



UNIDO's Biofuels Strategy

**Sustainable Industrial Conversion
and Productive Uses of Biofuels**



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

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UNIDO BIOFUELS STRATEGY

Sustainable Industrial Conversion and Productive Uses of Biofuels

1. Introduction and definitions

The production and use of biofuels have entered a new era of global growth, with both the scale of the industry and the number of countries involved reaching unprecedented levels. Surging investments in biofuels production are being driven by a variety of factors, that include the development of more efficient conversion technologies, the introduction of sound new government policies, growing international trade and of course, the rising price of oil. Underlying the growing commitment of governments to biofuels development is the desire to find new markets for farmers and their products - thereby providing employment, enhancing energy security and reducing emissions of carbon dioxide and other gases that are contributing to global warming.

Biofuels are defined as energy carriers derived from the conversion of biomass to provide sustainable inputs for heat, power, and transport applications. Biofuels can be liquid, solid or gaseous. The principle sources of biomass are agriculture and forestry.

There is a growing realization that the production of biofuels for energy on the scales necessary to supply significant shares of national and global energy provision will result in very substantial impacts (positive as well as negative) on the ecosystems, economies and cultures of the target regions. The protection of biodiversity, rural livelihoods and management of scarce water resources are critical considerations in any analysis of the potential for sustainable biofuels provision in any country. Therefore, whilst modern bioenergy could contribute significantly to poverty alleviation in rural areas, the effects of changes to the supplies of natural resources and ownership of those resources are of concern to policy makers.

This biofuels strategy was developed in response to increased interest by UNIDO's client countries for support to national biofuels strategies and programmes. In order for UNIDO's governing bodies to decide on the level of UNIDO's involvement in this subject area it was considered imperative to establish a process by which a comprehensive assessment of all factors influencing the implementation of biofuels programmes in developing countries is undertaken, and a clear strategy is developed.

As a first step, UNIDO, with the assistance of a renowned research institute, set up a biofuels task force to prepare a document summarizing global biofuels developments, initiatives by international, bilateral and other UN agencies and identifying potential areas for UNIDO's intervention. In addition to many internal discussions with UNIDO technical staff, an international meeting with experts from developing countries as well as representatives of UN partner agencies, research institutes and donor governments was organized. The outcome of all those consultations was compiled into a final document outlining UNIDO's position in the biofuels discussion.

This strategy builds on ongoing activities, and proposes a multi-disciplinary, integrated and focused approach to delivering a UNIDO biofuels programme. It outlines vision, objectives, target clients and beneficiaries of UNIDO support, and presents six focal areas of intervention.

2. The Need for a Bio-fuels programme at UNIDO

a. Context: A concise overview of the problem being addressed (the world energy market and its implications for developing countries)

The major share of today's human "appropriation" of biomass is dedicated to the provision of food, feed, and biomaterials (mainly fiber, and timber for construction). Currently, only about 10 percent of the biomass is used as biofuels, but residues find their way into cooking stoves, furnaces, and power plants. All forms of biofuels supply about 10 percent of the world primary energy demand, representing 90 percent of the global contribution of all renewable energies (REN21 2006). While biofuels shares in OECD energy supply decreased over the last decades¹, they remain an important source of energy in developing countries where on average a third of all primary energy comes from biomass; in some African countries, even up to 90%. The energy supply of approx. 2 billion people depends nearly exclusively on traditional bioenergy such as firewood or dung, mainly used for cooking (Karekezi 2004).

Future prospects

Forecasts show that in the most optimistic scenarios, bioenergy could provide for more than twice the current global energy demand, without competing with food production, forest protection efforts, and biodiversity. In the least favorable scenarios however, bioenergy could supply only a fraction of current energy use, perhaps even less than it provides today. This significant range of uncertainty of the sustainable global biofuel potential is a consequence of the uncertain developments in future agricultural and land-use policies, especially in developing countries. Factors such as increases in productivity could "free" the land for biofuel crops, and conversion of marginal and degraded land into biofuels production areas could expand the resource base as well. On the other hand, impacts from climate change such as heat waves and droughts, as well as competing uses of land (food, nature conservation) could severely restrict the future biofuel potential.

Feed vs. food

A key concern in the global biofuel discussion is the competition between land-use for biofuels production and food and feed production. If there is no direct competition it could show indirectly through economic (price) feedbacks as can be seen in recent sugar and corn price fluctuations. This competition has a special significance insofar as food security is concerned, and the MDGs clearly require policies to reduce hunger, and increase food security. In this respect, a switch to large-scale bioenergy production might have adverse indirect impacts on food security, which need further attention. As long as biofuels mainly come from plants which can be also used for food/feed production, the economic effects of coupling the energy (i.e. biofuel) market with food/feed markets could increase food/feed prices, and – hence – worsen the access to affordable food/feed for many. The indirect effect of increased prices for traditional agro-products, however, could increase farmer (and country) income, and thus help increasing food security, depending on the distribution of the increased income. As the overall outcome of such developments is still being debated, the FAO announced recently to research the food-versus-fuel issue in more detail (FAO 2006b). The outcome of this research should be considered key in safeguarding future biofuel development against food/feed competition.

