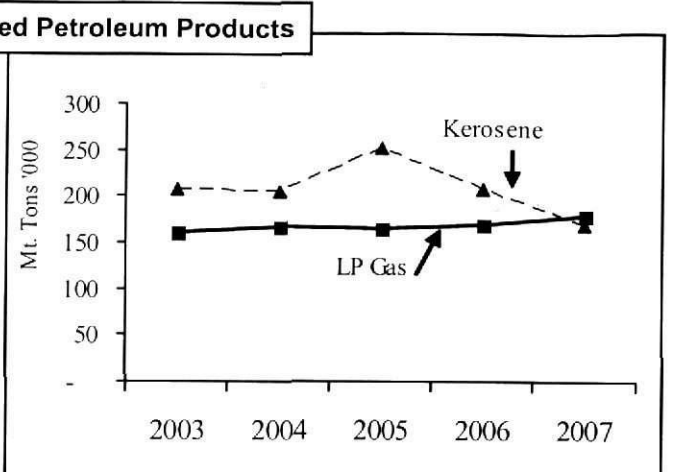
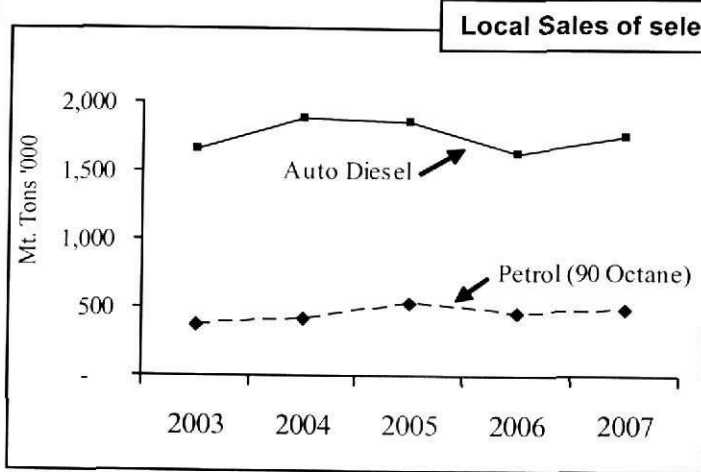
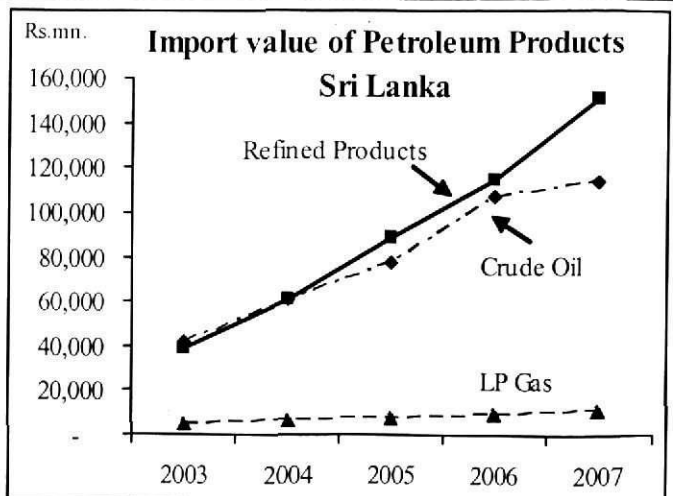
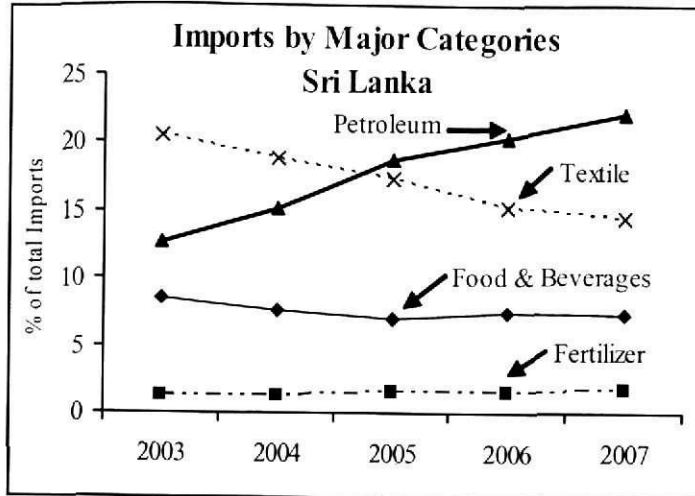


