



# A Comparative Study on Meeting the Energy Demand from Biogas in Pakistan

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## Abstract:

Pakistan is facing energy crises from past decade due to experiencing increase in energy demands. This current work is a comparative study to meet the energy demand from production of biogas from waste solid materials. The main emphasis is to treat biomass, manure, municipal waste, sewage and green waste to produce biogas using different technologies. At the ends there are some suggestions for effective planning of sustainable energy exploitation and facilitate for technology solution of further research. These suggestions are very useful for meeting the energy demand in Pakistan as well as for third world countries.

**Keywords:** Biogas, Sustainable energy, Biomass, Energy Demand.

## 1. Introduction

Being sixth largest country in the world, Pakistan is facing severe energy deficiency. According to a survey, world's per capita energy generation is 2657 KWh but in Pakistan it is 581 KWh. Energy demand of electricity in financial year 2010 rises more than 11% [1]. This rise in energy demand is due to rise in population and failure of previous policies to meet the energy demand. Pakistan is agricultural country having population of 170 Million in which 70% is involved with agricultural field having 480 dollars per capita income.

In order to meet the energy demand, the only solution is to use renewable energy because it is environment friendly, easy to implement in short time and most importantly lower in cost. Renewable energy technologies involve geothermal, wind, waste, biomass, solar and hydropower energy.

Pakistan's economy is increasing at an average rate of 7%. Due to this reason, energy demand is increasing drastically at an average rate of 8.4 % per year. Short fall of power supply is reached more than 5000 MW in its peak in summer season [1]. Energy supply in through different resources is shown in Table 1.

Table 1: Energy production in Pakistan [1]

Sr.	Resources	%
1	Natural Gas	47.5
2	Oil	30.5
3	Hydropower	10.9
4	Coal	9.2
5	LPG	0.7
6	Nuclear	1.2

## 2. Literature Survey

In this research paper, the main emphasize is to use one of the renewable i.e. production of biogas from different organic wastes such as manure, biomass, municipal waste, sewage and green waste.

Biogas technology is the only solution of reliable energy source after looking at the energy demand and living standard of nation. Biogas is best suitable for lightening and cooking purposes. A typical process for agricultural production of biogas is shown in figure 1.

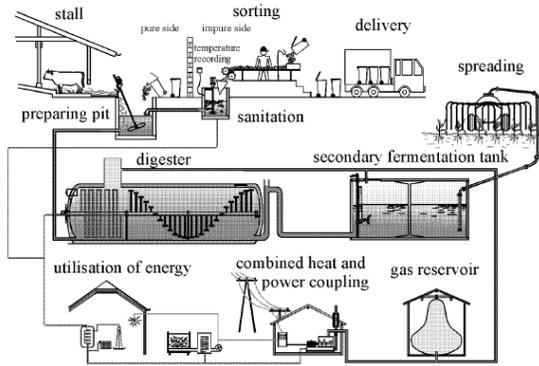


Figure 1: A typical modal for production of biogas using manure and other organic waste. [5]

Pakistan has total capacity of 19681 MW of electrical power generation units but the production is far very low due to high line losses (30 %) and low maintenance of power plants. To fulfill this gap private sector is producing 40% of the total energy requirement i.e. 7941 MW.

Brazil is the largest cane sugar producing country in the world and they are using steam turbine base cogeneration system for energy production estimated about 9000MW (Walter 2002).

In Pakistan, a large amount of residue of crops is available. Millions of tons of biomass is produced in Pakistan in form of crops residue, wood mills waste, rice husk, corn pith and cotton processing waste, which can easily be used in the production of bio gas.

