3. NORTH AMERICA

Source: World Factbook[1]

A) INTRODUCTION

Like those of other oil importing economies, Canada's is vulnerable to fluctuations in international oil prices, and the country has recently begun to embrace the economic and environmental potential of biofuels. Canada has also declared its interest in biofuels as a means of reducing ozone depleting gases and complying with its Kyoto Protocol obligations.[2] Political will and an advanced agroindustrial technology sector together enhance Canada's prospects for the development of a viable biofuels industry. Despite favorable conditions, however, growth in Canada's biofuels industry has not yet materialized. The country has not yet tapped its potential for the production of grain-based ethanol, conventional biodiesel obtained from lipid rich crops and food by-products, or nonconventional biodiesel derived from biomass. While Canada is positioning itself to develop its biofuels sector, substantial government funding and subsidies will be necessary to make the nascent industry viable. Should the government choose biofuels as a strategic economic sector, it must agree upon a biodiesel fuel standard, design the appropriate incentives, and determine how the industry can be competitive vis-a-vis its neighbors to the south.

B) GOVERNMENT POLICIES

While Canada possesses significant primary resources for the development of biofuels, only recently has the government begun to create the necessary legislative and regulatory framework to foster the sector's development. In 2002, Canada's provincial energy ministers met to discuss the renewable energy portfolio standards and to determine how developing technologies could be incorporated into Canada's energy and agriculture sectors to diversify the energy balance.[3] Despite its efforts, the group failed to produce a consistent approach. Programs, policies, and incentives vary widely across the country due to significant differences in industry structure, ownership of assets, market size, and political leadership. Since the 2002 meeting, the federal government has investigated the impact of different approaches to renewable energy development including preferred treatment, tax credits and exemptions, green marketing and procurement, and renewable fuels standards (RFS).

Climate Change Plan for Canada and the Biodiesel Initiative
The government released the Climate Change Plan for Canada on November 21, 2002. It was the result of intensive consultation with the provinces and territories, as well as with stakeholders and individual citizens to demonstrate the government's intention to confront climate change while ensuring economic competitiveness and growth. The plan renewed the government's pledge to work with automotive manufacturers to improve new vehicle fuel efficiency 25% by 2010 and proposed additional steps to encourage consumer demand for more efficient vehicles. The government also com-

mitted to new investments to boost public transit and manage growth in vehicle use, setting the goal of increasing the amount of gasoline containing 10% ethanol blend to 35% of the market and dedicating resources to increasing biodiesel production to 500 million liters.[4]

The Climate Change Plan in turn led to the elaboration of the government's Biodiesel Initiative, which was announced August 2003. The Initiative allocates CAD11.9 million ($10.5 million) over 4 years (2003 – 2007) to address technical and market barriers to the development of a Canadian biodiesel industry based on low-cost feedstocks such as yellow grease and severed canola.[5]

According to Natural Resources Canada (NRCan), the government department specializing in sustainable development and the use of natural resources, the Biodiesel Initiative builds on the federal government's decision in the 2003 budget to exempt biodiesel from the normal diesel fuel excise tax (CAD0.04 per liter) ($.035 per liter). In partnership with Canadian industry and provinces, activities are underway to coordinate and advance policy, remove technical and marketplace barriers, improve appropriate technologies, encourage early adoption, and generate awareness.

NRCan is addressing the specific challenges facing the development and use of biodiesel from low-cost feedstocks through the following targeted activities:

Table 3.1a: Primary Targets of Canada's Biodiesel Initiative:

Education and Awareness	Promoting the development of a Canadian biodiesel market through websites, publications, exhibits, and outreach events.
Technical and Economic Assessments	Demonstration and optimization of low-cost production technologies and processes at a commercial scale, through use of analytical models, expert advice, and industry participation.
End User Technology Demonstrations	Pilot projects for on-road and off-road transportation sectors, consisting of up to10 systematic and monitored demonstrations of biodiesel distrib. and use.
Technical Information and Fuel Specification	Standardization of fuel quality and content focused on B2, B5, B20 and B100 emissions analysis, fuel specifications, and fuel property analysis.
International Technology Linkages	Increased government and industry awareness of global biodiesel activities through joint studies, standards, technology transfer and shared knowledge.
Technology R&D	Supporting infrastructure development for feedstock supply through improved and lower cost feedstocks, feedstock handling, and process conversion.

Source: Natural Resource Canada[6]

Ethanol Expansion Program
The government launched the Ethanol Expansion Program in 2003. In the first phase, CAD72 million ($ 63.7 million) was allocated to six projects. In the second phase, the government invested an additional CAD46 million ($40.7 million).

Table 3.1b: Projects allocated contributions under Ethanol Expansion Program

Commercial Alcohols Inc.	$15 million to build a new plant in Windsor, Ontario (199 million liters)
Husky Oil Marketing Company	$10.4 million to build a plant in new Minnedosa, Manitoba (130 million liters)
Integrated Grain Processors Co-Operative Inc.	$11.9 million to build a new plant in Brantford, Ontario (119 million liters)
Permolex Ltd.	More than $1.1 million to expand its facility in Red Deer, Alberta (12 million liters)
Power Stream Energy Services	$7.3 million to convert a recently closed starch plant in Collingwood, Ontario (52 million liters).

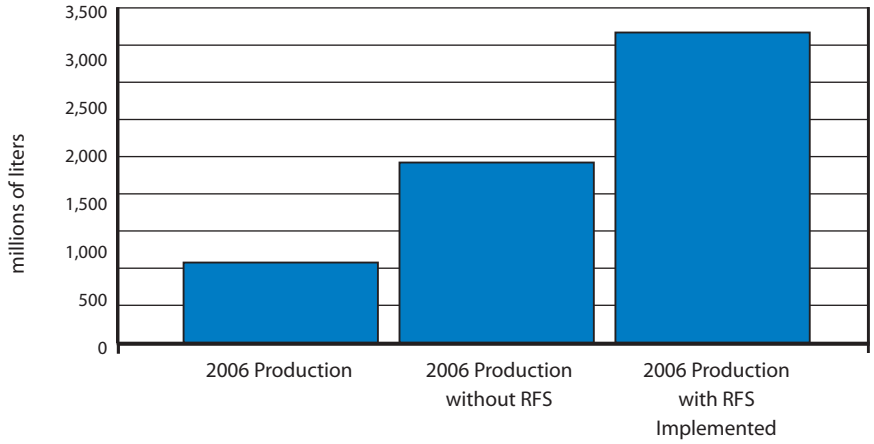
Source: Canadian Ministry of Natural Resources[7]

The 510 million liters of annual fuel capacity planned by these projects combined with additional production from the Ethanol Expansion Program would bring Canadian production to approximately 1.4 billion liters. If all these facilities meet their production targets, Canada will produce enough ethanol to meet the government's goal of having 35% of Canadian gasoline contain 10% ethanol by 2010.[8]

Renewable Fuel Standard and Tax Incentives

The degree to which renewable energy has taken root politically and socially was demonstrated recently in the political realm. During the 2005 general election, the main political parties both pledged to require a 5% Renewable Fuels Standard (RFS) for gasoline and on-road diesel by 2010. The RFS would legally bind all gasoline and diesel providers to sell fuel with a minimum 5% biofuel content. This provision would require 3.1 billion liters of ethanol and biodiesel a year, more than twelve times the amount the country currently produces.[9] In May 2006, the Canadian provinces agreed to support the federal government's push for the gasoline and diesel RFS by 2010.[10] While a defined RFS has yet to be passed, provisions contained in the October 2006 Clean Air Act will allow the government to require suppliers to sell fuel containing renewable content.[11]

Chart 3.1a: Projection of Canadian Ethanol Production to 2010 with and without RFS



Source: Agra CEAS and FO Lict

Federal Incentives
In order for Canada to achieve the 2010 targets, the government must craft the appropriate incentives to enhance production and shift consumption patterns. At present, the primary support instrument for fuel ethanol is a federal excise tax exemption amounting to 10 cents per liter of ethanol blended with gas. In addition to the federal initiatives, several Canadian provinces offer tax exemptions for biofuels and require fuel blending.

The Canadian government continues to support biofuels initiatives through substantial budget allocations and financing programs. In July 2006, the government declared that it will give small producers groups CAD$11 million ($9.7 million) to boost biofuel production and help meet the 2010 production target.[12] Further, Ottawa wants 5 percent of Canada's transport fuel to be renewable by 2010, which will require 3 billion liters of biofuels from 8 million tons of grain, oilseeds and biomass annually.[13] The first CAD$5 million ($4.3 million) tranche from the assistance package was released in September.[14] The government is developing a detailed strategy to increase production of biofuels which it plans to introduce to the Cabinet in late 2006. The majority of 2006 budget funds dedicated to biofuels will be directed to farmers and rural communities for the development of business proposals and feasibility studies for biofuels production.

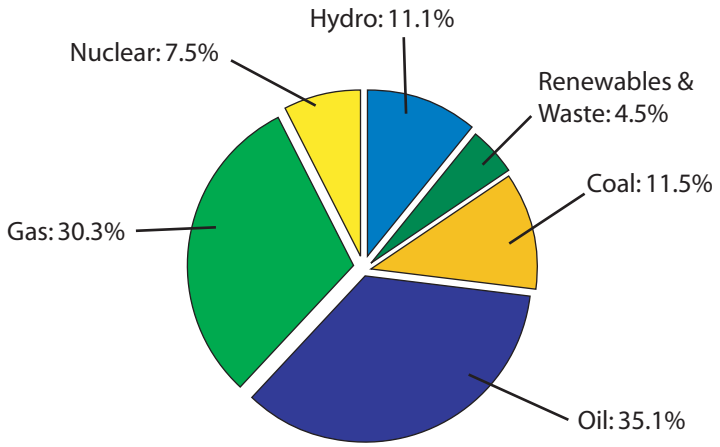
Provincial Initiatives
As discussed, several Canadian provinces provide road tax exemptions for ethanol-blended fuels, and some provinces, including Saskatchewan, Manitoba, and Ontario, apply mandatory blending rates. Each of these provinces is dedicating provincial resources to ethanol-specific initiatives and incorporating a range of incentives to boost production.

Relations with Brazil
Brazil is currently Canada's 16th-largest export market and 15th-largest trading partner. Key sectors in the trading relationship include agriculture, biotechnology, environment, energy, oil and gas, mining, financial services, pulp and paper, information technologies and telecommunications.[15] While the two countries have formed substantial commercial ties, there are no bilateral agreements or formalized relationship related to biofuels.

C) CURRENT SITUATION

Energy Matrix
Canada's energy portfolio is minimally diversified. Oil (35.1%) and gas (30.3%) constitute the majority of the country's supply, and only 4.5% of its energy comes from renewable sources. Consequently, the country continues to be vulnerable to volatile international prices.

Chart 3.1b: Canada'a Energy Matrix (2004)[16]



Source: International Energy Agency[17]

Significant investments in renewable energies including ethanol and biodiesel could further reduce Canada's dependence on imported oil and assist the country with its carbon emissions reduction commitments.

Production of Biofuels
Canada's biofuels industry has not fully matured. It is estimated that Canada produced 250 million liters of fuel ethanol in 2004 and will implement a 5% biofuels blend by 2010. If government programs are fully implemented, production could reach 1.4 billion liters in 2007 and 3.1 billion liters by 2010.[18]

Grain-based fuel ethanol
At present, grain-based production accounts for approximately 93% of production capacity with corn comprising 73%, wheat 17%, and barley 3%.[19] With the addition of new production plants currently under construction, grain-based fuel output is expected to at least triple over the next few years. Grain ethanol has now gained commercial acceptance and more than 950 retail outlets across Canada offer E10.

Oilseeds-based Biodiesel
Canola oil and animal lipids have the greatest potential to support an emerging Canadian biodiesel industry. There is underutilized capacity for additional canola oil production. Canada produces vast quantities of canola (rapeseed), as well as soy, mustard and corn, and has the potential to produce much more. The country is a net exporter of canola oil and non-crushed canola seed, making that crop the likely initial domestic feedstock source for virgin oil esterification biodiesel.[20]

Biodiesel can also be produced conventionally from other natural fats and oils, such as tallow, grease, and used cooking oil. Canada is a net exporter of tallow and grease, offering another potential domestic feedstock for production. Feedstock availability for biodiesel production has increased recently due to restrictions on the human consumption of certain animal products to avoid the spread of Bovine Spongiform Encephalopathy (BSE) and other animal diseases.[21]

Canada appears to have sufficient lipid feedstock to support an emerging biodiesel industry based on conventional biodiesel production and based on a demand of up to approximately 2% of the current transportation sector diesel consumption. The introduction of non-conventional biodiesel production technology and use of alternate low-lipid biomass resources could expand supply as the industry develops and demand grows.

Despite the adequate resource base, the commercial biodiesel industry in Canada remains limited. Small quantities are produced domestically to meet local demand, but barriers including cost have precluded the Canadian industry from taking root.[22] Despite these barriers, the first commercial biodiesel plant was recently constructed in Quebec and the industry is slowing expanding.

Current Biofuel Consumption
Until recently, biofuels consumption in Canada has been relatively low. In 2004, total fuel ethanol production and consumption amounted to approximately 250 million liters, of which approximately 200 million liters were produced locally using cereal grains such as corn, wheat and barley. Domestic production of biofuel provides for only 0.7% of the country's total petrol consumption.

Canada's agricultural sector does not produce adequate feedstocks to satisfy domestic demand. As a result, in 2005 Canada imported around 152 million liters of ethanol, most of which came from the United States. During the last five years, imports averaged 123.3 million liters while exports averaged 27.5 million liters.[23] According to Fleet Challenge Canada, reported usage of pure biodiesel across Canada was approximately 11,710,000 liters for 2005.[24]

D) PRIVATE SECTOR

A number of Canadian and international companies have invested significant financial resources in biofuels and related technologies. Most investment has been for new construction facilities, pilot projects, and conversion plants. Iogen, a joint venture between Royal Dutch/Shell and Petro-Canada, successfully launched a demonstration plant in Ottawa for the conversion of biomass into ethanol. At full capacity, the plant is designed to process approximately 30 tons of feedstock per day, and produce an estimated 2.5 million liters of cellulose ethanol per year.[25] In addition, the Canadian government is now investing more than $218 million to construct a full-scale commercial plant to produce cellulosic ethanol by 2007. The new facility will help Canada meet its 5% biofuels target by 2010.[26]

According to the July 2006 F.O. Lichts World Ethanol and Biofuels Report,[27] Suncor Energy Inc. recently announced that it is close to completing its St. Clair ethanol plant near Sarnia, Ontario. The 200-million-liter plant cost $107 million to build and will process 20 million bushels of corn a year. The plant began production in July 2006.

In addition, Tisdale Dehy Ltd unveiled plans to construct an ethanol plant on the site of its alfalfa processing facility west of Tisdale, Saskatchewan that will have the capacity to produce 90 million liters per year. Construction on the facility will start in 2007.[28]

SunOpta Inc., a natural and organic food company, recently announced that it would sell their advanced, patented technology to China Resources Alcohol Corp. (CRAC) for a cellulosic ethanol demonstration facility. The facility is expected to produce in Zhaodong City, Heilongjiang Province by the end of the year and involves the enzyme company, Novozymes. CRAC is among the biggest ethanol producers in China and aims to produce 5,000 tons of cellulosic ethanol annually by the end of 2007 and one million tons annually by 2012 by incorporating Sunopta technology and equipment.[29] SunOpta is also developing biomass conversion plants in Canada using materials like corn, grasses and wheat straw to produce ethanol.

Finally, Advanced Biodiesel Group (ABG) of Australia is considering the construction of a new biodiesel facility near Irricana, Alberta. The facility would process canola oil and animal fats.

E) RESEARCH & DEVELOPMENT

As the country focuses political energy and increases investment, Canada may assert itself as a leader in new biofuels technology. Canada has significant biodiesel-related research interest and capacity within government and university research facilities and has demonstrated notable innovation and leadership in ethanol processing technologies.[30]

Natural Resources Canada (NRCan) directs Canada's efforts to develop clean energy technologies. Through advancements in science and technology, NRCan helps Canadians utilize their resources to enhance the country's competitiveness. In conjunction with funding programs, the agency assists many Canadian innovators in the private and public sectors to commercialize their energy technology ideas.[31]

Waste-based fuel ethanol

The current focus of NRCan's Bioenergy Development Program is forestry waste such as wood chips and sawdust and agricultural wastes including straw and chaff. Significant research progress is being made as well on how to convert municipal wastes into usable fuel. It is estimated that the waste in the country now could theoretically provide adequate feedstock to meet Canada's fuel ethanol targets. Specifically, this would require 3.8 billion liters per year (based on a 10% blend in 2005 vehicle demand of 38 billion liters).[32] However, these wastes contain lignocelluloses (woody materials) that require special treatment not part of traditional grain ethanol production. Research to identify the processes able to capture this potential and produce ethanol from wastes is underway.

The CANMET Energy Technology Centre (CETC), Canada's primary energy science and technology (S&T) organization, works collaboratively with public and private entities to develop and promote clean energy technologies.[33] CETC actively promotes Canada's clean energy capabilities around the world by participating in international programs and trade missions and hosting foreign delegations. According to the CETC, a Climate Change Trade Promotion Officer (CCTPO) was established to promote Canadian clean energy technologies abroad. The Trade Promotion Officers (TPOs) are now located in Poland, Mexico, and India to facilitate the expansion of Canadian technologies and provide support for Clean Development Mechanism (CDM) and Joint Implementation (JI) projects to reduce greenhouse gas emissions.

The Office of Energy Research and Development (OERD) manages the government's energy science and technology activities. It provides funding to and works in partnership with twelve federal departments and agencies, including CETC. It also collaborates with other levels of government, the private sector, and academia. These partnerships facilitate S&T input to energy policy and program development.

OERD also advances Canada's energy S&T objectives through international collaboration, mainly by chairing the Committee on Energy Research and Technology (CERT) of the International Energy Agency (IEA) and by participating in IEA Working Parties. The IEA helps to research, develop, and commercialize energy technologies that promote the energy security, environmental protection, and economic development of its member countries. OERD also shares information and identifies opportunities for cooperation in energy technology fields of common interest to Canada, Mexico, and the United States.[34]

F) CONCLUSION

Like other oil importing countries, Canada's economy is subject to volatile fluctuations in international oil prices and, as a consequence, the country has begun to channel public and private funds into the development of biofuels to diversify its energy portfolio. Canada has also declared its interest in biofuel as a means of reducing ozone-depleting gases and fulfilling its obligations under the Kyoto Protocol. Despite relatively strong political will, an advanced biofuel industry has yet to materialize. Canada is a net importer of grain and does not possess the necessary domestic feedstock for a robust ethanol industry. There is potential, however, for the production of conventional biodiesels from lipid rich crops and food by-products and for nonconventional biodiesels derived from biomass. Canada is well positioned to develop the sector given its substantial biomass reserves and advanced industry capability and technology. However, the government must agree upon a biodiesel fuel standard and design the appropriate incentives for industry participation.

As of 2006, a number of Canadian and international private sector companies have invested in the development of biofuels and related technologies. The majority of investments have been in new construction facilities, pilot projects, and conversion plants. While such investments will enable Canada to develop its ethanol capacity, limited feedstock and operational costs will likely impede the sector from contributing substantially to Canada's overall energy independence or to a global biofuels market.

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Source: World Factbook[1]

A) INTRODUCTION

The rising costs of petroleum and the incidence of rural poverty in Mexico make a domestic biofuels industry a potentially attractive economic development strategy, particularly in regions where high fossil fuels costs render infeasible the use of conventional energy. While Mexico is a net exporter of oil, biofuels development in the country could still enhance domestic energy security through diversification and displace the 30% of domestic consumption currently imported by Petroleos Mexicanos (PEMEX). Mexico's biofuels industry could also help diversify the country's troubled sugarcane sector and reduce excessive greenhouse gas emissions.

In 2003, renewable energy sources accounted for 5.1% of Mexico's primary energy supply. The government has expressed a desire to increase the share to 8% by 2012. Recent studies by the Mexican government estimate bioenergy could supply 54-85% of domestic energy needs. The studies estimate that 27-54% can be derived from wood fuels, 26% from agro fuels, and another 0.6% from their byproducts.[2] Investments in a domestic biofuels industry would create significant socioeconomic benefits for Mexico by generating employment, preserving the environment, and provide a market for Mexico's excess sugar supply.

Mexico's natural resources suggest the country could develop a robust biofuels industry and achieve its domestic biofuels consumption targets. The nation cultivates several viable biofuels crops including maize, sugar, sorghum and oilseeds, and possesses extensive tracts of arable land that enjoy favorable climatic conditions. Recent renewable energy legislation provides a basic framework for renewable energy production and creates incentives to attract investors. However, the legal framework will need to be solidified and expanded if it is to attract sustainable investment, particularly from abroad, and enable Mexico to comply with its commitments under the Kyoto Protocol. As important, agricultural productivity remains below potential and will need to be augmented if Mexico is to have the necessary primary material to become a competitive player in the global biofuels industry.

B) GOVERNMENT POLICIES

In December 2005, the Mexican Government passed legislation setting the goal of reaching 8% renewable energy use by 2012. The law establishes a federally-supported fund to support the implementation of renewable energy projects. The law stipulates that producers may sell excess production (beyond what is mandated) to the National Electric System.

In February 2006, the government passed another measure, which supports the development of bioenergetics and the diversification of energy sources. It mandates a 10% ethanol fuel blend for the country's main urban centers. The law also grants the Inter-sector Commission for Rural Development the authority to establish regional programs for both ethanol and biodiesel and charges the Secretary of Energy (SENER) and the federal government with investing in and developing biofuels production. Under this purview, the Inter-American Development bank is cooperating with the SENER, providing technical assistance to evaluate the use of biomass in the production of ethanol and biodiesel. The law also creates a set of fiscal incentives to foster the production and consumption of bioenergetics. For example, the law exempts from the VAT entities that receive profits from the production of bioenergetics.[3]

While the government has drafted needed legislation, it must provide additional support to agriculture and create appropriate business and investment incentives in order to cultivate a viable and sustainable biofuels industry. States throughout the country are also recognizing the potential for biofuels to contribute not only to energy security, but also to economic growth, and they are acting to create a favorable business climate. For example, the technical secretary of Planning and Development for the state of Seplade, Salvador Acha Daza, sponsored a forum on bioenergy in the state capital to promote investments in alternative energy and craft a regulatory framework that allows investors to take advantage of the renewable energy potential in the region.[4]

NAFTA and Potential Impact on Biofuels Trade

On January 4, 1994, the North American Free Trade Agreement (NAFTA) officially took effect with the objective of progressively reducing and eliminating agricultural trade barriers between the United States, Canada and Mexico. Since its inception, agricultural workers, politicians and citizens have debated the economic impacts of NAFTA. Over the life of NAFTA, agricultural exports between Mexico and the U.S. have increased by $5.6 billion and $5.7 billion respectively[5] demonstrating the agreements ability to facilitate trade for all parties. Full implementation of the agreement is scheduled for 2008, at which point, trade protections for corn and other vital biofuels crops will be eliminated.

As 2008 approaches, Mexico's National Confederation of Agricultural Workers fears that corn and bean imports will flood the market and threaten domestic production.[6] Mexico's corn imports are expected to rise from 7.3 million tons in 2006 to more than 13 million tons in 2015.[7] However, Mexico's Secretary of the Economy, Sergio Garcia da Alba, downplayed the CNC's concerns by emphasizing a shift in U.S. agricultural policy toward ethanol production, predicting that increased ethanol production in the U.S. will absorb excess corn and sugar supplies and prevent the inundation of the Mexican market.[8] The U.S. National Corn Growers Association concurs with Mr. Alba's hypothesis stating that U.S. domestic demand for ethanol is expected to increase U.S. corn demand for ethanol production up to 20%. The corn feedstock for ethanol production is expected to come at the expense of exports.[9]

Among other energy sources such as crude oil and petroleum products, NAFTA includes provisions for ethanol and specifies that governments shall not apply restrictions such as tariffs, quotas, or export requirements, with limited exceptions.[10] Behind Canada, Mexico is the second-largest exporter of petroleum products to the United States, exporting 1.569 million barrels per day.[11] NAFTA could further facilitate energy trade between Mexico and the United States should Mexico develop a viable and competitive biofuels industry. Exports of ethanol and biodiesel could be easily traded between the two countries given the burgeoning U.S. ethanol demand and the increase in trade of biofeedstocks.

Regional Cooperation and Relations with Brazil

Mexico is a member of the Alliance for Renewable Energy and Energetic Efficiency. The nation hosted the first regional meeting and was appointed the regional representative to the Alliance for 2005-2007.[12]

Mexico's new president, Felipe Calderón, recently asked President Lula of Brazil for

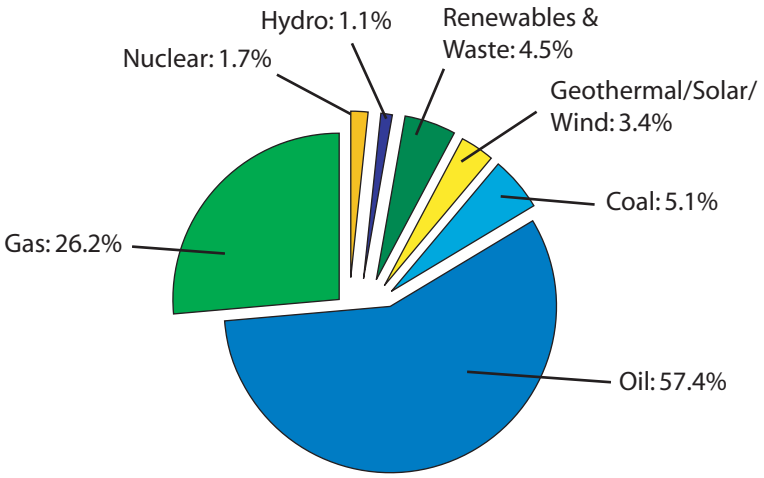
technical assistance in developing Mexico's ethanol industry. President Calderón made the request while discussing cooperation between Petrobras and Pemex to explore crude oil reserves in the Gulf of Mexico.[13] While the two did not elaborate on the details of potential technical cooperation, Brazilian representatives have toured Mexico and the region to identify potential partners for joint biofuels initiatives.

C) CURRENT SITUATION

Energy Matrix

The majority of Mexico's energy is derived from oil and gas with renewable energy sources comprising only a small fraction of the country's total energy supply. Mexico's dependence on fossils fuels for industry and transport, in particular, has helped make it the leading producer of fossil fuel emissions in Latin America. Mexico releases approximately 360 million tons of carbon dioxide annually.[14]

Chart: 3.2a: Mexico's Energy Matrix (2004)[15]



Source: International Energy Agency[16]

In Mexico, gasoline is oxygenated with 6% methyl tert-butyl ether (MTBE)[17], the majority of which is imported. Increased domestic production of ethanol could displace MTBE imports and save approximately $100 million a year in foreign exchange.[18] At present, groups such as "Fundación (e)mission", an environmental NGO based in Guadalajara, are promoting the use of a 10% ethanol blend in Mexico City, Guadalajara and Monterrey. Based on current levels of gasoline consumption in these three markets, the group projects that the market for ethanol would be between 500 and 600 million liters per year.[19]

Mexico produces 5 million tons of sugar and 56 million liters of ethanol per year, a level of production that is not sufficient to oxygenate gasoline for domestic consumption.[20] Biomass constitutes an estimated 8% of Mexico's primary energy, mainly through the use of wood for cooking and small industries.[21] Mexico's National Development Plan for 2001-2006 established the goals of diversifying energy sources and promoting the sustainable and efficient use of natural resources. The Energy Sector Program has committed to similar goals in order to increase the nation's use of renewable energy sources.

Crops grown for ethanol production

Mexico currently cultivates sugar, sorghum, and corn, which are all suitable for ethanol production. Mexico's sugar producers are best positioned to produce ethanol. The sugar industry directly or indirectly sustains 12 million Mexican workers and ranks 7th among global producers and 3rd in terms of tonnage yield per hectare.[22] The yield of sugarcane per hectare varies considerably among regions but, at an average of 72 tons

per hectare, 633 million hectares produce 5 million tons of sugar and 56 million liters of ethanol.[23] Overall, the cultivation of sugarcane accounts for 13.5% of total agricultural production and 0.5% of GDP.[24]

Mexico's sugar production has been increasing despite transformations in the sector including ownership restrucuturing. The country has been able to produce more than it consumes, but its prices are not competitive in world markets, in large part due to the strength of the country's agricultural unions. The existing surplus could, therefore, provide the ethanol industry with the raw material it needs while offering producers higher income for their harvest. To increase sugarcane and ethanol production, the industry is seeking to improve its selection of varietals, extend the growing season, and expand the use of soil stabilizers and fertilizers. The industry also intends to analyze whether such improvements would boost ethanol's competitiveness on the market. However, labor rigidities within the agricultural sector could increase the price of biofuels feedstocks, increasing production costs and reduce the global competitiveness of Mexican ethanol.

While sugar producers and refiners have the strongest technological capacity to produce ethanol, Mexico's corn producers also supply substantial resources suitable for biofuels. More than 55% of Mexico's agricultural workers engage in corn production, an industry which accounts for 11.3% of GDP.[25] In 2004, Mexico produced 11,806,710 tons of maize, valued at approximately $3.27 billion.[26] Despite being the world's fourth-largest maize producer, Mexico still imports maize to meet domestic needs. This production deficit means that Mexican corn producers would either have to significantly increase production or divert current supply to support a domestic ethanol industry.

