

Emission and noise norms – Developing Countries

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1. What is a standard?

Before we discuss whether International standards present an opportunity or a problem, it is necessary that we approach the subject with clarity of thought as to “What is a standard?”

In our technological and professional “superiority” we often tend to ignore the fact that words have a meaning and an etymology. The online etymological dictionary has the following to say about “standard”

"Rule, principle or means of judgement" is from 1560s. That of "definite level of attainment" is attested from 1711. Therefore we infer that a standard is a common reference, measure and a benchmark. Because it only indicates a “definitive level of attainment” a standard is by no means an end by itself, but more a road map towards a final objective. Therefore standards are essentially milestones or goals on the way to achieving the final objective.

Being goals, standards must specific, measurable, achievable, realistic and tangible. The connotation of the word “specific” is that the goal or standard has to be for a particular unique situation or scenario. The standard should be measurable using relevant measuring devices. More critically perhaps, a standard needs to be achievable and realistic. That is to say it has to be pragmatic (realistic but still a stretch) while also being enforceable (achievable).

We live in a world that has a number of standards. We do not have for example a universal standard of measurement for distances. Different parts of the world use kilometres or miles to measure distance. While on the subject of linear measurement standards, we have an interesting situation. Standards for paper sizes which are essentially linear measurements of the paper, we use inches or millimetres which are more practical rather than miles and kilometres.

We submit that standards have been evolving as technology has evolved. Yet these standards continue to be different in different areas. For example, the building standards of Europe with their emphasis on meeting the thermal insulation needs of a cold ambience would be totally irrelevant to tropical climates which necessarily warrant the establishment of a suitable set of building standards.

We also need to remember that standards are essentially part of the road map leading to the final objective. Therefore, depending on where one is, at any given point of time, standards for moving towards the same final objective could be different.

In view of the foregoing, we would like to submit that standards can be, to coin a phrase and an oxymoron at that, “Standards can be heterogeneously homogenous!”

To summarise:

- A standard is a common reference, measure and a benchmark

- A standard is not an end by itself but an intermediate goal in the roadmap for achieving the final objective.
- Standards need to be relevant and pragmatic to implement while being enforceable
- Standards leading to a common objective can be “heterogeneously homogenous”

2. Evolution of standards

How are standards established? They are essentially because of a perceived set of needs. The gold mark system, for example has come about because of a need for measuring the purity of gold in the jewellery industry and other applications. It also ensures the integrity of the concerned product. We are all familiar with the large number of different standards established in different industry sectors.

These standards are established based on inputs from concerned stakeholders. Therefore it can be surmised that standards are impacted by the relative strengths of key stakeholders and that these individual agencies or industry lobbies have a great influence over the content, severity and implementation effectiveness of the standard. It is possible that certain interest groups in the community could work at skewing the standard to their advantage, depending on their relative position of strength in the community. This is something that needs to be addressed effectively to ensure removal of bias, intended or otherwise in establishing a standard. An illustration to this effect follows:

The new data presented by the UN Framework Convention on Climate Change (UNFCCC) makes interesting reading: Developed countries have committed to cut greenhouse gas emissions by a paltry 3 % from 2011 to 2020. According to the UNFCCC secretariat's technical review, the developed countries have committed themselves to a reduction of 13 to 19 % of 1990 levels, something that is far short of the 25 to 40 % drop expected of them in order to keep temperatures from rising more than 2 degrees above pre industrial era – a tipping point that leads to dangerous climate change consequences. It appears that even here the developed countries will achieve only the lower limits. The European Union, which has always projected itself as a leader on the issue, has set up such a low target for 2020, ie., to cut emissions down by 20 % below 1990 levels has already achieved 18 % reduction by 2011. The US which has the highest accumulated emissions and the highest per capita emissions in the world, increased its emissions between 1990 and 2011 by 8 %. It has now committed to cut emissions by 5 % from 1990 levels by 2020. The review also warns that it is difficult to compute actual reduction in emissions as developed countries have not explained or clarified how much of the emission drops were obtained by buying credits for work done by them to cut emissions in the developing world.

