9	9.9
2110 < VW ≤ 2280	13.7	12.3	10.4
2280 < VW ≤ 2510	14.6	13.1	11.0
2510 < VW	15.5	13.9	11.7

Sources: Chengyongche Ranliao Xiaohaoliang (乘用车燃料消耗量)［Limits on Fuel Consumption for Passenger Cars] (promulgated by the Standardization Administration of China) (promulgated by the Standardization Administration of China) GB 19678-2004; Chengyongche Ranliao Xiaohaoliang Pingjia Fangfa Zhibiao (乘用车燃料消耗量评价方法及指标) [Proposed Fuel Consumption Evaluation Method and Targets for Passenger Cars] (promulgated by the Standardization Administration of China) GB XXXX-XXXX.

2. China's Scrappage & Rebate Program

The development of China's scrappage and rebate program can be divided into three periods: the probe phase (early 2000s), the mature phase (2009), and finally the adjustment phase (after 2010). The national subsidy program gradually developed through the implementation of various rules and regulations. The history of China's scrappage and rebate program dates back to 2001 when the State Council promulgated Measures for Scrapped Automobile Recycling.[76] In the beginning, the subsidy program only applied to vehicle scrappage with no accompanying rebate for new vehicle purchases.[77] The initial law outlined which vehicles meet the national scrap standards, including vehicles with serious engine or chassis damage, which fail to meet the

[76] Baofei Qiche Huishou Guanli Banfa (报废汽车回收管理办法) [Measures for Scrapped Automobile Recycling] (promulgated by the State Council on June 13, 2001).
[77] *Id.*

national motor vehicle technical conditions for safe operation or national emission standards for motor vehicles.[78] The purchase price of scrapped cars was based on the metal content of the vehicle and the market price for scrap metal at the time of scrappage.[79]

In 2002, following the Measures for Scrapped Automobile Recycling and reforms to the purchase tax on new vehicles, China implemented Interim Measures for the Administration of Old Scrapped Cars Subsidies.[80] This allowed consumers to receive a greater subsidy when they elected to scrap an old car and purchase a new one.[81] In this regulation, the Ministry of Finance retained the definition of old cars from the Measures for Scrapped Automobile Recycling so qualified vehicles did not change.[82] Under this program, the subsidy was entirely funded by vehicle taxes, so the rebate for an old vehicle did not exceed the purchase tax on a new vehicle.[83] Provincial departments distributed subsidies annually between September 1 and November 30 and were empowered to conduct inspections to ensure compliance with the program's regulations.[84]

In 2009, around the same time the CARS program was passed by Congress in the United States, the State Council greatly expanded China's car exchange rebate program—Exchanging Second-Hand Vehicles for New Ones.[85] Noting the higher fuel consumption from older vehicles

[78] *Id.*
[79] *Id.*
[80] Lao Yi Qiche Baofei Geng Xin Butie Zijin Guanli Zanxing Banfa (老旧汽车报废更新补贴资金管理暂行办法) [Interim Measures for the Administration of Old Cars Scrapped Subsidies] (promulgated by the Ministry of Finance on Dec. 12, 2002).
[81] *Id.*
[82] *Id.*
[83] *Id.*
[84] *Id.*
[85] Guowuyuan Bangongting Guanyu Zhuanfa Fazhan Gaige Deng Bumen Cujin Kuoda Nei Xu Guli Qiche Jia Dian Yi Jiu Huan Xin Shishi Fangan de Tongzhi (国务院办公厅关于转发发展改革委等部门促进扩大内需鼓励汽车家电以旧换新实施方案的通知) [Notice on Forwarding the Execution Plan of the National Development and Reform Commission and Other Departments on Promoting the Expansion of Domestic Demand and Encourage

and the need to stimulate demand amidst the global recession, the State Council increased available funding for the program from 1 billion Yuan ($160 million) to 5 billion Yuan ($800 million) total.[86] On top of this, local governments were free to further incentivize the exchange program with additional subsidies.[87]

As part of the expansion of the program, the Ministries of Finance and Commerce readjusted the base-line subsidies for different vehicle classes in China.[88] Under the new standards, there are two categories of vehicles: old vehicles, defined as six years or older, and Yellow Label vehicles.[89] Initially, per-vehicle subsidies ranged from only 3,000 to 6,000 Yuan ($475 to $950) based on vehicle model.[90] In late 2009, the Chinese government increased the subsidies in an effort to entice more participants after a sluggish start.[91] Under the revised standards, Yellow Label cars and trucks are eligible for a subsidy of between 5,000 and 18,000 Yuan ($800 to $2900) based on vehicle model.[92] Passenger cars with engine displacement greater than 1.35 liters are eligible for the full 18,000 Yuan subsidy.[93] "Old vehicles" are eligible for subsidies ranging from 6,000 to 11,000 Yuan ($950 to $1750).[94] The smallest passenger car eligible for this rebate is "medium-sized" (between 9 and 20 passengers)[95] and receives the full

Exchanging Second-Hand Vehicles and Home Appliances for New Ones] (promulgated by the General Office of the State Council on June 1, 2009).

[86] *Id.*

[87] *Id.*

[88] Caizhengbu, Shangwubu Guanyu Tiaozheng Qiche Yi Jiu Huan Xin Butie Biaozhun You Guan Shixiang de Tongzhi (财政部、商务部关于调整汽车以旧换新补贴标准有关事项的通知) [Notice on Issues Concerning Adjusting the Exchanging Second-Hand Vehicles for New Ones Subsidy Standards] (promulgated by the Ministry of Finance and the Ministry of Commerce on Dec. 28, 2009).

[89] *Id.*

[90] *China's Cash for Clunkers Program Extended, Effects Disputed*, CHINA AUTO WEB, May 21, 2010, http://chinaautoweb.com/2010/05/chinas-cash-for-clunkers-program-to-be-extended-effects-disputed/.

[91] *Id.*

[92] Notice on Issues Concerning Adjusting the Exchanging Second-Hand Vehicles for New Ones Subsidy Standards, *supra* note 88.

[93] *Id.*

[94] *Id.*

[95] China Vehicle Emission Control Annual Report, *supra* note 56, at 29 (Appendix: Vehicle Classifications).

