

Worldwide Fuel Quality Trends - Focus on Asia

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ABSTRACT

As global motorization continues on at a rapid pace, many countries have begun to address the adverse environmental impacts from motorization through implementation of motor vehicle and fuel quality control programs. While the car has become an indispensable part of modern life, there is increasing concern about its environmental impact, particularly the negative effects automotive emissions have on air quality and human health. It has long been acknowledged that pollutants emitted from cars and trucks contribute to a decline in air quality, which again can have an effect on human health. The environmental, public health and energy issues facing our nations and regions ultimately force governments to take action to address these issues.

The way in which countries across the globe have reacted and will react in the future to air quality, climate change and energy security pressures very much depends on the priority issues they are faced with and the structure of their automotive and energy sectors. This paper aims to give a general overview of the current fuel quality developments and possible trends in Asia and Australasia taking into consideration the pressure points illuminated above.

Keywords: fuel quality specifications, Asia, Australasia

1.0 INTRODUCTION

This report summarizes issues and drivers related to fuel quality developments in Asia and Australasia. Furthermore, this paper will give a brief overview of the recent and future changes to specifications of conventional gasoline and diesel. There are currently many countries that are in the process of reviewing their future fuel specifications and planning to finalize them by the end of this year. Following is the list of countries reviewed in this report:

Australia	Japan	Singapore
Bangladesh	Malaysia	South Korea
Brunei	Nepal	Sri Lanka
China	New Zealand	Taiwan
Hong Kong	Pakistan	Thailand
India	Papua New Guinea	Vietnam
Indonesia	Philippines	

2.0 Background Information – Future Projections

The transportation fuels sector has been rapidly growing in the past and is expected to do so in the future (see figure 1). The Energy Information Administration (EIA) made following projections on transportation energy (including gasoline and diesel) demand and vehicle growth rate.

Oil is expected to remain the primary fuel source for the transportation sector throughout the world in the future; the transportation fuels are projected to account for almost 57% of the total world oil consumption by 2020. Economic expansion and higher incomes are the main drivers that are expected to most increase and influence the use of energy in the transportation sector, especially the developing regions, including Asia. In fact, more than half of the increase in the world's transportation energy use is projected to take place in developing countries according to the EIA. The share of the transportation energy demand of the developing Asian region is expected to rise from 29% (1999) to 38% (2020) with an average annual growth rate of 4.9%. Growth is expected to be influenced by various government policies including plans to reduce (vehicle) emissions and congestion while still promoting alternative fuels, new vehicle technology and mass transit systems.

Although diesel is expected to experience the strongest growth after jet fuel in the transportation fuels sector, gasoline consumption in Asia is expected to exceed that of Western Europe by 2020.

India is projected to become the third largest transportation fuel consumer after the USA and China in 2020 with a yearly 6.8% growth in consumption from 1999 to 2020. Due to its vast population, however, on a per capita basis, India will still rank among the lowest in the world.

