BIOMASS FOR ENERGY IN EUROPE AND THE UNITED STATES

W. Geyer, Kansas State University, Manhattan, Kansas, wgeyer@ksu.edu
and
L. Iriarte, Polytechnique University of Madrid, Madrid, Spain,
leire_iriarte@yahoo.es

ABSTRACT. World energy needs vary significantly between geographical regions. Africa and the Middle East each use 4% of the world's consumption, while Latin America is 7%, the old USSR about 12%, Europe about 18%, and Asia and North America about 28% each (2001 data). International primary energy needs are different between industrialized and developing nations. The latter relies primarily on coal, biomass, and hydroelectric power, while industrialized nations rely on coal, petroleum, and natural gas. In the future, biomass use will likely increase from 3 to 5%, coal use will increase, and petroleum use will decrease slightly in the highly developed areas of the world. Biomass energy sources provide about 3% of the needs and will increase in importance.

KEY WORDS. Biomass, energy, coal, petroleum, hydroelectric power.

INTRODUCTION

Bioenergy and energy crops are attracting growing attention and support from the European Commission and member states (6). Also, the United States places high importance on developing resources and conversion technologies for producing fuels, chemicals, and power from biomass (10). In both areas renewable energy production will constantly increase due to restricted supply and use of fossil carbon resources world-wide. During a recent EU-US workshop hosted by US-DOE and EU DG TREN, it was concluded that biomass will be the primary energy source for the 21st century like fossil fuels in the past (6).

The motivation behind energy policies are energy security and benefits. Namely policy makers see domestic biofuels as potential reserves during emergences, such as war or an energy crisis like the one experienced in the 1970's. Also, many biofuels are considered to be cleaner burning than their petroleum counterparts. They are generally more biodegradable, nontoxic, and less likely to cause cancer.

Presentation at the 2007 Society of American Foresters National Convention, October 23-27, 2007. Address correspondence to the first author at the Kansas State University.

This paper depicts the context for energy crops in Europe and the United States of America focusing on the recently released European Biomass Action Plan (BAP) (4) and supportive measures in the Common Agriculture Policy (CAP) (12) for energy crops - - methodology and research processes are outlined; as well as providing a description and analysis of the foreseeable problems; and concludes with a discussion on the barriers and drivers for cultivating energy crops , plus recommendations on how to enhance supportive measures in the CAP.

WORLD

World energy needs vary significantly between geographical regions. In 2002, Africa and the Middle East each use about 4% of the world's consumption, while Latin America 7%, the old USSR about 12%, Europe about 18%, and Asia and North America about 28% each (1). In 2005 there was about an 11 % increase of energy use with about the same distribution between regions (BP 2007). Biomass provided about 6% of the total of which 26% was in Africa and 15% in Latin America. Total international primary energy use between the industrialized world countries and the developing countries differs substantially (Figure 1); major differences being petroleum, biomass, natural gas, and hydro power.

Figure 1. International energy use comparing industrialized to developing countries.