Energy Situation: Sri Lanka & Global



Source: Central Bank of Sri Lanka

Global Situation

Available renewable energy (TW)	
Solar	86,000
Hydro	7.2
Geothermal	32
Wind	870
Global Energy Consumption	15

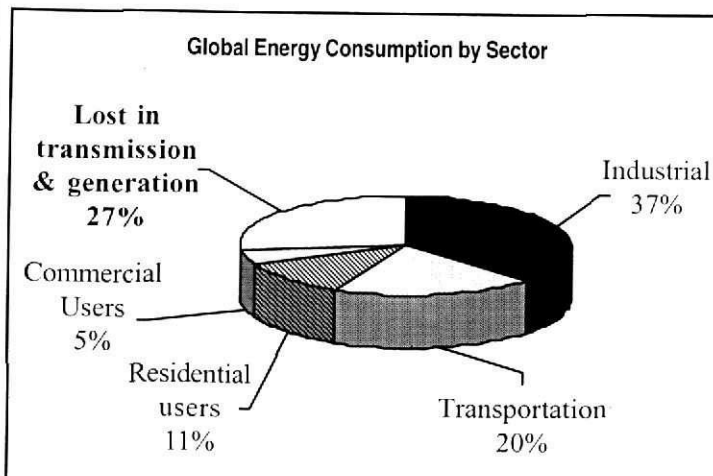
TW = Terawatt is equal to one trillion (10¹²) watts

Global Consumption of Energy - 2004 (TW)	
Oil	5.6
Gas	3.5
Coal	3.8
Hydro Electric	0.9
Nuclear	0.9
Geothermal, Wind, Solar, Wood	0.13
Total	15

Remaining Oil - 2005 (ZJ)	
Unrecoverable Oil	22
Future Additions	11
Proven Reserves	08
Oil Shales	11
Heavy Oil	03
Tar Sands	02
Total	57

ZJ = Zetta Joules (10²¹)

Source: http://en.wikipedia.org/wiki/world_energy



Per Capita Energy Consumption in different Ages

Age	Per capita Daily Energy Consumption ('000 KCal)				
	Food preparation	Agriculture	Industry	Transport	Total
Ancient Man (1 million years ago)	2				2
Hunter-Gatherer (100,000 years ago)	3	2			2
Primitive agricultural man (5000)	4	4	4		12
Developed agricultural man (1400)	6	12	7	1	12
Industrial man (from 1875)	7	32	24	14	12
Technological man (from 1970)	10	12	12	12	12

Source: Asoka Gunawardana : A World without oil or coal

Situation of Sri Lanka in Global Power and Energy Crisis

The energy resources of the world are fast depleting." News items such as these have frequently been appeared in the media from time to time since the 1970s. Fuel prices are continuously escalating in the world market. But the price of a barrel of petroleum has come down from US \$ 147 to 47 or more at the time of writing this paper. The recent decline in the prices of fuel by 50% or more shows that the relative prices of fuel are decided by different factors other than those of the fuel/energy sector.

Energy is interwoven in various ways with the lifestyles of people. Transport, electricity, heat, industrial and domestic energy are among them. Out of these, what affect us most is transport and electricity. However, the heat energy and the energy used for industries are at the forefront overtaking others.

Energy and Lifestyle

Our human body too produces energy. It is equal to a 100-watt bulb. However, every man in the society, ever since reaching civilised status, got accustomed to acquire or use extra energy. Thus, with the discovery of fuel and gas, the past and present generations have been using the energy that should have been used by future generations. After the Watt's discovery of the steam engine in 1769, people were inclined to use energy in a very large scale. As a result, a rapid transition took place from wood to charcoal, and thereafter to fuel. Since fuel was easily transportable and usable, it overtook the use of charcoal.

Lifestyle of the people in the world is inextricably intertwined with the energy. For instance, labour contribution in industrial activities in the US at the end of the 19th century was 94%. Today, it is only 8%. Thus, the man has got more relax time because of energy sources (Lomberg, 2005).

Do We have Enough Energy to Go on?

Oil, charcoal and gas, which are mostly used as sources of power and energy, were formed underground from plant and animal remains millions of years ago. These are known as fossil-fuel. Moreover, out of these fuels, thousands of other chemicals too are produced. The present lifestyle depends mainly on fossil fuel, that is, charcoal, gas and petroleum. But the current usage pattern has lasted less than 200 years. Therefore, these fuels have to be used economically.

