POLICY UPDATE

APRIL 2018

EARLY ADOPTION OF CHINA VI VEHICLE FUEL STANDARDS IN JING-JIN-JI AND SURROUNDING AREAS

ICCT **POLICY UPDATES** SUMMARIZE REGULATORY AND OTHER DEVELOPMENTS RELATED TO CLEAN TRANSPORTATION WORLDWIDE.

Following a similar move by Beijing, Tianjin and cities in four provinces implemented stringent new vehicle fuel standards in October 2017 as a step toward reducing air pollution in heavily populated areas. Tianjin and 26 cities in Hebei, Shanxi, Shandong, and Henan provinces put the China VI fuel requirements into effect about 15 months before the national deadline of January 1, 2019.[1] These jurisdictions also applied the new fuel standard to non-road equipment ahead of the national schedule.

BACKGROUND

In the *Air Pollution Control Action Plan*[2] released in 2013, China's State Council set a goal of improving air quality in 2017, including a reduction in the urban concentration of particulate matter (PM) by 10% compared with 2012. The plan set specific goals for densely populated Beijing, Tianjin, and Hebei, collectively known as Jing-Jin-Ji. The plan for this Northern China area called for increasing the number of days with "fairly good" air quality, reducing the fine PM concentration by 25%, and requiring that the annual concentration of fine PM in Beijing hold below 60 micrograms per cubic meter.

To achieve the plan's targets, Beijing published the Beijing VI vehicle gasoline and diesel standards in October 2016 and implemented them starting January 1, 2017.[3] In March 2017, Beijing, Tianjin, and the 26 other cities (known as the "2+26" cities, shown in Figure 1) jointly published the *Work Plan for Prevention and Control of Atmospheric Pollution in Jing-Jin-Ji and Surrounding Areas* (referred to below as the work plan).[4] The publication serves as an implementing document for the *Air Pollution Control Action Plan*.

1 Xinhua Net. (October 2017). 中国石油在"*2+26*"城市王城国*VI*油品升级 *[PetroChina has upgraded to China VI fuel in "2+26" cities].* Retrieved from http://www.xinhuanet.com/energy/2017-10/09/c_1121780149.htm

2 The Central Government of China. (September 2017). 国务院关于印发大气污染防治行动计划的通知 *[State Council released the notice of action plan on air pollution prevention].* Retrieved from http://www.gov.cn/zwgk/2013-09/12/content_2486773.htm

3 Beijing Municipal Environmental Protection Bureau. (October 2016). "京六"车用油品标准于*2017*年*1*月*1*日实施 *[Beijing VI vehicle fuel standards will go into effect starting January 1, 2017].* Retrieved from http://zhengce.beijing.gov.cn/library/192/34/35/436047/84571/index.html

4 Ministry of Environmental Protection, China. (March 2013). 关于印发《京津冀及周边地区*2017*年大气污染防治工作方案》的通知 *[The notice on releasing work plan for prevention and control of atmospheric pollution in Jing-Jin-Ji and surrounding areas].* Retrieved from http://dqhj.mep.gov.cn/dtxx/201703/t20170323_408663.shtml

Figure 1. "2+26" cities targeted in the work plan

The work plan emphasizes the importance of fuel quality and requires that China VI-qualified vehicle fuel, including both gasoline and diesel, be available in the "2+26" cities by the end of September 2017, 15 months in advance of the national schedule. The deadline was designed specifically for the winter season, when air quality is normally the worst of the year. In addition to upgrading vehicle fuel, the "2+26" cities banned general-purpose diesel oil. They required the substitution of China VI diesel for non-road equipment, paving the way for phasing in China IV non-road standards beginning in 2019.[5]

The China VI fuel standards are expected to support the "2+26" cities in reducing pollutants from motor vehicles under current emissions standards as well as future regulatory phases. Along with the ban on general-purpose diesel, the accelerated implementation of the China VI fuel standards is expected to reduce emissions from on-road and non-road vehicles. Based on past experience, the availability of qualified clean fuel removes the main bottleneck for phasing in stringent emissions standards. Thus, the use of China VI fuel in the "2+26" cities will enable the implementation of the China 6 emissions standards for light-duty vehicles and the

5 China Construction Machinery. (July 2017). 参加道路国六标准及非道路国四标准发动机技术对接会的通知 *[Notice of participating engine technology discussion for China VI vehicles and China IV non-road standards]*. Retrieved from http://www.ccm-1.com/show.php?contentid=79922

China VI standards for heavy-duty vehicles as early as 2019,[6] when more reduction of air pollution can be expected.

