POSITION BRIEF

© 2020 INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

APRIL 2020

WHY CHINA SHOULD NOT POSTPONE IMPLEMENTATION OF THE CHINA 6 EMISSION STANDARD FOR NEW CARS HUI HE

In late February of this year, the China Association of Automotive Manufacturers wrote a letter to the Ministry of Ecology and Environment requesting, on behalf of the Chinese automotive industry, a six-month delay in the nationwide implementation of China Stage 6 Limits and Measurements Methods for Emissions from Light-duty Vehicles (hereafter the China 6 standard).

The China 6 standard applies to light-duty vehicles—M1, M2, and N1 categories up to 3,500 kilograms of maximum mass, per the European regulatory classification—powered primarily by gasoline or diesel. Adopted in December 2016, it is scheduled to be implemented at the national level in two phases: China 6a starting on July 1, 2020 and China 6b starting on July 1, 2023.

Until July 1, 2020, provinces and cities may choose to adopt the standard early with a more lenient, transitional particle number (PN) limit of 6 x 10^12# per kilometer (km) for new gasoline cars that are otherwise fully China 6 compliant. A stricter and final PN limit of 6 x 10^11#/km, one tenth of the transition limit in magnitude, is scheduled to be in force starting on July 1.

In this paper, we refer to China 6 vehicles built to meet the stricter PN limit as China 6-PN11 vehicles and to those that can only meet the transitional PN limit as China 6-PN12 vehicles.

Weeks after the letter, an automobile magazine further clarified that the industry is essentially seeking two accommodations:¹

- 1. Allow the sale and registration of their stock of China 5 vehicles for an additional six months, until December 31, 2020.
- 2. Delay the implementation of the PN limit of 6 x 10¹¹#/km required in the China 6 standard, also for six months.

This came about in the context of an auto market downturn that has been ongoing since mid-2019 and was worsened by the outbreak of Coronavirus at the start of 2020. As such, car manufacturers expressed concern that they might not

www.theicct.org communications@theicct.org

twitter @theicct



^{1 &}quot;CAAM proposes to delay implementation of China VI emission standard," *China Automotive News*, February 24, 2020, <u>http://autonews.gasgoo.com/china_news/70016882.html</u>

have sufficient time to sell the inventory of pre-China 6 vehicles under these market conditions. The proposal was offered as a possible solution to ease the burden on carmakers, automobile dealers, and suppliers.

However, the ICCT believes that this delay is neither needed nor wise. For the following reasons, it would not benefit the Chinese economy, the auto industry, or, most importantly, public health.

- » Since March 2020, auto sales have shown strong evidence of rebounding. There is sufficient time for the industry to sell the China 5 and China 6-PN12 vehicle inventories and therefore for a complete shift to the China 6 standard, including the final PN limit, on July 1, 2020.
- » China 6 cars already dominate the new vehicle market and the vast majority of car manufacturers are well prepared. Any delay would simply penalize these early technology adopters and reward technology laggards.
- » The requested delay would result in extra emissions of $0.5-2.8 \times 10^{24}$ numbers, or approximately 610 tonnes of fine particles, about 440 tonnes of black carbon (a strong global warming agent), and about 310,000 tonnes of nitrogen oxides (NO_x) over the lifetime of these vehicles.² The total societal cost is estimated to be CNY3.1 billion, which possibly outweighs any short-term benefit to the few automakers that would take advantage of the delay.
- India's planned leapfrog to Bharat Stage VI (BS VI) emission standards, roughly equivalent to Euro 6 and China 6 standards, from BS 4, equivalent to Euro 4, was recently completed on April 1, 2020. As the country was in lockdown on that date because of Coronavirus, the Supreme Court will allow BS 4 inventories to be sold for 10 days after the lockdown ends. This may offer an encouraging example for China, as India successfully kept to the majority of its original plan for the standard despite the health crisis.

As an alternative to any delay in China 6 implementation and to address any potential harm to the economy, the ICCT recommends a combination of measures to support the sale of the pre-China 6 vehicle stock before July.

- » Use a stimulus package to accelerate the sale of in-stock China 5 and China 6-PN12 vehicles domestically before July 1.
- » Incentivize the export of China 6-PN12 cars, also to help sell the inventory.
- » Use additional incentives to promote the sale and use of China 6-PN11 vehicles to reward technological leaders.

The rest of this paper elaborates on why delay is a bad idea and discusses alternatives in greater detail.

