



UNIVERSITY OF
EASTERN FINLAND

Faculty of Science and Forestry

Bioenergy Markets and Policies (3513019)

Learning Diary

Shourav Dutta
Student ID: 291368
Erasmus Mundus M.Sc.–European Forestry

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Bioenergy: the basic concept

Bioenergy is a type of energy derived from biofuels. Biofuels are fuels produced directly or indirectly from organic material –biomass – including plant materials and animal waste. Overall, bioenergy covers approximately 10% of the total world energy demand. Traditional unprocessed biomass such as fuelwood, charcoal and animal dung accounts for most of this and represents the main source of energy for a large number of people in developing countries who use it mainly for cooking and heating.

More advanced and efficient conversion technologies now allow the extraction of biofuels from materials such as wood, crops and waste material. Biofuels can be solid, gaseous or liquid, even though the term is often used in the literature in a narrow sense to refer only to liquid biofuels for transport.

Biofuels may be derived from agricultural crops, including conventional food plants or from special energy crops. Biofuels may also be derived from forestry, agricultural or fishery products or municipal wastes, as well as from agro-industry, food industry and food service by-products and wastes.

A distinction is made between primary and secondary biofuels. In the case of primary biofuels, such as fuelwood, wood chips and pellets, organic materials are used in an unprocessed form, primarily for heating, cooking or electricity production. Secondary biofuels result from processing of biomass and include liquid biofuels such as ethanol and biodiesel that can be used in vehicles and industrial processes.

Bioenergy is mainly used in homes (80%), to a lesser extent in industry (18%), while liquid biofuels for transport still play a limited role (2%).

The role of policy in bioenergy market

European community has undertaken a review of its energy policy with the aim at improving the sustainability of energy use across Europe. As outlined in the Commission's Green Paper (COM 2006a), the new European energy policy is built on three core objectives:

1. Sustainability - to actively combat climate change by promoting renewable energy sources and energy efficiency;

2. Competitiveness - to improve the efficiency of the European energy grid by creating a truly competitive internal energy market; and
3. Security of supply - to better coordinate the EU's supply of and demand for energy within an international context.

Essential elements of this policy are the need to reduce energy demand; increase reliance on renewable energy sources and diversify energy sources; and enhance international cooperation. Eventually, these elements should contribute to the reduction of Europe's dependence on energy imports, increase sustainability and stimulate growth and jobs (COM 2006b). The support of renewable energies has played a big role in this context and already has a long history as a central focus of European energy policy. The Commission's most recent initiative, the energy and climate-change package (COM 2007) of January 10, 2007, established the target of 20 percent of all EU energy consumption to come from renewable sources by 2020. It is in this wider context of an integrated and coherent energy policy, in particular with respect to the support of renewable energy sources that the European Unions' bioenergy policy has developed.

Biomass already accounts for about half of the renewable energy used in the EU (COM 2005). Given the wide possibilities of energy uses of biomass, bioenergy is an important component in the renewable energy mix. In order to further support bioenergy use, a great deal of legislation has been passed in recent years. In contrast to other countries, the European bioenergy policy foremost aims to reduce greenhouse gas emissions, reduce dependence on imported fossil fuels and diversify sources of energy supply. However, bioenergy policies are also directed toward generating employment in agricultural and rural areas and promoting innovation and technological development (Schlegel & Kaphengst 2007, COM 2006c). Biofuels have received particular attention in the EU, representing one of the few renewable fuels for transport. After all, the transport sector is responsible for more than a quarter of all EU greenhouse gas emissions, and cars generate about 80 percent of the transport sector's emissions in the EU (Hansen & Vaals 2005).

Policy instruments

In bioenergy markets, there are different policy-based instruments that can affect markets in order to fulfilled objectives. This is a fundamental issue that largely affects its implementation. There are different tools, from more aggressive approaches such as quotas and restrictions, to subtler as promotion campaigns, green labeling or even research grants. Two commonly used instruments have been- subsidies and taxes.

In term of taxes, the tax incentives for biomass energy production generally could promote markets and increase demand for forest products. This also involves exemption from taxes and/or value added tax (VAT). Since 1997 (the entry into force of the Kyoto Protocol), countries such as the UK, France, Germany, Spain, Norway, Finland, the Czech Republic and Sweden, have increased taxes on oil and oil products. Denmark introduced a tax on carbon dioxide emissions before 1997. In some European countries, taxes on oil and oil products have increased significantly in accordance with the requirements of the Kyoto Protocol.