Biomass based biogas energy cogeneration technologies has been used in many different agro-industries for their power generation system such as [2]

- Plywood industries
- Sugar mills
- Pulp & Paper industries
- Palm oil mills

Pakistan's 1st biogas plant was operated in 1989 and 1.5 % of total energy requirement is already been produced from biomass and its consumption is increasing at an average rate of 5% [3]. About 70% of Pakistan's population lives in rural areas, which uses biomass for their living as a main source of energy by collecting shrubs and woods to meet their energy need. Almost 62 % of biomass is used by rural areas and urban areas use only 14 % of biomass, from which 12 % collect woods and 66% use natural gas. [4]

### 3. Biogas production method

Recycling of bio-wastes such as manure, biomass, municipal waste, sewage and green waste for the production of bio gas has mainly categorized in to two processes

1. Direct Combustion
2. Gasification

People living in rural areas mostly use direct combustion technique, in which heat is not properly utilized and this process is not environment friendly. Gasification technique involves fermentation process.

Composition of mixtures of all raw materials i.e. manure, municipal waste, crops residue, green waste & biomass, influences the rate of fermentation process. These all raw materials must be processed before entering in the digester to get a homogenous phase mixture.

In the digester, fermentation process must be kept constant. To get high performance and high biomass degradation rate of loading must be set according to the feed composition and thus a high quality of biogas is produced. This is a very simple and cheap process in which only a digester is required for carrying fermentation process. A simple process of digester is shown in Figure 2.

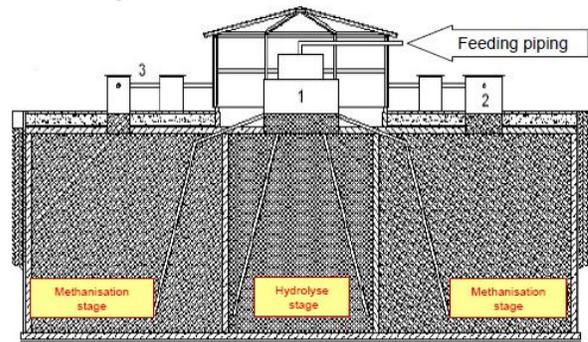


Figure 2: Digester showing feed and process mechanism

Anaerobic fermentation process is mostly preferred for the production of biogas in which, first the organic substances (polymer substrates) such as manure, biomass, municipal waste and green waste materials enter in the hydrolyzing phase, where it is converted in to broken elements and dissolved organic links such as alcoholic components, H<sub>2</sub> & CO<sub>2</sub> [7]. Then acidification phase starts and these broken elements are converted in to organic acids and at last converted in to acetic acid (Acetate) through acetogene phase. The final process is the methanogene phase in which bio gas comprises of CH<sub>4</sub>, H<sub>2</sub>, CO<sub>2</sub>, NH<sub>3</sub> and H<sub>2</sub>S is obtained. A simple block diagram process is shown in Figure 3.