An alternative to corn for ethanol production may be Mexico's competitive sorghum industry. Sorghum is Mexico's second largest crop, with over 6 million tons produced each year. Sorghum is more cost efficient than corn, but contains the same concentration of starch and could be utilized as an alternative feedstock for biofuel production.

Level of domestic ethanol consumption

Mexico currently consumes 164 million liters of ethanol and produces only 56 million, making the country a net importer. Current estimates suggest that the country's demand could reach 660 million liters per year. Mexico would require 5.760 million liters per year to satisfy the requirements for an E15 blend.[27] If production is incorporated into the production processes of the country's 58 sugar refineries ethanol production could increase substantially to satisfy growing local demand.

PEMEX does not have yet have plans for a plant to substitute MTBE with ethanol, which poses a major obstacle to the development of the industry in Mexico. The company will therefore not be able to comply with the Congressional order to add ethanol to its fuels by 2007.[28]

Prospects for biodiesel

While Mexico produces oleaginous seeds, development of the biodiesel industry remains limited. However, in 2005, El Grupo Energeticos S.A. and the Instituto Tecnologico de Estudios Superiores de Monterrey (ITESM) signed a cooperation agreement to produce biodiesel from animal fat. In July of that year, they opened a plant in Nueva Leon with the capacity to produce 500,000 liters per month.[29] In the first stage, the biodiesel will be used for industrial fuels in the north of Mexico. It is anticipated that subsequent phases will involve the commercialization of biodiesel production in Monterrey facilities with the capacity to produce 12 million liters per year.[30]

D) PRIVATE SECTOR

The Mexican energy sector has been closed to private investment since the 1940s and only began to open during the late 1990s. Authorities have recently recognized the potential to develop projects under the Kyoto Protocol's Clean Development Mechanism. At present, the Mexican authorities have issued 39 approval letters for CDM projects by the private sector.[31] Mexican industry is also making a concerted effort to incorporate

itself into the global biofuels industry. With the help of a $138 million investment from the Mexican government, Mexico expects to produce over 32 million liters of ethanol by 2007, using sugar and corn as the primary feedstock. The companies Destilmex and Nextach have committed to producing ethanol in Sinaloa, Nueva Leon and Sonora.[32] In addition, a group of industrial leaders recently met with the governor of Veracruz province to announce their interest in investing as much as $35 million in an ethanol plant in the northern part of the province.[33] While domestic investment in biofuels appears to be potentially healthy, burdensome restrictions and regulations in Mexico's energy sector are impeding the flow of international investment in biofuels.

E) RESEARCH & DEVELOPMENT

Mexico's Secretary of Energy is evaluating which sectors have the potential for using renewable energy. Through its 2006 legislation, the Mexican government is promoting and coordinating the integration of the National Network of Research and Development for Bioenergetics with the aim of coordinating and strengthening scientific research and technological development and promoting the proper management of natural resources associated with the production of biofuels and other bioenergetics. The law assigns the National System for Research and Technology Transfer the task of coordinating this research.[34] Specifically, the legislation provides for research and development dedicated to the development of agroindustrial technologies, the mechanized collection and transport of sugarcane, and the collection of vegetable oils and oilseeds for biodiesel as well as the gasification of biomass for the generation of electricity.[35]

The IADB has also funded a study to analyze the potential of the domestic biofuels inputs market, and the probable demand for such inputs. The study addresses the social, economic, technical and energy implications of the issue and seeks to collect the information needed to establish policy guidelines for a robust national industry.[36]

In addition, the IADB and SENER, with financial contributions from the United States Department of Energy, sponsored a feasibility study for the production of ethanol for transport.[37] According to IADB documentation, the study recommends the gradual introduction of ethanol into the Mexican fuel market in three phases. The first phase would utilize existing feedstock, with the next two phases expanding land use and the incorporating additional feedstock varieties. The plan incorporates an initial blending target of 5.7% to be eventually increased to 10% during the third phase. The plan would double employment in the sector, more than double the area under cultivation for biofuels and would require $2.24 billion in investment.

Additional research operations include the Instituto Tecnologico de Estudios Superiores de Monterrey (ITESM), which is using a biodiesel pilot plant that uses cooking oil as feedstock to study fuel properties and optimize the production process. The ITESM is also testing the performance of B100 in cars and is examining the potential of the jathropa plant as biodiesel feedstock.[38]

F) CONCLUSION

Given Mexico's natural resources, the country has great potential to develop a robust biofuels industry and achieve its domestic biofuels consumption targets. The nation cultivates several viable biofuels crops including maize, sugar, sorghum and oilseeds, and possesses extensive tracts of arable that enjoy favorable climatic conditions. Recent renewable energy legislation provides a basic framework for biofuels production and creates incentives to attract investors. However, this legal framework requires strengthening to attract sustainable investment and enable Mexico to comply with its commitments under the Kyoto protocol with respect to greenhouse gases. Agricultural productivity remains below its potential and will need to increase its efficiency and boost production if the country is to have the necessary feedstock for a viable and competitive biofuels industry.

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Source: World Factbook[1]

A) INTRODUCTION

The United States is the largest producer of biofuels in the world. The high and volatile price of oil and political pressure for energy independence and security have fueled both public and private investment in the U.S. biofuels industry. The development of the ethanol and biodiesel industries in the U.S. is helping to reduce agricultural surpluses and increase commodity prices, create rural employment, bolster farm income, and improve air quality by reducing GHG emissions. The biofuel industries have significant potential to reduce the US trade deficit and ease the country's dependence on foreign oil. Unlike Brazil and other Latin American countries that rely on sugarcane and sugar-related products for ethanol production, the United States utilizes corn as its primary feedstock. In the United States, ethanol derived from corn is produced at less than half the cost of U.S. sugar refining due to the commodity's abundance, its relatively low market price, and the existence of corn-related biotechnologies that contribute to efficient production.

While current energy prices are spurring biofuels investments, the long-term profitability of producing ethanol from corn and sugar will depend on the price of the two crops, the costs of conversion, and the price of gasoline. Government programs are injecting millions of federal and state dollars into the biofuels industry, allowing production to expand at relatively competitive prices. As ethanol production expands and the price of ethanol and petroleum moderate, opportunity costs for sugar producers increase and limit the industry's incentives for further development. Legislation such as the 2006 Farm Bill, Energy Bill, and the existing bans on MTBE will help support biofuels producers if and when gas prices moderate.

B) GOVERNMENT POLICIES

The biofuels industry has exhibited strong growth for more than a decade due in large part to federal policies promoting ethanol as a clean, renewable source of energy capable of bolstering the U.S. economy by injecting capital into the agricultural sector and enhancing energy security by reducing America's dependence on foreign oil. The 1970's oil crisis exposed the United States' vulnerability to fluctuations in the international oil price and generated political and economic interest in the development of renewable energy sources. Federal and state governments began issuing grants and subsidies to develop renewable energy facilities. Most early measures were ad hoc, however, and the alternative energy industry developed slowly.

Clean Air Act

In 1990, amendments to the federal Clean Air Act (CAA90) significantly enhanced

the demand for ethanol. The amendments sought to reduce automotive emissions by mandating the use of cleaner, more environmentally friendly fuels. The Oxygenated Fuels program sought to reduce carbon monoxide emissions, while the Reformulated Gasoline Program, originally introduced in California during the 1980's, focused on cutting smog-forming emissions.[2] At the time of the amendments, ethanol and methyl tertiary butyl ether (MTBE) were the primary oxygenates available to meet the requirements of the program. As a result of CAA90, U.S. ethanol production tripled, growth that was enhanced by the low price of corn and the high price of gasoline.[3]

MTBE Ban

U.S. ethanol production received another boost from coordinated efforts to ban MTBE, ethanol's competing gasoline oxygenate. In several incidents across the country, including notable cases in California, MTBE groundwater contamination revealed carcinogenic properties. In response to the positive economic performance of ethanol and the numerous pending state MTBE bans, ethanol production capacity expanded rapidly from 311.73 million liters in 2003 to 12.49 billion liters in 2004 and 14.38 billion liters in 2005.[4] While many states continue to maintain and expand MTBE bans recent federal energy legislation has eliminated the oxygenate requirement for gasoline and replaced it with a Renewable Fuels Standard.

Energy Policy Act of 2005

In August 2005, President Bush signed into law the Energy Policy Act, which explicitly called for investment and development in renewable energies. The Act authorized funding for a number of programs and tax incentives that have aided the ethanol and biodiesel industries. Provisions related to biofuels include:

Table 3.3a: Biofuels Provisions in the Energy Policy Act of 2005

Section 757 Biodiesel Engine Testing Program	Directs DOE to work with engine and fuel injection manufacturers to test biodiesel in advanced diesel fuel engines, determine impacts of different biodiesel blends, and study the emissions and warranty impacts of different blendstocks. Authorizes $5 million annually from 2006-2010.
Section 1342 Alternative Fuel Infrastructure Tax Credit	Provides a tax credit equal to 30% of the cost of alternative fueling property, up to $30,000 for business property. Qualifying alternative fuels are natural gas, propane, hydrogen, E85, or biodiesel blends of B20 or more. Buyers of residential refueling equipment can receive a tax credit for $1,000. For non-taxpaying entities, the credit can be passed back to the equipment seller. The credit is effective on purchases put into service after December 31, 2005. It expires December 31, 2009 (hydrogen purchases expire in 2014).
Section 1344 Biodiesel Excise Tax	Extends the tax credit for biodiesel producers established in the American Jobs Creation Act of 2004 (Public Law 108-357) through 2008. The tax credit is $.50 per gallon of waste-grease biodiesel and $1.00 for biodiesel. If the fuel is used in a mixture, the credit is one cent per percentage point of biodiesel used or 1/2 cent per percentage point of waste-grease biodiesel.
Section 1345 Small Agribiodiesel Producer Credit	Provides a $0.10 tax credit for each gallon of biodiesel produced by small producers (production capacity of less than 60 million gallons annually). This tax credit is capped after the first 15 million gallons produced annually.
Section 1346 Renewable Diesel Tax Credit	Amends the biodiesel tax credits to include renewable diesel fuel, which is derived from biomass by a thermal depolymerization process. The credit is $1 per gallon of renewable diesel.
Section 1347 Small Ethanol Producer Credit	Changes the definition of a "small ethanol producer" to a production capacity of up to 60 million gallons (instead of 30 million gallons).
Section 1823 Alternative Fuels Report Hythane and Biodiesel	Directs DOE to report on the potential for hythane and biodiesel to become large-scale sustainable alternative fuels. The report will include assessments of the environmental and energy security benefits of biodiesel and activities necessary to make hythane a competitive transportation fuel. DOE may issue grants to universities or colleges to assist in the report. The report is due to Congress in August 2006.

Source: United States Department of Energy[5]

Tax Incentives for Ethanol Fuels

Present law provides for a partial federal excise tax exemption of $0.51 per gallon ($1.93 per liter) for ethanol blended into gasoline. For example, fuel blended with 10 percent ethanol receives a tax credit of 5.1 cents per gallon. E-85, which is 85 percent ethanol by volume, receives a 43-cent per gallon credit. The Volumetric Ethanol Excise Tax Credit (VEETC) legislation passed in 2004 extends the effective date of the tax credit through 2010.[6] The tax exemption is directed at gas companies and petroleum blenders in an effort to incentivize the use of ethanol. Corn farmers do not receive direct benefits from the exemption. Further, the federal government provides three groups of income tax credits to further encourage ethanol use, including the alcohol blenders' tax credit, the straight alcohol credit, and the small ethanol producers' credit.

In addition, the federal government provides support to offset a portion of the costs

incurred by producers who must purchase additional feedstock for ethanol production. The Federal Bioenergy Program subsidizes a percentage of additional purchases of grain for ethanol and oilseeds used in biodiesel production. States have also offered significant subsidies to producers in an effort to attract investment. For example, Nebraska offers a $0.20 per gallon ($0.76 cent per liter) subsidy for eight years to producers able to generate a minimum level of ethanol output.

Renewable Fuels Standard

As an alternative to the oxygenate requirements imposed by the 1990 Clean Air Act amendments, the federal government has decided that all fuel sold in the United States must contain a specified amount of renewable fuel. Under the Energy Policy Act of 2005, the United States Environmental Protection Agency was designated as the entity primarily responsible for promulgating regulations to ensure that gasoline sold in the United States contains a minimum volume of renewable fuel. A national Renewable Fuel Program (also known as the Renewable Fuel Standard Program or RFS Program) will increase the volume of renewable fuel required to be blended into gasoline, starting with 15.14 billion liters in calendar year 2006 and nearly doubling to 28.39 billion liters by 2012. After lengthy deliberations among the EPA, refiners, renewable fuel producers, and many other stakeholders, a statutory default standard of 2.78% was put in place for 2006.[7]

The EPA is advocating a RFS for 2007 and beyond that incorporates RFS standards for refiners and other fuel producers, proposes a credit trading system, compliance mechanisms, and reporting requirements. The EPA estimates that the RFS will reduce petroleum consumption by 8.71 to 14.76 billion liters or roughly 1.0 to 1.6% of the petroleum that would otherwise be used by the transportation sector. Carbon monoxide emissions from gasoline-powered vehicles and equipment will be reduced by 1.3 to 3.6%. Emissions of benzene (a mobile source air toxin) will be reduced by 1.7 to 6.2%. The EPA also states that the use of renewable fuel will reduce carbon dioxide equivalent greenhouse gas emissions by 9-14 million tons, about 0.4 to 0.6% of the anticipated greenhouse gas emissions from the US transportation sector in 2012. Further, the agreement authorizes $100 million in 2006, $250 million in 2007, and $400 million in 2008 in grants for production of ethanol from a variety of sources including corn, biomass, sugarcane, and sugar beets.[8]

Analysts believe that the Renewable Fuels Standard will contribute to significantly increased production of corn-based ethanol, which is already prevalent and cheaper than ethanol from most other feedstocks. Goals for the annual volume of renewable fuel additives are as follows:

Table 3.3b: RFS Goals for Annual Volume of Renewable Fuels Additives

	2006	2007	2008	2009	2010	2011	2012
Bn Gallons	4	4.7	5.4	6.1	6.8	7.4	7.5
Bn Liters	15.1	17.8	20.4	23.1	25.7	28	28.4

Source: US Environmental Protection Agency[9]

If this doubling of US ethanol capacity occurs through corn-based ethanol production, the land needed to supply the industry would nearly double as well. Biological and mechanical improvements in technology may enhance yields and decrease the requirements for additional land, but current estimates anticipate that a dramatic expansion of farmland is likely.

Biodiesel and Biomass Policy and Tax Incentives

The RFS agreement also provides $110 million for each fiscal year 2005-2009 for pilot projects dedicated to the production of biodiesel. The RFS extended to 2008 the Biodiesel Blenders Tax Credit, which provides about one dollar per gallon ($0.26 per liter) through a federal excise tax credit to biodiesel blenders employing virgin vegetable oil feedstocks and $0.5050 per gallon ($0.13 per liter) to producers using recycled

grease and animal fats. This program began in 2004 under the American Jobs Act. The existing Commodity Credit Commission Bio-energy Program also supports biodiesel producers through grants when economic conditions do not support biodiesel production. Recent payments through the Commodity Credit program have been reduced, however, and the program is expiring this year.[10]

The Energy Policy Act of 2005 also created a new credit for small biodiesel producers equal to $0.10 per gallon ($0.02 cents per liter) on the first 15 million gallons (57 million liters) of biodiesel produced at facilities with an annual capacity not exceeding 60 million gallons (227.1 million liters). This credit is capped at $1.5 million per year.[11]

The Biodiesel Engine Testing Program provides $5 million per year in funding for fiscal years 2006-2010[12] to initiate a collaborative research project testing biodiesel in advanced diesel engine and fuel systems technology.

2007 Energy Proposals

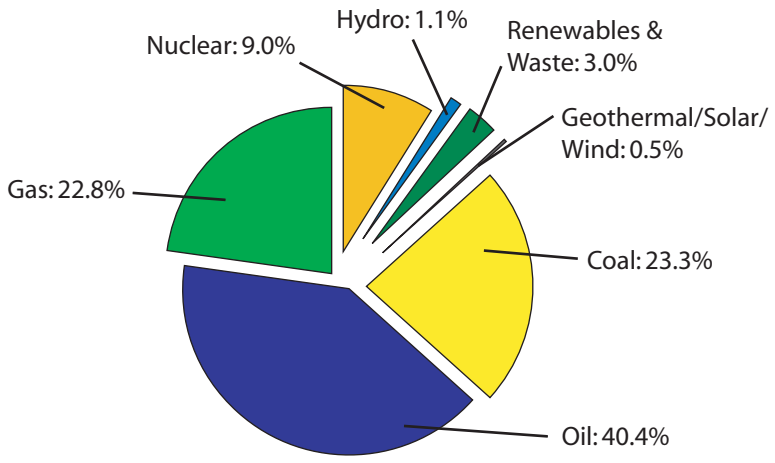
In the January 2007 State of the Union Address, President Bush announced a 20% reduction in petroleum use by 2017. The administration intends to achieve this target by increasing the supply of renewable and alternative fuels by setting a mandatory renewable fuels standard that will require 35 billion gallons of renewable and alternative fuels by 2017, a five-fold increase from the 2012 target currently in law. The proposal also seeks to reform and modernize the corporate average fuel economy (CAFE) standards in an effort to reduce projected annual gasoline use by up to 8.5 billion gallons. Through the energy proposal, the administration hopes to achieve an overall 20% reduction in gasoline use.[13]

C) CURRENT SITUATION

Energy Matrix

According to the International Energy Agency, in 2003 the United States relied on oil and gas for nearly 63% of its total energy supply with only 3% being derived from renewable sources and waste. According to the Energy Information Administration, imports account for 65 percent of US crude oil supplies, and oil imports are the largest component of the growing U.S. trade deficit.

Chart 3.3c : United States's Energy Matrix (2004)



Source: International Energy Agency[14]

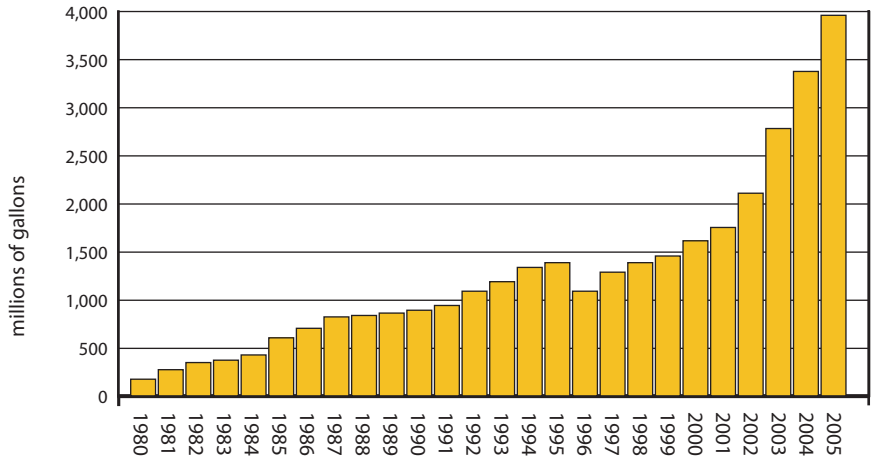
The US spends about $250 billion on crude oil imports annually. The U.S. uses 3.18 billion liters of oil a day–about 11.36 liters a day for every person in the country, 65% of which is imported. By 2025, demand is expected to rise to 26 million barrels (4.134 billion liters) a day, about 60% of which will be imported.[15]

An estimated 67% of US oil consumption is in the transportation sector. Approximately 140.05 billion liters of on-road diesel are used each year in the United States.[16] The production of 15.14 billion liters of ethanol last year meant that the US needed to import 27 billion liters of oil in 2005, valued at $8.7 billion.[17] While additional incentives remain necessary to shift consumption patterns, private investment coupled with federal and state efforts to increase the percentage of ethanol and biodiesel blends into the fuel mix are beginning to yield positive results, including the increase in percentage of ethanol blends for gasoline, reduction of harmful emissions, and revitalization of domestic agroindustry.

Ethanol Industry Capacity

Recent investment in the US renewable energy sector, particularly ethanol, has led to a rapid increase in production levels within the last few years. In 2005, 95 ethanol refineries in 19 states produced a record 15.14 billion liters of ethanol, up 17% from 2004 and 126% from 2001.[18] In 2005, dry mill refineries accounted for 79% of production capacity and wet mills for the remaining 21%. Rapid investment led to the completion of 14 new refineries in 2005 along with expansions of existing facilities, resulting in an annual capacity growth of 2.95 billion liters. At the end of 2005, 29 new ethanol refineries and 9 expansions were under construction with a total expected annual capacity of more than 5.68 billion liters.[19] The Renewable Fuels Association projects that these investments will increase U.S. ethanol production by more than 20% in 2006.[20]

Chart 3.3d: Historic U.S. Fuel Ethanol Production



Source: Renewable Fuels Association[21]

The Energy Information Administration (EIA) declared that U.S. ethanol producers were averaging 52.3 million liters of ethanol production per day in August 2006.[22] Ethanol demand remains strong, averaging 61.22 million liters per day. Existing stocks and imports are filling the gap between demand and domestic production.

Table 3.3c: Ethanol Statistics for August 2006

Fuel Ethanol Production	427.8mg	329,000 b/d
Fuel Ethanol Use	500.8 mg	385,000 b/d
Fuel Ethanol Stocks	384.7 mg	27.8 days of reserve
Fuel Ethanol Exports	0.0 mg	n/a
Fuel Ethanol Imports	133.2 mg*	n/a

Source: U.S. International Trade Commission[23]

While ethanol production facilities are present throughout the country, the majority of plants are in the Midwest's "grain belt". The concentration of facilities around feedstock production reduces transportation and related costs, enhancing industry efficiency.

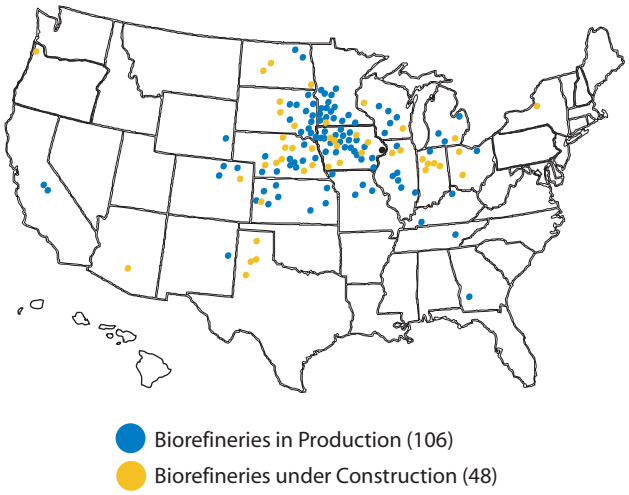
Table 3.3d: U.S. Ethanol Production Capacity by State

State	Capacity MMGal/yr	% of Capacity	No. of Plants	% of Plants
Iowa	1,606	33.0%	25	24.5%
Illinois	706	14.5%	6	5.9%
Nebraska	566	11.6%	11	10.8%
Minnesota	546	11.2%	16	15.7%
South Dakota	475	9.7%	11	10.8%
Wisconsin	193	4.0%	5	4.9%
Kansas	179	3.7%	7	6.9%
Indiana	122	2.5%	2	2.0%
Missouri	110	2.3%	3	2.9%
Colorado	93	1.9%	3	2.9%
Tennessee	67	1.4%	1	1.0%
North Dakota	51	1.0%	2	2.0%
Michigan	50	1.0%	1	1.0%
Kentucky	38	0.8%	2	2.0%
California	34	0.7%	3	2.9%
New Mexico	30	0.6%	1	1.0%
Wyoming	5	0.1%	1	1.0%
Ohio	3	0.1%	1	1.0%
Georgia	0.4	0.0%	1	1.0%
Total	4,872	100.0%	102	100.0%

Source: US EPA[24]

Still, production facilities are expanding across the United States, where they are contributing to economic growth and rural employment. Spending on annual operations and investment in new plants added a combined $32.2 billion of gross output to the US economy in 2005.[25]

Map 3.3a: U.S. Ethanol Biorefinery Locations



Source: Renewable Fuels Association[26]

Given the consistent, upward trajectory of production and investment, the US ethanol industry is projected to grow steadily through at least 2015.

Table 3.3e: Projected Ethanol Capacity and Production 2005-2015

	ETOH Capacity (MGY)	Net New Capacity (MGY)	Capacity Utilization	ETOH Production (MGY)	Corn Share	Other Feedstocks (MGY)	Ethanol Yield (Gal/Bu)	Crop Year Corn Use for ETOH (Mil Bu)
2005	4,286	686	93%	4,063	90%	600	2,750	1,586
2006	5,911	1,625	95%	5,615	90%	562	2,765	2,196
2007	7,611	1,700	95%	7,270	90%	723	2,780	2,502
2008	8,361	750	95%	7,945	90%	794	2,795	2,643
2009	8,761	400	95%	8,323	90%	832	2,810	2,751
2010	9,161	400	95%	8,703	89%	957	2,825	2,805
2011	9,461	300	95%	8,988	88.5%	1,034	2,840	2,853
2012	9,711	250	95%	9,225	88%	1,107	2,855	2,895
2013	9,961	250	95%	9,463	87.5%	1,183	2,870	2,926
2014	10,161	200	95%	9,653	87.5%	1,255	2,885	2,951
2015	10,361	200	95%	9,843	86.5%	1,329	2,900	2,976

Source: Legg[27]

Ethanol from Corn

Nearly 93% of the ethanol produced in the United States is produced exclusively from corn. The remaining 7% is produced from a blend of corn or similar grains. Less than 1% is produced from waste beverages, cheese whey, and sugars and starches combined.[28]

Table 3.3f: 2006 U.S. Composition of Ethanol Production Feedstock

Plant Feedstock	Capacity MM Gal/yr	% of Capacity	No. of Plants	% of Plants
Corn[a]	4,516	92.7%	85	83.3%
Corn/Milo	162	3.3%	5	4.9%
Corn/Wheat	90	1.8%	2	2.0%
Corn/Barley	40	0.8%	1	1.0%
Milo/Wheat	40	0.8%	1	1.0%
Waste Beverage[b]	16	0.3%	5	4.9%
Cheese Whey	8	0.2%	2	2.0%
Sugars & Starches	2	0.0%	1	1.0%
Total	4,872	100.0%	102	100.0%

[a]includes seed corn
[b]includes brewery waste

Source: US EPA[29]

84 of the 97 production plants processing corn use the dry milling process. Over the last decade, dry mills have dedicated significantly more resources to ethanol production, and new construction is almost exclusively dry mill-based. Dry-milled corn has increased from less than 150 million bushels in 1996 to nearly one billion in 2005-2006. Wet-mill production has remained relatively stable at approximately 500 million bushels per year. Employing average corn yields and standard ethanol extraction rates, ethanol production in 2005 would consume the amount of corn produced on almost 4.17 million hectares, up from 1.38 million hectares in 1996.[30] It is critical that corn supplies remain reliable and competitively priced in order to maintain an efficient and competitive ethanol industry.

The upsurge in public and private investment in corn-based ethanol has improved the United States' prospects for energy independence while transforming American agriculture. Once dependent on subsidy programs and vulnerable to erratic commodity prices, US corn and soybean farmers are capitalizing on the rush toward renewable forms of energy. If US and global demand for ethanol persist, farmers may see a corresponding increase in ethanol price, perhaps reducing the need for continued federal assistance programs. The economic incentives for ethanol production remain strong as long as oil prices remain elevated. According to estimates by Credit Suisse First Boston's Energy Group, "US production will remain economically sound so long as oil prices remain above $30 a barrel."[31] This projection assumes, however, that current federal subsidy programs will remain in place.

Ethanol from Sugar

The United States produces less than 1% of its ethanol supply from sugarcane and sugar beet feedstock. Using data from 2003-2004, it is estimated that the cost of converting sugarcane into ethanol would be approximately $0.63 cents per liter based on sugarcane market prices and estimated sugarcane processing costs (feedstock accounts for about two-thirds of total production costs). Sugar beet conversion costs were slightly more competitive at $0.62 cents per liter.[32]

Table 3.3g: Summary of estimated ethanol production costs (dollars per gallon)

Cost Item	U.S. Corn-wet milling	U.S. Corn-dry milling	U.S. Sugar Cane	U.S. Sugar Beets	U.S. Molasses[3]	U.S. Raw Sugar[3]	U.S. Refined Sugar[3]	Brazil Sugar Cane[4]	E.U. Sugar Beets[4]
Feedstock[2]	0.40	0.53	1.48	1.58	0.91	3.12	3.61	0.30	0.97
Processing	0.63	0.52	0.92	0.77	0.36	0.36	0.36	0.61	1.92
Total Cost	1.03	1.05	2.40	2.35	1.27	3.48	3.97	0.81	2.89

Excludes capital costs.
[2]Feedstock costs for U.S. corn wet and dry milling are net feedstock costs; feedstock costs for U.S. sugar cane and sugar beets are gross feedstock costs.
[3]Excludes transportation costs
[4]Average of published estimates

Source: United States Department of Agriculture[33]

No plants in the US currently produce ethanol from sugar, and production facilities that utilize sugar are significantly more expensive to construct and operate than those that use corn. Elevated production costs are due in large part to the significantly higher costs of sugar feedstock. Ethanol production from sugar would only be profitable as long as petroleum prices continue to be high. Sugar mills and refineries that incorporate technology enabling them to shift between sugar and ethanol production could capitalize on the growing ethanol market when market conditions are favorable. However, any reduction in the price of oil will reduce prospects for long-term profitability and remove incentives for sugar producers to incur the high capital and opportunity costs associated with restructuring production.