11,000 Yuan subsidy for this category.[96] The specific categories and subsidies are as follows: For "old vehicles": 13,000 Yuan for medium trucks, 9000 Yuan for light trucks, 6,000 Yuan for mini-trucks, 11,000 Yuan for medium-sized passenger cars.[97] For Yellow Label cars: 18,000 Yuan for heavy-duty trucks, 13,000 Yuan for medium trucks, 9000 Yuan for light trucks, 6,000 Yuan for mini-trucks, 18,000 Yuan for large load buses, 11,000 Yuan for medium-sized passenger cars, 7,000 Yuan for small passenger vans, 5,000 Yuan for mini-buses, 18,000 Yuan for 1.35 liters and above sedans, 10,000 Yuan for 1-1.35 liters (not inclusive) engine sedans, 6000 Yuan for one liter engine and below sedans.[98] It appears, therefore, that in addition to Yellow Label vehicles, the Chinese government is targeting older and larger vehicles, a logical choice given their higher NOx emissions.

The number of citizens who applied for rebate subsidies increased significantly after the State Council increased subsidy levels from early 2010 until May 2010.[99] In total, 90,000 people applied for subsidies, equal to a nearly six times increase in the number of applications received before the adjustments.[100] According to data from the Ministry of Commerce, sedans saw the greatest impact from the subsidy adjustment. From early 2010 to May 24, 34,000 sedans received subsidies, a 67-fold increase over the same time period before the subsidies were increased.[101] In 2010, the Ministry of Finance and the Ministry of Commerce allowed rebate participants to simultaneously enjoy the Subsidy for Exchanging Second-Hand Vehicles for New

[96] Notice on Issues Concerning Adjusting the Exchanging Second-Hand Vehicles for New Ones Subsidy Standards, *supra* note 88.
[97] *Id.*
[98] *Id*
[99] MINISTRY OF COMMERCE OF CHINA, *Adjustment of the Exchanging Second-hand Vehicles for New Ones Policy Was Effective,* http://www.mofcom.gov.cn/aarticle/ae/ai/201005/20100506932917.html.
[100] *Id.*
[101] *Id.*

Ones and the Vehicle Purchase Tax Reduction Policies.[102] The Exchanging Second-Hand Vehicles for New Ones Policy expired on December 31, 2010.[103]

One perceived problem of the program was the somewhat complicated procedure for obtaining a subsidy.[104] First, vehicles must comply with the national Exchanging Second-Hand Vehicles for New Ones model range, duration limits, and other requirements.[105] Second, the owners sell the scrapped cars to vehicle recycling and dismantling enterprises to receive a scrapped vehicles recycling certificate.[106] Next, the owners apply for the subsidy to the proper authority by presenting the scrapped vehicle recycling certificate, the purchase invoices of the vehicle, and identification.[107] Finally, owners receive the subsidy based on the notice issued by the authorities in conjunction with the local financial department.[108]

Passing and implementing China's rebate program required both horizontal and vertical cooperation among administrative agencies. Horizontal cooperation refers to the coordination of national departments to implement different aspects of the program. For instance, the Ministry of Commerce was in charge of organizing and guiding the program, the Ministry of Finance was responsible for funding the program, the Ministry of Public Security handled

[102] Caizhengbu Shangwubu Guanyu Yunxu Qiche Yi Jiu Huan Xin Butie Yu Cheliang Gouzhi Shui Jian Zhengce Tongshi Xiangshi de Tongzhi (财政部、商务部关于允许汽车以旧换新补贴与车辆购置税减征政策同时享受的通知) [Notice on the Approval of Simultaneously Enjoying the Subsidy for Exchanging Second-hand Vehicles for New Ones and the Vehicle Purchase Tax Reduction Policies] (promulgated by the Ministry of Finance and the Ministry of Commerce on Jan. 1, 2010, effective Jan. 4, 2010).

[103] Caizheng Bu, Shangwu Bu, Huanjing Baohu Bu Guanyu Qiche Yi Jiu Huan Xin Zhengce Dao Qihou Tingzhi Zhixing Deng You Guan Wenti de Tongzhi (财政部、商务部、环境保护部关于汽车以旧换新政策到期后停止执行等有关问题的通知) [Notice on Stopping the Implementation of the Policy of Exchanging Second-Hand Vehicles for New Ones After the Expiration and Other Relevant Issues] (promulgated by the Ministry of Finance, the Ministry of Commerce, and the Ministry of Environmental Protection on Dec. 30, 2010).

[104] *China's Cash for Clunkers Program Extended, Effects Disputed*, CHINA AUTO WEB, May 21, 2010, http://chinaautoweb.com/2010/05/chinas-cash-for-clunkers-program-to-be-extended-effects-disputed/ ("[T]he rebate application process is long and complicated.").

[105] Qiche Yi Jiu Huan Xin Shishi Banfa (汽车以旧换新实施办法) [Measures for Exchanging Old Vehicles to New Ones] (promulgated by the National Development and Reform Commission on July 13, 2009).

[106] *Id.*

[107] *Id.*

[108] *Id.*

vehicle registrations, and the Ministry of Environmental Protection was responsible for vehicle identification and inspection.[109]

Vertical cooperation refers to coordination between China's central and local governments. In Beijing, for example, the local scrappage and rebate program primarily focused on eliminating Yellow Label cars.[110] Beijing's program began in September of 2008 and ran until the end of 2010. During this period, owners could choose between the countrywide subsidy from the central government and the Beijing local government subsidy, but participants could not receive both subsidies.[111] Beijing plans to continue its scrappage and rebate program to further reduce the number of Yellow Label and old vehicles on the road. The local government implemented another round of subsidies in August of 2011 that will run until the end of 2012 and apply to all vehicles that do not meet China's Guo IV standards.[112] During this period, owners of old vehicles can enjoy rebates ranging from 2500 Yuan to 14500 Yuan ($400 to $2300) and additional enterprise incentives ranging from 2000 Yuan to 10000 Yuan ($300 to $1600).[113]

Guangzhou also implemented its own local program. There, owners of Yellow Label cars could enjoy the subsidy from the central government, the incentive from the local government, which equaled half of the national subsidy standards, and any additional discount from vehicle dealers when buying new cars.[114] Under Guangzhou's program, there were four

[109] *Id.*
[110] Guanyu Jinyibu Cujin Ben Shi Lao Jiu Jidongche Taotai Geng Xin Fangan, (关于进一步促进本市老旧机动车淘汰更新方案) [Plan on Further Promoting the Elimination of Old Vehicles] (promulgated by the Local People's Government of Beijing on Aug. 1, 2011).
[111] *Id.*
[112] *Id.*
[113] *Id.*
[114] Guangzhou Shi Guli Taotai Huangbiaoche Qiche Ji Yi Jiu Huan Xin Shishi Banfa (广州市鼓励淘汰黄标车暨汽车以旧换新实施办法) [Guangzhou Encourages the Elimination of Yellow Label Vehicles and Measures for Exchanging Old Vehicles for New Ones] (promulgated by the Local People's Government of Guangzhou on Dec. 18, 2009).

