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ENERGY-ENVIRONMENT ISSUE IN TRANSPORT OF VIETNAM

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Abstract

EURO 2 regulation was applied in Vietnam since the 1st July 2007. Although it is an easy regulation but it raises a lot of problems in quality of fuel and engine technology. Under pressure of environment protection laws, emission regulation in our country should be certainly more and more strict. Simultaneous improvement of fuel quality and engine technology satisfying emission regulation needs more investment for vehicles and fuel. The decision depends on economic growth of the country.

Basing on analysis of development of future vehicles and perspective of energy resources, the present paper suggests different possibilities for energy-environment issue in transport of Vietnam. According to the analysis, urban common transport should use electricity and gas fuels (LPG, NGV; retrofit instruments are needed to convert taxis, cars and motorcycles from petroleum to gas fuels. In near future, small size hybrid individual cars are suitable for Vietnam conditions.

The paper presents also some primary results in studying a two-place hybrid car running on electricity and LPG.

Keywords: LPG, Hybrid car, Motorcycle, Pollution, Emission Regulation

1. Introduction

The development of vehicles at different regions in the world is not the same but has common trend. The annual increase rate of automobile is so high, especially in SEA, ex. Korea is 20%, Malaysia is 70%... Contrary to the increase of automobile, and it is the decrease of motorbike. Economic specialists think that the automobile potential market will be shifted from East European and Latin American countries to SEA, Middle Asia countries and then African countries.

Following the forecast, quantity of Asia-Pacific automobiles is going to increase from 0.7 vehicles per 1000 people in 1985 to 10 vehicles per 1000 people in 2020 and then to 20 vehicles per 1000 people in 2060. This quantity depends on incomes. Automobile market is normally developed when GDP is greater than $2,000 USD (Figure 1).

The increase of automobile density causes 3 big problems. These are overload of transportation infrastructure, higher pollution and strategy of energy consume. The transportation and automobile industry in all countries are developed in such a way to reduce the effect of mentioned issues to economy and society.

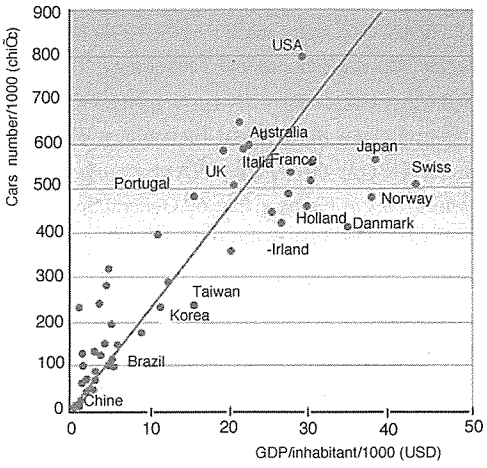


Figure 1. Automobile quantity versus GDP

The answer of the first problem is to project urban area, to upgrade transportation system, to expand roads, to design suitable road junctions, to build parks... and to develop proper public transport system. Figure 2 describes road-bed appropriation in urban traffic development. More automobile and less motorbike cause higher road-bed appropriation which brings out

the first problem. This problem becomes serious if public transport is not planned during urbanization.

To reduce pollution, automobile manufacturers continuously do researches to improve their products to adapt standards of pollution emission which are more and more seriously considered. Developed countries currently apply EURO 4 standard of pollution emission and be directed toward EURO 5 standard which is tighter. Vietnam has not stipulated any specific standards. From 1st July 2007, we started applying EURO 2 (figure 3). Although this standard is so low, but this start can set up several issues about fuel and engine technology. In consumption, if all automobiles in our country comply with this standard then level of pollution emission is still very high compared to developed countries. Hence, solutions in possible "clean" automobiles without modern engines equipped are considered to reduce a little bit pollution.