Ethanol from Cellulosic Biomass

The RFS for 2007 contains a provision requiring that 250 million gallons (946.25 million liters) of the renewable fuel consumed by 2013 be ethanol derived from basic cellulosic biomass ethanol.[34] Cellulosic biomass includes matter that occurs on a renewable or recurring basis including dedicated energy crops and trees, wood and wood residues, plants, grasses, agricultural residues, fibers, animal and other waste materials, and municipal solid waste. Ethanol produced in facilities where animal or other waste materials are digested or otherwise used to displace 90 percent or more of the fossil fuel normally used in ethanol production also meets the RFS's requirements. At present, there are no plants that qualify as producing ethanol from cellulosic biomass. However, ethanol produced from other organic matters such as manure may qualify under the current RFS and yield enough ethanol by 2013 to meet the RFS requirement.

Composition of the Ethanol Industry

The US ethanol industry is currently owned and operated by both corporations and farmer-owned cooperatives. Corporations currently run 55 plants, while farmer-owned coops control the remaining 47. An average ethanol plant has a mean annual capacity of 48 million gallons (181.86 million liters), with corporation-owned plants generally above the mean and farmer-owned cooperatives below.[35] Statistics compiled by the EPA show a certain degree of concentration within the industry, with eight companies producing 45% of total capacity.

Table 3.3h: US Ethanol Production: Top Eight Producers

Company	Capacity MMGal/yr	No. of Plants
Archer Daniels Midland	1,070	7
VeraSun Energy	230	2
Hawkeye Renewables, LLC	200	2
MGP Ingredients, Inc.	190	3
Aventine Renewable Energy, Inc.	150	2
Cargill Inc.	120	2
Abengoa Bioenergy Corporation	110	3
New Energy Corp.	102	1
Total	2,172	22

Source: US EPA

Trade Competitiveness of US Ethanol

The United States and Brazil are by far the largest and most competitive producers of biofuels. The cost of Brazilian ethanol produced from sugarcane is $0.22 cents per liter. US ethanol produced from corn costs 0.29 cents a liter to produce.[36] Higher production and transport costs make US ethanol more expensive than Brazilian product.

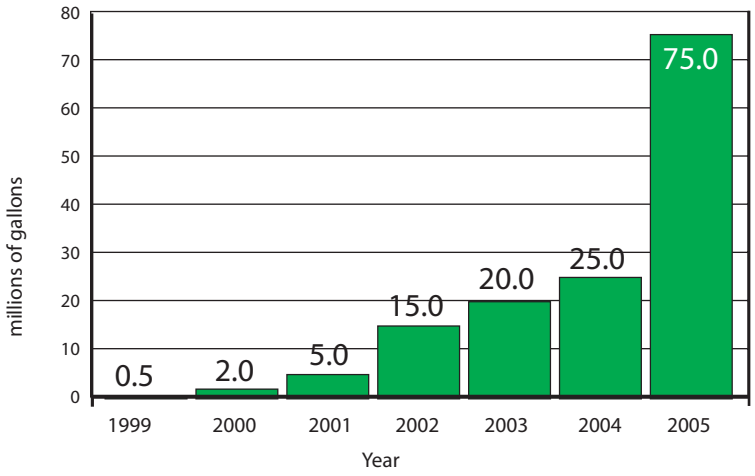
Given the competitive edge of Brazilian producers, the US has sought to protect the domestic ethanol market with an ad valorem tariff of 2.5 percent as well as an import duty of $0.54 cents per gallon ($0.14 cents per liter).[37] The tariff is meant to ensure that the benefits from the tax credits accrue to domestic rather than foreign producers. However, volatility in US ethanol prices and the competitive price of Brazilian ethanol have allowed increased amounts of Brazilian ethanol to enter the US market. In October 2005, Brazilian ethanol was $2.12 per gallon (including freight costs and import tariffs) and US ethanol was $2.47 per gallon. As a result, US imports of Brazilian ethanol jumped from zero in August 2005 to 2.7 million gallons (10.22 million liters) in September 2005 and have since increased further.[38]

Biodiesel

While not nearly as developed as corn-based ethanol, a small but notable biodiesel market exists in the US. Although the fuel can be produced from peanut, canola, cottonseed, and corn oil, the primary feedstock for US biodiesel is soybeans. Incentives created by the federal RFS program and tax code have greatly improved the industry's prospects. State legislatures have also strongly supported biodiesel. More than 275 bills supporting biodiesel were introduced in 2006, and 53 of them passed.[39]

In 2005, nearly 344 million liters of biodiesel were produced in the United States.[40] The Energy Information Administration projects that US production will increase to 1.567 billion liters in 2007 and then decrease to about 1.147 billion liters in 2012, assuming that the biodiesel blender tax credits expire in 2007.[41] According to the National Biodiesel Board, 85 companies now market biodiesel in the US market. Sixty-five facilities are currently under construction with another 13 expanding their operations.[42]

Chart 3.3c: Estimated U.S. Biodiesel Production



Source: National Biodiesel Board[43]

Indicators suggest that biodiesel capacity will continue to expand if support programs remain in place and the price of biodiesel remains high enough to attract investment. Indeed, increased capacity could ultimately outpace domestic demand.

While production is increasing, biodiesel has trouble competing with regular diesel on price. Feedstock costs constitute the majority of the production costs.[44] One gallon of biodiesel requires 7.3 pounds (3.31 kilograms) of soybean oil at a price of approximately $0.20 per pound (0.45 kilograms). Feedstock alone therefore costs a minimum of $1.50 per gallon (3.785 liters) before refining, transportation, and storage costs. Biodiesel can only compete when oil prices are abnormally high and commodity prices unusually low. Federal tax incentives offset some but not all of the price disparity. The relatively high price of biodiesel means it is generally used in blends ranging from 2-20%, with lower blends being less expensive.

Government forecasts suggest biodiesel could displace up to 37.85 billion liters of petroleum by 2030.[45] It is apparent, however, that a clearly articulated policy of incentives, tax credits, and mandates will be essential if biodiesel is to remain economically viable in the US energy market.

D) PRIVATE SECTOR

The United States has become the most attractive market in which to invest in renewable energy, according to a recent Ernst & Young index.[46] Increasingly supportive government policy, stemming from concerns about energy security and climate change, moved the US ahead of Spain, which had occupied first place in the index since March 2005.[47]

Ethanol

While some analysts warn that the deluge of investment in renewable energy may create an investment bubble, private investors and venture capital groups continue to pump resources into the sector. In August 2006, the alternative energy company Altra Inc. announced that it raised more than $120 million from private investors, bringing its total to more than $250 million from venture capital firms in fewer than six months.[48] With funding from investment groups including Kleiner Perkins Caufield & Byers, Sage Capital Partners and Khosla Ventures, Altra is building a nationwide network of ethanol and biodiesel plants that is projected to produce 1.9 billion liters of ethanol annually in a 18.9 billion-a-year ethanol market. The company has initiated the construction of an ethanol production plant in Ohio and recently acquired California's largest ethanol plant, Goshen, where it plans to expand production by 30% to nearly 132.5 million liters a year.[49] While the investments are sizeable and ethanol production

is growing rapidly, it still comprises a small fraction of the 529.9 – 567.75 billion liters of gasoline consumed in the US each year.

Biodiesel
Imperium Renewables recently began work on the nation's largest biodiesel fuel plant in Aberdeen, Washington. The plant will use farm crops to produce 378.5 million liters of biodiesel a year, more than the total US biodiesel output in 2005. According to the company's founder, the fuel will be suitable for any engine that uses traditional diesel fuel, and the plant will not need government subsidies to be profitable.[50]

E) RESEARCH & DEVELOPMENT

In his 2006 State of the Union address, President George W. Bush set forth an Advanced Energy Initiative to reduce US dependence on oil. Through the program, the President proposed a 22% increase in funding for clean energy research at the U.S. Department of Energy.[51] The Initiative specifically dedicates research and development funds to expand the production of ethanol, as well as other sources of renewable energy.

Corn
Total yield from US corn production has increased markedly over the last several years, reaching a record high of 160.4 bushels per acre in 2005.[52] Higher corn yields are primarily a result of genetically modified seeds and favorable weather. A large percentage of corn and soybeans planted in the US are genetically modified to resist insects, disease, herbicides, and harsh climate conditions. Improvements in farm management, farming methods, and energy efficiency also contribute to reduced production costs. Recently, farmers have begun using Global Positioning Systems (GPS) to improve the application and consistency of nutrients and chemicals.[53] Automation and computerization have also reduced labor requirements and increased the efficiency of plants.

Modern corn ethanol plants are employing a number of energy saving technologies, including heat exchangers to capture heat from cooking starch for use in the distillation process. Distillation processes now incorporate molecular sieves to capture and remove carcinogenic material, a practice which eliminates one round of distillation and saves as much as $25,000 per installation, thereby reducing energy costs by up to 20%.[54]

Biodiesel
Research into technologies that can reduce the costs associated with biodiesel production would expand the sector and improve the fuel's competitiveness within the market. Technologies to increase production yields and reduce the costs of oil seed crops would be particularly beneficial. Enhanced oil extraction technology could reduce existing pretreatment and ultimately cut prices. Other strategies for increased competitiveness include enhancing demand for by-products produced from crushed soybean and glycerin.[55]

Biomass and Cellulosic Ethanol
In April 2006, President Bush requested $150 million in the 2007 budget for research for advanced production of ethanol from cellulose. New biotechnologies to transform cellulosic material such as corn stalks, sugarcane bagasse, wheat and rice straw, and switch grass could yield almost 265 billion liters of ethanol a year.[56]

At the 2006 Advancing Renewable Energy Conference, the Agriculture and Energy departments dedicated $17.5 million for 17 biomass research, development, and demonstration projects with the objective of producing technologies that can enhance biofuels' market competitiveness.[57]

Significant research is underway on the development of cellulosic biomass for ethanol production. Cellulosic biomass is fermented and converted to sugars and then to ethanol. Given the abundance of cellulosic biomass in the US, ethanol costs could be reduced significantly if technologies are developed to produce ethanol from biomass on a large scale. According to the Energy Information Administration, "analysis of

technological goals for cellulose ethanol conversion suggests that ethanol could compete favorably with other gasoline additives without the benefit of a Federal subsidy if the goals were achieved. Enzymatic hydrolysis of cellulose appears to have the most potential for achieving the goals, but substantial reductions in the cost of producing cellulase enzymes and improvements in the fermentation of nonglucose sugars to ethanol still are needed."[58]

Dyadic International Inc. announced an agreement with Abengoa Bioenergy, the second-largest global ethanol producer, to develop one or more enzyme-mixture manufacturing systems for commercial development of cellulosic ethanol. Abengoa has agreed to invest $10 million in Dyadic,[59] and according to news sources, Dyadic will use the funds for research including a cost-effective enzyme production system for commercial use in bioethanol production.[60]

U.S. Agricultural Research Service
In light of ethanol's dramatic impact on US farmers and the potential of biofuels to serve as a clean, efficient fuel for use in the agricultural sector, the Agricultural Research Service designed National Program 307, which is dedicated specifically to biofuels research. The Program has four components: Ethanol, Biodiesel, Energy Alternatives for Rural Practices, and Energy Crops.[61] Currently, the program includes 120 projects throughout the United States including a study of the economic competitiveness of biofuels derived from grains and related biomass, an evaluation of ethanol technologies, and a project on the fermentation quality of sorghum.

Biobutanol
Recently, Dupont and British Petroleum (BP) announced a partnership to develop and market biobutanol as another clean and efficient alternative to gasoline. According to Dupont, biobutanol will have higher energy content than other biofuels, can be blended at higher levels, and will be generated from the same feedstocks.[62] Biobutanol is also expected to be less susceptible to separation if exposed to water and can be produced by retrofitted ethanol facilities.[63] The partners continue to develop biobutanol and plan to distribute the product as early as 2007.

U.S. Academic Institutions
Several elite US universities have opened research and development institutes to design technologies enhancing ethanol and biodiesel production.

The University of Minnesota's Initiative for Renewable Energy and the Environment (IREE) has funded more than 110 renewable energy-related projects involving over 275 faculty, research scientists, and students with grants totaling $19 million. In 2005, IREE grants of $11.5 million leveraged an additional $9.3 million in funds from government and industry. Among the projects funded by IREE is the Center for Biorefining, which coordinates the university's efforts in exploratory fundamental and applied research, stimulates collaboration with the private sector, promotes technology transfer, and fosters rural development. The center funds work on enzymatic hydrolysis and the conversion of swine manure into biofuels. It also supports the Biofuels Utilization Laboratory in the university's mechanical engineering department, which focuses on biofuels and engine performance.

Several institutions have received major research funding from major oil companies. Stanford University received $225 million from BP and $100 million from Exxon for an energy research program aimed at reducing greenhouse gas emissions. Texas A & M University also has ties to oil companies, particularly Shell, which has donated to the school for various projects. The University of California, Davis (UCD) hosts the UCD Bioenergy Research Group and has been awarded $25 million by Chevron to develop renewable transportation fuels from cellulosic material such as farm and forest residues, urban waste, and energy crops.

F) CONCLUSION

The upsurge in public and private investment in biofuels has improved the United

States' prospects for energy independence and transformed the country's agriculture sector. While still reliant on subsidy programs and vulnerable to erratic commodity prices, US corn and soybean farmers are capitalizing on the rush toward renewable forms of energy. The incentives for US ethanol production will be strong as long as oil prices remain above $30 per barrel. The extent to which ethanol producers can maintain a competitive advantage will depend on corn yields and market prices. New biotechnologies have helped to enhance production yields and reduce the overall increase in the amount of land harvested, but commodity prices and the opportunity costs of ethanol production ultimately will determine its relative competitiveness in the market.

Production and capacity trends for U.S. ethanol, biodiesel and cellulosic biomass remain on an upward trajectory due, in large part, to increased financial and tax support from federal and state governments. Increasing demand will require more corn feedstock and may compel farmers to increase their yields or divert feedstock from other uses. Trade support, including tariffs on foreign imports, will assist US ethanol producers to increase production. Despite concerns over a potential ethanol glut, strong economic incentives, active government involvement, and sustained global demand will continue to enhance the competitiveness of US biofuels. Increasing biofuels capacity and liberalizing trade policies will allow the US to respond to growing domestic demand for ethanol and support a viable and efficient international biofuels market.

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4. EUROPE

Source: World Factbook

A) INTRODUCTION

The principal goals propelling bioenergy in European countries are improving energy security, boosting rural development, and reducing greenhouse emission reductions. Transport is responsible for approximately 21% of the EU's greenhouse gas emissions, and recent European Commission directives have made biofuels in transport a regional priority. Not all member states are equally committed to the objectives set by the European Commission, but all are trying to some extent to achieve EU targets. Biodiesel accounts for 80% of European biofuels production and ethanol for the remaining 20% percent. Active market actors and lobbying groups have contributed immensely to the evolution of the market in recent years.

B) GOVERNMENT POLICIES

General Policy
Two European Commission directives will govern EU biofuels policy through 2010.

The first of these, issued in 2003, consists of a series of non-binding measures aimed at increasing biofuels supply and demand. The 2003 directive established an eventual target of 5.75% biofuels consumption in the transportation sector by 2010. In order to meet this target, the EU adopted its Strategy for Biofuels, which sought to:[1]

- Stimulate demand for biofuels
- Capture environmental benefits
- Develop production and distribution capacity for biofuels
- Expand feedstock supplies
- Enhance trade opportunities
- Support developing countries
- Support research and development

The Biofuels Directive also includes monitoring mechanisms for member states. Each country was required to report annually, beginning in 2004, on their biofuels measures and the share of biofuels in their national markets. These reports will form the basis for a European Commission biannual progress evaluation, which in turn will be the basis for amendments to the system of targets.[2]

The Energy Tax Directive makes it possible for member states to grant tax reductions and exemptions for biofuels under certain conditions. However, the two-year assessment report, together with the Energy Taxation Directive, aims to ensure that no overcompensation occurs. As production costs vary, especially for ethanol, the Commission is investigating to what extent instruments can take this into account while respecting international trade rules.

In 2006, the European Commission proposed extending an energy crop premium introduced by the 2003 Common Agricultural Policy reform to the eight member states that do not benefit from it. This would involve increasing the maximum area which can benefit from the aid to two million hectares from the current 1.5 million. The Commission also proposed allowing member states to grant national aid of up to 50 percent of the cost of establishing multiyear crops in areas where an application for energy crop aid has been made.[3]

The European Commission has also proposed additional changes to its recently amended Fuel Quality Directive, which sets common specifications for transport fuels used in mobile machinery such as vehicles, barges, trains and tractors. Under these changes, which would promote new standards to reduce air pollution and arrest climate change, including through greater use of biofuels, the commission would:[4]

- Oblige fuel suppliers to reduce CO2 emissions over the life-cycle of their fuels (from refining to end-use); beginning in 2011, suppliers would have to reduce emis sions per unit of energy by 1% per year from 2010 levels, resulting in a 10% cut by 2020;
- Establish a separate petrol blend with a higher permitted content of oxygenates, including up to 10% ethanol;
- Propose the mandatory introduction of vapor recovery equipment at filling stations to compensate for increased emissions of polluting vapors from greater use of etha nol.
- Mandate that all diesel fuel marketed have an ultra-low sulfur content (with a maxi mum of 10 parts per million) beginning in 2009.
- Reduce the maximum permitted content of poly aromatic hydrocarbons (found in diesel fuel) by one-third beginning in 2009.
- Mandate a reduction in the sulfur content of gasoil used by non-road machinery and inland waterway barges.

Relations with Brazil

The EU is Brazil's largest trade and investment partner. In 2005, the EU market was the destination of nearly a quarter of Brazilian exports, totaling $26.5 billion, an increase of nearly 10% over the previous year.[5] Total European investment in Brazil amounts to $102 billion. Agricultural exports to the EU increased by 29% percent during the period

2002-2004. Since 1999, Brazil and the EU have discussed establishing a free trade area between Mercosur and the EU.

The EU is not a primary destination for Brazilian biofuels exports, however, because the European market is largely focused on biodiesel. Still, the Netherlands and Sweden, which have focused more on ethanol, are two of Brazil's most important biofuels export markets, ranking fourth and fifth after India, Japan, and the US in 2005. Total sales to these two markets were more than 500 million liters in 2005, nearly 20% of ethanol exports.[5]

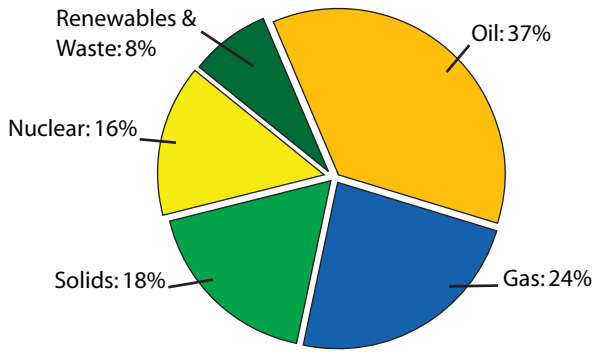
In 2004 the EC and Brazil signed an agreement for scientific and technological cooperation that could facilitate exchanges on biofuels.

C) CURRENT SITUATION

Energy Matrix

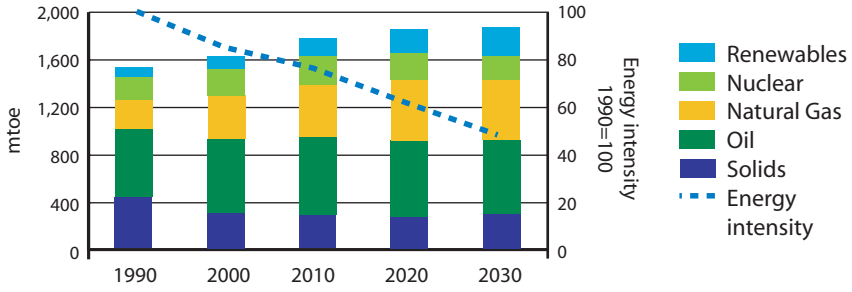
EU-25 primary energy consumption increased 41% from 1971 to 2003, a rate similar to that in the US.[6] Oil and natural gas remain the most important fuels. It is projected that in 2030 total energy consumption in Europe will be 15% higher than in 2000. This increase is expected to be met by natural gas and renewables.[7]

Chart 4a: Total Energy Consumption by Fuel (2004)



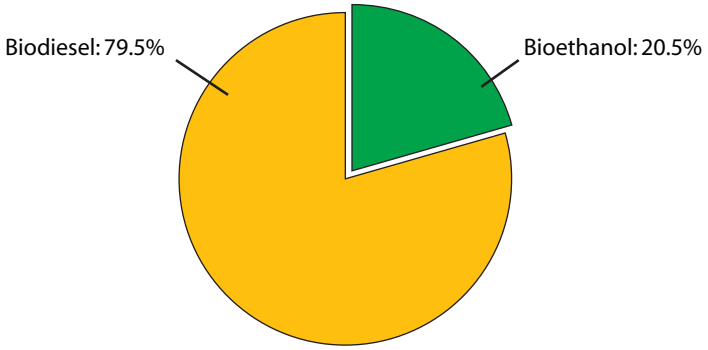
Source: Commission of the European Communities[8]

Chart 4b: Total Energy Consumption by Fuel and Energy Intensity



Source: A European Strategy for Sustainable, Competitive and Secure Energy. Commission of the European Communities. Working Paper. Annex to Green Paper. Brussels: 2006.10.

Chart 4c: Breakdown of the Biofuels Production in the European Union in 2004



Source: Biofuels Barometer[9]

Biodiesel

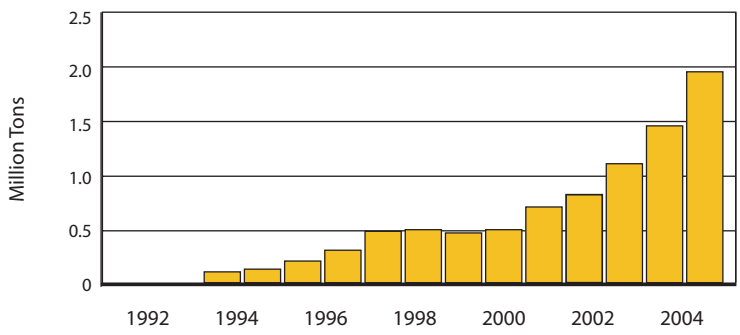
The European Union is the global leader in biodiesel. In 2004, upon accession of the new member states, the EU had 11 producer states. The top five biodiesel producers in the world in 2005 were Germany, France, the US, Italy and Austria.[10]

The EU accounted for nearly 89% of all biodiesel production worldwide in 2005, and its production capacity continues to expand dramatically.[11] According to the European Biofuels Board (EBB), biodiesel production in EU-25 countries jumped from 1.9 million tons in 2004 to 3.2 million tons in 2005, a 65% increase. Most biodiesel is produced in EU-15 states at the moment, although 20 EU countries produced the fuel on an industrial scale in 2006, up from 11 in 2005. By the end of 2006, EU biodiesel production capacity was expected to reach 6 million tons. These production levels indicate the transportation sector blend targets are not being met by member states, but changes to the EU's agricultural subsidy regime to encourage biofuels feedstock cultivation may boost production in the near term.[12]

European seed oil producers are increasingly turning from soybeans to rapeseed, which has a higher margin when used in biodiesel applications. Biodiesel produced from rapeseed and sunflower seed oil now accounts for 80% of EU biofuels production. The EU became a net importer of rapeseed for the first time in late 2005, a trend which is expected to continue as rapeseed imports increase to meet growing demand. Rapeseed oil imports are expected to reach 290,000 tons in 2006, dwarfing the 2005 figure of 33,000 tons.[13]

Major biodiesel producers include Diester Industrie (French), ADM (US, German subsidiary), Novaol (French), Natur Energie West (German), Fox Petroli (Italian), MUW (German), and Campa biodiesel GmbH (German).[14]

Chart 4d: EU Biodiesel Production since 1992



Source: Biofuels Barometer[15]

Table 4a: Biodiesel 2006 Production Capacity

Country	'000 Tons*
Austria	134
Belgium	85
Cyprus	2
Czech Republic	203
Denmark	81
Estonia	20
Finland	0
France	775
Germany	2,681
Greece	75
Hungary	12
Ireland	0
Italy	857
UK	445
Latvia	8
Lithuania	10
Luxemburg	0
Malta	3
Poland	150
Portugal	146
Slovakia	89
Slovenia	17
Spain	224
Sweden	52
The Netherlands	0
TOTAL	6,069

*Calculation based on 330 working days per year, per plant.
The above figures represent an overall picture of the EU-25 biodiesel capacity on July 1, 2006.

Source: European Biodiesel Board[16]

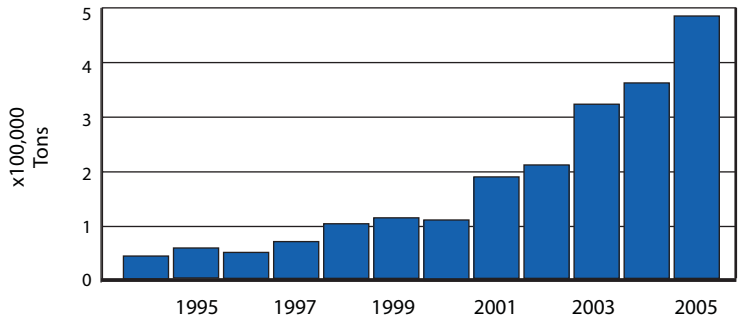
Ethanol

Ethanol production has been increasing since 1993. The share of ethanol used for transport, rather than beverage or industrial uses, has increased from less than 5% in 1995 to 35% in 2005. It is projected that by 2015 the transport sector will account for 80% of ethanol use.[17]

Spain is Europe's largest ethanol producer, producing a total of 194,000 tons in 2004, followed by France at 102,000, Sweden at 52,000, and Poland at 35,840. The EU-25 produced a total of 491,040 tons of ethanol in 2004.

This sector is controlled by large industrial groups and agricultural cooperatives. The Spanish group Abengoa is the largest ethanol producer in the EU. Its two plants in Spain together produced 226,000 tons of ethanol in 2004.

Chart 4e: EU Ethanol Production since 1993



Source: Biofuels Barometer

The EC reported in 2004 that ethanol production used about 1.2 million tons of cereals (0.4% of total supply) and one million tons of sugar beets (0.8% of total supply).[19] There is potential for more crops to be diverted to energy production.

In February 2006 the EU reformed its sugar sector. The reforms included a 36% cut in the internal sugar support price, elimination of the system of sugar purchases and a partial sugar production buyback. Sugar beet production now qualifies for payments when grown for biofuels purposes, and sugar used for the production of ethanol is not subject to quotas.[20]

Table 4b: EU Sugar Beets and Wheat Production in 2005

	Harvested	Yield	Production
Sugar Beet	2.2 million hectares (in 21 MS)	57.4 tons per hectare	126 million tons
Wheat	23 million hectares (in 25 MS)	5.4 tons per hectare	124 million tons

Source: USDA[18]

D) RESEARCH & DEVELOPMENT

An integral component of the EU Strategy for Biofuels is therefore the promotion of investment in R&D at the European and national level. The chief goal of EU research is to develop cost effective methods for producing advanced, second-generation biofuels, such as lingo-cellulosic ethanol, which produces fuel from waste rather than food crops. Current techniques for producing such fuels remain uneconomical for commercial applications.[21]

The current EU R&D agenda reflects a range of priorities and encompasses the entire production-consumption chain of biomass energy. This extends from basic research into plants, through breeding and selection, production, harvesting, drying, storing, processing and conversion (chemical, thermal or biological) to combustion which generates heat and electricity - including combined heat and power systems. The transportation sector is also an area of heavy focus, and the potential application of biomass fuel cell technology has attracted increased interest due to concerns over the sustainability and cost of hydrogen.

E) CONCLUSION

The European Union is expanding its biofuels sector significantly. The main drivers are environmental concerns, the need to invigorate the rural sector, and energy security. The outlook for a continued healthy biofuels market is good, and production is increasing at a rapid rate.

Despite producing a significant portion of global biodiesel and increasing production

of ethanol for transport, the EU faces a number of significant challenges in the coming years. Most important is the limited availability of arable land on which to cultivate biodiesel input crops such as rapeseed, although Ukraine's EU accession could help alleviate this constraint.[22]

EU biofuels policy is heavily influenced by the Common Agricultural Policy (CAP), which has come under fire during the Doha Round of trade talks and has been the subject of multiple unfavorable WTO rulings. In light of the recent sugar policy reform, it appears the CAP may be unsustainable in the long term, which may generate uncertainty in the EU's biofuels supply structure. Rapeseed and soybean imports by EU member states have been increasing rapidly, and this may foreshadow a more general trend.[23]

A further challenge is that even with the use of the most advanced production technologies, biofuels produced in the EU are not cost competitive with fossil fuels at current oil price levels. EU biodiesel currently breaks even when oil costs EUR60 ($76) per barrel, and EU ethanol would only break even at a EUR90 ($115).[24] New input crops and production methods could make biofuels more competitive. Ligno-cellulosic processing and biomass-to-liquid technologies, along with new forms of biodiesel, have been mentioned as potential lower-cost alternatives to current technologies.[25] Countries including Germany and the UK are actively promoting research into second-generation biofuels.