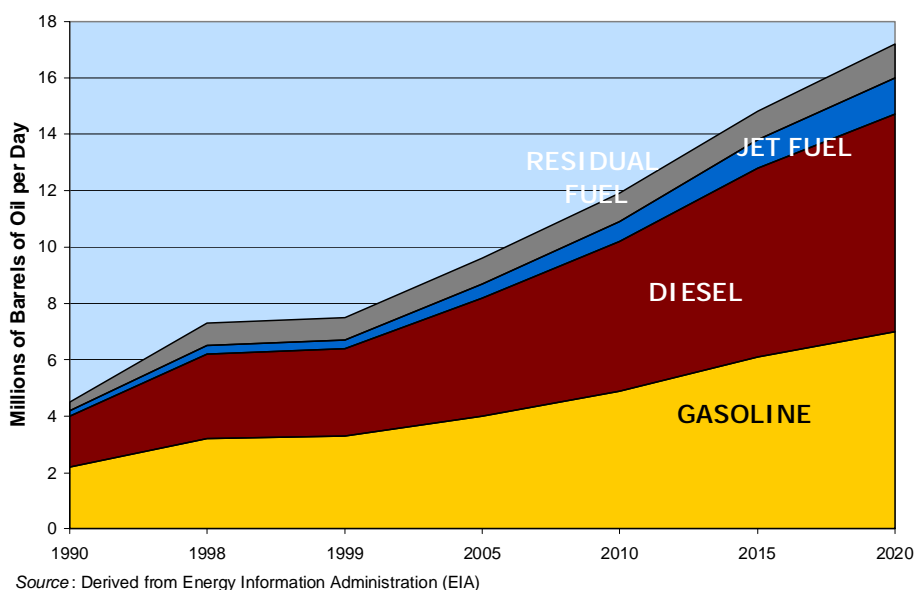
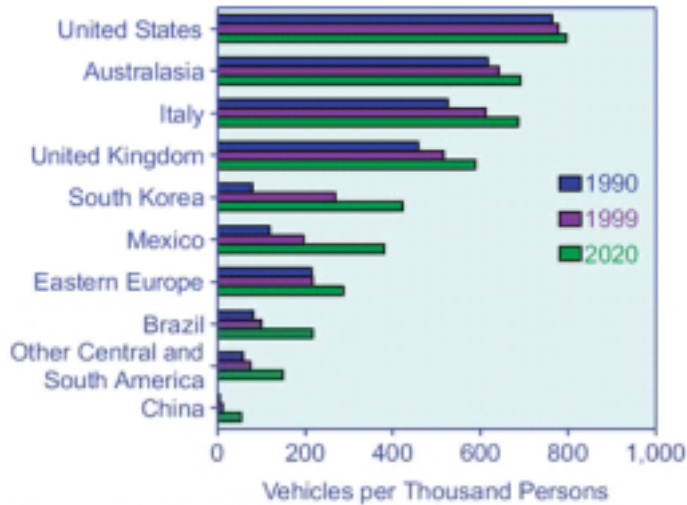


Figure 1. Transportation Fuels Consumption in the World

Vehicle numbers are also expected to continue to rise at a rapid pace in most developing countries (specifically Latin American and Asian countries) according to the EIA projections (see figure 2). The graph below depicts this growth in the automotive market in different areas of the world. The changing lifestyle and increase in income is the biggest driver for this development as cars are often seen as a status symbol that project wealth.

One of the countries in the developing Asian region that is expected to experience extremely strong growth in vehicle numbers is China. Passenger cars are expected to be the fastest growing component in the EIA's forecast in China; the number of vehicles per thousand people is projected to reach 52 in 2020 from 12 in 1999. With that China is expected to overtake Japan by 2005 and become the world's second largest consumer of transportation fuels.



Source: Energy Information Administration (EIA) / International Energy Outlook 2002

Figure 2. Development of the Automotive Market in the World

Contrary to the US, the Asian market is very heavily reliant on diesel fuel, see graphs 3 and 4 below. This of course also has an influence on the development of fuel quality standards as more emphasis is given to diesel quality, although there is a need to develop both diesel and gasoline. In some Asian countries there is only one standard for diesel quality regardless of its use – on-road / non-road vehicles or machinery. As an example, China’s diesel fuel specification applies to not just on-road vehicles, but also to agricultural machinery like tractors, water pump sets, threshers, and earth moving machines, to fishing vessels, to large scale use of diesel powered generator systems in the power deficient states or cities as well as industrial fuel. However, China is currently planning to introduce new diesel specification, solely for vehicles, which is planned to be implemented sometime in 2003.

Gasoline/Diesel Demand in Asian countries (2000)