ways to eliminate Yellow Label cars. First, individuals could scrap the old vehicle and purchase a new car like the national program.[115] Second, drivers were also given the option of scrapping the old vehicle without purchasing a new vehicle.[116] Third, the consumer could move the old vehicle out of Guangzhou and purchase a new car to receive the subsidy, and finally, a car owner could remove the old car from Guangzhou without purchasing a new car to receive a subsidy.[117] Guangzhou's local scrappage and rebate program ended on October 31, 2010.[118]

Guangzhou's regulations demonstrate a key flaw in China's vehicle scrappage and rebate programs: the practice, sometimes legal and sometimes not, of simply shipping old cars to less-developed areas. This problem is not confined to Guangzhou but occurs frequently throughout China's provinces and cities. Even In Beijing, 92.4% of old vehicles exchanged for subsidies are not actually scrapped but are shifted to less-developed areas in China.[119] Rather than eliminating pollution from these high-emitting vehicles altogether, it appears that pollution is simply shifted to poorer areas of China.

C. Analysis and Recommendations

Given the overwhelming benefits of eliminating Yellow Label vehicles in China, we recommend the Chinese government reinstate and increase support for its national rebate program. Taking these high-polluting vehicles off the road will reduce China's NOx emissions, CO_2 emissions, and fuel consumption.

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[115] *Id.*
[116] *Id.*
[117] *Id.*
[118] *Id.*
[119] *See* Beijing Old Motor Vehicle Phaseout Has Reached 175,000 and Expected to Reach 200,000 by the End of the Year, VEHICLE EMISSION CONTROL CTR. (Nov. 11, 2011), http://www.vecc-sepa.org.cn/news/news_detail.jsp?newsid=45991.

In addition to increasing support for the scrappage and rebate program, the Chinese government should also consider implementing changes to guarantee the most-polluting vehicles are taken off the road. First, because the benefits of removing these vehicles are so significant, the government should consider direct payments in exchange for Yellow Label vehicle scrapping. One problem common to CARS and China's national rebate programs is that they only apply to consumers who can afford to purchase a new vehicle.[120] Guangzhou has allowed for direct payments for vehicle scrappage without the need to purchase a new car, and this type of program could be expanded nationally.

Another problem is the growth of the used vehicle market in China, stemming in part from dealer incentives to trade-in old vehicles, which makes the rebate program comparatively less financially enticing to Chinese citizens.[121] The reason the Cash for Clunkers program worked in the United States was because the $3,500 or $4,500 voucher was greater than the value of the trade-in cars.[122] Once consumers can find a better deal by privately selling their cars, the rebate program fails. To keep attracting scrappage and rebate participants, China will need to increase subsidies for all types of vehicles. Data for all of China indicates that more than 2 million vehicles reach retirement age every year, but only 300 thousand of them are recycled while the rest continue to be driven.[123]

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[120] *See* Marianne Tyrrell & John C. Dernbach, *The "Cash for Clunkers" Program: A Sustainability Evaluation*, 42 U. TOL. L. REV. 467, 479 (2011) (noting that CARS "excluded people who did not have the financial means to purchase a new vehicle or wanted to give up their cars altogether").

[121] Xiao Taojun, *The Perfection of Our Exchanging Old Vehicles for New Ones Policy*, 6 HUBEI SOCIAL SCIENCES 98, 99 (2010).

[122] Linda Stern, *Driving a Better Bargain*, NEWSWEEK, (June 29, 2009), http://content.knowledgeplex.org/ksg/cache/assets/2801/3163/3163127.html.

[123] Qiche Yi Jiu Huan Xin Kaoyan Baofei Qiche Liu Xiang Jianguan (汽车"以旧换新"考验报废汽车流向监管),[The Policy of "Old for New" for Auto Tests for End-of-Life Vehicle Regulation Oversight], RESOURCE RECYCLING July, 2009.

Another necessary reform is to streamline the procedure for scrapping cars and receiving subsidies. Differing programs at the local and central government level make the process more confusing for participants. In addition, weak oversight by the central government allows Yellow Label cars to be shipped to less developed regions of the country. To truly eliminate these vehicles, the central government will need to ensure that local programs comply with the proper scrappage and recycling procedures. China should adopt the United States practice of destroying old vehicle engines and drive trains to ensure their effective removal.[124]

II. TAXES ON LARGE AND HIGH-EMISSIONS VEHICLES

A. United States "Gas Guzzler" Tax

In 1978, Congress passed the Energy Tax Act to encourage energy conservation through a system of taxes and tax credits.[125] Part of this Act phased in a gas guzzler tax on vehicle manufactures that sell vehicles with very low fuel economy.[126] Originally, the tax applied to vehicles with fuel efficiency less than 15 mpg but that cutoff has since been increased to 22.5 mpg.[127] The tax varies between $1000 and $7,700 based on the efficiency of the vehicle.[128] A vehicle that gets 21 mpg is subject to a $1,300 tax while a 15 mpg vehicle is taxed at $4,500.[129] According to the EPA, vehicles subject to the tax in 2010 were primarily luxury cars including

[124] Marianne Tyrrell & John C. Dernbach, *supra* note 120, at 478 ("[T]he engine in the trade-in vehicles had to be immobilized and the rest of the vehicle had to be shredded or crushed at a NHSTA-approved facility. Prior to crushing or shredding, some parts of the vehicles could be sold, but the engine and drive train could not be.").
[125] SALVATORE LAZZARI, CONG. RESEARCH SERV., RL 33578, ENERGY TAX POLICY: HISTORY AND CURRENT ISSUES 4 (2008).
[126] 26 U.S.C. § 4064 (2006).
[127] *Id.*
[128] *Id.*
[129] *Id.*

various BMW and Mercedes-Benz models or they are imports like Ferraris, Lamborghinis, and Porsches.[130]

Conspicuously absent from the EPA's list of gas guzzlers are SUV models that notoriously get terrible gas mileage. The gas guzzler tax only applies to vehicles that weigh less than 6,000 pounds[131] and only to those vehicles without off-road capabilities as defined by the Department of Transportation.[132] Thus, SUVs are completely exempt from the gas guzzler tax despite their primary use as passenger vehicles and their abysmal fuel economy.[133] In 2005, the corporate average fuel economy (CAFE) standard for light trucks, which includes SUVs, was just 21 mpg.[134] Thus, a majority of vehicles in the light truck category would likely be subject to the tax but for the "nonpassenger vehicle" exemption.