AS THE CORONAVIRUS OUTBREAK STABILIZES IN CHINA, WILL THE CAR MARKET BOUNCE BACK OR CONTINUE TO SINK?

The crux of the auto industry's concern is the pressure to sell the stock of China 5 and China 6-PN12 vehicles in the face of strong headwinds generated by the health crisis. Up until February 2020, the total China 5 inventory was about 260,000 and for China 6-PN12 vehicles, it was about 3 million.

² Estimates of particle number and black carbon mass are based on (1) the methodology specified in Athanasios Mamakos et al., "Cost Effectiveness of Particulate Filter Installation on Direct Injection Gasoline Vehicles," Atmospheric Environment 77(2013), 16-23, doi: 10.1016/j.atmosenv.2013.04.063; and (2) GDI car sales projections for April 2020 to July 2020, based on the China Passenger Car Association's overall market projection for 2020. Estimates for NOx emissions are from ICCT's own modeling.

The key question, then, is whether the market is likely to be able to absorb that amount of vehicle stock before July. Admittedly, new car sales in the first two months of 2020 slumped to a low not seen since 2015. In early March, the Chinese Passenger Car Association projected that without stimulus, annual new passenger car sales in 2020 would fall about 8% from last year.³ However, as the quarantine requirements were lifted in various cities, there was a remarkable rebound in new car sales starting in March. This is illustrated in Figure 1, and the rebound is even more evident in the early April market report, which shows that sales of passenger vehicles in the week of April 7-12 rose 14% from a year earlier. That marked the first weekly rise reported since the Coronavirus outbreak.⁴ Moreover, even if the overall 8% market decline comes to fruition, projected sales of new cars from April to July would be around 5.2 million. *That is far more than the total inventory of pre-China 6 cars.*



Figure 1. Historical and projected monthly new car sales in China from 2015. *Source:* For historical sales, various statistical books and sources; for projected sales, extrapolated monthly sales based overall assumption of 8% annual decline from 2019.

Even more encouraging, at the end of March, China's State Council announced three powerful measures to spur auto demand, including the extension of central subsidies for purchasing electric vehicles, lowering the value-added tax for secondhand vehicle transactions, and incentivizing the elimination of pre-China III trucks. Moreover, the central government has released two other plans since early 2019—the Implementation Plan to Further Optimize Supply, Promote Steady Growth of Consumption, and Promote the Formation of A Strong Domestic Market, and the Implementation Plan to Promote Key Consumer Commodity Upgrade, Circulation, and Recycling—and these are very comprehensive stimulus packages for the car market. Key measures in these plans include, but are not limited to, removing the limit on new car registrations in cities and incentives for rural consumers to buy small and clean cars. These are expected to further expand the market potential in both megacities and the rapidly growing rural markets. It is estimated that removing the new car registration limit alone could stimulate some 580,000 new car purchases in rest of this year.⁵

WHAT DOES THE PN LIMIT DO?

Because the auto industry is seeking to delay the particle number limit, let us take a closer look at what it does. In a nutshell, the more stringent PN limit will require the

³ Xinhua News (2020). 车市下行压力大, 乘联会再下调全年销量预期 [Vehicle market is facing downward pressure, CPCA will further reduce the annual sales expectation]. Accessed at: <u>http://www.gd.xinhuanet.com/newscenter/2020-03/11/c_1125694952.htm</u>

^{4 &}quot;Sales post first weekly rise since outbreak," *Reuters*, April 15, 2020, <u>https://www.autonews.com/china/</u> sales-post-first-weekly-rise-outbreak

⁵ Cheyun.com (2020). 多地区推出刺激消费政策, 车企迎来 "疫" 后第一波机遇 [Many regions launch the policy of stimulating consumption, vehicle enterprises is facing the first wave of opportunities after the "epidemic"]. Accessed at: http://www.cheyun.com/content/33638

installation of particle filters on petrol and diesel cars. These filters are critical for reducing emissions of the ultrafine particles that do the most damage to human health.