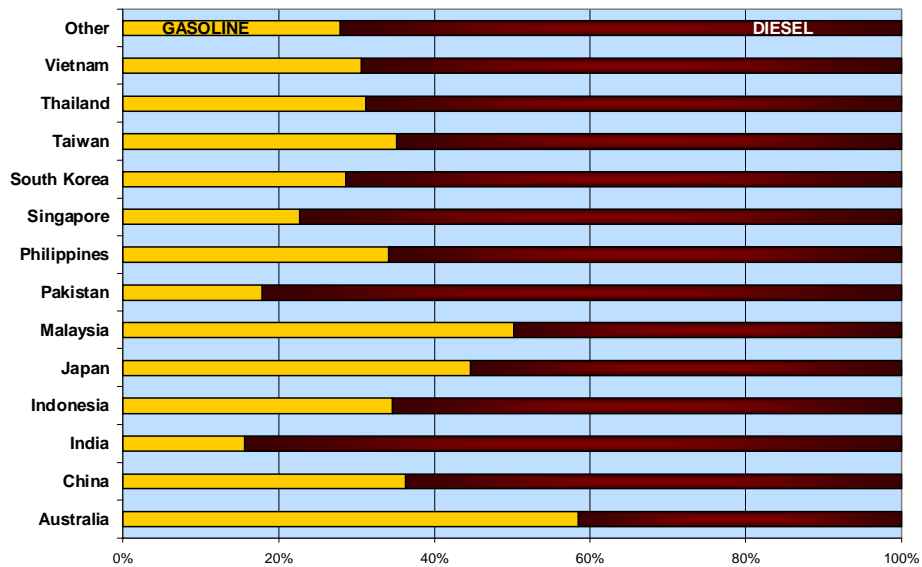


Figure 3. Gasoline and Diesel ration in Selected countries in Asia and Australasia (2000).

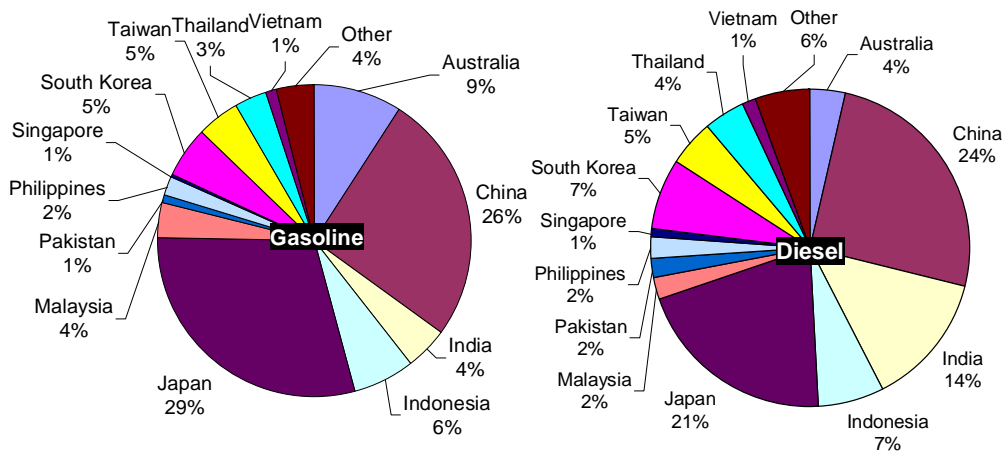


Figure 4. Gasoline and Diesel Demand in Selected countries in Asia and Australasia (2000).

3.0 Regional Overview

Although the aim of this report is not to categorize countries, fuel specifications evolved in a similar manner in different countries and they can therefore be grouped to be in the same development stage. The priority list for grouping each country is as follows:

- Category 1:** Generally unregulated
- Category 2:** Phase out of leaded gasoline, on-going or planned
- Category 3:** Reduce the content of sulphur and benzene in gasoline and/or reduce the sulphur content in diesel
- Category 4:** Further reduction of sulphur in diesel and/or reduction of benzene, sulphur, aromatics and olefins content of gasoline. In this step, the distillation characteristics are also often optimized.

It is important to note, that many of the discussed countries have in the last couple of years implemented new specifications, and therefore not many changes have occurred since then, although tightening fuel specifications is an ongoing process in many countries. Furthermore, a number of countries, mainly **Thailand, South Korea, Philippines, Japan, India** and **Taiwan**, are currently in the process of discussing their future fuel specifications. Many of the countries are expecting to finalize their specifications by the end of this year. Also Vietnam has proposed some changes to fuel specifications for 2003. Major changes have occurred in **Australia** and **New Zealand**, where new specifications were implemented in January and September of this year respectively. Also **Taiwan** and **South Korea** implemented new specifications starting January 2002. Taiwan is currently planning to change its specifications to quality based from the performance based that have been used so far. Furthermore, **India** has come out with a proposal for new specifications that are to be implemented in the near future, and **Sri Lanka** will enforce fuel specifications in January 2003.

