

21 August 2007

English only

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

**Report of the Ad Hoc Expert Group Meeting on
Biofuels: Trade and Development Implications of
Present and Emerging Technologies**

Palais des Nations, Geneva

19 June 2007

UNCTAD/DITC/MISC/2007/8

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1. The Ad Hoc Expert Group Meeting was held in the context of the activities of UNCTAD's Biofuels Initiative. At the Expert Meeting on the Participation of Developing Countries in New Dynamic Sectors of World Trade: Review of the Energy Sector, held from 29 November to 1 December 2006, participants expressed the desire for a specific meeting of experts to address biofuel technologies and the related trade and development implications. The Ad Hoc Expert Group Meeting on Biofuels: Trade and Development Implications of Present and Emerging Technologies was held in order to respond to that desire.

2. The meeting, held on 19 June 2007, was chaired by H.E. Mr. Eduardo Ernesto Sperisen-Yurt, Permanent Representative of Guatemala to the WTO. Mrs. Lakshmi Puri, Director of the Division on International Trade in Goods and Services, and Commodities, made introductory remarks.

3. Mrs. Puri noted that the technologies that been used so far to produce biofuels were rather simple and well known. The need to increase biofuel availability to meet growing demand, maximize feedstock use, reduce pressure on land and cut production costs was triggering a shift towards new and more sophisticated technologies. This "technological revolution" was likely to have impacts on trade and development and on the competitiveness of developing countries in the biofuels sector.

4. She stressed that biofuels were among the products emerging from the search for a new economic model based on low-carbon emissions. While a range of estimates existed, most studies had found that during their life cycle biofuels might provide reductions in greenhouse gas emissions as compared with fossil fuels. Furthermore, climate change benefits were expected to increase significantly with second-generation technologies. In addition, biofuels might provide an opportunity for developing countries to diversify agricultural production, increase rural incomes and improve quality of life. They might also enhance energy security and reduce expenditure on imported fossil fuels.

5. However, a number of concerns about increasing biofuels production and use were voiced. One such concern related to land increasingly devoted to fuel crops, with diversion from other purposes, such as food and feed production, forestry, animal grazing or conservation. In some regions, the availability of water, rather than land, might become a constraint on growing energy crops. Another concern was access to food and increasing world food prices. Higher prices for agricultural commodities would be welcomed by farmers, especially in developing countries, but would represent an additional development hurdle, especially for the urban poor. Engaging in large-scale energy-crop plantations might require a trade-off of lower food security for higher energy security.

6. The Ad Hoc Expert Group Meeting was designed to provide information about biofuel technologies to help in understanding the implications of biofuels development for issues such as those noted above. A number of experts made presentations that provided the basis for interactive discussion with participants. The experts were Dr. Eric Larson, a research faculty member at Princeton University's Princeton Environmental Institute in the United States; Dr. Antonio Pflueger, Head of the Energy Technology Collaboration Division, Office of Energy Efficiency, Technology and R&D at the International Energy Agency; Dr. Sergio C. Trindade, Director of Science and Technology of International Fuel Technology, Inc. and former United Nations Assistant Secretary-General for Science and Technology; and Dr. Alok Adholeya, Director of the Biotechnology and Management of Bioresources Division at The Energy and Resources Institute in India.

7. Dr. Larson reviewed the status and prospects of biofuel technologies, with a focus on understanding energy, carbon and economic features of first-generation and second-generation biofuels. He noted that first-generation biofuels – namely, ethanol from grains (e.g. corn, wheat and potato) or from sugar crops (i.e. sugar cane and sugar beets), and biodiesel from oil seeds (e.g. rapeseed, soybeans, sunflowers, jatropha, coconut and palm) or from recycled cooking oils – had a number of limitations: only a portion of the plant could be processed into biofuel; they competed with food/feed crops for land use; they were relatively expensive because of high feedstock costs; they provided only modest energy and greenhouse gas emissions reduction benefits; they produced large amounts of by-products (such as glycerin during production of biodiesel or distiller dried grains during production of ethanol from corn); and value needed to be derived from the sale of such by-products for a large-scale first-generation biofuel industry to function properly. Experts were quick to note that the important exception to this generally unfavourable evaluation of first-generation biofuels was ethanol made from sugar cane in Brazil, which scored positively on most of those indicators. This was due to that country's efforts over a period of 30 years to promote significant technological development and species improvement for ethanol production.

8. Despite their limitations, first-generation biofuels have some positive characteristics, including the ability to be blended with existing mineral fossil fuels, with minimal infrastructure changes, and there is large-scale production experience in Brazil and the United States from which other countries could learn. Additionally, the Brazilian experience with the Pro-Alcool programme has shown that ethanol can compete on price terms with gasoline, even without subsidies.