Epidemiological studies show that atmospheric particulate matter is directly linked to premature death and disease in urban populations and that there is no safe exposure threshold for small particle pollution. Particles smaller than 100 nanometers (nm) are much more likely to be captured in the human body and these ultrafine particles are considered the most damaging components of air pollution because they are small enough to travel into arteries; once there, they can trigger plaque build-up that may, in turn, lead to heart attack and stroke.⁶

Recent studies show that both diesel and gasoline cars may emit large amounts of ultrafine particles in volatile, semi-volatile, and solid forms. Figure 2 shows the fraction of particles that are inhaled and stay in the human body by particle size distribution; these are associated with a modern gasoline direct injection (GDI) engine during a cold start. The figure clearly demonstrates that the majority of particulate emissions generated by GDI during cold start are exactly the ultrafine particles of concern. In China, gasoline cars with GDI are nearly 40% of the current market and their share is projected to increase due to progressively tightened fuel efficiency regulations.⁷

To reduce the extra particle emissions from these GDI vehicles, the China 6 standard includes a PN limit of 6 x 10^11#/km. This is sufficiently stringent to require the use of a gasoline particulate filter (GPF), the primary technology proven to effectively control ultrafine particle emissions from gasoline engines. On the contrary, both the current China 5 standard and the transitional PN limit would not warrant adding this technology on new vehicles.



Figure 2. Fraction of particles breathed in and normalized particle concentration by particle size *Source:* Felipe Rodríguez, Yoann Bernard, Jan Dornoff, and Peter Mock, *Recommendations for post-Euro 6 standards for light-duty vehicles in the European Union,* (ICCT: Washington, DC, 2019), https://theicct.org/publications/recommendations-post-euro-6-eu

⁶ Yixing Du et al., "Air Particulate Matter and Cardiovascular Disease: The Epidemiological, Biomedical and Clinical Evidence," *Journal of Thoracic Disease*, 8(1), 2016, E8–E19, <u>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4740122/</u>

⁷ Source of GDI market share: China Automotive Technology and Research Center.

HOW HAS THE MARKET RESPONDED TO THE CHINA 6 RULE SO FAR?

Despite the original national standard timetable, 15 subnational governments have opted to implement the China 6 standard at least 1 year earlier to cope with air quality challenges. Major markets including Beijing, Shenzhen, Shanghai, Tianjin, and Guangdong even skipped the China 6a phase and directly executed the China 6b standard on July 1, 2019. These advanced regions represent more than 70% of the national car market.⁸

As these subnational markets shifted to China 6, automakers reacted quickly and positively in elevating their emission reduction technologies. Manufacturers have rolled out China 6 compliant models since early 2018, and the share of these models has grown over time. As illustrated in Figure 3, already more than 90% of new car model types certified and 97% of new cars sold are China 6. Of these, the majority–66%–are China 6-PN11 vehicles.⁹ In contrast, the share of China 5 new model certifications and actual sales of new cars has shrunk to less than 10% and 3%, respectively. Such trends affirm that the vast majority of auto manufacturers were already fully prepared for the new standard by early 2020.



Figure 3. Share of new passenger car model types by emission standard from January 2018 to February 2020.

Source: Vehicle Emission Control Center, Ministry of Ecology and Environment

WHAT WOULD BE THE IMPACT OF THE REQUESTED DELAY?

The most immediate consequence would be the loss of environmental and public health benefits. The extra pollutants that would be emitted are hazardous to human health and contribute to global warming. The requested delay would result in additional emission of 0.5-2.8 x 10^24 numbers, or approximately 610 tonnes of fine particles, about 440 tonnes of black carbon (a strong global warming agent), and about 310,000 tonnes of NO_x over the lifetime of these vehicles.¹⁰ The combined societal costs of this, including the monetary values of premature death, hospitalization, and other medical treatment for acute and chronic diseases; restricted activity days related to particulate matter emissions; building and material damages; crop loss; and ecosystem impacts

⁸ SinoLink Securities (2019). 国六排放标准专题分析报告 [Analysis report of China VI emission standards]. Accessed at: <u>http://pdf.dfcfw.com/pdf/H3_AP201907101338306264_1.pdf</u>

⁹ Data collected and analyzed from Vehicle Environmental Information Disclosure Platform of the Vehicle Emission Control Center of the Ministry of Ecology and Environment.

¹⁰ Estimates of fine particle and black carbon mass are based on (1) the methodology specified in Athanasios Mamakos et al., "Cost Effectiveness of Particulate Filter Installation"; and (2) GDI car sales projections for April 2020 to July 2020 based on the China Passenger Car Association's overall market projection for 2020. Estimates for NO_x emissions are from ICCT's own modeling.

associated with climate change, are estimated to be more than CNY 3.1 billion.¹¹ This possibly outweighs any short-term benefits to auto manufacturers.

