SUMMARY REPORT
Cleaner Fuels and Vehicles in Asia: Implementing the Global Sulfur Strategy
20 March 2018
United Nations Conference Centre
Bangkok, Thailand

UN Environment and Climate and Clean Air Coalition jointly organized a side event on 20 March 2018, on "Cleaner Fuels and Vehicles in Asia: Implementing the Global Sulfur Strategy" during the 2018 Asia Pacific Clean Air Partnership Joint Forum and Clean Air Week held in Bangkok, Thailand. The workshop provided a platform for various countries such as Thailand, India, China, Mongolia, Bangladesh and Indonesia to share their experiences in adopting and developing stricter vehicle emission standards and fuel quality. The agenda is found in **Appendix 1**.

UN Environment is the secretariat of the Partnership for Clean Fuels and Vehicles. The partnership has been instrumental in the global phaseout of lead in gasoline, and has been active in phasing down sulfur in fuels. The partnership's current priority is to promote the introduction of vehicle emission standards in tandem with equivalent fuel quality to maximize benefits on air quality. With the support of Environment Canada, UN Environment has developed a regulatory toolkit to assist countries in developing cleaner fuels and vehicle policies.

UN Environment is also hosting the Climate and Clean Air Coalition, which is implementing the Global Sulfur Strategy and supporting countries in their efforts to develop roadmaps for cleaner fuels. As such this session is organized to share experiences in adopting and developing vehicle emission standards and fuel quality roadmaps.

The workshop gathered over 30 representatives from 15 countries, namely, Mongolia, Bangladesh, Indonesia, Thailand, Myanmar, Nepal, Thailand, Maldives, Lao PDR, Malaysia, Sri Lanka, Cambodia, Afghanistan, and China. Attendees are listed in **Appendix 2.**

PROCEEDINGS

Welcome Remarks and Background to the PCFV Regulatory Toolkit and the Global Sulfur Strategy [Bert Fabian, UN Environment]

The CFV session was formally opened by Bert Fabian, Programme Officer in UN Environment's Air Quality and Mobility Unit, who provided a background of the Partnership for Cleaner Fuels and Vehicles (PCFV) and the Global Sulfur Strategy of the Climate and Clean Air Coalition. Mr. Fabian also presented the PCFV Regulatory Toolkit, which endeavors to provide a repository of regulatory options to lower sulfur levels in fuel and to establish corresponding vehicle emissions and fuel economy standards, as well as of case examples from developed and developing countries. The PCFV Regulatory Toolkit also aims to establish criteria for good regulatory practices, minimum legislation, and how to enforce fuel and vehicle standards.

He likewise mentioned that technology now exists to clean up vehicles, but that there is a need to ensure low-sulfur fuels so that advanced emission controls can run well in the vehicle fleet. For example, diesel particle filters (DPF) required by Euro VI reduce diesel PM levels to near-zero. Such discussions would be relevant given there are countries importing secondhand vehicles. An initiative was then set up to focus on fuel quality standards, called as the Global Sulfur Strategy[1] which sets a global timeline and calls on countries to move towards ultra-low (10 ppm) sulfur in fuels by 2030.

The supply side of the fuel market within a specific region will also have to be studied. For example, Mongolia does not have a fuel quality roadmap, yet the fuel from Russia and China entering Mongolia contains 50-500ppm sulfur, which provides an opportunity for the adoption of Euro 2 fuel specifications (Figure 1). Similarly, Nepal in South Asia currently follows Euro 3 vehicle emission and fuel quality standards, yet their vehicles mostly are imported from India which has adopted Euro 4, rationalizing a move towards adopted of Euro 4 standards. In Southeast Asia, fuels with 50 ppm sulfur is widely available and many oil firms also sell 10 ppm-sulfur fuels.

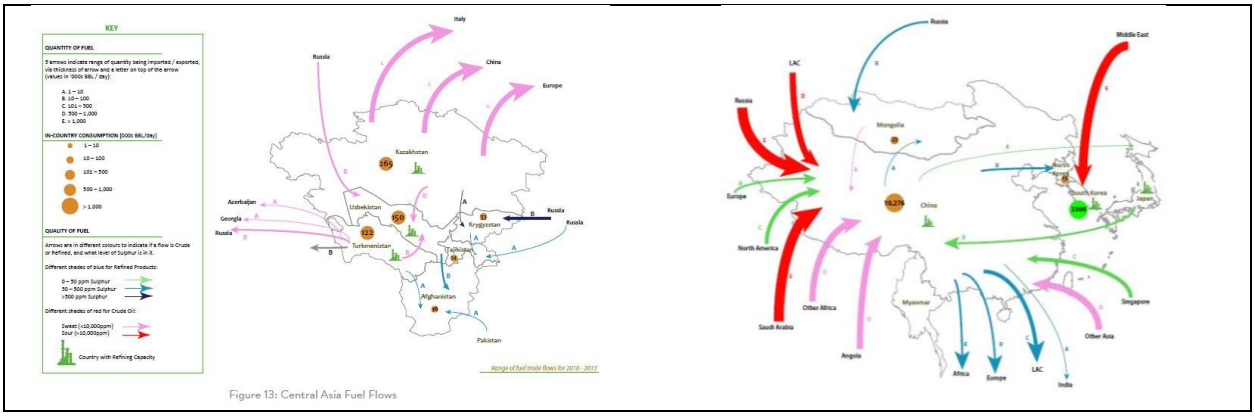

Figure 13: Central Asia Fuel Flows

[1] The Global Sulfur Strategy is formulated by the co-leads of the Heavy-Duty Diesel Initiative, namely, the Government of the United States of America, the Government of Canada, the Government of Switzerland, the United Nations Environment, and the International Council on Clean Transportation. For more information, visit http://ccacoalition.org/en/initiatives/diesel