The UNFCCC works on two tracks. One is to press countries to take higher emission cuts between now and 2020 and the second is to deliver a new program by 2015 that will put in place a formula for all countries to cut emissions from 2020. With almost two thirds of the limited carbon space being occupied by the developed world, the EU has made it conditional on countries such as India and China taking on commitments right away for them to take on higher targets for reducing carbon dioxide emissions. The US has made it clear that they will not increase their target for reducing carbon dioxide emissions in the pre 2020 period. These low or no commitments to reducing emissions by these developed countries, the developing world may be asked to take on higher levels of reduction post 2020. This can only be charitably named as “wielding the big stick”

Source: The Hindu Page 14 of Monday October 20, 2013

Standards are established based on a number of parameters. They are commonly established because of a critical need identification for optimum solution. An example that is relevant to this is the establishment in 2001 of the Mashelkar Committee by the Government of India for formulation of the auto fuel policy for the country. The report of the committee was accepted by the government in 2002. This committee recommended establishment of emission norms based on achieving optimum results. Instead of aiming at establishing uniform norms across the country, it suggested an optimum solution to meet the critical need of limiting pollution by a differential approach. High risk areas of automobile caused air pollution were identified. The 80:20 rule was applied to these areas and the emission norms were targeted at the top 33 pollution contributing cities.

Standards are also established after evaluation of technological availability and cost. Enforcement of norms or standards usually involves new technology which may not be universally available or is available only at comparatively high cost which may not be affordable to industries in all geographies. Further the actual implementation would also involve additional costs to the end user. This additional cost, which may be easily affordable to users in first world countries, would be unaffordable to customers in developing economies.

Even when a standard is established, implementation has to be phased out over a appropriate time frame, which will afford adequate time to phase out the units based on older standards and to ramp up production of units according to the newer norms. The time frame will have issues that affect the economies of the concerned region and will have to be sympathetic to the regional socio economic issues .

Finally, standards are established to meet a national or regional priority. A good example is the decision of the Supreme Court of India in 2004 to establish a norm for public transport vehicles in the New Delhi NCR region to use only CNG as a comparatively cleaner fuel in order to dramatically reduce the high levels of pollution.

To summarise:

- Standards evolve because of a perceived need
- Standards are based on inputs from concerned stakeholders and it is important to remove any sectoral or regional bias in the establishment of such standards
- Standards are established to provide optimum solutions
- Standards must factor technology availability and cost implications
- Standards must be established for implementation over a practical and sympathetic time frame and finally
- Standards are established to meet a national or regional priority.

3. Evolution is “Evolution”

In the previous sections we discussed about standards providing road maps towards achieving a final objective and that standards evolve. Taking the analogy further, it is obvious that there can be more than one road to reach the final objective and more than one way to travel there. Depending on where one is, and what one’s socio economic conditions are, one would choose the appropriate routing and vehicle. It is this same common sense approach that needs to be applied to the evolution of standards.

It therefore follows that as there are many roads leading to “Rome”, the mile stones for each road would be different. It is also obvious that the journey towards the final objective would have to be gradual and in stages rather than a continuous movement, with each stage depending on the resource availability and path constraints. Given that the vehicles for the various routes would be diverse, the time line for the journey also would be variable.

Such an approach in stages may not offer immediate breakthroughs or clearly apparent manifestations of change or big innovations. Rather they would represent an incremental approach that would ultimately end at the final objective, keeping in mind the implications of opting for appropriate technologies based on financial viability and variable speeds depending on the concerned stakeholders’ ability to assimilate them.

However, it is possible that even these incremental approaches, when spread over larger user groups will offer greater overall achievements than dramatic change models over a smaller user base. Therefore it stands to reason that the concept of one size fits all, will not apply to evolution of standards and that global standards and benchmarking without a clear understanding of regional issues would result in standards so evolved, remaining only on paper, with few takers.

Summarising:

- There are many roads and means to reach the final objective
- The starting points for each of the roads may differ
- The vehicles used to travel the road would be dictated by regional socio economic considerations
- The evolution of standards is thus a complex issue
- Operating as we are in a VUCA (Volatile, Uncertain, Complex and Ambiguous) environment, standardisation *per se* that is global, would not be appropriate and the need of the hour is to adopt different measures to ensure regional issues and problems are factored in.