One argument put forward is that the future generation will discover new sources of power and energy for themselves. It was about 30- 40 years ago that forecasts were made saying that world oil resources were going to be over soon. Yet, new oil resources are still being discovered, and there does not seem to be any rapid depletion in such resources. One argument is the people of the world came to the Iron Age from the Stone Age not because "the stones were over". That was because the iron was easily usable. Hence, the change in the sources of power and energy which are currently dependent on oil in the world takes place not because of the depletion of oil. However, it would change with the discovery of more profitable alternative sources of power and energy. This could be looked at in another way. The prices of oil in the world have still not gone up to an unbearable level. It is still a cheap source of energy. When oil prices are excessively expensive, the man will tend to utilise alternative sources of energy in a practical way. In short, it is an acceptable fact that man will turn to another cheap source of energy due to its high cost before the oil resources are over. Therefore, what is required is making provision for the necessary capital and technology for the future generation.

Moreover, efficiency in extracting oil from the earth is continuously enhanced. There is still 63% oil left in the 10 biggest oil wells in the US, which were abandoned after extracting oil. Present technology has been improved to obtain 50% more oil from the oil wells which are currently under extraction (Craig et al, 1996).

Attention has still not turned on tar and shale oil for the production of petroleum. Unfortunately, tar is thick, and therefore, it is costly to produce petroleum out of tar. It costed US \$ 28 to produce a barrel of petroleum in Canada in 1978, and it came down to US \$ 11 in the year 2000. Thus, the production of petroleum out of tar too will improve in the coming years. It is the opinion of the scientists that 550 billion barrels of petroleum could be produced out of tar, costing of US \$ 30 a barrel. This will help increase the amount of present oil reserves by 50%. (Energy Information Agency under US Department of Energy World Resources, 1997).

Shale oil means a fossil fuel resource which is a type of grey soft rock, usually formed from hardened clay and found in miry and marshlands in countries like Canada. According to global estimates, it is acknowledged that shale oil is

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Coconut Cultivation Board.*

available 248 times more than the conventional petroleum resources that exist today (Simon et al, 1994). Shale oil contains 8 times more energy than the petroleum (such as diesel & petrol). Shale oil deposits are available in the earth for another 5000 years going by the quantum of energy currently being used.

All these point out the fact that a shortage or crisis of power and energy will not occur in the world in the near future. According to the world energy statistics, people have to turn to other fossil fuels (tar and shale oil) before the depletion of petroleum. Because of this, we have shown that expenditure on petroleum out of our daily expenditure would come down in the future. Therefore, what is needed is establishing improved management strategies and creating a correct thinking on power and energy.

How Much Petroleum Resources Have Left in the World?

In 1914, the US Bureau of Mines announced that petroleum would be over by 1924. Similarly, in the year 1939, a forecast was issued to the US Department of Interior that in another 13 years time, petroleum would be finished. Again, in the year 1951, it was estimated that in the next 13 years, the petroleum would be depleted.

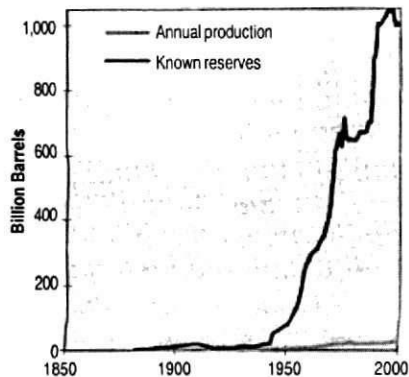
Professor Frank Notestine recently commented "We have been running out of oil ever since I have been a boy, it has still not happened."

In fact, petroleum prices and its productions are connected with the political problems of the world. Global political causes and connected matters take precedence over the discovery of petroleum and the smooth production. America has indirectly invaded Iraq. It is now fishing for causes to poke its fingers into Iran. In Nigeria, the oil production is affected by its political disputes. Similarly, sabotage and disruption to the Venezuelan socialist government's existence has contributed to the oil crisis in Central America. According to present estimates, 50% - 65% of the oil deposits are located within the Middle-East countries (*Annual Energy Review*, 1996). Hence, the prevalence of peace in

these countries is a decisive factor for the oil prices and its production in the coming century.

The Figure 1 shows the amount of oil discovered in the world and the annual production. Accordingly, there is no physical reason for any shortage of oil in the near future, that is in the next few decades. The possible causes are the changes in the global political and economic scenarios.

Figure 1
The world's known oil reserves and world oil production 1920-2000



(Source : Simon et al, 1994.)