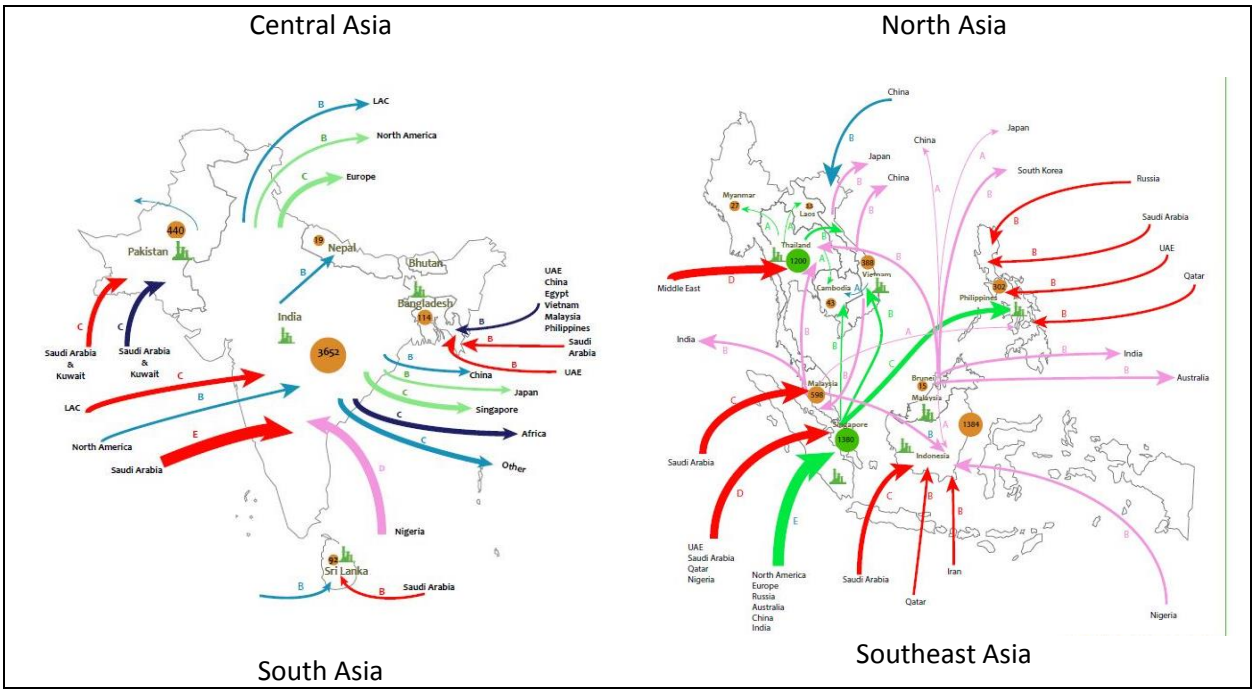

Figure 1. Fuel flows in various regions in Asia

Thailand: Implementing vehicle emission standards and equivalent fuel quality, and Roadmap to Euro 6/VI [Supat Wangwongwatana, Asian Institute of Technology]

Dr. Supat Wangwongwatana of Asian Institute of Technology firstly illustrated the current state of ambient and roadside air quality in Bangkok based on data from Pollution Control Department (PCD). Air quality has generally been improving, and major pollutant of concern is no longer total suspended particulates (TSP), but $PM_{2.5}$. Observations exceeding the standards is low but PM_{10} and $PM_{2.5}$ concentrations become higher near the roads. For $PM_{2.5}$, 50 out of more than 700 observations in Bangkok still exceeded the standard.

Many cities in Thailand face air pollution during the dry season (around December to February), but there are other sources of air pollution during this time such as the open burning of biomass. Vehicle population sees an increasing trend in Thailand, and vehicle registration in Bangkok reached 9.8 million by the end of 2016. Despite this, Bangkok had seen decreasing levels of carbon monoxide (CO), TSP, PM_{10}, and NO_X. Since Bangkok introduced Euro 4/IV fuel quality standards in 2012, declining levels of nitrogen dioxide (NO_2), ozone (O_3), as well as sulfur dioxide (SO2) and benzene levels have been observed.

For HDVs, Euro III emission standards apply. Euro III emission standards apply to motorcycles in Thailand until 1 January 2018 when they started the enforcement of Euro IV standards for motorcycles. All motorcycles in Thailand have also switched from 2-stroke to 4-stroke. Although Thailand has not banned the production of 2-stroke motorcycles, it was technically not feasible for motorcycle manufacturers to meet the standards by continuing to use 2-stroke engines.