Endnotes

[1] Press Release, "Commission Urges New Drive to Boost Production of Biofuels," Europa, 8 Feb. 2006, 11 Sept. 2006 <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/06/135&format=HTML&aged=0&language=EN&guiLanguage=en>.
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Source: World Factbook

A) INTRODUCTION

In addition to having abundant hydro and biomass resources, Austria is committed to non-nuclear energy. Renewable energy enjoys a prominent position in Austria's overall energy requirements, with consumption ranking third in Europe, after Sweden and Finland.[1] Hydropower is the country's primary renewable energy source, and 10% of Austria's energy supply comes from biomass and waste.[2] In 1991, Austria had opened its first industrial biodiesel production plant.[3] Since then, numerous other plants have been constructed, and today Austria has the capacity to produce an estimated 133,000 tons of biodiesel a year.[4]

B) GOVERNMENT POLICIES

Austria's revised Fuels Ordinance of November 2004 translated the EU Biofuels Directive into national targets for biofuels market share, obligations for fuel suppliers, and sustainability certificates guaranteeing minimum requirements.[5]

Since October 2005, distributors in Austria have been required to incorporate a 2.5% biofuels blend into fuels.[6] The national target for biofuels in the transportation sector is 4.3% by October 2007, rising to 5.75% by October 2008 for all combustion engine fuels except those used for aviation.[7] This schedule outpaces the targets required by the EU Biofuels Directive.

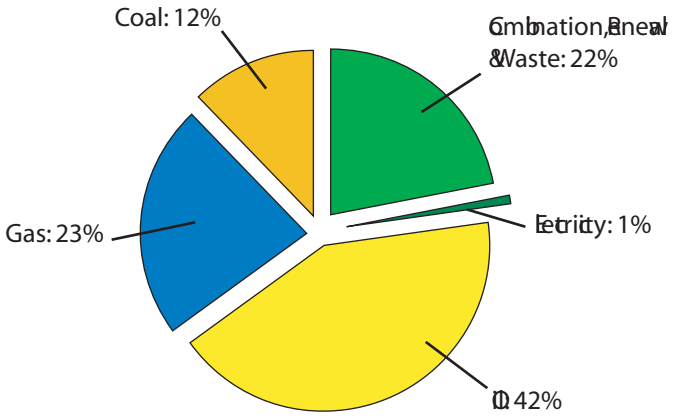
Tax incentives for biofuels include full exemption from the mineral oil tax (MOT) for pure biodiesel, an exemption begun in 2000 to facilitate further consumption.[8] Beginning October 1, 2007, a tax reduction for ethanol will be issued and the tax for ethanol blends will be reduced by EUR5 ($6.4) per 1,000 liters.[9] There is also a disincentive for refineries that do not blend their products with biofuels in the form of a non-compliance penalty, which is EUR23 ($29.4) per 1,000 liters of diesel and EUR13 ($16.6) per 1,000 liters of gasoline.[10]

Relations with Brazil
There is currently no cooperation between Austria and Brazil in biofuels.

C) CURRENT SITUATION

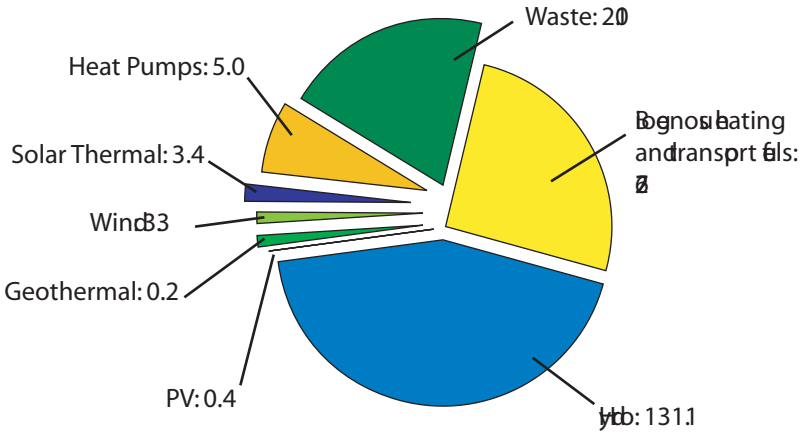
Energy Matrix
Austria's growing industrial sector requires new energy supplies.[11] It has a significant renewables sector, in which hydropower is the dominant source. 46% percent of the country is forested, and there is already significant use of forest-related raw materials for biomass energy, principally for district heating.[12] Rapeseed is the primary feedstock for biodiesel production.

Chart 4.1a: Primary Energy Consumption in Austria (2004)



Source: Austrian Energy Agency[13]

Chart 4.1b: Primary Energy Consumption from Renewables in Austria (2004)



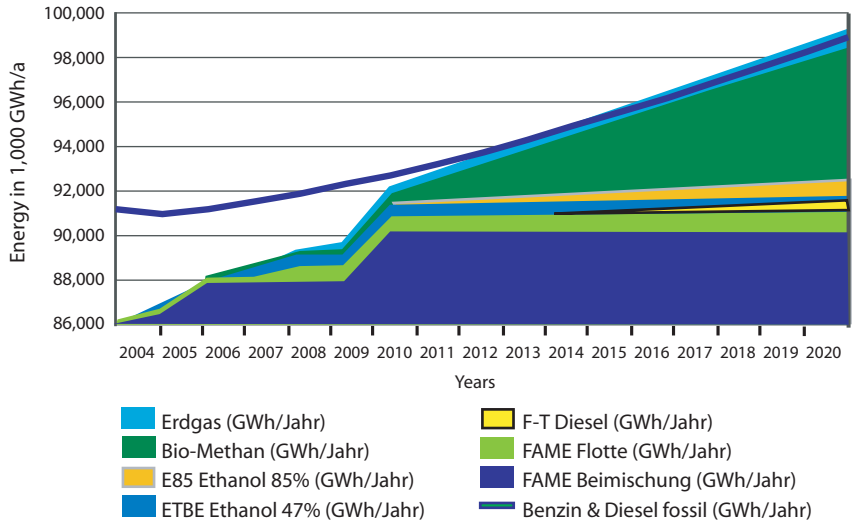
Source: Austrian Energy Agency

Production

There are now nine large-scale biodiesel plants in operation, with three more operating on a trial basis.[14] Austria produced 85,000 tons of biodiesel in 2005, although it had the capacity to produce approximately 125,000 tons.[15] 90 percent of Austrian biodiesel was sold abroad, primarily to Italy and Germany, where the going price for biodiesel is much higher.[16] In 2006, Austria could produce as much as 134,000 tons of biofuels, but will not likely produce to capacity.[17] Currently, there is no large-scale production of fuel ethanol in Austria.

Austria's projected biofuels outlook through 2020 is summarized in the chart below.[18] The Austrian Energy Agency estimates that the country will expand its use of biofuels in the coming years, and Austria could realize its full potential by moving even further beyond the EU mandates and issuing targets based on domestic production potential. The Austrian Energy Agency has suggested increasing the content of biodiesel to diesel from 4.7% to 10% by volume, increasing the content of ETBE to petrol from 5.75% to 15% by volume, creating infrastructure for gas vehicles such as bus and truck fleets, and creating demand for gas and petrol vehicles.[19]

Chart 4.1c: A Potential Development Path for Biofuels through 2020



Source: Austrian Energy Agency[20]

D) PRIVATE SECTOR

Austria has two companies that are world leaders in industrial-scale biodiesel plants: Biodiesel International with its multi-feedstock technology plants and Vogelbusch with its ethanol plants. The country also boasts world-leading research institutions and numerous smaller biofuels technology companies. In June 2006, Frankfurt-based Lurgi AG began constructing a $25 million biodiesel plant with the capacity to produce 100,000 tons of biodiesel per year.[21] When completed, this plant will be the largest biodiesel facility in the country.

Austrian sugar company Agrana is building a 190 million liter ethanol plant, the country's first, mainly using wheat and sugar beets as feedstock.[22] The plant will be located in Pischelsdorf and will become operational in mid-2007.[23]

E) RESEARCH & DEVELOPMENT

Since the first pioneering biodiesel research in 1973, Austria has continued extensive research and development activities in the biofuels industry.[24] The present version of the Austrian Energy Research and Technology Plan (drafted in 2002) focuses on gain-

ing technological leadership in bioenergy, increasing the share of renewable energy sources in industrial processes, and boosting the use of renewables in transport, among other goals.

Austria's federal ministries, the governments of the Laender, FWF (Fonds zur Forderung der wissenschaftlichen Forschung), FFF (Forschungsforderungsond fur die Gewerbliche Wirtschaft), ITF (Innovations und Technolgiefonds), and the Austrian National Bank each provide funding for renewable energy research activities.[25] In 2005, nearly $9 million in public money was earmarked for projects in the field of renewable energy.

The Federal Institute of Agricultural Engineering has been a key actor in Austria's biofuels R&D, particularly since it initiated a biodiesel pilot project in the mid-1980s.[26] Additionally, the Austrian Biofuels Institute offers professional and logistical support for biodiesel projects.

Aside from publicly funded research, private biofuels producers are developing new and innovative technologies and approaches to utilizing biofuels. Biodiesel International is one such corporation and has collaborated with such organizations as Graz University and Vogel & Noot.[27]

F) CONCLUSION

Through its high-level research institutes, Austria will increase its biofuels options and could be at the forefront of future biofuels development. Significant potential exists for technical cooperation between Brazil and Austria.

Endnotes

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Source: World Factbook

A) INTRODUCTION

Since Czechoslovakia split into Czech and Slovak republics in 1993, the Czech Republic has been restructuring its state-owned companies in various areas, including the energy sector. The government has tried to improve its energy efficiency and reducing carbon dioxide emission levels by introducing renewable energy laws and promoting the industry. The country has no gas or oil and very limited hydro resources.[1] With two nuclear power plants and a natural coal supply that will remain a large component of the country's energy make-up for the foreseeable future, renewable energy comprises only about 3% of the country's total energy consumption. The government has set targets for a substantial increase, including having renewable sources provide 8% of electricity by 2010.[2] The country has been producing rapeseed-based biodiesel for 15 years.

B) GOVERNMENT POLICIES

Since 1990, the Czech Republic has supported the production of rapeseed oil methyl esters (RME) for automotive fuel, under the "Oleoprogram". Due to a series of grants allotted to RME producers under the program, production plants were established in a relatively short period of time. Additional public resources have been used to promote RME and biodiesel production, and a biodiesel blend containing 31% RME has been produced for domestic consumption since 1997. In 2004, a new subsidy system based on world fuel prices was introduced, limiting subsidized production to 100,000 tons of RME in 2005.[3]

When the Czech Republic joined the European Union in May 2004, it was given until 2006 to adjust state aid for domestic RME production to meet EU standards. The country has since incorporated the EU Biofuels Directive into national policy measures in the form of three main pieces of legislation. The first decree (No. 86/2002 Coll.) stipulates the obligation of producers, importers, and distributors to ensure a minimum amount of biofuels and other fuels produced from renewable sources to stock the domestic fuel market. The second decree (No. 229/2004 Coll.) guarantees the quality of RME according to international standards (EN 12214), including requirements for 31% RME blended fuel/biodiesel. The third main biofuels decree (Government Order No 66/2005 Coll.) establishes a national system for placing biofuels on the open market.[4]

Biodiesel

Additionally, the government has instituted substantial, fuel-specific legislation aimed at encouraging production. A subsidy for the production of RME compensates producers for the higher costs of production and lower energy efficiency of biodiesel. The Czech government has also tried to create adequate market conditions for RME, including by making the RME in blended biodiesel free of excise duties. Legislation currently being drafted will allow biofuels use in 2007, following the cessation of the country's transitional period. Beginning in January 2007, a simplified refund program will take effect for 5% RME biodiesel blends.[5]

Ethanol

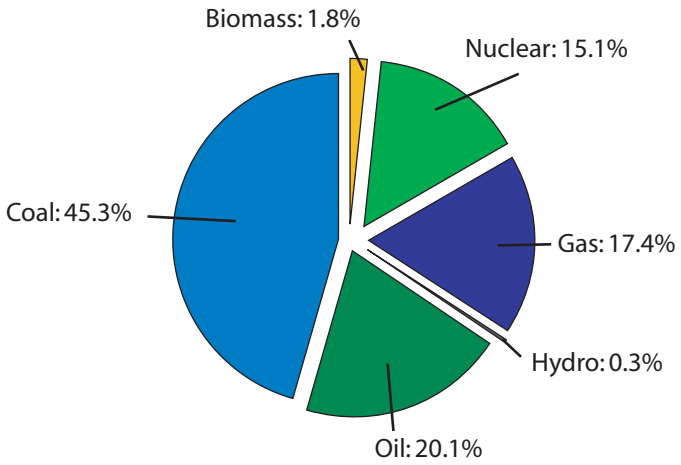
The Czech Republic has developed a compensatory system for ethanol production as well. Although no bio-ETBE production facilities are currently operational in the country, the Czech Republic is following the European standard of allowing up to a 5% blend of ETBE in gasoline. Additionally, ethanol is expected to be marketed directly, and high ethanol content fuels such as E85 and E95 will also be used.[6]

C) CURRENT SITUATION

Energy Matrix

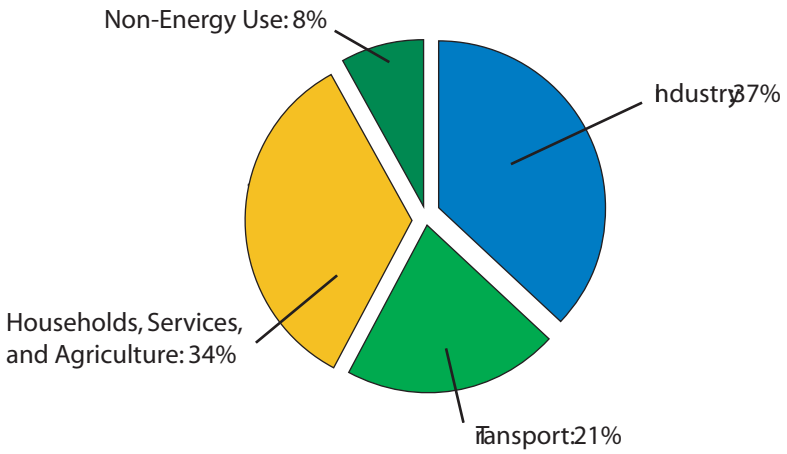
As Chart 4.2a shows, the Czech Republic relies heavily on coal, oil, gas, and nuclear energy. Biomass accounted for only 1.8% of energy demand in 2003, and its share in 2006 was 3%. The Czech Republic has substantial coal supplies, which provide the majority of energy production. Oil is primarily imported from Russia, though natural gas is increasingly being imported from Norway to prevent excessive reliance on Russian suppliers. Two nuclear power plants and limited hydroelectric power production also supply the market.

Chart 4.2a: Primary Energy Demand of Czech Republic (2003)



Source: Enerdata

Chart 4.2b: Final Energy Consumption by Sector in Czech Republic (2003)



Source: Enerdata

Production and consumption of both ethanol and biodiesel are expected to grow significantly by 2010, according to recent report submitted to the European Commission. As shown in the table below, rapeseed-based biodiesel is projected to almost double, with domestic consumption (as a share of diesel) rising almost 40%. Ethanol production is expected to increase by 26%, with domestic consumption (as a share of gasoline) rising nearly 20%.

Table 4.2a: Production Outlook of Biofuels and Their Share of Liquid Fuels

		2006	2010
RME production	thous. ton	170*	320*
Ethanol production	thous. ton	174	220
Diesel sales	thous. ton	3300	3500
Petrol sales	thous. ton	2222	2357
Liquid fuels (diesel + petrol)	thous. ton	5522	5857
RME share of diesel sales	%	4.63*	6.43*
Ethanol share of petrol sales	%	7.8	9.3

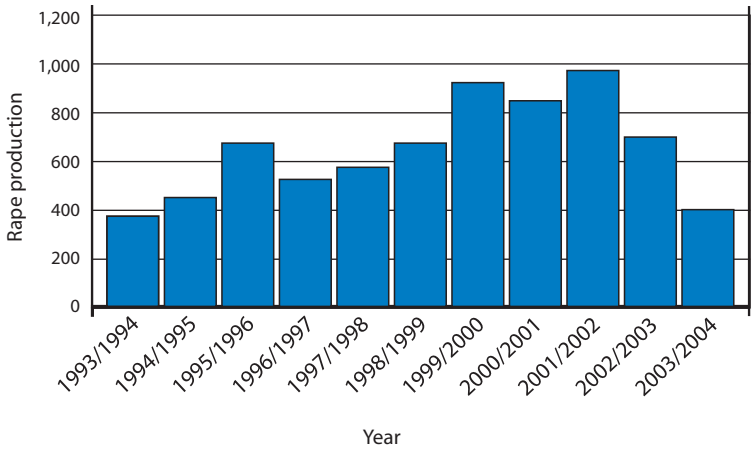
Source: European Commission[7]; *Extrapolated from change in production from 2004-2005

Production and Consumption

Biodiesel

Upon joining the EU in 2004, the government was forced to cancel its RME production subsidies. The result was the deterioration of the local RME market and the collapse of blended diesel consumption. Nonetheless, RME/biodiesel remains the most highly developed biofuel in the country. Even though it produced below capacity in 2005, the Czech Republic produced 133,000 tons and made a name for itself as a major biodiesel producing country within the EU.[8] In 2006, the country had the capacity to produce 203,000 tons of biodiesel though production was likely lower. There are now 14 RME producers in the Czech Republic.[9]

Chart 4.2c: Production of Rape (thousands of tones)



Source: Promotion of the Biofuels Utilization in the Czech Republic by Using Economic Tools

Ethanol

Production of ethanol/ETBE for automotive fuel has been confined to a series of pilot projects to test its market potential. Further complicating its development, current legislation prohibits the dual use of alcohol production facilities for ethanol production so as to avoid misuse and fraud; only "authorized producers" are permitted to sell ethanol on the Czech market. As new ethanol facilities become operational, consumption is expected to increase from 2007 onward. However, the level of domestic consumption will depend on the development of a flex-fuel car market in the Czech Republic.

D) PRIVATE SECTOR

Recent domestic investment into biofuels includes Agrofert Holding, a leading domestic agricultural company and fertilizer producer, which plans to build a plant for processing rapeseed for biodiesel, which is likely to be located in Lovosice in North Bohemia. The company is also considering foreign acquisitions in biodiesel.[10]

Setuza, the leading Czech producer of biodiesel, with 45% of the domestic market, has been unable to meet its financial obligations of up to Kc 4 billion (approximately US$185 million), despite receiving numerous and generous government subsidies. The leading domestic private equity company, PPF, has bid to take over the company and its debt, although as this report went to press no decision had been reached as to which company would acquire Setuza. The Setuza deal may have regional repercussions as most of its biodiesel is sold to Germany.[11]

The government is also privatizing its banking, telecommunications, and energy sectors, a process that is expected to prompt added foreign investment.

E) RESEARCH & DEVELOPMENT

The National R&D Policy 2004-2008 lists energy as one of several long-term research priorities.[12] A discussion in September 2006 among energy researchers at the Ministry of Industry and Trade revealed that a lack of funding is an impediment to energy research.[13] The Czech Republic is also currently the chair of the EUREKA Initiative, which is committed to enhancing the competitiveness of European industry through the promotion of cross-border, market-oriented innovation.[14] Specific to biofuels research, the Czech Research Institute for Crops Production has undertaken a number of studies funded by the National Agency for Agricultural Research, ranging from improved breeding of rapeseed to next generation ethanol processing methods.[15]

F) CONCLUSION

Based on its established biofuels targets, its allotted budget, and current agricultural production the Czech Republic has the capacity to become a major player in the biofuels industry and has passed ambitious, national legislation to make it happen. Still, there is some doubt that the country has the ability to fully implement its legislation. Government policies remain convoluted and excessively bureaucratic, which has pushed biofuels producers to export an increasing amount of their product.

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A) INTRODUCTION

Finland is the second-largest European consumer of biofuels, after Sweden. However, unlike many European countries, Finland has used its biofuels more in industry and power generation than in the transport sector. This situation is likely to change soon, however, given strong recent government support for biofuels as a transportation fuel as part of its overall energy strategy of promoting renewable energy consumption. An increase in biofuels' share of transport fuel from a paltry 0.1% in 2005 toward the EU 2010 target of 5.75% should see both consumption and production surge in Finland.

B) GOVERNMENT POLICIES

Energy Policies

In November 2005, a new energy and climate strategy laid out the government's approach to meeting its Kyoto Protocol commitment of restricting greenhouse gas emissions.[2] Key in the strategy are the adoption of renewable energy resources and the improvement of energy conservation measures.

The strategy sets out three main targets:[3]

1. Increasing renewable energy consumption 15% by 2015, and at least 40% by 2025. Renewable energy would then account for 33% of primary energy consumption, as compared to 23% in 2003.
2. Reducing energy consumption 5% by 2015.
3. Cutting emissions by 11 million metric tons annually, in accordance with Kyoto Protocol commitments. This will be achieved, in part, by the acquisition of two million metric tons of emission reduction credits annually.

Biofuels

Despite the 2003 Biofuels Directive, which set an EU-wide target of 2% biofuels use by December 2005, Finland initially established a much lower target of just 0.1%.[4] However, Finland took over the EU's rotating presidency in the second-half of 2006, and that responsibility seemed to produce a stronger commitment to the development and use of biofuels.

This commitment is underpinned by the creation of the Biofuels Taskforce in late 2005 to study biofuels use and production for the transportation sector. The Taskforce submitted its report to the Ministry of Trade and Industry in March 2006. The key recommendation was that the share of biofuels in transportation fuel should reach 1% in 2008, 2% in 2009, and 3% in 2010. It is estimated that achieving the 2010 target will result in annual costs of $66 to $106 million and a 4 cent per liter increase in fuel prices.[5] The 3% target was deemed more realistic than the EU target of 5.75%, considering the costs and the availability of biofuel feedstocks. The Taskforce further estimated that the development of second-generation biofuels could boost biofuels usage to 7-8% by 2020.[6]

The Biofuels Taskforce has recommended that each oil retailer be given flexiblity in determining the specific type of biofuel to be used and its source. Domestic oil refiners and retailers will be able to make decisions according to market prices and not be restricted to domestically-produced biofuels or biofuels produced using raw materials

of domestic origin.[7] This recommendation was backed up by the Prime Minister, who emphasized that biofuels must be profitable in order to be sustainable.[8] It has, however, contributed to fears that the Finnish biofuels industry will import cheaper raw material such as Brazilian sugarcane and Malaysian palm oil instead of relying on local feedstock such as sugarbeet.[9]

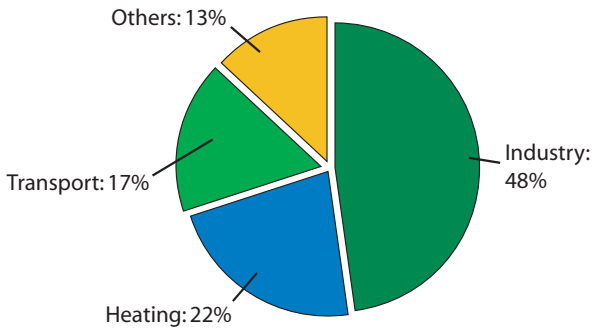
Despite the Taskforce's more modest recommendations, the government has proposed a law requiring adherence to the EU target of a 5.75% biofuels mix by 2010.[10] The Finnish Prime Minister Matti Vanhanen has even said that investing in renewable energy and biofuels is the only way that Western countries can influence oil prices because energy demand will continue to grow faster than supply.[11] Meanwhile, legislative support for the biofuels industry continues to grow. In March 2006, 144 out of 200 members of parliament signed a private bill that would reduce the tax on ethanol and biodiesel by at least 93 cents and 53 cents a liter respectively.[12]

The government has also unveiled the National Grain and Oil Seed Strategy for 2006-2015, which suggested that half a million hectares could be devoted to cultivating crops for bioenergy production. Producing energy crops could boost the Finnish grain and oilseed sector, especially since yields per hectare for grain and oil seed crops have dropped over the last 15 years. By setting the goal of growing crops for biofuels production, the government hopes to provide the impetus needed to raise the yield level by 20%.[13]

C) CURRENT SITUATION

Due to the cold climate, geographical location and industrialized economy, energy consumption per capita is high in Finland. In 2005, the total energy consumption was approximately 32.4 million tons of oil equivalent (MToe). Renewable energy, predominantly wood-based biofuels, accounts for 25% of total energy consumption, although it is utilized more in the industrial and heating sectors than in the transportation sector.[14] It is hoped that doubling the use of bioenergy over the next two decades will boost energy self-sufficiency to 40%, from 30% in 2005.[15]

Chart 4.3a: Energy Consumption by Sector



Source: Ministry of Trade and Industry[16]

Biofuels

Despite relatively high bioenergy use overall, Finland has not aggressively introduced biofuels into its transportation sector; the government's 2005 target for biofuel use in the sector was a mere 0.1%, while the EU recommends that biofuels constitute 2% of transportation fuel. Local consumption of biofuels for transportation has also been relatively low, totaling just 6,160 metric tons in 2003.[17]

Ethanol

Finland produces 108 million liters of ethanol annually. Because local biofuels feedstock such as barley is limited, ethanol production relies heavily on imported raw material such as Brazilian sugarcane. The majority of production is slated for export markets,

as local consumption is still minimal.[18] This situation is likely to change with expected biofuels legislation, which will see local biofuels consumption jump. The cultivation of biofuels feedstock should also rise. The National Grain and Oil Seed Strategy has projected that ethanol production from grains will rise significantly in 2008. 160,000 hectares of the proposed 500,000 hectares of land for energy crops production has been slated for barley production, with each hectare of barley estimated to produce 1,000 liters of ethanol.[19]

Biodiesel

Biodiesel production in Finland is just beginning and is limited to a few players. The largest biodiesel producer is Neste Oil, whose $132 million biodiesel plant (with an annual capacity of 202 million liters) is scheduled to come on-stream in the second quarter of 2007. The company also has plans to build a similar-sized plant at the same location in Porvoo.[20] The only other significant biodiesel producer in Finland is energy company Fortum, which is building a biodiesel plant at its Porvoo oil refinery, due to come on-stream in the summer of 2007, with an annual capacity of 170,000 tons.[21]

The main biodiesel feedstock in Finland is animal fat, as domestic production of turnip rape is consumed almost entirely by the food industry.[22] However, with the new government-backed initiative to develop energy crops, production of rapeseed is projected to rise to more than 500,000 metric tons by 2015. To achieve this, the yield rate needs to increase to 2 metric tons per hectare, because the maximum available land for oilseed crops cultivation is 250,000 hectares.[23] It is estimated that one hectare of rapeseed can produce an average of 500 liters of biodiesel.[24]

D) PRIVATE SECTOR

The use of biofuels in the transport sector is just beginning, and the number of private sector players is very small. As discussed, Neste Oil is the largest biodiesel producer in Finland. The company also claims to have pioneered second-generation biodiesel technology and intends to invest several billion dollars in new projects over the next decade to further its strategy of producing biodiesel in various markets. Neste reportedly already has its eye on new plants in Germany and California.[25]

Private sector participation in the biofuels sector is expected to increase soon given the projected upswing in biofuels consumption. A number of companies, such as Finnish food company Lannen Tehtaat and energy firm St1 (see below), have conducted feasibility studies on possible biofuels plants. Specifically, Lannen Tehtaat is interested in building an ethanol plant in either western or southwestern Finland, regions that are large producers of barley.[26]

E) RESEARCH & DEVELOPMENT

The development of second-generation Finnish biofuels technologies is a key recommendation of the Biofuels Taskforce,[27] as it is expected that new production technologies will at least halve the additional costs incurred by the economy in the utilization of biofuels.[28] Thus far, a large part of Finland's second-generation biofuels R&D is concentrated on forest biomass as well as in community and farming waste.[29] The main government body funding biofuels research is the Center for Technology Development (Tekes), which devoted 90% of the $20.5 million in 2004 funding for renewable energy to bioenergy.

Biofuels R&D projects are usually conducted via public-private joint ventures. Research Center VTT, the largest contract research organization in Northern Europe has launched a pilot project on gasification equipment which will refine synthesis gas from biomass (such as bark and peat) for the production of biodiesel. The project, with an overall budget of $5.3 million, is one of the largest energy projects financed by the Finnish Funding Agency for Technology and will involve private sector players such as Neste Oil and forest industry companies UPM and SotraEnso.[30]

Another public-private project, St1 Biofuels Oy, a joint venture between energy firm St1

and the Technical Research Center of Finland, has launched a pilot plant to produce ethanol from waste generated by the food processing industry, which researchers say should make ethanol production profitable even on a small scale.[31]

Private-sector companies are also engaging in R&D on their own. Local oil major Neste Oil has unveiled the NExBTL technology, which is a biomass-to-liquid technology that can produce biodiesel from either vegetable oils or animal fats. First-generation technology generally relied exclusively on vegetable oils, and this new development gives biodiesel producers flexibility in selecting raw material, which increases cost-effectiveness.[32] NExBTL technology was awarded the Chemical Industry Federation of Finland's Innovation Award in 2006.[33]

F) CONCLUSION

With the ambitious new targets for biofuel use in the transport sector, it is clear that biofuels consumption is set to rise in Finland. Growing demand will likely provide the impetus for a series of new biofuels plants across the country. However, given the limitations on domestic biofuels feedstock and the government's unwillingness to require sourcing from local biofuels production, it is likely that Finland will grow in significance as an importer of both biofuels feedstock and biofuels end-products.

