

Cogeneration policy to contest climate changes and the future of sustainable energy

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Abstract. Although Pakistan is 135th ranked in reports of greenhouse gases [GHG] emissions, but it sticks up at 16th position globally in the terms of vulnerability to climate change. Adverse impacts of climate change on Pakistan are expected to raise more. Thermal power plants running on fossil fuels are main producers of electricity; the most used form of energy in Pakistan. Climate change impacts and dependency on foreign petroleum has compelled the policymakers to seek out cheap, indigenous and renewable sources. In the present article, cogeneration system and its impact on the environment especially in climate change scenario has been analyzed. The required information was collected through literature survey, observations and interviews. Pakistan's national policy regarding the subject is weighed up from J-tariff in 1990 to present biomass cogeneration policy 2013 for the encouragement of cogeneration as a means of conserving energy. Surplus electricity can be consumed to meet the household-level demands and employment generation in rural areas. The paper will review the potential impact of cogeneration policy on climate changes in Pakistan. Moreover, there will also be looked at national cogeneration policy to achieve the future energy goals.

1. Introduction

In modern world, the increment in energy's consumption volume per capita per year is the insignia of the civilization prosperity. Both oil and natural gas are still the world's chief energy sources meeting the global demand about 60 percent [1]. There are many substitute sources are being researched and explored with the technologies continually improved.

Pakistan is suffering from severe energy deficit; the energy supply and demand gap are very large. The outstanding energy deficit results in load shedding of 10–12 hours in urban areas while rural areas face electricity shortage for 16–18 hours [2]. Still many areas of our country deprived of electrification. Indigenous oil and gas resources are limited and may not sustain over two decades [3]. Climatic changes are extremely harming Pakistan's social, environmental and economic sectors due to increased population growth with zero adaption to the adverse effects of climatic ups and downs [4].

Although there seems no connection between the energy supply and climatic changes occurring in Pakistan, but both the issues are linked together. The clean and environmentally friendly energy is the need of the day. Energy harvested through the cogeneration can also solve the climate change issue.



Table 1. Properties and chemical analysis of bagasse.

Composition	Percent by Weight
Water Content	46-52
Sucrose and other soluble impurities	2-6
Fiber content	43-52
Carbon	23.7
Volatiles	42.5
Hydrogen	3.0
Moisture	49
Oxygen	22.8
Ash	1.5

The successive and concurrent production of various valuable forms of energy [usually thermal/mechanical] in a single, integrated way is known as cogeneration system. Sugarcane bagasse is the leftover, after the juice is extracted from sugarcane. Biochemical analysis of sugarcane bagasse presented in Table 1. The mechanical energy produced is utilized driving electrical turbine to generate electricity and thermal energy is employed directly for industrial processing or indirectly to produce steam [5]. To counter the effects of changes in climatic conditions, the country can adapt cogeneration policy with other measures as an action plan. Potential of the cogeneration system to bring about substantial energy cost savings is the key advantage. As whole energy conversion efficiencies are much greater than many existing industrial cogeneration systems, which reject heat directly into the atmosphere [6].

In Pakistan, a currently, main portion of the electricity is being generated through thermal power plants [7]. The thermal power plants use the fossil fuels; the combustion of such fuels release greenhouse gases into the atmosphere that is the main reason of climate change. Generation of electricity from the combustion of bagasse in the cogeneration system was basically a policy issue. In this article, the national cogeneration policies have discussed and analyzed, made how the cogeneration can be beneficial for Pakistan in the climate-changing scenario.

2. Methodology

The required data was collected mostly through observations and interviews of the technical persons. Environmental and socioeconomic impacts discussed. The complete literature survey was performed about the cogeneration from sugarcane in Pakistan and impact of Climate change.

3. Results and discussion

3.1 Variations among climatic settings of Pakistan

According to climatic gauges are showing changed trends in Pakistan [8][9]. The upsurge in average temperature all over Pakistan was observed. As per predictions of the Intergovernmental Panel on Climatic Change [IPCC] there will be slightly more upsurge of temperature rise in the areas where Pakistan is situated [9]. Warming up the climatic system is unequivocal [10].

3.2 Vulnerability of energy sector to climatic changes

Pakistan foresees 8.8 % growth in the energy sector, an entire energy demand of 361 million tons of oil equivalent [MTOE] by 2030 [9]. For long-term frequent energy supply; sustained efforts are required that must effectually consider the climate change effects. Changes in climatic conditions will affect the energy sector in both direct and indirect ways.

