Energy Policy ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Nonconformity of policy ambitions with biomass potentials in regional bioenergy transition: A Dutch example

Evren Özcan, Maarten Arentsen *

University of Twente, Centre for Studies in Technology and Sustainable Development (CSTM), Drienelostraat 5, 7522 NB, Enschede, Overijssel, Netherlands

HIGHLIGHTS

- Biomass resource potential assessment performed with Dutch province as case study.
- Methodology presented to translate technical biomass potential into policy domain.
- Nonconformity found between the province's policy ambition and biomass potential.
- Five policy measures identified to cope with this nonconformity.

ARTICLE INFO

Article history:
Received 28 June 2013
Received in revised form
9 September 2013
Accepted 14 October 2013

Keywords:
Bioenergy policy
Biomass potential assessment
Regional bioenergy transitions

ABSTRACT

Numerous regional authorities within the European Union are committed to meet renewable energy targets in line with the EU-20-20-20 strategy. Energy from biomass occupies a pivotal position in the renewable energy strategy of many regions. Effective bioenergy policy often depends on an assessment of the regional resource potential for energy from biomass. Using the Dutch province of Overijssel as a case study, this study presents a biomass resource potential assessment, based on existing statistics and a resource-focused methodology, to determine the region's theoretical and technical potential. Additionally, a methodological framework is provided to translate the outcome of this biomass resource potential assessment into the policy domain, to allow the region's bioenergy policy ambition to be evaluated. The results indicate that Overijssel's potential bioenergy target is a share of 8.3%, which does not match with the desired policy target of 14%. It is therefore clear that it is unlikely that the province's bioenergy ambition will be met with the current supply of biomass, in the absence of additional policy measures. The outcome of the biomass resource potential assessment has therefore been used to deduce and recommend multiple policy measures.

1. Introduction

The increasing concern for security of supply and climate change has redefined the priorities of energy policy across Europe (Helm, 2007). The European Union has recognized these challenges and approached them with new élan and considerable momentum, to shape a common energy policy based on security of supply, competitiveness and sustainability (European Commission, 2007). Significant legislative progress has been demonstrated with the adoption of the EU Climate and Energy Package, which incorporates the EU 20-20-20 targets for climate change and energy. As part of this package, RES Directive 2009/28/EC sets binding national targets for the share of renewable energy sources in the total energy consumption such that an EU-average share of 20% will be reached by 2020. The binding national target for the Netherlands has been set at 14%. Moreover, each Member State is committed to a mandatory share of 10% renewable energy in transportation.

The diversification of the energy mix with renewable energy sources is thus a key objective of the EU's common energy strategy. Currently, energy from biomass – including waste – is the largest source of renewable energy consumed in the EU-27, representing a 69% share of the total renewable energy consumption in 2010, which is almost 9% of the EU's total energy consumption (European Commission, 2012). Similar figures are found for the Netherlands, where energy from biomass takes a 74% share in the total renewable energy consumption (Statistics Netherlands, 2012). As a consequence, biomass is a dominant renewable energy source for heating, power generation and transportation fuels. It thus occupies a pivotal position in current strategies to meet the EU 20-20-20 targets.

These strategies are not only addressed at supranational and national level; a great deal of momentum is also transferred to

* Corresponding author. Tel.: +31 53 489 5772; fax: +31 53 489 4850.
E-mail address: m.j.arentsen@utwente.nl (M. Arentsen).

0301-4215/$ - see front matter © 2013 Published by Elsevier Ltd.
http://dx.doi.org/10.1016/j.enpol.2013.10.046

regional and local levels. An example of regional and local engagement is the Covenant of Mayors, which commits local authorities to meet self-imposed climate and energy targets.

The physical characteristics of biomass also encourage regional or local bioenergy solutions. Due to the low energy density and low mass density of unprocessed biomass, for example, it is more favorable to limit the distance over which biomass is transported by keeping the harvest and the initial processing steps close together. Moreover, effectively closing the mineral balance of biomass demands local biomass utilization and processing. Furthermore, since the availability of biomass resources is determined geographically, regions with high biomass availability have an additional incentive to opt for bioenergy development.

Although bioenergy complies with the climate change and renewable energy ambitions of many regions, there is still a need for a quantitative assessment of the biomass resource potential to analyze the regional potential for energy from biomass. This analysis can subsequently be used to support bioenergy policy making. For that reason, the biomass resource potential of numerous cases is broadly assessed for different types of potentials, with multiple approaches and various methodologies (Batidzirai et al., 2012). As an addition to the common literature, this paper presents a resource-focused methodology, based on existing statistical data, to assess the technical biomass potential of the Dutch province of Overijssel. This technical biomass potential is introduced in dimensionless form by evaluating it in the context of regional energy consumption. The dimensionless technical biomass potential is then used as a basis for further policy analysis.