Not only does the Internal Revenue Code in the U.S. fail to discourage truck and SUV purchases, it may actually encourage them. Under the Deficit Reduction Act of 1984, Congress limited depreciation allowances on luxury vehicles used for commercial purposes.[135] Originally, Congress intended to discourage people from purchasing expensive luxury cars for business

[130] *Vehicles Subject to the Gas Guzzler Tax for Model Year 2010*, U.S. ENVTL. PROT. AGENCY (July 14, 2011), http://www.epa.gov/fueleconomy/guzzler/420b11034.pdf.
[131] 26 U.S.C. § 4064 (2006) ("The term 'automobile' means any 4-wheeled vehicle propelled by fuel . . . which is rated at 6,000 pounds unloaded gross vehicle weight or less.").
[132] 26 U.S.C. § 4064 exempts automobiles treated as "nonpassenger automobiles" under rules promulgated by the Secretary of Transportation pursuant to 49 U.S.C. § 32901. That section states that a passenger automobile "does not include an automobile capable of off-highway operation that the Secretary decides by regulation has a significant feature (except 4-wheel drive) designed for off-highway operation; and is a 4-wheel drive automobile. . . ."; *See* 49 C.F.R. § 523.5 (2009) (defining non-passenger automobiles).
[133] *See* LAURA MACCLEERY, ET AL., PUBLIC CITIZEN, SUVS: THE HIGH COSTS OF LAX FUEL ECONOMY STANDARDS FOR AMERICAN FAMILIES 19 (2003) (comparing average SUV fuel economy with average car fuel economy).
[134] NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., FINAL REGULATORY IMPACT ANALYSIS, CORPORATE AVERAGE FUEL ECONOMY FOR MY 2011 PASSENGER CARS AND LIGHT TRUCKS I-1 (2009), *available at* http://www.nhtsa.gov/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE_Final_Rule_MY2011_FRIA.pdf.
[135] GARY GUENTHER, CONG. RESEARCH SERV, RL 32173, TAX PREFERENCES FOR SPORT UTILITY VEHICLES (SUVS): CURRENT LAW AND LEGISLATIVE INITIATIVES IN THE 109TH CONGRESS 8 (2005).

use.[136] However, "the limits no longer effectively serve this purpose because they have not kept pace with increases in the cost and improvements in the quality and design of passenger cars . . . [such that] any passenger car placed in service in 2005 whose purchase price was $13,860 or more was deemed a luxury car under IRS regulations."[137] This creates a major loophole because not all SUVs are considered passenger cars.[138] Any vehicle that weighs more than 6,000 pounds is exempt from the luxury car restriction.[139] Thus, a small business taxpayer looking to purchase a vehicle for both business and personal use has a strong incentive to buy an SUV over 6,000 pounds.[140]

The SUV loophole in both the gas guzzler tax and available tax deductions on luxury vehicles demonstrates that the United States tax code both fails to incentivize small vehicle purchases and it fails to punish the worst gas guzzlers. SUVs emit both more CO_2 and more NOx per vehicle mile travelled than normal cars.[141] We do not attempt to quantify the pollution impacts of poor tax design in the United States but offer these examples to illustrate that tax policy can have enormous implications on a country's vehicle fleet. The Chinese government should take this lesson to heart when designing vehicle consumption taxes to ensure consumers are not incentivized to buy the worst performing vehicles.

B. China's Vehicle Consumption Tax Structure

[136] *Id.*
[137] *Id.*
[138] Lawrence Zelenak, *The Loophole That Would Not Die: A Case Study in the Difficulty of Greening the Internal Revenue Code*, 15 LEWIS & CLARK L. REV. 473 (2011).
[139] *Id.*
[140] *Id.* at 474 (describing a story about a healthcare consultant's decision to purchase a Ford Excursion because of its significant tax deduction).
[141] STACY C. DAVIS & LORENA F. TRUETT, OAK RIDGE NATIONAL LABORATORY, AN ANALYSIS OF THE IMPACT OF SPORT UTILITY VEHICLES IN THE UNITED STATES 4 (2000).

China has a more comprehensive system for vehicle taxation. The vehicle consumption taxes in China are based on the vehicle's cylinder capacity. Vehicles with an engine displacement of less than or equal to 1.0L are taxed at 1%, vehicles with a displacement between 1 and 1.5L are taxed at 3%, between 1.5 and 2L at 5%, between 2 and 2.5L at 9%, between 2.5 and 3L at 12%, between 3 and 4L at 25%, and vehicles with a displacement greater than 4L at 40%.[142] These rates were adjusted to encourage consumers to purchase smaller vehicles.

In 2008, the State Council announced plans to strengthen fuel savings by reducing the consumption tax rate on low-emission passenger cars and raising the rate on high consumption cars.[143] The tax rate for vehicles with a displacement less than or equal to 1L was decreased from 3% to 1% while the rate for vehicles with an engine displacement between 3 and 4Lwas increased from 15% to 25%.[144] Finally, for vehicles with a displacement greater than 4.0L was increased from 20% to 40%. Six months later, the Ministry of Finance announced a reduction of the vehicle purchase tax for passenger cars with an engine displacement less than 1.6L to 5%.[145] Originally, the reduced tax rate was slated to last only until the end of 2009, but the reduced rate has been extended indefinitely.[146] In 2010, the Ministry of Finance harmonized the lower tax rate

[142] Caizheng Bu, Guojia Shuju Zongju Guanyu Tiaozheng Chengyongche Xiaofei Shui Zhengce de Tongzhi (财政部、国家税务总局关于调整乘用车消费税政策的通知) [Notice on the Adjustment of the Passenger Car Consumption Tax Policy] (promulgated by the Ministry of Finance and the State Administration of Taxation on Aug. 1, 2008).

[143] Guowu Yuan Jinyibu Jiajiang Jie You Jie Dian Gongzuo de Tongzhi (国务院关于进一步加强节油节电工作的通知) [Notice on Further Strengthening the Work of Fuel Saving] (promulgated by the State Council on Aug. 1, 2008).

[144] *Id.*

[145] Caizheng Bu, Guojia Shuiju Zongju Guanyu Jian Zheng 1.6Sheng Yixia Xiao Pailiang Chengyongche Cheliang de Tongzhi (财政部， 国家税务总局关于减征 1. 6L 升及以下小排量乘用车车辆购置税的通知) [Notice on the Reduced Vehicle Purchase Tax on Passenger Cars with 1.6L or Lower Displacement] (promulgated by the Ministry of Finance and the State Administration of Taxation on Jan. 16, 2009).