3.3 National cogeneration policy regarding sugar industry

Since 1990, the sugar factories have been passing on surplus electricity generated through bagasse combustion to the national grid. The lack of an attractive market to export excess electricity had halted investments in the cogeneration system. The previous policy introduced in the 1990's to carry across the electricity from sugar factories to national grid was known as J-tariff. Up to 4 MW could be supplied and the contracts were made on the principle of "as and when delivered" basis. It was the responsibility of sugar factories for the necessary arrangement of interconnectivity to the national grid. Moreover, the energy consumed by the sugar industry in the off season from the national grid was adjustable with the energy exported by the sugar unit. The tariff was only 1.70 Pakistani rupees per kWh. The interest of the sugar factories in the export of electricity declined due to this low tariff. A new national energy policy formulated in 2002; that had blurred the J-tariff. No new agreement was signed, and electricity export from sugar factories became negligible by 2007. Since last decade, the government of Pakistan [GOP] has made many changes. A renewable energy policy excluding power produced from sugarcane bagasse introduced in 2006. The main emphasis put in photovoltaic, wind power and energy from hydro systems.

Now the government has realized the potential of this valued, low-cost energy. Alternate renewable energy policy introduced in 2012 keeps all renewable fuels for power cogeneration. Rule of "take and pay" has been declared for energy entrepreneurs above 50 MW. Initially, the sugar units located at "Dera Ismail Khan" has made a contract for export of 15 MW power. The imposed tariff is PKR4.88 per kWh for next ten years together with bagasse fuel cost of PKR3.62/ kWh. Establishment as independent power production unit or under the possession of existing sugar industry was allowed in 2012 policy. The IPPs can utilize coal and bagasse as co-fuel.

3.3.1 Improvements in cogeneration policy 2012. Sketch of policy regarding power cogeneration systems was ratified by the economic coordination committee of Pakistan's government on March 6, 2013 [11]. This policy has covered all issues about high-pressure cogeneration systems, applying bagasse, and relevant biomasses as fuel. The policy has been much improved providing incentives to sugarcane factories to upgrade the conventional boilers to high-pressure technology [minimum 60 bar] or set up new ones to produce-high pressure steam and green electricity. Pakistan's government keeps intentions to get almost 1,500 megawatts from sugar factories, to reduce the load shedding pressure [12].

3.3.2 Alternative energy development board's role. Alternative energy development board [AEDB] is working in facilitating the investors to setup bagasse-fired cogeneration systems in Pakistan is appreciable. AEDB is following IPP to raise the electricity up to 2000 MW through cogeneration systems.

3.3.3 Current scenario. Currently, seven factories are in a position to export the surplus power and four units are in the pipeline. The Government of Pakistan intends to install such projects on a fast track basis. Therefore national electric power regulatory authority [NEPRA] has to decide the applications in less than sixty days. The sugar factories have been instructed to completely install the project in three years only. Incentives offered to IPPs are also valid for the sugar mill co-generation projects. Another issue of using alternative fuel has been rectified by allowing the utilization of co fuels without any limits.

3.4 Environmental benefits

Green electricity generation through cogeneration systems in sugar industries keeps auxiliary benefits in reduction of greenhouse gases [13] discharge and replacement of conventional fuels [14]. A sugar factory having capacity of 2500 TCD may reduce the discharge of CO₂ approximately 0.166 million tons through generation of 22 MW as the release of greenhouse gases are much lower in the combustion of bagasse thereby decreasing the environmental pollution [15].

3.5 A path to sustainable development

The sugar industry of Pakistan has been faced dual challenges, heavy bill of furnace oil fuel [for combustion in boiler] and sugar as a lone product for sale. Superficially there is no relation among both issues. But the single solution to meet these issues are generation of electricity by combustion of bagasse in high-pressure boilers. The use of furnace oil will be finished and a lucrative source of income for the sugar factories will be created.

4. Conclusion

To context the climate changes, Pakistan must be determined to use the energy resources in efficient and environmentally friendly manner. Energy efficient policies especially cogeneration policy must be addressed sensitively due to the direct relationship between the climatic changes, economic growth, and social development objectives. Cogeneration of electricity and heat at the sugar factories can play the key role to reduce the GHG emissions into the atmosphere. The liberation of CO₂ and fossil fuels consumption is decreased, so cogenerations through sugarcane bagasse impact positively the climate changes in Pakistan. The government of Pakistan should review the national cogeneration policy and must plan to avoid from climate-related issues. Further, the bagasse cogeneration system can reduce the electricity prices over the next several years.

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