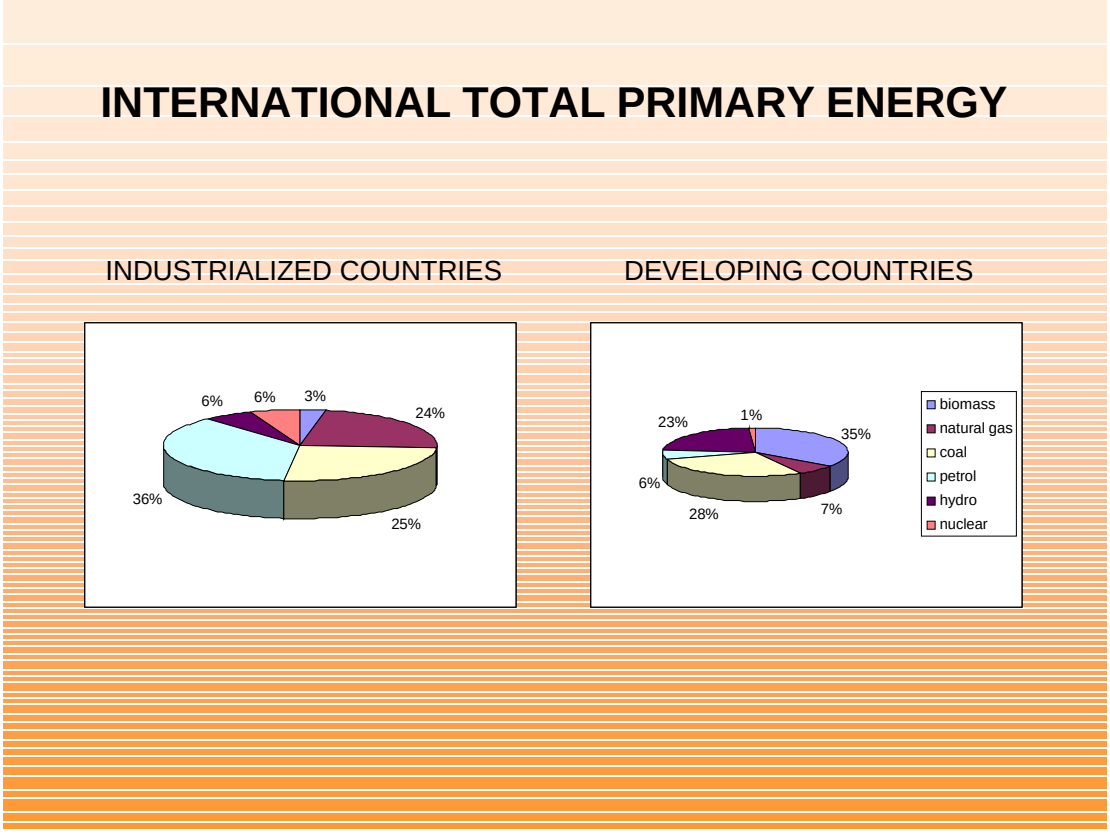

Table 1. (8) presents possible world energy production obtained from agriculture. Twenty percent of arable land dedicated for energy production (20tTS/ha) would give around 10% of total world energy required in 2050. Adding 7.5% from non-collected straw (11), 4.5% from collected waste processing, and 15% from forest or pasture would result in almost 40% of the entire energy needs in 2050. Increased energy demands, energy efficiency, and energy saving all mix into the situation. The arable land in Asia covers over 1/3 of the total world arable land. Therefore countries like China and India are vital biomass producers (8).

Table 1. World energy production from agriculture.

Energy supply 2050 by sources	**Scenarios & calculations**	**References**
1) Non collected straw (50%)	75000 PJ/year	Sanders 2005
2) Collected waste processing (50%)	45000 PJ/year	
3) Forest/pastures (50%)	150000PJ/year	
4)10% arable land	50550 PJ/year	Holm-Nielson et al 2005
5) 20% arable land	101100 PJ/year	
6) 30% arable land	152000 PJ/year	
Total (1+2+3+5)	371100 PJ/year	

Note: 1 PJ equals 10^{15} J

EUROPE

The need for European Community support for renewable energy is clear. Several of the technologies, especially wind energy, hydro power, biomass, and solar applications are economically viable and competitive and the Commission's White paper for a Community Strategy sets out a strategy to double the share of renewable domestic energy from 6 to 12% by 2010 (5). Table 2. presents 1995 and 2010 plans for energy production. There is projected an increase of 83.3% for biomass and much less for the other renewable forms of energy.

Biomass currently meets 4% of the EU's energy needs. The aim is to increase biomass use to around 150 Mtoe by 2010 (8). Emanating from this work, a Biomass Action Plan (BAP) (7) was developed in 2005 which defines how to accelerate the development of bioenergy from agricultural residues, forestry residues, waste streams, and energy crops, in order to generate heat, electricity, and biofuels for transport (5). The Common Agricultural Policy shapes the utilization of agricultural land comprised of arable land, permanent crops, and permanent pastures. CAP attempts to enhance productivity through boosting high-profile projects. Little progress had been made between 1997 and 2000 (12).

Table 2. European renewable energy production and forecast.

Energy source	Renewable energy supply				Increase	
	1995		2010		1995 to 2101	
	(Mtoe)	(%)	(Mtoe)	(%)	(Mtoe)	(%)
Biomass	44.80	60.3	135.00	74.2	90.20	83.8
Hydro power	26.40	35.5	30.55	16.8	4.15	3.9
Wind	0.35	0.5	6.90	3.8	6.55	6.1
Thermal solar	0.26	0.3	4.00	2.2	3.74	3.5
Photovoltaic	0.002	0.0	0.26	0.1	0.26	0.2
Geothermic	2.50	3.4	5.20	2.9	2.70	2.5
Total	74.31	100.0	181.91	100.0	107.60	100.0

Note: Mtoe equals 1000 tons oil equivalent.