Dr. Wangwongwatana also presented road transport emission projections if Thailand is to stay on Euro 4. Although the analysis accounted for the expected vehicle population increase, NO_X, CO and PM emissions are expected to decrease as there is an anticipated phasing-in of new Euro 4/IV vehicles to replace the in-use Euro 2/IV or Euro 3/III vehicles on the road. However, once all vehicles are Euro 4/IV, emission levels could potentially rise given the continued increase in vehicle population.

This would support the need for advancing to Euro 5 or 6 fuel quality standards. There are also technologies such as diesel oxidation catalysts (DOC) and diesel particulate filters (DPF) that could also effectively trap 95-99% PM. For the Euro VI diesel trucks, there will also have to be additional NO_X control or a selective catalytic reduction (SCR) system. According to Dr. Wangwongwatana, Euro 5/V fuels with 10ppm sulfur content is available in Thailand; in fact, two petroleum companies have E20 gasoline fuel like Euro 5, but the quantity is inadequate.

Thailand's Pollution Control Board established a Sub-Committee on Emission Standards for Motor Vehicles on 25 February 2015 to develop the roadmap for Euro 5/V or 6/VI standards, and has established four Task Forces, namely, Task Force on vehicle emission standards, on fuel quality, on inspection and maintenance program, and on emission inventory for Bangkok. The proposed roadmap that they have agreed with automotive and petroleum industry in Thailand is outlined below. The petroleum industry generally needs five years of lead time as desulfurization units will have to be installed in the refinery.

- Euro 5 or 6 fuel quality standards (gasoline and diesel): 1 January 2023
- LDV emission standards
    - Euro 5: 1 July 2023
    - Euro 6: 1 July 2029
- HDV emission standards
    - Euro 5: 1 January 2026
    - Euro 6: 1 January 2032

Dr. Wangwongwatana also said that there is a cost and benefit analysis of Euro 5/6 implementation, and that the impacts of leapfrogging to Euro 6 standards for the vehicles that have been studied. They found that additional reductions in PM and NO_X levels especially in the near-term would be achieved in the case of leapfrogging to Euro 6, and that immediate emission reduction would be obtained from the *existing* vehicle fleet once lower sulfur fuel is used. However, the Thailand government is also expanding the railway network to meet growing commuter demand and to ultimately reduce the use of personal vehicles.

India: Overview of Bharat IV and VI standards implementation and development in India [Anumita Roychowdhury, Centre for Science and Environment]

Ms. Anumita Roychowdhury of the Centre for Science and Environment firstly described the proliferation of pollution hotspots across India and how such would be worrying especially in the cities in northern India which is landlocked. The greatest threat that air pollution poses is that, according to Journal of Indian Pediatrics 2017, Indian children are growing with smaller lungs—about 10% smaller when they become adults in India. Thus, the Indian government developed a comprehensive plan action plan. In 2017, when PM2.5 went far beyond safe limits, the government implemented smog / pollution emergency plan. However, the judiciary, which was one of the driving forces of the said plan, recognized that India cannot

be on an emergency mode, stressing the need for an action plan to properly monitor sources of pollution and to create short-, medium- and long-term actions that can be monitored. It was through these circumstances that the plan had taken shape which became legally binding.

India experienced explosive motorization over the last decade. The Ministry of Health became involved for the first time to help understand the impact of actions on ambient air quality of the city and to understand the trend of air quality over time. Their involvement became more significant because ambient concentration is not a sufficient representation for human exposure, and it is the exposure and the proximity to the source of pollution that pose the health risks. For instance, while both powerplants and motor vehicles have an effect on ambient air quality, the powerplants are outside of the city and the people in the city are closer and are thus more exposed to the pollution from motor vehicles. A range of other evidences came forward to show why India needed to pay closer attention to vehicles such as Health Effects Institute's study on the influence of vehicle pollution being 300 to 500 meters away from roadside. In Delhi, more than 55% (17 milllion people) live within 500 meters from some major roads.

Narrating the development of vehicle emission standards in India, Ms. Roychowdhury said that Delhi did not yet have vehicle emission standards in 1998. But the Supreme Court, in 2000, gave the industry two months to meet to Euro I standards, and then another nine months to meet Euro II standards. As a result, within one year, Delhi had Euro II standards in 2000. Subsequently, because of judicial pressure, other cities in India also complied with Euro II emission standards.

As India was industrializing rapidly, the first leapfrog that Delhi attempted to do was to move from Euro II to CNG. In 2003, National Auto Fuel Policy was developed which mandated that all new vehicles in the cities that were on Euro II to move to Euro III emission standards in 2005, and that the rest of the country shall move to Euro II. The policy also mandated that, by 2010, the cities then on Euro III shall follow Euro IV standards, while the rest of the country shall move to Euro III.