9. Dr. Larson explained that second-generation biofuels – those derived from lignocellulosic materials (e.g. crop residues, grasses and woody crops) – might be produced by either biological or thermochemical routes. Either route would provide several important benefits as compared with first-generation biofuels: a larger portion of the plant could be converted to fuel, with a more efficient use of natural resources; species could be bred for energy characteristics, leading to high yields with low inputs; second-generation biofuels could lead to substantial reduction of greenhouse gases; they are potentially lower in cost thanks to cheaper feedstock costs; and they will not compete directly with food crops. They could therefore help mitigate the conflict between land use for food/feed/fibre and for energy crops. For those reasons, undertaking the research and development needed to accelerate the switch from first- to second-generation biofuels is justified.

10. On the negative side, second-generation biofuels are more capital-intensive and require larger facilities in order to capitalize on economies of scale than do first-generation biofuels. Research and development breakthroughs are needed for improving conversion processes and reducing costs for biological second-generation biofuels. Specifically, the need for micro-organisms tailored to specific feedstocks and able to undertake the necessary conversion more effectively is inhibiting progress towards the commercial visibility of biological processing routes. According to Dr. Larson, the relevant technologies are likely to be commercially available within 10 to 20 years.

11. On the other hand, technologies for thermochemical second-generation biofuels are currently available, and there is practical experience in that area because of the application of those technologies to fossil fuels. What is required, therefore, is to make the necessary investments for applying existing technology

to biomass conversion. Thus, thermochemical biofuel technologies could be commercially available in 5 to 10 years.

12. Even after the commercial introduction of second-generation biofuels, however, production of first-generation biofuels from already established facilities is likely to continue. Since it is likely that capital investments will have already been paid back, continued production at those facilities will be economically viable as long as production costs can be recovered from the sale (subsidized or unsubsidized) of the biofuel.

13. According to the experts, the characteristics of second-generation biofuels will significantly impact on trade and competitiveness in the biofuel sector. The benefits of large-scale processing of second-generation biofuels provide a potential competitive advantage for industrialized nations. However, developing countries might have the opportunity to compete in the production of second-generation biofuels because of comparative cost advantages in producing feedstocks due to better growing climates, and lower land and labour costs. Nonetheless, in order to be competitive in international markets, developing countries will need to have production systems whose scale and efficiency are world-class. Second-generation technologies will be particularly advantageous for developing countries if they can bring about improvements in the conversion process and in feedstock production.

14. It was stressed that second-generation biofuels might offer extensive economic and health benefits by providing clean sources of fuel for home cooking in rural areas, replacing firewood, crop residues, coal and kerosene, and reducing indoor air pollution and associated respiratory diseases. According to the experts, three billion people cook with solid fuels, and the World Health Organization estimates that indoor air pollution from cooking contributes to at least 1.6 million premature deaths a year. Diverting small quantities of biofuels to the cooking sector may help address this serious health problem.

15. The experts agreed that, in the long run, the food-versus-fuel dilemma could be made less problematic by the use of non-edible feedstocks for biofuels production via second-generation technologies.

16. Dr. Trindade discussed the contribution of biofuels in the context of overall energy policy, noting that they made up a small portion of emerging clean energy technologies, which might be dominated by solar energy in the very long term. He stressed that there was a need to change the mindset of consumers in order to improve energy efficiency from the demand side. All agreed that there was a clear need to reduce energy consumption in all sectors, and for developing countries in particular to improve energy efficiency. However, energy efficiency was not sufficient to ensure that the goals of energy security and climate change mitigation were achieved. Advances in domestically produced renewable transportation energy supply were also needed.

17. There was a consensus that reducing greenhouse gas emissions required action and that biofuels had a role to play, especially in the transport sector, where it was difficult to find replacements for mineral fuels. Dr. Pflueger noted that according to an estimate by the International Energy Agency, transition to alternative energy scenarios based on lower greenhouse gas emissions would not add costs to the global economy, but the changes would imply winners and losers. He cited such dynamics as the main reason why changes were resisted.

18. Since biofuels production is currently dominated by the United States and Brazil, the meeting discussed those countries' experiences. The Brazilian experience with ethanol production was examined in depth in order to draw

lessons that might be applicable in the development of biofuels programmes in other countries and to examine economic influences and government policies affecting the biofuels market. It was noted that the US biofuels market remained dependent on subsidies and high tariffs, while in Brazil learning and a strong domestic market had made biofuel production competitive without such support. It was also noted that vehicle design was not a major impediment to the introduction of biofuels, but that lack of infrastructure constituted a significant obstacle. That issue was more notable in the United States, where only a small fraction of fuelling stations were fitted with ethanol pumps. In addition, a lack of adequate port facilities hindered Brazil and other developing nations in competing in the international market.

