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THE EMERGING BIOFUELS MARKET:

REGULATORY, TRADE AND DEVELOPMENT IMPLICATIONS

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NOTE

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EXECUTIVE SUMMARY

The sharp increase in the price of petroleum products, the finite nature of fossil fuels, growing environmental concerns, especially related to greenhouse gas emissions, and health and safety considerations are forcing the search for new energy sources and alternative ways to power the world's motor vehicles. Biofuels – fuels derived from biomass – may offer a promising alternative. Some analysts estimate that substituting by 2020 up to 20 per cent of mineral fuels consumed worldwide with biofuels is a feasible option.

Several developed and developing countries are establishing regulatory frameworks for biofuels, including blending targets. They are also providing different kinds of subsidies and incentives to support nascent biofuel industries. These developments are expected to spur a sustained worldwide demand and supply of biofuels in the years to come.

Increased production, use and international trade of biofuels may slow down the process of global warming and provide an opportunity for developing countries to diversify agriculture production, raise rural incomes and improve quality of life. It may enhance energy security and reduce expenditure on imported fossil energy.

Efficiency considerations indicate that feedstock and biofuel production has to take place in the most efficient countries. Several developing countries – with land to devote to biomass production, a favourable climate to grow them, and low-cost farm labour – already are or may become efficient producers. Energy security considerations, however, may prompt less-efficient countries to engage in biofuel production irrespective of economic and environmental considerations.

Ethanol features today as a very dynamic commodity with international trade recording a strong growth. Developing countries, particularly Brazil, have benefited from that dynamism, including by taking advantage of existing preferential trade arrangements. South-South trade and transfer of technology are taking place. Conversely, there appears to be little international trade in ethanol feedstocks. Subsidies are likely to contribute to the expansion of domestically produced feedstocks in developed countries.

Biodiesel production outside of the EU is still limited and this explains the absence of significant international biodiesel trade. Recent heavy investments in several countries indicate that production and international trade are poised to grow. Trade in biodiesel feedstocks is on the rise: the traditional structure of the plant-oil industry may also explain this trend.

International trade in biofuels and related feedstocks may provide win-win opportunities to all countries: for several importing countries it is a necessary precondition for meeting the self-imposed blending targets; for exporting countries, especially small and medium-sized developing countries, export markets are necessary to initiate their industries. Nevertheless, biofuels face tariffs and non-tariff measures. This can offset lower production costs in producing countries, represent significant barriers to international trade, and have negative repercussions on investments in the sector. Moreover, export performance is often penalized by the graduation of the successful exporting countries from the preferential schemes. A more liberal trade regime would greatly contribute to the achievement of the economic, energy, environmental and social goals that countries are pursuing.

With a considerable increase in trade in feedstocks and biofuels expected, sustainable production is becoming a key concern and is currently being considered as a possible requirement for market access. Certification and labelling of biofuels and feedstocks remains, however, a complex issue. Unnecessary trade barriers can be avoided by a fair criteria-development process characterized by widespread participation, transparency, and consideration of certification capacity building in developing countries.

Some specific challenges for developing countries include: (i) avoiding diverting too much land from food production to energy crops; (ii) avoiding sharp rises in the prices of food, especially for net-food importing developing countries; (iii) finding ways to ensure that small farmers do not face undue barriers to participation in the sector; (iv) and gaining access to relevant energy technology, including advanced technologies that are expected to reap greater environmental benefits. Conscious decisions, sharing of information and data collection, organizational strategies, government support services, technical and financial assistance will be necessary to minimize the risks and enhance the benefits that emerging biofuel markets may present to developing countries.

UNCTAD, through its BioFuels Initiative, is providing developing countries with access to economic and trade policy analysis, capacity-building activities, and consensus-building tools to help them address those and other challenges.

INTRODUCTION

The era of "easy" energy is over. Governments, intergovernmental organizations, corporations, NGOs and even individuals are asking themselves a number of questions that are crucial for the sustainable development prospects of all countries. How do we meet the world's energy needs? What role will renewable and alternative energies play? What is the best way to combat climate change? How do we accelerate improvements in energy conservation? How can developing countries best exploit the opportunities for diversification and new markets offered by the changing energy equation? Alternative energy sources, including biofuels, may form part of the answers to these questions. While alternative energy sources grow faster than any other energy source, they still account for a very limited share of primary energy demand, therefore they are not expected to replace fossil fuels but to play a complementary role in satisfying world energy demand.

Section 1 of this study analyses recent developments in international energy markets. Sections 2 and 3 address market, regulatory developments and tariff regimes for biofuels in a number of developed and developing countries, while section 4 deals with the technological prospects of the biofuel industry. Section 5 addresses the issue of subsidies. Subsequently, the study focuses on the opportunities that emerging biofuel markets may offer, especially to developing countries, in terms of diversifying energy sources and reducing dependence on fossil fuels, mitigating climate change effects, increasing markets for agriculture products and enhancing the participation of rural communities in economic activities. Biofuels, however, raise some basic concerns. The actual and potential challenges and opportunities, especially for developing countries, are analysed. Section 7 presents some data on trade flows for biofuels and related feedstocks. Section 8 deals with some specific WTO issues which may have direct implications for biofuels. The last section of the study illustrates UNCTAD's present and forthcoming activities under the BioFuels Initiative and the overall role that the organization is planning to play as an international hub for biofuels.

1. THE PRESENT ENERGY SCENARIO

The global economy depends to a large extent on energy derived from fossil carbon sources, mainly oil, coal and increasingly natural gas. Fossil fuel resources are finite, but not yet near to exhaustion. It is estimated that 970 billion barrels of oil have been consumed so far, while around 1400 billion barrels are still to be extracted, which should take not more than 30 years at the current rate of production. An additional crucial problem is oil production capacity, which may peak in the next 5 to 15 years before starting to decline.[1]

The International Energy Agency (IEA) has a different perspective. Its latest analysis indicates that global primary energy demand is set to increase by 1.6 per cent per year from 2005 to 2030, driven mainly by transport. The projected growth is, nevertheless, slower than growth over the past three decades, which ran at 2.1 per cent per year. Fossil fuels will remain dominant, accounting for more than 80 per cent of the projected increase in primary energy demand to 2030. Natural gas demand will grow fastest, but oil will still be the largest individual fuel source. Members of the Organization of the Petroleum Exporting Countries (OPEC), especially in the Middle East, will meet most of the demand growth. Though renewable forms of energy will expand rapidly, they start from a small base and cannot displace fossil fuels as the over-riding source of energy in this timescale.[2]

Recent oil price increases, although stemming largely from other factors, provide a glimpse of a likely future of rising oil prices due to escalating extraction costs as increasingly marginal resources

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[1] Estimation by the Association for the Study of Peak Oil and Gas, *ASPO Newsletter*, April 2006 found at: http://www.peakoil.ie/downloads/newsletters/newsletter64_200604.pdf, visited on 3 May 2006.

[2] IEA, World Energy Outlook 2005, Summary, found at: http://www.iea.org/textbase/npsum/WEO2005SUM.pdf, visited on 22 March 2006.

have to be exploited. Since exploitation of those resources is also often associated with more challenging environmental consequences, the incentives to reduce oil consumption are clearly strong.

While petroleum continues to dominate the fuel mix of developed countries, oil consumption has declined in all sectors except transport since 1973. The fall in oil consumption was particularly strong in manufacturing and electricity generation, a result of both fuel switching and a strong decline in energy use per unit of output. The decline in oil demand in stationary sectors was sufficient to offset the growth in transport oil demand, so that in 2001 oil demand levels in the Organization for Economic Co-operation and Development (OECD)'s countries were comparable to those in 1973.[3] At the global level, however, oil demand reached 80 million barrels per day in 2004 from 56 million barrels per day in 1973, due to increased consumption in non-OECD countries.[4]

Fossil fuels have provided the world with a means for transportation, lighting, heating, cooking, manufacturing and information. They have greatly contributed to overall development, economic growth, employment and communication. They have, however, also had high environmental costs. According to some estimates, carbon dioxide levels in the atmosphere are 30 per cent higher than the highest levels registered during the last 400,000 years[5] with proven adverse climate impacts and associated social and economic costs. If current government policies do not change, energy-related emissions of carbon dioxide are projected to increase by 1.6 per cent per year from 2003 to 2030, reaching 37 billion tonnes in 2030, as compared with 24 billion tonnes in 2005.[6] Therefore, irrespective of the supply-demand situation, continued utilization of fossil fuels is, and will increasingly become, a source of atmospheric carbon concentrations. This will be unsustainable from an environmental and economic point of view.

Most agree that the energy challenge of this century – providing the affordable energy needed to achieve, expand, and sustain prosperity for all while avoiding intolerable environmental disruption – cannot be met without a huge increase in the global energy-innovation effort. While it would be unrealistic to think that new energy sources could solve all the energy problems that countries face at present, their development may contribute to alleviating climate change-related problems and lessening the dependence of energy-importing countries on fossil fuels. Exploring the potentialities of alternative energy sources would thus be suitable in economic, environmental, strategic and political terms. In addition, efforts should be deployed to achieve a more sustainable path of energy consumption through efficiency gains and demand-side management.[7]

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[3] IEA, *Oil Crises and Climate Challenges: 30 Years of Energy Use in IEA Countries* - Fact sheet, 2005, found at: http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1556, visited on 22 March 2006.

[4] BP statistics found at: http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/publications/energy_reviews_2005/STAGING/local_assets/downloads/spreadsheets/statistical_review_full_report_workbook_2005.xls, visited on 27 April 2006.

[5] Concentration of carbon dioxide in the atmosphere in the past is estimated by measuring its content in polar ice. Figures from IPCC (2001), found at: http://www.grida.no/climate/ipcc_tar/vol4/english/wg1figts-10.htm, visited on 27 April 2006.

[6] IEA, Energy Information Centre, Energy Projections, found at: http://www.iea.org/Textbase/subjectqueries/keyresult.asp?KEYWORD_ID=4107, visited on 7 August 2006.

[7] While an inhabitant in the United States consumes on average 8 toe a year, an European consumes 4 toe a year with the same standards of living. A Chinese consumes 1 toe a year, an Indian or a Kenyan 0.5. Toe stands for tonnes oil equivalent, which represents the total energy consumption expressed in terms of tonnes of oil. Source from IEA Statistics found at: http://www.iea.org/dbtw-wpd/Textbase/subjectqueries/maps/world/tpes_pop.htm, visited on 27 April 2006.

2. BIOFUELS

A biofuel is any fuel derived from biomass.[8] This study will concentrate on bioethanol and biodiesel because they are the most widely used liquid biofuels. The most suitable plants for energy production tend to be either those that grow fast and produce woody material that can be easily burned, such as willow, eucalyptus and miscanthus; plants that produce oil that is high in calorific value, such as soy, palm, sunflower, rape seed and castor oils; or plants with a high content of sugar that can be fermented.

Bioethanol – an alcohol produced by the biological fermentation of carbohydrates derived from plant material – can be used directly in cars designed to run on pure ethanol (hydrated ethanol, which has usually about 5 per cent water content), or blended with gasoline (at up to 25 per cent) to make "gasohol". Dehydrated (anhydrous) ethanol is required for blending with gasoline. No engine modification is typically needed to use the blend. Ethanol can be used as an octane-boosting, pollution-reducing additive in unleaded gasoline, thereby substituting for chemical additives such as MTBE. At present Brazil is the only country that uses ethanol as both a 100 per cent substitute for gasoline and a blend. In all other countries that utilize biofuels, ethanol is blended with gasoline in different proportions. Ethanol is also used as a solvent in industrial applications, while its oldest and most traditional use is in making spirits or alcoholic beverages.

Biodiesel is a synthetic diesel-like fuel produced from vegetable oils, animal fats or recycled cooking grease. It can be used directly as fuel, which requires some engine modifications, or blended with petroleum diesel and used in diesel engines with few or no modifications. Biodiesel is made through a chemical process called transesterification. The process leaves behind two products - methyl esters (the chemical name for biodiesel) and glycerin, a valuable byproduct used in soaps and other products.

When life cycle analysis is applied to the emissions from use of different transport fuels, both combustion and evaporative emissions need to be included, as well as the full life cycle of the fuel. A full life cycle analysis of emissions takes into account not only the direct emissions from vehicles (which are referred to as downstream emissions) but also those associated with the fuels: extraction, production, transport, processing, conversion and distribution; these are referred to as upstream emissions or pre combustion emissions.

While a range of estimates exist, most studies have found that, depending on the feedstock and energy used to refine the fuels, both bio-ethanol and bio-diesel can provide significant reductions in greenhouse gas emissions compared with gasoline and diesel fuel. Feedstock production and conversion to final fuel is becoming increasingly efficient from the point of view of CO_2-equivalent emissions, especially for ethanol from sugar cane and from lignocellulosic feedstock.[9] Biofuels can provide air quality benefits when used either as pure fuels or when blended with petroleum fuels. Benefits include lower CO, SO_x and volatile organic compounds emissions. Ethanol and biodiesel can be used to enhance certain characteristics of gasoline and diesel, thereby aiding fuel performance.[10]

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[8] Biomass includes organic matter available on a renewable basis, such as forest and mill residues, agricultural crops and residues, wood and wood residues, animal wastes, livestock operation residues, aquatic plants, fast-growing trees and plants, and the organic portion of municipal and relevant industrial wastes.

[9] Lignocellulosic feedstocks are woody materials, grasses and agricultural and forestry residues that contain cellulose, hemicellulose and lignin. They can be broken down in a number of ways to be used as biofuels.

[10] IEA (2004). *Biofuels for Transport, An International Perspective*, Paris, April, at 12-14.

3. MARKET AND REGULATORY FRAMEWORKS IN SELECTED DEVELOPED AND DEVELOPING COUNTRIES

World production of ethanol from sugar cane, maize and sugar beet increased from less than 20 billion litres in 2000 to over 40 billion litres in 2005. This represents around 3 per cent of global gasoline use. Production is forecasted to almost double again by 2010. Brazil is the world's largest ethanol producer and exporter. Its 16 billion litres of 2005 production represented some 36 per cent of the world total. The 15 billion litres of ethanol produced in the United States accounted for one third of global production. China and India are distant third and fourth producers at 9 per cent and 4 per cent respectively of world production.[11] At present, biodiesel accounts for less than 0.2 per cent of the diesel consumed for transport.

The cost of large-scale production of bio-based products is currently high in developed countries. For example, the production cost of biofuels may be three times higher than that of petroleum fuels, without, however, considering the non-market benefits. Conversely, in Brazil and other developing countries, the costs of producing biofuels are much lower than in the OECD countries and very near to the world market price of petroleum fuel. For example, the current cost of production of ethanol is about $0.20/litre in Brazil and about $0.40/litre in India, roughly comparable to the pre-tax prices of gasoline and diesel in these countries.[12]

The United States

In the United States, ethanol is produced from maize, with a larger consumption of fossil fuels in the production process and a lower energy balance compared with ethanol produced from sugarcane outside the United States.[13] In 2005, 14.4 per cent of the nation's maize crop was used to produce ethanol; this percentage is expected to reach 20 per cent in 2006.[14]

The number of vehicles using ethanol is growing and, since 1980, ethanol production from maize has increased by a factor of ten. In 2005, ethanol accounted for about 3 per cent of the total US consumption of motor gasoline on a volume basis. This result was brought about partially by the need to reduce air pollutants in big cities in order to comply with the Clean Air Act, which requires cities with significant air quality problems to promote cleaner fuels, and partly by subsidies and tax breaks for producing ethanol.

New legislation was recently passed in the United States which has implications for biofuel consumption, namely the Farm Security and Rural Investment Act of 2002, the American Jobs Creation Act of 2004 and the Energy Policy Act of 2005. The Farm Bill establishes new programmes and grants for procurement of bio-based products to support development of bio-refineries[15]; to educate the public about benefits of biodiesel fuel use; and to assist eligible farmers, ranchers and rural

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[11] Oxford Analytica, *North America/Brazil: Ethanol in fuel market*, 20 July 2006.

[12] Gonsalves J.B. (2006). *An Assessment of the Biofuels Industry in India*, UNCTAD/DITC/TED/2006/6, at 17.