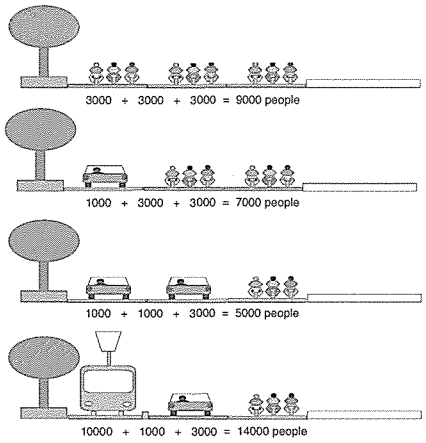


Figure 2. Road-bed appropriation in urban traffic development

Concerning about energy, present transportation mostly depends on gas and petrol. This resource becomes more and more exhausted. In history, energy crisis in 1973 showed the risk of a gas and petrol based economy. The recent increase of crude petrol reminded that the risk is on the watch if a versatile energy strategy is not well prepared and built.

According to UK petrol statistics magazine, crude petrol in earth's womb is able to be mined in 42 years, NGV 62 years and fossil coal 228 years. Crude petrol reserves mined per year are different at different places in the world (figure 4).

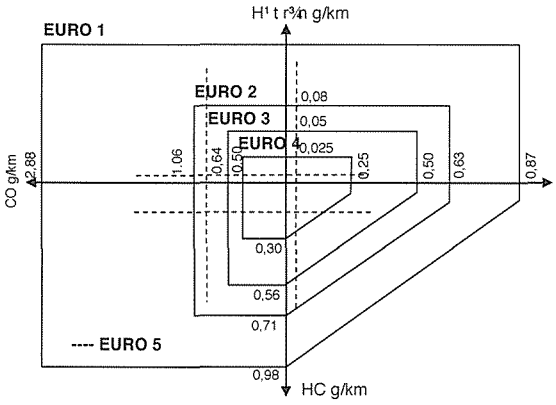


Figure 3. Standard of pollution emission

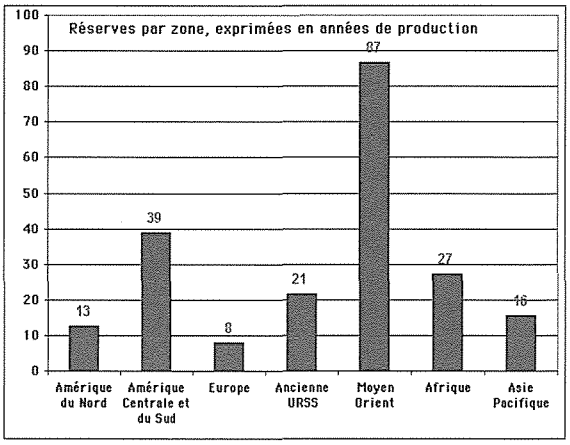


Figure 4. Crude petrol reserves (Source: UK Petrol Statistics Magazine)

2. Public transport, a case study in Danang

Public transportation at most cities in Vietnam is not properly concerned. Common vehicles in cities are motorbikes. There are 16 million motorbikes in circulation and increasing rate bigger than expected. Public transportation fallen into oblivion produces serious problems during social economic development such as, traffic jam, accident, pollution, energy... Hanoi and Ho Chi Minh cities have overcome by combining buses and underground trains.

In order to reduce investment in future, public transportation is needed to be seriously considered during urban planning and reorganizing, especially for Danang at this time.

Known as one of the fasted cities of urbanization, Danang is forming urban satellite centers towards west-north and east-south (figure 5). These urban centers are needed to be connected by public transport system which is not really interested in by urban planners so far.