[146] Caizheng Bu, Shangwu Bu Guanyu Yunxu Qiche Yi Jiu Huan Xin Butie yu Cheliang Gouzhi Shui Zhengce Tongshi Xiangshou de Tongzhi 财政部，商务部关于允许汽车以旧换新补贴与车辆购置税减征策同时享受的通知 [Notice of the Ministry of Finance and the Ministry of Commerce on the Approval of Simultaneously

with the vehicle exchange rebate program by allowing consumers to enjoy both the rebate subsidy and the reduced tax rate when purchasing a car with 1.6L or smaller engine size.[147]

C. Analysis and Recommendations

The United States experience with the explosion of SUVs demonstrates the dire consequences of poorly designed tax policy. Fortunately, China has not adopted a light duty vehicle category that exempts SUVs from vehicle taxes and fuel economy standards.[148] More research is necessary to determine the vehicle purchase tax impact on consumer demand in China. It is unclear how effective the higher tax rates are in deterring their manufacture or purchase. China could also look to countries such as Denmark, which imposes a 200% tax penalty on the purchase of all new vehicles.[149] Such a policy would allow China to exempt certain vehicles from the tax, such as hybrids, to encourage quicker adoption of the best available technologies.[150]

III. ELECTRIC VEHICLE SUBSIDIES

A. Electric Vehicles in the United States

In 2010, two different electric vehicles hit the market in the United States: the Chevrolet Volt and the Nissan Leaf.[151] While these two vehicles are currently far too expensive to get much market penetration in the United States, they have generated excitement about the prospects for an electric vehicle future. The Chevrolet Volt is a plug-in hybrid electric vehicle that can also run

Enjoying the Subsidy for Exchanging Second-hand Vehicles for New Ones and the Vehicle Purchase Tax Reduction Policies] (promulgated by the Ministry of Finance and the Ministry of Commerce on Jan. 4, 2010).

[147] *Id.*

[148] FENG AN, ET AL., *supra* note 41, at 12.

[149] Nelson D. Schwartz, *In Denmark, Ambitious Plan for Electric Cars*, N.Y. TIMES, Dec. 2, 2009, at A1, *available at* http://www.nytimes.com/2009/12/02/business/energy-environment/02electric.html.

[150] *Id.* (discussing Denmark's policy of exempting electric vehicles from the country's 200% vehicle purchase tax).

[151] Danielle Changala & Paul Foley, *The Legal Regime of Widespread Plug-In Hybrid Electric Vehicle Adoption: A Vermont Case Study*, 32 ENERGY L.J. 99, 101-03 (2011).

on gasoline. It has the ability to travel up to 40 miles solely on its 16 kilowatt hour (kWh) battery.[152] The Nissan Leaf relies entirely on an electric motor with a 100-mile range between charges.[153] Electric vehicles present opportunities to significantly reduce pollution because electric motors are inherently more efficient than internal combustion engines[154] and because they emit no pollution at the tailpipe.

However, while electric vehicles may emit no pollution on the road, they are responsible for any pollution emitted as a by-product of generating the electricity that powers them. In the United States, the reduction in greenhouse gas emissions from electric vehicles is potentially significant. Nationwide, electric vehicles should on average reduce greenhouse gas emissions compared with conventional vehicles.[155] However, studies evaluating the greenhouse gas reductions from electric vehicles vary considerably because of assumptions about regional electricity mix, time of charging, fuel-efficiency of comparison vehicles, and which emissions to include in a lifecycle analysis.[156] Most studies seem to agree that there is some CO_2 benefit from plug-in electric vehicles but they disagree as to its extent.[157]

NOx emissions from electric vehicles in the United States are likewise difficult to analyze. One key advantage of electric vehicles is that they eliminate NOx emissions from the vehicle itself.[158] This is key because "major air quality issues and health concerns related to NO_X

[152] *Id.* at 101.
[153] *Id.* at 103.
[154] *Id.* at 115 ("A traditional internal combustion gasoline engine is only about 20% efficient, that is, only 20% of the energy in gasoline actually powers the wheels.").
[155] *Id.* at 114 ("For each mile driven on electricity rather than gasoline, carbon dioxide emissions are reduced by an average of 42%.").
[156] *See* JONATHAN DOWDS, ET AL., UVM TRANSPORTATION CENTER, PLUG-IN HYBRID ELECTRIC VEHICLE RESEARCH PROJECT: PHASE II REPORT 6-8 (2010)(discussing studies that find the greenhouse gas reduction benefits of plug-in electric vehicles over hybrid gasoline electric vehicles range from 4-25%).
[157] *Id.*
[158] K. PARKS, ET AL., NAT'L RENEWABLE ENERGY LAB., COSTS AND EMISSIONS ASSOCIATED WITH PLUG-IN HYBRID ELECTRIC VEHICLE CHARGING IN THE XCEL ENERGY COLORADO SERVICE TERRITORY 21 (2007).

are from emissions in populated areas."[159] While the electric vehicle is still responsible for emissions associated with generating the electricity to power the car, the harmful pollution comes from power plants outside the cities where most people live and work. Although the net NOx reductions from electric vehicles in the United States may be minor, shifting the locus of the pollution to a handful of points sources could have significant public health benefits.[160]

In his 2011 State of the Union address, President Obama announced an ambitious goal to have one million electric vehicles on the road by 2015.[161] Currently, the U.S. supports the electric vehicle industry with a consumer tax credit up to $7,500 for qualifying vehicles.[162] Vehicles with a battery capacity of at least 4 kWh qualify for a base tax credit of $2,500.[163] The base amount is supplemented by an additional $417 per kWh of capacity above 4 kWh, up to a maximum $5,000.[164] Both the Nissan Leaf and the Chevy Volt qualify for the full $7,500 tax credit.[165] To receive the entire tax credit, consumers must have a total tax liability after all other deductions of at least $7,500, otherwise the credit is only valid up to the taxpayer's total liability.[166] This tax credit will be gradually phased out on a vehicle-by-vehicle basis when the total number of a specific vehicle's sales reaches 200,000.[167]