Brunei, Nepal and **Papua New Guinea** have generally not regulated their fuel quality and could therefore be grouped together into category 1. Although fuel quality is not regulated, industry agreed limits exist and unleaded gasoline is available on the market in these countries. Currently these countries have no known plans to introduce fuel quality regulations or tighten their specifications. Nepal and Papua New Guinea don't have any refineries in their countries currently, which is why they are completely dependent on imported products and due to insufficient regulating of fuel quality regulations, severe problems can arise. Nepal, for example is currently experiencing severe air pollution problems related to the high levels of benzene in the imported gasoline. This is one of the issues addressed in the currently ongoing taskforce meetings for future fuel specifications in Nepal. Furthermore, a refinery is being built in Papua New Guinea to go online in 2004. Most of the produced fuel is planned to be used indigenously, but about 35% of the volume will be left over for export. Therefore, it could be expected that fuel specifications similar to Australia are introduced in Papua New Guinea in the future.

The next group of countries would comprise of countries that have regulated their automotive fuel quality, but that generally still have leaded gasoline on their market or are in the process of completely phasing it out. Countries belonging to this group, category 2, would be **Bangladesh, Indonesia, Vietnam** and **Pakistan**.

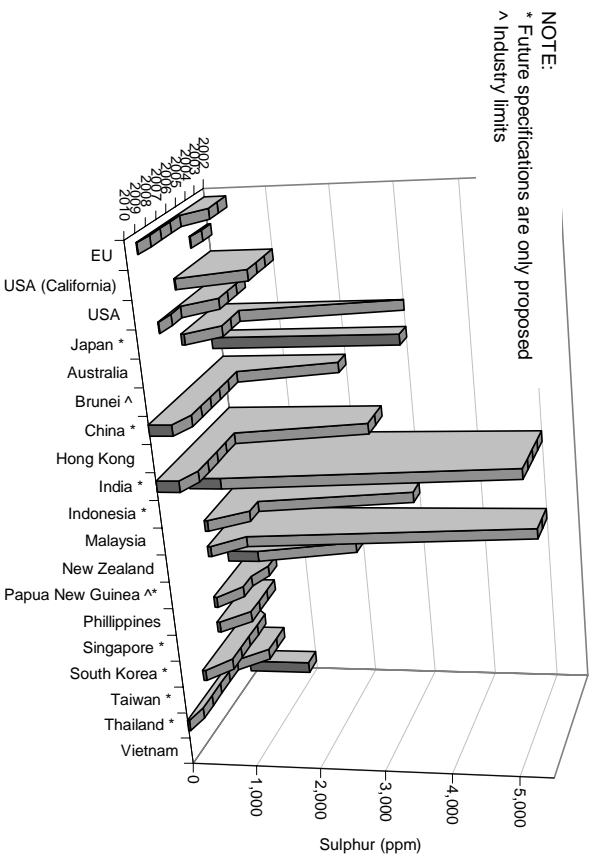
Indonesia is taking steps towards phasing out leaded gasoline, the planned phase it out is currently by the end of 2004. Although Bangladesh, Vietnam and Pakistan have phased out leaded gasoline from their market regulations in Bangladesh and Pakistan still allow 0.84 g Pb/l and 0.35 g Pb/l respectively. Bangladesh introduced unleaded gasoline in 1999, Vietnam in 2001 and Pakistan in June 2002. Sulphur limits, especially in diesel, tend to be very high (1,000ppm or more for gasoline and 5,000ppm or more for diesel) in these countries. Limits for benzene, aromatics and olefins in gasoline tend to be high, if regulated at all (generally not).

Australia, China, India, Malaysia, New Zealand, Singapore, Thailand and Philippines all have regulated fuel specifications and have reduced the sulphur and benzene limits in gasoline and/or reduced the sulphur content in diesel and could therefore be grouped together into category 3. Regulated levels for sulphur vary from 350 to 1,000 ppm and for benzene from 2.5 to 5 vol% in gasoline and for sulphur in diesel from 500 to 3,000 ppm. Furthermore, many of these countries have already or are in the process of planning their future fuel quality specification developments. Australia and New Zealand enforced new fuel specifications in January and September 2002 respectively and have made plans up until 2006 with the intention to eventually align themselves with European specifications. Also India has regulated plans for specifications up to 2010. Singapore, China, Thailand and the Philippines have plans to tighten their fuel specifications, but these have yet to be finalized. Malaysia has so far not made any specific plans for the future.