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Source: World Factbook

A) INTRODUCTION

France is currently the largest producer of renewable energy in Europe and possesses an active biofuels sector.[1] In 2003, it was the second largest EU producer of biodiesel after Germany, and the second largest EU producer of ethanol after Spain.[2] France is a net energy importer; its total energy consumption exceeds its production by a large margin.

B) GOVERNMENT POLICIES

A July 2005 law set ambitious biofuels targets that outpace the standards set up the EU Biofuels Directive. By 2008, 5.75% of domestic fuel consumption must come from biofuels; in 2010, the share will be 7%; and in 2015, 10%.[3]

In the fall of 2005, the French government announced an aggressive plan to raise domestic fuel ethanol production to 800,000 tons by 2008. Based on current consumption forecasts, this amount would meet the 5.75% blend requirement and allow France to reach the EU biofuels targets two years ahead of schedule. In order to achieve these targets, all stakeholders (agriculture, the oil industry, car manufacturers, and the government) agreed in late 2005 to introduce higher levels of direct blending.[4]

The French government distributes its biofuels production quotas through a tender system, and output up to these quotas is eligible for tax incentives. However, it remains unclear whether the existing incentives will be sufficient to spur the necessary

private investment.[5] In 2005, the government's quota was 417,000 tons for biodiesel (VOME) and 100,000 tons for ethanol (ETBE). However, total biofuels production was only 504,000 tons, up from 467,500 tons in 2004.

In addition to tax incentives, the French government also provides direct financial support to oilseed growers to stimulate production. Beginning in 2006, farmers will be permitted to incorporate their own rapeseed oil into the fuel used on their farms. Some elements in the government have expressed concern that this measure will lead to reduced tax revenue and uncertain environmental impacts. Moreover, tax increases on biofuels passed in 2006 (32% for biodiesel and 15% for ethanol) may be an indicator of the future direction of French biofuels policy.[6]

Relations with Brazil

During a May 2006 meeting, Presidents Chirac and Lula da Silva signed a bilateral agreement to promote the development of biofuels industries in developing countries (please see the Private Sector section below for additional information).[7]

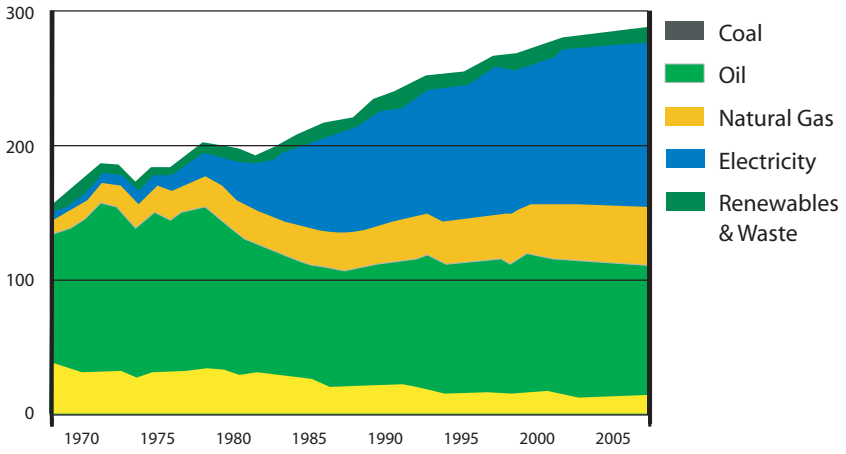
Dagris, a French energy firm, has invested (along with Petrobras and Brasil Ecodiesel) in a venture to research castor bean biodiesel and set up a plant to manufacture the fuel in Bahia state. This investment was sparked by a 2003 state government incentive program, which has attracted approximately $103 million in total private investment.

C) CURRENT SITUATION

Energy Matrix

Between 1973 and 2005, the structure of French energy consumption changed markedly. Coal decreased from 15% to 5% of energy consumption, oil decreased from 67% to 33%, and gas doubled to 7%. Nuclear energy accounts for 42% of consumption. Renewables account for approximately 5% of energy consumption. Production in France is now predominantly nuclear (89%) and renewable (9.4%). The country has also successfully diversified its oil supply, reducing dependency on the Middle East from 71% percent in 1973 to 27% in 2005. The North Sea now provides 26% of France's oil, Africa 11%, and Central Europe 23 %.[8]

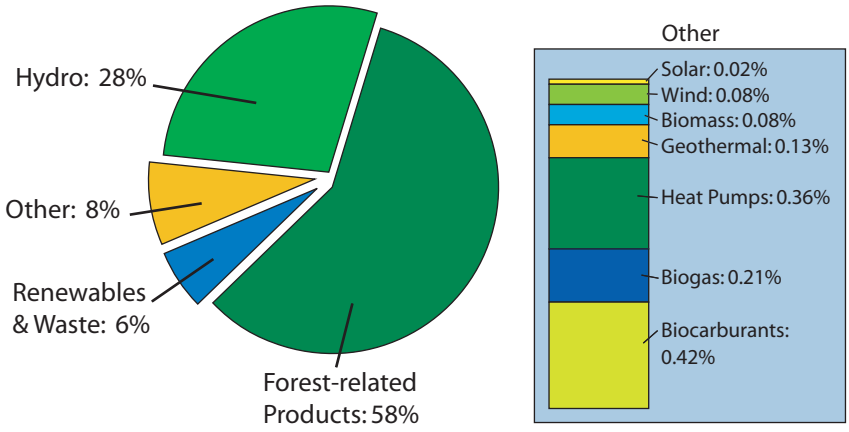
Chart 4.4a: France's Energy Consumption (2005)



Source: Ministry of Economy, Finance & Industry[9]

In 2005, 28% of renewable energy production came from hydropower, forest-related products represented 58%, biomass 6%, and all other renewables amounted to 8%.

Chart 4.4b: Renewable Energy Production (2005)



Source: Ministry of Economy, Finance & Industry[10]

In April 2006, Prime Minister Dominique de Villepin declared the government's intention to increase production capacity through the construction of seven new biodiesel and three new ethanol plants by 2008.[11] The government intended to quickly approve the manufacture of up to 950,000 tons of biodiesel and 150,000 tons of ethanol. Biofuels producers such as Cristanol, Tereos, Abengoa, and Prolea rely heavily on rapeseed oil, but they also use inputs from sugar beets, wheat, sunflower seeds, and corn crops, which are all extensively farmed.[12] The increase in production capacity and changes in regulatory limits are expected to help the biofuels industry meet the targets established by the government in 2005.

Ethanol

Ethanol is derived from domestically grown sugar beets, wheat, and other sources and is converted to Ethyl Tertio Butyl Ester (ETBE), which can be blended with gasoline to a maximum level of 15 percent. Approximately 120 million liters of ethanol are converted into 219,000 tons of ETBE.[13] French petroleum giant TotalFinaElf is the leading player in domestic biofuels production (the company is also active in a number of other European countries) and has partnered with the French National Association of Wheat Producers, the French Confederation of Beet Growers, and other producers to build ETBE plants at the company's refineries in Dunkirk and Le Havre. Along with the Total refinery in Feyzin, these units produce all of France's ethanol.[14]

Total had planned to expand ETBE capacity by 155,000 tons through the construction of two new facilities, but the company has been hesitant to commit to new investments as a result of changes in tax incentives.[15] (The recent reduction in the fuel consumption tax to zero on fuels meeting mandated biofuels-blend targets may help the expansion's prospects.)

Biodiesel

Domestic producers derive Vegetable Oil Methyl Ester (VOME) from both rapeseed and sunflower seed oil of both domestic and foreign origin. VOME is blended with diesel at a rate of 5% for commercial use and up to 30% for public transportation applications.[16] Production of VOME biodiesel has nearly doubled during the past two years. In 2004, domestic output was 348,000 tons, and production capacity by the end of 2006 is expected to reach 775,000 tons.[17] Several manufacturers are planning on investing a combined EUR one ($1.28) billion in the construction of up to 10 new plants.

France is a major exporter of rapeseed oil to Germany, which imported 1.18 million tons of the crop, 68% of that country's rapeseed imports in 2002 and 2003.[18] There are doubts that France can meet domestic consumption targets of VOME with available rapeseed. According to the French technical institute, the country would need to

devote all current rapeseed cultivation to biodiesel production to meet the 2008 target of 5.75%. The rapid expansion of oleic sunflower cultivation, a projected 35% in 2006, indicates that alternatives are already being pursued. Imports of rapeseed or other vegetable oils are another possible path to meeting domestic demand.[19]

D) PRIVATE SECTOR

Created through the merger of Union SDA and Beghin-Say, market leader Tereos planned to begin production at its new EUR90 ($115) million ethanol plant at Origny Sainte Benoite (Aisne) in October 2006. This factory, which will primarily process sugar beet syrups, will have the capacity to produce 300 million liters of ethanol per year and will replace an existing facility with less production capacity. The company also plans to refit the former SODES synthetic ethanol plant at Lillebonne (Seine-Maritime) in 2006 at a cost of EUR130 ($166) million. The Lillebonne factory will be able to process up to 840,000 tons of wheat into 300 million liters of ethanol per year. Tereos also operates ethanol distilleries at Bucy, d'Artenay, de Morains, and Lillers, which have a total capacity of 80 million liters. Following a 2006 merger with Sucreries et Distilleries des Hauts de France, which produced 45 million liters of ethanol from 400,000 tons of sugar, the Tereos group possesses ethanol production capacity of 700 million liters at 13 distilleries in three countries. The company's expansion plans project a total capacity of 1.5 billion liters per year by 2010.[20]

Cristal Union (CU) is another big player in the French ethanol market. The company has invested EUR180 ($230) million in ethanol production capacity and had a total output in 2004/5 of 160 million liters. CU reportedly plans to commence production of up 350 million liters of ethanol per year at its new Bazancourt-Betheniville (Marne) plant in 2007.

A number of other companies have also indicated interest in entering the French biofuels market. Groupe Soufflet, a privately-owned agribusiness firm, has announced that it will build an ethanol plant at Le Meriot, where up to 300,000 tons of wheat will be processed per year. Roquette has proposed constructing a similar plant in Alsace. Finally, Abengoa of Spain plans to build a EUR100 ($128) million ethanol plant at Lacq in southern France that will process up to 180,000 tons of biofuels inputs.[21] Diester Industrie, a large farmer-owned biodiesel company is also exploring plans to double production capacity at its Compiegne and Grand-Couronne plant and to build three new plants in Sete, Saint-Nazaire (Façade Atlantique), and Le Meriot by 2008.[22]

E) RESEARCH & DEVELOPMENT

A primary driver of R&D is the French scientific interest consortium Agriculture for Chemical and Energy (AGRICE), which supports attempts to develop new, non-food uses for renewable plant-based products. AGRICE promotes research in a number of areas related to industrial conversion of crops to chemicals (e.g., solvents, lubricants, and surfactants), materials (e.g., polymers), and energy (liquid and solid biofuels). The consortium began its activities with projects tasked with replacing products derived from fossil-sources with plant-based products. AGRICE has subsequently expanded its operations to encompass agronomic improvements, project economics, market research, and environmental assessments.[23]

The government-funded National Institute for Agricultural Research (INRA) also supports biofuels research as part of its broader research mission. INRA has identified ethanol production as a focal point, particularly in the area of lignocellulosic-derived fuels.[24] Such second-generation biofuels have attracted increased interest in Europe in the past year, and researchers in Germany and the UK are pursuing similar avenues. The crops targeted for study are dry by-products such as straw (from cereals, corn, etc.), annual crops harvested as whole plants (such as wheat), perennial crops harvested annually (such as alfafa), other perennial crops (such as switchgrass), and forests containing a variety of species for the production of woodchips.[25]

One of the sponsors of INRA's work is the National Research Agency (ANR), through

its National Bioenergy Research Programme. With nearly $20 million in annual funding, the program is dedicated to expanding the range of bioenergy resources in France. 98% of the total funding goes to various lignocellulosic research projects, including economic analysis and process optimization.[26]

The French government also announced in May 2006 that it would commence an investment program of EUR4 ($5.1) billion, a large portion of which is destined for renewable energy and biofuels research.[27]

F) CONCLUSION

France's official objective for biofuels blends in the country's transportation sector is nearly twice that of the EU target through 2010.[28] However, the government's strategy for meeting this target remains murky, and successor governments may yet reverse course. However, as an integral component of the government's stated policy to reduce dependence on both hydrocarbons and foreign energy supplies, France's commitment to expanding biofuels production capacity is fairly clear.[29]

Remaining challenges are the supply of biofuels feedstock and the cost competitiveness of domestic production. However, the tax incentive program will likely be altered if oil imports originating outside the EU increase to a politically untenable level. In order to discourage a significant increase in the importation of biodiesel input, the French government has begun exploring biodiesel options other than VOME and crude vegetable oil, such as Animal Oil Methyl Ester (AOME) and Vegetable Oil Ethyl Ester (VOEE).[30]

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A) INTRODUCTION

Already the leading global producer of biodiesel, Germany has established a technology exchange with Brazil to further develop its industry. Germany is also a global leader in the broader application of alternative fuel, and in 2006 it provided 10.2% of its electricity needs through renewable sources.[1] In 2005, renewable energy accounted for 6.4% of Germany's total energy supply, and the renewables industry saw turnover of EUR16 billion and employed (directly and indirectly) 170,000 people.[2]

Germany has pursued a more aggressive policy than the one put forward by the European Commission directive on biofuels. Like most of Europe, Germany is pushing its domestic biofuels industry to decrease dependence on fossil fuels for environmental, geopolitical, and security reasons. The country's obligation to pursue a reduction of greenhouse gas emissions under the Kyoto Treaty, along with long-standing initiatives to increase energy efficiency, has created an environment conducive to biofuels consumption.

Germany is also an active participant in the EU research goals of developing cost-effective technologies for producing second-generation biofuels, such as lingo cellulosic ethanol, created from waste products rather than food crops.

B) GOVERNMENT POLICIES

German promotion of renewable energy is governed by the March 2000 Act on Grant-

ing Priority to Renewable Energy Sources and an August 2004 amendment to that law. This law sets a series of targets for the incorporation of renewable forms of energy into the national energy supply over the next two decades. Operators of electrical grids have an obligation to give priority to renewable sources, and renewable electricity supplies must comprise at least 12.5% of total supply by 2010 and at least 20% by 2020. The 2004 amendment to the act eased the implementation of these targets, particularly with regard to investment in infrastructure and distributional networks.[3] The current right-left coalition government recently announced its intention to increase mandatory targets in the transportation sector, exceeding the levels envisioned by the EU directive.[4]

EU member states are bound by a European Commission directive from 2003 to promote the use of biofuels in the transportation sector. Initially, it was mandated that biofuels replace 2% of all petroleum fuels by the end of 2005 and 5.75% by the end of 2010. The current German government included this directive in its coalition agreement. The biofuels portion will be achieved primarily by blending biofuels with fossil fuels and, to a lesser extent, through the use of pure biofuels. In their "Biomass Action Plan", the European Union recently strengthened its stance on biofuels.[5]

The German government recently announced renewable energy goals that exceed EU directives.[6] The share of renewable energy should increase:

- to at least 4.2 % of total energy consumption by 2010, to at least 10% by 2020, and to about 50 % by mid-century;
- to at least 12.5 % of electricity consumption by 2010 and to at least 20% by 2020;
- and to 6.75% of fuel consumption by 2010.

There is currently a complete tax exemption for biofuels. With a normal tax rate of EUR0.65 ($0.83) per liter on petroleum fuels, this incentive greatly increases personal and commercial biofuels consumption.[7] The Government's program of market-based incentives is financed through revenue derived from ecological tax reforms and received a total of EUR193 million ($246 million) in federal funding in 2005. The draft budget for fiscal year 2006 proposed an increase to EUR180 million ($230 million). Aside from tax incentives, the government has also assisted larger bioenergy projects through low-interest loans from the Reconstruction Loan Corporation (KfW). Such projects have so far included biogas plants, biomass heating plants, and geothermal systems.[8]

The result of the German government's efforts has been a concrete expansion of production and consumption of biofuels in the country. The 2004 amendment to the Renewable Energy Sources Act led to a marked acceleration in the area of electricity generation from biomass. The enhancements in the most recent version of the law include:

- the optimization of payment rates according to size of installation
- the awarding of special premiums for the use of renewable energy crops and/or forest waste
- the promotion of new technologies for operating biomass facilities in combined heat and power plants (CHP)

At the end of 2004, the German Federal Government outlined a fuel strategy for Germany as a part of its first progress report on strategies for sustainable development. The government announced that it intends to comply with the EU target trajectory for biofuels consumption of 2.0% of total fuel consumption this year. 2004 also saw the publishing of an assessment by a group of experts on the potential for various technologies, including the use of biofuels, to assist in the reduction of greenhouse gas emissions. The assessment made several main points:[9]

- Through 2020, biodiesel and ethanol are expected to play an increasingly important role in the German energy supply, especially as admixtures to traditional petroleum fuels. However, the development of domestic biofuels supplies will be constrained by the limited area for feedstock cultivation.
- The existing tax incentive scheme should be continued in the medium term to spur

continued consumption of biofuels
- Beyond 2020, special emphasis should be given to alternatives with the greatest capacity to replace fossil fuel consumption, such as:
  - o Synthetic fuels from solid biomass (BTL)
  - o Combined drive systems (hybrid automobiles)
  - o Hydrogen (engines and fuel cells)
- While a great deal of the technology necessary to implement these recommendations currently exists, the report recommended continued R&D support, particularly in the area of BTL technologies.

Relations with Brazil

Germany has had strong ties with Brazil since the beginning of the 19th century. Germany is one of five major foreign investors in Brazil (together with the United States, Spain, France, and the Netherlands) and is one of Brazil's most important commercial partners. The two countries hold an annual meeting of governmental authorities and business leaders (the Brazil-Germany Economic Meeting) to foster bilateral economic relations. Energy cooperation is one subject which has been discussed at these meetings. The most recent, which took place in July 2006, involved 450 companies from both countries.[10]

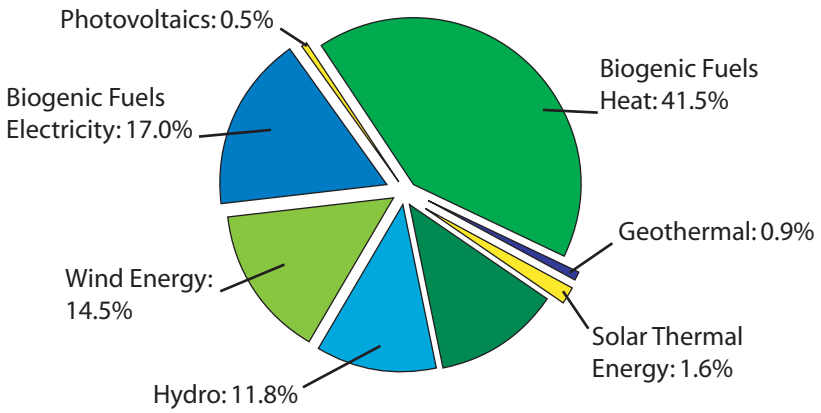
Brazil - Germany trade flows totaled $9.1 billion in 2004. Germany imports mainly soybeans, iron ore, and coffee, while Brazil imports machinery and equipment from Germany.[11] The Brazilian-German Chamber of Commerce is very active in trade relations between the two countries.

C) CURRENT SITUATION

Energy Matrix

As demonstrated by the graphs below, Germany has had success diversifying its energy supplies. Renewables account for 4.5% of total energy supply. The largest share is used for heating and the second largest share for electricity. Transport accounts for 12.2% of total renewable energy supply.

Chart 4.5a: Primary Energy Supply from Renewable Sources (2005)

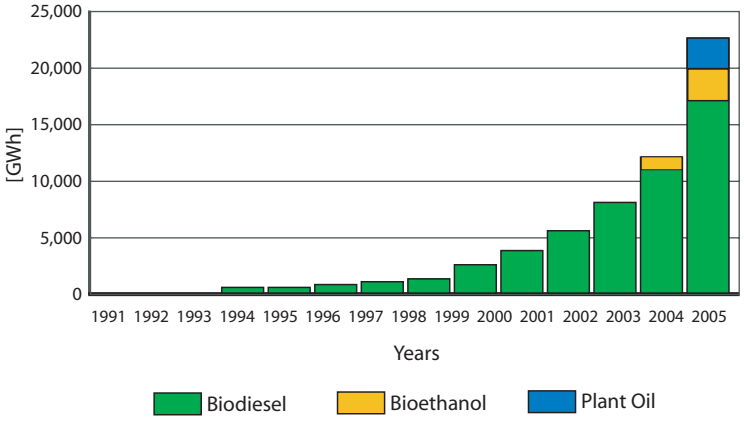


Source: BMU publication, "Renewable Energy Sources in Figures - National and International Development", status: May 2006

In the German transport sector, biofuels consumption has experienced dramatic growth in recent years. Biofuels currently account for 3.6% of final energy consumption in transportation. From 2004 to 2005, biofuels sales rose from 1.1 to 2.2 million tons. Biodiesel accounted for the bulk of sales in 2005 (1.8 million tons), though ethanol (0.22 million tons) and plant oil (0.19 million tons) showed strong gains during the same period. In addition to significant increases in production capacity, the Mineral Oil Tax Act has proved a primary driver of this growth in biofuels consumption. Under this law,

petroleum-biofuels blends are eligible for a range of tax credits and exemptions.[12]

Chart 4.5b: Trends in energy generated from biogenic vehicle fuels



Source: Trends in Renewable Energies in 2005. May 2006.11

As in most other Western European countries, the primary constraint on the continued development of the German biofuels sector is the limited amount of arable land. The cultivation of input crops currently occupies a government-mandated 1.2 million hectares. Rapeseed is the largest crop in terms of area, with 0.4 million hectares devoted to its cultivation. The government has designated 0.15 million hectares of wheat for ethanol production and 0.1 million hectares for the production of other biomass-derived products, such as lubricants, insulation, and paint. The remaining 0.55 million hectares designated for biofuels' feedstock have yet to be utilized. Rapeseed for non-biofuels applications has also grown by an additional 0.34 million hectares.[13] The potential for domestically produced biomass is estimated to be sufficient to meet between 9% and 14% of total domestic energy demand in 2030.[14]

Table 4.5a: Area and energy potential for common liquid biofuels in Germany, 2005

	Rapeseed *(1000 ha)*	**Wheat for Ethanol** *(1000 ha)*	**For thermo-chemical conversion** *(1000 ha)*	**Total area available** *(1000 ha)*	**Potential of RME/ Ethanol** *(PJ/a)*
Arable land	342	-	-	11,825	50
Set-aside land	400	150	550	1,200	

Source: Kaltschmitt at al., 2005. 24

Biodiesel

Production

Germany is Europe's leading producer of biodiesel and accounted for nearly half of the EU production total as recently as 2003 (see Chart 4.5b). In 2004, twenty firms produced approximately 1.1 million tons of biodiesel in the country. Of the seven largest biodiesel producing firms in Europe, three are German, and a fourth is the German subsidiary of an American company.[15] Germany is one of three European countries (Sweden and Austria are the others) where the sale of pure biodiesel for use in adapted engines is permitted. Production remained relatively stable from 2000 to 2003, and following a dramatic decrease in 2004, capacity increased by nearly 50% in 2005.

Rapeseed-derived biodiesel, also known as fatty acid methyl ester (FAME), is currently the most widely used biofuel in Germany. Biodiesel production capacity is expected to increase to approximately 3 million tons by the end of 2007.[16]

The German government's subsidy regime for biodiesel input crops is in transition. At

the moment, production of up to 100,000 liters of rapeseed oil per farm is subsidized; however, the federal government has introduced a new subsidy system that is expected to spur an additional 350,000 tons of biodiesel production per year in the near term.[17]

Consumption
In 2004, roughly a third (376,000 tons) of total biodiesel production (1.1 million tons) was distributed through retail channels in Germany, and the remainder was supplied directly to industrial and commercial consumers or blended with fossil fuels.[18] Commercial consumers such as truck fleet operators were responsible for roughly 60% of biodiesel consumption in 2004.[19] It is difficult to estimate the breakdown of biodiesel sold through retail channels, as both commercial and private consumers purchase fuel from Germany's 1,900 biodiesel outlets. Biodiesel sales increased from 130 thousand tons in 1999 to 1.7 million tons in 2005. An important factor in the success of biodiesel in Germany is an exemption from the mineral oil tax, which renders the fuel significantly cheaper than traditional diesel. (This price advantage is partially offset by the mileage differential between the two fuels, as biodiesel offers less energy per liter than diesel.[20]) Biodiesel derived from rapeseed oil is currently the only type covered under warranty by German car manufacturers.[21]

Consumption patterns are likely to change with the introduction of the EURO IV set of emissions standards for passenger vehicles, which will all but preclude the use of pure biodiesel in passenger cars. Producers are therefore expected to concentrate their marketing of pure biodiesel to commercial fleet operators in the future. Biodiesel blends of up to 5%, which are compatible with the EURO IV standards, will likely become the primary form of retail consumption.[22]

According to the Federal Biogenic and Renewable Fuel and Power Association (BBK), Germany's new tax regime for biofuels and the decline of oil prices over the past months have resulted in a loss of price competitiveness for pure biodiesel.[23] The BBK has consequently advocated a more favorable tax and compensation scheme, and the Federal Parliament is expected to revisit renewable energy policy in early 2007.

Ethanol
Production
Germany is a relative newcomer as a producer of fuel ethanol, with its first production commencing in late 2004 at the Mitteldeutsche Bioenergie plant in Zorbig (Sachsen-Anhalt), which has a capacity of one million hectoliters. A 2.6 million hectoliter plant at Schwedt (Brandenburg) began production in 2005. In contrast with the rest of the EU, synthetic alcohol also accounts for significant segment of the market in Germany. The country's main producer, Sasol, operates a 140,000 ton plant in Herne, which corresponds to roughly 80% of the industrial market.[24]

The German Government does not regulate ethanol according to its intended use. The implication of this stance is that alcohol produced for human consumption and industrial purposes is treated in the same manner by the federal authorities. Because the federal government maintains the exclusive right to market alcohol within Germany, the government buys alcohol from producers at officially-set rates. This arrangement has resulted in an industry populated by small and medium-sized producers, though there has been a recent trend toward consolidation. The leading producers are currently KWST, Südzucker, and Sauter.[25]

As mentioned above, the traditional market for ethanol is expected to stagnate, while demand for ethanol in fuel applications is expected to continue its increase. The capacity of the newly opened plants is more than sufficient to supply the current demand for ETBE, which is 600,000 tons annually. The excess capacity is likely to be employed in the production of ethanol for fuel-blending applications.[26]

The current government is expected to slash direct subsidies for sugar production, thus raising the price for ethanol inputs in the near term. The reduction of sugar subsidies could impact German agricultural production and encourage the consolidation of sugar beet growers attempting to achieve the economies of scale necessary to make

the crop's continued cultivation viable.[27]

Germany is the largest importer of biofuels products within the EU, with approximately 23% of total European production sold in the country.[28] This figure corresponds to about 200,000 cubic meters of biofuels. Germany is an exporter of synthetic ethanol, which is not used in fuel applications, but rather for chemicals, pharmaceuticals, cosmetics, and food.[29]

D) PRIVATE SECTOR

The Association of the German Biofuels Industry (VDB) is an important private promoter of biofuels initiatives, particularly with regard to biodiesel.[30] There are currently 20 biodiesel producers in Germany operating on an industrial scale, the majority of which are domestic firms. Foreign firms have also pursued investments in Germany; Cargill began construction on a EUR25 million biodiesel manufacturing facility in Frankfurt am Main, which will eventually produce up to 250,000 tons per year.[31] Given the size and increasingly attractive nature of the German biofuels market, the UFOP expects foreign investment to make up a significant portion of total biofuels investment in Germany in the near term.[32]

Because domestic rapeseed supply has not kept pace with demand from the biofuels industry, German biodiesel producers have begun investing in oilseed cultivation abroad. EOP Biodiesel, a large German producer, recently announced a joint venture to cultivate rapeseed in Ukraine, and other producers are expected to pursue similar avenues in the near future.[33]

E) RESEARCH & DEVELOPMENT

Official governmental support for R&D in renewable energy has its origin in the first Arab oil embargo of 1973. In Germany, the Federal Ministry of Food, Agriculture and Consumer Protection (Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz) is the primary governmental supporter of R&D projects related to bionergy. In 1999, the government introduced its Market Incentive Program, which offers over EUR200 million ($255 million) annually for renewable energy programs, including biofuels research. Under the auspices of its Renewable Resources Agency, the Ministry funds 92 bioenergy projects at a cost of EUR28.4 million ($36 million). The Ministry's current bioenergy R&D priorities are biogas and biofuels, particularly vegetable oils and solid biomass-to-liquid (BTL) applications for transportation.[34]

The VDB is also an important coordinator of R&D activities and works with other industry groups to promote such activities. These include the Union for the Promotion of Oil and Protein Plants (UFOP), the Biodiesel Quality Management Working Group (AGQM), and the Agency for Renewable Resources (FNR).

The Automobile Industry Association (VDA) has expressed its desire to promote the further development of second-generation biofuels technologies, such as Biomass to Liquid fuels.[35] The VDA's efforts to coordinate industry involvement in biofuels R&D appear to remain in their infancy. The profusion of diesel technology in the Germany automobile market could push automakers' funds toward biodiesel research and away from domestic ethanol efforts.[36]

F) CONCLUSION

Germany's status as a leading global producer of biofuels, particularly biodiesel, depends on both substantial government support and high petroleum prices. Recent market developments and tax system changes have decreased the competitiveness of the domestic biofuels industry. While the government is committed to increasing the use of alternative energy sources, challenges for the industry remain. Beyond national tax incentives, agricultural production is heavily influenced by the EU's Common Agricultural Policy (CAP). Depending on the direction that future multilateral trade negotiations take, the EU's system of subsidies and other economic aid to agricultural pro-

ducers could change drastically in the long-term. Because of the connection between agricultural commodity price levels and the competitiveness of biofuels, the evolution of international trade regimes will also shape the development of this market.[37]

Germany and Brazil already have a strong bilateral relationship rooted in trade, and the two countries are actively exploring cooperation in area of biofuels.