4. No “simple common” standards exist today

It is rather strange that while on the one hand there is a demand for uniform standards, no such simple common standards exist today. Let us take a very common problem that all travellers face today. In an increasingly digital web assisted world, trade and industry would come to a grinding halt without our portable computing devices. However, we need electricity to power these devices and the interface that stands between power supply and our portable device is the common plug and socket. Many are the times we have travelled to an overseas destination and been stumped by the standards for the socket there being incompatible to the plug provided on our portable computing device.

In the case of digital equipment, we also come across various manufacturers using proprietary connectors that are just not common, resulting in one having to have a new set of connectors for different geographies. This is however just the tip of the iceberg. We still have different voltages in different geographies and no effort has been made for a common standard.

Standards also are used as protectors and trade barriers to different economies and nations. We have different standards for different countries viz., ASAE,SAE,ISO,ECE,EEC,BIS,JIS,DIN, BS and so on and so forth.

Given the diversity in human physiognomy, ergonomics designed for the average Japanese would differ from that for the average American or European. Even in the case of attire, we have different standards for different regions. Shirt sizes in the US use collar sizes and sleeve lengths and different fits while in Asia, it is mostly chest sizes that are used to specify collars!

Quite often there is a temptation to opt for “the best” available standard for use, ignoring regional needs and problems resulting in a set of standards that are announced but indifferently practiced and enforced.

Summarising:

- There are no simple common standards
- Political will and regional needs dominate standards today
- Standards are often used as trade barriers and as protectors and lastly,
- Copying the best available standard as the universal norm may be neither practical nor effective.

5. A case study - emission norms for a tractor

The countries of the developed world have stringent auto emission norms. The quantum of automobile emissions in these countries is cluster oriented and defined by population densities and city and road networks. In these countries, vehicle density per unit population is also much higher than comparable figures from developing and underdeveloped economies. Further in these countries, the risks of high emissions are predominantly concentrated to large population clusters and dense road network areas. As may be seen from fig1., pollution levels due to automobile emissions are higher in the cities rather than in rural areas.

In reality, while the automobile and population density is not uniform across all clusters, developed countries have preferred to have a common norm for their geographies as a whole without any consideration being given to individual current and future population density be it of people or automobiles. In fact we feel that the perhaps the need to be technology leaders and the current comparatively better economic factors have led to many of the countries concerned to opt for such a universal norm which is in many ways an overreaction not based on reality. Placed as they are in the top of the Maslow's needs hierarchy triangle, perhaps it is the need for self-actualisation that has driven these countries pushing for a universal norm without a reality check!

In the **Figure 1** above, the lowest level represents the area where the largest human populations in under developed economies live. Here what is needed is the establishment of standards that use locally available low cost technologies that are affordable, enforceable and sustainable. At the mid-level, we have the developing economies which need standards that are relevant to their current situation and which offer optimum solutions in terms of technology and cost. At the highest level, are the developed economies which can afford to opt for the highest standards that would be expensive but affordable to their people?

Acceptance of high standards could also at times be due to a socio political need to showcase technological supremacy and to differentiate themselves from less affluent countries. But the question then is “Differentiation at what cost?” In the case of developing and under developed economies, while there may be some temptation to accede to such universal norms may exist, the stark reality of such differentiation having a very large cost implication that their economies cannot bear, do stand in the way and rightly so.

The world today is composed of a heterogeneous mixture of economies. Even the map of the GDPs of various countries (**Fig. 2**) depicts averaged out per capita GDP which does not reflect the regional disparities within the nation.

Africa, China and India are very clear examples with certain regions of these countries having a much larger per capita GDP than the average national GDP. Such disparities make the national average figures meaningless. An 80:20 rule application within the country boundaries for the application of emission norms is what is critical today and affordable and it is this approach that will impact the overall pollution levels rather than just having a uniform norm across the country, which given the large base of users and geographical area and uncertain political will, will make it difficult to enforce. In fact China is using this 80:20 approach! Therefore, what works in China, should be applicable all over the world. Even within a country, we need to use different “yard sticks” and improvement methods.

Developing countries, given their comparatively larger population and area base have approached pollution on a more practical “need to deal” basis. **Figure 2** shows pollution data city and rural area wise for China.

