

The Introduction of CNG as Alternative Fuel for Two-stroke Vehicles

Autorickshaw Demonstration Project in Pakistan

Speaking Notes

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Check Against Delivery



Ladies & Gentlemen

It is a great pleasure for me to share with you our findings and experience about two-stroke vehicles, particularly autorickshaws. I would like to commend our host, the Asian Development Bank and its partners, including the World Bank, the US Asia Environment Partnership and the Ministry of Transportation Vietnam Register who took the initiative to bring us together at this regional forum.

We all share a common interest in a healthier environment, and are working together on how best to achieve that goal. Transportation is the backbone of any modern economy. Revolving wheel is the universal sign of economic progress. Let's join hands to keep the wheels of progress moving on the right path; the healthier path. I will use the accompanying PowerPoint presentation.

●What is the problem?

The three-wheel auto-rickshaws are abundantly available in South Asia. They are powered by two-stroke engines and lubricating oil is directly mixed with gasoline while filling the fuel tank. Bajaj in India and Vespa in Pakistan are perhaps the largest producers of these particular vehicles in South Asia although many others have joined in the recent years. The vehicle is particularly suited to the narrow and crowded city streets in large population centres due to its light-weight and excellent maneuverability. Most repairs and routine maintenance are carried out by the operators themselves thanks to its simple design.

The major disadvantage of the 2-stroke engine is its high level of emissions, especially particulate matter resulting from un-burnt lubricant and gasoline. Scavenging losses occur when the engine is drawing in the air/fuel mix while also exhausting the combustion gases from the previous combustion event. A portion of the incoming fuel-oil mixture is exhausted with the combustion gases in raw form. These emissions in turn clog the muffler very quickly, causing the rickshaws to experience power loss and engine heat-up. The operators respond in two ways: 1) they increase the amount of lubricant used, up to 12% compared with 2% recommended by the manufacturers. To reduce their increased lubricating costs, they resort to using sub-standard lubricating oil. This response feeds the problem instead of solving it; 2) they remove the muffler and replace it with a locally manufactured model which has hardly noise reduction partitions. It causes a tremendous amount of noise pollution.

●What are the alternatives?

Like vehicular pollution generated by cars, the long term solution lies in improved, efficient and cleaner engines which would replace the existing technology. Traffic management, stricter monitoring regimes and increase in the role of public transportation are natural solutions. An effective Inspection & Maintenance (I&M) program should be part of any solution.

The case of two-stroke vehicles, however, is somewhat different than other vehicles. They are used mostly by poor people for whom finding affordable transportation is an overwhelming priority. Rickshaws are used as taxis and their clientele is primarily from lower income groups. The numbers of vehicles are staggering, running into millions. Their useful life is quite long, running into as much as 30 years. That means vehicles sold during the past five years could be around for another 25 years. While phasing out these vehicles is certainly desirable, the process will take a long time unless drastic actions are taken, either by buying out the owners (which will require huge sums of money), or banning the vehicles (which will cause considerable hardship to the poor owners and operators). Therefore, a short-term or interim solution such as the use of cleaner alternative fuels including Compressed Natural Gas (CNG) and Liquefied Natural Gas (LPG) is highly desirable.

●How are we helping?

Canada is involved in demonstration projects in Bangladesh, Egypt, India and Pakistan. Environment Canada is working with a Canadian company, Yugo-Tech Inc. to optimize and demonstrate a technology to convert two-stroke rickshaws and motorcycles to operate on Compressed natural gas (CNG) and Liquefied Petroleum Gas (LPG) depending upon local availability of the fuel. These efforts are partly funded by Canada's Technology Early Action Measures fund (TEAM) and the Canadian International Development Agency (CIDA). Public awareness, training and institutional capacity development for monitoring and controlling vehicular emissions and creating enabling environment for rewarding cleaner options constitute integral part of these demonstration projects.

●Is the solution technically viable?

We have converted 60 rickshaws in Pakistan since November 2000 which are being monitored by the local EPA staff for technical and

environmental performance. The owner-operators of these rickshaws were selected from a group of volunteers who had the option to have their CNG kits removed at no cost to them. Some did opt out because CNG refueling stations are still not as widely available as gasoline filling stations. However, the kits were reinstalled in rickshaws which were on the short-list. Users have got the hang of the technology and initial fears of starting trouble, engine heat up and power loss have been overcome. As before, the rickshaws are by and large maintained by the owner-operators themselves.