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Source: World Factbook

A) INTRODUCTION

Due to limited legislation, poor climatic conditions and marginal crop yields, Hungary has yet to develop a viable biofuels industry. Unlike its neighbors, Hungary has not demonstrated interest in aggressively engaging the sector. A lack of political will and marginal demand provide few incentives for the government and investors to promote the industry. While Hungary has made concerted efforts to diversify its energy matrix and reduce dependence on Russian oil, the country has not dedicated the necessary resources to cultivate the industry. At present, the country struggles to comply with EU biofuels directives and is not projected to be a notable player in the region.

B) GOVERNMENT POLICIES

Despite the overarching power of the Soviet Union, Hungary began reforming its economic and energy structure as early as the 1980s. The country undertook a number of initiatives that slowly enabled economic liberalization and the diversification of the country's energy matrix. The government signed the United Nations Convention on Climate Change in 1994 and is obliged to reduce its carbon dioxide emissions by 6% between 2008 and 2012. Hungary is also eligible to participate in Joint Implementation projects assisting other countries to comply with their emissions reductions commitments.[2]

In 2001, the government instituted an energy plan envisaging that the country's primary energy supply would grow 1% between 2000 and 2020. According to the plan, the share of coal is expected to decrease by 11%, oil is to remain stable at 31%, and gas is expected to increase to 41%.[3]

Over the last several years, Hungary has focused on diversifying its primary energy resources away from petroleum and away from Russia. Further, the country has and continues to promote increased energy efficiency by encouraging conservation, price deregulation, environmental protection, and foreign investment in energy projects. On May 1, 2004, Hungary acceded to the European Union and continued to adjust its energy policies to conform with EU directives.

Coinciding with its accession to the EU, Hungary committed itself to the standard 2%

target for renewable energy by 2005 and the 5.75% target for 2010. Hungary developed biofuels legislation in order to comply with two relevant EU directives on biofuels: Directive of 2003/30/EC[4] for vehicles and Directive 2003/96/EC[5] for the harmonization of energy taxes.

In 2004, the Hungarian Government approved a national plan for the promotion of the use of biofuels for transport with the intention of providing a legal and regulatory framework that would enable the commercial production of biofuels. Hungary's Renewable Energy Sources (RES) target for biofuels was legislated under 2233/204 and set an original national target of 0.4-0.6% utilization for 2005, and a 2.0% target for 2010. The Hungarian Parliament set a revised goal of 2% for 2007 and 4% for 2010.[6]

In the official 2004 report to the European Commission on the promotion of biofuels, the Hungarian government stated that due to professional and financial considerations, direct blending of bio-ethanol in engine fuel was not advisable.[7] As of 2005, Hungary had not achieved the 4% target, leading policymakers to encourage greater biofuels consumption.

Biofuels Incentives – Excise Tax Reimbursement and Direct Area Payments
According to a 2004 European Commission report on Hungarian biofuels, amendments to the Act on Excise Tax eliminated the tax-free status for pure biodiesel and only recognized biofuels blended with ETBE. The amendments established the following excise tax reimbursements:

- $0.23/liter for biodiesel sold by gasoline company with maximum 5% blend in 2005
- $0.39/liter of bio-ethanol with a maximum 7.05% blend.

Without the exemption, an excise duty of EUR340 per 1000 liters would be applicable to biodiesel and an excise duty of EUR414 per 1000 liters would be applicable to ETBE.[8]

Compulsory blending standards will be removed for bio-ethanol in June 2007 and for biodiesel in January 2008, but retailers must utilize a minimum of 4.4% to be eligible for the lower excise tax.[9]

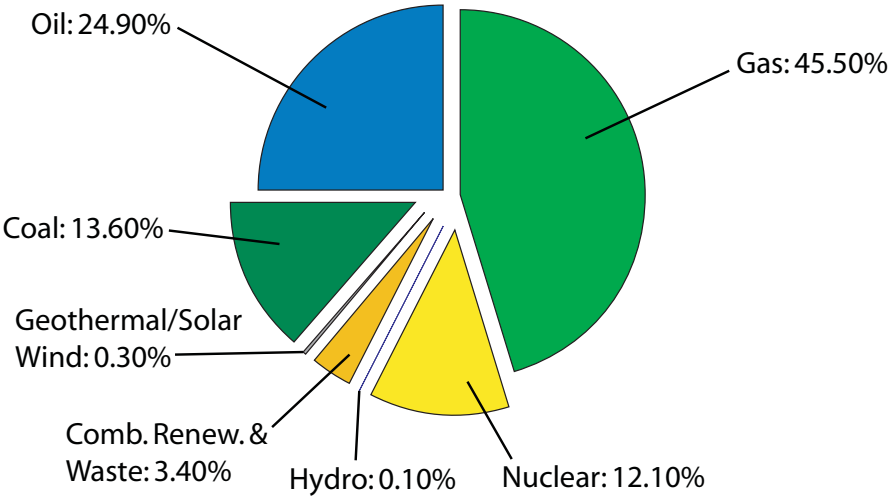
Further incentives for biofuels producers include Direct Area Payments, which provide grains and oilseed producers with a EUR86.21/hectare payment in addition to a national government payment of EUR 80.92/hectare in 2005. The European Agricultural Orientation and Guarantee Fund may also provide biomass producers with an additional EUR32/hectare.[10]

More recently, the European Commission expressed its intention to provide crop subsidies to Hungary and the other states that acceded to the Union in 2004. The subsidies will provide EUR45 ($57) per hectare beginning in 2007 with an area limit of two million hectares, allowing subsidies of up to 50% of the costs of establishing new energy crops.[11] Further, a January 2006 government planning session led to renewed discussion on biofuels and biofuel incentives. Officials stated the bio-fuel industry will be a priority under the National Development Plan II and will propose excise tax exemptions for E85 fuel and make additional provisions for the use of biodiesel.[12] The EC and the Hungarian government hope the subsidies will enable the biofuels industry to take root.

C) CURRENT SITUATION

Energy Matrix
Domestic energy production currently provides approximately half of Hungary's energy needs, with dominant supplies derived from oil, gas, coal, nuclear power and lignite. The remaining 50% of Hungary's energy needs is met by oil imports.

Chart 4.6a: Hungary's Energy Matrix (2004)



Source: International Energy Agency[13]

Through the country's energy plan, Hungary is beginning to diversify away from oil and is incorporating a greater proportion of natural gas into its energy matrix.

Table 4.6a: Hungary's Primary Energy Supply 1990-2010 (millions of metric tons of oil equivalent)

Fuel Type	1990	1996	1997	2000	2005	2010
Coal	6.12	4.6	4.35	4.01	4.63	5.38
Oil	8.52	6.85	6.98	7.16	7.52	7.75
Natural Gas	8.9	10.22	9.7	10.06	10.23	10.32
Nuclear	3.58	3.7	3.64	3.65	3.65	3.65
Hydroelectric	0.02	0.02	0.02	0.02	0.02	0.05
Other *	0.37	0.22	0.44	0.99	1.03	1.08
Total	28.46	25.8	25.31	26.09	27.28	28.4

* includes renewables (other than hydro) and energy-from-waste
Source: OECD/IEA[14]

Current energy policies and limited investment in renewable energy capacity render the prospects for biofuels limited in the short to medium term.

Ethanol
While current production of ethanol is limited, Hungary possesses ample, arable land suitable for the production of grains and other feedstock. While large tracts of land could be utilized for feedstock production, poor crop yields have dissuaded investors.

Hungary's two distilleries, Hungrana and Gyori Szeszipar, are responsible for all of the countries 10,000 metric tons of bio-ethanol production in 2005. Less than a half of that production was absorbed within the domestic market by the oil company Mol, with the remainder being exported to Slovakia and Austria.[15]

Biodiesel
Hungary utilizes an area between 70,000-140,000 hectares for the production of rapeseed, which yields between 100,000-300,000 metric tons annually. While no commercial biodiesel was produced or sold in 2004, the Ministry of Agriculture and Rural De-

velopment recorded 2,000 metric tons of biodiesel production in 2005.[16] While information on the processing capabilities is sparse, there are isolated instances of industry investment.

Production and Consumption
As the exclusive consumer, the Mol Company's purchase agreements dictate production levels. Mol's 2007 production targets were 50,000 metric tons of biodiesel and bio-ethanol, and the company projected an annual increase of 10,000 metric tons to 2014.[17]

Beginning in 2007, the Hungarian government plans to construct a series of small-scale bio-ethanol plants in collaboration with local livestock farmers. According to the Hungarian Ministry of Agriculture, the government does not intend to subsidize the construction of the plants due to the fact that investors may qualify for other pre-existing incentives (e.g. corporate tax holidays, subsidized loans) and may also qualify for EU subsidies.[18] Interest in developing the plants has since dwindled due to falling oil and industrial alcohol prices.

D) PRIVATE SECTOR

Despite the fact that Hungary has limited supporting legislation and a minimal production base, foreign investors are injecting capital into the country's biofuel sector, albeit on a relatively small scale. Last year, Amidonn Kft, the Hungarian division of Italy's Catelli Holding, announced plans to build a EUR100 million agro-business complex in northeastern Hungary. The complex will include an apple-gelatin plant, a plant for pharmaceutical additives and a bio-ethanol plant. The complex is expected to be operational by in 2-3 years.[19]

Further, Swedish ethanol investor Sekab recently announced plans to invest EUR60 million in four Hungarian ethanol plants. To date, no domestic venture capital firms have invested in Hungarian biofuels.[20]

While interest in investing in Hungarian biofuels is marginal, Hungarian firms have invested in biofuels outside of Hungary's borders. In late July 2006, a consortium of seven Hungarian companies, US-based CSLM Development, and Germany's Commerzbank formed to develop a EUR380 million bio-ethanol project in Serbia. The project is expected to require one million tons of wheat and 500,000 tons of maize and is projected to produce a total of 545,000 tons of ethanol from the two feedstocks.[21]

E) RESEARCH & DEVELOPMENT

While research into Hungarian biofuels is limited, a few notable organizations are conducting research into the viability of bio-ethanol and biodiesel in the country. The Combustion Institute promotes and disseminates research into the field of combustion science and organizes conferences on subjects including biofuels and fluid dynamics.

The Hungary Energy Centre is a non-profit energy-efficiency and energy information agency. In addition to promoting energy efficiency in Hungary, the organization collaborates with the European Union's Organization for the Promotion of Energy Technologies to promote the use of energy-efficient technology and the development of renewable energy sources, including biofuels.

A consortium comprised of Mol, Pannon University Research, the Hungarian Academy of Sciences, and the oilseed grower KITE is conducting research on second-generation biofuels in western Hungary.[22]

F) CONCLUSION

At present, the prospects for biofuels production in Hungary are limited. Limited legislation, poor crop harvests, and minimal demand all discourage the development of a viable industry. Current policies such as the excise tax on biofuels only recognize biofuel blends and, in effect, discourage the production of pure biodiesel. While minimal

investment is occurring in small-scale bio-ethanol projects, Hungary is not projected to play a significant role in the EU or Eastern European biofuels sector.

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Source: World Factbook

A) INTRODUCTION

Italy is highly dependent on external energy supplies and fossil fuels, and its progress on biofuels is uneven. However, Italy's non-compliance with EU directives related to biofuels does not constitute a rejection of Europe's move towards alternative energy regimes. In fact, Italy has increased its biofuels production capacity in recent years and has implemented tax incentives to spur the production of biofuels and biofuel inputs. It also initiated the Global Bioenergy Partnership at the G8.

B) GOVERNMENT POLICIES

In June 2006, Europe's energy chief took legal action against Italy for its failure to comply with the EU biofuels directive. Italy had previously earned a "reasoned opinion" from the European Commission, the last step before facing a lawsuit at the European Court of Justice, for its failure to submit a report on national biofuels use due in July 2005. Italy also earned the ire of the Commission for failing to properly justify its low biofuel targets for 2005. The EU has set non-binding targets of a 5.75% share for biofuels by 2010, a goal that Italy is likely to miss. According to the Commission, biofuels had an Italian market share of just 0.6% in 2003 and less than one percent in 2004.[1]

Although it has thus far failed to document its activities to the Commission, Italy did implement tax exemptions on up to 200,000 tons of biofuels in 2005. In keeping with its desire to promote the domestic cultivation of biofuels feedstock, the country has structured its tax incentives to favor ethanol—derived from domestically produced

surplus wine, sugar beets, and corn—over biodiesel, which is primarily produced with vegetable oils imported from France and Germany. Biodiesel consumption grew from 70,000 tons in 2000 to 310,000 tons in 2004, exceeding the then-quota for tax relief,[2] and it is widely believed that the agricultural lobby pressured the government to transfer tax relief to ethanol.[3]

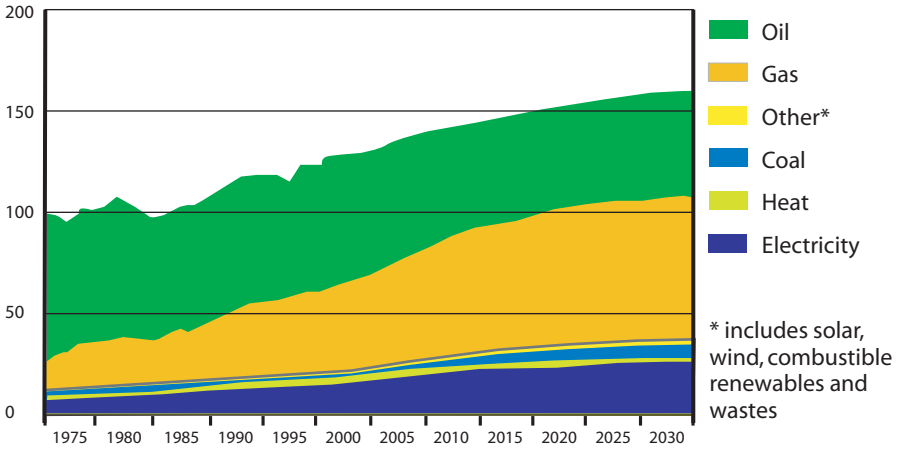
In mid-2006, Alfonso Pecorano Scanio, Italy's Environment Minister, announced a government program that aims to have renewable energy sources account for 25% of total energy consumption by 2011. He also indicated that the government intends to present a law that reconfigures Italy's renewable energy policy to the German model. Scanio maintained that the law would comply with existing EU directives and the demands of the Kyoto Protocol.[4]

Relations with Brazil
Relations between Italy and Brazil on biofuels are so far limited to a joint chamber of commerce (Consultoria Empresarial Brasil Italia) established in 2003 with the goal of encouraging cooperation on energy, IT, communications, and tourism. The organization has established a network of companies, universities, research institutions, and government bodies in both countries with a focus on renewable energy and has organized a number of joint events with Brazilian counterparts. It aims to promote European investment in Brazil's renewables sector and offers to consult on projects and help identify investment partners.[6]

C) CURRENT SITUATION

Energy Matrix
Renewables provided 8.2% of Italian consumption in 2004, and the majority of biomass is used directly in the residential sector.[7] As the graph below indicates, the IEA forecasts that this will increase in future decades.

Chart 4.7a: Total Final Consumption by Source 1973-2030



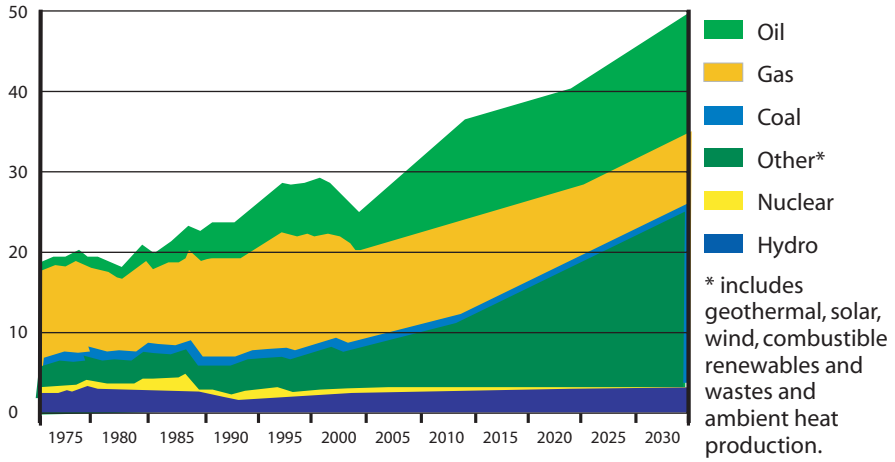
Source: Energy Balances of OECD Countries, IEA/OECD Paris, 2003: and country submission.

Biodiesel
Italian biodiesel production capacity was estimated at 827,000 tons in 2005, although actual production was only 396,000 tons. In 2006, production capacity was expected to rise to 857,000 tons.[8] Italian biodiesel is principally produced from rapeseed oil imported from France and Germany; domestic rapeseed cultivation is negligible.

Fuel Ethanol
Italy has been a latecomer to fuel ethanol production and only began converting ethanol into ETBE on an industrial scale in late 2005. In the first half of 2006, the Italian

government revamped its biofuels production incentive scheme by shifting funds previously allocated for biodiesel into fuel ethanol. The legislation allocated EUR73 ($94) million per year to provide tax relief for the production of 100 million liters of ethanol per year. In contrast to biodiesel, which is primarily produced from imported rapeseed and soybean oil, Italian ethanol production relies mainly on domestically-sourced surplus distilled wines, sugar beet, and maize.[9] In 2004, sugar beet molasses constituted 43% of production, wine 42%, grains 13%, and fruit 2%. Total production is approximately 200 million liters.[10]

Chart 4.7b: Total Final Production by Source 1973-2030



Source: Energy Balances of OECD Countries, IEA/OECD Paris, 2003: and country submission.

D) PRIVATE SECTOR

Alcoplus, a 2005 joint venture between Alc.Este. SpA and Caviro Sca, has an annual production capacity of 120 million liters of ethanol. This figure represents approximately 60% of domestic ethanol production capacity, excluding wine alcohol.[11] Alcoplus has since announced that it will diversify into ethanol production and has created the Societa Italiana Bioetanolo (Sibe) to market its products. The company is also considering building a fuel ethanol plant in Ferrara with an annual capacity of 42 million liters, equivalent to 50% of the current government quota.[12]

E) RESEARCH & DEVELOPMENT

The Italian National Agency for New Technologies, Energy and the Environment (ENEA) conducts a wide range of scientific research and technology development efforts including modest support for research into biofuel technologies.[13]

An Italian initiative also led to the establishment of the Global Bioenergy Partnership initiative (GBEP), launched in 2006 as response to a G8 Plan of Action for Energy. Italy now shares the presidency of the GBEP with Mexico. The partnership has identified short-term priorities, including updating the inventory of existing networks, identifying gaps in knowledge, carrying out feasibility studies for market building activities, raising awareness, and formulating guidelines to measure greenhouse gas emission reductions resulting from the increased use of biofuels in the transport and energy generation sectors.[14]

F) CONCLUSION

Given Italy's resources, inputs for biodiesel production in Italy will have to be imported. At the moment, these imports come primarily from France and Germany, but increased consumption may make Italy a good export market for Brazil. Ethanol in Italy

can be made out of established indigenous crops such as distilled wines, sugar beet, and maize, an opportunity that is being exploited by the private sector. However, cultivation of these crops may soon reach its limit, creating possible export opportunities for Brazil. There is also scope for technology transfer and other cooperation between the two countries, some of which have already been initiated by the private sector.[15]

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Source: World Factbook

A) INTRODUCTION

Poland has the world's fifth largest proven hard brown coal reserves, and more than half of its energy production is derived from coal. However, renewable energy is gaining importance in the country. By 2020, Poland expects renewable energy to comprise at least 14% of its fuel and energy balance.[1]

Poland's greenhouse emissions plummeted by nearly 30% between 1988-2002.[2] This earned Poland a surplus of CO2 credits available for sale under the Kyoto Protocol. Consequently, the country is not facing the same pressure to meet emissions targets and is instead motivated primarily by a desire to restructure Poland's agricultural sector through the development of a domestic biofuels industry. With nearly 60% of its land used for agricultural purposes and almost 30% covered in forests, the potential for bioenegy in Poland is quite significant.[3] Additionally, land and labor in Poland are available at below EU-15 cost.[4] There is some limited domestic biofuels consumption, but most current production is exported to Germany.[5]

B) GOVERNMENT POLICIES

Although Poland has used ethanol and ETBE for more than a decade, its increased use as transport fuel faces considerable opposition from oil companies, car producers, and consumers. Initial efforts to introduce biofuels were passed in parliament but later vetoed by the President. In June 2006, however, the government finally adopted a biocomponents and liquid biofuels bill that requires 5% biocomponents in liquid fuels.[6]

The target for 2010 is 5.75% biofuels use, in accordance with the EU Biofuels Directive.[7] Poland's strong agriculture and agro-industry lobbies are pushing the government to support the industry.[8]

The legislation also permits farmers to produce ethanol, biomethanol, esters, dimethylo-ether, poor vegetable oil, biogas, biohydrate, and synthetic biofuels for their own use up to 100 liters per hectare of agricultural land. At least 50% of biofuels feedstock must originate in the farm where the fuel is produced.[9]

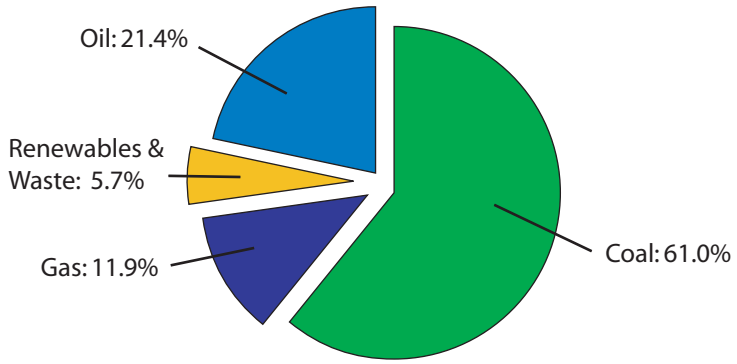
Poland has also adopted the Biofuel Quality Control and Monitoring System bill, which ensures that the government will retain control over biofuels production and requires that biofuels be registered and labeled so drivers are able to distinguish between biofuels and fossil fuels. The bill adopted by the government passed the first reading in Parliament and could come into effect in early 2007.[10]

Relations with Brazil
There is currently no cooperation between Poland and Brazil in terms of biofuels.

C) CURRENT SITUATION

Energy Matrix
Of the new EU members, Poland is the only one to have developed a significant biofuels sector. Still, the country appears to be experiencing difficulties complying with the biofuels targets established in the EU Biofuels Directive. Poland, along with seven other EU member states (Denmark, Ireland, Finland, the UK, Hungary, Portugal, and Greece) failed to meet the 2% target set for 2005, only reaching 0.5%.[11]

Chart 4.8a: Fuel Shares of Total Energy Production in (2003)



Source: IEA

Biodiesel
Poland posted a noteworthy about-face when it reported that it had produced 100,000 tons of biodiesel in 2005 after having produced none in 2004.[12] Production is expected to increase by another 50% this year.[13] The country's accession to the EU likely played a crucial role in this transformation. Its new status as an EU member state has given Poland access to new technology and better varietals.[14]

Ethanol
The momentum for biofuels production in Poland was slowing with the extensive closings of agricultural distilleries across the country between 1990 and 2004. In 1990 there were about 950 plants in Poland. There are now only about 100 small agricultural distilleries, in addition to 20 producers of dehydrated ethanol in Poland with an aggregate production capacity of about 500 million liters.[15] The industry's contraction resulted from the withdrawal of government sponsorship and tax exemptions.[16]

Ethanol in Poland is mainly produced from starch distillate made from either rye or potatoes. Producers are also growing increasingly interested in sugar beet, maize, triticale, and molasses, however no significant level of production has been developed.

Total estimated ethanol production capacity in Poland is between 600 and 1,000 million liters per year.[17] The facility in Trzebinia currently has the largest production capacity in the country—100,000 tons of methylester per year.[18]

D) PRIVATE SECTOR

As expected, new biofuels legislation has created significant interest among investors in Poland. According to a recent GAIN report, stock prices for companies that plan to invest in biofuels production have increased dramatically. In 2006 alone, there were four large conferences organized by various institutions to discuss biofuels production and use. Industry representatives are concerned, however, that the legislation does not include incentives such as tax reductions for biofuels production.[19]

Biodiesel
It is estimated that approximately $300 million was invested in new biodiesel plants last year, and seven or eight firms are likely to invest more by the end of 2007.[20] Experts at the Polish Institute for Agricultural Economics say that biodiesel production by 2010 could realistically reach 400,000-500,000 tons.[21]

Ethanol
Poland has the potential to become one of the leading ethanol manufacturers and exporters in Europe. In addition to several smaller plants, there are plans for the construction of two or three single-stage units with a total production capacity of approximately 100 million liters per year.[22]

BRASCO Holding is the largest ethanol manufacturer in Poland. The company's Leszno facility and Cargill's Wroclaw plant have a combined annual ethanol dehydration capacity of 170 million liters. Earlier this year, Cargill announced a US$35 million expansion project of its plant in Wroclaw.[23]

E) RESEARCH & DEVELOPMENT

Although the government maintains that research into renewable energy sources is an important priority, most projects have yet to be finalized. There were several research programs undertaken between 2000-2004, including one testing a high blend (20-30%) biodiesel in city buses. Overall, however, the industry suffers from under-funding and a lack of political commitment.[24]

The Renewable Energy Centre of Excellence and Competence in Poland (RECEPOL), lead by Grzegorz Wisniewski, is deeply involved in Poland's plans for boosting RES capacity.

F) CONCLUSION

Poland has the advantages of low land and labor costs and abundant biofuels feedstock. The USDA estimates that total capacity could reach more than 250,000 metric tons by early 2007.[25] However in spite of the country's substantial agricultural production and technological potential, its distilleries and dehydration facilities are reported to be operating at only 10-15% capacity.[26] A number of obstacles are preventing Poland fulfilling its potential to be among the leading biofuels producers in Europe. Although a bill has been proposed, Poland has yet to pass biofuels legislation necessary to meet the EU Biofuels Directive targets. Additionally, the lack of quality standards and quality control measures (also under consideration) has created a bad image for biofuels with the general public and in the media. Moreover, the use of short-term decrees to dictate biofuels production in Poland offers producers little opportunity for long-term planning.[27]

Endnotes

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Source: World Factbook[1]

A) INTRODUCTION

Russia is the largest producer and exporter of fossil fuels in the world and is often thought to have no need for renewable energy development.[2] However, the carbon-intensive nature of Russia's energy production and consumption and the country's Kyoto Protocol commitment create a need for the development of clean, green alternatives such as biofuels, for which Russia's enormous biomass resources boast abundant and varied feedstock. Despite growing awareness, no legislation or incentives for biofuels production exist. Instead, ethanol and biodiesel production has sprung up across the country on an ad-hoc basis, primarily in response to a growing grain surplus and opportunities for biofuels export to the European Union.