Policy on bioenergy in EU

The policy based on bioenergy is one of the renewability energy concepts and EU has set the policy mainly in three parts which are listed below:

a) Environmental policy

This policy is adopted to prevent the climate change condition by encouraging investors in green technologies and practices which can reduce the carbon emission and at the same time create employment opportunities. Kyoto protocol, European Union emission trading scheme (EU ETS) are some of the organizations working in climate or environmental sector.

b) Energy policy

Policy was set to secure the energy supply. EU has also implemented energy policy in many different stages in 1997, 2001, 2003, 2006, 2007, 2008 etc. Taxes subsidies etc. are implemented to meet the objectives. The latest 2009 EU directives has ambitious plans to have at least 20% of total energy should be generated from renewable sources by 2020.

c) Agricultural policy

EU has implemented this policy to increase productivity and to secure the food supply. Further, to maintain the fair standard of living for agricultural population which can be done by securing

reasonable retail price for customers. CAP (common agricultural policy) is one of the very important policies in EU and most of the EUs budget applies in this area. This policy is one of the reasons why countries like Norway and Iceland are not in EU even though they are in Schengen.

Policy issues- real driver in EU

In an effort to formulate a strategy towards sustainable energy production for Europe and to diminish strategic dependence on imported fuels, in particular oil for transport, several political initiatives have been taken within the European Commission and the individual member countries (in Europe). The targets of the energy policies of the EU are:

- meeting the Kyoto objectives,
- doubling the share of renewable energies of gross inland energy production,
- improving energy efficiency, and
- maintaining security of supply.

To achieve these targets the EU has adopted different policies and measures: White Paper on energy policy, White Paper on RES & Action Plan, Green Paper on security of supply, directives on renewable electricity, emissions trading, liquid biofuels, cogeneration, and buildings, and various support programs.

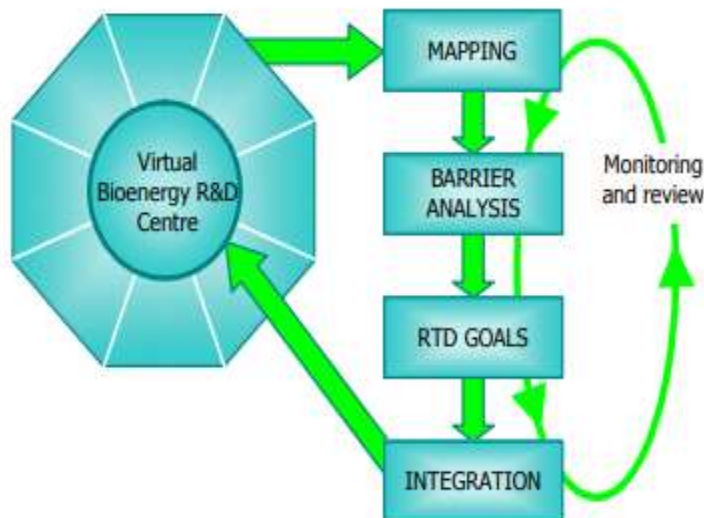


Figure-1: A map of the processes involved in Bioenergy

Adoption dynamics

Sweden has implemented willow as an agricultural crop for bioenergy production during this 20 years' time period thereby establishing more than 14000 ha of arable land. Driving forces behind this successful plantation scheme was a Swedish policy which was implemented after oil crisis in 1970s. By 1980s- 1995, country had already produced their commercial SRP (short rotation plantation) as well as programs for economic and policy incentives. The policy tools were mainly based on subsidies, taxes; promotions and R&D. Similar system were adopted in other countries like UK and Germany. In overall those policy programs worked quite well in Swedish case although there was a negative effect of subsidies as farmers did not care enough attention to the plantation once they received the grants. In a similar case, Finland had a big failure in reed canary grass plantation because of high number of plantations, subsidies and expectations.

Bioenergy target by 2020

In March 2007, following recommendations from the EC's Renewable Energy Road Map, the EU Parliament signed up to a binding target to source 20 per cent of its total energy from renewables by 2020. The Road Map provides a realistic path to achieving the target but only if all member states significantly boost their renewable energy production in the electricity, transport and heating and cooling sectors. The report hones in on bioenergy's contribution to reaching the 20 per cent target, indicating just how much it could contribute over the next decade. In 2005, biomass contributed 70 Terawatt hours (TWh) electricity or nearly half of the EU's non-hydro, renewable electricity. The electricity sector is well ahead of the transport and heating sectors in utilizing renewable energy. The Road Map estimates renewable electricity will reach 19 per cent by 2010, nearly hitting the 21 per cent target set by the RES-E Directive. By 2020, 34 percent of overall electricity consumption could come from renewables. Of this, biomass could contribute about 300 TWh, mainly from solid biomass, followed by biogas, with bio-waste providing the remainder.