How prices of oil, gas or charcoal should be decided? is a matter that needs to be investigated.

As at present, prices of petroleum are decided according to decisions of the Oil Producing and Exporting Countries (OPEC), demand and supply situations, taxes imposed by respective countries, and changes in the global economic situations (as now) or activities of the international banks. Although it practically happens in this way, the price should be decided on two factors, i.e., cost of production and the profit margin. Unfortunately, the prices of petroleum or products of related energy sources are decided not on the above two factors but on entirely different causes. Therefore, a voice against an energy crisis is a delusion.

When future prices are considered, Charcoal prices would relatively be low due to heaviness in weight and environmental pollution. Due to petroleum possessing extra energy and its relative compactness, petroleum prices would prevail high. Gas is clean; but its transportation is difficult. However, since it can be exported from one country to another through pipe lines, the prices of gas may be decided above that of charcoal.

How Did the Global Energy Crisis Develop?

Actually, it is a fact that political and economic factors have contributed to this. "Wastage" caused by inefficient use of energy by man is instrumental

to this situation. It has been pointed out that 43% of the energy used in America goes waste. Further, it has been pointed by the US Department of Energy that 50% -94% of the energy used in the households can be saved. Similarly, in keeping with new technology, it has been possible to manufacture safe cars that can run 50km- 100km per litre of petrol (Miller, 1998). In fact, the reason for the non-spread of the improved technology in the world is that it does not pay the current low energy prices and level of technology.

On the other hand, there is a good tendency. When things are observed globally, it looks that many nations are using energy more efficiently. Thus, the quantum of energy used for the current level of production of goods in the United States of America is equal to the quantum of energy used in the year 1800. But the quantity of goods produced then is thousand times less than that of today. In the UK, the quantum of energy being used for the today's level of production is equivalent to that in the year 1880. In Japan, it is equal to the level of energy used in the year 1973. The fuel efficiency of the motor vehicles now used in the US has been increased by 60% more than that prevailed in the year 1973 (Schipper, et al. 1996). Presently, heating of houses in America and Europe has become 24%-45% more efficient than in the year 1973. Saving of energy in the domestically- used washing machines has increased by about 50%.

Wood was used in large scale in the past to heat houses in the cold countries. Since it was expensive and forests got destroyed, charcoal was subsequently used. Later, gas took its place because of its convenience. In fact, atomic, wind, solar or biogas energy could be used as alternative sources for this.

In these circumstances, there is no power and energy crisis globally now. What is more significant is efficient use of energy generated out of fossil-fuel and further improvement of the connected technology. On the other hand, energy requirements will be balanced with the development and use of alternative sources of power and energy.

Is the World Ready to Depend on Fossil Fuel Further?

As described earlier, fossil fuel will exist for some more decades or centuries. The challenges are maintaining the production and price levels and the improvement of the technology.

However, all countries are in agreement with the development of "Alternative energy" sources as an alternative to fossil fuel. Because of this reason, it has been decided that by the year 2016, 20% of

the total energy requirements of the US should come from alternative energy sources. As a result, there was an inclination to use soya oil, corn oil, and palm oil as bio-fuel extensively all over the world. For this reason, a phobia about a food shortage was spread wide across the world. In the light of this, Food and Agriculture Organisation pointed out that the lands being utilised for food crops should not be converted to energy crops. This position was declared in Sri Lanka too.

To my mind, there is no truth in this. The reason is that food and energy can not be separated from each other because when the price of one increases the price of other too increases. It has become very necessary to integrate the world agricultural community with food and energy. For instance, when dairy cows are reared, milk production increases. At the same time, production of bio-gas can be increased using the cattle manure. When palm oil is used for "bio diesel", a more competitive market emerges for coconut oil.

This type of narrow decisions will not contribute to develop global technology. For instance, there are number of methods to produce fuel air (gas) in place of Liquefied Petroleum gas. One way is "Bio gas". It is not difficult to pack this into cylinders. This method helps a house wife in preparation of her dinner. For example, a house wife, who sets off early morning for work, can put her kilogram of rice or manioc together with a suitable micro-organism in a cylinder prior to leaving home. Again, when she comes back home in the evening, she could cook her dinner with the gas obtained from the cylinder containing the rice or manioc. No hurdle should be placed for producing and using such technology.