An indirect but potentially more destructive impact is that the delay would punish OEMs, other providers in the supply chain, and the 15 regions that have already invested more time and resources in preparing for the regulations. Since 66% of the new car market today has already been meeting the China 6 standard and the final PN limit, delay would penalize the *mainstream* market and only reward technology laggards.

HOW TO SUPPORT THE INDUSTRY WITHOUT DELAYING IMPLEMENTATION

To address the recent market difficulties without creating negative environmental and health impacts or disincentivizing early technology adoption, China could consider a combination of the measures below.

» Craft a stimulus package to accelerate the sale of the existing stock of China 5 and China 6-PN12 vehicles domestically before July.

Following the strong variety of measures from the central government, a few major cities have pursued a mix of measures, fiscal and non-fiscal, to boost their own local markets. Some were specifically to promote the sale of China 6 vehicles and they are detailed in the table below.

	Guangzhou	Foshan	Zhuhai	Changsha	Zhuzhou	Shenzhen
Subsidy for purchasing a new car			Unclear amount	CNY3,000/car for selected local brands	3% of price up to CNY 3,000/ car for local brands	
Subsidy for purchasing a new China 6 car		CNY2,000/car				
Subsidy for replacing an old car with a new China 6 car	CNY3,000/car	CNY3,000/car				
Lift of registration cap	Added 10,000 quota					Added 10,000 quota

Compiled by ICCT from various government announcements in Guangzhou, Zhuhai, Foshan, Changsha, and Hunan province, and from news. See detailed sources in footnote.¹²

To generate the societal cost estimate, we used the average lifetime societal costs for fine particle and black carbon emissions specified in Athanasios Mamakos et al., "Cost Effectiveness of Particulate Filter Installation." In that paper, the lifetime societal cost of typical light-duty vehicles in Europe is between 33-94 euros per vehicle for the PN emissions (an average of 64 euros per vehicle), and 1-43 euros per vehicle for the black carbon emissions (an average of 22 euros per vehicle). Then we multiplied these values with projected sales of new passenger cars with GDI from July 2020 to December 2020, the period of time during which the China 6 regulatory requirement would be delayed, using the three steps that follow. First, our projected sales of new cars during this time period is 11.6 million and is extrapolated from the China Passenger Car Association's 8% annual sales decline (over 2019). Second, using the China Automotive Technology and Research Center's GDI penetration data (40%), our estimated number of new cars with GDI to be sold from July to the end of the year would be 11.6 million x 40% = 4.64 million. Third, we multiply 4.64 million cars with average, combined particulate matter and black carbon societal cost (64+22 = 86 euros per car) to get to a total cost of about 398 million euros. This converts to about CNY3.1 billion using an exchange rate of 7.75 CNY to 1 euro. Lastly, we expect that the total societal cost would be more than CNY3.1 billion because the calculation did not include the impact of excessive NO, emissions, due to the limitations of our methodology and source data.

12 Zhuhai Development and Reform Bureau (2020). 珠海市人民政府关于有效降低疫情影响促进经济平稳运行的 实施意见 [Opinions of Zhuhai Municipal Government on effectively reducing the impact of the epidemic and promoting the smooth operation of the economy]. Accessed at: http://fgj.zhuhai.gov.cn/zwgk/ zcwj/content/post_2511816.html, and Guangzhou Municipal Government (2020) 广州市人民政府关于印发 广州市坚决打赢新范肺炎疫情防控狙击战努力实现全年经济社会发展目标任务若干措施的通知 [Notice of Guangzhou Municipal Government on the measures to ensure the success of Guangzhou's prevention and control of COVID-19 and the measures to achieve the goal of economic and social development throughout the year]. Accessed at: http://www.gz.gov.cn/gfxwj/szfgfxwj/gzsrmzf/content/post_5687669.html, and Foshan Municipal Governmental (2020). 佛山市人民政府办运室关于印发佛山市促进汽车市场消费并级若干措施 (试行) 的通 知 [Notice of Foshan Municipal Government on the measures of promoting vehicle market consumption upgrade]. Accessed at: http://www.foshan.gov.cn/gkmlpt/content/3/3607/post_3607909.html#37, and 163 News (2020) 珠海成为全国第4个出台汽车消费激励政策的城市 [Zhuhai becomes the fourth city in China to issue incentive policies for motor vehicle consumption]. Accessed at: https://mong.l63.com/20/0314/13/ F7MBRO4V00259DLP.html, and Cheyun.com (2020). 参地区推出刺激消费政策, 车企迎来 "疫" 后第一波机遇 [Many regions launch the policy of stimulating consumption, vehicle enterprises is facing the first wave of opportunities after the "epidemic"]. Accessed at: http://www.cheyun.com/content/336638 We recommend that the central government and/or other cities adopt similar policies to accelerate the sale of China 5 and China 6-PN12 car inventories. In addition, the purchase incentive in rural areas can be designed to promote the sale of such vehicles to help digest the inventory, as well.