The heating and cooling sector accounts for nearly half of Europe's overall energy consumption, but renewable energy only powers 9 percent of this often overlooked sector. Biomass will be the main contributor in raising renewable energy levels in the sector, with use expected to double by 2020, according to the Renewable Energy Road Map (Figure 2). Biomass will remain the dominant source of renewable heat in the long term.

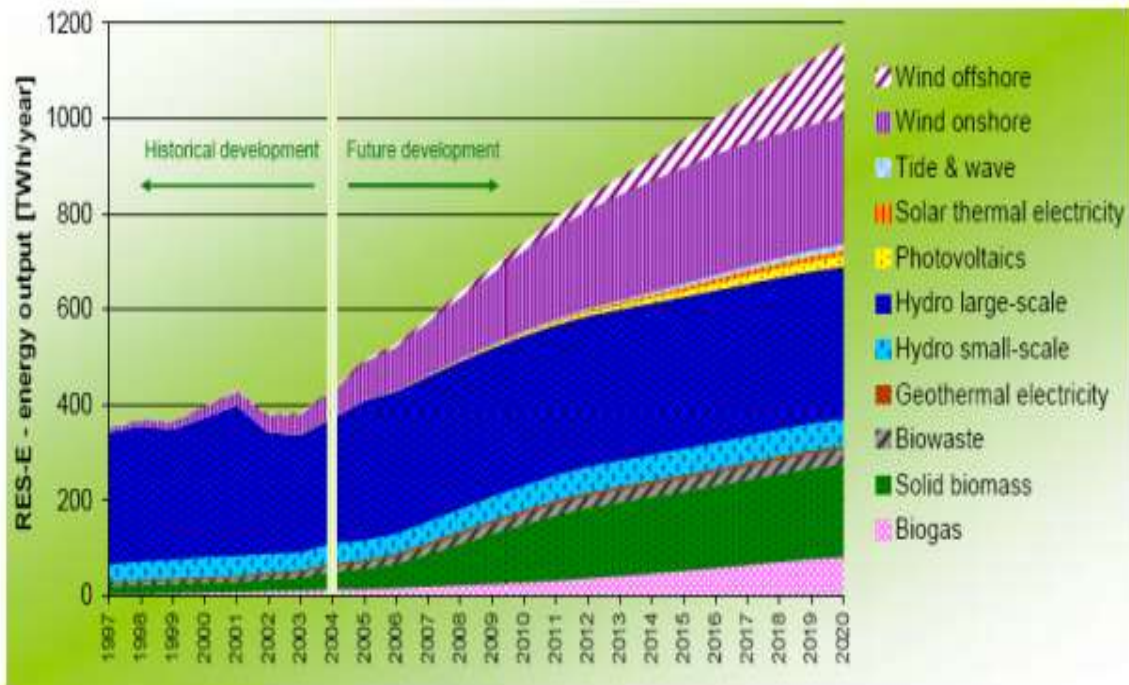


Figure-2: Renewable Energy Road Map

Bioenergy Governance

Bioenergy supply chains pass several layers of governance, including both emerging governance mechanisms that specifically address bioenergy (e.g., bioenergy sustainability standards and certification systems) and existing regulation of sectors involved, such as work environment regulations, environmental codes, best-management agriculture/forestry practices, and international trade standards. The EU Renewable Energy Directive (EU-RED) includes a specific set of sustainability requirements on biofuels that companies producing for the EU-RED market need to comply with. Compliance can be verified through an approved voluntary certification scheme. This example of co-regulation was widely supported in a recent global bioenergy survey. However, implementation within EU-RED can be challenging. The scope of private governance is limited (e.g., only 10% of the world's forests are certified) and public governance in prospective bioenergy producer countries may be based on norms and sustainability priorities that do not coincide with those expressed in the EU-RED. Furthermore, besides that legislation

may not suffice to safeguard sustainability as expressed in EU-RED, the capacity to enforce legislation may be insufficient.