Economic competitiveness

Concerning economic competitiveness of biofuels, already today, heating applications based on modern biofuels can compete with oil and gas, and electricity generation with biogas from residues, landfills, or waste-water treatment undercuts costs of oil- and gas-fired power plants. Ethanol from sugarcane in Brazil is competitive without subsidies at 35-50 US\$/bbl oil (WB 2005), while most other liquid biofuels for transport need further development before becoming economically attractive at oil prices in the 50 US\$/bbl range. Yet, volatility in oil prices could also endanger investments in market introduction of biofuels.

¹ There are some exceptions to this trend, e.g., Austria, Denmark, Finland, and Sweden. Also in Germany, drastically higher shares of bioenergy are expected in the future (Fritsche et al. 2004).

Trade implications

International biofuel trade is an issue for global players, with SMEs having a minor role so far. As a consequence of the energy price and supply security developments, however, interest in global trade of biofuels is spreading. Since the mid-1990s, biomass trade flows increased rapidly, partly as a result of reduced marine bulk transport cost. Many trade flows are between neighboring countries, but long-distance trade also occurs, for example, with export of ethanol from Brazil to Japan and the EU, palm kernel shells from Malaysia to the Netherlands, wood pellets from Canada to Sweden. Nearly all of that trade is across waterways, or uses large maritime cargo vessels. The IEA Bioenergy Task 40 projects a significant increase in global shipping of biofuels in the next years.

In addition, the failure of the WTO Doha Round in opening agricultural markets of OECD countries (and to restrict subsidized agricultural exports) shifts the focus of traditional farming from cash crops to dedicated bioenergy crops, which have the prospect of higher revenues on international markets if converted into biofuels.²

Sustainability issues

With the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg, and the formulation of the Millennium Development Goals (MDGs)³, sustainable development in general, and its link to energy became prominent issues in global fora. In this context, there are currently many national and international initiatives underway to safeguard against negative social and environmental impacts of future bioenergy developments. Concerns over land use (as referred to in the food vs. feed discussion), land ownership, loss of biodiversity and genetically modified organisms (GMOs), greenhouse gas emissions, soil erosion and other soil degradation, water use and water contamination, human health impacts, labour conditions and rights of children are all part of the sustainability discussion and international efforts to formulate standards.

Climate change

Bioenergy could in comparison to fossil fuels drastically reduce greenhouse-gas and air emissions if managed adequately. However, there are many factors to be taken into account when quantifying Greenhouse Gas (GHG) emissions. Current knowledge of GHG balances of biofuels indicates a rather large range (Larson 2006). For specified regions like the EU, quantification is possible with regard to the different bioenergy crops, conversion routes, and by-product utilization rates (OEKO 2006). For other regions like the USA, and a few developing countries (Brazil, China, India), some data on the life-cycle GHG balances exist, while other countries like Thailand have ongoing research programme in that area.

Technology transfer

Realization of the potential of biofuels depends to a great extent on the availability of competitive conversion technologies. Yet, these technologies are not readily available in developing countries. To this end, there is need for support mechanisms that would encourage the transfer of relevant technologies and associated capacities from technology producers to technology markets. Since UNIDO's focus will center around providing such support mechanisms the following sections will describe the current situation with regard to existing and future conversion technologies⁴:

² Market access and differences in tariff structure are another cause. Furthermore, biodiesel is regarded as an industrial product, whereas bioethanol is treated as an agricultural product and, therefore, faces higher import duties.

³ Although there is no specific MDG relating to energy, the MDGs cannot be met without affordable, accessible and reliable energy services (UN Energy 2005).

⁴ For a comparison on biofuels conversion technologies with regard to costs a separate full report to this strategy document is available.

Existing Conversion Technologies

Solid Biofuels

The conversion of solid biofuels to energy is quite a traditional human activity – from the fire used in pre-historic times to modern cooking stoves⁵, and electricity generation from biogenic residues burnt to generate steam for high-pressure-turbine power plants.

Biomass gasification technology based on solid biofuels has become commercially viable in recent times for both - power generation and process heat applications in industry. Realizing the potential of gasification technology to meet the distributed power energy and industrial applications for process heat in SMEs, a number of large projects are under implementation in several countries by various agencies including UNIDO. Interestingly, the market introduction of such technologies in developing countries is far more rapid in developing countries such as India than in industrialized ones.

Medium-to-large cogeneration using biofuels is already in the market, and could benefit from gasification developments, especially for industrial process heat, and on-site cogeneration. With “hybrid” schemes and “biorefineries” for multiple outputs becoming available in the next decade, power and fuel markets might well overlap or even merge, allowing the bioenergy industry to optimize their outputs according to market development, and revenue opportunities.

With the emerging bio- and thermochemical conversion systems for bioenergy, the bioenergy power and heat sector will be coupled more closely to the transport sector. Indirectly, this will also couple the commodity prices for traditional agricultural and forestry products with the energy sector. This development would mean that the agro- and forestry product industries will have to consider the developments in the biofuel markets far more closely, and then decide whether to become active in those markets. For this, there is a clear need of support for the decision-making process, especially for SMEs.

Liquid Biofuels

Bioethanol and biodiesel have emerged as dominating liquid biofuels on the global scale in replacing fossil fuels (i.e. gasoline and diesel) not only in the transport sector, but also with huge potential for heat and electricity generation.