The remaining cities in the four provinces still follow the national timeline for implementing China VI fuel standards.

CHINA VI FUEL STANDARD

In December 2016, the General Administration of Quality Supervision, Inspection, and Quarantine (AQSIQ) and the Standardization Administration of China (SAC) released the China VI vehicle fuel quality standards for gasoline and diesel.

GASOLINE

As with the China 6 light-duty vehicle emissions standards,[7] the China VI gasoline standards (GB 17930-2016)[8] set two phases—VIA and VIB. China VIA will be phased in starting in 2019, and China VIB, beginning in 2023.

Compared with the China V gasoline standards, China VI tightens the requirements for four main properties—benzene, aromatics, olefins, and T50, as listed in Table 1. With the stringent specifications outlined, China VI fuel along with vehicle tailpipe emissions standards will improve public health by reducing air pollutants, including hydrocarbons, carbon monoxide, ozone, and PM.

The Beijing VI gasoline standards (DB11/238-2016),[9] released in October 2016, align with the China VIB standards, with the exception of Reid vapor pressure (RVP). Considering the unique weather patterns in Beijing, three RVP ranges were designated for winter, summer, and spring/fall, rather than two for winter and summer, as highlighted in Table 1.

6 Jintou Net. (April 2017). 国六来了：这6个省市被点名了，油价车价都要涨？ *[China 6 is coming to these six provinces; are the prices of both vehicles and oil going to increase?]* Retrieved from http://cj.sina.com.cn/article/detail/1780635941/225397?column=licai&ch=9&display=0&retcode=0

7 The International Council on Clean Transportation. (March 2017). *China's stage 6 emission standard for new light-duty vehicles (final rule).* Retrieved from https://www.theicct.org/sites/default/files/publications/China-LDV-Stage-6_Policy-Update_ICCT_20032017_vF_corrected.pdf

8 National Energy Administration. (December 2016).车用汽油 *[Gasoline for motor vehicles].* Retrieved from http://www.nea.gov.cn/135459819_14666509732751n.pdf

9 Beijing Municipal Environmental Protection Bureau. (October 2016). 本市发布实施北京市第六阶段《车用汽油》《车用柴油》地方标准*[Beijing releases the implementation of the Beijing VI gasoline and diesel fuel standards].* Retrieved from http://www.bjepb.gov.cn/bjhrb/xxgk/jgzn/jgsz/jjgjgszjzz/xcjyc/xwfb/607980/index.html

Table 1. Improvement of key properties for gasoline fuel standards

Property	China V	China VIA	China VIB	Beijing VI
Benzene (percent by volume)	1	0.8	0.8	0.8
Aromatics (percent by volume)	40	35	35	35
Olefins (percent by volume)	24	18	15	15
T50 (degrees Celsius/Fahrenheit)	120° C /248° F	110° C /230° F	110° C /230° F	110° C /230° F
Reid vapor pressure (RVP) (kPa)	45-85 (Winter, Nov-Apr) 40-65[1,2] (Summer, May-Oct)	45-85 (Winter, Nov-Apr) 40-65[1,2] (Summer, May-Oct)	45-85 (Winter, Nov-Apr) 40-65[1,2] (Summer, May-Oct)	47-80 (Winter, Nov-Mar) 42-62 (Summer, May-Aug) 45-70 (Spring/Fall, Mar-May/ Sep-Nov)

[1] *Guangdong sets RVP as 60kPa all year round*
[2] *Guangxi, and Hainan must comply with summer RVP limits year-round.*

DIESEL

Table 2 compares the improvements under China VI diesel standards (GB 19147-2016),[10] with China V. These include setting stringent limits for polycyclic aromatic hydrocarbons (PAHs) and flash point, and adding a requirement for total pollutant content. Total pollutant content, replacing the specification of mechanical admixture, will help better control diesel quality. The China VI diesel standards are scheduled to phase in around 2019.