International bioenergy trade

In the past decade, international bioenergy trade of both solid and liquid biofuels has shown high growth rates – the total trade volume of major bioenergy commodities such bioethanol (used for fuel), biodiesel and wood pellets have all increased by a factor of 10 or more between 2000 and 2010. Total international trade volumes of liquid biofuels exceeded 200 PJ in 2010; the trade of solid biomass trade exceeded 300 PJ. This increasing demand has triggered a debate on the sustainable production of biomass. However, international bioenergy trade – if done right – can have important benefits in terms of:

- Socio-economic development, and
- Sustainable management and the rational use of natural resources.

Bioenergy markets are about to change. The current increasing demand for biomass is creating opportunities for exporting regions of traditional fuels, such as Brazil (ethanol), Argentina, Malaysia and Indonesia (biodiesel and vegetable oils) and Canada, the US and Russia (wood pellets). It is clear that major supply and demand regions are geographically separated, which means that global bioenergy trade will play a major role to match supply and demand. Also the required investments into mobilization of resources (including the production of biomass, development of infrastructure and distribution hubs etc.) need to be investigated thoroughly.

	Asia	America	Africa
Social sustainability	+++	+++	+++
Land use	++	+++	+
Water	+	+++	++
Biodiversity	0	++	0
Soil	0	+	0
Ecosystem services	-	0	-
Carbon stock	-	-	-
Air	---	-	---
GHG emissions	---	---	---

Figure-3: Coverage of general sustainability aspects in bioenergy related legislation

International bioenergy market

The global bioenergy market is undergoing constant evolution to provide its users some of the most dependable and advanced solutions. Bioenergy refers to renewable energy that is generated from materials derived from biological sources. For instance, biomass is a source of bioenergy that may include manure, wood, waste, straw, sugarcane, and many such byproducts.

Bioenergy is the single largest renewable energy source today, providing 10% of world's primary energy supply. It plays a significant role in several developing countries, where it provides basic energy for cooking and space heating. The deployment of advanced biomass cooking stoves, clean fuels, and additional off-grid biomass electricity supply in developing countries are key measures to improve the current situation and achieve universal access to clean energy.

The bioenergy market is broadly classified into biofuels and biogas. Biofuels consists of bioethanol and biodiesel. Biogas is produced by processing residual waste from livestock (dung, manure, and unconsumed food), food production (fruit and vegetable waste, residues from meat, fish and dairy processing, brewery waste, food waste), and effluents from industrial as well as municipal wastewater treatment plants.

Bioethanol in the biofuel segment is mainly produced by the sugar fermentation process, although it can also be manufactured by the chemical process of reacting ethylene with steam. Biodiesel is a clean burning renewable fuel made using natural vegetable oils and fats. Biodiesel is made through a chemical process which converts oils and fats of natural origin into fatty acid methyl esters.

Bioenergy market in North America is increasing due to the stringent emission norms in the region. U.S. in North America is anticipated to lead the production of bioethanol during the forecast period whereas Germany in Europe is expected to lead the biogas production from 2016 to 2024. The bioenergy market in Europe is anticipated to grow due to favorable subsidization schemes regulated by government in countries such as the Germany, France, the U.K., and Sweden related to bioenergy use and production. Major EU directives, commonly known as the Promotion of Renewable Electricity, Biofuels and Landfill Directives, along with the European Emissions Trading Scheme and parts of the Common Agricultural Policy, are some of the most important drivers behind the growth of bioenergy in the European Union.

Bioenergy regions

As a world leader in renewable energy technology, Europe plays a central role in understanding and building appropriate institutional support structures to promote a green electricity market. The RES-E Directive is one of the legislative foundation stones upon which Europe's renewable energy sector is being built. Adopted in 2001, the RES-E Directive set a target for a 21 percent share of electricity from renewables by 2010. Implementation of the directive by member states has been uneven, but much progress has been made: A comprehensive EU regulatory framework is in place and member states have adopted, and are working towards, national targets for green electricity. However, administrative and grid access barriers to the growth of renewable energy sources (RES) need to be removed at local, national and European levels.

A Bioenergy working group analyzed the implementation of the RES-E Directive in Finland, the Netherlands, and Germany focusing on electricity production from biomass. This section begins with a look at how the RES-E Directive is being implemented in Finland, Germany and the Netherlands. The country reviews present the status of bioRES-E production, highlight trends from 1990 to 2005, and analyze the competitiveness of bioRES-E during this time. Technical and non-technical barriers encountered in implementing the RES-E Directive in each country are identified. Future scenarios for bioRES-E in various EU countries are outlined. A general overview of the directives impact on the EU25 follows. Finally, the main RD & D priorities to increase electricity production from biomass are identified.