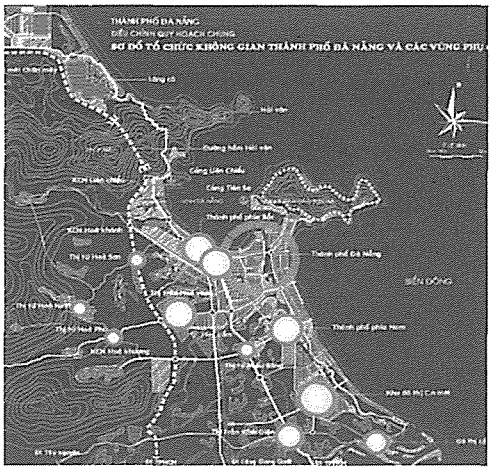


Figure 5. Danang Planning till 2020

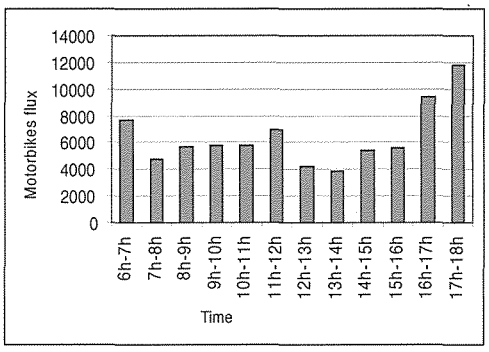


Figure 6. Density of motorbikes on Ton Duc Thang Street

A survey about traffic flow in Ton Duc Thang Street which connects the city center to industrial zones and to universities gave a density of approximate 12,000 motorbikes per point per rush hour (figure 6). Level of pollution and accidents on this street has increased alarmingly. Therefore, research of forming public transport system for Danang is very necessary.

Selection of vehicles for public transport is a problem of optimized synthesis in there combining tramway for heavy transport (see main route in figure 7) and clear buses (using LPG or NGV) for carrying customers from tramway stations to other bus stops is a great choice for Danang [3], [4].

As described, modern tramway is not a train; it is defined as car running on light railway obeyed the law for car. So crossroads between tramway rails and roads will not obstruct traffic compared to train system.

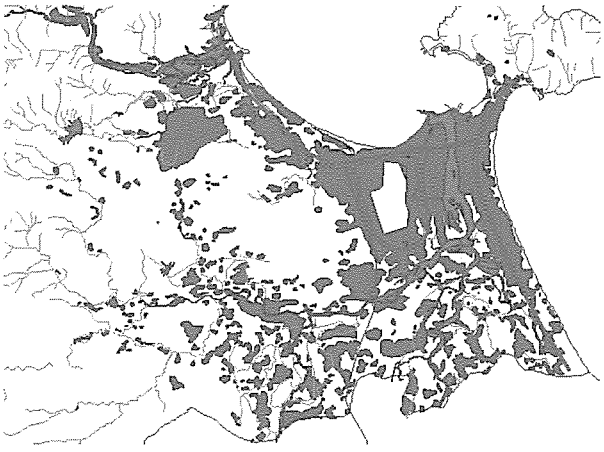
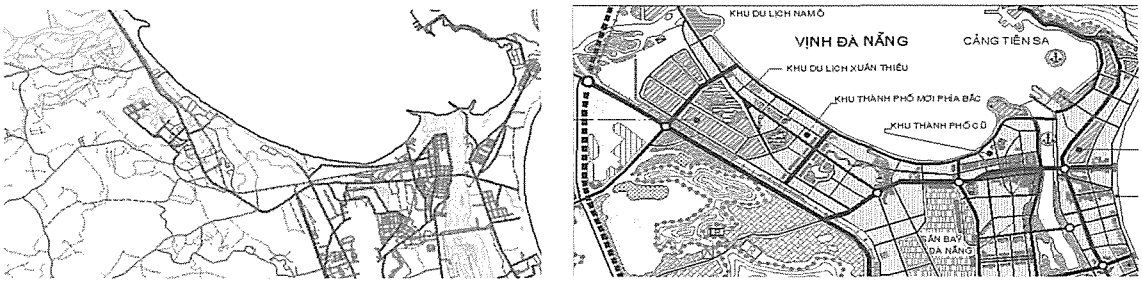


Figure 7. Principal lignes of common transport in Danang

Project of building tramway has to be long-term planned and focused on prior areas needed to be quickly urbanized. Based on orientation of economic and social development of Danang till 2020, north tramway route should be a priority. As planned, Danang - Lien Chieu railway is going to be removed in 2008 (figure 8), then this railway is reasonably suggested to be transformed into



a. Now b. Planning till 2020

Figure 8. Development of Danang City toward North and Northwest

tramway route. To keep investigation saving, in the 1st stage, above railway should be kept as origin, just building tram stations and crossroads. When residents get familiar with tramway and the demand higher, this route will be upgraded to modern 2-way route. Using available railway as tramway route is to avoid housing clearance and compensation as much as possible, to expand urbanization at tramway stations and to serve transport demand between city center and potential north. This tramway route actively fosters local economic and social development.

