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REPORT

International Conference on Biofuels

Kuala Lumpur, Malaysia
5 – 6 July 2007

organized in collaboration with:

United Nations Industrial Development Organization (UNIDO)
Malaysian Palm Oil Board (MPOB)
Ministry of Plantation Industries and Commodities, Malaysia (MPIC)

UNIDO

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

MPOB

Report

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PREFACE

The soaring price of finite fossil oil, which is, however, not yet near to complete depletion, and the exacerbation of global warming caused by greenhouse gas emissions, including carbon dioxide, have encouraged the search for new, environmentally friendly energy sources. Biofuels, being carbon neutral and renewable energy, have attracted a significant amount of attention as a promising alternative. A biofuel is defined here as any fuel derived from biomass. Bioethanol and biodiesel are the most widely known liquid biofuels.

To address global warming and to reduce dependence on fossil oil, a number of countries have introduced political and regulatory frameworks to mandate or encourage the use of biofuels for transportation, in many cases through subsidies or incentives. At regional levels, for instance, the Biofuels Directive 2003/30/EC has been in place in the European Union to promote the use of biofuels for transportation by setting guidelines and targets. Similarly, the sixteen heads of the ASEAN Member States agreed to expand the production and use of biofuels when they convened in Cebu, in the Philippines, in January 2007.

The opportunities and challenges in biofuels production, use and trade vary from country to country. It seems that there are significant opportunities offered by biofuels to developing countries. Certain African countries, for instance, may be able to produce biofuels from locally available feedstock, taking advantage of favorable climate and soil conditions. The production of crops, grains or plants for biofuels also has the potential to address the issues of rural development and poverty alleviation by increasing the level of agricultural activities. The production of foods and/or biofuels based on such agricultural products may also attract additional investment in new business opportunities and produce positive spillovers.

The use of biomass and crop oil for biofuels is a nascent market and emerging issues in many aspects of biofuels may significantly affect their future scenarios. The regulatory framework is one of those aspects. The market for biofuels is largely regulation driven. While more countries are joining the market by introducing their own regulatory frameworks, some countries are reviewing those they already have in place. Technology is another area of emergence. The biofuels conversion technologies that have been used so far are by and large mature and rather simple technologies. However, research and development for new technologies has been under way, which may change the whole market drastically overnight if and when a major technological breakthrough is achieved. While a significant increase in demand is expected for biofuels, sustainable production of biomass as a feedstock is becoming a key concern. This issue may take different forms, such as the efficient use of land, competition with biomass for food use, negative impacts from changes in land use and so forth. In the case of the EU for example, the introduction of a system for certification of socially and environmentally sustainable production of biomass is currently being discussed as a possible requirement for market access.

Stakeholders at all levels are in need of the most up-to-date information and insights to keep abreast of new developments taking place in various areas of this nascent global market, in pursuit of the opportunities that biofuels offer, while the mitigation of risks or negative impacts is addressed. With this situation as the backdrop, the Malaysian Palm Oil Board (MPOB), the Ministry of Plantation Industries and Commodities and the United Nations Industrial Development Organization (UNIDO) decided to organize the International Conference on Biofuels jointly, to offer a platform where diverse stakeholders could deliberate and exchange views, experiences, information and insights on various aspects of biofuels.

The Conference was held on 5 and 6 July 2007 in Kuala Lumpur, Malaysia. This report presents the speeches delivered as well as the summaries of presentations by the speakers, together with the slides they used at the Conference. The information included here, is as it was presented by each speaker at the Conference unless it is noted otherwise. As an aid to the readers, lists of selected abbreviations and an index are provided at the end of this report.

INTRODUCTION

Objectives

The objectives of the Conference were:

- to discuss the latest developments in policy and in the production and utilization of biofuels
- to evaluate recent outcomes and results in their utilization
- to provide a platform to discuss issues related to biofuels
- to discuss the latest biofuel production technologies
- to discuss sustainability issues related to biofuels and their feedstock production
- to provide avenues for networking and business link-ups between entrepreneurs, biofuels producers, biofuels raw materials suppliers, automobile manufacturers/ assemblers, equipment suppliers, petroleum companies and other interested parties
- to review and chart the future direction and developments of biofuels

Participants

More than 400 participants from 26 countries took part on each day of the 2-day Conference. The participants were various stakeholders, including growers, plantation companies, biofuels producers, biofuels exporters and importers, engineering firms, financial institutions, insurance companies, equipment manufacturers, oil companies, utility companies, industrial associations, cooperatives, academics, R & D institutes, policy makers, international and regional organizations and investment promotion agencies.