Power and Energy Management in Sri Lanka

Before the introduction of the fossil fuel, our country was self sufficient in power and energy. Our main energy was the wood and parts of plants. With the advent of fossil fuel (petrol, diesel and charcoal), the country became dependent on energy sources coming daily from foreign countries. Though we got the independence winning the democratic freedom, the country is dependent on foreign energy sources. We have still not discovered petroleum. Like us, many countries in the world do not have petroleum. However, these countries have managed the power and energy problem better than us. In Marshal Islands which are very small in size, coconut oil is being used in large scale for running vehicles. In the neighbouring India too, energy sources such as wood, chaff, wind are utilised for the biggest industry to the smallest rural industry in a well-planned manner. It was as late as in 2006 that

"Sustainable Energy Authority" too was established to develop our country's inherent energy sources.

Out of the total energy now being used, 47% is obtained from petroleum, 05% is derived from hydro. Still, 48% of the total energy is generated basically from firewood (Report of Sustainable Energy Authority, 2008). Therefore, it should be stated that we are still in a favourable position. Main hydro-power projects have been properly implemented. Within the last two years, a number of small hydropower projects have become operational with the co-operation of the private parties. The output of these amounts to around 140MW. Since furnace oil price has gone up, some industries have been quick to change over to firewood or other alternative sources of energy. For example, tea factories have again increased the use of firewood for drying tea leaves. Desiccated coconut factory owners have been inclined to operate the boiler which was earlier used out of furnace oil, with coconut shells, a bio fuel. Paddy boiling is mostly done by chaff. Pelwatte Sugar Company produces 20MW electricity out of sugarcane refuses. Some more improvements at research level are taking place.

Our Challenges

In the light of global energy crisis, it does not seem that we are on the right track. As such, the Ceylon Electricity Board incurs a daily loss of Rs.45 million. That loss has been passed on to Ceylon Petroleum Corporation. At first sight, these two are highly inefficient institutions in the country. The fundamental cause for this is the monopoly.

Domestic Electricity Supply

Ceylon Electricity Board (CEB) holds the monopoly of supplying electricity in the country. Although other institutions are capable of producing electricity, the private sector can hardly come forward because of the monopoly in the transmission and distribution of electricity of the CEB. Generation of electricity in the decade of 1980 was almost entirely out of hydro power; but 47% of electricity is now produced out of diesel. Here, big bungling has taken place due to politically-motivated decisions. During one era, 5-6 hours power cut was implemented. Thereafter, on a political promise, power cut was withdrawn in 6 months time. However, that too was done in such way that the electricity consumers seeing stars on receipt of their electricity bills. Making use of the opportunity, some private businessmen who even *did not know the meaning of the word.* "Auto Diesel" started several power plants with the support of the

government across the country to generate electricity using diesel. The volume of diesel burnt at one such power plant per day exceeds one hundred thousand litres. That too was done transporting a long distance from Colombo. The bulk of the money collected from the innocent electricity consumers went into the purse of these private electricity suppliers. The only investment made by them is the investment on diesel engines. All other expenses are borne by the country's economy. Fuel adjustment charges are recorded in the monthly bill of the electricity consumers. At least, had they used furnace oil instead of diesel, it would have been more economical.

This inefficient state of affairs has been recently challenged by an order of the Supreme Court. An order had been delivered providing relief to electricity consumers. But CEB will not incur losses from that. That burden will be placed on the industrial sector, thus making the possibility that Sri Lanka the only country in the world charging the highest rates from the industrial sector, and such a situation cannot be ruled out. Due to this, we will be unable to export our products competitively.

Until recently, all avenues to improve alternative energy sources were prevented by the dictatorial policies of the CEB. For instance, a payment of Rs 18/- is made for a unit of electricity produced and supplied out of diesel. When it comes to firewood (dendro) the payment is only Rs. 13.57 per unit. It is Rs.10/= for a unit generated out of hydro (Sustainable Energy Authority, 2008). Hence, encouragement is created towards producing electricity out of imported diesel, and not out of domestic resources. Although there are number comments to be made in respect of the domestic electricity supply, one point needs to be highlighted here. Electricity usage in the morning/dawn of the day is minimal. The charge per unit during this time is Rs 8/-. Since diesel power plants are operational during the day time, price per unit is around Rs. 16/- . From 7.00pm to 10.00pm, when gas turbines are operated, 1,700 MW of electricity, the required maximum power at present for such lime of a day is obtained. Therefore, the cost of a unit of electricity in a day varies according to the time of the day. Hence, what the electricity consumers should do is to use electricity in the dawn or morning of the day for non-essential purposes, when the cost per unit prevails at minimum (e.g. for water pumping, ironing, welding). By this, country's expenditure on electricity could be reduced. On the other hand, those electricity consumers who can afford could contribute to the national electricity grid by producing

electricity through solar energy during the day time, and after using electricity from the national distribution system for domestic purposes in the night, payment is made for the difference (Net metering). This contributes to betterment of the country's economy.