Bioenergy Market: By Region

- North America
- U.S.
- Canada
- Mexico

Europe

- Germany
- U.K.
- France
- Rest of Europe

Asia Pacific

- China
- India
- Japan
- Rest of Asia Pacific

Rest of World

- Brazil
- Argentina
- Mozambique
- Others

Pellet markets

In Europe, there are four core areas of pellet production: Central Europe (Bavaria, Austria, neighboring areas of France, Switzerland, Italy), Scandinavia (Southern Sweden), Finland and Baltic. These four regions account for 30-50% of Europe's total pellet production. However, each of these four markets has been developed with different policy incentives. The price of the pellets depends highly on the living area, the closer to production sites, the lower the price. This is mainly due to the high transportation costs.

Pellet trade takes place mainly with a country's neighbors because long distance transportation is expensive. Norway for instance exports huge loads of waste wood to Sweden because there is no pellet industry in Norway but in Sweden. When it comes to wood chips, Sweden, Denmark and Germany are the main importers and Russia and the Baltic countries the main exporters.

Internationally important pellet trade flows are from Canada to Europe and lately also from the US to Europe. In Europe, most of the pellet exporters are located in Eastern Europe and Spain/Portugal and most of the importers in central Europe and Scandinavia (except for Finland which is an exporter). Although Sweden is a net importer, it is also the second largest pellet producer after Germany. The largest per capita consumers are Sweden and Denmark. However, the market for pellets strongly depends on the heating plant. For instance, in central Europe, most of the heating plants are small scale or in domestic homes (55%), whereas in Finland and Sweden 70% are large scale heating plants with 50-500 MW.

Future trends of bioenergy

The future potential of bioenergy was estimated according to the availability and costs of different biomass feedstock in each region. Estimates for the feasible, large-scale production of heat, electricity and biofuels are based on reasonable transportation distances of feedstock, district and process heat loads, and existing heating and power plant capacity. Estimates of small-scale bioenergy use are based on statistical data on existing heating systems and their

energy sources. The additional availability of feedstock was estimated for two cost levels (Figure 4).

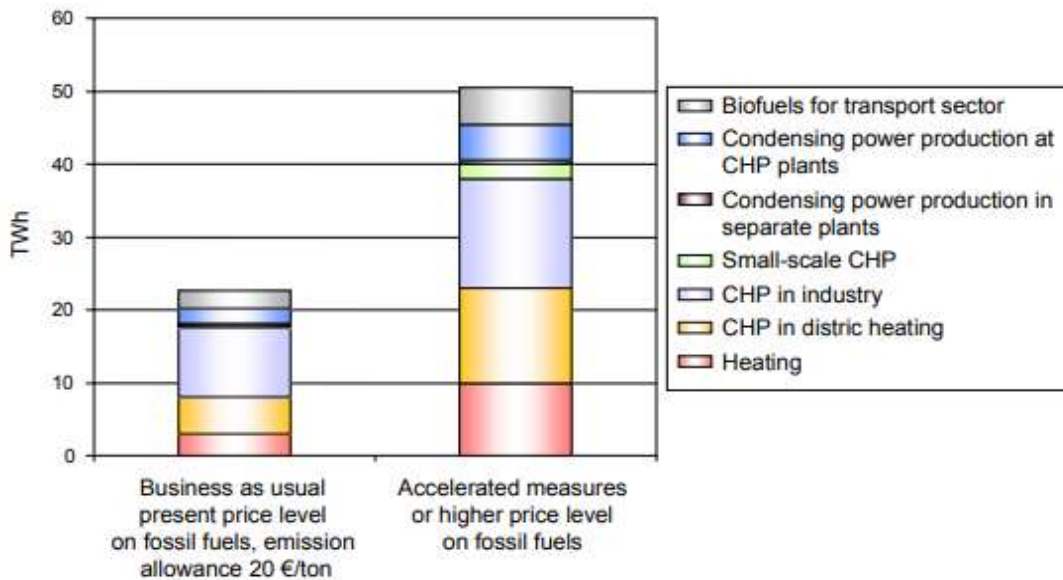


Figure 4: Additional use of bioenergy in different sectors in two scenarios in Finland by 2020.

The first uses the present price of fossil fuels, taxes and subsidies; the second nearly doubles the fuel costs. Wood fuels account for over half of the additional biomass feedstock, the remainder being agro-biomass and bio-waste. The study also looks at upgrading the current use of feedstock by processes like drying and flue gas condensing. Additional availability of peat is also projected because peat covers anywhere from 30-70 percent of the fuel demand of boilers over 20 Megawatt thermal (MWth) in Finland.

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