Time and Place of Conference

The International Conference on Biofuels took place on 5 and 6 July 2007 at Putra World Trade Centre (PWTC), Kuala Lumpur, Malaysia.

Conference Program

Thursday, 5 July 2007

8:00 am	Registration
9:00 am	Welcome Remarks by Y.Bhg. Dato'Sabri Ahmad Chairman of MPOB
9:15 am	Remarks by Dr. Kandeh Yumkella Director-General of UNIDO
9:30 am	Official Opening by Y.B. Datuk Peter Chin Fah Kui Minister for Plantation Industries and Commodities, Malaysia
10:00 am	Refreshments
10:30 am	Keynote Speech Sustainable Biomass Fuels as Alternatives to Oil Prof. Yasuhiro Daisho, Waseda University, Japan
Session 1:	Global Development in Biofuels Chairperson: Mr. Heinz Leuenberger Director, UNIDO Austria
10:50 am	Roles of Public Sector Players in Global Biofuels Market Sergio Miranda-da-Cruz, UNIDO, Austria
11:10 am	Biofuels Regulatory Frameworks Global Outlook Wang Zhongying, Energy Research Institute, China
11:30 am	Biofuels Opportunities and Challenges: Developing Country Perspective Mariano Salazar, Department of Energy, the Philippines
11:50 am	Product Quality & Standard Specification of Biofuels: Issues and Development Candace Vona, International Quality Center, USA
12:10 pm	Bioethanol: the Brazilian Experience Osvaldo Kawakami, Petrobras, Japan
12:30 pm	Q&A
12:50 pm	Lunch
Session 2:	Supply, Demand, Economics and Sustainability of Biofuels Chairperson: Tan Sri Datuk Dr. Augustine S.H. Ong President, Malaysian Oil Scientists and Technologies Association (MOSTA), Malaysia
2:00 pm	The Future Impact of Biofuels on World Agriculture James Fry, LMC International, UK
2:40 pm	Supply, Demand, Economics and Sustainability of Biofuels Amintha Weerawardena, Rabo Bank, Malaysia
3:00 pm	Biodiesel: The Malaysian Investor's Perspective U.R. Unnithan, Carotino Sdn Bhd, Malaysia

3:20 pm	Global Methanol and Biodiesel - Linked for Better or Worse Mark Berggren, Methanol Market Services Asia, Singapore
3:40 pm	Q&A
4:00 pm	Refreshments
4:20 pm	Life Cycle Assessments of Biofuels – as related to Greenhouse Gas Emissions Ralph Sims, International Energy Agency, France
5:00 pm	Overview of Recent Development in Sustainable Biomass Certification Martin Junginger, Copernicus Institute of Utrecht University, The Netherlands
5:40 pm	Q&A
6:00 pm	End of Session

Friday 6 July 2007

Session 3:	Production of Feedstock Dr. James Fry Managing Director, LMC International UK
8:30 am	Feedstock Production in Perspective Gustavo Best, Food and Agriculture Organization, Italy
8:50 am	Emerging Sustainable Feedstock: The Tree Borne Oil Seeds N. Vedaraman, Central Leather Institute, India
9:10 am	Renewable Resources from Oil Palm for the Production of Biofuels Dato' Dr. Mohd. Basri Wahid, Malaysian Palm Oil Board, Malaysia
9:30 am	Q&A
9:50 am	Refreshments
Session 4:	Production Technology and Applications: Biofuels from Oils and Fats Chairperson: Dato'Dr. Mohd Basri Wahid Director – General Malaysian Palm Oil Board, Malaysia
10:10 am	MPOB Palm Biodiesel Production Technologies Choo Yuen May, Malaysian Palm Oil Board, Malaysia
10:30 am	Technology for the Exploitation of Jatropha as Raw Material for Biodiesel: The Indian Experience B. Jaya Kumar, Nandan Biomatrix Limited, India
10:50 am	Hydroprocessing of Palm Oil for Biofuel Production Prabhakar Nair, Universal Oil Products Asia Pacific Pte. Ltd, Singapore
11:10 am	Emerging Technologies for Biofuels Production and their Assessment S. Miertus, ICS/ UNIDO, Italy
11:50 am	The Suitability of Different Biogenic Fuels for Use in Modern Diesel Injection Systems Heinz Stutzenberger, Geschäftsbereich Diesel Systems Engineering Fuels, Germany
12:10 pm	Q&A
2:30 pm	Lunch