[13] The energy output/input ratio for corn is 1.3-1.8, as compared to 8.3 for sugar cane. Moreover, ethanol plant using sugar cane can be energy self-sufficient, export surplus electricity to the grid and generate commercial by-products.

[14] Interestingly, in the early 1920s the Standard Oil Company sold a 25 per cent by volume ethanol in gasoline in the State of Maryland. However, high maize prices coupled with transportation and storage problems ended the project. Some years later, Henry Ford and others launched again the idea of using ethanol as a fuel and built a fermentation plant to manufacture ethanol specifically for motor fuels. During the 1930s more than 2,000 service stations sold a mixture of ethanol made from maize and gasoline: the so-called gasohol. However, low petroleum prices made the ethanol option economically unappealing. This, in addition to the then limited sensitiveness to environmental problems, led to the closing of the fermentation plant in the 1940s. Source: Smith, D.C., "Biotechnology for fuels", *Refocus*, November/December 2003, at 53.

[15] A bio-refinery is a facility able to produce a variety of outputs such as electricity, chemicals, plastics, food and fibres in addition to biofuels.

small businesses in purchasing renewable energy systems. It allows payments to eligible producers to encourage increased purchases of energy feedstocks for the purpose of expanding production of bioenergy and supporting new production capacity.

Through the end of 2004, gasoline blended with ethanol received a partial exemption from the motor fuels excise tax. This exemption made ethanol-blended fuel price-competitive with gasoline. In 2005, the excise tax exemption was replaced by a tax credit (Volumetric Ethanol Excise Tax Credit - VEETC) that will be in force until the end of 2010. VEETC is the most significant among the numerous US federal and state level tax incentives put in place to boost ethanol use.[16] The 2005 Energy Policy Act[17] repealed the Clean Air Act requirement that reformulated gasoline contain at least 2 per cent oxygen by weight (MTBE and ethanol being the most commonly used oxygenates in the past). In place of this requirement, the bill establishes a Renewable Fuels Standards (RFS). Under the RFS, annual production of gasoline is required to contain ethanol or other renewable fuels, starting with 15.12 billion litres in 2006 and going up to 28.35 billion litres in 2012. Most of this requirement will likely be met by ethanol. The Energy Bill also established tax credits for the purchase of fuel cell, hybrid, alternative fuel, and advanced diesel vehicles.

Numerous states also subsidize the production of biofuels. Incentives include grants for the construction of plants, exemptions from or reductions in state fuel-excise tax, and various benefits or tax holidays provided by municipalities.

Subsidies and incentives are provided independently from the environmental impact that ethanol may have during its entire life cycle (e.g. amount of fertilisers used for maize production, soil erosion, transportation, GHG emissions at the processing plants), therefore, supporting biofuel production in the United States seems to find its main *raison d'être* in energy security considerations, much more than in environmental considerations.

There are 101 ethanol plants in the country, however production is very much concentrated among very few large players, with the top five companies accounting for 30 per cent of ethanol manufacturing. Eighty per cent of feedstock production is concentrated in the Midwest Corn Belt. Because the feedstock producing region and the ethanol consuming regions (East and West Coasts) are far away, feedstocks are shipped by train or rail with high costs and negative environmental implications. Additional negative environmental impacts are caused by the large amount of water and fertilizers ordinarily used for maize production and the fact that several ethanol producers use coal-fired power generation.[18]

In 2005, over 283 million litres of biodiesel were sold in the United States, up from 94.5 million in the previous year. Many large fleets in the United States now run on biodiesel with entities such as the United States Post Office, the US Military, metropolitan transit systems, and school districts being major users. Biodiesel production is currently expensive: wholesale biodiesel from virgin oils costs two or three times more than conventional diesel; biodiesel from recycled grease is less expensive but still costs considerably more than conventional diesel. Due to the high costs of producing biodiesel in the United States, the US Congress created a new tax credit for blenders of biodiesel in 2004. The credit equates to one US cent per cent of biodiesel in a fuel blend made from

[16] Under the new excise tax credit system, gasoline refiners and marketers are required to pay the full rate of tax (18.4 cents per gallon) on the total gasoline-ethanol mixture (including the ethanol portion), but are able to claim a $0.51 per gallon tax credit or refund for each gallon of ethanol used in the mixture. The credit is paid on the amount of alcohol added to the fuel mixture. See*: A Guide to the New Tax Law: Changes in Tax Incentives for Ethanol and Biodiesel*, found at: http://www.cleanairchoice.org/outdoor/PDF/EthanolTaxBrochure1anuary%2020_2005.pdf, visited on 2 May 2006.

[17] On July 2005, the US Congress passed the first comprehensive energy legislation in over a decade. The bill aims at strengthening the domestic electrical infrastructure, reducing dependence on foreign oil, increasing conservation and expanding the use of clean renewable energy. The White House, *The Energy Bill: Good for Consumers, The Economy, And The Environment*, Fact Sheet, 29 July 2005, found at: http://www.whitehouse.gov/news/releases/2005/07/20050729-9.html, visited on 23 March 2006.

[18] Oxford Analytica, *North America/Brazil: Ethanol in fuel market*, 20 July 2006.

agricultural products like vegetable oils, and one-half US cent per cent for recycled oils. The incentive is taken at the blender level. Blenders will be driven to pass most of the savings on to consumers out of sheer competition, however some of the tax incentive may be put towards infrastructure costs.[19]

Box 1

Biofuel related trade regimes
United States

In 2005, the United States imported around 720 million litres of ethanol, representing 5 per cent of domestic consumption. Imports originate mainly from Brazil and reach the US market either directly or via Caribbean countries. The United States imposes MFN import duties of $14.27 cent/litre plus a 2.5 per cent *ad valorem* tariff on fuel ethanol. In many cases, this tariff regime offsets lower production costs in other countries and represents a significant barrier to imports as well as a tool to guarantee a captive market for US ethanol producers.

A limited amount of ethanol may be imported duty-free under the Caribbean Basin Initiative (CBI) even if most of the steps in the production process were completed in other countries. More specifically, if produced from at least 50 per cent local (CBI) feedstocks, ethanol may be imported duty-free into the US market. If the local feedstock content is lower, limitations apply on quantity of duty-free ethanol. Nevertheless, up to 7 per cent of the US market may be supplied duty-free by CBI ethanol containing no local feedstocks. In this case, hydrous ethanol produced in other countries (mainly Brazil), can be shipped to a dehydration plant in a CBI country for reprocessing. After the ethanol is dehydrated, it is imported duty free into the United States. Currently, imports of dehydrated (anhydrous) ethanol under the CBI are far below the 7 per cent cap (approximately 3 per cent in 2005), though the situation may change as agribusinesses, some of them North American, invest in ethanol plants in the Caribbean. Dehydratation plants are currently operating in Jamaica, Costa Rica, El Salvador and Trinidad and Tobago.

Duty-free ethanol imports have also played a role during the negotiations of the US-Central America Free Trade Agreement (CAFTA). However, CAFTA did not introduce major changes. It does not increase overall preferential access to the U.S. ethanol market but it does establish country-specific shares for El Salvador and Costa Rica within the existing CBI quota. The other CAFTA countries retain existing CBI benefits on ethanol.

There is support in some quarters to eliminate tariffs on imported ethanol so as to increase supply and mitigate fuel price increases. Duty-free treatment of ethanol in the United States has, however, raised concerns. Critics argue that expansion of duty-free imports from CBI would undermine the domestic US ethanol industry. In particular, they point to ethanol produced in Brazil, sent to CBI countries for dehydration, and then exported duty-free to the United States. However, the considerable expansion of the US ethanol market expected in the wake of the 2005 Energy Policy Act should appease domestic ethanol producers' and maize growers' apprehensions. On the other hand, the numerous state-level subsidies provide so many incentives to domestic production that significant barriers to imports would remain even if the import tariffs were to be removed.

[19] National Biodiesel Board, *Tax Incentive Fact Sheet*, found at: http://www.nbb.org/members/membersonly/files/pdf/fedreg/20041022_Tax_Incentive_Fact_Sheet.pdf, visited on 1 May 2006.

The European Union

In 2001, the European Commission launched a policy to promote the use of biofuels for transport in order to reduce greenhouse gas emissions and the environmental impact of transport, as well as to increase security of supply, technological innovation and agricultural diversification. The basis of such a policy is a "regulated market-based approach", where market forces play a role, but market interventions are regarded as necessary to achieve the stated goals. In May 2003, Directive 2003/30/EC (Biofuels Directive) entered into force[20]. The Directive requires that Member States introduce legislation and take the necessary measures to ensure that, beginning in 2005, biofuels account for a minimum proportion of the fuel sold on their territory: 2 per cent by December 2005 and 5.75 per cent by December 2010, compared with 0.6 per cent in 2002. These are indicative targets. Since the 2005 target was not achieved (biofuels attained an EU-wide share of only 1.4 per cent of transport fuel), the European Commission is considering establishing mandatory targets. To meet the 5.75 per cent target, the Commission is envisioning a scenario where the EC produces 50 per cent of the needed feedstock, requiring 8 million hectares of energy crop plantation, and the remaining 50 per cent of needed feedstock is imported.

In parallel, legislation was developed on taxation of energy sources. According to Directive 2003/96/EC[21], Member States may apply total or partial exemptions or reductions in the level of taxation to, *inter alia*, forms of energy derived from solar, wind, tidal or geothermal energy, or from biomass or waste. These tax concessions are considered as state aids, which may not be implemented without prior authorization by the Commission in order to avoid undue distortion of competition and over-compensation.

The third pillar of the EU biofuel legislation relates to fuel quality.[22] In 2003, the environmental specifications for market fuels were amended to establish specifications for gasoline and diesel. The new specifications include biofuels. The European Committee for Standardization (CEN) has set limits on biodiesel blending to no more than a 5 per cent share by volume for technical reasons.[23] This strict technical requirement represents an obstacle to achieving the targets set in the Biofuels Directive. It is expected, therefore, that the Fuel Quality Directive will be revised.

The EU currently has a special aid programme for energy crops grown on non-set-aside land. Energy crops are eligible for a premium of euro 45 per hectare, within a maximum guaranteed area of 1.5 million hectares total. In 2005, an estimated 0.5 million hectares received the energy crop payment.[24]

The EU production of biofuels amounted to around 2.9 billion litres in 2004, with bio ethanol totalling 620 million litres and biodiesel the remaining 2.3 billion litres. The feed stocks used for

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[20] Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport, Official Journal L 123 of 17.05.2003, at 42-46.

[21] Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity, Official Journal L 283 of 31.10.2003, at.51-70.

[22] Council Directive 98/70/EC of 13 October 1998 relating to the quality of petrol and diesel fuels, Official Journal L 350 of 28.12.1998, as amended by Directive 2003/17/EC of 3 March 2003, Official Journal L 76 of 22.3.2003.

[23] There are three existing specification standards for diesel and biodiesel fuels: (1) EN 590 describes the physical properties that all diesel fuel must meet if it is to be sold in the EU, Iceland, Norway or Switzerland. It allows the blending of up to 5 per cent biodiesel with 'normal' DERV a 95/5 mix. In some countries such as France, all diesel sold routinely contains this 95/5 mix; (2) DIN 51606 is a German standard for biodiesel, it is considered to be the highest standard currently existing, and is regarded by almost all vehicle manufacturers as evidence of compliance with the strictest standards for diesel fuels. The vast majority of biodiesel produced commercially meets or exceeds this standard; (3) EN14214 is the standard for biodiesel recently finalized by the European Standards Organisation (CEN). It is broadly based on the German standard.

[24] Under the CAP, EU farmers are requested to set aside 10 per cent of their land to qualify for other CAP benefits. See: Schnepf R. (2006), *European Union Biofuels Policy and Agriculture: An Overview*, CRS Report for Congress, March 16, at 4, found at: http://www.usembassy.it/pdf/other/RS22404.pdf, visited on 2 May 2006.

ethanol production are cereals and sugar beet, while biodiesel is manufactured mainly from rapeseeds.[25] In 2004, EU biodiesel production used 27 per cent of EU rapeseed crop. In the same year, bioethanol production used 0.4 per cent of EU cereals production and 0.8 per cent of EU sugar beet production. The EU is by far the world's biggest producer of biodiesel with Germany producing over half of the EU's biodiesel. France and Italy are also important biodiesel producers, while Spain is the EU's leading bioethanol producer.

Currently, locally produced biofuels are not cost-competitive in the EU. Production costs are still high, mainly due to high-priced internal feedstocks. Despite of the recent reform of the sugar sector, the EU's internal sugar prices are expected to remain substantially above international market prices and sugar will then continue to be an expensive feedstock.[26] EU-produced biodiesel breaks even at an oil price of around $72 per barrel, while EU-produced bioethanol becomes competitive with oil prices of around $107 per barrel.[27] Therefore, while biodiesel is already competitive with oil (though not necessarily with imported biodiesel), bioethanol is still far from it. Consequently, the competitiveness of EU-produced biofuels will depend on subsidies, and in the case of bioethanol on import tariffs as well. Possible diminishing production costs may, however, change the situation in the years to come.

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[25] EC Commission Press Release, *Biofuels Strategy: Background memo*, MEMO06/65, 8 February 2006, found at: http://europa.eu.int/rapid/pressReleasesAction.do?reference=MEMO/06/65&format=HTML&aged=0&language=EN&guiLanguage=en, visited on 24 March 2006 and Schnepf R. (2006), *European Union Biofuels Policy and Agriculture: An Overview*, CRS Report for Congress, March 16, at 3, found at: http://www.usembassy.it/pdf/other/RS22404.pdf, visited on 2 May 2006.

[26] On February 2006, the EU adopted a significant reform of its sugar sector, including a 36 per cent cut in the internal sugar support price, elimination of the intervention system of sugar purchases, and partial sugar production quota buyback. The sugar reform could impact biofuel stock availability since it substantially reduces internal sugar beet production incentives. However, EU sugar export restrictions, the exclusion of sugar used for bio-ethanol production from the sugar production quotas, and various incentives provided to energy crops producers could conversely have a positive impact on sugar beet availability in the EU market. See: Schnepf R. (2006), *European Union Biofuels Policy and Agriculture: An Overview*, CRS Report for Congress, March 16, at 4-5, found at: http://www.usembassy.it/pdf/other/RS22404.pdf, visited on 2 May 2006.

[27] Ibid, at 3.

Box 2

Biofuel related trade regimes

European Union

The EU imported more than 250 million litres of ethanol during the period 2002-2004. About 30 per cent of this volume was imported as normal MFN trade and subject to specific import duties of euro 0.102/liter on denatured alcohol (HS 2207 20) and euro 0.192/liter on undenatured alcohol (HS 2207 10). Brazil is the largest ethanol exporter to the EU with all of its exports subject to MFN tariffs. During the 2002-2004 period, 25 per cent of EU ethanol imports were from Brazil.

The remaining 70 per cent of EU alcohol imports entered under preferential trade arrangements (61 per cent entered duty free and 9 per cent at reduced duty), including the Generalized System of Preferences (GSP, applying to many developing countries), the Cotonou Agreement (for ACP countries), the Everything But Arms (EBA) Initiative (for LDCs), amongst others. Pakistan, with a 20 per cent share of EU ethanol imports, was the largest exporter under preferential trade arrangements. Other ethanol exporting countries that benefited from EU trade preferences included Guatemala, Peru, Bolivia, Ecuador, Nicaragua and Panama (which benefited from unlimited duty-free access accorded under special drug diversion programmes); Ukraine and South Africa (under the GSP); the Democratic Republic of Congo (under EBA); Swaziland and Zimbabwe (as ACP countries); Egypt (under the Euro-Mediterranean Agreement); and Norway (under special quota).

The new GSP Regulation – which applies from 1 January 2006 to 31 December 2008 – no longer provides for any tariff reduction for either denatured or undenatured alcohol. However, the Regulation includes an incentive scheme for sustainable development and good governance. The scheme provides unlimited and duty-free access to denatured and undenatured alcohol. All countries that already benefited from the previous drug scheme, plus Georgia, Sri Lanka, Mongolia and Moldova, are included in the incentive programme. Pakistan, one of the most competitive ethanol producers and exporter, lost its privileged status under the GSP in October 2005 and no longer appears to be competitive in the European market. In May 2005 the European Commission initiated an anti-dumping investigation against Pakistan and Guatemala – the largest duty-free exporters over the 2002-2004 period – for dumping of ethanol. The proceedings were officially dropped one year later when the full customs tariff was restored on Pakistani imports.