Bioethanol from biomass as a substitute for gasoline is currently the main biofuel globally as it has proven efficiencies, and established economics. Suitable biogenic feedstocks contain high shares of sugar, or starch, which is catalyzed into simple sugars, and then fermented into ethanol. Sugar cane in particular stands as the feedstock that already provides a large amount of ethanol in Brazil. Other crops, which can be converted into ethanol, are cassava⁶, maize, potatoes, sorghum, sugar beet and wheat. The conversion of their starch content into sugar has a high process energy demand, so that the cost of the product is quite high.

Biodiesel is an important liquid biofuel: oilseed-yielding plants like castor, cotton, jatropha, palm, rape, soy, etc. offer a feedstock from which straight vegetable oils (SVO) can be derived by physical and chemical treatment (milling/refining).

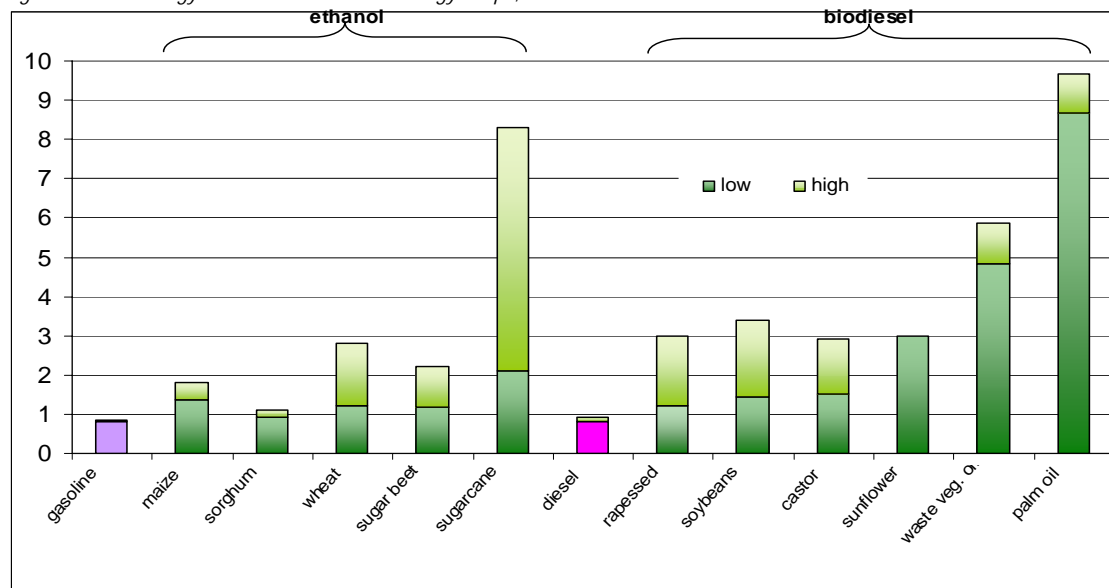
⁵ It should be noted that modern biomass use for cooking is also an issue on the household level (e.g., through efficient stoves, biogas, ethanol-based gelfuel). As this report is mainly concerned with biofuel conversion in the industrial sector, these technologies will not be discussed any further.

⁶ For example, research in Thailand indicates moderate prospects for future cassava-based ethanol (JGSEE 2006).

The SVO can then be processed further into fatty acid methyl esters (FAME), also known as biodiesel⁷. With respect to future market potentials, smaller-scale biofuel cogeneration systems with diesel engines using liquid biofuels (SVO or FAME) as inputs become attractive additional options, especially for stand-alone and mini-grid applications in developing countries as well as for “green” electricity generation in industrialized nations (e.g., Netherlands).

The net energy yields of bioenergy crops used for liquid biofuels are given in the following figure in which all in- and outputs are considered, i.e., agrochemicals, by-products, and auxiliary fossil energies⁸.

Figure 1 Net Energy Yield Factors from Bioenergy Crops, and Fossil Fuels



Source: adapted from WWI/gtz (2006); data give the ratio of energy output per unit of fossil energy input

For developing countries it is potentially valuable that biodiesel can also be derived from plants such as jatropha, which show comparatively low yields, but need only minor inputs so that their overall costs might be moderate if land and labour costs are low. Jatropha can also be grown on marginal and even degraded land, and needs only little irrigation during the first years.

Gaseous Biofuels

Biogas – at least in Europe - has developed in the last years far beyond the mere fermentation of biomass residues like dung, liquid manure, or organic household wastes: nowadays, it can be derived from “modern” bioenergy crops such as maize (or corn), wheat, and even more interestingly from industrial wastes as well as from mixed or double cropping farming systems which can integrate various “old” plant varieties into their rotation, and give net energy yields comparable to the best palm oil, or sugarcane plantations. High rate biomethanation process has been applied in many countries to obtain biogas from industrial wastes as well as from liquid municipal wastes for use on a commercial basis to generate power or process heat.

⁷ Another route for biodiesel is to “hydrotreat” unprocessed bio-oils (from castor, cotton, palm, soy etc.) so that no transesterification is needed to stabilize the biodiesel.

⁸ Note that farming practices such as reduced tilling, use of organic fertilizers etc. could significantly change the net yield ratios.