» Incentivize the export of China 6-PN12 cars to both help clear those inventories and help destination markets to reduce their vehicular emissions.

China's vehicle exports have continued to grow since the early the 2000s. As shown in Figure 4, in recent years, aided by the Belt and Road Initiative (BRI), Iran, Russia, Chile, Saudi Arabia, Algeria, Iraq, and Bolivia became top destination markets for China's vehicles. Figure 5 shows that the majority of the markets along Belt and Road trade zones currently have Euro 5-equivalent emission standards or below for lightduty vehicles, and Figure 6 shows that many of these countries, including Iran, Russia, and Chile, already have low-sulfur fuel, i.e., sulfur content less than 50 parts per million (ppm), available. The availability of low-sulfur fuel is crucial for China 6 vehicles with advanced aftertreatment systems to function properly. Exporting the much cleaner China 6-PN12 vehicles to economies participating in BRI where lowsulfur fuel is available would be a double win for both China and these countries. Another appealing destination for China 6 vehicle export is Thailand. To address poor air quality, the country has recently announced a move to the Euro 5 emission standard starting next year and is considering requiring Euro 6 cars by 2022.¹³ These sudden decisions have left its domestic auto industry a bit unprepared to meet the demand. Given this situation, export of China 6-PN12 vehicles from China would be welcomed to help Thailand meet its urgent need to cut vehicle emissions. Also, the fuel sulfur limit in Thailand is under 50 ppm.

We recommend that the central government develop promotion policies for exporting China 6-compliant cars to regions where low-sulfur fuel is available.



Figure 4. Value of vehicle export from China by top 10 destination, 2000-2017 *Sources:* https://oec.world/en/profile/country/chn/ and Ministry of Commerce 2019. Annual Report on High-Quality Development of China's Automotive Trade (2019), Accessed from http://images.mofcom.gov.cn/wms/201912/20191230105409100.pdf

13 Marimi Kishimoto, "Thailand's rush to cut emissions leaves automakers in the dust," Nikkei Asian Review, March 17, 2020, https://asia.nikkei.com/Business/Automobiles/Thailand-s-rush-to-cut-emissions-leavesautomakers-in-the-dust

Euro equivalent 2019

- Euro 1
- Euro 2
- e Euro 3
- e Euro 4
- e Euro 5
- Euro 6



Figure 5. Global gasoline vehicle emission standards by Euro equivalent as adopted in 2019. *Source*: ICCT Modeling Center analysis of data from Stratas Advisors, UN Environment, TransportPolicy.net, and government sources.

Estimated average gasoline sulfur content in 2019

- <=15 ppm
- 🗕 16-50 ppm
- 🗕 51-350 ppm
- 351-500 ppm
- 501-2,000 ppm
- 2,001-10,000 ppm



Figure 6. Global gasoline fuel sulfur level as adopted in 2019 *Source:* ICCT Modeling Center analysis of data from Stratas Advisors, UN Environment, TransportPolicy.net, and government sources.

» Use additional incentives to promote the use of China 6-PN11 vehicles

While the two actions recommended above focus on clearing inventory in the near term to avert delay in implementing the China 6 standard nationwide, there is an extent to which they might disfavor sales of the cleaner China 6-PN11 cars. To correct for this, we also recommend the government consider usage incentives, such as an expedited registration process and exempting China 6-PN11 vehicles from traffic restrictions during heavy pollution days.

Lastly, China is not without other alternatives. For one, India was recently successful in leapfrogging from Euro 4-equivalent BS IV to BS VI vehicle emission standards, which are roughly equivalent to Euro 6 and China 6 standards. While India is a different context and therefore not totally comparable, the only concession made was short—after the Coronavirus lockdown is lifted, car dealers will be given an extra 10 days to sell BS IV vehicles.¹⁴ This could be an encouraging example for China.

¹⁴ Zhenying Shao, "Bharat Stage VI Emission Standards: Mission NOT Impossible," The International Council on Clean Transportation staff blog, April 13, 2020, https://theicct.org/blog/staff/bharat-stage-vi-missionnot-impossible