Duty-free and quota-free access is granted to the LDCs under the EBA Initiative. While exports of ethanol from EBA countries have so far been negligible, new opportunities may emerge in those countries, particularly as a result of increased sugar cane cultivation.

Under the Cotonou Agreement, ACP countries qualify for duty-free access for both denatured and undenatured alcohol. However, imports of ethanol from South Africa, which exported approximately 5 million litres per year to the EU market over the 2002-2004 period, are since 1 January 2006 subject to the full MFN duty. As in other sectors, export performance is often penalized by the graduation of the successful countries from the preferential schemes.

EU imports of biodiesel are subject to an *ad valorem* duty of 6.5 per cent. Since biodiesel production outside of the EU is still limited, there has been no significant external trade, but there has been considerable intra-European trade. Recent heavy investments in a number of developed (e.g. Australia and United States) and developing countries (e.g. Brazil, India, Indonesia, Malaysia) indicate that these countries are in the process of becoming producers and possibly exporters of biodiesel. International trade of raw materials is growing. To relax pressure on rapeseed oil production, European biodiesel producers have begun sourcing feedstocks from foreign sources. Between 1999 and 2005, EU imports of palm oil (primarily from Malaysia) have more than doubled to 4.5 million tonnes (representing 18 per cent of world palm oil imports).

Brazil

In 1975 Brazil started a government-sponsored programme – the world's largest commercial programme on biomass – to make ethanol from sugarcane and develop the needed technology. The ultimate goal of the programme was to reduce dependence from imported petroleum products. Environmental and social considerations, however, played an important role as well.[28]

Nearly half of Brazil's annual sugar cane harvest is devoted to producing ethanol. Sugar cane production expanded from about 50 Mt in 1970, to over 280 Mt in the 2004-2005 harvest. Brazil intends to increase its ethanol production from the present 16 billion litres to above 20 billion litres in the next decade. The country exports today around 2.5 billion litres.

Nowadays four million cars in Brazil run on pure hydrated ethanol (i.e. ethanol containing a maximum of 5 per cent water)[29], while almost 1.8 million vehicles are able to run in the form of flex fuel.[30] The share of flex-fuel cars reached 22 per cent in 2004, 40 per cent in 2005, and is expected to rise to 60 per cent in 2006.[31] By 2010 all new light vehicles are expected to be flex. All gasoline in the country is blended with ethanol at a 20-25 per cent blending rate. According to the US Congressional Research Service, Brazilian ethanol production costs are 40 or 50 per cent lower than in the United States. Costs of production have gone down mainly due to significant increases in agricultural yields, the introduction of advanced techniques in agricultural management and large demand. There are currently no direct subsidies for ethanol production in Brazil, though there is an internal tax differential between ethanol and gasoline depending on the state.[32]

Ethanol is produced in over 320 plants, with 41 new mills being built to expand production capacity. The centre-south region of Brazil accounts for almost 80 per cent of feedstock production. Though environmentally sound management techniques are used, concerns have been voiced about the emergence of a regional monoculture. Production in new areas is possible, but the implications regarding crop substitution, existence of appropriate infrastructure and environmental impacts have to be carefully examined.

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[28] The Brazilian National Alcohol Programme, or Proalcool, was created on November 1975, by Decree No. 76.953.

[29] The development of Alcohol-only cars began in Brazil after the 1970's oil crisis, with government support. The development of the alcohol engine was done at the Instituto Tecnológico da Aeronáutina – ITA (the Brazilian Air Force Institute of Technology). This project led to various patents related to the engine, including a new carburetor for alcohol engines. Some of the major problems encountered when developing the alcohol engine was corrosion, carburetion and engine start-up problems. As technology evolved, these problems were solved with the usage of new materials to protect the engine components against corrosion and the usage of electronic fuel injection. Today the technology used in the alcohol engine is very mature, with almost three decades in widespread use in Brazil. Alcohol fuelled cars have comparable performance than the gasoline equivalents, with better results in acceleration and maximum speed but with less autonomy (alcohol consumption is approximately 30 per cent higher than gasoline).

[30] Flexi-fuel vehicles are cars that can run on two sources of fuel, such as gasoline and ethanol or gasoline and natural gas. The gasoline-ethanol flex-fuel technology was created by Ford Motor Company in the 1980s. The flex-fuel vehicle runs on gasoline or ethanol or on any blend of gasoline and ethanol, using a single fuel tank, fuel system and engine which are substantially different from the traditional ones. In 1994, the Brazilian subsidiary of Robert Bosch Group began the development of the flex-fuel engine in Brazil. They envisioned the flex-fuel engine as a substitute for the alcohol only engines that were facing a decline in sales. The flex-fuel engine would provide additional security for customers, being able to use either gasoline or alcohol, and also would represent saving for the auto manufactures as they would not need to develop two different product lines (alcohol and gasoline vehicles). The development of the flex-fuel engine in Brazil used the alcohol engine as a base, and consequently was significantly different from the engine developed in the United Sates. The first flex-fuel model was introduced in Brazil in 2003 by Volkswagen. GM, Fiat and Ford quickly followed suit.

[31] Tokgoz S. and A. Elobeid (2006). "Policy and Competitiveness of US and Brazil Ethanol", *Iowa Ag. Review*, Spring, Vol. 12, No.2, found at: http://www.card.iastate.edu/iowa_ag_review/spring_06/article3.aspx, visited on 20 June 2006.

[32] Teixeira Coelho, S. (2005). *Biofuels - Advantages and Trade Barriers*, UNCTAD/DITC/TED/2005/1, 4 February, at 5 and 12.

The total amount of investments in the agricultural and industrial sectors for ethanol production during the period 1975-1989 reached a total of $4.92 billion. On the other hand, the resulting reduced oil import needs allowed for $52.1 billion savings from 1975 to 2002.[33]

In 2002 Brazil launched a biodiesel programme which presented many similarities with that for bioethanol. The biodiesel programme targets collective and merchandise transport as well as off-grid electricity generation in remote areas where kerosene burning is currently the major energy source. In December 2004, a bill (Law No. 11.097) was passed authorizing a voluntary 2 per cent addition of biodiesel to petrol diesel. Starting in 2008, the mix will become mandatory and by 2013 the required percentage of biodiesel in the mix will go up to 5 per cent. The use of several oil seeds and several technologies is permitted. Some tax exemptions are allowed for biodiesel producers who utilize castor oil and palm oil as feedstock, to enhance the participation of the rural communities of the North-East States of Brazil (the poorest States) in the programme. According to some estimates, the mandatory use of biodiesel will make its domestic demand jump to 900 million litres in 2008 and 2.65 billion litres in 2013.[34]

Recently, the Brazilian oil company Petrobras has developed and patented the H-Bio, a diesel oil which is obtained from the mixture of vegetable oil with petroleum during the refining process. The oil used in the tests is soy oil, but the oil from other oleaginous plants may be used, such as castor seeds, sunflower seeds, oil-palm and cotton. Petrobras plans on starting the industrial scale production of the H-Bio as of December 2006.[35] H-Bio is expected to provide Brazil with international leadership in the biodiesel segment of the biofuel industry. The two programmes for H-Bio and for conventional biodiesel are supposed to be complementary.

Guatemala

Guatemala's expenditure on petroleum has increased by 87 per cent since 2002 and its petroleum consumption has doubled in the last 10 years. Besides serving as transportation fuel, 46 per cent of Guatemala's electricity is generated by plants fired by petroleum fuel.[36] Biofuels could therefore be crucially important to help reduce Guatemala's dependence on costly petroleum imports and to provide new markets for domestically-produced agricultural products which have been badly affected by decreasing world prices. The country is, however, missing a coherent policy plan and coordination

In 2004, Guatemala produced 64 million litres of ethanol (including potable alcohol) by the fermentation of molasses.[37] The country has excellent resources for sugarcane cultivation and, with 197,000 hectares, it has the largest cultivated area of sugarcane in Central America. It has also the best sugarcane yield in the region. In 2004, Guatemala exported 604,963 tons of molasses.[38] About 250 litres of ethanol are produced per ton of molasses. Based on molasses availability, Guatemala has more than enough ethanol for complying with a possible target of 10 per cent blending in gasoline, provided it has the distilleries to convert molasses to ethanol. Currently, the country has only one distillery. However, Brazilian investors are planning to build up to three additional distilleries with the

[33] *Ibid*., at 16.
[34] "Biodiesel: tendência no mundo e no Brasil", *Informe Agropecuario*, Vol. 26, No. 229, 2005, at 7-13.
[35] The Brazilian process mixes vegetable oils with distillates (both diesel and benzene) in a process called hydrogen hydrogenation. The result makes for a biodiesel that contains less sulfur, is easier to produce, can be used in existing diesels in high ratio's, and is cheaper than classic biodiesel. Most importantly it does not require dedicated biodiesel factories, but makes use of facilities in existing petroleum refineries. Source: Biopact, Brazil opens another energy front with the new kind of biodiesel: "H-Bio", 23 June 2006, found at: http://biopact.com/2006/06/brazil-opens-another-energy-front-with_23.html
[36] "Peak Oil in Guatemala and the U.S.: Energy Crises at Both Ends of the Development Spectrum", *Global Public Media*, 13 September 2005, found at: http://www.globalpublicmedia.com/articles/493; "Guatemala's oil consumption and production", *US Energy Information Administration*, found at: http://www.eia.doe.gov/emeu/cabs/Central_America/Electricity.html, both sites visited on 8 August 2006.
[37] Annual world production of ethanol by country http://www.ethanolrfa.org/industry/statistics/#E
[38] UN Commodity Trade Database http://unstats.un.org/unsd/comtrade/

goal to produce 100 million liters of ethanol per year. Brazilian export strategy in this field includes not only the export of ethanol fuel technology and factories but eventually the export of Brazilian flex-fuel cars, especially because Central American and Caribbean countries do not manufacture vehicles. On the other hand, those countries are interested in making changes in their energy matrix and replicating the Brazilian successful experience with ethanol production. At the 2005 Brazil-Sica (Central American-Caribbean Integration System) summit, it became clear that the region and Brazil have converging interests and needs in this area.

Guatemala was involved in the first EU investigation involving the dumping of ethanol. On 11 April 2005, the Committee of Industrial Ethanol Producers of the EU (CIEP) lodged a complaint with the European Commission against Pakistan and Guatemala for dumping ethanol on the European market. The group, which represents more than 30 per cent of total EC ethyl alcohol production, claimed that the trade practices were in conflict with Article 5 of Council Regulation No 384/96 on protection of dumped imports from non- European Community countries[39] and were causing material injury to EC ethanol producers.

The Commission initiated anti-dumping proceedings on 26 May 2005.[40] The CIEP supplied prima facie evidence to justify the proceedings. However, the industrial group withdrew its complaint on 31 January 2006, citing a change in the Generalised System of Preferences on Pakistani ethanol. The change at hand restored the full EU customs tariff to Pakistani imports - which had previously enjoyed a 15 per cent import tariff reduction. This policy shift resulted in reduced imports from Pakistan and subsequent alleviation of low ethanol prices. Because the charge was initiated on the combined effects of imports from both Pakistan and Guatemala, a significant change in the trade policy toward the former weakened the complainant's case against the latter. The proceedings were officially dropped by the European Commission on 25 April 2006.[41] Financial losses estimated by CIEP hover around 20 million euros after combining dumped, subsidized, and illegal imports. The EC has firmly committed to closely and consistently monitor the ethanol imports from both Pakistan and Guatemala in the future.[42]

Commercial production of biodiesel has not yet started in Guatemala and current production takes place on a trial basis using Jatropha and used cooking oils. The biggest determining factor of successful implementation of a commercial biodiesel plant is a stable supply of vegetable oil. Jatropha is ideally suited for cultivation in Central America and Guatemala is exploring the possibility to use African palm as well for biodiesel production.

China

China launched its biofuels initiative (The National Biomass Ethanol Gasoline Pilot Project) in 2002 in response to the nation's rapidly increasing fuels needs, raising levels of air pollution and rural economic development goals.[43] The pilot project was initially launched in four provinces throughout China's central and northeastern region to create a market infrastructure and demonstrate production potential. The sites were chosen for their abundance of maize which, at the time, was over-

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[39] OJ L 56, 6.3.1996, p. 1. Regulation as last amended by Regulation (EC) No 461/2004, OJ L 77, 13.3.2004, p. 12.

[40] OJ C 129, 26/05/2005 pp.22-0025.

[41] Decision 2006/301/EC, OJ L 112, 26.4.2006, pp 13-14.

[42] PRWeb (2006), *European Commission Sends Clear Signal to Pakistani and Guatemalan Dumped Ethanol Producers*, May, found at: http://www.prweb.com/releases/2006/5/prweb384847.htm, visited on 25 July 2006.

[43] Runqing H., L. Juneng & W. Zhongying, "China's Renewable Energy Law and Biomass Energy", *Industrial Biotechnology*, Vol.1, No.4, December 2005, at 222-227, found at: http://www.liebertonline.com/doi/pdf/10.1089/ind.2005.1.222?cookieSet=1, visited on 6 June 2006; "China works to increase biofuels production, use", *Biodiesel Magazine*, August/September 2005, found at http://www.worldbiofuelssymposium.com/Aug_Sept_05_BDM_China.pdf, visited on 2 June 2006; Lui D. (2005), *Chinese development status of bioethanol and biodiesel*, presented at the 2005 Fuel Ethanol Workshop & Tradeshow in Kansas City, KS, found at: http://unit.aist.go.jp/internat/biomassws/material/Liu-Dehua.pdf, visited on 2 June 2006.

produced and under priced. In 2004, the dissemination project was expanded to five new provinces and certain cities.

As of 2005, China's bioethanol production capacity was around 3.6 billion litres, thanks to a series of financial and tax policy measures. Those include the exemption of bioethanol from China's consumption tax, the total refund of VAT on bioethanol, and subsidies for loss associated with the production, transportation and sale of bioethanol.

More than 80 per cent of ethanol produced in China uses maize, cassava or rice as feedstock. An additional 10 per cent is produced from sugar and another 4 per cent is derived from paper pulp waste. China is, however, planning to manufacture ethanol using stalks and plants produced from wasteland and low-quality land not suitable for grain production. The maize-for-ethanol project has spurred market demand for maize and the prices of maize have been increasing strongly in the past year.

Contrary to bioethanol, biodiesel does not benefit from special incentive programmes and only a few small plants in the country are currently producing biodiesel. The feedstocks used include waste cooking oil and oils from some oleaginous plants. Significant technological research is, however, underway concerning biodiesel.

In February 2005, the National People's Congress passed "The Renewable Energy Law of the People's Republic of China", a framework law which entered into force on 1 January 2006. The legislation, which draws particular attention to energy derived from biomass, confirms the importance of renewable energy in China's national energy strategy, encourages investment into the development of biomass, removes barriers to the development of the renewable energy market, and sets up a financial guarantee system for the development of renewable energy. The law includes a "punishment and reward" system designed to encourage the entire society, particularly companies, to develop and use renewable energy, financially punishing those companies and individuals that do not meet the obligations as set out by law.

The Philippines

The Philippine government is actively promoting the integration of biofuels into its energy portfolio as a means of increasing its energy self-sufficiency, environmental stewardship, and economic development.[44] The demand for gasoline in the Philippines is predicted to increase over 60 per cent in the next decade and the country is highly dependent on imported energy: In 2004, it imported 49 per cent of its energy supply, up from 46 per cent in 2003. Meanwhile, environmental concerns, including air quality and global climate change, have assumed prominence in recent years, increasing the attractiveness of cleaner fuels. The 2005 Energy Plan aims at increasing energy self-sufficiency to 60 per cent by 2010. Additionally, the Philippines is actively promoting itself as a host to projects financed under the Clean Development Mechanisms (CDM) of the Kyoto Protocol.