B) GOVERNMENT POLICIES

Renewable Energy

There is no policy framework for renewable energy technologies in Russia. Renewable energy was not considered a notable input in the national energy mix in the country's 2003 energy policy document, the *Energy Strategy of Russia up to 2020*, which sought to increase energy efficiency as well as implement a proper energy pricing policy in the country.[3]

In 1999, the first Russian Renewable Energy Law was passed by the State Duma and Council of Federation, but was vetoed by President Yeltsin.[4] Since 2004, efforts to resuscitate a renewable energy law have been led by state-owned electricity generation and distribution monopoly UES. Key considerations in the second draft include the determination of which energy sources would be considered renewable sources; the current draft includes solar, wind, hydro, tidal, wave, geothermal, and biomass energy. It also identifies the different support measures for renewable energy that could be implemented.[5] Russia's ratification of the Kyoto Protocol in 2004 has given Russia added impetus to develop alternative cleaner energy sources like biofuels to reduce carbon emissions.[6] In fact, the State Duma has made the discussion of the alternative energy sources bill and the Ministry of Industry and Energy's plan to draft a federal target program ensuring higher energy consumption efficiency key considerations for its 2006 session.[7]

Biofuels

Russia also has no policy framework for biofuels. However, in 1997, the government imposed a three-year ban on ethanol imports. The ban was lifted in 2000, but ethanol import duties have remained excessively high, at 100% or $2.63 per liter, whichever is higher.[8] The duty has cut ethanol imports almost to zero. The tax structure also imposes high taxes on fuel ethanol for domestic consumption, which means that new Russian ethanol plants are largely producing the fuel for export to the EU, as biofuels

produced for export are tax-exempt.[9]

In August 2006, the Ministry of Agriculture extended its interest-rate subsidies for 5-year commercial investment loans to include companies using advanced technology to process high-protein crops, which would include the production of ethanol from wheat and corn as well as biodiesel from oil seeds such as rapeseed and soybeans.[10]

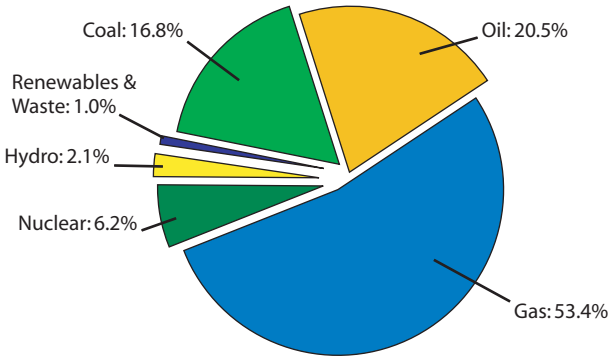
Relations with Brazil

As part of a joint statement by Russian President Vladimir Putin and Brazilian President Luiz Inacio Lula Da Silva in October 2005, the two countries agreed to strengthen cooperation between their respective oil, gas, and petrochemical companies. The document also called for an exchange of experience in renewable energy sources, with a particular focus on ethanol.[11]

C) CURRENT SITUATION

Russia is the largest producer and exporter of fossil fuels in the world.[12] With just 2.8% of the world's population, Russia boasts 12% of explored oil reserves, 34% of natural gas reserves, and 20% of coal reserves.[13] With such an abundance of fossil fuel reserves, it is unsurprising that Russia relies almost completely on fossil fuels, particularly natural gas (Chart 4.9a), for its energy supply. This, together with Russia's commitment to ensure exports of oil and gas to the CIS and some Eastern European countries, has resulted in Russia becoming a carbon-intensive country, with emissions per capita (at 3.6) far above the global sustainability target.[14]

Chart 4.9a: Share of Total Primary Energy Supply in 2003



Source: IEA[15]

Due to the diversity of its climate, terrain and geology, Russia is also richly endowed with renewable energy resources. Local experts estimate that the country's economic renewable energy potential could be as much as 30% of its actual total primary energy supply (TPES).[16] However, in 2003, renewable energy only accounted for 1% of Russia's TPES, or 3.1% if large hydro energy is taken into account.[17] In particular, Russia, which is home to 22% of the world's forests,[18] has enormous potential in bioenergy and produces up to 15 billion tons of biomass annually, which can be converted into heat, electricity and biofuels for transport.[19]

Ethanol

Russia has a national ethanol capacity of one billion liters, the majority of which is consumed by the beverage alcohol industry, which produced 716 million liters in 2005.[20] The country currently produces no fuel ethanol. However, Russia has had experience, dating from the 1930s, in constructing biomass-processing plants, which utilized waste products from local paper factories to boost industrial ethanol output. Due to high production costs, the original 21 plants with a combined annual capacity of 150 million liters had dwindled in 2000 to just 11 operational plants with a combined output of 9.9 million liters. The feedstock of choice had also been switched from waste products to

sugarcane molasses.[21]

Fuel ethanol production in Russia is in its infancy, with a number of fuel ethanol plants in the works. Although the positive environmental qualities of biofuels have been a factor, the ethanol initiative is primarily a response to the grain surplus that resulted from the bumper harvests of the last few years.[22] The surplus resulted in the export of 12.5 million metric tons of grain in the 2005/2006 crop year.[23] Output from almost all the planned ethanol plants is intended for export markets in the EU and is expected to bring in substantial profits, given the rising utilization of biofuels in EU transport industries.[24]

In April 2006, Russia announced that it would commence construction of its first major fuel ethanol plant in 2007. The plant, which will be located in grain-growing Volgograd Region, will require $200-250 million in investment and will utilize 900,000 metric tons of wheat annually to produce 380 million liters of fuel ethanol. Output is almost entirely intended for export to the EU.[25] This announcement was followed by plans by private-sector firms Bashneft-Yug and YugTransitServis to build fuel ethanol plants, with annual capacities of 157,000 and 300,000 metric tons respectively. The plants will be located in the Rostov region, one of Russia's major grain producing regions, and are expected to attract more than $250 million in investment.[26] Other Rostov region ethanol projects include one by grain trading giant Yugtranzitservis (YTS), which has proposed to build an ethanol plant with an annual capacity of 250,000 to 300,000 metric tons near its grain terminals at Azov and Taganrog river ports.[27]

Outside of the Volgograd and Rostov regions, ethanol plant projects in the planning stage include one by the Titan Group to build an ethanol plant in its home base of Omsk in Siberia with an annual capacity of 150,000 metric tons. In addition, the regional administration of Nizhni Novgorod, Russia's third largest city, is also considering an ethanol plant.[28]

Biodiesel

Russia produces almost no biodiesel. However, a number of companies have recently announced plans to build biodiesel plants, with rapeseed as the feedstock of choice. National output of the oilseed has been rising steadily, from 300,000 metric tons in 2005 to an expected 550-600,000 metric tons in 2006. The Russian Agriculture Ministry has also set targets of increasing rapeseed output to 1.5 million metric tons in 2007 and 5 million metric tons in the long term.[29] As with the ethanol industry, biodiesel produced from the proposed biodiesel plants are also intended for export markets in the EU.

Upcoming biodiesel projects include a plan by Rostov-based Azov Shipyards to build a biodiesel plant with an annual capacity of 150,000 metric tons, a proposal by Moscow-based T and T Trade firm to build a biodiesel plant with an annual capacity of 100,000 metric tons in the central Orvol region, as well as effort by five Russian agribusiness firms in the central region of Lipetsk to build a biodiesel plant to produce 90,000 metric tons of biodiesel annually. To supply feedstock for the plant, the group intends to increase the cultivation of rapeseed in Lipetsk from the current 25,000 hectares to 100,000 hectares by 2008.[30] The Association of Volgograd Region's Agribusinesses has announced plans to build a biodiesel plant, together with an oil-extracting plant with an annual processing capacity of 500,000 metric tons of oil seeds.[31]

Production/Supply Infrastructure

Although Russia has enormous biomass resources, the biofuels industry will remain scattered and ad hoc because there is almost no supporting infrastructure in the country. Not only is there a dearth of federal legislation promoting renewable energy, let alone biofuels, there is almost no financing available. The situation is compounded by the lack of subsidies for biofuels production and the imposition of heavy taxes on production for domestic consumption. In addition, there is little available biofuels production equipment and technology, a shortage of trained personnel, and an absence of national standards to encourage confidence in biofuels consumption.[32]

D) PRIVATE SECTOR

Experts have said that the future direction of private-sector investment in Russia's biofuels industry will depend heavily on the outcome of the Bohim ethanol plant in Taiynsha, Kazakhstan, which in October 2006 was the first ethanol plant in the former Soviet Union to go online. Bohim, which uses wheat as a feedstock, is jointly owned by Russia's Titan and Kazakh's Basko, and has an annual capacity of 57,000 metric tons. There are fears that biofuels may be difficult to sell, given that there are no subsidies for the industry, and that domestic production is taxed heavily.[33]

Despite these reservations, the majority of new plants are being proposed and undertaken by private-sector firms. In particular, the largest player appears to be Siberian petrochemical company Titan Group. In addition to being a partner in the Kazakh Bohim ethanol plant, Titan also has plans to build an ethanol plant in its home region of Omsk. Company president Mikhail Sutyaginsky has also projected that the group will have no less than 10 ethanol plants in Russia over the next five to seven years.[34]

Unfortunately, Russia's largest private-sector energy players appear to lack confidence in the country's alternative energy market. For example, GML, the principal owner of Russian oil giant Yukos, has expressed interest in investing $655 million in alternative power engineering, specifically in biodiesel and wind power, but believes that investing in the Commonwealth of Independent States, especially Russia, is out of the question.[35]

E) RESEARCH & DEVELOPMENT

Information on Russia's R&D sector for biofuels is unavailable; however, given the relative infancy of the country's biofuels sector, it is unlikely that substantial R&D has taken place. It should be noted, however, that Russia has had extensive experience in producing ethanol from cellulosic materials; it was one of the countries that built and operated ethanol-from-cellulose (EFC) plants during World War II, when output was prioritized over profitability. Today, a few of these plants are still operating, making Russia a key candidate to develop cost-effective and commercially viable EFC technologies.[36]

F) CONCLUSION

Given the scattered nature of Russia's nascent biofuels industry, it is unlikely that the country will become a major player in the global biofuels industry. To begin with, the country has no legislation promoting biofuels production nor is a mandatory biofuels blend likely in the near future. Although there is a small but growing trend of mostly private-sector sponsored projects to produce ethanol and biodiesel for export to the EU, these efforts are unlikely to achieve any scale given the lack of subsidies for biofuels production. Unless there is stronger government and infrastructural support, Russia will remain a small biofuels player, despite the country's enormous potential in biomass resources, and the expanse of available land to cultivate biofuels feedstock.

Endnotes

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Source: World Factbook

A) INTRODUCTION

Spain's energy demand has grown steadily in recent years and appears set to continue growing for the foreseeable future. The country's domestic energy sources and infrastructure are inadequate to meet accelerating demand, leading to an energy supply crunch.[1] In an attempt to cope, Spain has embarked on an aggressive energy market liberalization program that has so far outpaced the current timeline set by EU energy market directives. It has also adopted an active Renewable Energy Program (REP), which seeks to have renewable sources provide 12% of supply by 2010.

B) GOVERNMENT POLICIES

Spain's Promotion Plan for biofuels set a target of consuming the equivalent of 16.6 million tons of oil from renewable energy sources in 2010, equivalent to 12% of Spain's projected energy consumption for that year.[2] Under this scheme, the government hopes to generate more than EUR1 ($1.27) billion and 46,000 new jobs through 2015.[3] In the transportation sector, the plan aims to replace the equivalent of 2.2 million tons of oil (3.6 billion liters) in 2010.[4]

Table 4.10a: Spain's Renewable Energy Targets, 2005-2010

Resources *(toe)*	
Cereals and biomass	550,000
Wine alcohol	200,000
Pure vegetable oils	1,021,800
Used vegetable oils	200,000
Applications	
Bioethanol	750,000
Biodiesel	1,221,800
Totals	
Primary energy (toe)	1,971,800

Source: Spanish Ministry of Industry, Tourism and Commerce [5]

Table 4.10b: Projected Direct Blending with Transport Fuels (%)

	2005	2006	2007	2008	2009	2010
Ethanol/Gasoline *(excluding ethanol in ETBE)*	0	2.03	4.7	7.54	11.12	17.21
Biodiesel	0.08	1.42	2.25	2.92	3.97	5

Source: F. O. Licht

Spain's current incentive regime fully exempts a limited volume of ethanol from taxation (normally EUR37 per hectoliter), though this incentive expires in 2012. The government earmarked EUR2.85 ($3.62) billion for sales tax breaks for ethanol and biodiesel producers over the period 2005-2010, in order to reach the targeted 5.83% share of total consumption. As a result, the use of biofuels is set to more than quadruple from the current level of 500,000 tons by 2010.[6]

The REP will provide direct financial support for renewable energy production in the form of investment subsidies, premiums paid on electricity generated from renewable sources, and financial incentives for biodiesel and ethanol production.[7]

The REP has come under fire from industry groups due to its meager demand-side initiatives. Some players have also argued that capacity exists for up to 10% biofuels blends (rather than the current 5% mandate). Biofuels producers would also like to see auto manufacturers explicitly endorse biofuels consumption by extending their consumer warranties to the use of biofuels blends.[8]

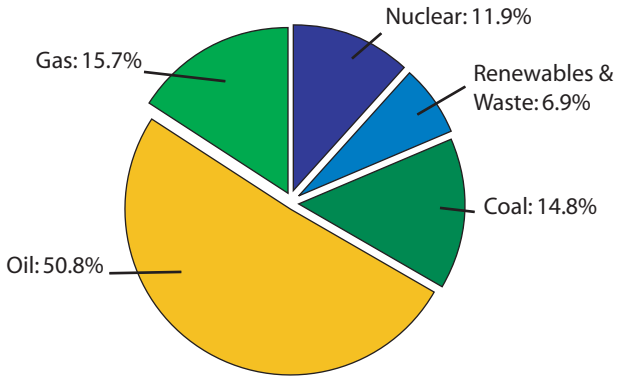
The implementation of the REP targets would reduce carbon dioxide emissions by six million tons and decrease petroleum imports by 16 million barrels by 2010.[9]

Relations with Brazil
There is currently no cooperation between Spain and Brazil on biofuels.

C) CURRENT SITUATION

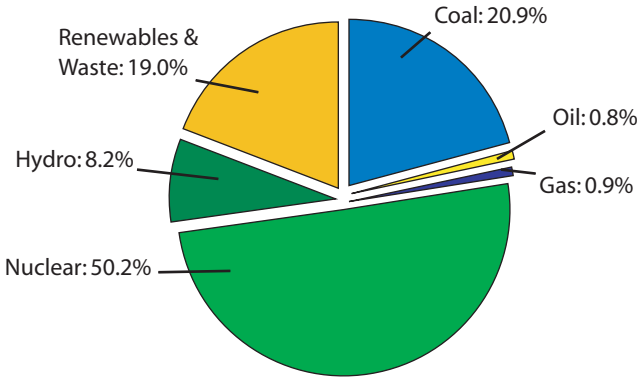
Energy Matrix
Spain relies on external sources for 80% of its energy needs. Primary energy consumption and energy intensity have grown faster than expected over the past five years.[10] This dramatic increase in energy demand, coupled with the need to meet Kyoto Protocol targets, spurred the drafting of the REP.

Chart 4.10a: Spain – Shares of Total Primary Energy Supply 2003



Source: IEA

Chart 4.10b: National Production of Energy in 2004

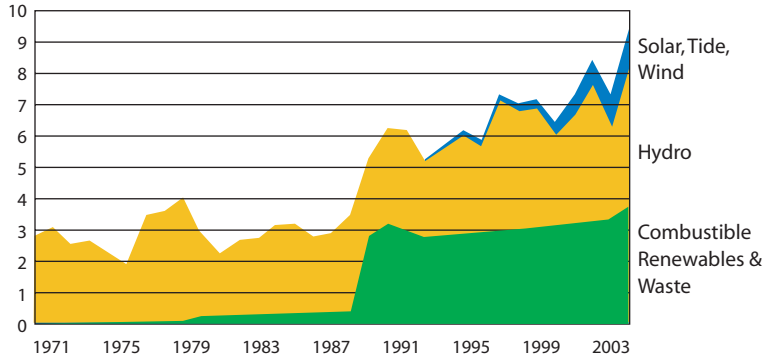


Source: in Spain, Ministry of Industry, Tourism and Trade 2004

Consumption

Spain has set ambitious targets for the use of renewable energy and introduced a new regime for the sale of renewable energy on the domestic market that is expected to increase supply.[11] Spain's biofuels consumption is expected to be the equivalent of 2.2 million tons of oil annually by 2010. This figure would represent 5.38% of petrol and diesel consumption for transport, slightly above the target in the EU's biofuels directive (5.75% in 2010).[12]

Chart 4.10c: Spain – Total Primary Energy Supply from Renewables (Mtoe) in 2003



Source: IEA

Production

Despite Spain's continued reliance on foreign energy sources, the country is the second largest producer of fuel ethanol in the EU and has taken steps to increase its biofuels production capacity. Regions leading production include Galicia, Aragón, Andalucía, and Castilla and León. The major biofuels producers in Spain are Abengoa, Bionet, Meroil, Samca, Acciona, and Acor. In 2004, approximately 254 million liters of fuel ethanol were manufactured in Spain. The country's current total ethanol production capacity of approximately 326 million liters is expected to rise by another 200 million liters with the completion of a new ethanol plant.[13] Biodiesel production began in May 2004 when a plant in Cartagena opened. Total biodiesel production was only 14 million liters that year, but the complete exemption of the fuel from national hydrocarbon taxes is expected to spur production dramatically.[14]

Spain's major primary crops are barley, sugar beets, wheat, grapes, maize, olives, tomatoes, potatoes, and oranges. In 2004, Spain harvested 22.5 million tons of cereals. It is forecast that Spain will produce 6.2 million tons of wheat in 2006 (last year's crop was only 3.8 million tons due to drought). It is estimated that 50% of Spain is arable land, and 26% of this was in use in 2004.[15] These favorable conditions support the projection that Spain will increase its production of biofuels significantly in the future.

Table 4.10c: Projected Spanish Production Capacity (million liters)

	2005	2006	2007	2008	2009	2010	Total
Annual Capacity	66.4	398	513	513	695	921	3,106.40
Ethanol	0	198	248	248	297	494	1,485
Biodiesel	66.4	200	265	265	398	427	1,621.40

As estimated in the REP

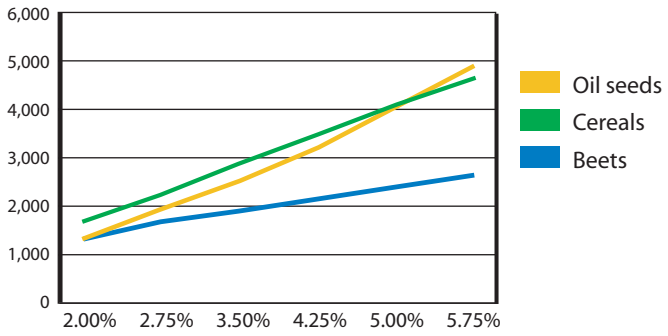
Source: F.O. Licht

Table 4.10d: Projected Investment in New Capacity (EUR millions)

	2005	2006	2007	2008	2009	2010	Total
Biofuels	12.9	170.6	205.6	200.8	231	335.8	1,156.70
Ethanol	0	133.8	158.9	150.9	170	272.2	885.8
Biodiesel	12.9	36.8	46.7	49.9	61	63.6	270.9
Tax deductions	18.6	135	175.2	189	233.9	334	1,085.70

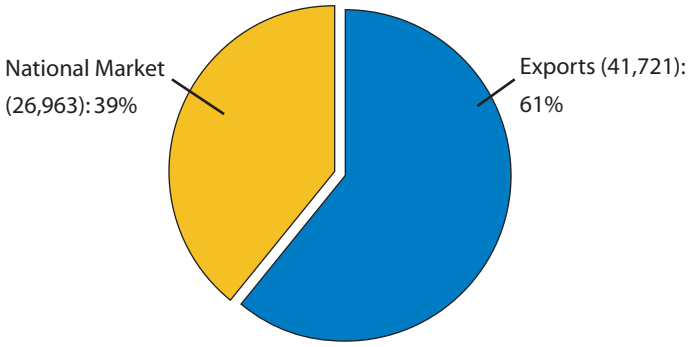
Source: F.O. Licht

Chart 4.10d: Agricultural Scenario if the objectives of the REP are met in 2010



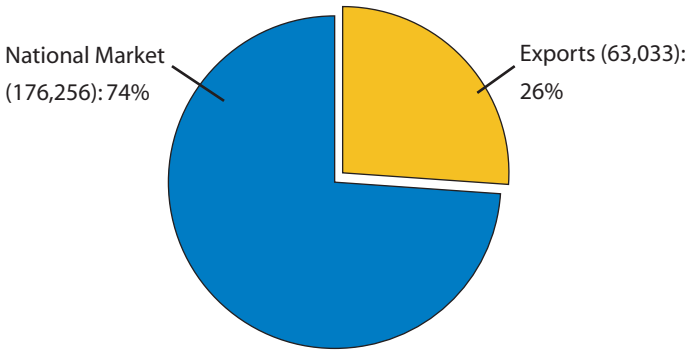
Source: Spanish Renewable Energy Action Plan

Chart 4.10e: Sales of Biodiesel Produced in Spain in 2005



Source: Spanish Renewable Energy Association (APPA)

Chart 4.10f: Sales of Ethanol Produced in Spain in 2005



Source: Spanish Renewable Energy Association (APPA)

The charts above demonstrate that Spain produces approximately three times as much ethanol as biodiesel. Biodiesel, however, has largely been exported, while the majority of ethanol is consumed domestically.

D) PRIVATE SECTOR

Sugar producer Ebro Puleva recently announced plans to build a EUR53 ($67.4) million biodiesel plant in Jesula, in the province of Cadiz. The facility is expected to have an annual production capacity of 200,000 tons and will process rapeseed. The company also has plans to construct a fuel ethanol plant on the site of the company's sugar factory in Burgos. The EUR55 ($69.9) million plant should become operational in 2009 and will produce up to 100 million liters of sugar beet-derived ethanol per year.

Chemical and paper company Sniace plans to build an ethanol plant in Zamora in a joint venture with electricity producer Iberdrola and others. The plant's production capacity is projected to be 120,000 tons per year. Sniace has two other ethanol manufacturing projects in the works: a 125 million-liter facility in Torrelavega scheduled to commence production at the end of 2008 and a facility in Poland with annual production capacity of 200,000 tons.[16]

The leading Spanish food group, SOS Cuetara, plans to invest EUR35 ($45.5) million in the construction of a biodiesel plant in the town of Andujar. The plant will use rapeseed as its main input and has a planned production capacity of 200,000 tons.[17]

Abengoa, the Spanish engineering company, is a leading producer of fuel ethanol. The firm currently operates three plants that produce ethanol for ETBE conversion, with a total capacity of 4.26 million hectoliters per year. Abengoa may also partner with energy firm EVE on an ethanol plant that will have an eventual capacity of up to 200

million liters.[18] Abengoa is also active in ethanol in Brazil.

Spain's Renewable Energy Association (APPA) boasts 29 members from the biofuels industry. The association provides information about the sector as well as specific client services, mainly in the legal realm, and acts as a lobbying group with the government.

E) RESEARCH & DEVELOPMENT

The REP outlines a number of goals for R&D in the biofuels sector. On the production side, the government cites the need to develop new technologies for the collection, conditioning, transport, and storage of raw materials. Furthermore, the plan highlights the need to develop production methods that utilize new inputs, such as different plant varietals and animal fats. For ethanol and biodiesel, the REP indicates that the selection and optimization of plant varieties for production inputs remains an important task. The plan also envisions the use of biofuels in captive transportation fleets for both practical and demonstrative purposes.[19]

The Spanish Institute for Energy Diversification and Conservation (Instituto para la Diversificación y Ahorro de la Energía, IDAE) is a publicly owned, business-structured entity reporting to the Ministry of Industry, Tourism and Commerce through the General Secretariat for Energy. The IDAE promotes energy efficiency and the rational use of energy in Spain. It also seeks to promote the diversification of energy sources and the use of renewables. It promotes these aims through dissemination activities, technical consulting, and the implementation of technologically innovative projects. This includes the promotion of Spanish technologies abroad, particularly in Europe, the Mediterranean, and Latin America.

Spain's Abengoa, the largest ethanol producer in Europe, is deeply involved in R&D. It announced the opening of the world's first commercial cellulosic ethanol plant in northern Spain in late 2006.[20] The Madrid Polytechnic University is also actively involved in bionenergy research

F) CONCLUSION

The current system of tax incentives has proved highly successful in spurring production and demand for biodiesel, and Spain is investing heavily in expanding capacity.[21] The country's natural endowments should allow the agricultural sector to gain enormously if the REP objectives are met. Continued government support for the development of a strong biofuels sector could produce more jobs, less energy dependency, and environmental sustainability. With the support of numerous associations and private companies, the outlook for Spain's biofuels sector is good.

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Source: World Factbook[1]

A) INTRODUCTION

Sweden is Europe's largest consumer of biofuels, which account for 17% of the national energy supply. Biofuels constitute 3% of Sweden's transport fuels, surpassing the EU Biofuel Directive's 2005 target of 2%. However, given its small agricultural sector, Sweden is also the only European country that imports the bulk of its biofuels needs. Given its strong consumption growth, Sweden has also been singled out as the EU country with the most potential for developing a flex-fuel car industry.[2] The Swedish biofuels industry is projected to see strong growth in the near future because of solid support in the form of government subsidies. It should also be boosted by the national drive for a cleaner, more sustainable energy sector, as evidenced by the country's goal of becoming oil independent by 2020.

B) GOVERNMENT POLICIES

Energy Policies

As a member of the Kyoto Protocol, Sweden affirmed its commitment to climate improvement by passing the National Climate Policy in Global Cooperation Bill in 2005, which verified the 2002 target of reducing emissions to 4% lower than 1990 levels before 2008. A medium-term target of reducing emissions to 25% of 1990 levels by 2020 was also stipulated. The bill also sought to meet the EU Biofuels Directive's target of 5.75% biofuels use by 2010.[3]

The bill was followed by the establishment of the Commission on Oil Independence in December 2005, which was tasked with formulating a comprehensive blueprint to achieve Swedish Prime Minister Göran Persson's goal of making Sweden oil-independent by 2020. The Commission presented its findings in June 2006 and identified three main objectives to be achieved by 2020:[4]

- Consumption of oil in road transport shall be reduced by 40 to 50% through increased fuel efficiency and the development of new fuels
- In principle no oil shall be used for heating commercial and residential buildings
- Industry shall reduce its consumption of oil by 25-40%.

For the purposes of this report, a closer examination of the first objective is most relevant. To reduce oil consumption in the transport sector, a number of measures were proposed. First, in order for Sweden's private cars to become 25-50% more energy efficient than current standards, a higher proportion of diesel vehicles utilizing biodiesel and the development of hybrid vehicles utilizing electricity should be encouraged.

Second, the Commission recommended that Sweden produce 12-14 TWh of biofuels annually from forest and arable land by 2020 in order to increase the share of renewable fuels in transportation. To achieve this, the Commission calls for government funding of R&D for second-generation biofuels, such as biogas and bio-DME (dimethyl ether), which promise higher energy efficiency. This should be supported by economic control instruments such as tax relief and fuel certificates, as well as government grants for the

cultivation of energy crops.

Biofuels
Sweden is a leader in biofuels for transportation. In 2005, the country established a biofuels target of 3% of total transport fuel consumption, the highest among EU member states, and above the 2% stipulated by the EU Biofuels Directive.[5] Sweden has also aligned its national target for 2010 in accordance with the directive at 5.75%.

To support the biofuels industry, the government has implemented a tax strategy whereby biofuels, as carbon dioxide-neutral fuels, can be exempt from both the carbon dioxide and energy taxes from 2004 to 2009.[6] As energy taxes represent approximately 30% and 40% of the price of gasoline and diesel respectively, this tax-free status allows biofuels to be competitive against gasoline and diesel despite their higher production costs.[7] The most recent budget proposal proposes the extension of this tax break to 2013.[8] There has also been a proposal to abolish the value-added tax on biofuels.[9]

On the demand side, the government promotes biofuels by granting free parking for and lower taxes on clean vehicles[10] and presents companies that use clean vehicles with a 30% investment subsidy. The consumption of clean vehicles is also encouraged by a tax reduction on purchases through 2008 and insurance fees that are reduced by as much as 20%.[11] In addition, a minimum of 25% of all new government vehicles purchased in 2005 were required to be partially fueled by either biogas, bioethanol or electricity. The requirement was raised to 35% in 2006.[12]

On the supply side, to increase the availability of biofuels, the government passed a law in December 2005 requiring gas stations selling more than 3,000 cubic meters of fuel annually (which includes up to 60% of all Swedish gas stations) to sell at least one type of biofuel. In 2006, the government reserved $6.25 million for this purpose.[13]

Ethanol
Regulations have created a 5% mandatory ethanol blend in Sweden. In late 2005, the government clarified the ethanol tax exemption in a bid to close a loophole which allowed ethanol imported for the purposes of fulfilling the required 5% biofuel blend to be classified under a lower tariff for other chemicals, while also benefiting from biofuels tax relief. Under the new law, which became effective in January 2006, companies wishing to take advantage of the 100% tax exemption on ethanol must show that they have paid the (higher) import tariff for natured ethanol. The higher tariff has already resulted in gas retailers imposing higher gas prices. The higher cost of imported ethanol should give a substantial boost to the price competitiveness of domestic ethanol against imported ethanol.[14]

Biodiesel
Biodiesel is also eligible for 100% tax exemption, and government regulations currently allow for a 2% blend of biodiesel or RME (rapeseed methyl ester) in diesel. In addition, the Swedish Road Administration is currently studying the possibility of implementing a 5% mandatory blend of RME, as well as the potential environmental and health impacts of the emissions from such a biodiesel blend.[15]

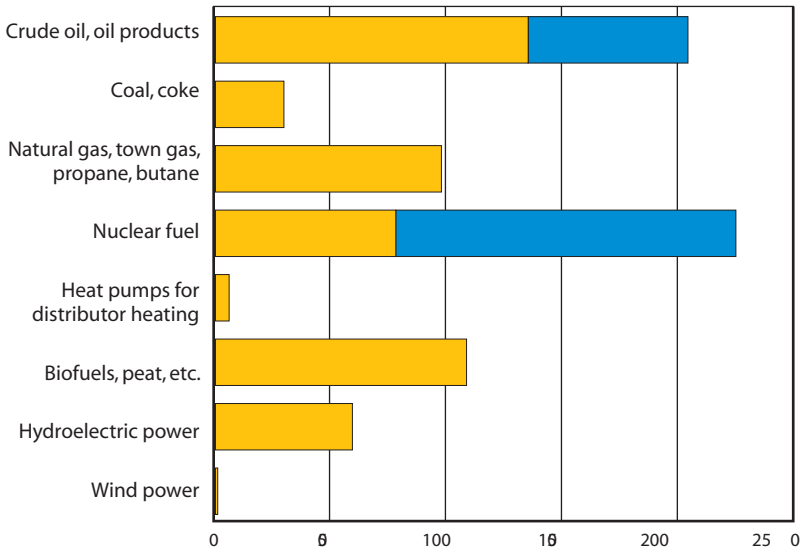
Relations with Brazil
In 2004, four times as much ethanol was imported than was domestically produced,[16] and more than 80% of Sweden's ethanol consumption originated in Brazil.[17] However, the higher tariffs now pegged to imported ethanol in Sweden may in the future shift imports from non-European countries such as Brazil to EU states.[18] On another front, Sweden has not established any investment protection agreements with Brazil.[19] The two countries are also collaborating on technical expertise. The Swedish Energy Agency is assisting Brazil in the development of three cogeneration projects at Brazilian sugar mills in Sao Paulo using bagasse.[20]

C) CURRENT SITUATION

Energy Matrix

The use of oil as a percentage of total energy supply has fallen from 70% in 1970 to 30% today as the supply of renewable energy has increased to about 28%.[21] Electricity production in Sweden is dominated by hydropower and nuclear power, although the Swedish Parliament has decided to gradually phase out its use of nuclear energy.[22] As such, renewable energy will play an ever-increasing role in Sweden's energy portfolio. Sweden's long-term vision is to become oil-independent and eventually utilize renewable energy sources for its entire energy supply. Biofuels are becoming an increasingly important component of Sweden's overall renewable energy focus. Today, biofuels account for approximately 17% of Sweden's total energy supply.[23]

Chart 4.11a: Total Energy Supplied in Sweden (2004)

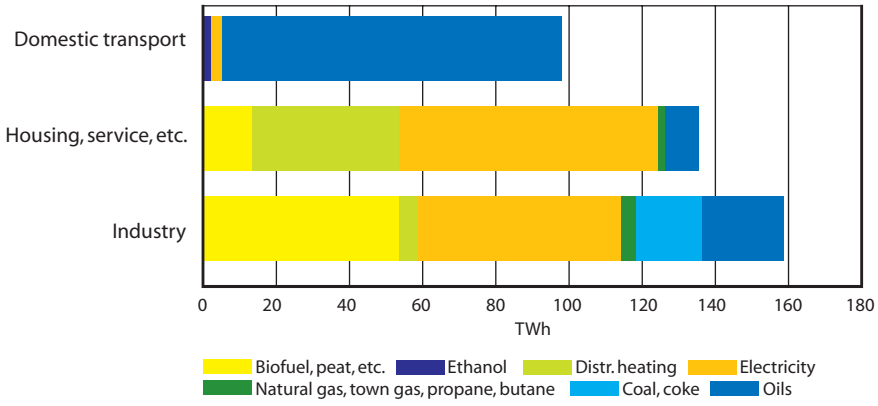


Source: Commission on Oil Independence[24]

Biofuels

Sweden's transport sector is 94% dependent on oil-based fuels [Chart 4.9b], with gasoline and diesel constituting up to 97% of road transport fuel (8 billion liters) and biofuels accounting for the remaining 3%.