Table 2. Improvement of key properties for diesel fuel standards

Property	China V	China VI	Beijing VI
PAHs* (percent by mass)	11	7	7
Density @ 20° C, kg/m³, min.	810-850	820-845	820-845
Flash point, Abel, °C, min.	55	60	60
Total pollutant content (mg/kg)	N/A	24	N/A

** Polycyclic aromatic hydrocarbons*

In addition to Jing-Jin-Ji's early adoption of the China VI fuel standards, Guangdong has announced a plan for early implementation of the China VI fuel standards province-wide, and the China VI vehicle tailpipe standards in the Pearl River Delta area.[11] A detailed timeline hasn't yet been unrevealed. Coincidentally, India has recently

10 National Energy Administration (2016). 车用柴油 *[Automobile diesel fuel]s.* Retrieved from http://www.nea.gov.cn/135459819_14666509323171n.pdf

11 Guangdong Provincial Government. (July 2017). 广东省人民政府办公厅关于广东省大气污染防治强化措施及分工方案的通知 *[Notice of Guangdong's intensification measures on prevention and control of air pollution and detailed action plan].* Retrieved from http://www.gdep.gov.cn/zwxx_1/ggtz/201708/P020170801638527128781.pdf

advanced the timeline of its Bharat Stage VI (BS-VI) fuel standards, equivalent to the European Union V fuel standards. The new standards will now be deployed in the Delhi National Capital Territory (NCT Delhi) as early as April 2018 and in the National Capital Region by 2019.[12]

COMPARISON WITH INTERNATIONAL STANDARDS

The China VI gasoline and diesel standards are generally more stringent than the Euro V fuel standards currently in force in the European Union, although China's fuel quality standards otherwise mostly follow European precedents. The following tables provide detailed comparisons of China's recent fuel-quality parameters with those of India, Europe, the United States, and the Worldwide Fuel Charter.

12 Government of India. (November 2017). *Pre-ponement of introduction of BS -VI grade auto fuels in NCT Delhi.* Retrieved from http://pib.nic.in/newsite/PrintRelease.aspx?relid=173517

Table 3. Gasoline fuel standards comparison

Fuel Property	China V	China VIA	China VIB	Beijing VI	India Bharat Stage VI	Euro V	EPA Tier 3			CARB[1] (CaRFG3) (refiners must use Predictive Model to determine specs., not exceeding cap. limits)			Worldwide Fuel Charter Category 4[2]
						2009/30/EC	General testing	Low-temperature testing	High altitude testing	Flat limits	Average limits	Cap limits	
Research Octane (RON), min.	95-89	95-89	95-89	95-89	91/95[9]	95–91	NS				NS		91–95–98
Motor Octane (MON), min.	90-84	90-84	90-84	90-84	81/85[9]	85–81	NS				NS		82.5–85–88
Anti-Knock Index (AKI), min.	84-87-90	84-87-90	84-87-90	84-87-90	NS	NS	91				87-88.4		NS
Aromatics, vol%, max.	40	35	35	35	35	35	19.5-24.5			25	22	35	35
Olefin, vol%, max.	24	18	15	15	21/18[9]	18	4.5-11.5			6	4	10	10
Benzene, vol%, max.	1	0.8	0.8	0.8	1	1	0.6-0.8			0.8	0.7	1.1	1
Sulfur, ppm, max.	10	10	10	10	10	10	8.0-11.0			20	15	30 20[3]	10
Washed Gum Content, g/m³, max.	5	5	5	5	4	5	5				5		5
Density 15C, kg/m³	720-775 (20°C)	720-775 (20°C)	720-775 (20°C)	720-775 (20°C)	720-775	720–775	NS				NS		715–770
RVP, kPa	45-85	45-85	45-85	47-80	60	60/70	47.6[4] max			48.2 / 47.6[5] max	NAP	44.1-49.6	Temp > 15° C:
	Winter (Nov-Apr)	Winter (Nov-Apr)	Winter (Nov-Apr)	Winter (Nov-Mar)		max.	6.91 psi max			7 / 6.9 psi max		6.4-7.2 psi	45–60
	40-65[8]	40-65[8]	40-65[8]	42-62									15 C>=T>5 C:
	Summer (May-Oct)	Summer (May-Oct)	Summer (May-Oct)	Summer (May-Aug)									55–70
				45-70									5 C>=T> -5 C:
				Spring/ Fall (Mar-May/Sep-Nov)									65–80
													-5 C>=T>-15 C:
													75–90
													Temp < -15° C:
													85–105
Lead, mg/l, max.	5	5	5	5	5	5	2.6				5		NS
Manganese, mg/liter, max.	2	2	2	2	NS	MMT<6 (by 2011) MMT<2 (by 2014)	8 (1/32 g/gallon)				ND		ND
Oxygen, % m/m	2.7 (max.)	2.7 (max.)	2.7 (max.)	2.7 (max.)	2.7	2.7 (max.)	NS			1.8 - 2.2	NAP	0 - 3.5 1.8[6] - 3.5 / 3.7[7]	2.7

