Available online at www.sciencedirect.com

SciVerse ScienceDirect

http://www.elsevier.com/locate/biombioe

Impact of the Renewable Energy Sources Act in Germany on electricity produced with solid biofuels – Lessons learned by monitoring the market development

P. Sauter [a,*], J. Witt [a], E. Billig [a], D. Thrän [a,b]

[a] Deutsches Biomasseforschungszentrum (DBFZ),[1] Department of Bioenergy Systems, Torgauer Strasse 116, 04347 Leipzig, Germany

[b] Helmholtz Centre for Environmental Research (UFZ),[2] Department of Bioenergy, Permoser Strasse 15, 04347 Leipzig, Germany

ARTICLE INFO

Article history:
Received 18 July 2012
Received in revised form
10 January 2013
Accepted 13 January 2013
Available online 13 February 2013

Keywords:
Renewable Energy Sources Act (EEG)
Feed-in tariffs
Combined heat and power plants (CHP)
Solid biomass
Database
Technology parameter

ABSTRACT

The increased use of renewable energy is the declared objective of the European and German climate policies. According to the German government, renewable energies will contribute to 35 percent of electricity production by 2020. In a bid to meet these ambitious targets, the Germany government implemented the EEG 2000. This policy guaranteed a fixed tariff for 20 years to all renewable energy plant operators providing electricity to grid. Following this policy implementation, significant market growth could be verified for nearly all renewable energy sectors. Approximately 20 percent of Germany's electricity today is met be renewables. In order to ensure an efficient growth and encourage technology providers to optimize and develop new innovative technologies a constant market monitoring and periodic amendments to the feed-in tariffs are required.

In order to monitor the impact of the EEG and the development of the solid biofuels within the German energy supply system a comprehensive database with about 10 000 datasets has been accumulated over the last decade. This inventory database with various types of information is continuously updated, integrated and validated for data quality. It has emerged that this represents now the most complete and relevant database in Germany. Through the analysis of this database it can be shown, that the enactment of the EEG in 2000 has resulted in a tenfold increase in the number, as well as in the installed capacity of biomass CHP plants. These biomass CHP plants now contribute approximately 9 percent of the total electricity generated from renewable energy sources. The database analysis has also identified that there is a correlation between technology options, stakeholders and biomass sources, as these have changed in line with the changes in framework conditions over the last three EEG periods.

* *Corresponding author*. Tel.: +49 341 2434 552; fax: +49 341 2434 133.
E-mail address: philipp.sauter@dbfz.de (P. Sauter).

[1] www.dbfz.de.

[2] www.ufz.de.

0961-9534/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biombioe.2013.01.014

1. Introduction

Starting in 2001, the European Parliament and the Council approved the Directive 2001 77 EC followed by the Directive 2009 28 EC in 2009 to promote electricity production from renewable energy sources on the domestic electricity market. At a national level, Germany created the National Renewable Energy Action Plan (nREAP), in which is set the target of producing 35 percent of the total electricity from renewables by the year 2020. As a supporting scheme, the so called "EEG"– Renewable Energy Sources Act– was established in 2000 with the aim of increasing the percentage of renewable energy in electricity production. To encourage electricity production from renewable sources and to ensure environmentally and innovative technology concepts as well as cost-effective supporting schemes, the EEG was amended three times since its establishment (in 2004, 2009 and 2012) to date. During these periods the goals of the nREAP could be integrated [1]. The proposal is to meet 38.6 percent of the German electricity consumption with renewable energies by 2020, with 8.9 percent approximately derived from biomass [2]. By the end of 2011 renewable energies contributed to 20 percent of German electricity consumption that are mainly supported by the EEG. Biomass is one of the most important energy carrier among the renewables and contributes to almost one third of the electricity produced [3]. The special characteristic of solid biofuels is that it is easy to store and can be used efficiently in combined heat and power plants.

Against the backdrop of fast moving national and global economic and environmental policies, decision makers – such as the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety – need to be updated with independent information in order to review current market framework conditions and the impact of existing support schemes like the EEG. Official statistics from the federal agencies about market developments are not available in the short term, but often policies have to react quickly in order to achieve targeted objectives or to correct undesirable developments. Therefore, other information sources are implemented to close the gap between official statistics and updated market information.

To monitor the impacts of the EEG on the market a comprehensive database was built up. This database includes various parameters for most of the biomass power plants in Germany by combining information from different sources. Queries from this database are used to show the development of specific issues, needed to evaluate the EEG e.g. in terms of electricity production from solid biofuels.

This article aims to describe and discuss the impact of policy decisions within the EEG on solid biomass power plants. In a first step, the structure and incentives of the EEG, as well as the resulting market developments, are characterized. In a second step the results of analysis on impacts which specific instruments within the EEG has had on the electricity production generated from solid biofuels are illustrated.

2. The EEG

The EEG is one of the instruments (e.g. Renewable Energy Heat Act (EEWärmeG), Biofuel Quota Act (BioKraftQuG)) used for promoting energy production from renewables in Germany. Since the implementation of the EEG, electricity produced from renewable sources has increased from 10 GW in 2000 to 65 GW in 2011. The target of the EEG is to establish a cost-effective and sustainable supply of energy while protecting the climate and the environment [2]. This is achieved by financially supporting electricity production through renewable energies and by providing favorable legal conditions. The financial support is based on fixed feed-in tariffs, which are tariffs for electricity produced and fed into the grid by plants established to produce electricity using solar, hydro, wind, landfill gas, sewage gas and biomass. The economic development of the energy market and the market on a whole is taken into account by defining the rate of the feed-in tariffs, in order to avoid windfall gains. Additionally special premiums were used in the past to boost and to guide specially designated plant concepts. The feed-in tariffs are pro-rated according to the power capacity class of the plant. The EEG limits its plant-specific support to 20 MW of production capacity in order to promote decentralized electricity production. In principle, plants with lower electrical power capacity get a higher tariff. To ensure a high security of investment, the tariffs are fixed for 20 years, beginning with the year the plant starts producing electricity [4]. The feed-in tariffs consist of a basic tariff which has been adjusted in each EEG period. Additionally, in the case of solid biofuels, plants commissioned in the EEG periods 2004 and 2009 were able to receive premium payments. These premiums were grouped into the premiums for the production of combined heat and power, the use of special types of biomass and the installation of innovative technologies [5,6].

Technologies supported by the technology premium received funding for "*electricity generated in one of the following installations or using one of the following technologies or procedures and where heat is used in accordance with Annex 3 or an electrical efficiency of at least 45 per cent is achieved*:

a) *conversion of the biomass by means of thermochemical gasification*,
b) *fuel cells*,
c) *gas turbines*,
d) *steam engines*,
e) *organic Rankine cycles (ORC)*,
f) *multi-fuel installations, especially Kalina cycles*,
g) *Stirling engines*,
h) *technologies for the thermochemical conversion exclusively of straw and other stalk biomass*" (EEG 2009, Annex 1 [5]).

Premiums were paid for specific types of biofuels which are residues such as bark, forest residues and tree-cuttings along the roadside to avoid serious intervention into nature and direct competition with food production [5–7].

The costs of the EEG are transferred to the electricity consumers; however exemptions are given for highly energy-dependent enterprises. They only pay a reduced EEG levy. Also customers of energy suppliers with a share of more than 50 percent of renewable energy do not have to pay the EEG levy [8]. One effect has been that the EEG levy for "common" electricity consumers has sharply increased from 20.47 € MWh^{-1} in 2010 to 52.77 € MWh^{-1} as it will be in 2013, representing approximately 20 percent of the consumer electricity price [8,9].