The second leapfrog in Delhi was catalyzed by the concern on massive dieselization which had economic implications. Around this time, ICCT also analyzed that, in Delhi, cancer risk is four times greater from diesel cars compared to petrol cars. Dieselization was also increasing engine size of overall vehicle fleet, so fiscal disincentives were also placed for diesel. From 2015 to 2016, the Supreme Court had been clamping down on dieselization, banning the sale of 2-liter diesel cars and SUVs in Delhi and NCR. Disincentives such as environmental pollution charge for diesel cars were imposed. Under the court order, the fund collected is available for pollution control in and around the city. In fact, monitoring stations in and around Delhi have been set up with the said fund. The National Green Tribunal also imposed a ban on 10-year-old diesel cars in Delhi. Such pressure on diesel created uncertainty in the market for diesel cars, which really accelerated the transition to Euro IV.

India intended for a stepped introduction of Euro IV, focusing in only 13 cities. Then, in March 2017, the Supreme Court directed full transition at once for all existing and new models from 1 April 2017, and denied transition time. In 2016, the government also issued the notification for the leapfrogging directly to Euro VI with in-compliance regulations in 2020. This also mandates Euro VI emission standards for motorcycles (two-wheelers), and 10 ppm sulfur fuels from April 2018.

The next discussion relating to Euro VI was on the emission control systems. ICCT and ICAT conducted a study in Delhi which tested real-world emissions, and it revealed that adding one diesel SUV to Delhi's fleet is equivalent to adding 25 to 65 small petrol vehicles in terms of NO_X emissions. Given the complexity relating to emission control systems of internal combustion engines, opportunities relating to electromobility are being explored. In fact, there are about 10 cities in India procuring electric buses and it was found that the prices are equal to high-end diesel buses.

China: Case of China in implementing China 4/IV and designing China 6/VI standards [Zifei Yang, International Council for Clean Transportation]

According to Ms. Zifei Yang of International Council for Clean Transportation (ICCT), China has adopted China 4/IV since 2012 and China 5/V since 2015. China's "airpocalypse" in 2016 generated attention and pressured the government to act on air pollution. From the transport sector, China then sought to accelerate the adoption of 10 ppm sulfur fuel to as early as 2017. The availability of 10 ppm sulfur fuel would be available in Beijing, Shanghai, and other polluted areas. China V standards was subsequently required from all LDVs and HDVs beginning 2017.

Before China 6/VI, China has been following the European pathway of emission standards. The proposed China 6/VI will have relatively similar parameters as Euro 6/VI emission standards but more stringent. However, although standards are becoming increasingly more stringent, the real-world emission (RWE) level is inconsistent with this trend. Following such evidence, ICCT conducted a China-specific study looking at on-road emissions of vehicles in China, specifically conducting PEMS-testing data of 122 vehicles covering both LDVs and HDVs from China 0 to China 5/V.[2] The study revealed that, after the introduction of China 4/IV vehicles, RWE of NO_X significantly reduced. Still, RWE for the China 4/IV standards is generally not that much lower than China 3/III vehicles, and that some of the best and worst bus performers are from the same model produced by the same manufacturer. Although technologies exist to reduce emissions, the test cycles are note representative of real-world driving conditions.

China amended Clean Air Law in 2016. The sections stipulating monitoring the emission of vehicles increased to 18, increasing from 4 sections in the previous version of the said law enacted in 2000. With this alone, manufacturers have more responsibilities to report, and the central government has more authority to check the compliance of the emission standards of the manufacturers. There are also clear provisions in the law that empowers the Ministry of Environmental Protection (MEP) to recall the vehicles if they find any issues on compliance to emission standards.

In 2017, China published the China 6 LDV standard. It is split in two phases:

- China 6a will take effect on 1 July 2020. The limits are similar to Euro 6 but it is fuel-neutral
- China 6b will take effect on 1 July 2023. The limits are more stringent than 6a.

In terms of test procedures, China will shift from the New European Driving Cycle (NEDC) to Worldwide Harmonized Light Vehicle Test Procedure (WLTP), which is a more dynamic test cycle and thus better represents driving conditions in China, and will adopt real-world driving emissions (RDE) testing, using it

[2] Real-world emissions in China: A meta-study of PEMS data. https://www.theicct.org/publications/real-world-emissions-china-meta-study-pems-data

for type approval and in-use conformity tests. China 6 also comes with enhanced on-board diagnostics (OBD) provisions, and enhanced compliance through emission warranty and defect reporting.

Most LDVs in China are gasoline vehicles, but there are issues concerning the poor calibration that generates high NO_X, and three-way catalysts may be tampered with. With China 6, it would be based on European RWE package 2, with modifications that address the unique driving conditions in China. Secondly, it is not only for pre-production type approval phase, but also for in-use conformity tests. The third relates to the inclusion of particulate number requirement for the RDE testing. Ms. Yang also presented the comparison of China 6 and Euro 6 RDE requirement.

China VI HDV standard remains a proposal from April 2017, which would also be in two phases:

- China VI a (Jan 1, 2020) – equivalent to Euro VI
- China VI b (Jan 1, 2023) – same limits but introduces PN limits for PEMS test, remote OBD requirement etc.