From the figure it is clear that control of pollution levels in Beijing and Shanghai are critical today and they have also taken this up. Similarly in India, based on the Mashelkar report, auto emission norms are stringent in the identified 33 cities of India.

Even within automobiles as a whole, tractors warrant a differentiated approach. I am afraid that even in developing countries; the need to showcase technological superiority has far outweighed the real needs. In most of these countries, tractor population is concentrated in rural areas and forms a small fraction of the total vehicle population of the country. Moreover, vehicle density in rural areas is much smaller than that in the cities. Hence in the case of tractors, the pollution potential and density far outweigh the need to catch up with automotive standards. Interestingly, a country like Australia has taken the right and practical path of keeping tractors at Zero emission levels.

The reasoning is quite straight forward. We cannot use the same measuring stick to measure all categories of automobiles. Tractors, by virtue of their being widely dispersed in rural areas and comparatively being lesser in number, need to have norms that are practical and make economic sense.

In developing economies, one also needs to consider the social impact of such adherence to universal norms. The needs in developing economies are many and social needs are overwhelming. With limited resources, such economies have urgent needs.. Clean drinking water for all would obviously take priority over clean fuel everywhere. When developing countries have poor drinking water supply and limited sanitation and healthcare facilities, would it be practical or just to allocate scarce resources in order to ensure that refineries supply 15 ppm sulphur fuel. Would the country be able to afford to clean up its fuel supply chain that has already been contaminated by years of pumping high sulphur fuel. These are difficult questions to overlook. In these cases would it not be better for the country to permit tractors or machinery operating in sparsely populated areas to run on zero emission. Would it not be more socially relevant to prioritise emission norms area by area and do localised pollution control rather than clubbing all areas under one class for emission norms?

Let us move on to specifics. Developing countries need to implement technology that adds perceived and felt value to customers. Enforcing technology for technology’s sake is neither enforceable or sustainable. These countries are looking for optimum cost and easy maintenance and not high cost and

high maintenance as it would affect their economies. Most farming communities understand a simple “Do it yourself” technology. In practice, if we offer them superior technology that they perceive as not needed, then, they roll it back to the lower tier in the fields today, despite the manufacturers ensuring that the engines satisfy the higher norms. It is quite common for customers in such economies to tune the fuel injection pump to get the best economy at the cost of higher emissions. They replace the dry air cleaner with oil bath type of air cleaner. Where there is a need to replace elements for achieving emission norms, they simply discard the elements. Even some manufacturers of passenger cars have been reported to have done such malpractices at their end while claiming to meet the higher norms. In a developing economy, fuel efficiency becomes the key to cost effective operations and hence the problem of such economies being unable to either enforce or sustain the norms effectively. Enforcement is the weakest of all links in developing countries.

These being the case, one can easily foresee what their reaction would be when DOP and electronics are added to the less than 100 HP tractors that are the backbone of agriculture in these developing economies. The issue is further complicated by the absence of any clearly outlined recycling policy with adequate infrastructure to run it. Another interesting and a further complication in such economies is that it is quite common for customers to store fuel in drums and what may be called “containers”, leaving the fuel liable to contamination and hence adding to the pollution. Trucks and commercial vehicles whose population is comparatively much higher, are seen to have secondary tanks built in so that they can buy and store fuels from rural areas as it is cheaper than the higher cost low sulphur fuel in the city, totally defeating the purpose of enforcing emission norms in select cities.

Therefore the problem is quite complex and needs special attention and care and just acceding to a universal norm would not really be a practical or an optimum solution. Let us move to noise norms, leaving emission norms for the present.

Noise is governed by the same factors as emission. Noise is a function of vehicle density, population density and proximity to road networks and cities. In a slow moving tractor, operating in a noise is probably a lesser evil with a lower impact on the environment than emission. It therefore needs to be treated differently. Rather than high levels of cost intervention, what are needed are cost effective and locally relevant interventions.

In the developing economies, agriculture utilises lower horse power tractors, working at much lower speeds and hence without wind cutting noise, without climate controlled cabins or for that matter cabins of any sort. With the low levels of ambient noise levels in rural areas and much lower population densities (**Fig. 3**), bystanders if any are not unduly affected by tractor operation noise and in any case can move a few feet away from the noise source, something that would not be possible on a crowded city street. They are just too far away for the noise to impact them adversely! However, the operator would be definitely impacted by the engine noise

In a high speed vehicle such as a car, both the engine noise and the wind noise affect the bystanders extensively. On the other hand the operator and other occupants of the car travel in a sound protected cabin and noise has little or no effect on them. This is the reason for the erection of sound baffles on highways, especially where they pass close to human habitations to protect the bystander from the noise of cars and other high speed vehicles.