Three biofuels constitute the primary focus for the country. Coco-methyl ester (CME) is produced from indigenously-abundant coconut oil. Its qualities as a diesel fuel substitute are noteworthy both for stationary and automotive engines. The oil industry is, however, still reluctant to promote CME blends, citing lack of testing on rust implications and pipeline capabilities as rationales for their reticence. Jatropha-methyl ester (JME) is made from the vegetable oil of seeds from the jatropha curcus plant. In 2005, the Philippines produced around 83 million litres ethanol, mainly from sugar.

In 2004, President Macapagal Arroyo required all government bodies and affiliates to substitute at least 1 per cent of their diesel use with CME. Government agencies also launched a programme to substitute CME for diesel fuel in the island province of Romblon to demonstrate its potential benefits. Throughout the pilot project, environmental impact assessments will be conducted and operating data will be carefully tracked for use in future undertakings. In November 2005, the

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[44] This section is based on: Bleshielda Flores M., *Potential Use of Clean Development Mechanisms (CDM) in Fostering Biofuels Development in the Philippines,* UNCTAD, forthcoming.

Philippine congress passed a bill which requires all gasoline sold to be blended with 5 per cent ethanol within two years. The government is also offering economic incentives for the promotion of renewable energy including duty-free input imports, tax credits for domestic capital equipment, and tax exemptions for real estate. Furthermore, the government set up a profit sharing scheme for the proceeds from renewable energy development projects.

These government-led initiatives are successfully spurring private-sector investment as evidenced by Petron's commitment this year to sell coco-diesel products in its fuel stations. Additionally, Japan-based Marubeni Corp. plans to invest in five new ethanol distilleries and cogeneration plants in the Philippines, and Hong Kong-based Asiagen has shown interest in building an ethanol plant there as well. The Kyoto Protocol's allowance for biofuel projects under the CDM brings further opportunities for the deployment of biofuels.

Barriers to further diffusion of CME include lack of standards, processing costs, weather volatility, and immature technologies. However, the government can help CME overcome these obstacles by offering tax exemptions, tariff reductions, and research funding.

The Philippine government has implemented the following five strategies to encourage the expansion of biofuel markets: (i) build capacity for national authorities to develop and implement a new regulatory framework; (ii) expand external assistance and support through the coordination of regional and international initiatives; (iii) establish national databases for bioenergy sources to facilitate more efficient markets; (iv) develop programmes to more effectively utilize the supply and demand sides of biofuels; (v) launch pilot projects to verify the technological feasibility and provide lessons for subsequent activities.

India

With 4.8 per cent annual growth in energy demand and only 25 per cent of consumed crude oil produced domestically, India is looking increasingly to biofuels to meet a significant fraction of its energy needs. Escalating oil prices and environmental concerns provide further impetus for engaging in biofuels. [45] To advance the production and use of biofuels, the Indian government has set ambitious targets. Beginning in 2003, the national government mandated the use of a 5 per cent ethanol blend in gasoline in nine of its sugar-rich states, a standard that will eventually extend to the entire country. In addition, the government is pursuing a National Biodiesel Mission (NBM) which aims at replacing 20 per cent of the country's diesel requirements with biodiesel by 2012.

Ethanol is produced in India from sugarcane molasses. While India is the world's fourth largest producer of ethanol at 1.6 billion liters in 2005, it is also the world's largest consumer of sugar. In 2004, a drought during the monsoon season limited the amount of sugarcane feedstock available for ethanol production, prompting a relief of the 5 per cent blend mandate and the importation of significant volumes of ethanol, mainly from Brazil. Sweet sorghum and tropical sugar beet are being investigated as feedstock alternatives to sugar for ethanol production, and their use would help the ethanol industry to overcome problems related to molasses price and availability. India may eventually require ethanol imports on a regular basis if the government mandates blends upwards of 10-20 per cent nationally.

Jatropha is the preferred source of biodiesel in India and local authorities regard its use as a good option, especially because the plant can grow in wastelands. Through demonstration projects, the Indian government has created high-yielding varieties of the plant, cultivated the feedstock, built processing plants, demonstrated vehicle performance using the biodiesel blend, and organized seminars to expand awareness of biodiesel programmes. The principal obstacle in reaching the government's NBM is convincing the farmers that large-scale cultivation of Jatropha can be profitable. Similar to the situation with ethanol, meeting a national target of 20 per cent biodiesel blend may require imports.

[45] This section is based on: Gonsalves J.B. (2006). *An Assessment of the Biofuels Industry in India*, op. cit., *supra*.

While the private sector has been largely slow in responding to government promotion of biofuels, two plant projects have secured financial backing and are due to go online by the end of 2006. In addition, the Southern Online Biotechnologies biodiesel plant underway in Andhra Pradesh is seeking certification as a CDM under the Kyoto Protocol. Having already secured the approval of the Indian government, the project will employ 100 people and offset nearly 27,000 tons of CO_2 equivalent annually at an upfront capital cost of Rs 171 million ($3.69 million).

Government-sponsored demonstration projects and CDM certification incentives have experienced some success in attracting private investment. However, the infrastructure and technologies for feedstock cultivation and processing still need to be further developed.

Thailand

The Thai government, in the midst of restructuring and privatizing its energy sector, is aggressively pursuing the production and use of biofuels to meet the country's rapidly growing energy demand and has prioritized the development of domestic, renewable biofuels. By 2012, Thailand's ethanol and biodiesel programmes are estimated to save the country an annual $325 and $675 million respectively.[46]

The National Biofuels Committee (NBC) is responsible for all policy formulation and project implementation concerning biofuels. While they work in conjunction with the ministries of finance, agriculture, energy, industry, and science, the NBC has its own funding mechanisms called Special Purpose Vehicles (SPV) to aid project implementation.

The government-sponsored programme on gasohol, a blend of gasoline and ethanol, aims to increase ethanol production to levels sufficient to replace the entire national gasoline demand with a blend of gasoline and 10 per cent ethanol by 2012. While Thailand currently has only three ethanol plants, three more are scheduled to open by the end of 2006 and an additional 18 are licensed. To stimulate initial demand, all government vehicles are required to use gasohol. Because Thailand is a major exporter of molasses, sugar, and cassava, primary feedstocks for ethanol, the country is poised to become a major Asian exporter of ethanol as well. In 2005, bioethanol production accounted for around 300 million litres.

Thailand's government continues substantial intervention in its ethanol market development. To facilitate price stability and long-term contracts, the government has fixed prices for sugar and ethanol. It has also predetermined ethanol's revenue distribution for growers (70 per cent) and processors (30 per cent) and is even considering a ban on molasses exports to increase the amount of feedstock available for ethanol. Given its natural resources, government support, and geographic location, Thailand may become the leading exporter of ethanol to energy-hungry Asian nations like Japan and China.

In addition to ethanol, the government has launched a strategic plan to replace the national diesel demand (85 million litres/day) with a blend of diesel and 10 per cent biodiesel by 2012. To reach this target, the government is aggressively developing plantations to cultivate palm oil and Jatropha. While palm oil provides very high yields, its oil becomes solid at higher temperatures than many other vegetable oils, making biodiesel produced from it unsuitable for winter use without additives. And while Jatropha has numerous virtues as a biofuel feedstock, it is not yet grown on a large commercial scale in Thailand. In addition to the agricultural capacity required for biodiesel, 26 processing plants need to be built at a total investment cost of $520 million. To demonstrate the benefits of biodiesel, the government has launched a pilot project in Chiang Mai. Using a 2 per cent blend of waste cooking oil, the project fuels 1,000 public passenger pick-up trucks.

The Kyoto Protocol's CDM provides another avenue for biofuels to integrate into the larger energy market. Some of the advanced technologies employed in ethanol processing are attempting to gain CDM certification to defray some of the initial capital costs. Two biodiesel projects are being

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[46] This section is based on: Gonsalves J.B. (2006). *An Assessment of the Biofuels Industry in Thailand*, UNCTAD/DITC/TED/2006/7.

considered for CDM status, a crude palm oil plant in Bangkok and a very large sunflower oil plant in the northern province of Loei.

South Africa

South Africa's government published its "White Paper on Renewable Energy" in November 2003. The country depends chiefly on domestic coal and imported oil to meet its energy demand.[47] The White Paper calls on the government to develop the physical infrastructure and institutional capacity needed to expand the budding domestic biofuel market. The South African government recognizes the need for financial incentives to make the nascent biofuels market competitive with existing fossil fuels. This gradual, phased programme begins by facilitating a number of "early win" investments that will demonstrate the benefits of renewable energy. Foreign investment through the Kyoto Protocol's CDM will hopefully bolster domestic financial assistance.

To successfully implement its renewable energy agenda, the government will focus on four strategic areas: financial instruments, legal instruments, technology deployment, and education in the form of awareness programmes and capacity building. The Department of Minerals and Energy (DME) has responsibility for the nation's renewable energy policy and the National Energy Regulator, launched in November 2005, oversees market access. The DME has established a joint implementation committee of stakeholders for biodiesel and is currently in the process of creating one for bioethanol.

National legislation serves as both an impetus and a product of South Africa's renewable energy agenda. First, the government has called on resources from the Central Energy Fund, a fuel tax deposit fund enacted as law in 1977, to help fund ethanol and landfill gas projects. Also, biofuel production is hoped to spur rural job creation in line with the 2000 Integration Sustainable Rural Development Strategy which promotes the sustainable development of rural areas. Furthermore, the Federal Gas Act of 2001 granted a 30 per cent tax reduction to fuels derived from renewable sources in order to stimulate domestic biofuel production. Ethanol production in 2005 accounted for 390 million litres.

To address the demand-side of the biofuels market, the government set a goal to provide 4 per cent of the total national energy requirements with renewable resources by 2013. Soya and sugar cane are currently the predominant feedstocks for biofuel production, although other crops such as sweet sorghum and maize are quickly gaining acceptance. In addition, South Africa, following the path of several other African countries, has set up a lead phase out programme which will be completed in 2007, further opening market access to ethanol additives in gasoline.

As of May 2006, the South African government was actively investigating the suitability of different crops, providing support to small-scale farmers, and working on the development of technical standards for biofuels. Meanwhile, farmers and other interested stakeholders are increasingly hopeful about the expansion of the biofuels market. GrainSA, an organization of grain farmers, is supporting a project proposal called Ethanol Africa which would build eight bioethanol plants. The first of these plants, located in Bothaville, is scheduled to begin production in 2007 with a yield of 155 million litres of ethanol annually.

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[47] This section is based on: IEA (2004). *Biofuels for Transport*, op. cit, *supra*; Le Roux, H. (2005), "South Africa sows crops-to-energy seeds", *Creamer Media's Engineering News Online*, found at: http://www.engineeringnews.co.za/eng/news/today/?show=78440;
Ndou, C. (2006). "Biofuels Project Takes-Off", *BuaNews Online*, found at: http://www.buanews.gov.za/view.php?ID=06050917151005&coll=buanew06;
South Africa Department of Minerals and Energy. (2003). *White Paper on Renewable Energy Found at:* http://www.dme.gov.za/publications/pdf/policydocs/white_paper_on_renewable_energy.pdf. All sites visited on 30 May 2006.

Table 1

Biofuel profiles of selected countries

Country	**Production (2005 liters)**		**Leading feedstocks**		**Recent enabling legislation/ body**	**Blend mandates/goals?**	**Remarks**
	Ethanol	**Biodiesel**	**Ethanol**	**Biodiesel**			
United States	15B	290M*	Corn	Soybeans	Energy Policy Act of 2005, VEETC	Yes (28.35B liters by 2012)	National energy security large motivator for biofuel programmes; subsidy of 51 ¢ per gallon of ethanol used in fuel and a 50 ¢ or $1-a-gallons subsidy for biodiesel; many subsidies at state level as well.
European Union	950M*	2.3B (2004)	Cereals and sugar beets	Rapeseed	Directive 2003/30/EC	Yes (2% by 2005 (not met) and 5.75% by 2010)	Policy goals: mitigate climate change, secure energy supply, advance technology, and diversify agriculture; land scarcity makes blending goals difficult without imports; tax concessions for bio-energy.
Brazil	16B		Sugarcane	Castorbean oil, soya oil	PROALCOOL (1975) & National Biodiesel Programme (2002)	Yes (20-25% ethanol. 2% biodiesel, 5% in 2013)	World's largest ethanol producer and exporter; produces ethanol at lowest cost; well developed biofuel transportation infrastructure; biodiesel "H-Bio" recently developed and patented by Petrobras.
Guatemala	64M****		Molasses	Jatropha		No	Excellent sugar cultivation; investigated by EU for dumping ethanol; Brazilian investors are investing in distilleries and hope to create market for flexfuel cars.
China	3.6B		Maize, cassava, rice	Waste cooking oil, vegetable oils	Renewable Energy Law of the PRC (2005)	Yes (in certain provinces)	Vehicle ownership increased 600% in last decade driving fuel demand** and the need for alternative fuels; China's policy on biofuels will largely determine the development of biofuels on a global scale; incentive programmes for ethanol.

The Philippines	83M****		Sugar	Coco-methyl ester, jatropha	Biofuels Act of 2005	Yes (1% biodiesel, 5% ethanol)	Government support to biofuel investment; biofuel production geared to social goal (job creation and related political stability); forthcoming Asian private investments for ethanol processing.
India	1.6B		Molasses	Jatropha	National Indian Biodiesel Mission	Yes (5% ethanol in certain states, 20% biodiesel by 2012)	World's second largest sugar producer; sweet sorghum & tropical sugar beet investigated as feedstock alternatives to sugar; sugar market heavily regulated; meeting future blending goals predicted to require imports.
Thailand	300M****		Sugarcane molasses, cassava	Jatropha, palm oil	National Biofuels Committee	Yes (10% ethanol & biodiesel by 2012)	Government-fixed ethanol price and revenue distribution; location, natural resources, and government support create potential for ethanol exports, especially to China & Japan.
South Africa	390M****		Sugarcane, sweet sorghum, maize	Soya oil, (Jatropha use under debate)	White Paper on Renewable Energy	Yes (since 2006 voluntary blending targets)	Government in the process of finalizing a national biofuels strategy; completing lead phase out programme in 2007 will expand market for ethanol; government & private sector investigating new energy crops; biofuel production geared to social goals (job creation in rural areas).

*Source: Worldwatch Institute. (2006). Biofuels for transportation: Global potential and implications for sustainable agriculture and energy in the 21st Century.
** Source: Ling, K.C. (29 September 2005). China seeks boost from biofuels. Bloomberg News online. Retrieved 4 Aug. 2006 from http://www.iht.com/articles/2005/09/29/bloomberg/sxfuel.php.
*** Source: Wilson, S. C., Matthew, M., Austin, G. & von Blottnitz, H. (2005). Review of the status of biodiesel related activities in South Africa. Report for the city of Cape Town, South Africa.
****Source: Annual world production by country http://www.ethanolrfa.org/industry/statistics

Other selected developing countries

Other developing countries are getting involved in biofuels as well. *Malaysia*, the world largest palm oil producer, is expanding palm oil plantations and setting up biodiesel plants both to offset its dependence on fossil fuels and to service the German market.[48] The country is planning to establish a mandatory blend of mineral diesel with 5 per cent biodiesel from palm oil starting in 2008. The government has already issued seven licenses to companies interested in building biodiesel plants.

In *Colombia*, a bill was passed in December 2004 (Bill 939) authorizing the mix of biodiesel with petrol diesel, in accordance with quality standards to be set up by the Ministry of Energy and Mines and the Ministry of Environment. The Bill provides for 10-year tax exemptions for some feedstock production, including palm oil, and for 10-year tax exemptions for biodiesel used in diesel engines domestically produced; it includes a commitment for the Ministry of Agriculture to encourage the production of seed oils to be used as biodiesel feedstocks.

In 2002, the government of *Peru*[49] announced its intentions to become an ethanol exporter, mainly to the US market. The government hopes to export over 1.1 billion litres of ethanol by 2010. To reach this target, the government outlined plans for a $185 million "mega-project" which includes construction of a 1,029 km pipeline from the central jungle of northern Peru to the port of Bajovar and 20 distilleries to convert sugar cane. A U.S. engineering firm is serving as private investor by fronting the entire cost of the project.