In this proposal, there would also be three engine tests, namely, World Harmonized Stationary Cycle (WHSC), World Harmonized Transient Cycle (WHTC) cycles and the World Harmonized Not-To-Exceed (WNTE), and one full-vehicle PEMS testing requirement. PEMS test would be for both type approval test and in-use compliance test. Comparing Euro 6 with the proposed China VI, the NOx limits would be similar but China VI b, a PN limit is added. Specifications relating to payload, ambient temperature and altitude also vary.

Because China VI will not take effect until 2020, supplemental China V HDV standard had been developed to address high NO_X emissions of in-use vehicles. The standard was introduced in Sep 2017 and took effect on 1 October 2017. It required PEMS testing for new and in-use HDVs that are still subject to China V standards, making China the first country to attempt to solve a known deficiency in the Euro V type-approval process. The standard consists of two emission limits: brake-specific emission limits and instantaneous emission limits. Exceedance in one of those two limits means failure of the test.

As a summary, Ms. Yang emphasized that RWE remains high as emission standards continue to tighten, but that remote OBD with real-time reporting (for HDV only) are being utilized. China's PEMS requirements are modified from those adopted in Europe to address its distinct conditions such as high altitude, cold temperature and urban congestion. She also highlighted that cities may play a role in introducing more stringent pilot-testing and other programs, noting that, it was Beijing that firstly introduced China V standards and the supplemental PEMS testing for China V, which was subsequently recognized and adopted at the national level.

Mongolia: Status and Challenges in developing and implementing stricter vehicle emission standards [Adiyasuren Tshokhio, Ministry of Environment and Green Development]

The plans and roadmaps for fuel quality and vehicle emission standards in Mongolia as enumerated by Prof. Adiyasuren Tsokhio include the following: 1) Import better quality fuel; 2) Improve vehicle emission standard; 3) Ensure implementation of state vehicle inspection program; 4) Improve public awareness (air pollution, fuel quality, etc.); 4) Install Diesel Particulate Filter (DPF) in public transportation; 5) Improve

air quality monitoring network related to vehicle emission, and; 6) Establish air quality monitoring centers for vehicle emission.

Mongolia's vehicle emission standard follows Euro 2. Prof. Tsokhio also notes that out of all imported vehicles only 4-14% are new and remaining 86-96% are secondhand vehicles. The primary sources of imported vehicles are Japan, Hong Kong, and South Korea.

Most vehicles in Mongolia are running on gasoline (about 56%), diesel (24%), and hybrid electric vehicles (17.3%). Mongolian Standards (MNS) 0217:2017 and MNS 0216:2017 requiring the use of Euro 5/V fuel was approved in April 2017 and will take effect on 16 May 2017 (for gasoline) and on 1 October 2018 (diesel). Mongolia imports its petroleum products primarily from Russia (97% as of 2017) and China (2%), a large fraction of which is diesel (55%) and gasoline with octane number above 90 (25%).

Still, Prof. Tsokhio notes that Mongolia is still using low-quality fuel that has sulfur content above 2000 ppm. Russia, the main supplier of Mongolia, offers Euro 2 (sulfur content 501–2000 ppm). Another concern in Mongolia are the illegal production and trade of fake petroleum products in Mongolian market, as well as the price consideration of petroleum products. Euro 2 fuel is cheaper than Euro 5 fuel, and a slight increase in fuel price creates public frustration. Despite these, the government aims to update vehicle emission standard and to establish laboratories to inspect fake and low-quality fuel during the 2019-2023 period.

Bangladesh: Status and Challenges in developing and implementing stricter vehicle emission standards [Noor E-Alam, Roads and Highways Department]

In Bangladesh, Mr. Noor-E-Alam from the Roads and Highways Department, narrated that about 60% of their 3.2 million vehicles are motorcycles as of 2017. Car ownership in Bangladesh on average is 1.8 units per 1000 people, while motorcycle ownership is 11.87 units per 1000 people.

Bangladesh emission standard for new diesel LDVs is Euro I, but they are currently proposing to move to Euro II by this year, 2018, and then to Euro III by 2020. The same standards apply to all commercial diesel vehicles. Meanwhile, emission standard for new petrol and CNG LDVs is Euro 2, but the proposal is to move to Euro 3 by 2018 and then Euro 4 by 2020. The same standards apply to all commercial CNG vehicles. Among the main contributors to vehicle emissions in Bangladesh is the preponderance of pre-Euro vehicles on the roads. However, Mr. Noor-E-Alam states that Bangladesh mostly imports its HDVs from China, India, and South Korea, and its LDVs from Japan, India, and South Korea. Motor vehicles being imported into Bangladesh must not exceed 5 years old. This means there is a window of opportunity to set standards based on where vehicles are coming from as these vehicles entering Bangladesh could be considered relatively clean.

While poor fuel quality is among the major sources of vehicle emissions in Bangladesh, the government now has a roadmap for reducing sulfur in diesel to 50 ppm by 2023. From 2016, Bangladesh had stopped importing diesel that has more than 500ppm sulfur content. At present, 80% of diesel in Bangladesh is imported while 20% is locally produced. Transport in Bangladesh is powered generally by unleaded petroleum gasoline and diesel. CNG for LDV/bus/truck vehicle segments was introduced in 1995; however, due to the shortage of CNG, the recent initiative was to introduce LPG (for LDV) which Bangladesh can import and use for the transport sector, as well as electricity.