The **Table 2** (source http://www.engineeringtoolbox.com/outdoor-noise-d_62.html) above illustrates the vast difference in ambient noise levels across octaves in rural and urban areas. It is very clear that the rural ambient sound is much lower than urban ambient sound. In fact there is no appreciable

increase in rural ambient sound during the day as compared to night time levels shown above. One also needs to keep in mind that the measure of sound is on an exponential scale and not an arithmetical scale. While 0 decibels is the threshold of hearing, 60 dB is normal conversation and at 90 to 95 dB , sustained exposure could cause damage to hearing. According to OSHA, daily permissible levels of noise exposure (8hour day) are 90 dB. NIOSH limits this to 85dB.

As mentioned earlier, while cars have sound isolated cabins, even in developing economies, tractors on the other hand, do not have such air conditioned cabs to isolate sound. One reason for this is of course the additional cost and the other and most probably key reason is the fact that an air conditioned cab in a tractor would consume about 10 to 15 % of engine power in these small tractors and the tractor user can hardly afford this as it adds to his operational cost if he is to go in for a higher HP tractor and also affects his productivity adversely. So the farmer in developing economies would rather forego comfort rather than engine power and productivity!

The actual working conditions of tractors in rural areas are very different from urban areas. While manufacturers may control and limit engine noise through noise suppression measures such as noise reduction baffles and noise suppression pads within the bonnet of tractors, while being used, it is a common sight in the developing countries to find that the bonnet with its noise suppression material is removed and set aside to avoid any damage to the sheet metal during use, which could affect resale value of the tractor. Moreover, during operations such as puddling in South East Asia, such noise suppression pads would be severely damaged by the water and soil mixture in which the tractor operates. So the pads would no longer be effective!

Therefore we need a cost effective noise suppression device, essentially to protect the operator. This would have to be fairly simple to use and easily affordable to replace. Such a device is commonly used in the construction and airline industry. It is the ordinary ear muff. It is rather strange that with the availability such simple alternatives, especially in developing economies, they are being asked to opt for impractical and costly noise suppression efforts. It is rather similar to developing a high tech pen that could write on paper in space, whereas the common lead pencil would do it at almost insignificant cost!

For purposes of commercial exploitation, developed economies pass on technologies that their economies can afford, to developing economies which actually do not need such high tech solutions and can well do with low end cost effective products and technologies, and use the resources so saved for more urgent and critical needs.

As mentioned earlier, tractors work in rural areas and almost isolated from the presence of other human beings. There is no movement of clusters of vehicles in such areas and even in villages, the number of tractors per village will be a miniscule fraction of the number of vehicles in a city street in the same geography. The tractors are low speed vehicles and wind noise is almost no existent. In developing economies, incorporating noise suppression devices by manufacturers would impact the cost of the tractor significantly and add to cost of agricultural production without any appreciable benefits. Despite these efforts, due to practical reasons cited above, these noise suppression efforts would come to nought in developing economies, due to enforcement issues.

Summarising:

- Impact of noise on bystanders in the case of tractors that operate mostly in rural areas is not an issue
- Impact of noise on the tractor operator can be effectively minimised by using low cost ear muffs.

- Proposed noise suppression devices whether by suitable cabins for operators or enclosures and suppressors for the engine are not optimum solutions
- Noise suppression efforts would add to the cost of tractors and hence cost of food production unnecessarily

It is our submission therefore that the current noise norms are adequate and appropriate and there need not be any further change to these norms. Operators on tractors who are the only ones to be impacted by noise can easily be asked to wear ear muffs to avoid hearing loss.

6. Conclusions

International standards are necessary. There is no denying it. However, international standards must be relevant to every situation, region and geography. They should be offering optimum cost effective solutions. They should be practical and enforceable.