Railway salvage has been applied in developed countries, especially best experiences from Germany. Trams are manufactured to adapt existing railway width but tram's functionality is still remained. Hence, 1 meter width of Vietnam railway (compared to 1.435 meter width of modern railway) is not a matter. Besides, equal widths of railway and tramway route may allow both train and tram using the same infrastructure; tramway may use railway to go farer and train may use tramway route to transport cargo into the city.

Based on experiences of the first tramway route, other heavy tramway routes of East and airport belt will be developed. Danang public transport is later solved to match the height of such a top category city and also a bridgehead city of SEA East West Lobby.

3. "Clean" individual vehicles suitable for Vietnam conditions

Clean vehicle with zero emission is the goal of automobile researchers and manufacturers nowadays. There are many initiatives published in recent years, focused on improving combustion process of diesel engines, using non-traditional fuels for cars like LPG, NGV, methanol, ethanol, biodiesel, electricity, fuel cells, solar energy and hybrid cars. The trend of clean car development is described in figure 9. In point of this view, the cars using NGV are ideal for environment protection. The hybrid cars using both electrical and thermal power are present practical solution in proximity to clean cars.

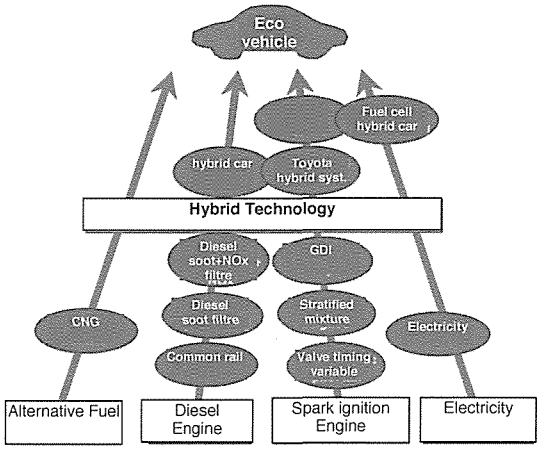


Figure 9. The trend of clean car development

As above described, main individual vehicles in Vietnam today is motorcycles with more than 16 millions in quantity. Almost all motorcycles are driven by traditional engines using carburetors, so the pollution level is very high. If one car has a cylinder volume equal to that of 16 motorcycles then there are a million of cars using obsolete engines (with carburetors). If an old type car emits pollution equal to 10 new type cars, then pollution level from motorcycles in Vietnam is equal to a country with 10 millions cars of new generation (income 7000USD/person/year).
To minimize the pollution from motorcycles, previous projects gave the solution of using LPG instead of gasoline with LPG/gasoline converter GA5. This solution is very practical; it reduces 80% pollution amount emitted compared to gasoline engine.

According to the estimation of automobile specialists, the automobile potential in our country is very high, especially the average and low cost cars which are affordable for the majority of Vietnamese people. At present, when the transportation infrastructure in our country has not been developed, the houses in the city are small, parking areas have not been built adequately; the individual cars of large size would bring a lot of difficulties to the transportation system as well as the car users. As a result, the determination of a car design which is suitable for the infrastructure and meets the standards of pollution emission in our country is very necessary. Firstly, individual car using in our country must be a common means of transport that can replace the motorcycle. Therefore, it must be small and light with the same speed and working distance as motorcycle but safer and more comfortable, especially in protecting the user from the rain, sunshine and dust. The price of this car should be cheap so that the majority of people can afford to purchase. In those conditions, the small size two-seat cars are the most appropriate for our country.