Peru's sugar sector produced nearly 1 million tons in 2003, which is enough to meet local sugar demand. However, the low price of sugar on the world market has deterred the country from exporting large volumes of sugar. Ethanol production offers an attractive alternative to the end use of domestic sugar and can offer farmers a financially rewarding alternative to the illegal production of coca crops: ethanol production therefore has a strong political connotation. Beginning January 2005, motor vehicles in Peru were required by law to use gasoline that is blended with 10 per cent ethanol as a replacement for lead. However, law enforcement seems to be quite limited.

Malawi initiated its bioethanol programme in 1982 and since then has been blending ethanol continuously in percentages varying from 10 to 20 per cent. It has recently built a second distillery, which came on line in 2005. The Federal Department of Energy sponsors several programmes related to biofuels, namely the National Sustainable and Renewable Energy Programme; the Programme for Biomass Energy Conservation; the Assessment of Alternative Energy Sources in Malawi, and Renewable Energy in Malawi.[50] However, much of the recent activity in feedstocks for biodiesel cultivation is the result of a private company's initiative which gives farmers free Jatropha trees to

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[48] CropBiotech Update, *Biodiesel for Malaysians*, 24 March 2006.

[49] Source: Berg Ch. (2004). *World Fuel Ethanol Analysis and Outlook*, April, found at: http://www.distill.com/World-Fuel-Ethanol-A&O-2004.html; Berg Ch. (2005). *Eco-Economy Updates: Ethanol Production Examples Worldwide*, Earth Policy Institute, June, found at: http://www.earth-policy.org/Updates/2005/Update49_data.htm; Berg Ch. (2003). "Peru Co. to Begin Ethanol Exports to U.S.", *Ethanol Producers Magazine*, June, found at: http://www.ethanolproducer.com/article.jsp?article_id=1279&q=peru&category_id=40, Ryan, Missy (2003). *Peru plan aims to supply Calif. with ethanol fuel*, March, found at: http://www.bbibiofuels.com/news/view.cgi?article=724. All sites visited on 21 July 2006.

[50] Sources: Agra-net.com, F.O., Licht *World Ethanol & Biofuels Report*, "Biofuels and the International Development Agenda", found at: http://www.energyfuturecoalition.org/pubs/Biofuels%20Seminar%20FOLichts.pdf;
D1 Oil plc. (2006), *Malawi -Working with Tobacco Farmers*, found at: http://www.d1plc.com/global/africa_malawi.php; Malawi Federal Government. (2006). *Department of Energy, found at:* http://www.malawi.gov.mw/Mines/Energy/Home%20%20Energy.htm; MBendi website (2006). *Malawi: Electric Power*, found at: http://www.mbendi.co.za/indy/powr/af/ma/p0005.htm; Mkoka, C. and M. Shanaan. (2005). "The bumpy road to clean, green fuel", *Science Development Network Online.* found at: http://www.scidev.net/Features/index.cfm?fuseaction=readFeatures&itemid=477&language=1; Mkoka C. (2005). "Malawi Explores Biodiesel as a Cash Crop", *Environmental News Service*, found at: http://www.ens-newswire.com/ens/jul2005/2005-07-15-04.asp. All sites visited on 30 May 2006.

plant along with an engagement to later buy the Jatropha oil harvested for biofuel processing. The farmers, not the private company, retain ownership of both the land and the trees. The Biodiesel Agricultural Association serves as liaison between the private company and the Malawian farming community. The association has embarked on a nationwide campaign to discuss the crop's potential in stakeholder communities and encourages farmers to utilize land not suitable for other crops in order to maximize their economic potential. However, a chicken and egg situation is hampering Malawi's feedstock market from expanding more rapidly, namely farmers do not want to shift their production to Jatropha in the absence of processing facilities, and investors are hesitant to build processing facilities before feedstocks become available. The same situation is almost always true in many developing countries.

Mauritius has harnessed bagasse from sugar cane in cogeneration plants that meet 60 per cent of its electricity needs during the seven-month harvesting season. In 2001, Alcodis, the only large-scale producer of ethanol from molasses in the Indian Ocean region, initiated a project in Mauritius. The plant became operational in 2004 and made its first shipment (3.5 million liters) to the EU in August of that year. As production capacities mature, the plant will produce 30 million liters of ethanol annually.[51]

[51] Source: *Ethanol Producers Magazine Online*, (October 2004). "Mauritius sends ethanol to EU", found at http://www.ethanolproducer.com/article.jsp?article_id=847; Mauvilac Group website, (2006). "Bulk Ethanol Exports from Mauritius", found at: http://www.mauvilacgroup.com/fr/ethanol.htm, sites visited on 2 June 2006.

4. THE TECHNOLOGICAL DIMENSION

The technologies used so far to produce biofuels are rather simple and well-known. However, some developing countries still have to improve their capacity to adapt existing technology, including soft technology, to local conditions. The need to increase biofuel availability to meet growing demand, maximize feedstock use, and reduce production costs will necessitate switching to more sophisticated technologies.

The present "first generation" feedstocks have a content of sugar, starch or oil that can be converted into biofuels using conventional technology. "Next generation" feedstocks will be harvested mainly for their cellulosic content. The conversion of cellulosic biomass into liquid biofuels implies a more complex process and more advanced technology.[52]

Moving from sugar-rich to cellulose and hemicellulose-rich feedstocks has some major advantages, including (i) a much larger array of feedstock options; (ii) less competition on land use, and (iii) greater environmental benefits due to the possibility to use the feedstocks to power the process of conversion from biomass to fuels.[53]

Cellulose-rich feedstocks comprise agricultural wastes, including those produced during production of food crops and forest products (e.g. straw and leaves) and those resulting from conventional ethanol production (e.g. wheat straw, maize stover, rice straw and bagasse) and forest residues, such as under-utilized wood and logging residues, dead wood and excess small trees. They also include municipal solid wastes, such as wood, paper, cardboard and waste fabrics; wastes from the pulp and paper processes; and energy crops, such as switchgrass, miscanthus, hybrid poplar and willow.

Grasses and woody crops can be grown in a large range of lands, as opposed to conventional biofuel crops that require specific soil and climate conditions. Forest and agricultural crops residues are largely available and can supply an increasing amount of biomass for biofuels production without displacing land from other uses.

Finally, the lignin residues that remain after extracting the cellulose and hemicellulose from the plant can be used as boiler fuel to provide the energy that is required to convert cellulose into alcohol.

At present, there is no commercial production of ethanol from cellulosic biomass, however, R&D projects are ongoing in the United States and Canada. Cellulosic biomasses are expected to begin supplying feedstocks for biofuel production within the next 10-15 years. Nevertheless, in late 2004, a Canadian firm – Iogen – announced its intention to build the world's first commercial-scale cellulose-to-ethanol plant. The plant, which takes leftover straw from surrounding farms and turns it into ethanol, is expected to come on stream in 2007.[54] It is expected that much less pressure will be put on traditional crops, once cellulosic technology is commercially available.

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[52] Different technologies can be used for producing biofuels from cellulosic biomass. The enzymatic conversion technology implies two steps, first the cellulose and hemicellulose portions of the biomass are broken down into sugar; secondly, the sugar is fermented to make ethanol. The first step is rather complex from a technical point of view and considerable R&D projects are underway to develop biological enzymes that can break down cellulose and hemicellulose in an efficient and low-cost manner. Ideally, the same "microbial community" should be used to produce both the enzymes that help break down cellulose to sugars and to ferment the sugars to ethanol. Another approach to convert biomass into fuel is gasification, a system that converts the biomass into a gas which can then be converted into fuels (the Fischer-Tropsch process). The Fischer-Tropsch process, however, is already used to produce liquid fuels from natural gas and coal. Source: IEA (2004). *Biofuels for Transport*, op. cit., *supra*, at 37-43.

[53] *Ibid*, at 38.

[54] Information found at: http://www.iogen.ca/news_events/press_releases/VW%20Shell%20Jan%2006.pdf, visited on 23 March 2006.

These technological developments may have far-reaching implications for rural economies. They imply that one can start to diversify the sources of biomass and move beyond those which are high in calorific value or have readily available sugars. The manufacturing and export opportunities may multiply for countries which have land to devote to biomass production, a favourable climate to grow them in and low-cost farm labour.

While conventional biotechnology and plant breeding continues to play an important role in developing new crops and cultivars, genetic engineering of existing crops may enhance the number and precision of trait modifications and the variety of plant products available for industrial use.

Genetic research into dedicated energy crops is still at a very early stage. Current research is focused on mapping gene sequences and identifying key locations where modifying genetic code could provide significant benefits. Major advances in genetic mapping, gene function studies, and field trials of newly created materials are not expected to occur before 2010. Co-products of genetic engineering of plants may include vaccines and other pharmaceuticals, enzymes, oils, and plastics.[55] In the future, novel chemicals and materials that cannot be produced from petroleum may be directly extracted from plants.[56]

Genetic modification could be used to produce plants that have nitrogen-fixing ability, are easy to harvest and can be grown extensively to produce protein, carbohydrates, and fibres which can all be processed through a bio-refinery into a range of industrial, edible and energy products.[57] Genetic engineering may result in energy crops which have a higher percentage of cellulose or hemicellulose and lower lignin content, as well as a greater ability to take up carbon in their root systems. Crops could also be modified to produce large quantities of the enzymes that are necessary for feedstock conversion to ethanol.[58] Oilseed crops could be bioengineered to become the source of bio-based lubricants and esterified fatty acids that are the main ingredient in biodiesel.

Modern biotechnology can also be used for increasing yields. The annual rate of increase in agricultural yields over the past 40 years has been significant.[59] Improved genetics via plant breeding and recurrent selection and technical farming improvements account for the major portion of yield increases. The introduction of GM varieties has also played a role. Crop yields are of particular importance because they affect the amount of residues generated and the amount of land needed to meet food, feed, and energy demands.

In the framework of the debate on technology, two issues seem to need special attention, namely the possible negative impact that subsidies and incentives currently provided to users of existing technology may have on the switch to new technologies; and the lack of sufficient and coherent private and public R&D to allow a faster move to technological solutions that provide answers to the many challenges posed by biofuels.

[55] IEA (2004). *Biofuels for Transport*, op. cit., *supra*, at 48-49.

[56] Monsanto has experimented with a GM plant to produce a biodegradable plastic by inserting four genes from the plastic-producing bacteria into varieties of oilseed rape and cress. This turns the plants into biological factories making plastic that can then be extracted from the plant. The company however decided that the new plant would not be commercially viable and the research was therefore abandoned. See: BBC News, *Scientists unveil plastic plants*, 28 September 1999, found at: http://news.bbc.co.uk/1/hi/sci/tech/459126.stm, visited on 23 March 2006. See also: UNCTAD (2004). *The Biotechnology Promise*, New York and Geneva, at 46-47.

[57] Sims, R. E. H. (2004). "Biomass, Bioenergy and Biomaterials: Future Prospects" in *Biomass and Agriculture: Sustainability, Markets and Policies*, OECD, September, at 9.

[58] IEA (2004). *Biofuels for Transport*, op. cit., *supra*, at 49.

[59] In Germany, a 2 per cent annual increase in yields was achieved from the 1950s to the present. In the United States, maize grain yields have risen steadily from 1965 to 2000 at an average annual change of 1.2 per cent. Recent trends in OECD countries confirm steady improvement in food crops yields of around 1 per cent per year.

5. SUPPORT MEASURES

Mandatory blending targets and incentives are being widely used to spur production and consumption of biofuels. Country programmes implemented at the federal, state and city levels include subsidies, loan guarantees, loans, direct payments and grants. Subsidies may also exist in the form of tax breaks and incentives to construct conversion plants and other capital equipments, or to purchase biofuels and biofuel cars. In addition, the biofuel market is distorted by the fact that the agricultural sector in many developed countries is the largest recipient of governments' subsidy programmes. For example, in the United States the maize sector received $37.4 billion between 1995 and 2003. Subsidies to the agricultural sector are thus becoming subsidies to the energy sector.

On the other hand, some studies have shown that the cost of subsidizing the growing biofuel sector will be at least partly offset by resulting reductions in other agricultural subsidies (for example, set-aside land payments might be reduced if these lands are used to produce biofuels). As biofuels gain prominence on political agendas, agricultural policies will need to be more closely reconciled with energy, environmental, trade and overall economic policies and priorities.[60]

Ultimately, the question becomes whether biofuels should be subsidised and, if so, for how long. If biofuels provide net societal benefits that are not captured in the market system, then there may be a case for subsidies. If, conversely, subsidies become a source of revenue from which a small number of large producers primarily benefit, then the case for granting them is much weaker.

Brazil's experience suggests that it may be worth subsidizing a nascent ethanol industry. In other countries – where agricultural, climate and market conditions may make the biofuel industry unviable without governmental support – the question of whether it is appropriate to subsidize developing domestic industries remains. Efficiency considerations indicate that feedstock and biofuel production has to take place in those countries which are best suited for doing so in an environmental and economically sound manner. However, energy security considerations may prompt countries to engage in biofuel production irrespective of economic and environmental considerations.

Public and private support to R&D of improved technology may be instrumental to make biofuel production less costly and more competitive with mineral-fuel production. In the long run, it may diminish the need to subsidize the biofuel sector.

[60] IEA (2004). *Biofuels for Transport*, op. cit, *supra*, at 21.

6. DEVELOPMENT CHALLENGES

Biofuels may contribute to the crucial goals of enhancing energy security, energy diversification and energy access; improving health from reduced air pollution; and boosting employment and economic growth for rural communities. It may offer new end-markets for agricultural products and, therefore, add value to them. These markets may also be more stable than markets for traditional export commodities, thus providing improved income stability for farmers.

The above-mentioned goals are crucially important for all countries, but particularly for developing countries. People in developing countries suffer the most from limited access to commercial energy[61], from outdoor and indoor air pollution[62], and from the declining prices (in real term) of their agricultural exports.[63]

Biofuels will provide different types of opportunities to different countries. Several countries in Africa, Asia and Latin America enjoy the appropriate climate and soil conditions to produce energy crops and have large areas potentially available for energy crop production without affecting forests and other sensitive ecosystems. Biofuels grown in tropical areas are cheaper and can displace a larger share of petroleum than biofuels produced in more temperate feedstocks.[64] A development challenge especially relevant to Africa is the competition between cash crops and subsistence crops. This seems to include the possible competition between crops for energy as opposed to crops for food. In North America, the challenge may involve how much land countries are willing to divert from food production to energy crops. In Europe, the challenge may be to find the right balance between domestically-produced and imported feedstocks, considering the limited land available for feedstock production. For both North America and Europe, a key question is how many incentives governments are willing to provide to feedstock and biofuel production and the long term economic sustainability of such policies.

Biofuels can also contribute to a development path that is less carbon-intensive. The CDM of the Kyoto Protocol[65] offers a useful financial incentive that can help attract sustainable development-

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[61] Almost 1.6 billion people in developing countries do not have access to electricity today, representing one-quarter of world population. Most of the electricity-deprived are in Asia and sub-Saharan Africa. By 2030, half the population of sub-Saharan African will still be without electricity; Africa is the only region where the absolute number of people without access to electricity will increase by 2030. See: *World Energy Outlook, 2004, Fact Sheet: Energy and Development*, found at:
http://www.iea.org/textbase/papers/2005/weoenergydevel_fact.pdf, visited on 30 September 2005.

[62] Air pollution causes premature deaths and chronic illnesses, which have a strong negative impact on the human and economic resources of the countries affected. Air pollution has been a steadily growing problem in developing countries, where urban expansion and rapid industrialization are accompanied by increasing road traffic and growing energy consumption. In India, indoor air pollution from dirty fuels causes as many as two million premature deaths a year, particularly among women and girls, who do most of the cooking.

[63] Despite recent bullish patterns that started in 2003 (in absolute value), long-term commodity prices decline (in real terms) led to severe deteriorating terms of trade for many commodity-dependant developing countries, influencing balance-of payments stability, impeding development, impacting social welfare as well as increasing impoverishment and environmental degradation. See *UNCTAD Commodity Price Bulletin*, *World Commodity Survey* (various issues), and the *Commodity Yearbook 2003*.

[64] *Biofuels for Transportation: Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century*, prepared for the German Ministry of Food, Agriculture and Consumer Protection (BMELV) in coordination with the German Agency for Technical Cooperation (GTZ) and the German Agency of Renewable Resources (FNR) (Washington, DC: 2006), at 35.