Future conversion technologies

Liquid biofuels

In the last decade, other options for liquid biofuels were researched and two “new” conversion routes are currently in the pilot stage. These “next” or 2nd generation biofuels differ technology-wise and benefit from a larger biomass feedstock supply:

- To extend the biofuels yield, the whole plant material is to be used as a feedstock.
- The feedstock can come from “non-food” perennial crops (in principle, woody biomass and tall grasses) and ligno-cellulosic residues and wastes (e.g. woodchips from forest thinning and harvest residues, surplus straw from agriculture).

Ligno-cellulosic biomass from fast-growing perennial crops such as short-rotation wood and tall grass crops require less agrochemical inputs. Furthermore, the root systems of perennials remain in place after harvest so that these crops, compared to annual ones, reduce erosion, and could increase carbon storage in soil. However, high biomass yields will typically be achieved only on good soils with sufficient water supply.

Gaseous biofuels

Biogas can be upgraded to substitute natural gas (SNG) so that it can be fed into existing natural gas pipeline systems (both locally, nationally, or even for cross-border trade). Alternatively, it can be compressed into “green” compressed natural gas (CNG) to be used in gas-engine vehicles (buses, cars, trains, trucks etc.). Biogas-derived SNG can be “blended” with natural gas in any mixture. Biogas could further be processed into a green GtL (gas-to-liquid), thus becoming directly available as a powerful and very clean-burning liquid fuel, although this route seems costly. Nevertheless, current markets for CNG vehicles are, with the noteworthy exception of countries such as Argentina, rather small, and gas transmission and distribution infrastructures are often missing in developing countries.

Biorefineries

Biomass can not only be converted into biofuels, but also to bulk and fine chemicals (or biomaterials), which are nearly equivalent to those derived from fossil hydrocarbons, and might offer more interesting revenues than bioenergy or biofuels alone. The concept of a “biorefinery” aims to optimize the conversion of biomass feedstocks so that its output mix reflects the highest revenues, and covers all attractive markets.

As with the 2nd generation biofuel technologies to which biorefineries are closely related, it is currently not possible to know with any certainty how future biorefinery concept will perform, what they will cost, and which products they are going to deliver to the market. The concept is promising insofar as oxygenated chemicals become more prominent, and biochemical conversion knowledge is benefiting from developments of GMO-related processing. Still, biorefineries will not be off-the-shelf systems, nor small-scale neighbouring plants: their complexity will be high, and to become competitive, their size will be in the order of thousands of MW_{th}, thus resembling their fossil name-relatives. Infrastructure needs will be accordingly high, and their most probable way of becoming a reality will be as an “offspring” of 2nd generation biofuel plants.

The overall biorefinery technology paradigm is important, though, as it indicates the willingness to consider biomass in all potential areas of application. If process control evolves, the biorefinery paradigm might foster spin-offs suitable for smaller-scale application, i.e., benefit not only hi-tech businesses, but also SMEs in developing countries. It should be understood that this is a possibility, not a guarantee.

b. [Potential of bio-fuels for developing countries: current and future situation](#)

Biofuels are relevant renewable sources of energy especially in developing countries, and have huge potential to serve up to some 30 percent of the global energy consumption in the near future (when taking into account the vast potentials of energy efficiency in the transport sector). The realization of this potential depends on technological improvements, innovations, and market conditions in both developing and industrialized countries.

It is anticipated that increased flows of biofuels could come from agricultural and forestry when pre-processing and conversion of dedicated bioenergy crops and residues or by-products into marketable biofuels (e.g., pellets, ethanol, biodiesel etc.) become parts of the agro- and forestry business, as is the case in some countries. Future liquid (and gaseous) 2nd generation biofuels for transportation could come from non-food crops, cellulosic biomass, and wood.

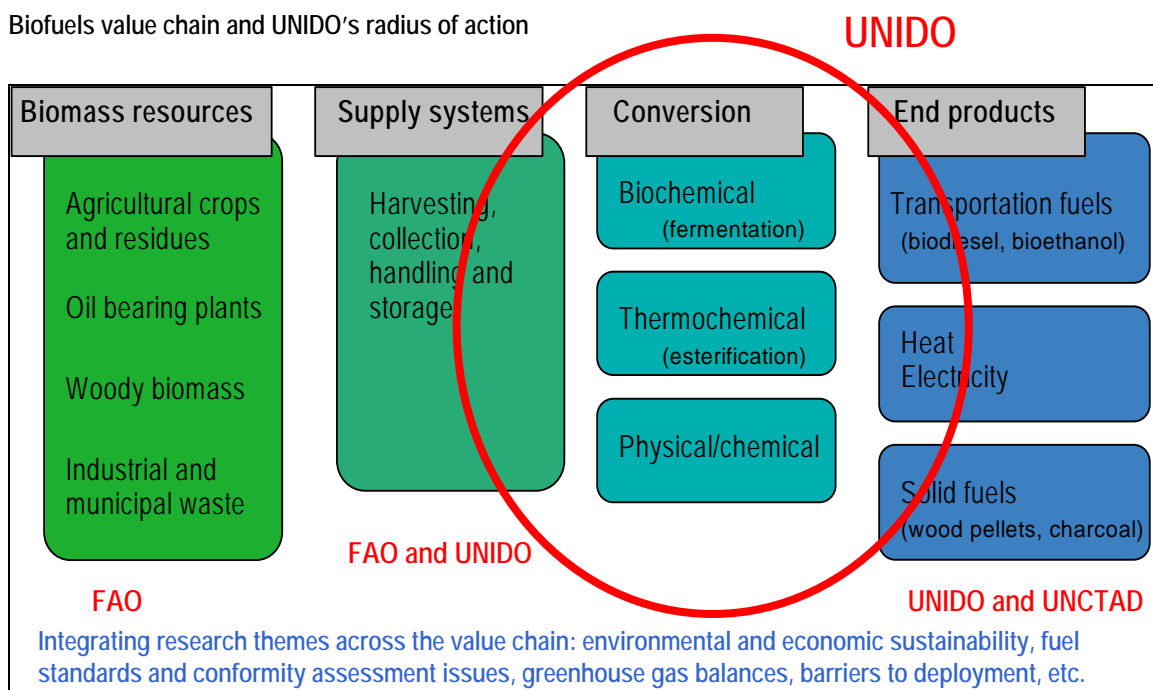
Today, Brazil is the most active player in liquid biofuels, but also China, India, several Latin American countries, Malaysia, South Africa, and Thailand have their own national liquid biofuels programmes. Most developing countries have started to consider liquid biofuels as a domestic energy option, or as one for exports. Several governments in both developing and industrialized countries have implemented legal requirements to introduce liquid biofuels through quota schemes for blending biofuels with petroleum-based gasoline and diesel, or through preferential tax treatments (WWI / gtz 2006).