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[159] *Id.*
[160] *Id.*
[161] *Obama Administration Pushes Electric Vehicles*, INSTITUTE FOR ENERGY RESEARCH (Mar. 10, 2011), http://www.instituteforenergyresearch.org/2011/03/10/obama-administration-pushes-electric-vehicles/.
[162] 26 U.S.C. §30D (2010).
[163] *Id.*
[164] *Id.* ("In the case of a vehicle which draws propulsion energy from a battery with not less than 5 kilowatt hours of capacity, the amount [of additional subsidy] is $417, plus $417for each kilowatt hour of capacity in excess of 5 kilowatt hours.").
[165] Both vehicles have a battery capacity greater than 4 kWh, which qualifies them both for the base subsidy of $2,500. After the base, each additional kWh of capacity is worth $417. Thus, a vehicle with a battery capacity equal to or greater than 16 kWh will qualify for the entire $7,500 subsidy. *See* Danielle Changala & Paul Foley, *supra* note 151, at 102-104 (stating that the Leaf and the Volt qualify for the entire available tax subsidy).
[166] *Id.* ("The credit allowed under subsection (a) for any taxable year . . . shall not exceed the excess of the sum of the regular tax liability . . . .").
[167] *Id.*

In addition to the federal tax credit, some states offer additional subsidies to make the steep price of plug-in electrics more reasonable. California offers a rebate up to $5,000 for qualified electric vehicles.[168] Unlike a tax credit, a rebate can be applied directly at the time of purchase and applies to everyone regardless of tax liability. Washington took a different approach and exempted electric vehicles from state sales tax.[169] Both Tennessee and Florida offer incentives and subsidies for consumers to build charging stations at their homes.[170]

B. ELECTRIC VEHICLES IN CHINA

In October 2010, China's State Council issued a general policy pronouncement on "accelerating and fostering the development of strategic emerging industries."[171] One such emerging industry is the so-called "new energy automobile industry," which includes plug-in hybrid electric vehicles and pure electric vehicles.[172] China's goals include technological breakthroughs in batteries and electronic control, as well as popularizing and industrializing production of these new energy vehicles.[173]

Turning this general support into concrete policy, the Ministry of Finance debuted a pilot program in five cities to offer subsidies to consumers who purchase electric vehicles and plug-in hybrid electric vehicles.[174] The ambitious program offers up to $8,785 towards the purchase of a

[168] *Electric Car Subsidies by State*, PLUG-IN (2011), http://www.plug-in.com/electric-car-subsidies-by-state/.
[169] *Id.*
[170] *Id.*
[171] Guowu Yuan Guanyu Jiakuai Peiyu he Fazhan Zhanluexing Xinxing de Jueding (国务院关于加快培育和发展战略性新兴产业的决定)[Decision of the State Council on Accelerating the Fostering and Development of Strategic Emerging Industries](promulgated by the St. Council, Oct. 10, 2010) ST. COUNCIL GAZ., 2010, at 32.
[172] *Id.*
[173] *Id.*
[174] Caizheng Bu, Keji Bu Gongye he Xinxi Hua Bu, Guojia Fazhan Gaige Wei Guanyu Kaizhan Siren Goumai Xin Nengyuan Qiche Butie Shidian de Tongzhi (财政部、科技部、工业和信息化部、国家发展改革委关于开展私人购买新能源汽车补贴试点的通知) [Notice on the Interim Measures of Financial Subsidies for Pilot Private

pure electric vehicle and up to $7,320 for a plug-in hybrid electric vehicle.[175] The total subsidy for each vehicle is 3000 Yuan ($475) per kwh of capacity up to the respective limits for each vehicle type.[176] To qualify for the subsidies, pure electric vehicles must have a minimum 15 kwh of capacity and plug-in hybrids must have a minimum of 10 kwh.[177] These generous subsidies are narrowly designed to give the new industry a boost, and therefore when a manufacturer sells 50,000 new energy vehicles the subsidy will be appropriately reduced.[178] In addition, China plans to build charging stations in the five test cities, which include Shanghai, Shenzhen, Hangzhou, Hefei, and Changchun.[179] Local governments administer the programs in these five cities under the supervision of the Ministry of Finance, which appropriates the subsidies.[180]

Following the announcement of the pilot program, China's 12th Five Year Plan spanning 2011-2015, reaffirmed support for promoting the "leapfrog development of key fields" including the "development of plug-in hybrid electric vehicles [and] pure electric vehicles . . . ."[181] China expects new energy vehicles and other emerging strategic industries, which includes such broad categories as renewable energy and next-generation information technology, to comprise 8% of China's GDP by 2015.[182] While China's Five Year Plans are not binding law, they provide a useful overview of the central government's priorities for the five-year period. When broad goals are articulated in a Five Year Plan, state agencies often announce more specific plans to meet

Purchase of New Energy Vehicles] (promulgated by the Ministry of Finance, the Ministry of Science, the Ministry of Industry and Information Technology, and the National Development Reform Commission on May 31, 2010).
[175] *Id.*
[176] *Id.*
[177] *Id.*
[178] *Id.*
[179] *Id.*
[180] *Id.*
[181] China 12th Five-Year Plan, *available at* http://news.xinhuanet.com/politics/2011-03/16/c_121193916_32.htm.
[182] *Id.*

countrywide goals. Thus, it is likely that China will continue to expand support for electric vehicles throughout the country.

China currently struggles with a lack of long-term goals and standards in the development of the new energy automotive industry, which threatens the development of electric vehicles in China. The main problems include the high price of new energy vehicles, imperfections in battery technology, and the construction of supporting facilities.[183] While electric vehicles may eventually be a logical transition away from gasoline, they will likely remain far too expensive for the average Chinese consumer for decades. According to China's special component of the twelfth Five Year Plan on the development of the electric vehicle industry, China will focus on solving the technical problems in the new energy vehicle industry.[184] Specifically, development of the "pure electric drive" will be a major focus for China's new energy vehicle development, and other research will try to improve battery, motor, and electronic control technology.[185]

In addition to central government programs, local people's governments are also focusing on promoting new energy vehicles. In Beijing, the government has invested over one billion Yuan ($159 million) for purchasing new energy vehicles and has budgeted for their continued operation.[186] By the beginning of 2011, Beijing had a total of 2260 new energy vehicles, including 870 hybrid vehicles and 1390 pure electric vehicles, giving Beijing the distinction of

[183] *New Energy Vehicle Excitement Behind the Chaos* (March 19, 2012), http://www.21cbh.com/HTML/2012-3-19/zMMDcyXzQxMDgzMQ.html.
[184] [Qiche] Diandong Che "Shierwu" Guihua Gongbu huo Chanye Gaochao ([汽车] 电动车"十二五"规划公布或产业化高潮) [Announcing the Electric Car "Five Year Plan" to Meet the Challenges of Industrialization] (promulgated by the Ministry of Finance, the State Administration of Taxation, and the Ministry of Industry and Information Technology on April 7, 2012), *available at* http://info.china.alibaba.com/news/detail/v0-d1025596097.html.
[185] *Id.*
[186] *Beijing Financial Support for Popularizing New Energy Vehicles*, VEHICLE EMISSION CONTROL CTR. (July 26, 2011), http://www.vecc-mep.org.cn/news/news_detail.jsp?newsid=44346.

being the city with the highest utilization rate for new energy automobiles.[187] Unfortunately, private citizens have yet to adopt electric vehicles and one primary problem is a lack of electric vehicle charging stations.