Some of the initiatives of the government to reduce automobile pollution include the introduction of 13,000 CNG-run 3-wheelers or auto-rickshaws as a replacement to the 60,000 two-stroke petrol-driven units in Dhaka and Chittagong city. Outside of Dhaka and Chittagong, these are all powered by electricity. Because of such shifts, there was a reduction of $PM_{2.5}$ levels in Dhaka City from 2011 to 2015, and there was an avoidance of 6,000 premature deaths annually, and annual savings of USD 1.15 billion. In 2016, Bangladesh also launched its first digital Motor Vehicle Inspection Center in Dhaka together with Korea International Cooperation Agency (KOICA).[3] There would be need for large investments to develop more of these inspection and maintenance centers even outside of Dhaka.

The preponderance of pre-Euro vehicles on the roads remains to be a concern. The lack of inter-ministerial coordination also slows down efforts in addressing vehicle pollution or furthering vehicle emission standards. Although Bangladesh Road Transport Authority has not yet officially allowed the electric auto-rickshaws to run in Bangladesh as guidelines are still being set, there are many of such units plying the country's roads (about 1 million in total). Other challenges include the need for stricter law and enforcement to prevent fuel adulteration, for dedicated supply of cleaner fuels (i.e. 500 pm sulfur content in diesel), and for public awareness about air pollution and enforcement of vehicle emission and fuel quality standards.

Indonesia: Status and Challenges in developing and implementing stricter vehicle emission standards [Ahmad "Puput" Safrudin, Committee on the Phase-Out of Lead (KPBB)]

Mr. Ahmad Safrudin mentions that air pollution is still threat in Indonesia, specifically PM10 as well as black carbon, citing also a study conducted in 2016 on health impacts that concludes that 58.3% of the Jakarta population (>10 millions) suffered various related-air pollution diseases/illness, and paid the direct medical cost IDR 51.2 trillion (about USD 3.9 billion). A separate study conducted five years ago with the support of UN Environment also found that implementing Euro 4 vehicle emission standard by 2021 (Option 1) would result to Total Economic Benefit of IDR 1,970 trillion (health cost, production saving and fuel saving); moreover, accelerating the implementation of Euro 4 standard by 2016 (Option 9) would double Total Economic Benefit to IDR 3,973 trillion and cut the cost of emission reduction by 21.30%.

Indonesia's vehicle fleet is dominated by motorcycles, like Bangladesh. Indonesia's emission standard follows Euro 2/II since 2005, and, for motorcycles, Euro 3/III since 2013. The Euro 4/IV implementation[4] for new vehicles came in effect on 10 March 2017, and that for current production will be effective 10 October 2018. Euro 6/VI is being considered for 2023, like Thailand.

On fuel quality, Indonesia's state-owned oil company Pertamina have started producing gasoline and diesel fuel that are Euro 4/IV-compliant since August 2017 and have distributed it since December 2017. Shell likewise since 2016 has distributed gasoline and diesel fuel with 54 ppm Sulfur content. However, one of the challenges relates to adequate supply of quality fuel. Indonesia currently has 6 refineries. From these refineries, the existing gasoline supply by 2025 is estimated to be 13 million kiloliters, but demand is projected to reach 77 million kiloliters, showing a deficit of 64 million kiloliters. Deficit is also demonstrated for diesel fuel supply. To address this, the Refinery Development Master Plan was

[3] More information at http://www.daily-sun.com/arcprint/details/179077/2016/10/29/Vehicle-Inspection-Centre-opens-in-city/2016-10-29

[4] Regulation of Ministry Environment and Forestry No. P.20/MENLHK/Setjen/KUM.1/3/2017 on the standard exhaust emission of Euro 4-type motor vehicles.

formulated to meet the country's demand. Since 2016, the government had also begun to allow investors to develop refineries in the country.

Indonesia recognizes the need to adopt lower emission vehicle (LEV) standard to address air pollution in Indonesia. Although Pertamina and Shell has started to supply fuel which is comply to the requirement of Euro 4/IV Vehicle Standard, quality fuel supply remains to be a big challenge. Another concern relates to the portfolio of principal of car manufacturers who tend to be ambivalent on developing global business strategy, selling both advanced and old technologies. The challenge is to ensure compliance with the vehicle emission standard--Euro 2 (2005), Euro 4 (2018), Euro 6 (2023)—as doing so would result to reduced PM, HC, CO, NOx, SO_X emissions, and to economic benefit at least IDR 3,973 trillion through fuel efficiency, production saving and public health improvement.

UNESCAP – Sustainable Urban Transport Index (SUTI)

Mr. Madan Regmi from the Transport Division of UNESCAP described briefly the Sustainable Urban Transport Index (SUTI) developed by UNESCAP to help summarize, compare and track the performance of transport systems in cities which includes ten indicators such as safety, quality and reliability, affordability, air quality and emissions. As part of the first phase, SUTI has been piloted in four (4) cities, namely, Colombo, Kathmandu, Hanoi, and Jakarta. Initial results have been shared in Colombo, Sri Lanka, in 2017. UNESCAP is moving into the second phase with five (5) cities, namely, Dhaka in Bangladesh, Ho Chi Minh City in Viet Nam, Yangon in Myanmar, and potentially another city in Indonesia as well as in Fiji such as Suva. Excel SUTI data sheet and data collection guideline are readily available from UNESCAP. For more information, the leaflet distributed during the forum is available as 0.