National Transport System

National transport system appears to be completely disorganised Public conveyance system has to be developed. By improving the public highways, the petrol and diesel wastage can be reduced to a great extent. The measures that are already been taken to modernise the public transport system like buses and trains have to be appreciated. However, plenty are the things to be done. Introduction of electric trains, further development of railway lines, increase in the speed limits of trains, and improvement to the system of goods transport by trains are some among them. Also needed to be done soon are the development of public car parks, which have been already proposed to reduce traffic congestions in main cities, and the development of public transport system within main cities (like underground rails).

Future Power and Energy Development

If planned properly, problems related to power and energy in Sri Lanka can be easily managed. For this purpose, the following are important:

- Preservation of energy and use of efficient of equipment.
- Development of alternative sources of energy.

Sustainable Energy Authority is already engaged in appreciable activities for preservation of energy. Sensitising individuals/Organisations/Industries, preparation and supply of plans for preservation of energy, and introduction of efficient equipment are currently being done.

I think we should discuss more on development of alternative sources of energy. They are the production of alcohol, use of bio-gas, generation of heat/electricity from firewood, and utilisation of solar wind power in the rural areas.

If we can develop sugarcane cultivation in 60,000 hectares of land as proposed to the Government by the National Science Foundation (NSF) recently, 300,000 metric tons of sugar (50% of our annual requirement) can be produced annually.

Contd. on page 08

The volume of Alcohol (Ethanol) derived as a by-product from the sugar production is 40 million litres. The annual production of ethanol for liquor consumption is 13 million litres (NSF, 2008). If the balance ethanol of 27 million litres could be added to petrol, it would constitute 2.7% of the total annual requirement of petrol (Gasoline). Similarly, the amount of electricity that can be generated from sugarcane refuse will exceed 100 MW.

As a matter of fact, the Excise Act has affected the advancement of energy sources adversely. This Act has prevented the production of alcohol as a rural energy source. We are against the consumption of liquor. But it must be used as an alternative source of energy. For instance, the day is not far away, when an individual would run his motor bike with the alcohol produced from the toddy tapped from his own few coconut palms. The day has been made distant due to state interventions. In fact, what has resulted from the Excise Act is only the collection of revenue by the Government and the few approved businessmen becoming multi-millionaires. With the advancement of the cellulose digestive technology, the legal impediments to the domestic manufacture of alcohol will have to be removed. Then, one need not turn to the fuel itself to obtain petrol.

Bio-gas is a key energy source that should be developed in this country. By improving dairy farming, bio-gas can be produced easily in rural areas. Now the technology has been developed to obtain electricity by operating electric generators using bio-gas. For example, bio gas of 5 cubic

metres can be obtained in a day from 6 dairy cows, and thereby a generator with a horse power of 0.75 can be operated for 3 hours a day. The proportionate electricity generation is 2 units a day. Thus, around 700 units of electricity are generated in a year. This is sufficient for a rural family.

On the other hand, when gliricedia is cultivated in a coconut land of 2.5 acres, 10 metric tons of firewood with 20% moisture can be obtained, and using this, a gassifier of 3.5 kW can be operated for 1600 hours. The amount of units of electricity that could be obtained is 5000 per year which is equivalent to 8,000 litres of diesel. What this shows is that import of petroleum to the country can be substantially reduced.

We should not become a nation wasting power and energy. Therefore, the people should be made aware of the effective use of power and energy. Sensitising programme should commence from the school education.

Conclusion

In conclusion, what needs to be mentioned is that it is an acceptable fact that there exists a crisis of power and energy globally. It is not due to a shortage of power and energy, but because of other interwoven global political and economic matters. Therefore, it is foolish to form a phobia of a shortage of power and energy. The reason being that we have to only make use of the sun light of 22,000 square kilometres (with 15% efficiency) which touches a solar power plate, in order to meet total global power and energy. The present power and energy sources suffice for a number of years. At

the same time, there are energy sources, some of which need to be utilised while others are yet to be scientifically discovered. However, it is a crime to waste power and energy while economising the use of it should be a human quality.

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