As part of our research, we took a research trip to an electric vehicle charging station on December 29, 2011. The station, under Hangtian Bridge, is Beijing's first electric vehicle charging center with around ten private vehicle chargers. It does not appear that any of the vehicle chargers have been used. There is currently a private parking facility blocking the entrance to the charging station and anyone who needed to charge a vehicle would have to pay the parking fee to enter. Beijing plans to construct 256 charging stations with 42,000 individually vehicle chargers during the 12th Five Year period (2011-2015).[188] It costs about 5 million Yuan ($800,000) to build a medium-sized charging station with 10 vehicle chargers, including the infrastructure costs, distribution facilities, and operating costs.[189] Beijing has already spent 400 million Yuan ($65 million) on eight charging stations.[190] Right now, most, if not all, of Beijing's charging stations are not used by private citizens.[191]

Since the end of 2010, Guangdong Province has also begun ramping up investment into its electric car industry. At the Development and Promotion of the Use of New Energy Automobiles industry convention, which was held in Shenzhen, Guangdong Province at the end of 2011, Vice Governor of Guangdong Province, Zhu Xiaodan emphasized that in 2012 Guangdong will

[187] *Id.*
[188] Beijing Jiang Jian 4 Wan Diandong Che Chong Dian Zhuang (北京将建 4 万电动车充电桩) [Beijing Plans to Build 40,000 Electric Vehicle Charging Stakes], http://bjwb.bjd.com.cn/html/2011-09/20/content_453411.htm?div=-1.
[189] Jimo de Baishe Beijing Diandong Qiche Chongdian Zhan Diaocha (寂寞的摆设 北京电动汽车充电站调查) [Lonely Decorations - Beijing's Electric Charging Stations Investigation] http://auto.163.com/11/0727/16/79VV1VBE00084TV1_2.html.
[190] *Id.*
[191] *Id.*

become a leader for new energy vehicle pilot demonstrations and regional applications, and master a number of the core technologies and industrial capabilities.[192] According to the plan for the development of new energy vehicles of Guangdong province, in 2015 Guangdong will establish the network facilities, industry support system, and policy environment to meet the development requirements of electric vehicles.[193] Guangdong's production capacity will be greater than 200,000 electric vehicles.[194] Guangdong will try to make electric cars account for 3% to 5% of total new car sales and the production of electric cars account for about 5% of all cars produced.[195]

C. Analysis and Recommendations

Unfortunately, widespread adoption of electric vehicles in China will actually have negative environmental consequences in terms of both CO_2 emissions and conventional air pollutants. Electric vehicles are powered by electricity from the grid, which means they are only as clean as the power plant that generates their electricity. In 2008, 80% of China's electricity was generated by coal-fired power plants.[196] Even in 2035, coal's share of the mix is projected to remain fairly high at 66%.[197] In China's northern regions, coal generates well over 90% of the electricity consumed there.[198] By contrast, in southern China where water resources are abundant, hydropower displaces a significant amount of coal, reducing its share to 65% of

[192] *Guangzhou's 800 Million Yuan Plan to Promote Electric Cars*, VEHICLE EMISSION CONTROL CENTER (May 4, 2011), http://www.vecc-sepa.org.cn/news/news_detail.jsp?newsid=43107.
[193] *Id.*
[194] *Id.*
[195] *Id.*
[196] U.S. ENERGY INFO. ADMIN., INTERNATIONAL ENERGY OUTLOOK 2011 97 (2011).
[197] *Id.*
[198] Hong Huo, et al., *Environmental Implication of Electric Vehicles in China*, 44 ENVTL. SCI. & TECH. 4856, 4857 (2010).

electricity generated there in 2008.[199] These differences in the sources of electricity generation have enormous bearing on the lifecycle environmental consequences of electric vehicles.

According to one study, the break-even point between electric and conventional vehicles for CO_2 emissions occurs when 87% of the electric grid is powered by coal.[200] Thus, in some regions, China could currently realize a reduction in net CO_2 emissions with electric vehicles. At most, the current reduction in CO_2 emissions over conventional vehicles in any region of China is 25%, similar to the countrywide average reduction expected in 2035 based on projections of China's electricity mix.[201] It appears, therefore, that the potential for CO_2 emissions reductions from electric vehicles is modest even over the long run.

The outlook for electric vehicles with respect to NOx emissions in China is worse. With China's current electric mix, electric vehicle NOx emissions are double those of conventional vehicles, and they are likely to remain substantially higher in 2030.[202] Recent research also indicates that, even after accounting for the locus-shifting effect from highly congested areas to coal-fired power plants, electric vehicles are still worse for public health in China than conventional vehicles.[203] While new technology such as selective catalytic reduction in coal-fired power plants has the potential to significantly reduce NOx emissions from the electricity sector, these technologies are not widely deployed.[204] Of course if China cleans up its electricity grids and employs the most advanced technology, it could dramatically reduce the environmental

[199] *Id.*
[200] *Id.*
[201] *Id.* at 4858; *see also,* ROBERT FARLEY, ET AL., ELECTRIC VEHICLES IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT IN CHINA 21 (2011) (finding a maximum 23% current reduction in greenhouse gas emissions from electric vehicles).
[202] *Id.* at 4858-59.
[203] Shuguang Ji, et al., *Electric Vehicles in China: Emissions and Health Impacts*, 46 ENVTL. SCI. & TECH. 2018, 2021 (2012).
[204] *Id.* at 4859 ("The penetration rate of SCR in China was estimated to be lower than 10%.").

impact of electric vehicles, but at the same time, conventional and gasoline-hybrid vehicles are also likely to improve.

By every environmental measure, electric vehicles either offer inferior benefits than other available technologies or they are simply worse than conventional vehicles. Absent some unforeseen technological breakthrough, such as coal carbon capture and sequestration, and widespread deployment at an unprecedented rate in China, electric vehicles are likely to remain an environmental liability for at least the next twenty years. To reap the most environmental benefits from subsidies and other regulations, China should reconsider subsidies for electric vehicles in favor of other technologies.