Asia-Pacific Low-Carbon Lifestyles Challenge: MotionECO [Shutong Liu]

The session also provided a platform for participants of Asia-Pacific Low-Carbon Lifestyles Challenge to present their work. Mr. Shutong Liu, founder of MotionECO, is creating the market for sustainable biofuel made from waste cooking oil that can be used in transportation, public services and logistics, or anywhere that conventional diesel is used. Mr. Liu narrated that, alongside the threat posed by air pollution from the transport sector in China, there was also a food health risk which is one of threat that comes out of illegally using recycled waste cooking oil. He shared that sustainable fuel produced from waste cooking oil could help reduce up to 90% GHG emissions and dramatically reduce pollution from the exhaust. MotionECO's solution is to utilize such waste oil to make sustainable fuel.

APPENDIX 1 WORKSHOP AGENDA

March 20, 2018
United Nations Conference Centre
Bangkok, Thailand

9:00 – 9:20	**Welcome Remarks and Background to the PCFV Regulatory Toolkit and the Global Sulfur Strategy** Bert Fabian, UN Environment
9:20 – 10:00	**Implementing vehicle emission standards and equivalent fuel quality and the Case of Thailand's Roadmap to Euro 6/VI** Supat Wangwongwatana, Asian Institute of Technology
10:00 – 10:30	**Overview of Bharat IV and VI standards implementation and development in India** Anumita Roychowdhury, Centre for Science and Environment
10:30 – 10:45	**Coffee/Tea Break**
10:45 – 11:15	**Case of China in implementing China 4/IV and designing China 6/VI standards** Zifei Yang, International Council for Clean Transportation
11:15 – 12:15	**Panel discussion on challenges in developing and implementing stricter vehicle emission standards** Mongolia – Adiyasuren Tshokhio, Ministry of Environment and Green Development Bangladesh – Noor E-Alam, Roads and Highways Department Indonesia – Ahmad "Puput" Safrudin, Committee on the Phase-Out of Lead (KPBB)
12:15 – 12:25	**Asia-Pacific Low-Carbon Lifestyles Challenge** Shutong Liu – MotionECO
12:25 – 12:30	**Closing Remarks** Bert Fabian, UN Environment

APPENDIX 2 LIST OF PARTICIPANTS

ASIA PACIFIC CLEAN AIR PARTNERSHIP

2018 Asia Pacific Clean Air Partnership Joint Forum and Clean Air Week

Theme: Solutions Landscape for Clean Air

Cleaner Fuels and Vehicles in Asia: Implementing the Global Sulfur Strategy

20 March 2018 | 9:00 am – 12:30 pm

United Nations Conference Centre

Bangkok, Thailand

Name	Position	Organization	Signature
ADIYASUREN Tsokhio	Director, NOU; CCAC	Ministry of Environment & Tourism, Mongolia	
NOOR-E-ALAM	Project Hauager GDSUTP	Ministry of Rood Transport	
Ahmad "Puput" Safrudin	Executive Director	KPBB - Indonesia	
Chengliang Fan	Researcher	JGSEE, Thailand	
Lin Lin Tun	Deputy Director	Ministry of Industry, Myanmar	
Aung Phyoe Minn	Assistant Director	Ministry of Industry, Myanmar	
Shankar Prasad Paudel	Senior Divisional chemist	Department of Environment	
[illegible] + ZL	Consultant	Darwin Corporation	
TSATSRAL BATMUNKH	Head	APRD, Mongolia	
Rajan Thapa	Program Manager	Clean Energy Nepal	Thapa
Song Wei	Vice President	Darwin Corp.	Song Wei
Liu, Henjun	President	Darwin Corp.	Liu
Mannipa Kuson	Environmentalist	Pollution Control Department	M. Kuson
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MOHD AZUWAN ABDULLAH	ASSISTANT SECRETARY	MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT, MALAYSIA	
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CHULAM MOHD MALIKYAR	Deputy Director Gen.	NEPA / Afghanistan	
Shakeel Malik	Addl Secretary	M/o Climate Change	
Zifei Yang	Researcher	ICCT	
Madan Rao	FAO	ESCAP	
J.S. KAMYOTRA	Environmental Expert	India	JSey
Adelaida B. Roman	Senior Program Specialist	RRCAP, AIT	
MOHD AZUWAN	ASSISTANT SECRETARY	MINISTRY OF NATURAL RESOURCES & ENVIRONMENT	
Mr. Sivannakone Malivarn	Deputy Director General	MONRE LAO PDR	
Mr. Sinmanolack SINBANDHIT	Senior technical	— " —	SSBH
KATHLEEN DEMATERA	Transport Program Coordinator	Clean Air Asia	

APPENDIX 3 SUSTAINABLE URBAN TRANSPORT INDEX

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

Sustainable Urban Transport Index (SUTI)

Sustainable Urban Transport Index (SUTI) is a framework of indicators for the assessment of urban transport systems and services in a city. The following table lists the 10 indicators, measurement units and normalization range. The indicators and SUTI can help summarize, track and compare state of urban transport performance in a city. SUTI can serve as a useful tool for cities to assess the achievement of the SDG 11, more specifically target 11.2 and implementation of the New Urban Agenda.

