TECHNOLOGY FACTSHEET
COMPACT BIOGAS DIGESTER FOR URBAN HOUSEHOLDS[1]

1. **Sector:** Energy

2. **Introduction:**

The conventional biogas digesters occupy too large to be accommodated in an urban household. More over the amount of conventional feed materials such as cow dung or perished vegetable materials are difficult to find in an urban area. An urban housewife would not like to handle such materials in such large volumes to generate biogas for cooking. On the other hand use of a solid fuel such as fuelwood is very cumbersome for an urban household. Even the best solid fuel stove developed by the NERD Centre is not elegant enough to satisfy a modern urban housewife. The lighting up and controlling the heat outputs of such stoves are very tedious. For these reasons LPG is the most preferred fuel for household cooking, despite the very high cost of LPG.

To resolve these issues, Appropriate Rural Technology Institute of Pune, Maharashtra, India (www.arti-india.org) has developed a "Compact Bio Gas Digestor".

3. **Technology Name:** Compact biogas Digester for Urban Household

4 **Technology Characteristics:** (Feasibility of technology and operational necessities*)*

The volume of this digester is 1.5 m3. It essentially consists of two plastic tanks. The larger tank acts as the digester vessel, while the smaller tank acts as the gas holder. The smaller tank is inserted into the larger tank with the mouth downwards. See Figure 1. Capital cost including all materials and labour and a gas burner is US$ 500 (LKR 57,000). 2 kg of starchy material is needed as the feed stock to produce 500 g of methane required to cook a day's meals for a family. If proper feed materials are used, the retention time in the digester is expected to be 72 hours.

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[1] **This fact sheet has been extracted from TNA Report – Mitigation for Sri Lanka. You can access the complete report from the TNA project website** http://tech-action.org/

Figure 1– ARTI Biogas Reactor

As starchy materials are difficult to or too expensive to obtain, the University of Moratuwa conducted trials on various materials to determine the output of biogas generation. This research study revealed that leaves of Gliricidia is the most effective material to be used as the feed material for biogas production. (Ref: 3). In this project it is proposed to demonstrate the feasibility of using Gliricidia leaves as the primary feed material along with food wastes generated in households in the ARTI type of digesters to generate adequate biogas for cooking purposes. It is also proposed to develop a suitable technology to process Gliricidia leaves and establish a supply chain to facilitate urban housewives to acces such materials at competitive prices. Figure 2 shows the use of biogas for cooking purposes in Sri Lanka.

Figure 2 - Use of Biogas for Cooking Sri Lanka

5. Country specific applicability:

Sri Lankan economy is growing at around 8% per annum. The annual percapita income is over 2000US$. This value is expected to reach double this value in the next 6 to 10 years. With such growth rate, the demand for LPG as a fuel for household cooking is increasing.LPG is an elegant fuel. It can be lit instantaneously. The heat output of an LPG stove could be varied from zero to full rated value with in a fraction of a second. Combustion of LPG does not produce any smoke. As LPG is free of sulphur, SOX emissions are nil. Hence every housewife who could afford the initial cost of switching from fuelwood to LPG and the operating cost of LPG has no hesitation in indulging in such changeover. The growth of LPG in the household and commercial sectors is remarkable. In fact not only the urban sector, households in the semi-urban sector too are gradually switching from fuelwood to LPG.

Even the most elegant solid fuel based cooking stoves would not satisfy the requirements of a contemporary housewife in Sri Lanka. On the other hand, LPG is either imported in its final form or is produced from imported petroleum fuels. The drain on foreign exchange resulting from this purchase is very severe. Hence there is an urgent need to develop an acceptable alternative to LPG.

Hence the challenge is many fold. Firstly, we need to develop a hardware which could be constructed in an urban household. Secondly, the device/ technology should be simple to operate by a non-technical housewife. Thirdly, there should an established supply chain to deliver or make it easily purchasable for any consumable item required to operate the proposed system. And lastly, it should be cheaper than LPG.

The proposed system meets all these requirements. ARTI of Pune, India has developed a simple reasonably priced hardware to produce biogas od adequate quantity for a household. University of Moratuwa (UOM) has identified a suitable material which could be used as the feed stock to generate the required amount of gas. UOM has found that Gliricidia leaves are an acceptable feed material for biogas production.

However, there is a need to organize the supply chain to provide regular supply of Gliricidia leaves to in a readily usable form to the households. This has not been done yet. R&D is needed to accomplish this task. Indications are that this could be achieved in the near future.

6. Status of the technology in the country and its future market potential:
Status of the technology has been already discussed in the previous section.

Market Potential:
The total number of households in the country is 4.5 millions. Of this amount 1.5 millionsare located within the urban and semi-urban areas. Unless an alternative is found, sooner or later, all these households will be using LPG for cooking meals in households. The expected consumption is over 200,000 tonnes of LPG per year. Hence the potential for the proposed technology is 1.5 million Compact Biogas Units and 10 million tones of Gliricidia leaves per annum. Although these are theoretically possible, it would be very difficult to meet this target, In the initial phase only 50,000 (out of 1.5 million) households are targeted.

7. **Barriers:** *After completion of barrier analysis and only for selected technologies.*

8. **Benefits:** (How the technology could contribute to socio-economic development and environmental protection)

The benefits of this technology are as follows.

Social Benefits

- Employment opportunities in the development of supply chain for feed materials.
- Employment opportunities in the construction of biogas digesters and production of biogas stoves.
- Employment opportunities in the collection and marketing of liquid fertilizers.

Economic Benefits

- Urban housewives will be able to reduce the cost of fuel used for cooking by switching from expensive LPG to cheap biomass feed materials.
- Savings in foreign exchange for the country from the reduction in consumption of LPG.
- Rural farming communities will be able to increase their income by processing and marketing Gliricidia leaves.
- Some of the middle income households would switch from fuelwood to biogas thus enjoying a smoke free and healthy home environment.
- Income from the production and use of liquid organic fertilizer.

Environmental Benefits

- A biogas unit introduced through this technology is capable of generating biogas which is equivalent to 0.5 kg of LPG per day. On a yearly basis this would replace182.5 kg of LPG with a calorific value of 46.1 MJ/kg. The emission factor for LPG is 63.1 tCO_2/TJ. Hence each biogas unit introduced with this technology would reduce emission by 0.530 tCO_2/y
- On a national basis, in the short term of the 5 million households in the country, if 1% of the households resort to this technology, the emission reduction would be 0.530 x 50,000 = 26,500tCO_2/y.
- The switch to biogas from fuelwood in the middle income households would result in a smoke free and healthy environment in these homes.

9. **Operations:** *After completion of barrier analysis and only for selected technologies.*

10. Costs:

The capital cost of a 1 m^3 compact biogas plant is US$ 500 = Rs. 57,000 (Ref. 5). This unit will generate equivalent of 182.5 kg of LPG. = 8413.25 MJ = 8413.25 x 4.18 Mcal = 35167.385 Mcal

= 3.5167 toe. Hence the capital cost required to generate 1 toe = 57,000/3.5167 = Rs. 16,208/toe/y.

To develop the supply chain of the feed material an estimated Rs. 1.0 million is required.

11. **References:**

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