c. [Existing support for developing countries in bio-fuels: gaps that UNIDO can fill, customer demand](#)

Biofuels are a rather new issue for nearly all institutions. Most other UN and multilateral organizations, national institutions, and the private sector are currently formulating their positions, approaches, and partnerships with respect to biofuels. On the UN level, only FAO, UNEP and UNCTAD are clearly “visible”, while all others are currently considering their approaches, and strategies. Biofuels are seen as a major option to reduce poverty (FAO 2006), to increase income in rural regions (UNCTAD 2005), and to contribute to greenhouse-gas reduction (UNDP 2005).

The role that industry plays in biomass flows, where it converts agricultural and forestry commodities into food/feed products, biomaterials, and biofuels, can be best illustrated by the following figure:

Biofuels value chain and UNIDO’s radius of action



Source: IEA (2005), adjusted by UNIDO

Industry, and particularly SMEs occupy key functions in:

- Producing food, feed and fiber (food industry; pulp & paper industry etc.);
- Preprocessing wastes and residues (e.g., pelletization);
- Manufacturing equipment with various technologies (assembly / maintenance, logistics); and
- Converting feedstocks into biofuels (combustion, fermentation, gasification etc.).

Timing for UNIDO's biofuels initiative is good as intense endeavours are currently underway to form cross- and inter-agency cooperation with links to other multilateral organizations (G8, IEA, UNF, FAO, WB, UNDP and UNCTED), and create "hubs" to focus and disseminate relevant information such as the Global Bioenergy Partnership (GBEP) supported by the Government of Italy and hosted by FAO. At regional levels, EU (and most of its Member States), Japan, and the USA are committing significant R& D resources to biofuels, as well as actively formulating and implementing policies for further biofuels in their markets. The Energy Centre at the Swiss Federal Technical Institute in Lausanne (EPFL) is coordinating a multi-stakeholder effort, the Roundtable on Sustainable Biofuels.

At global level, biofuels trade and sustainability concerns are key issues under discussion and have called for international action to safeguard against negative social and environmental impacts. A variety of voluntary schemes like product labeling and certification, but also suggestions for internationally binding regulation for governmental support schemes (e.g., subsidies or preferential treatment) are currently researched and discussed widely.

d. [UNIDO's capacity to fill gaps \(modified SWOT analysis\)](#)

UNIDO has a long and excellent record of promoting bioenergy technologies, especially regarding biomass gasification for electricity and process heat (with Indian Institute of Sciences in India and other partners). Furthermore, UNIDO has outreach to core industries in biomass area (agro, wood), and have started developing programmes on biofuels. Biogas, sustainable forestry management, and related work on standards are already part of the cleaner and sustainable production and agro-produce waste management activities, which are an element of the UNIDO/UNEP network of National Cleaner Production Centers. UNIDO's work on the CDM has great relevance for bioenergy, but is so far more focused on the mechanism itself than on specific projects.

UNIDO carries out capacity building, technology assessments, information dissemination, training, and evaluation in areas close to biofuels. Here, the International Centre for Science and High Technology (ICS) in Trieste is a special asset of UNIDO, which currently prepares a survey on available and emerging technologies for biofuel production, especially for palm oil as a feedstock. In that context, an electronic decision-support tool is being developed. In cooperation with industrial partners such as the Malaysian Palm Oil Board, ICS works on catalytic processes for palm oil-based biodiesel, glycerol as a feedstock for fine biochemicals, and related issues.

UNIDO's internal strength lies in the integration of services related to biofuels: Agro-Industries (Module 5), and Sustainable Energy and Climate Change (Module 6) are key, while Investment & Technology Promotion (Module 2), Industrial Competitiveness and Trade (Module 3) and Environmental Management (Module 8) present opportunities in the future.

