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Towards carbon neutral combustion. LCOE analysis of co-firing solid particles and gaseous fuel in Latvia

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Abstract

One of the main obstacles to transfer to carbon neutral energy management is technological transition. An important task is to change fuel used in the boiler furnace from natural gas (fossil fuel) to biomass. The easiest but most expensive solution is the installation of a biomass boiler. Other solutions include burner replacement or additional installation, but these options are more complex from an engineering and technical point of view.

By replacing natural gas with wood particles, boiler output is reduced, because the value of combustion heat, furnace load and specific combustion parameters are lower, as well as the temperature and pollution with nitrogen oxides NOx decrease. It is especially important when energy end user improves energy efficiency and reduces energy consumption. As a result there is excess installed capacity in the boiler house.

The feasibility of co-firing is calculated with Levelised Cost of Energy analysis.

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Keywords: biomass; sawdust; natural gas; levelized cost of energy; co-firing

1. Introduction

Climate change mitigation and adaptation are becoming a major key concern for all nations. The commitments of the European Union to integrate renewable energy resources and reduction of greenhouse gas emissions by 20 %

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by 2020 relative to the base year 1990 has motivated the European Union to double its consumption of renewable energy sources from 6 % of aggregate utilization in 1996 to 12 % in 2010 as the objective of the European Union strategic energy plan [1].

Previous methods of energy generation and utilisation have led to unsustainable financial, social and ecological consequences. In spite of the fact that the economic crisis mostly resulted in lower industrial activities and lower ecological effects in the developed countries, it has also hampered the sustainability innovation projects at various levels between different nations. The present unsustainability of current frameworks of energy generation and utilization requires a generous move keeping in mind the end goal to achieve sustainability. Modern and developed energy generation methods and procedures are needed, and the organizations and associations that control the energy generation methods must change the way in which they work. Changes and advance will be required in a wide assortment of energy production projects and methodologies, which will need to incorporate new plans of action and advances in administration methodologies, including better approaches to judge business execution and achievement [2].

One of the ways, how to reach the European Union plans, is to use innovative biomass in co-firing with natural gas or biogas. The innovative biomass consists of residues from wood production like leaves and saw dusts or residues from agriculture like straw. Using innovative biomass would increase the renewable energy share and reduce greenhouse gas emissions as biomass is assumed a carbon neutral fuel. The innovative biomass would maintain efficient ecosystems and conservation of biodiversity and would lead to more sustainable forests management and consequently to more resilient forest structures.

The advantages of the biomass co-firing with natural gas would provide safe and efficient heat supply to consumers supply in addition to the environmental benefits and fuel flexibility as, in the event of temporary biomass shortage, the natural gas can guarantee safe and efficient energy production. Latvia, with more than half of its area covered by forests, is among the wealthiest biodiversity countries in Europe in addition to its well-established custom of nature protection. However, from the principle of ecological problems, the overexploitation of forest resources in Latvia is minor [3].

Wood consumption can substitute fossil fuels and other carbon concentrated materials however can lessen the carbon stock in forests. The motivation of the development wood co-firing with natural gas in Latvia is the great accessibility of wood biomass in Latvia and use of the wood waste for energy production. Moreover, co-firing provides a good solution for the problem of biomass moisture content variations which could lead to incomplete combustion and energy production variations with low efficient boilers so this leads to more efficient combustion which guarantee better particulate burnout with less emissions. It is worth to tell that the main advantage of biomass co-firing is the reduction of carbon dioxide greenhouse gas emissions if compared to energy production from fossil fuel combustion [4].

The most regularly utilized economic related indicator for studying and analysing renewable energy recently is the Levelized Cost of Energy (LCOE). Fundamentally, this cost of energy is computed through dividing all the cost reduced to a present reference by the aggregate energy yield which is also adjusted to a present reference. In spite of the fact that the LCOE can be helpfully utilized for benchmarking of various projects and technologies on a financial basis from a full scale point of view, it has a few confinements that make it not fit for selection among fundamentally unrelated choices and neither for assessing investment particular choices [5].

In this paper natural gas co-firing with biomass is analysed with the LCOE method to see possibilities of implementing co-firing in Latvia's energy sector. This research is important as natural gas will gradually be replaced by biogas which is carbon neutral. Moreover, biomass co-firing with solid wood particles will reduce impact on climate change.

2. Methodology

LCOE is the steady unit cost per kWh or MWh of an instalment stream that has the same present value as the aggregate cost of building and working an energy producing plant over its life span. Generally, LCOE is calculated for a period of 20 to 40 years as currency units per MWh or kWh [6].

LCOE can be classified according to the following [6]:

- Real LCOE which is a constant stream of values indicated in today's monetary value;
- Real LCOE with inflation which is the nominal stream of values that keeps real value content;
- Nominal LCOE which is a constant stream of values in nominal monetary value.