[65] The Kyoto Protocol entered into force on 16 February 2005, following ratification by the Russian Federation in November 2004. As of 10 July 2006, a total of 164 countries and regional economic integration organizations had ratified the agreement (representing 61.6 per cent of global emissions). Notable exceptions include the United States and Australia. The Kyoto Protocol sets legally binding greenhouse gas emission limits and reduction commitments for industrialized countries and countries with economies in transition (Annex 1 countries). Emission reductions should be primarily achieved through domestic actions. Additionally, the Protocol allows Parties to meet part of their commitments through reductions abroad using International Emissions Trading (IET), Joint Implementation, and the Clean Development Mechanism (CDM). The latter is

related investments into developing countries. To date, however, the only liquid biofuel CDM project under consideration is: "Biodiesel Fuel Production Project in Indonesia" (see box 3) which is currently at the validation phase.[66] The low flow of CDM biofuels project is due to at least two factors: (i) the lack of capacity in CDM project development; and (ii) limited availability of CDM baseline methodology specifically developed for biofuels projects and geared to assess their potential to contribute to global GHG emission reductions and sustainable development. The latter represents a hurdle especially for small feedstock producers who in most cases are not aware of the final use of their products. Conversely, large agro-business conglomerates are in a much better position to track the whole biofuel production chain and quantify the contribution of their products to emissions reduction.

Box 3

Proposal for a biodiesel fuel production project in Indonesia

This project proposes to build a biodiesel plant (near an existing palm oil mill) in the Palembang area of South Sumatra. The pant would produce biodiesel from palm oil waste and sell the resulting fuel to palm oil mills and a rubber factory in the same geographic area. Biodiesel will power the electricity supply systems of the nearby factories that are currently powered by mineral diesel.

Substituting biofuels for a portion of fossil fuels used reduce GHG emissions, addressing global warming problems; promoting energy conservation, and reducing air pollution caused by burning fossil fuels. The building and operation of the refinery would create employment in the rural area and mitigate worker migration to large cities.

Traditionally, the oil residues remains after palm oil is processed are removed and treated before disposal because they are known to pollute water. The proposed project will instead use the waste as raw material for biodiesel production – a use it has never had before – while simultaneously diminishing the burden of water treatment.

Waste will be collected from each palm oil mills by hydraulic pump and processed in oil separation and extraction tanks. Collecting and processing the waste at the mill site will significantly reduce both the cost and volume of transport. The entire process of waste collection, oil separation and oil extraction will be carried out using existing low-cost technology. The technology, which until now has only been used in scale projects, will be applied on a larger scale. This proposed project activity will be able to produce biodiesel at lower cost than mineral diesel. Other initiatives taken in the country which attempted to replace fossil fuels with biofuels have faced the hurdle of highly-priced raw materials, which have made the switch from fossil fuels to biofuels economically unattractive.

This project can be categorized as a "Switching fossil fuels" modality (type III.B. of UNFCCC document "Simplified Modalities and Procedures for Small-Scale CDM Project Activities). According to the proposal, switching from mineral diesel to biodiesel will reduce the CO_2 emission from the palm oil mills and the rubber factory by a total of 5,459 tons annually, and CO_2 emissions from fossil fuels by a total 864 tonnes.

Source: Bio-Diesel Fuel Production Project in Indonesia, Pacific Consultants International, 6 August 2004.

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the only vehicle for trading emissions with developing countries. The purpose of the CDM is to benefit both investor countries – which can meet their emissions reduction targets at the lowest possible cost by taking advantage of the lower marginal cost of reducing emissions in developing countries – and the developing countries which can benefit from new investments that contribute to their sustainable development.

[66] Source: UNEP Riso Centre. Once the project design document has been completed and the host country approval has been received, all documents have to be submitted to a designated operational entity for review and approval – a process called validation. The validation process confirms that all the information conveyed and assumptions made within the project design document are accurate and/or reasonable. This phase precedes the registration with the CDM Executive Board.

Table 2

Current distribution of biopower CDM projects

Resource/technology	Registered*	Registration requested**	Review requested***	Under review****
Large-scale biomass co-generation: Bagasse	29	0	0	0
Large-scale biomass co-generation: Other	2	0	0	0
Biomass for user energy	16	3	0	0
Small-scale electricity with renewable biomass	37	3	3	1
Consolidated electricity generation from biomass residues	3	0	0	0
Biomass energy use in cement industry	3	1	0	0
Total biopower projects	**90**	**7**	**3**	**1**
Liquid biofuels	0	0	0	0
Total biofuel projects	**0**	**0**	**0**	**0**
All CDM projects total (8 Aug 2006)	**256**	**50**	**7**	**7**

Source: UNFCCC

Registered: These projects have completed the CDM registration process by attaining formal acceptance by the Exec. Board.
Requesting registration: These projects have been passed on to the Exec. Board for final registration consideration
Review requested : These projects have been requested to be reviewed further by either one involved party or three members of the Exec. Board
Under review: These projects are currently under additional review

Other biofuel methodologies under development: NM82: Khon Kaen fuel EtOH in Thailand NM108: 30 TPD Biodiesel porject in Andra Pradesh NM129: Mathyl-ester biodiesel from sunflower on unused land in Thailand NM142: Plam Methyl Ester **-** Biodiesel project in Thailand

Source: UNEP Riso Centre

Despite their potential to contribute to sustainable development, engaging in large-scale production of biofuels in developing countries also entails challenges. Four issues have to be addressed: (i) the effect on other land uses by production of energy crops; (ii) effects on food prices, particularly for net-food importing developing countries; (iii) the inclusion of small producers so as to ensure that they benefit from the new dynamism of the sector; (iv) access to new energy technology so as to ensure that the use of appropriate technology in developing countries is promoted.

Land uses

One concern involves land increasingly being devoted to fuel crops, with diversion from other purposes, such as food and feed production, forestry, animal grazing or conservation. In the mind of some observers, this is a threat to the availability of suitable land for all purposes. In some regions, the availability of water, rather than land, may become a constraint to growing energy crops. Scientific evidence shows, for example, that some biofuel crops consume very large amounts of fertilizers and water.[67] According to some, engaging in large scale energy-crop plantations may require a trade off between lower food security for higher energy security.

The subject of the possible competitive uses of land for the production of food, feed or fibre – as opposed to energy production – has been extensively studied in Brazil. In sugar cane production regions, evidence indicates that, contrary to competing with other crops, sugar cane production has favourable effects on other crops. This synergy is the result of two factors: (a) the additional income enabled through sugar cane agro-industrial activity capitalizes agriculture and improves general conditions for producing other crops; and (b) the high productivity of cane per unit of land enables a significant production of cane, with a relatively small land occupation.[68]

Biodiesel can be produced from non-edible plants, such as Jatropha trees, which grow on marginal, degraded and even desert soils unfit for food or feed production. In the future, the plant's entire biomass will likely be transformed into fuels, as opposed to the small fraction currently used to produce energy. Cellulose-rich residues of agriculture production, such as straw, will increasingly be used as feedstocks. On the other hand, once the energy content is extracted from a plant, the residues can have a variety of applications, including as organic fertilizers, thus contributing to agriculture production. Agricultural production may also serve food and energy needs simultaneously. In the case of sugar cane, for example, sugar for human consumption is first extracted. Molasses is used to produce biofuels, and residues (bagasse) are burnt to produce electricity. Modern biotechnology can increase crop yields and modify plant characteristics to enhance their conversion to fuels. All these developments indicate that the risk of competition between crops for food as opposed to crops for energy may be less serious than perceived at present.

Genetic modification of fuel-dedicated crops – aimed at increasing yields and at developing suitable traits – may raise fears linked to perceived threats of agro-biotechnology to plant life and health, to the conservation of biodiversity and to the environment at large. People's resistance to GM plantations, for whatever purpose they may be grown, represents a concern that needs to be addressed. The environmental, sustainability and public perception aspects of genetically modified energy crops plantations should be carefully evaluated before widespread production starts.

[67] For example, sweet sorghum is being promoted as a future alternative to sugarcane for ethanol production partly because it requires less than half the water that sugarcane does, thus allowing water conservation for other uses and also allowing it to be grown without irrigation in regions where water is scarcer.

[68] Nastari P.M., I de Carvalho Macedo and A. Szwarc, *Observation on the draft document entitled "Potential for Biofuels for Transport in Developing Countries", The World Bank Air Quality Thematic Group*, July 2005 at 22, found at: http://www.unica.com.br/i_pages/files/ibm.pdf, visited on 23 March 2006.

Effects on food prices

Food import bills are a major concern of the net food-importing developing countries (NFIDCs).[69] If an expanding global biofuels market drives up commodity prices, the ability of consumers in NFIDCs to buy food may be imperiled. The most significant source of food in NFIDC is cereals, including rice, wheat, maize, and millet. Of these crops, only maize and wheat are currently used to produce biofuels on a large scale, in this case ethanol. However, if the market for biofuels becomes strong enough, lands currently devoted to growing other crops may be diverted to growing feedstock.

It is indeed possible that the price of crops used for biofuel production may increase. However, in the longer term, the income effects from energy crop cultivation and from having food prices rise from the present artificially low levels may offset the short term negative impacts on poor consumers in developing countries.

Small producers' involvement

The third main development concern involves whether small and local producers will indeed be able to benefit from the new dynamism of the sector. It is notable that there are economies of scale in the cultivation of many energy crops and in the transformation of feedstocks to biofuels. Most bioethanol feedstocks exhibit large economies of scale. For biodiesel crops there may be options for more decentralized production and processing. To facilitate small farmers' involvement, organizational support can be provided to help them to participate fully in this production. Contract farming arrangements or cooperatives may be a suitable means of ensuring the participation of small producers. These results should ideally be reached without over-regulating the sector. Small producers may be involved at the local level, while large companies will most likely take care of trading feedstocks internationally. Promotion of small-scale production may be conducive to the creation of sustainable livelihoods, whereas large-scale export production might generate income but provide fewer livelihoods.

Turning to transformation, the minimum efficient scale of sugarcane feedstock for bioethanol production has been estimated in Brazil as between 1 and 2 Mt cane per year. In many developing countries this represents a very high target. Among the major producers in southern Africa, for example, only four of the 40 existing sugar factories exceed this scale.[70] In order to achieve such economies-of-scale without relying solely on very large estates, greater coordination among cane producers as well as between cane producers and factories will be needed. Increases in feedstock availability, diversification of feedstocks and better access to export markets may also prove necessary.

Some new developments are also worth considering. Agro-industrial multinational companies are getting increasingly involved in the biofuel business by producing and transporting the raw materials and, above all, by building refineries. They are also setting up strategic alliances with oil companies to secure the business of biofuels distribution using existing networks. Alliances have been formed as well between oil and car companies both to produce biomass and to develop new biofuel conversion technologies. While the above-mentioned developments indicate a new dynamism in biofuel markets from which farmers and small plant owners may benefit, the increasing presence of agro-industrial, oil and car conglomerates in the sector may marginalize small producers. Therefore, appropriate mechanisms to safeguard them have to be put in place.

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[69] The NFIDCs is made up of the following 19 countries: Barbados, Botswana, Cuba, Côte d'Ivoire, Dominican Republic, Egypt, Honduras, Jamaica, Kenya, Mauritius, Morocco, Pakistan, Peru, Saint Lucia, Senegal, Sri Lanka, Trinidad and Tobago, Tunisia and Venezuela. This list is often grouped with least developed countries (LDCs) during trade negotiations involving food because they share similar food security challenges.

[70] Johnson F. X. & E. Matsika (2006). "Bio-energy trade and regional development: The case of bio-ethanol in southern Africa", *Energy for Sustainable Development*, Vol. X, No.1, March, at 49-59.

Access to energy technology

Finally, getting involved in R&D and switching from crop to biofuel production will increasingly require relevant technology. The energy technology which has been used so far is by and large regarded as a mature and rather simple technology that developing countries can easily handle and accommodate to domestic needs. "Next generation" technology, however, may become considerably more complex and expensive. It is questionable if most developing countries will be able to obtain such technology. The interaction of strong IPR regimes with access to technology, especially in developing countries, may also be problematic.

Developing country involvement throughout the whole biofuels production chain therefore seems to be the key condition for ensuring economic growth and diversification, as well as sustainable development. Possible instruments to make this happen include support to small producers and cooperatives; use of public procurement for increasing the market share of small producers and cooperatives; development and implementation of competition law; transfer of technology; and investment in R&D.

7. Trade flows for biofuels and related feedstocks

Global trends for biofuels and related feedstocks

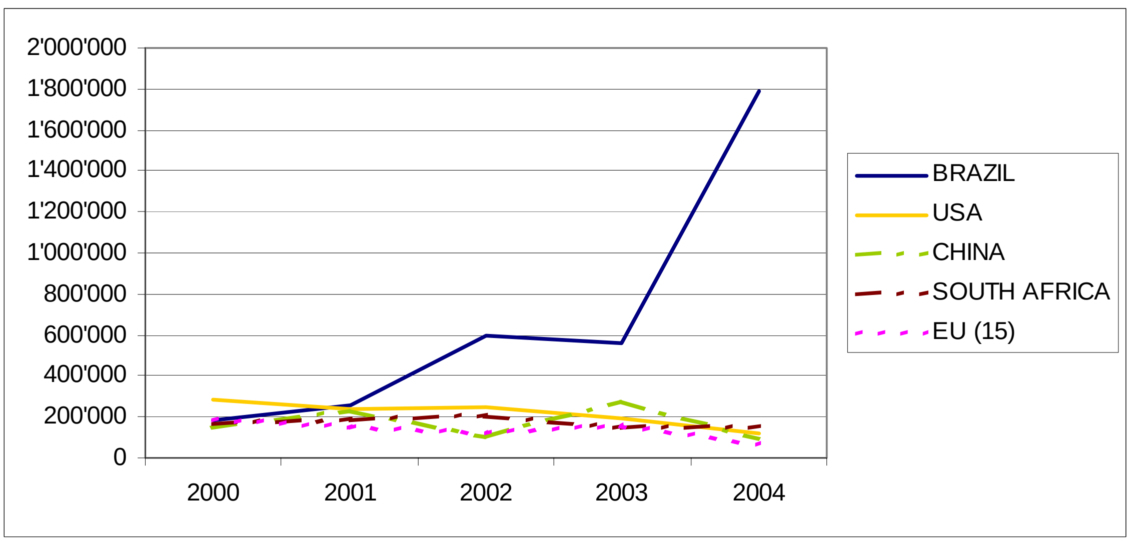
Biofuels promise new and dynamic export flows of both raw materials and finished products. Today global trade in biofuels, however, remains fairly small relative to both biofuel demand and traditional fossil fuels trade. In 2004, international trade of ethanol was around 3 billion litres, as opposed to around 920 billion litres of international trade in crude oil. A truly international market for fuel ethanol will require more producing countries to be in a position to export large surpluses.

In collecting and analyzing data on trade flows in biofuels and tariff regimes thereon, some basic difficulties are encountered: first, the current lack of proper codes for distinct biofuels in the harmonized system commodity description and coding system (HS); second, the multiple potential uses of feedstocks, which makes it difficult to track the percentage of agriculture production devoted to biofuel manufacturing as opposed to feed and food consumption or other industrial uses. However, break-downs of final uses of feedstocks are carried out by some countries at the national or regional grouping levels.

Bioethanol

Figure 1 shows the evolution of ethanol exports from the five largest exporters during the period 2000-2004.

Figure 1
Exports of undenatured[71] ethanol of strength >= 80% (HS 220710) from the five leading world exporters (in tonnes)



Source: UNCTAD calculations based on COMTRADE

[71] There is currently no specific customs classification for bioethanol for biofuel production. This product is traded under HS code 2207, which covers un-denatured (HS 2207 10) and denatured alcohol (HS 2207 20). Both denatured and undenatured alcohol can be used for biofuel production. However, it is not possible to establish from trade flows which share of imported alcohol is used in biofuel production. In this table, statistics are limited to un-denatured alcohol which is more suitable for use as a fuel, while denatured ethanol is often used as a solvent. Moreover, world trade of denatured ethanol corresponds to only a seventh of trade of un-denatured ethanol and remained basically unchanged during the 2000-2004 period.