With respect to biofuels development in developing countries, UNIDO's strength is that the organization:

- Maintains very good links to relevant industrial sectors (especially SME) which are key future players in the Bioenergy / biofuel arena, and its Service Module 2 (Investment & Technology Promotion) could be seen as an asset with respect to (needed) investments in the biomass conversion technologies market of developing countries;
- Maintains country-level implementation nodes, and regional offices, but it also has business-related networks, especially the Investment and Technology Promotion Offices (ITPO);

- Maintains own research capacities (e.g., ICS Trieste), and operates active collaboration with RTD partners in developing countries;⁹
- Addresses B2B issues and customer outreach problems related to biofuels, through its joint effort with UNEP-DTIE in the CP area;
- Can rely on its SME partnerships and outreach/training activities, which are valuable routes to convey and disseminate information and data on bioenergy in general, and biofuels in particular;
- Provides access to environmental support systems through its Cleaner Production Centers and can make use of those centers for information dissemination and training programmes on biofuels;
- Works on export consortia which is a potential – but excellent - base for biofuel considerations from a developing country point of view;
- Works in the area of Trade Capacity Building and has the largest portfolio among UN agencies – a clear “strategic asset”;
- Has activities regarding CDM, which could be extended to cover biofuels, thus making use of its industrial outreach.

Concluding from the above list, UNIDO has excellent opportunities to move itself into the center, and to create valuable inputs for the biofuels development at large.

On the other hand, it must be acknowledged that UNIDO has currently:

- No immediate access to (bio) fuel distributors, and biofuel logistics;
- No strong link to prime technical institutions for the biochemical route to biofuels, as well as weak ties to biofuels industry associations;
- No working relationship with the (base) chemical industry converting biomass.

⁹ UNEP manages this through its network of collaborating centers.

3. The Bio-fuel Programme

a. [Vision and Objectives, including statement explaining bio-fuels' role in the overall Renewable Energy Programme and Energy and Environment thematic priority](#)

Availability of energy is central for poverty reduction. UNIDO's energy programme aims to reduce and/or remove the obstacles that hinder the access to affordable and sustainable energy in poor rural areas of developing countries, in particular LDCs, and to demonstrate the economic and technical viability of modern energy systems based on locally available renewable sources (biomass, solar, wind, mini-hydro) while building the productive capacities needed to sustain those systems.

In this context of promoting renewable energy sources, biofuels play an important role in realizing UNIDO's mandate and addressing different Millennium Development Goals as

- biofuels for electricity, heat and transport are key options to ensure access to energy, especially for rural areas;
- biofuels provide an opportunity to promote establishment of local small businesses, and thereby create economic revenue, and employment;
- biofuels contribute to diversifying energy supply, and hedging risks of impacts from global fossil fuel price increases;
- biofuels provide a means to reducing greenhouse gas emissions, especially by applying the CDM.

It is UNIDO's vision to be the lead UN agency to enhance access to energy, diversify fuel supply sources, create income opportunities in rural areas and reduce greenhouse gas emissions by promoting sustainable industrial conversion processes and productive uses of biofuels.

UNIDO's programme objective is to ensure that its client government institutions, private sector and industry related organizations are in a position to take effective and efficient decisions on their biofuels programmes, especially with respect to the selection of available technologies and the steps required to adopt promising technologies currently under development..

b. [Target clients and beneficiaries of UNIDO Support](#)

Clients are:

- Governments and national institutions dealing with policy and regulatory issues;
- Industry associations;
- Universities and research institutes;
- Banks and investment funds.

Target beneficiaries are:

- Small and medium sized enterprises, which manufacture equipment for the biomass conversion industry, preprocess (e.g. pelletise) or process biomass for food, feed or fuel production (food, pulp and paper, chemicals), or have access to energy (biodiesel for generators, biomass gasification for electricity grids).
- Small farmers benefit by having access to biodiesel to run their generators or their agricultural machinery. In addition, they may make additional income from preprocessing biomass as feedstock for biofuels production.
- Larger private and public entities such as energy/electricity suppliers.

c. [Services to be provided](#)

1. Proposed UNIDO services

The main focal areas where UNIDO will contribute to the biofuels field with own programmes and projects are as follows:

1. Profiling biofuels (reducing risks and uncertainties for investment)
2. Solid biofuels: South-South technology transfer, and commercialization
3. Liquid biofuels: Ethanol from residues and wastes - demonstrating the value chain
4. Liquid biofuels: Biodiesel - building the local-global bridge for SMEs
5. Gaseous Biofuels: Biogas from industrial wastes
6. Biorefineries: providing clearinghouse service

1. Profiling Biofuels

UNIDO will help create clear “profiles” of productive and sustainable biofuels provision and uses, in particular highlighting that this comprises far more than biofuels for transport. Best practices will be made visible, including information on sustainable biofuels potential, and employment and poverty reduction benefits.

Biofuels need investments, i.e., an active role of the private sector. Financing of biofuel projects will occur only if stable markets with adequate revenues are perceivable for investors, especially with regard to SMEs. The availability of data on and experiences with conversion technologies in terms of cost, efficiency, emissions, maintenance requirements, and suitability for developing countries is crucial.

As uncertainty on future potentials exist, integrated country analyses are needed to address different land-use priorities. Country case studies with industry partners are needed, and national workshops to disseminate results and define national biofuels strategies.