One such technology, currently available and much more price-competitive than plug-in electric vehicles, is the gasoline powered hybrid-electric vehicle. Hybrid electric vehicles, like the Toyata Prius, can reduce greenhouse gas emissions by up to 37% compared to their conventional counterparts.[205] Moreover, hybrids take advantage of shielding their combustion engines from rapid accelerations thereby reducing emissions of other air pollutants.[206] Current models can reduce NOx and SOx emissions by up to 71% and 81% respectively.[207] Thus, in China existing hybrid vehicles currently yield greater environmental benefits than electric vehicles will likely offer in 2030. Add to this the fact that no new infrastructure is required to support hybrid vehicle deployment and the environmental case for electric vehicles is lost. Unfortunately, sales of Prius-style hybrids in China remain surprisingly weak.[208] One factor

[205] U.N. ENVTL. PROGRAMME, HYBRID ELECTRIC VEHICLES: AN OVERVIEW OF CURRENT TECHNOLOGY AND ITS APPLICATION IN DEVELOPING AND TRANSITIONAL COUNTRIES 11 (2009).
[206] *Id.* at 10.
[207] *Id.* at 11 (Figure 7).
[208] Jonathan Watts, *China's Love Affair with the Car Shuns Green Vehicles,* THE GUARDIAN, Aug. 24, 2011, http://www.guardian.co.uk/environment/2011/aug/24/china-cars-green-vehicles. ("Chinese show little sign of

Country	Electric Vehicle Subsidy (PHEV/BEV)	Hybrid Vehicle Subsidy
United States	• Up to $7,500 ($2500 base) • Phaseout begins when 200,000 vehicles are sold • Both Leaf and Volt get max credit	(Expired December 31, 2010) • Up to $3,400 tax credit • Individual model phaseout began when 60,000 sold

contributing to weak sales are high import tariffs for crucial parts[209] and a lack of government subsidies for purchasing gasoline hybrids. The following chart summarizes how the United States and China have incentivized plug-in and gasoline hybrid vehicles:

Sources: Notice on the Interim Measures of Financial Subsidies for Pilot Private Purchase of New Energy Vehicles, *supra* note 155; 26 U.S.C. § 30D (2011); 26 U.S.C. §30B (2011).

interest in electric and hybrid vehicles despite ambitious government plans. Last year, Toyota managed to sell only one Prius—the world's most commercially successful hybrid car—in the fastest-growing market.").

[209] KELLY SIMS GALLAGHER, ENERGY TECH. INNOVATION PROJECT, ROUNDTABLE ON BARRIERS AND INCENTIVES FOR HYBRID VEHICLES IN CHINA 3 (2006), *available at* http://belfercenter.ksg.harvard.edu/files/report_hybrid_roundtable_final_9_6_06.pdf ("One reason for the higher price is because of the 10-28% tariff that is paid on imported parts and components.").

	• Additional state subsides (up to $5,000 in California)	• According to one estimate 3% of all vehicles sold in U.S. today
China	• $9,400 (60,000 Yuan) for BEVs • 50,000 Yuan for PHEVs • Up to $18,800 (120,000 Yuan) for the BYD e6 • Pilot program started in 5 cities in 2010	• $469 (if displacement under 1.6L) • No different from internal combustion engine vehicles

Unlike the United States, China has never offered any special subsidies for traditional hybrids. Instead, China has opted to pursue purely electric and plug-in hybrids as a "leapfrog technology."

Despite heavy government subsidies, electric vehicles remain far more expensive than their hybrid counterparts. Even when fuel savings are factored into the cost, electric vehicles are far more expensive than fuel-efficient alternatives.[210] The following chart illustrates price differences between plug-in electric vehicles and gasoline hybrids in the United States and China:

Sticker Price for Plug-In Electric and Hybrid-Electric Vehicles[211]

Vehicle	Plug-In: Y/N	Price

[210] *See* Danielle Changala & Paul Foley, *supra* note 151, at 107-108 (discussing the higher lifetime cost of electric vehicles).

[211] Marc Gunther, *How Much Does an Electric Car Really Cost?*, http://www.greenbiz.com/blog/2011/04/20/how-much-does-electric-car-really-cost (last visited Feb. 15, 2012); Keith Bradsher, HERTZ TO BEGIN RENTING ELECTRIC CARS IN CHINA, http://www.nytimes.com/2011/08/24/business/global/hertz-to-begin-renting-electric-cars-in-china.html (last visited Feb. 15, 2012); A LIST OF HYRBID SEDANS http://www.hybridcars.com/hybrid-sedan (last visited Feb. 15, 2012). All prices except for the SAIC Roewe and BYD e6 are MSRPs in the United States. The cost of purchasing a Toyota Prius and Hybrid Honda Civic is substantially higher in China because of heavy import taxes on vehicle parts from Japan. The listed prices are before subsidies/taxes are applied.

SAIC Roewe 750	Y	$37,260
BYD e6	Y	$47,000
Chevy Volt	Y	$40,280
Nissan Leaf	Y	$32,780
Toyota Prius	N	$24,000
Hybrid Honda Civic	N	$24,000
Ford Fusion Hybrid	N	$28,700
Lexus CT 200h	N	$29,100

Taken together, the high cost, infrastructure requirements, and environmental consequences of electric vehicles reflect that China is not yet ready to pursue an all-electric future. Instead, China should consider substituting its current policies favoring plug-ins for subsidies favoring hybrid vehicle technology. Lowering import tariffs and exempting hybrids from the vehicle purchase tax would also help encourage rapid adoption of the technology.

CONCLUSION

If China is going to meet its aggressive emissions reduction goals over the next five years, the government will have to institute strong policies to manage its vehicle fleet. With a scrappage and rebate program, the Chinese government has an opportunity to take the worst-polluting vehicles out of commission. By adjusting its comprehensive system of vehicle purchase tax rates, the Chinese government can effectively steer consumers towards purchasing smaller, more efficient vehicles. Finally, by subsidizing the best new technologies, the Chinese government can ensure that the vehicles of the future will be cleaner and more efficient than today's. These three approaches represent the full spectrum of policies that target past, present, and future vehicles.

By taking lessons from the United States, China can avoid the mistakes and mirror the successes of the developed world in the realm of vehicle emission control. While the gas guzzler tax was a policy failure that China should avoid, the smooth operation of the Cash for Clunkers program and subsidies for gasoline-hybrid vehicles in the United States are examples of successful market approaches that China can draw on for its own programs. Market-based solutions are not the only answer for controlling vehicle emissions, but the growing scale and nature of the vehicle emissions challenge will require policymakers from both the United States and China to use a combination of tools to minimize the environmental and public health consequences of vehicles.