From above mentioned analysis, we can come to the conclusion that the future developmental trend of automobiles is toward the clean cars, in which hybrid cars combining the power of the gasoline engine with the electric motor are upper hand nowadays. To prepare for this trend, type of the electric-thermal hybrid should be selected for power train system for Vietnamese cars, in which the electric motor is run by batteries and the thermal engine is run by LPG or NGV.

Using the above mentioned power train system for personal cars in our country will bring benefits in several fields. In fact, the majority of electric energy in our country is produced by the hydroelectricity (regenerative energy) without the polluted exhausted fumes. NGV and LPG are the products of petrol distillation process. The petrol in our country is not too much but natural gas could be supplied rather plentifully. At present, we have exploited the natural gas mines at the south for producing electricity and fertilizer. We have Dinh Co Gas Production Plant and the Oil Refinery No 1 in Dung Quat is going into operation in next years. So our capability to self supply gas fuel will be great.

4. First step result of research on two-seat hybrid car in Vietnam.

The research group "clean vehicles" of University of Danang has researched and produced power train system for two-seat hybrid car, supplied energy from 2 sources: the electric motor run by batteries and the thermal engine run by LPG. The system scheme is described in figure 10.

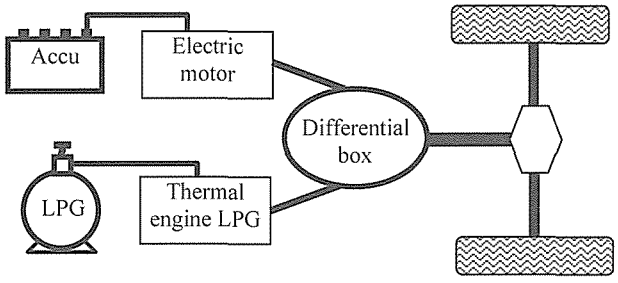


Figure 10. Two-seat electric-LPG hybrid car power train system scheme

On the scheme, the electric motor of power 3KW is supplied from battery source 48V. Thermal engine with cylinder volume 125cm^3 has origin from a motorcycle, transferred to the one run by LPG thanks to fuel converting auxiliary GA7. Two above mentioned power sources are able to drive the car active gear separately or simultaneously. Maximum speed of the car is 35km/h when running only by electric motor, 45km/h when running only by LPG thermal engine and 65km/h when running by both power sources. Figure 11 introduces the image of the hybrid car power train system after installing. Figure 12 shows the image of the car on testing.

The specifications of above mentioned car are suitable for running condition in city. Pollution emission level is almost ideal: it emits no pollution at all when running by electric motor and by LPG thermal engine, the pollution emission is only about 20% of the pollution emission from a motorcycle.

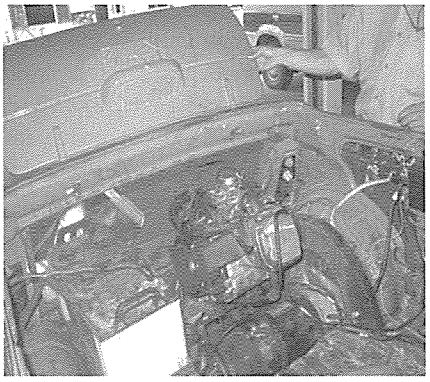


Figure 11. Install power train system for hybrid two-seats car

Figure 12. Hybrid two-seats car testing

5. Conclusion

- Pollution emission standard of Vietnam at present is very low compared to developed countries. By the traditional way (engine innovation, increasing fuel quality), Vietnam hardly compares with developed countries in limiting environment pollution.
- The most executable solution is early using "clean" fuel, mainly gas fuel (NGV, LPG) on hybrid cars, hybrid motorcycles and fast developing of public transport system with vehicles which is able to carry great amount, running by electricity and natural gas.
- Using natural gas also has important sense in national energy strategy while the petrol source of our country is going to be gone and the natural gas supply is still plentifully.

Acknowledgement

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