Profiling and country assessments to determine potential business opportunities in the biofuels sector need to be carried out with partners in developing countries already having capacities to implement biofuels programmes (e.g., Argentina, Brazil, India, Malaysia, South Africa, etc.). At the same time, less advanced countries can benefit from South-South cooperation with those more experienced partners. Given that the use of modern biofuels is relatively new, developing countries have few own capacities to research, consider, and evaluate such business opportunities. Hence, there is a clear need for integrated national strategies which take into account the specific settings of SMEs in the value chain.

Last but not least, UNIDO is in a unique position to contribute to the emerging issue of sustainability standards for biofuels. UNIDO's approach is to disseminate relevant information to its partners in industry, and to assist biofuel industry associations and representatives from developing countries to actively participate in this area.

2. Solid Biofuels: South-South Technology Transfer & Commercialization

UNIDO will support the South-South technology transfer and market introduction of biomass gasification in partnerships with respective industrial developers in the (smaller-scale) power sector. Collaboration with IEA Bioenergy Task 36 could bring in a North-South component. The activity will build on the successful establishment of the UNIDO Center of Excellence for biomass gasification at the Indian Institute of Sciences in Bangalore, India. Few large-scale demonstration plants are already under implementation in several countries. In that regard, UNIDO will also highlight biomass cogeneration as a key option for CDM based on its own work in that area.

3. Liquid Biofuels: Ethanol from Residues and Wastes – demonstrating the value chain

UNIDO will focus in the near-term on the conversion of residues (especially from food industry) to ethanol. Guidance on and technology assessments of all biofuel pathways will be made available to UNIDO's clients. For

ethanol from industrial wastes, a pilot programme will be established in which participants from SMEs in developing countries, and donor contributions (e.g. from DFID, GTZ, KfW, as well as GEF) will be sought.

4. **Liquid Biofuel: Biodiesel - Building the Local-Global Bridge for SMEs**

UNIDO will foster decentralized biodiesel production, where issues such as feedstock availability and cost, fuel quality, labor safety, and environmental performance would be addressed. UNIDO aims to establish a (possibly virtual) "round table" on experiences with decentralized biodiesel production, and will create a platform for data, manufacturers, and successful projects. For this, UNIDO will strategically use and extend its current activities with ICS Trieste.

UNIDO will contribute to "bridge" rural biofuel developments with respect to global trade and markets by establishing links between respective SMEs, its own trade activities, and logistic providers to bundle the potential of decentralized biodiesel. Malaysia's private sector initiative to demonstrate best practices in producing palm oil sustainably will be supported.

5. **Gaseous Biofuels: Biogas from Industrial Wastes**

Most agro-based SMEs generate significant amount of biowaste. This waste can be used to generate biogas, which could in turn be used to generate process heat or used to generate electricity. The production of energy from biowaste from SMEs presents several advantages to SMEs including enhanced productivity and competitiveness. UNIDO will contribute to the development of promotion of such technologies in relevant SMEs through technology transfer support, capacity building and investment promotion.

6. **Biorefineries: Providing Clearinghouse Services**

UNIDO aims to set up a clearinghouse service on biorefineries as a special contribution to the ongoing establishment of global knowledge hubs (or platforms) within the UN System. Here, UNIDO's technology assessment capacities, its existing channels for disseminating information, and its collaboration with industry and research partners in developing countries and the Cleaner Production Centers are key assets.

2. [Service delivery](#)

Inter-agency co-operation: In view of the multi-disciplinary nature of biofuels UNIDO cannot and should not operate in isolation of its UN partners. Any programme needs to be coordinated closely with other agencies and partners (for instance, focus of FAO programme is on biomass feedstock supply issues). Therefore, UNIDO's plans to have a joint unit with FAO are key to the success of any biofuels programme. UNIDO should assist in strengthening FAO's International Bioenergy Platform by serving as the SME information intermediary, i.e. a one-stop shop for biofuel conversion issues.

Furthermore, UNIDO needs to more actively participate in currently on-going initiatives by the UN system such as GBEP and in system-wide programmes such as the development of a Bio-Wikipedia system. Other examples of co-operation with UN partners are joint research programmes, particularly in the areas of profiling and preparation of country assessments.

In-house co-operation: As stated earlier in section 2.d., SWOT analysis, UNIDO's strength lies in the fact that it has several service modules, which lend themselves to supporting an inter-disciplinary biofuels programme. The challenge is to make use of all tools, methodologies and existing centers for developing and promoting a focused biofuels programme.

In developing countries, small and medium-sized enterprises (SME) play a central role in the conversion processes of biofuels. Across the value chain different cross-cutting issues, which are of relevance to UNIDO's stakeholders such as policy makers, investors, entrepreneurs, industry associations and researchers, need to be addressed. Examples where in-house and inter-agency co-operations are necessary include:

- Capacity building for policy makers to enable legislative and policy decisions in support of biofuels production. This includes research on lessons learnt, what works what doesn't in which context, as well as organization of training programmes and development of training modules on biofuels – activities, which can be performed by ECB/RRE in close co-operation with ECB/EE and PCF/RST as well as other UN agencies such as FAO and UNEP, and bilateral agencies active in this field (GTZ, SIDA, Dutch);
- Institutional support to SMEs to promote biofuels based process heat production for local use to enhance rural development and create employment. This would involve support to local bioenergy industry associations to provide technology advice and business support services (through cluster programme or Cleaner Production Centers) – activities, which can be performed by ECB/RRE in close co-operation with ECB/CP, PSD, and AGR.
- Institutional support to SMEs to promote exports (through existing cluster programmes or Cleaner Production Centers). This may include investors fora and assistance in the implementation of sustainability standards – activities, which can be performed by ECB/RRE in close co-operation with ITP and TCB as well as UNCTAD and bilateral agencies.
- Demonstration projects to directly support SMEs in production of biofuels and manufacturing of equipment for energy producers. This involves technology transfer activities such as technology selection, acquisition and adaptation and analysis of local market conditions – activities, which could be performed by ECB/RRE in close co-operation with PSD.