However, given the diversity of our world and the vast chasms of economic and technological disparities that exist, it would not be just to impose international standards that do not recognise social responsibility. This is what the WHO has to say about the need for safe drinking water and hygiene

About 2.6 billion people – half the developing world – lack even a simple ‘improved’ latrine and 1.1 billion people have no access to any type of improved drinking source of water. As a direct consequence:

- *1.6 million people die every year from diarrhoeal diseases (including cholera) attributable to lack of access to safe drinking water and basic sanitation and 90% of these are children under 5, mostly in developing countries;*
- *160 million people are infected with schistosomiasis causing tens of thousands of deaths yearly; 500 million people are at risk of trachoma from which 146 million are threatened by blindness and 6 million are visually impaired;*
- *intestinal helminths (ascariasis, trichuriasis and hookworm infection) are plaguing the developing world due to inadequate drinking water, sanitation and hygiene with 133 million suffering from high intensity intestinal helminths infections; there are around 1.5 million cases of clinical hepatitis*

Source: http://www.who.int/water_sanitation_health/mdg1/en/

What should the developing world tackle on priority? Should such economies use the limited resources at their disposal to address this undeniable need for safe drinking water and sanitation or should they use it to meet international standards that involve solutions that are not the optimum, not relevant to the geography and application.

In the case of emission norms, we fully endorse the view that such norms should be applicable to population dense, vehicle dense and road network dense areas. However applying such norms to tractors in the developing world ignores the social rights of a majority of the world’s population for what are called basic human rights, right to clean water, right to food, right to education and right to decent housing and sanitation. Imposing universal norms would burden developing economies with a costly technology that would divert scarce resources from priority areas mentioned above. These

norms, as discussed earlier would remain on paper and would neither be enforceable or sustainable. The outcome in the end would be that it would be a very expensive exercise in self deception.

In the case of noise reduction, we fully endorse appropriate norms in population dense, vehicle dense and road dense areas. In rural areas, enforcing such norms for tractors in developing economies will only be wasteful as the operator would prefer lower cost and increased productivity rather than opt for noise suppression whether through baffles and pads or through airconditioned cabs. Use of cost effective and simple methods of noise suppression for the operator are available and should be recommended

In the final analysis, standards are necessary. But standards need not be universal as there are many roads to the final objective and many starting points. Therefore standards need to be locally relevant and sensitive, cost effective, enforceable and sustainable. Standards should not be a means of technological hegemony by developed nations on developing economies who can neither afford them nor actually require them at this stage of their development. In the case of tractors in developing economies, the above statements are eminently applicable and need serious consideration.