The objective of this study is not only to identify the biomass resource potential of the Dutch province of Overijssel, but also to provide a methodological framework to translate the outcome of a biomass resource potential assessment into the policy domain, thus allowing the bioenergy policy ambition of the province of Overijssel to be evaluated.

2. Province of Overijssel

The province of Overijssel is chosen as the case study region for the biomass resource potential assessment. This province is located in the eastern part of the Netherlands and houses 1.3 million inhabitants in 25 municipalities, with a total surface area of 3421 km^2 (Fig. 1). Nearly half of the population (47%) lives in five urban municipalities, while the remainder is scattered among eighteen rural municipalities and two small-urban municipalities; the last two have a marginal population count but a high population density. As a result, the province can be characterized as multiple urban agglomerations compactly situated within a highly rural landscape.

The land use in the province is mainly agriculture (70%), followed by nature reserves (14%) and built-up area (13%). The cultivated land is primarily used as pasture land (71%) and to grow fodder (21%), with other arable farming activities (7%) and horticulture (1%) taking a minor share (Statistics Netherlands, 2013). As these statistics indicate, agricultural activity in Overijssel is predominantly cattle farming. As a consequence of the large livestock herd and regulatory restrictions on fertilizer use, Overijssel has a surplus of manure available.

The province is furthermore committed to the EU target of 20% renewable energy consumption in 2020 (Province of Overijssel, 2011). A special policy program – *Programma Nieuwe Energie* – has been adopted and implemented to achieve this ambition. This program places a great emphasis on reducing energy consumption in the built environment, and renewable energy production from biomass. Considerable financial resources are also reserved to achieve this renewable energy ambition, with the establishment of a 250M€ fund for soft loans.

Currently, almost 6% of the energy consumption in the province is met from renewable energy sources. Biomass is the main renewable energy source, taking a 90% share in the province's renewable energy portfolio. This share is composed mainly of waste incineration, woody biomass combustion and first generation biofuel production. The province's objective is to maintain bioenergy as the primary source for renewable energy: a minimum share of 70% within the renewable energy portfolio is envisioned. It is therefore clear that an expansion of the provincial renewable energy capacity is required to meet the adopted 20% renewable energy target and the underlying 14% bioenergy target by 2020. However, since no comprehensive potential study has ever been published, to the authors' knowledge, the real potential for bioenergy development in the province of Overijssel is unknown. For that reason, it is useful to conduct an assessment of the province's biomass resource potential.

3. Methodology

Different methodological frameworks have been used previously to conduct biomass resource potential assessments. Batidzirai et al. (2012) reviewed the current methodological heterogeneity by categorizing studies according to the type of potential, approach and methodology used. Following the categorization and terminology of Batidzirai et al. (2012), this paper presents a resource-focused statistical analysis as the overarching methodological framework to determine the technical biomass potential. This methodological framework is depicted in Fig. 2. As this framework only applies to a single case study region and only accounts for local biomass resources, biomass trade is excluded from the calculations of the biomass resource potential.

In this study the technical biomass potential is defined as the amount of bioenergy that can be produced on the basis of the theoretically available amount of biomass resources, constrained by the technical options available in the region under study. It is thus necessary first of all to determine the theoretical biomass potential. As specified by Chum et al. (2011), the theoretical potential describes the biomass supply that is theoretically available within biophysical limits. It is therefore found by collecting data on the available biomass resources.

The theoretical potential can subsequently be cascaded into the technical potential by taking technical limitations and competing biomass allocations into account. The technical limitations here are imposed on the basis of two bounding scenarios, so that the technical potential is presented within an upper and a lower technological bound. The resulting technical potential is then evaluated within the context of energy consumption in the case study region. A dimensionless technical potential is therefore introduced by dividing the technical potential by the corresponding energy consumption. This dimensionless technical potential hence describes the potential share of bioenergy in the current energy consumption. The result of the biomass resource potential assessment can then be translated into the definition of the regional policy ambitions.

3.1. Classification of biomass

A classification of biomass resources is needed to organize the acquired data. Six main categories of biomass resources are therefore identified: woody biomass, agricultural residues, grasses, manure, municipal solid waste, and other biomass. The various types of biomass are subsequently grouped within these main categories. Twenty relevant types of biomass have been distinguished in the case

Please cite this article as: Özcan, E., Arentsen, M., Nonconformity of policy ambitions with biomass potentials in regional bioenergy transition: A Dutch example. Energy Policy (2013), http://dx.doi.org/10.1016/j.enpol.2013.10.046