As illustrated, international trade in ethanol underwent a strong expansion, from very limited exports in 2000 led by the United States and the EU, to a dynamic market in 2004 largely dominated by Brazil. Brazil has about 50 per cent market share of global ethanol exports, with India and the United States as main export markets.

Moving to the main feedstocks currently used to produce ethanol, the following table shows the evolution of world exports of raw cane sugar.[72]

Table 3

World export of raw cane sugar (HS 170111)

Year	**2000**	**2001**	**2002**	**2003**	**2004**
Value (‘000 USD)	3'183'077	4'285'574	2'777'927	3'414'243	2'932'829
Quantity (tonnes)	16'479'857	17'916'099	12'930'182	16'752'065	14'457'897

Source: COMTRADE

The pattern of cane sugar exports does not show any trade increase over the period 2000-2004. As trade in cane sugar does not seem to be affected by the surge in ethanol production, one can assume that sugar is not traded for the purpose of ethanol production. Several factors may contribute to this situation: ethanol production from sugar is a rather widely known and cheap process that can be easily replicated; the cost of transporting raw sugar, as compared with equivalent ethanol, makes it uneconomical;[73] and most sugar-based ethanol is produced in integrated plants that can divert the molasses stream to either refined sugar or ethanol.

The other main feedstock used to produce ethanol is maize. As it is the case for sugar cane, the surge of ethanol production does not seem to have had any relevant impact on world trade of maize. This may also be due to the fact that the top maize world producer – the United States – is also a large ethanol consumer and this limits the scope for maize exports.

As international trade in feedstocks does not seem to evolve along the path of growing ethanol demand, it can be assumed that producing countries are for the time being relying on domestically produced feedstocks for ethanol manufacturing. The availability of subsidies and incentives for feedstock production in developed countries may contribute to this trend.

Biodiesel

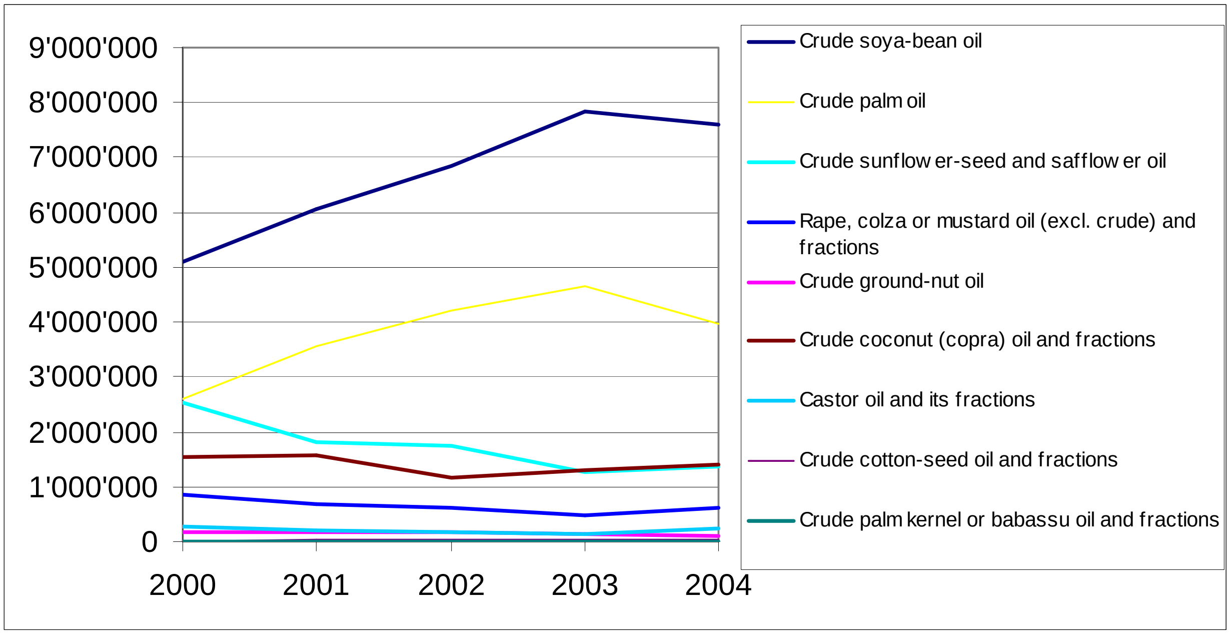
The international market of biodiesel is in its infancy, therefore no reliable trade statistics are available. Biodiesel has recently been reclassified by the World Customs Organization under the HS code 3824 90 – an industrial code which includes a large spectrum of chemical products and preparations of the chemical or allied industries (including those consisting of mixtures of natural products) not elsewhere specified or included. It is, therefore, difficult to identify trade flows, trends

[72] Sugar beet has not been included because its trade figures concern mainly European countries (where it is essentially produced) and trade relates to sugar exports from East European countries to the European Union (15) or from the European Union (15) to Arab countries. Moreover, most likely sugar imports in those countries are not meant for ethanol production.
[73] According to UNCTAD estimate, 150 kg of sugar are necessary to produce 100 litres of ethanol (equivalent to 80 kg).

and opportunities specific to biodiesel. Trade in biodiesel feedstocks, however, has experienced significant growth that may be partly attributed to the rising demand for biodiesel.

Figure 2

World export of selected vegetable oils (in tonnes)



Source: UNCTAD calculations based on COMTRADE

Exports of palm oil and soybean oil have registered a sharp increase since 2000. Main importers of soybean include several Asian developing countries that use it for food purposes. Therefore, the surge in soybean exports does not seem to be linked to biodiesel production.

The pattern is different for international trade in palm oil, which is the second most traded oil worldwide. The diet of many developing countries, but not developed countries, includes palm oil. There are flows of palm oil from Indonesia and Malaysia to developing countries such as India, Bangladesh, Kenya and Mexico, and to developed countries such as Germany, the Netherlands and the United Kingdom. While it is hard to assess which percentage of palm oil is used as food and which percentage is used as energy feedstock, it can be assumed that part of the recent palm oil import surge into the EU has been used for biodiesel production. Another non-food use of palm-oil, however, is to burn it in electric power plants, which some companies are doing to comply with targets on renewable energy use.

Trade flows seem to indicate that feedstocks are traded internationally and that oil processing into biodiesel takes place in countries different from those which produce the feedstocks, as opposed to bioethanol which is manufactured where its feedstocks are cultivated. One possible explanation is that biodiesel until now has been produced almost exclusively in the EU, where incentives have created a market large enough for producers to exploit economies of scale. Additional considerations related to logistics may also play a role. Edible oils are usually traded as crude oils, while refining takes place in the importing countries. A limited number of large firms control the refining process. The transport, storage and other facilities which are used for trading crude edible oils may then be used for trading biodiesel feedstocks.

8. WTO IMPLICATIONS

Environmental goods and services

Paragraph 31 (iii) of the Doha Development Agenda has launched negotiations on “the reduction or, as appropriate, elimination of tariff and non-tariff barriers to environmental goods and services.” Negotiations on environmental goods have been carried out by the Committee on Trade and Environment Special Session (CTE-SS) and by the Negotiating Group on Non-Agriculture Market Access (NAMA). Negotiations on environmental services have been conducted within the Special Sessions of the Council for Trade in Services. Lacking conclusive progress in the negotiations, the paragraph relating to environmental goods and services included in the Hong Kong Ministerial Declaration (December 2005) simply instructed Members to "expeditiously complete the work" under paragraph 31(iii).

Before the suspension of the Doha negotiations on 24 July 2006, the environmental goods negotiations focused on how to define “environmental goods” and criteria to identify them. Somewhat problematic were so-called “environmentally preferable products” (EPP)[74], especially those that would have to be defined by their process and production methods (PPMs). Several approaches were proposed, including: (i) establishing a positive list based on national submissions; (ii) adopting the environmental project approach (EPA) suggested by India, under which environmental goods and services would be liberalized within the framework of environmental projects undertaken at the national level and approved by national authorities; and (iii) combining the environmental project approach with the list approach (integrated approach), as suggested by Argentina.[75]

By using the above-mentioned criteria, the list of goods to be potentially regarded as environmental goods became extremely large (around 480 products). This has caused WTO members to consider two sets of "indicative parameters" for screening the products included in the lists. Additional considerations – such as transfer of technology, special and differential treatment, and the achievement of win-win-win results – were also considered to streamline the lists.

According to some countries, the definition of environmental goods covers, *inter alia*, renewable energy products, which could include ethanol and biodiesel and related products. Improved market access for products derived from or incorporating cleaner technologies, such as "flexi fuel" engines and vehicles, could also be pursued.[76] Moreover, parts and components of biodiesel and bioethanol plants could be classified as environmental goods. Importantly, however, while biodiesel is classified as an industrial product under the HS code 382490, ethanol is classified as an agricultural product under the HS code 2207. That means that, in principle, it was not under the mandate of the NAMA Negotiating Group, which was responsible for drawing up the modalities for any tariff reductions affecting environmental goods.

Many disagreements among countries on the identification of environmental goods, on the scope and approach to take to liberalize trade in such products, and on mechanisms for regularly updating the product list to account for constantly moving targets, have hampered any conclusive result. Moreover, the interaction between the work of the CTE-SS and that of the NAMA Negotiating Group remained unclear. WTO members could not find a common position on whether environmental goods, if and when identified, would profit from special tariff reductions or whether they would benefit from the tariff reductions of other products under the NAMA mandate. The suspension of the

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[74] According to UNCTAD's definition, EPP products are those that cause significantly less 'environmental harm' at some stage of their 'life cycle' than alternative products serving the same purpose.

[75] Yu V. P. (2006). *Defining a Negotiating Strategy for Asian Developing Countries in the WTO Environmental Goods and Services Negotiations: Going for Win-Win Solutions*, Asian Regional Dialogue on Environmental Goods and Services, March, found at: http://www.ictsd.org/dlogue/2006-03-02/Vice_Yu.pdf, visited on 30 May 2006.

[76] *Environmental Goods for Development - Submission by Brazil*, TN/TE/W/59, 8 July 2005, para. 10-11.

Doha negotiations may likely prompt countries to look to bilateral and regional agreements as quicker and more predictable tools to remove tariffs and non-tariff measures affecting international trade in biofuels and related technologies.

Moving to environmental services, while developing countries are by and large net importers of environmental services, biofuels is an area where some of them have developed expertise and could be in a position to export services. In this field, companies often export integrated packages of goods, technology and trained personnel.

Export opportunities may emerge, especially through Mode 1 (cross-border trade), which is of special relevance for consultancy and other kinds of services which do not require physical presence in the importing country, and through Mode 4 (movement of natural persons). Restrictions on Mode 1 can significantly impact trade in services related to biofuels. For instance, residence may be required in the importing country to supply that country's market on a cross-border basis. Limitations on the movement of natural persons may also affect the capacity to export services related to biofuels, since companies may need to bring in specialized professionals.

The entry into force of the Kyoto Protocol in February 2005 may allow a lucrative service sector to develop around the trading of emissions rights. The complexities involved in conducting, monitoring, verifying and enforcing emissions trading schemes and in designing and implementing carbon credit projects allow considerable margin for the market development of various services activities. The early experiments in emissions trading have underlined the key role of large consulting firms from industrialized countries which are at present benefiting from new business opportunities.[77] Sustainability assessments are also in great demand.

According to GATS services sectoral classification list, consultancy services fall under the general category of "other business services". The question is then whether the consultancy services described above may be classified as environmental or energy services in consideration of their specific use in the biofuels or CDM fields. It is worth to recall that under the GATS classification, services sectors are classified in a mutually exclusive way: services in one sector cannot be covered by another sector. Some WTO Members propose that, in addition to the identification of “core” environmental and energy services, commitments should also include ancillary services such as engineering, R&D and consultancy services.[78]

Labelling and certification

With considerable increases in feedstocks trade expected to allow countries to meet their self-imposed biofuels targets, the sustainability of biomass production is becoming an increasingly important issue. Sustainability requirements are currently being considered for biofuels to enter developed country markets.

Concerns related to feedstock production refer to the risk that increasing biofuel demand will lead to the cultivation of previously uncultivated land. This could include land with a high environmental value or high level of stored carbon. Under some circumstances, cultivation of land could reduce its environmental value and release CO_2 into the atmosphere. The negative effects of such a situation could possibly eclipse the greenhouse gas benefits of biofuels. There may be other cases that the cultivation of biofuel raw materials could jeopardise the environmental advantages of biofuels. Some biofuels deliver more greenhouse gas benefits than others, and some deliver more security of supply benefits than others. Some believe that these characteristics should be properly reflected in a system of certificates.

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[77] Zarrilli S. (2003). "International trade in energy services and the developing countries", in *Energy and Environmental Services: Negotiating Objectives and Development Priorities*, UNCTAD/DITC/2003/3, New York and Geneva, at 55-58.

[78] See for example the Plurilateral Request on Energy Services which includes management consulting services and services related to management consulting, found at: http://www.tradeobservatory.org/library.cfm?refID=78716

These considerations have prompted some countries, companies and NGOs to consider developing criteria that energy feedstocks should meet in order to prove their overall sustainability. Certification systems that attest compliance with the established criteria would then be developed and certificates or labels would become preconditions for entering certain markets, especially developed markets where consumers may be particularly sensitive to environmental and /or social issues.

The Dutch government is already working on criteria for sustainability assessments of biomass utilization in biofuels production. The European Commission is conducting a public debate regarding, among other topics, the suitability of a certification system to ensure that biofuel feedstocks have been cultivated under minimum environmental standards. In addition or alternatively, certificates might be issues to indicate the greenhouse gas or security-of-supply impact of each type of biofuel[79]. WWF's European Policy Office has requested that the EU mandate certification of all biofuels used in the EU, whether they come from domestic or imported sources. In WWF's view, the certification system must be based on enhancing the potential of biofuels to cut greenhouse gas emissions while avoiding negative environmental impacts related to biofuel production.

Precedents in the field of sustainability certification exist in the forestry, agriculture and electricity areas. The development of certification systems in forestry was a market-based response to address public concerns about tropical deforestation, resulting loss of biodiversity and the perceived low quality of forest management. The introduction of forest certification was led by the Forest Stewardship Council (FSC) and a range of other schemes were operational at the end of the last decade.[80]

For the agricultural sector, different certification systems exist that were implemented to ensure that the products are produced in an environmental sustainable way and are safer or healthier for the consumer. Certification in organic agriculture has the longest history: the first environmental label for organic agriculture was introduced at the European level in 1991.[81]

Certification systems for so-called "fair-traded" agricultural products have also been implemented to ensure "fair" payment of agricultural products, enhance producers' quality of life, improve market access for their products and reduce dependency on middlemen.

In the energy sector, a number of green electricity labels exist and some of them include definition and criteria for biomass.[82] Though there are significant differences in the conditions required for biomass, in principle, there are two approaches to define green electricity from biomass: (i) definition and criteria involving the feedstocks (e.g. qualifying crops, ecological integrity of cultivation) and exclusion of certain technologies (e.g. genetic engineering); and (ii) specifications for criteria regarding the processing of the feedstocks at the plant level.[83]

Criteria in existing certification schemes addressing sound resource management and responsible enterprise behaviour are being considered in the development of potential criteria for the sustainable production and trade of energy feedstocks. The existing criteria refer to production sustainability, leakage effects, food and energy supply security, biodiversity conservation, greenhouse

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[79] European Commission, Energy and Transport Directorate-General, *Review of EU biofuels directive. Public consultation exercise, April-June 2006*, April 2006, found at: http://ec.europa.eu/energy/res/legislation/doc/biofuels/2006_05_05_consultation_en.pdf, visited on 15 June 2006.

[80] Lewandowski I. and A. Faaij (2004). *Steps towards the development of a certification system for sustainable bio-energy trade*, Copernicus Institute of Sustainable Development and Innovation, July.

[81] *Ibid*. Systems for organic agriculture include EKO, IFOAM, SAN and UTZ KAPEH[81].The EUREPGAP system is the most prominent system for the certification of agricultural products from a quality stand point. The rules for production under EUREPGAP concentrate on quality management, the minimization of negative environmental impact through crop production and on track-and-trace control of the products.