USA

The Biomass Research and Development Act of 2000 created the Biomass R&D Technical Advisory Committee (BTAC) to provide advice to the Secretaries of Agriculture and Energy on program priorities (9). It set a national vision having as its goals the following: biomass will supply 5% of the nation's power, 20% of its transportation fuels, and 25% of its chemicals by 2030.This goal is equivalent to 30% of the current petroleum consumption and will require approximately one billion dry tons of biomass feedstock annually-- a fivefold increase over the current consumption (3).

Biomass is already making key energy contributions in the Unites States, having supplied nearly 2.9 quadrillion Btu (quad) of energy in 2003 (10). It has surpassed hydro power as the largest domestic source of renewable energy. Biomass currently supplies over 3% of the total energy consumption. More than, 75% of biomass consumption in the U.S. comes from forest lands.

The BTAC reports (2) that the USA can produce enough biomass feedstock (a 30% replacement by 2030) to meet much of our needs from forestland (25%) and agricultural land (75%).

COMPARISIONS BETWEEN EUROPE AND USA ENERGY NEEDS

About 23% of the USA's primary energy consumption comes from coal, which is greater than Europe –15%. Nuclear power provides only about 8% of our energy usage, while Europe's is 15%. All the other primary sources are about the same in both regions, except biomass usage is greater in the USA (Table 3).

Table 3. Consumption of primary energy sources in Europe and the USA.

Source	Europe	USA
	(%)	(%)
Coal	15	23
Petroleum	41	39
Natural gas	23	24
Nuclear	15	8
Hydro power	2	<1
Renewable	4	4
Detail of renewable	-	-
Biomass	47	92
Wind	2	2
Heat solar	1	0.6
Geothermal	5	5.2

RECOMMENDATIONS

In Europe, to accelerate the diffusion of energy crops, it has been proposed (6) that CAP introduce establishment subsidies, expand information campaigns, initiate demonstration projects, support agricultural cooperatives, and promote conversion technology expand projects. In the USA two potentially large sources of forest biomass not currently being used are logging and other removal residues, and fuel treatment thinning. A 50% increase in crops yields, a doubling of residue-to-grain ratios, developing more efficient harvesting equipment, and using no-till cultivation, growing perennial crops dedicated for bioenergy, using idle cropland and pastures, animal manure, and using a larger fraction of other residues (2) are necessary to meet the goals.

LITERATURE CITED

1) BP WORLD ENERGY. 2007. Primary energy consumption. http://www.bp.com/worldenergy/.

2) BTAC (Biomass Technical Advisory Committee). 2002a Vision of bioenergy and biobased products in the United States. http://www.bioproducts-bioenergy.gov/pdfs/BioVision_03_Web.pdf (October).

3) DOE (U.S. Department of Energy). 2003. Roadmap for Agriculture biomass feedstock supply in the United States. DOE/Ne-ID-11129. U.S. Department of Energy, November.

4) EUROPA. 2007a. Biomass action plan. http://europa.eu/scadplus/leg/en/lvb/1270.14.htm

5) EUROPA. 2007b. Innovation and technological development in energy. http://europa.eu/energy/res/index_en.htm.

6) EUROPA. 2007c. Renewable energy: white paper laying down a community strategy and action plan. http://europa.eu/scadplus/leg/en/lvb/1270.23.htm.

7) EUROPEAN COMMISSION. 2006. Biomass action plan. Luxembourg: Office for Official Publications of the European communities.

8) HOLM-NIELSEN, J.B. 2005. Biomass in the context of biorefineries. Optimal biomass production for energy utilization and new products. Baltic Biorefinery Symposium. Aalborg University, Esbjerg.

9) McCORMIC K. H. NILSSON, and M. TOMESCU. 2006. Energy crops and the common agriculture policy. World Energy 2006. p. 72-78.

10) PERLACK, R.D., L.L.WRIGHT, A.F. TURHOLLOW, R.L. GRAHAM, B.J. STOKES, AND D.C. ERBACH. 2005. Biomass as feedstock for a bioenergy and bioproducts industry: the technical feasibility of a billion-ton annual supply. USDOE and USDA. Oak Ridge National Laboratory, Oak Ridge TN. USA. 59 pp.

11) Sanders, J. 2005. Biorefinery, the bridge between agriculture and chemistry. Wageningen University and Research Center. IEA Workshop: Energy Crops & Bioenergy. Utrecth, NL, 22nd of September 2005.

12) RUOFF, R. 2003. The common agricultural policy and biomass production. Proceedings of the European Union legislation drives bioenergy conference. 14 November 2003. Brussels, Belgium.