The most advanced countries or regions in Asia in terms of fuel quality specifications belonging to category 4 are **South Korea, Japan, Hong Kong and Taiwan**. These countries have planned or completed reductions in the sulphur levels in diesel and/or in the benzene, sulphur, aromatics and olefins content of gasoline. In general, the maximum sulphur content in gasoline in these countries is below 150 ppm. Regulated levels for benzene levels are below 1.5 vol% and aromatics levels vary between 35 and 42 vol% in gasoline. The maximum sulphur limit in diesel is 500 ppm. Future plans include the introduction of ultra-low sulfur (ULS) fuels. In Japan ULSD (diesel with less than 50 ppm sulfur) has already been introduced in Tokyo and both Japan and Taiwan for example are discussing the possible introduction of 10ppm sulfur diesel around 2008 and 2011 respectively. These countries have also already implemented strict vehicle emission limits, which are almost comparable to the current EU emission specifications. In the case of South Korea, some emission specifications are even stricter than in the EU.

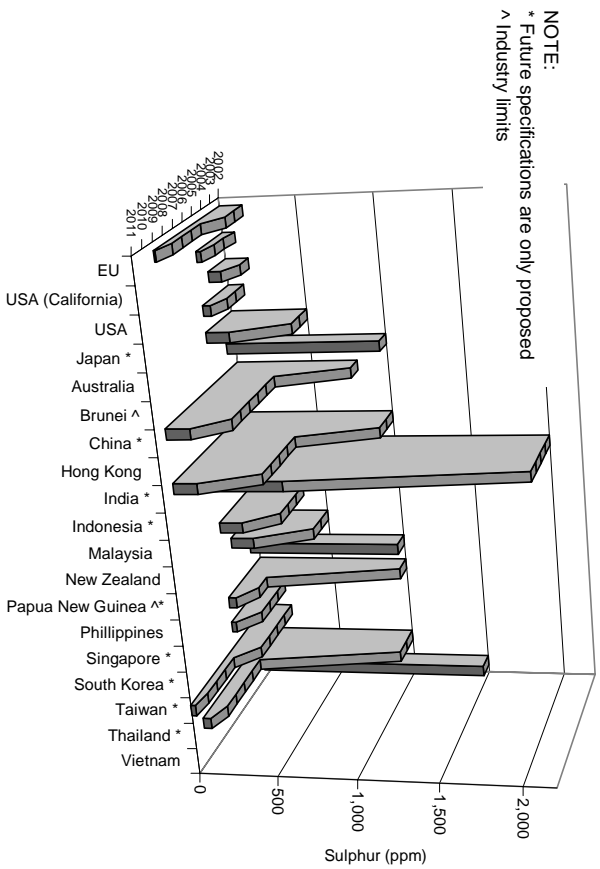
In the future, fuel specifications in Asia will call for further reducing the sulphur content to even lower levels in both gasoline and diesel, as well as the reduction of other components as aromatics, benzene etc. Also, refinery modifications will require significant investments to enhance low-sulphur production capacities. New technologies not just for the refining but also the vehicle emissions control will need to be implemented to enable air quality goals to be met in the face of rising transport demands. Also, the unique composition of motor vehicle fleet and the high numbers of two and three wheelers, some of them with four stroke motors in many of the Asian countries will call for special attention to further cut down air pollution.

Harmonization in fuel specifications is expected to continue slowly, Hong Kong, South Korea, Japan and Taiwan leading the way in Asia. In the following graphs you can find overviews of the planned future developments of sulphur reductions in gasoline and diesel. Please note that for visual purposes, only the most common grade of gasoline (mostly unleaded regular) or diesel of each of the countries is presented in the graphs. The U.S. and European fuel property levels are shown as reference. Please also keep in mind that many countries are currently in the process of finalizing fuel specifications for the future, so some changes can be expected.



Source: /FQC

Figure 5. Current and Future Diesel Sulphur Limits (ppm) in Asia and Australasia



Source: /FQC

Figure 4. Current and Future Gasoline Sulphur Limits (ppm) in Asia and Australasia