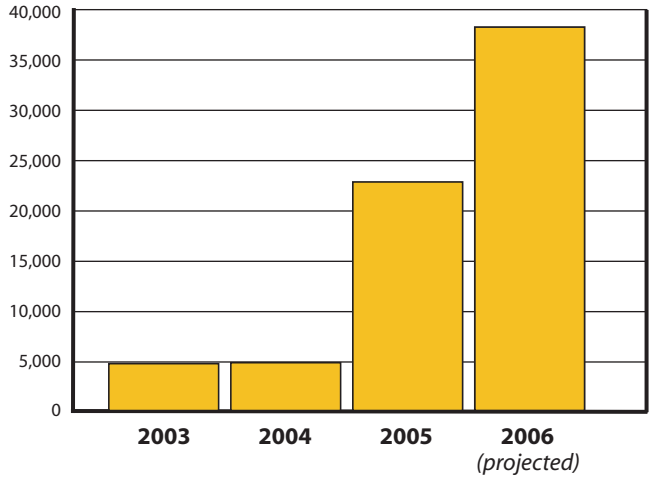
Chart 4.11b: Energy Use by Sector in Sweden (2004)



Source: Commission on Oil Independence[25]

Renewable fuel use in the transport sector is still relatively low given the high use of biofuels for industrial and heating purposes in Sweden. Nonetheless, transport use is quickly gaining momentum. In January 2005, the sale of environmentally-friendly cars increased 188% from the same period in 2004.[26] Both Volvo and SAAB Swedish-based car manufacturers are heavily involved in the production of bio-fuel cars.

Chart 4.11c: Ethanol Cars Bought in Sweden



Source: BioAlcohol Fuel Foundation

Ethanol

In 2005, Sweden produced 71 million liters of fuel ethanol, less than a third of the 260 million liters consumed that year.[27] Sweden is the only European country that is using direct blending at an extensive level. Some 85% of gasoline sold in Sweden contains E5, gasoline blended with 5% ethanol. Sales of E85, gasoline blended with 85% ethanol, are also surging, with figures from the Swedish Petroleum Institute (SPI) showing that approximately 17 million liters of E85 have been sold during the first five months of 2006,[28] four times as much as last year, a significant achievement considering gasoline sales decreased by 3.5%.[29]

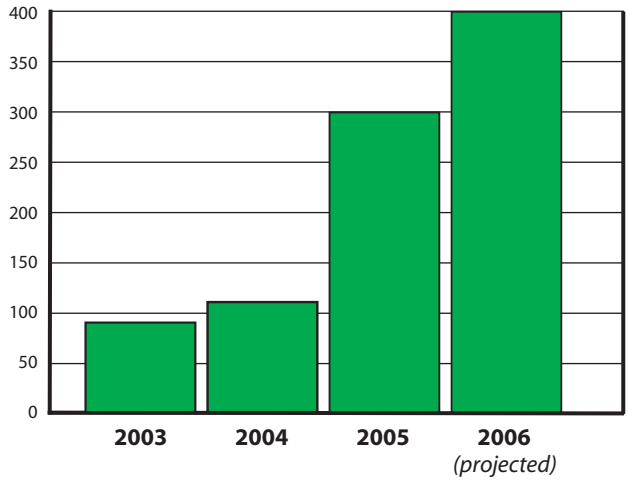
Consumption of fuel ethanol is quickly outpacing domestic production capacity, as evidenced by the rapid increase in ethanol filling stations [Chart 4.11d]. 189 million liters of fuel ethanol were imported in 2005, with 80% of ethanol imports coming from Brazil.[30] The remainder was primarily sourced from Italy. It is projected that the change in tax legislation in 2006 (see government policies) may lead to an increase in imports from Europe and a fall in imports from Brazil as non-EU imports become less competitive.

Biodiesel

Biodiesel production and consumption lags behind ethanol in Sweden, with only 7,000 metric tons of biodiesel produced in 2005. Swedish biodiesel is produced largely from rapeseed and is also known as RME or rapeseed methyl ester. Sweden's rapeseed cultivation area was a relatively small 80,000 hectares in 2005, and approximately 50% of rapeseed used for biodiesel production is imported from Germany and Denmark.

There is currently only one biodiesel producer in Sweden, Karlshamn, which accounted for the 7,000 metric tons produced in 2005. The company began construction of a second biodiesel plant in April 2006, which is expected to boost Karlshamn's total biodiesel capacity to 40,000 metric tons annually when it is completed. Indications that the government will soon raise the legal blend percentage to 5% have attracted new players. In November 2005, Preem Petroleum and Pestorp unveiled a joint venture to begin construction of a 53,000 metric tons-per-year biodiesel plant in January 2007.

Chart 4.11d: Opened Ethanol Filling Stations in Sweden



Source: BioAlcohol Fuel Foundation

Biofuels Capacity Expansion

A major factor determining the level of possible biofuels capacity expansion is the availability of arable land. Table 4.11a suggests that Sweden has the necessary land to achieve a significant biofuels feedstock cultivation expansion.[31]

Table 4.11a: Outlook for Potential Acreages for Biofuels Crops Production

Acreages for biofuel	2005 ha	TWh	2020 ha	TWh	2050 ha	TWh
Agricultural land in total	3 215 600		3 215 600		3 215 600	
comprising agricultural land for						
energy crops	80 000	0.5	160 000	2	400 000	11
fallow acreage	320 000	0.0	320 000	4	320 000	10
waste products, straw, fertiliser, etc.		0.5		4		11
previous agricultural land	400 000	0	400.00	2	400 000	12
Forest land in total	23 000 000		23 000 000		23 000 000	
Production		94		94		94
comprising increased productivity						
in existing forest land				23		30
intensive afforestation	0	0	200 000	2	1 150 000	27
other biofuels, waste, peat, etc.		13*		23		33
Total biofuel acreage ha/energy TWh	26 615 600	108	26 615 600	154	26 615 600	228

* including imports assessed to be 7-9 TWh in 2005

Source: Commission on Oil Independence[32]

However, the majority of Sweden's biofuels are produced from forest-related material, much of which is secondary outputs from other production processes like logging and sawmills. Domestically-produced biofuels are also generally used close to where they are produced. These usage patterns make Sweden's domestic biofuels locally efficient but limit their viability as a mass-production fuel and as an export.[33]

D) PRIVATE SECTOR

Private-sector participation is more pronounced in the ethanol industry in Sweden. Svensk Etanolkemi AB, or SEKAB, is the leading supplier of blended ethanol fuels on the European market and is the only chemical company in Europe with the capacity to produce ethanol-based acetaldehyde and ethylacetate from biological raw materials.[34] The company also produces E95 and Thermol, a biological-based ethanol used in refrigeration and heating. SEKAB's Domsjo factory has recently applied for permission to triple its ethanol production to approximately 300,000 liters per year.[35] Another ethanol producer, Agroetanel, plans to expand the capacity of its plant in Norrkoping

and more than quadruple its current production capacity. Once completed in 2008 (estimated date), the $125 million plant will have the capacity to produce 200,000 cubic meters of ethanol.[36]

Meanwhile, Sweden's biofuels stakeholders are looking to increase domestic production of RME in order to offset the high levels of imported bioethanol.[37] In May 2006, the Crop Marketing Association (Lantmannen) and the Swedish Farmers Supply were reported to have begun construction of a new RME factory in Karlshamn.[38] The new factory will have the capacity to produce 45 million liters of RME per year.

These private sector developments promise to increase Swedish indigenous supply. However, the country's size relative to its increasing demand for biofuels suggests that imports will continue to play a significant role.

E) RESEARCH AND DEVELOPMENT

The Swedish government is the dominant player in the country's energy R&D sector. In spring 2006, the government renewed its energy R&D bill, a program that has been instituted since 1975. Aside from R&D, the bill focuses on commercialization activities to further technologies and processes required for an ultimate transition to a fully renewable energy-derived energy system.[39]

Table 4.11b: Government Support for R&D on Alternative Fuels

Program	Fuel Type	Support Period	Govt. Support
Ethanol production from wood	Ethanol	1998 – 2004 (7 years)	$31 million ($4.4 million/year)
Alternative Transportation Fuels	Methanol, Fischer-Tropsch Diesel, DME and Hydrogen	2002 – 2006 (4 years)	$8.3 million ($2.1 million/year)

Source: Swedish Government[40]

Government aid for biofuels R&D is expected to intensify. As part of its recommendations for an oil-independent Sweden by 2020, the Commission for Oil Independence urged the government to increase its funding for R&D on the development of ethanol from forest raw material. It also called for strong support for R&D into the development of a complete infrastructure for biofuels in suitable areas such as Lake Mälare Valley and Skåne. [41]

The government is also providing extensive funding for energy-related research through universities and institutions of technology. The main emphasis of this work is on the development of gasification techniques for wood fuels and black liquor, vehicle fuel technology and emission cutting incineration technologies. The government has also invested in the R&D of second-generation biofuels, collaborating with other stakeholders to hold a conference in Stockholm in 2005 bringing global experts together to discuss the possibilities of second- generation biofuels for transport.[42] Another public-private partnership project is the $40 million initiative called Green Car 2, which was launched in June 2006 to promote the development of new vehicle technologies. The initiative will involve partnerships between auto manufacturers, universities and the government.[43]

Similarly, many private companies have been granted government funding for research purposes. Swedish car maker, Volvo, was granted an $8.7 million subsidy, worth 50% of the overall cost of the project, by the Swedish Energy Agency for the development of third-generation vehicle technology for DME (dimethyl ether), which is produced by gasifying biomass.[44] The project involves extensive research into adopting tank and fuel injection systems for DME use.

F) CONCLUSION

Despite the tightening of the tax regulations regarding ethanol imports into Sweden, and the corresponding improvement in price competitiveness for domestic ethanol, Sweden should remain a major export market for ethanol in the short to medium term, as the country's inadequate biofuels infrastructure and less advanced technology will keep domestic production behind consumption levels. In addition, plans to expand cultivation of biofuels feedstock are still in the early stages and reliant on commercially-unproven wood biomass. However, it is clear that the Swedish government has made a strong commitment to the development of biofuels, as is apparent from the key position of biofuels in the country's energy roadmap. All signs suggest that biofuels will continue growing in both consumption levels and economic importance in Sweden.

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Source: World Factbook

A) INTRODUCTION

On January 1, 2006, one of Ukraine's biggest fears became a reality—Russia cut off natural gas exports to the country. Although the supply was restored three days later, the incident highlighted Ukraine's urgent need for energy independence.[1] In March 2006, the government approved the Energy Strategy of Ukraine through 2030, which calls for using 6.6 million tons oil equivalent (mtoe) of renewable energy by 2030.[2] Less than two weeks after it was approved, however, the strategy was put on hold as the country plunged into political instability surrounding the parliamentary elections.

Finally, in August 2006, four months of political uncertainty ended when Ukrainian President Viktor Yushchenko accepted Victor Yanukovich's appointment as the new prime minister. It is anticipated that Ukraine's effort to decrease the country's high energy intensity, increase the use of domestic energy resources, and meet EU standards will now continue. Ukraine is considered the only country in the region that could compete with Brazil in biofuels exports.

B) GOVERNMENT POLICIES

In July 1999, the Ukrainian parliament passed legislation permitting 6% oxygenated additives to gasoline. The bill also included a 50% excise tax reduction on blended gasoline. Alcohol producers responded by producing 23 million liters of ethanol a year, but the tax incentive was abolished in 2002.[3]

An official "Ethanol Program" was initiated in July 2000 to transform the country's distilleries into both industrial and fuel ethanol producers. Additionally in 2003, several pieces of legislation sought to enhance the productivity of both ethanol and biodiesel. A presidential decree in September 2003 aimed to develop biodiesel manufacturing and to harmonize Ukrainian legislation with the EU. In late 2005, the parliament approved a biofuels bill, which included a 50% excise tax reduction for gasoline mixed with ethanol. However, President Yuschenko vetoed the bill.[4]

Relations with Brazil

Although Ukraine and Brazil are not currently cooperating in the biofuels industry, they do interact on a number of different fronts, notably missile and satellite technology.

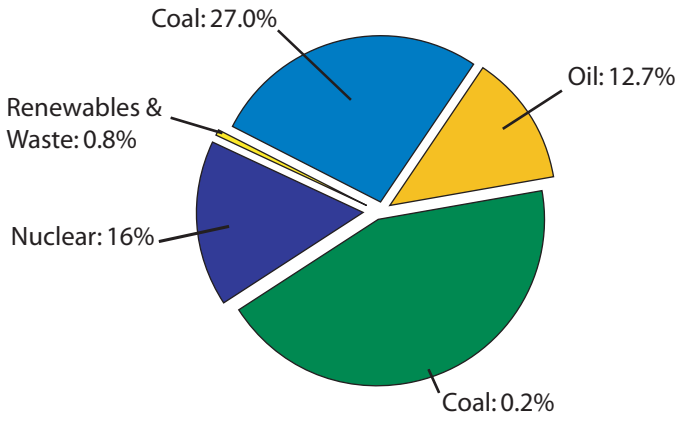
C) CURRENT SITUATION

Energy Matrix

Biomass now constitutes about 0.5 percent of the country's energy supply, or 0.7 mtoe (tons of oil equivalent).[5] The IEA estimates that the share is slightly higher, as seen

below.

Chart 4.12a: Shares of Total Energy Supply (2003)



Source: International Energy Agency

Ethanol

Biofuels comprise a growing but still marginal share of renewable energy in Ukraine. Today, Ukraine is the second-largest alcohol producer in Eastern Europe. The sector struggled in the late 1990s after Russia chose to stop importing from its southern neighbor, and in response Ukraine initiated a series of diversification reforms that incentivized the production of fuel ethanol.[6] The country produced 246 million liters of all grades of ethanol in 2005, though only a portion was fuel ethanol.

Biodiesel

In the past several months, biofuels projects in the Ukraine have been announced at a frenzied pace, particularly in regards to biodiesel. In the first quarter of 2006, construction began on two new biodiesel plants with an annual capacity of 100,000 tons/year and at a cost of $35 million each. Work also began recently on three rapeseed oil plants, each with productive capacity of 20,000 tons/year. The country has announced plans to more than double the agricultural land dedicated to rapeseed production in 2006 to 169,000 hectares, and increase the land dedicated to soy from 435,000 to 569,000 hectares. By 2010 it is estimated that Ukraine could have a productive capacity of 600-700,000 tons/year of vegetable oil for biodiesel, greatly exceeding expected domestic demand.[7]

Ukraine has ample biomass residues available for energy production, and biomass may cover about 5.3% of total energy demand.[8] Biomass utilization technologies are only in the beginning stages of their development in Ukraine, but they have strong prospects for the future.[9]

D) PRIVATE SECTOR

The state-owned company UkrSpirt holds a controlling stake in all 87 ethanol plants and is the sole authorized exporter. The company's main production facilities use beet molasses as their primary feedstock (48%), as well as wheat, corn, rye and barley. To date, UkrSpirt has seen limited success mainly due to the limited supply of the required agricultural materials, such as molasses.[10]

Second-generation cellulosic ethanol production is being introduced by the Canadian firm DynaMotive Energy Systems (DES). A new plant aims to produce 200 tons/day and the company has bought land sufficient to expand to 800 tons/day.[11] In March 2006, DES forged a strategic R&D alliance with the Consensus Business Group to "secure biomass markets and thereby gain opportunities for project development, biofuels production and the establishment of a green credit pipeline." Many of these opportu-

nities are in Ukraine, where the alliance intends to explore possible sources of biomass based on their composition and heating value and undertake feasibility studies.[12]

The renewable energy industry in Ukraine is beginning to attract big names, such as General Electric, Siemens, Sharp, and Royal Dutch Shell.

E) RESEARCH & DEVELOPMENT

The September 2003 presidential decree called for the government to support the development of technology and infrastructure for the production of fuel from biological raw materials. It also planned to develop the international scientific and technical cooperation on the manufacture and use of fuel from biological raw material.
In September 2006, Ukraine hosted the third international conference on biomass for energy in Kiev organized by the Institute of Engineering Thermophysics, the National Academy of Sciences of Ukraine, and the Scientific Engineering Centre Biomass (SECB), currently the leading Ukrainian company working in the sector. Its main activities are consulting, R&D, feasibility studies, and project implementation.[13]

F) CONCLUSION

While its biofuels program is still in the early stages, Ukraine is one of the few countries considered to have the potential to compete with Brazil as a biofuels exporter. The state is supporting the development of renewable energy sources, and the country has an abundance of cheap, fertile land. In addition, the availability of technically-skilled but low-cost labor suggests that Ukraine should be able to produce biofuels at a cost competitive with fossil fuels. It is estimated that by 2010 Ukraine could have a productive capacity of 600-700,000 tons/year of vegetable oil for biodiesel, greatly exceeding expected domestic demand. The country plans on exporting this oil to the EU and is harmonizing its standards with the EU. State of the art agricultural techniques and second-generation production technology would both serve to expand Ukraine's potential. Furthermore, the Ukrainian Bioenergy Association (UBA) is attempting to ensure the viability of Ukraine's biofuels sector as it touts achievement targets, assembles financing, and facilitates cooperation with governmental and regulatory entities.

Although the government appears committed to decreasing its oil dependency and reducing its carbon dioxide emission levels, Ukraine's medium-range renewable energy targets are far below of its potential, and it remains to be seen whether even these aims can be achieved. The country still faces a lack of financing, widespread corruption, and a highly inefficient bureaucracy.

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Source: World Factbook

Biofuels production and use remains modest in the United Kingdom (UK). The country has been an importer of Brazilian fuel ethanol and the two countries have also collaborated on projects aimed at expanding the global market for ethanol. The construction of new UK plants attests to the growth of the country's biofuels market. Britain also has land that could be used for second-generation energy crops, and like other European countries, it needs to create rural jobs. The government is supporting the biofuels sector through tax incentives, though the private sector has thus far acted as the primary driver of the industry.

B) GOVERNMENT POLICIES

UK biofuels policy is currently governed by the 2004 Energy Act. In order to stimulate domestic biofuels production, the UK government reduced the excise duty on ethanol by GBP20/hl (almost EUR30/hl) in January 2006. In March 2006, Chancellor of the Exchequer Gordon Brown announced the Renewable Transport Fuel Obligation (RTFO), which requires that 2.5% of the country's motor fuel come from renewable sources by 2008, a tenfold increase over the 2006 level of 0.25%. This target will increase to 3.75% in 2009 and 5% in 2010. It is important to note that the RFTO target of 5% by volume falls short of the EU Biofuels directive target of 5.75% by energy content. To achieve a 5.75% level by energy content for ethanol, approximately 9% inclusion by volume would be necessary. [1]

Fuel producers that fail to meet these targets will be required to pay penalties of GBP0.15 per liter. These penalties are expected to partially offset the cost of the government's tax incentive program, which reduces excise duties by GBP0.20 per liter for producers that meet the blend targets. The government has also emphasized that it intends to continue to raise targets above 5% after 2010.[2]

The government also plans to introduce Enhanced Capital Allowance schemes. Eligible plants will have 100% of the first-year qualified spending written off against taxable profits. Eligible plants include those that incorporate on-site bioenergy use or produce second-generation biofuels.[3]

The government has also announced it will provide GBP2 million of funding each year to research non-food crops. The Department of Environment, Food and Rural Affairs (Defra) will provide funding of GBP600,000 a year, and the Department of Trade and Industry's technology program will allocate a share of its GBP15 million research and development budget to second-generation biofuels.[4]

Local government is also starting to get involved with biofuels promotion. The Somerset county council in cooperation with Avon, Ford Motor Company, the Energy Saving Trust, Wessex Water and Wessex Grain has put 40 Ford Focus flex-fuel cars into opera-

tion in the local police department.[5]

A recent report written by members of parliament criticized the government's bioenergy support schemes as being overly focused on biofuels to the detriment of biomass. Biomass is seen as a potential way of developing second-generation aviation fuels which can reduce the climatic impact of England's huge aviation sector. The report also expressed concern as to the piecemeal nature of the country's bioenergy policy. Finally it was asserted that more resources should be spent on the development of second-generation biofuels, which have the potential to further decrease greenhouse emissions.[6]

Relations with Brazil

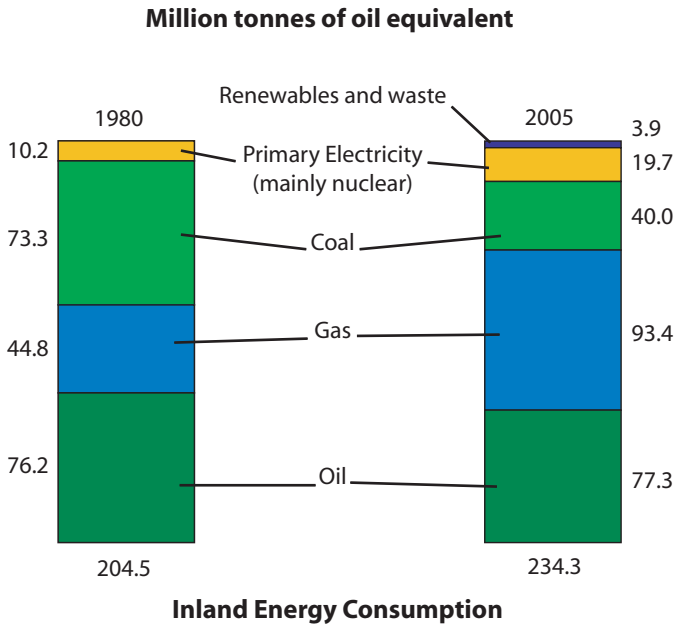
The UK and Brazil agreed in September 2006 to cooperate on the promotion of sugar production in sub-Saharan African countries for use as an input in ethanol production. Both Mozambique and South Africa are expected to receive assistance under the proposed program.[7] Both countries appear keen to develop the infrastructure necessary to increase sugar production in the low-cost region. Trade in biofuels has exploded almost overnight between the two countries. In contrast to 2004, when the UK imported no biofuels from Brazil, total imports of ethanol from Brazil were 140 million liters in 2005. The UK is now a major importer of Brazilian fuel ethanol, though this trade is expected to decline as two British fuel ethanol plants come online in 2007.[8]

C) CURRENT SITUATION

Energy Matrix

When comparing the UK's energy consumption in 1980 and 2005 it can be seen that coal consumption has decreased, while gas, nuclear and renewable energy consumption have all increased (oil consumption has remained roughly the same). In terms of sector use, transport and domestic energy demand has increased, while industry demand has declined and services demand has remained steady. The UK has large coal, natural gas, and oil reserves, though it is increasingly concerned with energy security issues as reserves are depleted.

Chart 4.13a: Renewable Energy Sources (2005)



Source: UK Energy in Brief July 2006.13

In 2004, biofuels only accounted for 0.04% of total road fuel sales, but this increased to 0.24% in 2005. Consumption included 33 million liters of UK-produced biodiesel and

85 million liters of imported ethanol.[9]

Biodiesel
The UK now has a biodiesel production capacity of 350 million liters, which is expected to increase by 114 million liters by the end of 2006. Rapeseed, imported palm oil and recycled vegetable oil are the primary sources of production.[10] In 2005, Scotland opened the UK's first large biodiesel plant, which has the capacity to produce 50 million liters of biodiesel a year from waste cooking oil and animal fats.

Ethanol
Plants in the planning stage or under construction are projected to produce a total of 450 million liters of ethanol for the UK market.[11] The country's first major ethanol production plant is currently under construction in Wessex and will eventually convert 340,000 tons of domestically-grown grain into 131 million liters of fuel ethanol per year.[12]

TDefra argues that if only 10% of the UK's 5.8 million hectares of arable land and 0.6 million hectares of set-aside are reserved for energy crop production, another 2 million tons of ethanol could be generated. Furthermore, the UK exports approximately 2.5-3 million tons of wheat every year that could be utilized for ethanol production. The National Farmer's Union (NFU) argues that the 5% RFTO target is within domestic production capacity.[13] Traditional UK crops suitable for biofuels production include wheat, sugar beet, and rapeseed.

D) PRIVATE SECTOR

As a result of the government's new tax incentive scheme for biofuels production, construction on two fuel ethanol plants began in early 2006. Greenspirit Fuels, a division of Wessex Grain, is constructing the ethanol plant discussed above, and a new British Sugar facility in East Anglia will produce 70 million liters from domestic sugar beets beginning in 2007. Following the UK's adoption of the RTFO, the Home Grown Cereals Authority (HGCA) predicted total demand for ethanol and biodiesel would reach 2.5 million tons within the next five years.[14] BP began an investment program in synthetic ethanol in 1999, and its plants have reached an annual capacity of up to one million tons; however, BP's ethanol production is currently devoted to chemical rather than fuel uses.[15]

Sir Richard Branson, head of Virgin, has promised to invest $3 billion in renewable energy over the next 10 years. Virgin will invest most of this in biofuels in this early stage, and has plans to launch the UK's first biofuels-powered rail service. It is lobbying the government to win a concession on the duty for blended biofuels, which is currently seven times the levy for industrial diesel fuel. Virgin's airline business is also engaged in dialogue with other airlines, airport and aircraft manufacturers to explore the possibilities of ethanol-fueled aviation.

Investors are also reported to be increasingly interested in UK biofuels. Graham Meeks of Climate Change Capital, a specialist merchant bank, told the BBC "We're seeing an enormous amount of interest from investors in this sector [biofuels]."[16]

E) RESEARCH & DEVELOPMENT

The Energy Technologies Institute, expected to begin operating in 2008, is dedicated to accelerating the development of secure, reliable and cost-effective low-carbon energy technologies for commercial deployment. In addition to initial funding for the ETI, the Department of Trade and Industry is to provide GBP50 million ($95 million) each year over 10 years beginning in 2008-09. The government expects that the separate Energy Research Partnership will raise a total of GBP1 billion ($1.89 billion) over the next ten years, including matching funding from the private sector. As of September 2006, EDF Energy, Shell, BP, and E.ON UK have committed to providing funds.[17]
The Engineering and Physical Sciences Research Council funds an energy program including energy and climate change research. It aims to develop, embrace and exploit

sustainable, low-carbon and energy efficient technologies and systems to enable the UK to meet the government's energy and environmental targets by 2020.[18]

Since being established in 2004, the UK Energy Research Centre has carried out research into demand reduction, future sources of energy, infrastructure and supply, energy systems, sustainability and materials for advanced energy systems.[19]

The Society of Motor Manufacturers and Traders (SMMT), the Biosciences Federation, and the Royal Society for Chemistry are all involved in research of biobutanol. Dupont and BP are currently involved in research as well.[20]

F) CONCLUSION

The United Kingdom is rapidly increasingly its biofuels production capacity. It has suitable land, labor, government support, and private-sector confidence. The outlook is very positive for a healthy market to develop. Demand has yet to reach significant levels but transport demand for biofuels increased almost 17% from 2004 to 2005. The country already has established a working relationship with Brazil concerning biofuels in Africa. The two countries will continue this cooperation and have plans to expand on it in the realm of research and technology. Indeed given the UK's increased capacity in biofuels production, the future of this relationship may primarily lie in R&D.

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