It is commonly assumed that CNG reduces a vehicle's power. Although this is a common observation in retrofitted cars also, it should not necessarily be the case. CNG is a more powerful fuel than gasoline. Its octane number is 130 compared with 87 for normal grade gasoline. We were surprised to learn that a local rickshaw owner, who had a family owned repair shop in Lahore, increased the compression ratio of his rickshaw to match the more powerful CNG. When we checked its compression power, it was more than five horsepower, slightly more than a brand new gasoline operated rickshaw!

● Is it economically viable & socially desirable?

In Pakistan, an average rickshaw operating two shifts of eight hours each consumes 10 litres of gasoline in one day costing Rs. 330. To travel the same distance, the same rickshaw consumes two cylinders of CNG, costing no more than Rs. 150. That is a saving of Rs. 180 per day in fuel costs.

An average rickshaw consumes one litre of lubricating oil per day. To save money, low quality cheaper lubricant is used which still costs the operator Rs. 45. A CNG operated rickshaw needs one-quarter lubricating oil. If the rickshaw uses high quality T-2 oil meant for two-stroke engines, it costs Rs. 25 per day, saving the operator another Rs. 20 per day. In terms of operating costs, an average rickshaw reduces its fuel plus lubricating costs by 53% from Rs. 375 to Rs. 175.

After allowing for the cost of ownership of the rickshaw or its daily rental of Rs. 100 per day, we found that the operator's net daily income increased by 100 % from Rs. 200 to Rs. 400. Please note that the amounts we are talking about are very small in absolute terms, highlighting the financial vulnerability of the rickshaw operators, which must be taken into consideration while considering options to address the environmental issue.

We have been closely interacting with the volunteer rickshaw owners and here is one example: These three brothers (shown in the slide) own one rickshaw which they operate in three shifts. The family, including their respective wives and children and their father who is blind, are dependant on this rickshaw. Their fourth brother is unemployed and looks around for odd jobs every day. For them, this project is the most effective poverty alleviation project. This is the first environmental initiative in which the participants can gain financially rather than face punitive action. They are asking for loan for another rickshaw, operated on CNG!

Pakistan is dependent on imported fuel since domestic production is far less than its requirements. On the other hand, natural gas is locally produced and is abundantly available to meet the needs of the transportation sector. As a result, the national and provincial governments in Pakistan are fully supporting the initiative and we are enjoying tremendous cooperation.

● Is it environment-friendly?

CNG (and LPG) are well known cleaner alternative fuels, and I do not need to quote specific emission numbers. The emissions of total hydrocarbons (THC) are not only reduced but the ratio of its more toxic components such as Volatile Organic Compounds and smog precursors is also significantly reduced. In countries where leaded gasoline is still being used, CNG automatically eliminates lead from emissions. As I have mentioned before, the rickshaws operating on the roads generate a lot more emissions than a well tuned two-stroke engine should, because the problem feeds on itself, exacerbating the adverse environmental repercussions.

Due to controlled mixing of lubricating oil in the gas (CNG), the emission of particulate matter, which is receiving increased attention due to its adverse health impact, is drastically reduced. A recent study of air quality in Pakistan found that the concentration of particulate matter in the air in Lahore was 895 micrograms per cubic meter, 8 times higher than the WHO standard of 120. Interestingly enough, one of the major obstacles we had to overcome initially was the *lack of tailpipe smoke*. We had to reassure the rickshaw operators that the CNG converted rickshaws were generating power *without generating visible smoke*! Tailpipe smoke was seen as an indicator that the rickshaw was healthy!!

CNG drastically reduces the emission of harmful and toxic substances such as carbon monoxide; another air quality study funded by the World Bank found that urban air pollution was causing US \$369 million to Pakistan's economy.

●What is needed now?

Ladies and gentlemen, we need to move forward to integrate our environmental agenda with our poverty alleviation agenda, and our equity agenda. While we have put together funding mechanisms which allows major industries to access funds for innovation, upgradation and modernization to clean up, the owners of autorickshaws have no access to institutional credit, such as microfinance. They are dependent upon non-institutional sources of credit with extremely high interest rates. Commercial banks would not lend them money. The reasons are not difficult to find; they are on ADB's webpage! I reproduce them for you:

About 90% of the 180 million poor households in the region still lack access to institutional financial services. Most formal financial institutions deny the poor financial services because of

- *perceived high risks*
- *high costs involved in small transactions*
- *the poor's inability to provide marketable collateral for loans*

I urge you, our host the ADB in particular, to include rickshaw conversion costs eligible for the microfinance programs in Asia, supported by ADB and other development finance institutions.

Thank you all.