D. Implementation of the Bio-fuels Programme

1. Proposed sequencing for introducing the services

- The complexity and cross-sectoral nature of the biofuels issue need integrated approaches within UNIDO, namely the joint work of its service modules, and collaboration between programmes. For that, a Biofuels Team will be formed which would coordinate all focal area activities.
- The joint bioenergy unit with FAO should be strengthened and a more active involvement of the work of IEA bioenergy should be sought. In addition, UNIDO will participate in the preparation of REN 21 annual reports, provide inputs on the technology section of BioenergyWiki and join roundtable on sustainable biofuels. These co-operations need to be formalized as soon as possible.
- Conferences and workshops, which have been planned to be undertaken during 2007, will serve as a platform to discuss, identify and develop project ideas and concepts, which could translate into a full operational programme by 2008.

2. [Work plan for introducing the services and fully developing the programme](#)

Phases	Activities	Region	2007	2008	2009	
PLANNING	Biofuels Conferences	Africa South Africa*	May / June			
		Asia Malaysia**	July			
		SE Europe Croatia***	October			
	EGM on Biofuels and CDM	Global	November			
	Conference on RE	Africa			February	
		Latin America Brazil****	October			
DEVELOPMENT	Policy level: Awareness raising/ Strategy development/ Country assessments / Research activities	Africa Liberia			March	
		Asia India***** Pakistan*****	November			
		Latin America Cuba*****	August			
		SE Europe Bosnia	July			
		Middle East Libya			March	
		Global UNEP joint research	November			
	Institutional level: Capacity building/ Technology surveys / Methodologies	Africa Senegal Zambia*****	November Ongoing		Ongoing	Ongoing
		Asia Pakistan Myanmar*****			June	
		Latin America Cuba	Ongoing	Ongoing	Ongoing	Ongoing
		SE Europe Croatia Belarus*****	October November	Ongoing	Ongoing	Ongoing
		Middle East Libya			March	
		Global – CB Swiss Fund CDM method.	October		January	
	Demonstration projects: Technology transfer	Africa Tanzania Zambia	December Ongoing		Ongoing	Ongoing
		Asia India	August		Ongoing	Ongoing

		Latin America Cuba	Ongoing	Ongoing	Ongoing
		SE Europe Romania Belarus		June	Ongoing
		Middle East Libya		March	
		Global			

* Regional meeting to be held in South Africa on biofuels will provide inputs for AU Summit. Modalities are still being worked out.

** International meeting in Malaysia (Kuala Lumpur) will focus on production, use and trade aspects of Palm oil.

*** Regional meeting proposed in Croatia will focus on industrial conversion and use of liquid biofuels in East / Central European region.

**** International meeting on renewable energy will be held jointly with the Government of Brazil. Biofuels will be one of main areas of focus at the meeting.

***** UNIDO proposes to set up a Center of Excellence on Solid Biofuels Technologies at the Indian Institute of Sciences, Bangalore, India.

***** Pakistan RE project for GEF funding is under formulation. It would include biofuels as main source of energy for electricity and heat applications.

***** Cuba GEF project on renewable energy covers biofuels based power generation and process heat in the selected industries.

***** Zambia GEF project on renewable energy based mini-grids in rural areas covers one mini-grid based on biofuels in remote rural areas of Zambia.

***** Myanmar RE project for GEF funding is under formulation. It would include biofuels as main source of energy for electricity and heat applications.

***** Belarus RE project for GEF funding is under formulation. It would include biofuels as main source of energy for electricity and heat applications.

IMPLEMENTATION	Policy level: Awareness raising/ Strategy development/ Country assessments / Research activities	Africa Liberia		January	
		Asia India, Pakistan, Myanmar		March	
		Latin America Cuba, Brazil		January	
		SE Europe Croatia, Bosnia		January	
		Middle East Libya		March	
		Global UNEP joint research		May	
		Institutional level: Capacity building/ Technology surveys / Training modules	Africa Zambia, Tanzania	Ongoing	Ongoing
	Asia India ICEBGT India IISc		Ongoing	Ongoing	Ongoing
	Latin America Cuba, Nicaragua		Ongoing	Ongoing	Ongoing
	SE Europe Croatia, Belarus, Romania			January	Ongoing
	Middle East Libya			March	
	Global CB Swiss Fund CDM meth.			March	January
	Demonstration projects: Technology transfer		Africa Zambia GEF	Ongoing	Ongoing
		Asia India (IISc)	June	Ongoing	Ongoing
		Latin America Cuba GEF	Ongoing	Ongoing	Ongoing
		SE Europe Croatia, Belarus, Romania		January	Ongoing
		Middle East Libya		March	
		Global			