[82] *Ibid.* Eugene Standard, Austrian Ecolabel, Bra Miljöval (Sweden), Ecoenergia (Finland), Gruener Strom Label (Germany), ok-power (Germany), Milieukeur (Netherlands), naturemade (Switzerland), Green Power (Australia), Green-e (USA), Environmental Choice (Canada).

[83] Oehme I, (2006). *Development of ecological standards for biomass in the framework of green electricity labelling*, WP 2.2, Report from the CLEAN-E project, February, at III.

gas emissions, water conservation, strength and diversification of local economies, human health and safety, rights of children and indigenous people, adequate quality of life, and labour conditions. However, there is more experience applying some and little or no experience applying other of the above-mentioned criteria. Therefore, caution should be used when applying those criteria to the bio-energy field.[84]

While ensuring sustainability is a legitimate goal, applying labelling or certification to feedstocks and biofuels remains a rather complex issue. To ensure that certification does not become an obstacle to international trade, especially from developing countries, sustainability criteria should be developed through a transparent and fair process where countries, both producing and consuming, are effectively represented. To this end, support is needed to improve developing country capacity to play an active role in the development of criteria. Criteria and related certification schemes must be easy to apply and flexible enough to take account of local conditions. Measures to ensure conformity can also act as powerful non-tariff barriers if they impose costly, time consuming, and unnecessary tests or duplicative conformity assessment procedures. Developing countries have traditionally encountered difficulties getting certificates issued by their domestic certification bodies recognized by the importing countries. In most cases they have had to rely on the expensive services provided by international certification companies. If certification or labelling requirements are established, they should be coupled with financing and technical assistance to improve the capacity and credibility of developing country certification bodies while enlarging certification access to medium and small-sized companies. In this context it is also worth recalling that no labelling schemes exist for fossil fuels or nuclear energy.

Turning to WTO rules, the Agreement on Technical Barriers to Trade (TBT Agreement), covers technical regulations and standards, including packaging, marking and labelling requirements, and procedures for conformity assessment. The Code of Good Practice for the Preparation, Adoption and Application of Standards (Annex 3 to the TBT Agreement) refers to the activities carried out by any standardization body, including non-governmental bodies, which develop standards, i.e. rules, guidelines or characteristics for products and related processes and production methods with which compliance is not mandatory. The Code seeks to bring all standards within its purview and provides for transparency in the preparation, adoption and application of standards. A "grey" area in the field of labelling remains the TBT coverage of labelling programmes that refer to the way specific goods have been produced (processes and production methods - PPMs). While a multiplicity of labelling programmes are based on the life cycle approach and therefore take PPMs into account, many WTO members keep the position that such programmes, by referring to processes and production methods that often are not reflected in the final characteristics of the products, are not covered by the TBT Agreement. These programmes would then escape from multilaterally agreed trade rules, such as non-discrimination, abstention from creating unnecessary obstacles to trade and proportionality. Nevertheless, they would have a significant impact on trade flows.

A quite active debate took place in the 1990s regarding, among other issues, the transparency of eco-labelling schemes. The concerns which prompted this debate were that eco-labelling schemes - by being voluntary and often developed by private bodies, would fall under the transparency rules set by the Code of Good Practices, which are not very stringent. Moreover, the acceptance of the Code by standardization bodies is optional. WTO Members reached the agreement to make efforts on a voluntary and non-binding basis to maximize the use of the Code of Good Practice for eco-labelling programmes and to apply the notification obligations meant for mandatory measures to voluntary measures, including those developed by non-governmental bodies. A similar solution could apply to certification schemes of biofuel/feedstock, especially voluntary programmes developed by non-governmental bodies. The main benefit of such a solution is that producers and exporters would be informed in advance of the development of certification and labelling programmes and would have opportunity to provide comments on proposals as well a time to adjust to the new requirements before their implementation.

[84] Lewandowski I. and A. Faaij (2004). op.cit, *supra.*

The "like" products issue

The criteria being developed to distinguish sustainably-produced energy feedstocks from other feedstocks raise a fundamental question over whether such a distinction between products which share the same physical characteristics and final uses is consistent with internationally agreed trade rules. The national treatment principle incorporated into GATT Article III implies non-discrimination between domestic and imported goods. This means that the importing country is not allowed to apply to foreign products measures more onerous than those applied to "like" domestic products. In the context of Article III, the determination of what constitutes "like products" is a crucial issue, since the national treatment obligations apply only if two products are "like".

In assessing whether products are "like", the controversial issue is whether the analysis should be limited to the product's physical characteristics or should also take into account the process and production methods. The relevant jurisprudence is not conclusive, and authoritative authors are deeply divided on the subject.[85] On the one hand, it has been argued that there is no real support in the text and jurisprudence of the GATT for the product/process distinction[86] and that the distinction is neither warranted nor useful in practice.[87] On the other hand, it has been suggested that there is a textual basis in GATT Article III and the Note Ad Article III for the product/process distinction and that the distinction should be retained to prevent protectionist abuses.[88] The product/process distinction is therefore an open issue. Jurisprudence related to GATT Article XX (General Exceptions), on the other hand, seems to have evolved to interpret Article XX as covering measures that distinguish products on the basis of the production processes.[89] As far as the relationship between Article III and Article XX is concerned, the Appellate Body in the asbestos case regarded the two Articles as complementary and not mutually exclusive.[90] Distinguishing feedstocks on the basis of environmental standards remains a complex legal issue.

The "like products" issue may also be of relevance as far as domestic taxation is at stake, particularly because biofuels benefit in several countries from numerous tax breaks while mineral fuels are subject to heavy internal taxes. According to GATT Article III.2, regulations and taxation measures should not discriminate between products which compete with each other in a given market. However, some exceptions may be invoked to justify discriminatory tax treatments, including when human, animal or plant life or health, or environmental protection are at stake (GATT Article XX (b) and (g)).

If different fuels – such as mineral fuels and biofuels – fall into the category of "like" or "directly competitive or substitutable" products, a country that subjects those fuels to different tax regimes may be considered to violate its multilateral trade obligations unless it has legitimate reasons for holding such a discriminatory system. While the reason usually mentioned to biofuels to enjoy favourable tax regimes is their contribution to the achievement of environmental goals, their environment balance through out the entire life cycle may not be always positive. The actual

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[85] However, it has been stressed that the "trade policy elite has simply accepted the notion of a sharp divergence between measures on products and PPMs as if such a distinction had been written into the GATT all along, and not simply invented in the *Tuna/Dolphin* case": Trebilcock M.J. and R. Howse, *The Regulation of International Trade* (London and New York: Routledge, 1999) at. 413.
[86] Howse, R. and D. Regan (2000). "The Product/Process Distinction - An Illusionary Basis for Disciplining 'Unilateralism' in Trade Policy", *European Journal of International Law* 11, pp. 249 ff., at 264-268.
[87] Cosbey, A. (2001). "The WTO and PPMs: Time to Drop a Taboo", *Bridges* 5 No. 1-3, at 11-12.
[88] Jackson, J.H. (2000). "Comments on Shrimp/Turtle and the Product/Process Distinction", *European Journal of International Law* 11,at 303-307.
[89] In the *US - Shrimp* case (*United States-Import Prohibition of Certain Shrimp and Shrimp Products,* Appellate Body Report adopted on 12 October 1998, WT/DS58/AB/R), the Appellate Body stated that "It appears to us, however, that conditioning access to a Member's domestic market on whether exporting Members comply with, or adopt, a policy or policies unilaterally prescribed by the importing Member may, to some degree, be a common aspect of measures falling within the scope of one or another of the exceptions (a) to (j) of Article XX.(para 121).
[90] *EC - Asbestos*, at para 115.

contribution to emissions reduction of maize ethanol produced by using coal-fired power generation is, for example, questionable. The different tax regimes imposed on biofuels as opposed to mineral fuels find their *raison d'être* in the policy options taken by governments to encourage substitution away from oil and consequently reduce energy imports and to spur the development of domestic biofuel industries. While these reasons are legitimate, pursuing them through internal tax discrimination may be questionable under WTO rules.

9. UNCTAD'S ROLE IN THE FIELD OF BIOFUELS

The UNCTAD BioFuels Initiative, which was launched in June 2005, was conceived to offer a facilitating hub for biofuel programmes already underway in a number of institutions. While several initiatives already exist, dispersed among UN and non-UN bodies, it was felt that a "meeting point" was necessary to share experience and provide support to developing countries.

The Initiative aims to provide UNCTAD membership with access to sound economic and trade policy analysis, capacity building activities and consensus building tools. The Initiative is committed to remain flexible to specific national circumstances and needs. It will attempt to share lessons from success cases, as well as illustrate problems encountered by developed and developing countries alike in dealing with the technical, policy, and economic aspects of biofuels. It will work closely with the private sector.

More specifically, the BioFuels Initiative will help assess the potential of individual developing countries to engage in the emerging biofuels market. In doing so, it will look at the links between domestic energy policies, food security, production and export diversification, environmental management, job creation and rural development. It will deal with trade flows, tariff regimes, and market access and market entry-related issues affecting international trade in biofuels. It will tackle issues related to the use and production of biofuels as emerging investment opportunities for developing countries. The Initiative will provide policy guidance, ideas and examples on how to address the challenges that countries will face when engaging in this new market. By creating an International Advisory Expert Group, UNCTAD will be well-equipped to deal with the many different technical issues related to biofuels' production and international trade.

The 2006-2007 Work Plan includes:

- Preparing a technical paper on biofuel trade flows and tariffs, including relevant non-tariff barriers;
- Preparing a concept note on biofuels as a development tool and on UNCTAD's role and strategy in the field;
- Preparing a paper on how to best organize the emerging market for biofuels;
- Preparing a paper on baseline methodologies used in project proposals submitted for consideration as CDM project activities (in cooperation with UNEP-Risoe). The focus will be on approved baseline methodologies used, hurdles encountered, feedstocks deployed for biofuel production;
- Preparing a paper on the relationship between agricultural production for food and for energy uses (in cooperation with FAO and UNEP);
- Establishing cooperation with other biofuel initiatives sponsored by other intergovernmental organizations (e.g. FAO International Bio-Energy Platform, UNEP, IEA, World Bank, UNIDO, among others), governments (G8/Italy Global Bio-Energy Partnership), or both;
- Establishing cooperation with Regional Development Banks with a view to carry out specific country/subregional/regional projects on biofuels;
- Establishing partnerships with applied research centres and NGOs aimed at sharing technical expertise and conducting joint activities (e.g. TATA group, UNF, Energy Future Coalition, CENBIO-USP, IIED, WorldWatch Institute, and the IISD's Global Subsidies Initiative among others);
- Establishing partnerships with the private sector aimed at creating concrete biofuels opportunities in specific developing countries;

- Contributing to the setting up of the International Advisory Expert Group;
- Setting up a dedicated website for the exchange of relevant papers, posting of domestic regulations and experiences on biofuels and announcement of relevant meetings;
- Providing background documentation for and support to a discussion on biofuels at the UNCTAD Expert Meeting on energy as a dynamic sector in world trade (29 November-1 December 2006);
- Following up on the results of the CSD-14 (May 2006) and participating in the CSD-15 (May 2007) and in other relevant international meetings on biofuels;
- Conducting feasibility studies on biofuels opportunities and potentials in a few developing countries.

CONCLUSIONS

Most agree that the energy challenge of this century – providing an affordable energy needed to achieve, expand and sustain prosperity for all, while avoiding intolerable environmental disruption – cannot be met without a huge increase in the global energy-innovation effort. Alternative energy sources, including biofuels, form part of this effort.

Several developed and developing countries are establishing regulatory frameworks for biofuels, often including blending targets of biofuels with mineral fuels. They are also providing different kinds of subsidies and incentives to support nascent biofuel industries. These developments are expected to spur a sustained worldwide demand and supply of biofuels in the years to come.

The production, use and international trade of biofuels offer an opportunity to slow down the process of global warming. While use of biofuels will not be enough to halt climate change by itself, it offers an important and potentially cost-effective contribution.

The emergence of biofuel markets provides an opportunity for developing countries to diversify agriculture production, raise rural incomes and improve quality of life. Biofuel use could enhance energy security and reduce developing countries' expenditure on imported fossil energy, thereby freeing up resources for other uses. In this context, it is important to identify technologies, organizational strategies and government support services that allow small producers to engage in biofuel production. Technical and financial assistance will be necessary to facilitate the process. Data collection and information sharing will assist decision-making. Conscious decisions will need to be made if smaller-scale biofuel production is to be successful. Social equity, geographical distribution and poverty impacts should be essential components of domestic biofuels policies and not an afterthought.

Efficiency considerations indicate that feedstock and biofuel production has to take place in the most efficient countries. Several developing countries – with land to devote to biomass production, a favourable climate to grow them, and low-cost farm labour – are well placed to become efficient producers. However, energy security concerns may prompt less efficient countries to engage in biofuel production – instead of imports – irrespective of economic and environmental considerations.

International trade in biofuels and related feedstocks may provide win-win opportunities to all countries: for several importing countries it is a necessary precondition for meeting the blending targets included in their domestic regulations; for exporting countries, especially small and medium-sized developing countries, export markets are necessary because there are economies of scale in the cultivation of many energy crops and in the transformation of feedstocks to biofuels.

International trade in ethanol has gone through a period of strong expansion, moving from very limited exports in 2000 to a dynamic market in 2006. Developing countries, particularly Brazil, have benefited. But others, including South Africa, Pakistan and some Central American and Caribbean countries, are also becoming active exporters, often by taking advantage of existing preferential trade arrangements. South-south trade and transfer of technology are also taking place.

There appears to be little international trade in ethanol feedstocks and this situation is unlikely to change. It can then be assumed that producing countries will continue to rely on domestically produced feedstocks for bioethanol manufacturing for the foreseeable future. Subsidies are likely to contribute to the expansion of domestically produced feedstocks in developed countries.

Biodiesel production outside the EU is still limited and this is why there has been no significant international trade. Recent heavy investments in a number of developed and developing countries, however, indicate that those countries are in the process of becoming producers and possibly exporters of biodiesel. Trade in biodiesel feedstocks is on the rise, indicating that the raw agriculture materials, rather than the industrialized finished products, are being traded internationally. The traditional structure of the plant-oil industry may also explain this situation.

Some biofuel imports are allowed into the EC and US markets duty-free and quota-free under different preferential trade arrangements. The remaining imports, however, face tariffs which offset lower production costs in producing countries and represent significant barriers to imports. Moreover, export performance is often penalized by the graduation of the successful exporting countries from the preferential schemes. Tariffs and non-tariff barriers applying to biofuels hamper international trade and have negative implications on investments in the sector. Ultimately, they may jeopardize the goals of reducing greenhouse gas emissions and improving security of energy supplies. The Doha negotiations on environmental goods and services provided an avenue for reducing tariffs and non-tariff barriers affecting trade in biofuels and related products. However, the suspension of the negotiations on 24 July 2006 may likely prompt countries to look to bilateral and regional agreements as quicker and more predictable tools for the removal of tariffs and non-tariff measures affecting international trade in biofuels and sustainable energy technologies.

Labelling and certification may be instrumental to ensure that widespread biofuel production and use will indeed be conducive to environmental improvements. Certification and labelling of biofuels and related feedstocks remains, however, a rather complex issue. Efforts should be deployed to ensure that the development of sustainability criteria and certification systems contribute to reaching environmental objectives without creating unnecessary barriers to international trade, especially to exports from developing countries.

The technologies used so far to produce biofuels are rather simple and well-known; the need to increase biofuel availability to meet growing demand, maximize feedstock use, and reduce production costs will necessitate switching to more sophisticated and likely proprietary technologies. These developments may hamper developing country efforts to become viable and efficient suppliers of biofuels. Transfer of technology and capacity-building will contribute to facilitate developing country access to relevant energy technology and know-how.

Growing biofuel demand implies that the manufacturing and export opportunities may multiply worldwide. However, biofuels will provide different types of opportunities to different countries. UNCTAD, through its BioFuels Initiative, is providing developing countries with access to economic and trade policy analysis, capacity building activities, and consensus building tools to help them exploring these opportunities.