Indicators for SUTI

No	Indicators	Measurement units	Weight	Range	
				Min.	Max.
1	The extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes	0 - 16 scale	0.1	0	16
2	Modal share of active and public transport in commuting	Trips/mode share	0.1	10	90
3	Convenient access to public transport service	Perecentage of population	0.1	20	100
4	Public transport quality and reliability	Percentage satisfied	0.1	30	95
5	Traffic fatalities per 100,000 inhabitants	Number of fatalities	0.1	35	0
6	Affordability – travel costs as part of income	Per cent of income	0.1	35	3.5
7	Operational costs of the public transport system	Cost recovery ratio	0.1	22	175
8	Investment in public transportation systems	Percentage of total investment	0.1	0	50
9	Air quality (PM10)	µg/m3	0.1	150	10
10	Greenhouse gas emissions from transport	CO2 Eq. Tons/capita/year	0.1	2.75	0
	Total		1.00		

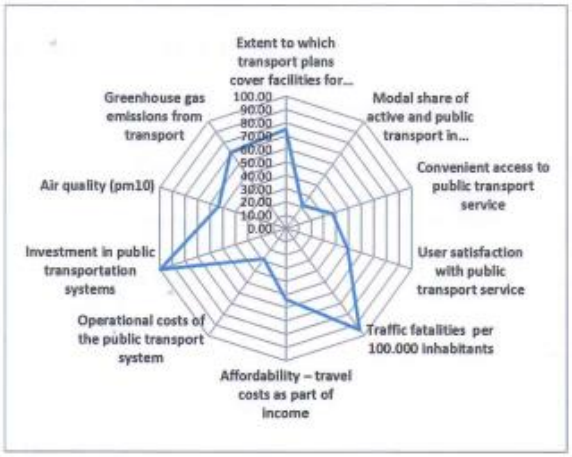
Indicators on different scales are normalized and performance of each indicators is compared on a scale of 1-100 and SUTI is derived by geometric aggregation of 10 indicators, based on equal weighting. A data collection guideline and an Excel SUTI data sheet are developed to support data collection and analysis. Entering data for all ten indicators will calculate SUTI, generate a spider diagram and allow a review of the city's overall state of urban transport as well as performance against each indicator.

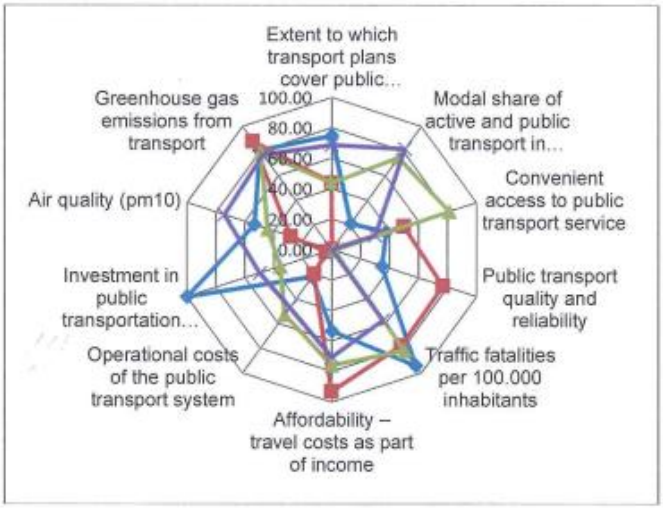
In the spider diagram, the state of each indicator can be observed. A high value (near the outer circle of the diagram) indicates good result, whereas the opposite is the case for a low value. Based on this result the city can for example consider if there are areas where it would like to focus more attention

in the future, or areas where the data should be examined more closely. Repeating the exercise at a regular interval, will allow a city to track improvements in performance and results of its efforts to improve urban transport system over time.

Analyzing SUTI for several cities will allow comparison and ranking of performance across cities in a standardized way. It is important that each city collects data for the ten indicators and follows the same procedure and guideline to be able to compare results across cities.

A capacity building workshop was organized in Colombo in October 2017 to share the results of pilot application of SUTI in four cities – Colombo, Greater Jakarta, Hanoi, and Kathmandu.





UNESCAP would like to encouage cities and countries to use SUTI for assessment of urban transport systems and use results to initiate and implement policy measures to improve urban transport systems and services. UNESCAP is also looking for collaborating partners to support collection of urban transport data and application of SUTI in more cities.

More information on SUTI is available from:
http://www.unescap.org/publications/monograph-series-sustainable-and-inclusive-transport-assessment-urban-transport-systems
http://www.unescap.org/events/capacity-building-workshop-sustainable-urban-transport-index-suti

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