19. The biofuels industry and developments in India were examined in a presentation by Dr. Adholeya as an example of an emerging market. India had pursued a strategy of public-private cooperation that had concentrated on jatropha, but was also examining crops such as sugar cane and sweet sorghum. Dr. Adholeya stressed that great importance was attached to domestic technological innovation in areas such as biodiesel from crops grown on wastelands, quality planting material, mycorrhiza in feedstock production, and biotechnology. A key technological objective was to engineer micro-organisms and enzymes that could degrade lignocellulosic biomass more effectively than currently known organisms. There was also great interest in the potential of algae for enabling biodiesel and bacteria to convert biomass into hydrogen. Financing methods such as microcredit and crop insurance were being used in India to support biofuels development.

20. The experts agreed that if biofuel production was to succeed, a country had to have a strong domestic market as well as a national technological innovation system. The presence of an established innovation system allowed a country to take advantage of new technologies and adapt them to its needs. On that point, it was noted that research universities, training abroad for national researchers, well-developed standards and norms, and financing were essential. A combination of private and public sector efforts was important, and there must be consensus among the core stakeholders in the Government, the oil industry, the automotive industry and biofuel/feedstock production. Joint ventures were singled out as positive instruments to facilitate transfer of technology.

21. The presentations acknowledged that a global market for biofuels already existed and would most likely grow over time. That market was currently supported by legislation and mandatory blending targets, as well as current and predicted high oil prices. While it was emphasized that establishing domestic demand through regulatory mandates might be an important first step, experts noted that international trade was needed for the sustainability of biofuels markets.

22. For countries to ensure energy security and for the sector to become stable and predictable, it is important that large quantities of biofuels be produced and made available on the world market. Therefore, if there are occasional shortages in domestic supply, countries can rely on the international market. International trade may then ease the pressure on biofuels production. Experts noted that with this in mind, the United States and Brazil had agreed to collaborate on promoting biofuel production in other nations. Like all other energy commodities, biofuels need to be traded internationally and have futures and options markets.

23. Experts commented on the overprotection of domestic biofuels and feedstock producers in several developed countries. They noted that the

subsidies and import tariffs most commonly used were obstructing entry into the market, especially by producers in developing countries, and partially nullifying the advantages of lower production costs in those countries.

24. However, it was also noted that all existing biofuels programmes began with some type of governmental support. Experts emphasized that those incentives were important during the early stages of biofuel initiatives, but that for the purpose of capitalizing on market forces they should have clearly defined sunset dates.

25. Statistics were presented that demonstrated that, with the exception of Brazilian sugar cane ethanol, biofuels and biodiesel without subsidies were currently not competitive with mineral fuels. While carbon credits may be influential in the future, the carbon market is novel and unstable at present.

26. Certification was discussed as a possible mechanism to ensure the sustainability of biofuels. This idea was generally approved of, although Dr. Trindade suggested that fossil fuels should also be subject to sustainability certification requirements. However, it was indicated that certification might act as a barrier to trade, and that its WTO implications should therefore be explored.

27. Since most second-generation technologies are being developed in the private sector, intellectual property rights were a major concern during the meeting's interactive debates. Experts noted that micro-organisms needed to break the lignocellulose molecules during biological conversion and catalysts needed to convert gas into liquids during thermochemical conversion were closely protected by intellectual property rights. Many shared the view that technology transfer would be greatly facilitated if the receiving country had the technological knowledge and capacity to adapt imported technologies to its domestic needs, or in short, had a national innovation system in place.

28. The role of genetically modified organisms in emerging biofuel technologies was discussed by participants. While the issue was not explored in depth, it was noted that genetic engineering was currently used for enzyme production for second-generation biological feedstocks. This contained application seemed to be generally accepted, while the use of genetic engineering in feedstock production gave rise to a number of concerns related to environmental and, more specifically, biodiversity preservation. Careful steps, with close oversight by the public sector, would be important if genetically engineered biomass feedstocks were pursued.

29. The meeting successfully facilitated dialogue and learning among the over 70 participants and experts present. The trade and development implications of emerging biofuels technology were explored in detail and important issues were given a forum for discussion. The UNCTAD Biofuels Initiative aims to continue to support those expert dialogues.