NS = Not specified; NA = Not available; ND = Nondetectable; NAP = Not applicable

Notes:

1. *Refiners and fuel importers could choose to comply with the maximum (flat) limit, or the averaging limit coupled with a cap limit. Refiners and importers could also certify alternative specification by using the predictive model to demonstrate that emissions are equivalent to those of a gasoline meeting the flat limits or the averaging limits plus cap values.*
2. *Applicable to markets requiring Euro 4, Euro 5 heavy duty, US EPA Tier 2 or 2007/2010 Heavy Duty On-Highway or equivalent emission standards.*
3. *Applies on December 31, 2011.*
4. *CAA specifies a limit of 62.1 kPa (9 psi) for any gasoline sold during the high ozone season (Jun. 1 to Sept. 15). More stringent volatility (summer RVP) requirements are set for RFG, which vary by the region and month, and range from 48.3-62.1 kPa (7-9 psi). EPA provides a 1.0-psi RVP allowance for gasoline containing ethanol at 9 to 10 volume percent.*
5. *47.6 kPa (6.9 psi) applies when a producer is using the CaRFG3 Predictive Model to certify a final blend NOT containing ethanol; otherwise, the 48.2-kPa (7.00 psi) limit applies.*
6. *1.8% winter minimum applies from Nov. 1 to Feb. 29 in the South Coast Area and Imperial County.*
7. *If the gasoline contains 3.5 % > ethanol ≤ 10%, the maximum oxygen content cap is 3.7 %*
8. *Guangdong sets all-year RVP limit as 60 kPa; Guangxi, and Hainan must comply with summer RVP limits year round*
9. *Fuel qaulity specification for regular/ premium gasoline*

Table 4. Diesel fuel standards comparison

Fuel Property	China V	China VI	Beijing VI	India Bharat Stage VI	Euro V	EPA	CARB		Worldwide Fuel Charter
						Conventional diesel	Reference fuel[1]	Designated equivalent limit[1]	Category 4[2]
Polyaromatics, vol%, max.	11	7	7	8	8	NS	1.4	3.5	2
Sulfur, ppm, max.	10	10	10	10	10	15	15	15	10
Cetane number, min.	51	51	51	51	51	Cetane index >= 40 or aromatics <= 35%[3]	48	53	55
Density @ 15°C, kg/m³, min.	810-850 (20°C)	820–845 (20°C)	820–845 (20°C)	845	845	NS	NS	NS	820[4]
Flash point, Abel, °C, min.	55	60	60	35	55	NS	54	NS	55
Ash content, % m/m, max.	0.01	0.01	0.01	0.01	0.01	NS	NS	NS	0.001
Viscosity @ 40°C, mm²/s	3.0-8.0	3.0-8.0	2.5-7.5	2.0–4.5	2.0–4.5	NS	2.0–4.1	NS	2.0[5]

PP = Diesel pour point; NS=Not specified

1. *The California regulations allow flexibility in meeting the limit on aromatics. Producers or importers could either produce a fuel that meets the designated equivalent limits or certify a fuel formulation by demonstrating that the exhaust emission reduction of a candidate fuel is equivalent to those with the reference fuel; the "low-emission" fuels typically have a much higher cetane number and lower sulfur but higher aromatics, higher polycyclic aromatics, and higher nitrogen than the reference fuel*
2. *Applicable to markets requiring Euro 4, Euro 5 Heavy-Duty, U.S. EPA Tier 2 or 2007/2010 Heavy-Duty On-Highway, or equivalent emission standards*
3. *The EPA requires either a minimum cetane index of 40 or a maximum aromatic content of 35 percent. Premium diesel fuel defined by the National Institute of Standards and Technology (NIST) requires a minimum cetane number of 47.0. It is up to individual states to adopt the NIST premium diesel requirements*
4. *Can be relaxed to 800 kg/m³ when ambient temperatures are below -30°C. For environmental purposes, a minimum of 815 kg/m³ can be adopted*
5. *Can be relaxed to 1.5 mm²/s when ambient temperatures are below -30°C and to 1.3 mm²/s when ambient temperatures are below -40°C*