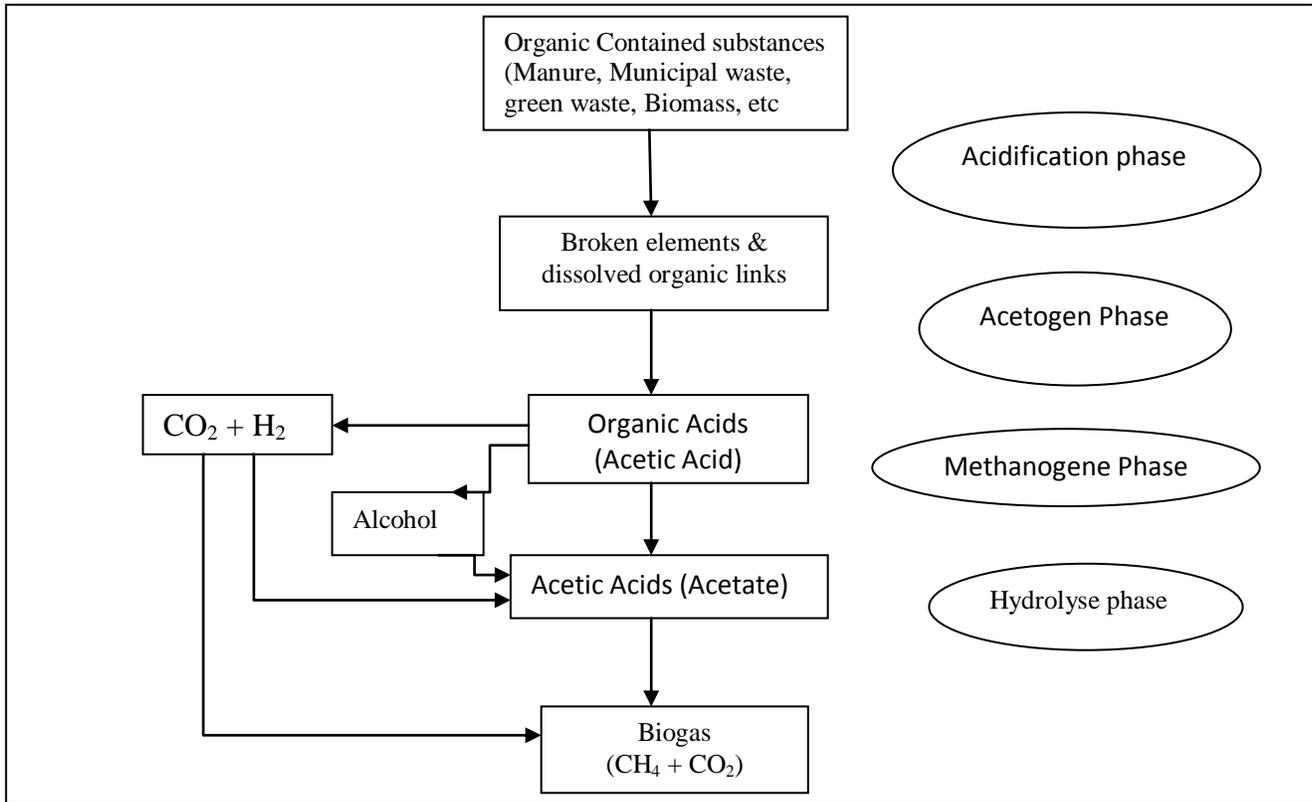


Figure 3: Block diagram for the biogas production mechanism

#### 4. Energy Production

A yield of approximately 320 m<sup>3</sup> is achieved when an isolated plug flow reactor is operated at an average temperature of 42 °C. The data given for anaerobic digestion given in the literature for many feeds such as biomass, manure, etc can vary with the change in composition. [6]

Retention time in the digester can be from 20-30 days depending on the process condition, isolation and composition of feed.

#### 5. Conclusions

Biogas process is the cheapest source of energy because for meeting the energy demand, Pakistan is importing energy in terms of crude oil, rental power systems, Iran gas pipeline system, etc and every year a huge amount of total budget is consumed for importing this energy. According to a survey 12 Billion dollars were spent for importing crude oil in 2008 and it will rise up to 27 Billion dollars in 2018.

Pakistan wood production will be conserved if we use biogas technology through fermentation process as Pakistan's domestic energy demand is increasing at an average rate of 24% per annum and about 90 % of wood

production in Pakistan is used as fuel, according to an estimated 7000 ha annually.

Biogas products have many benefits related to environment as it reduces green house gases. It also improves the quality of fertilizer and helps in recycling organic wastes.

According to a survey a farmer can decrease the 2-3 Tones of emissions of CO<sub>2</sub> per year, while operating the biogas plant.

Biogas producing plants fed with organic wastes show good performance, high yield and can be operated safely. Pakistan's support towards biogas technology has been considered very successful program because it is not only produce gas for household purposes but also use as good quality slurry for fertilization.

To increase the agriculture production, decrease the rate of deforestation and to improve the health of rural areas, Biogas support program (BSP) is introduced by the Pakistan Government in 2000 in which almost 1200 Biogas plants have been commissioned & operated and from which 98% are functioning now. An additional support of 1200 biogas plants has been installed last year. In addition, BSP has targeted 10,000 Biogas plants, which will recover 27% of potentiality.

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