Figure 1

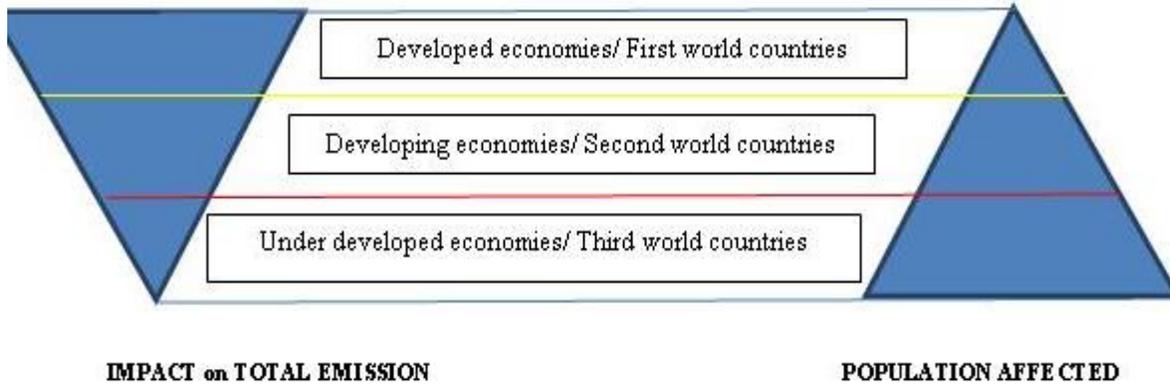


Figure 2

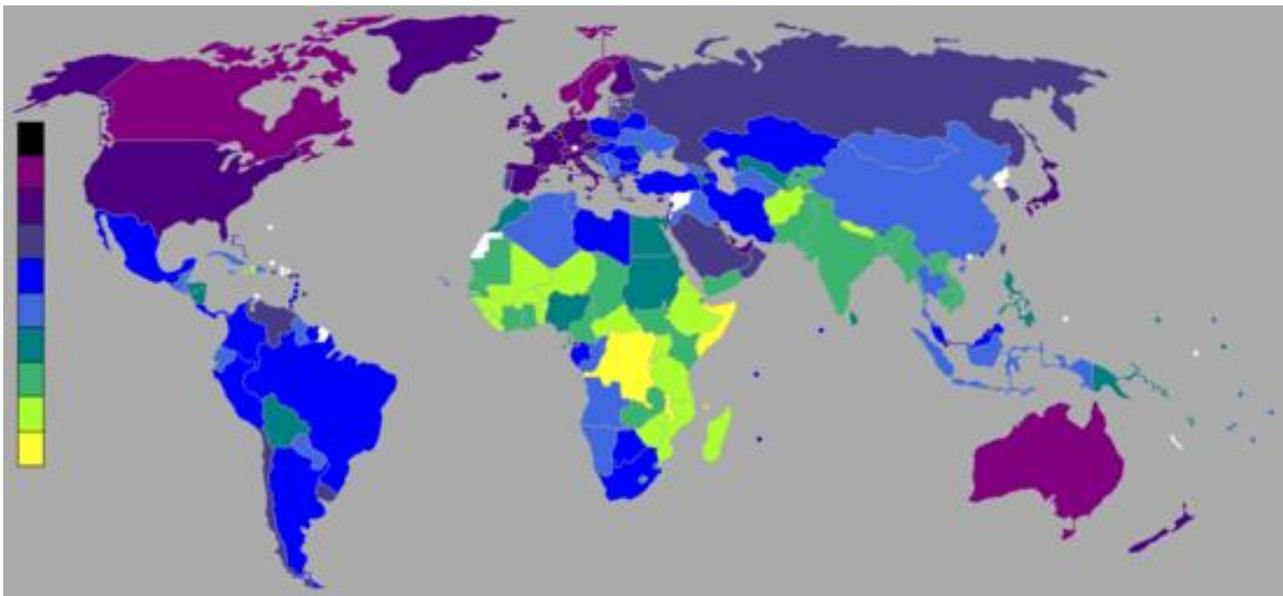


Figure 3



Figure 4



Figure 5



Table 1. Selected Specifications of Diesel Fuel for Motor Vehicles

	China III	China IV	China V
National Fuel Standard	GB 19147-2009	GB 19147-2013	
Municipal/Regional Fuel Standards	GB 19147-2009	DB11/239-2007 (Beijing) DB31/428-2009 (Shanghai) DB44/695-2009 (Guangdong)	DB11/239-2012 (Beijing)
Sulfur content, mg/kg	≤ 350 (GB 17691-2005)	≤ 50 (GWKB 1.2-2011)	≤ 10 (GWKB 1.2-2011)
Cetane number, min-max	50-53 (GB 17691-2005) 45-49 (GB 19147-2009)	47-51	
Polyaromatic hydrocarbons, % (m/m)	3-11 (GB 17691-2005) ≤ 11 (GWKB 1.2-2011)	≤ 11 (DB11/239-2007) (GWKB 1.2-2011)	≤ 11 (GWKB 1.2-2011)
Availability	2013.07 (nationwide)	2015.01 (nationwide) Beijing: 2008 Shanghai: 2009 Shenzen: 2009 Guangzhou: 2009	2018.01 (nationwide) Beijing: 2012.06

Table 2. Outdoor Sound Pressure (dB)

Conditions		Octave Band Center Frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
Night-time	Rural, no nearby traffic of concern	42	37	32	27	22	18	14	12
	Suburban, no nearby traffic of concern	47	42	37	32	27	23	19	17
	Urban, no nearby traffic of concern	52	47	42	37	32	28	24	22
	Business or commercial area	57	52	47	42	37	33	29	27
Daytime	Business or commercial area	62	57	52	47	42	38	34	32
	Industrial or manufacturing area	67	62	57	52	47	43	39	37
	Within 300 ft (91 m) of continuous heavy traffic	72	67	62	57	52	48	44	42