Session 5:	Production Technology and Applications- Biofuels from Biomass Chairperson Dr. Choo Yuen May Deputy Director-General (R&D), Malaysian Palm Oil Board, Malaysia
2:45 pm	Production of Biogas from Palm Oil Mill Effluent Anhar Suki, Golden Hope Plantations, Malaysia
3:05 pm	Technology for Exploitation of Waste from Palm Oil Production: Gasification/ Pyrolysis Ferrucio Trifirò, University of Bologna, Italy
3:25 pm	Development of Cellulosic Bioethanol Franziska Müller-Langer, Institute for Energy and Environment, Germany
3:45 pm	Biomass to Liquid Fuels: Sharing Experience Colin Chin, Shell Global Solutions, Malaysia
4:05 pm	Q&A
Session 6:	Panel Discussion Is it a Sustainable and viable Business? Chairperson: Datu Dr. Michael Dosim Lunjew Secretary General Ministry of Plantation Industries and Commodities, Malaysia
4:25 pm	Panelists: Dr. Kandeh Yumkella - UNIDO, Austria Dr. Gustavo Best - Food and Agriculture Organization, Italy Dr. James Fry - LMC International, UK Dr. Anhar Suki - Golden Hope Plantations, Malaysia
5:50 pm	Closing Remarks by Datu Dr. Michael Dosim Lunjew Secretary General, Ministry of Plantation Industries and Commodities, Malaysia
6:00 pm	Refreshments

WELCOME REMARKS

Y. Bhg. Dato' Sabri Ahmad
Chairman
Malaysian Palm Oil Board

WELCOME REMARKS

(transcript)

Y. Bhg. Dato' Sabri Ahmad
Chairman, Malaysian Palm Oil Board

Honorable Y. B. Datuk Peter Chin Fah Kui, Minister of Plantation Industries and Commodities for Malaysia,

Your Excellency Dr. Kandeh Yumkella, Director-General of the United Nations Industrial Development Organization, UNIDO,

Y. B. Datu Dr. Michael Dosim Lunjew, Secretary-General, Ministry of Plantation Industries and Commodities,

Y. B. Dato' Dr. Mohd Basri Wahid, Director-General, Malaysian Palm Oil Board,

Your Excellencies and distinguished guests,

Ladies and gentlemen,

Welcome and a very good morning to all of you.

Let me at the onset welcome you to the 2007 International Conference on Biofuels, organized by the Ministry of Plantation Industries and Commodities, MPOB, in collaboration with UNIDO.

First and foremost, I would like to thank the Honourable Minister, Datuk Peter Chin Fah Kui, for consenting to officiate and declare this Conference open. I would also like to welcome and thank Dr. Kandeh Yumkella, Director-General of UNIDO, for being here at this function. I understand Dr. Yumkella will also be actively involved in the Conference as a session panelist.

To all our foreign guests, selamat datang and welcome to Malaysia.

Ladies and gentlemen,

the oil palm industry is one of the main pillars of Malaysia's economy, contributing some 32 billion Malaysian Ringgit in export earnings last year. As you know, Malaysia is the largest producer and exporter of palm oil in the world, or at least it has been until this year.

In 2006, Malaysia produced a total of 15.88 million tonnes, of which 14.4 million were exported. The industry provides employment for more than one million families from the plantation right down to the processing sectors. The Malaysian Palm Oil Board, or MPOB, a statutory body incorporated by our country's parliament, has been given the task of carrying out research and development, licensing, enforcement and various other functions related to the palm oil industry.

Traditionally, palm oil is used mainly for food. Over the last two days, our Prime Minister has reiterated that food will be given priority vis-à-vis energy. The transformation of palm oil into globally accepted edible oil was achieved, but not without blood, sweat and tears. Apart from the conciliatory efforts in announcing the industry's performance, the MPOB and the Ministry had to carry out extensive technical promotion and independent nutritional studies and to face attacks against palm oil in certain quarters on nutritional grounds.

As I said, all these efforts have now made palm oil the vegetable oil which is produced and traded more than any other oil in the world.

The palm oil industry has also moved into the non-food sector, mainly oleochemicals, which are produced largely from palm kernel oil. The oleochemical industry, with 17 oleochemical plants, produced 5.6 billion Ringgit worth of oleochemical products such as fatty acids, fatty esters, fatty alcohols and glycerine in 2006. The oleochemical sector has moved from producing basic oleochemicals to high value-added products in the form of soap and detergents, cosmetics, personal care products and polyurethane, as well as industrial products. And soon we will also be producing methyl ester sulphonate, an ingredient for the detergent industry, which is environmentally friendly and also very competitive vis-à-vis fossil-based ingredients.

Ladies and gentlemen,

with the advancement of research funded by the MPOB, the oil palm industry is now set to launch a new growth industry, the biofuel industry. Renewable energy is really not new to the oil palm industry. Virtually all palm oil mills use biomass in the form of fiber and shells from palm oil milling as fuel to run their boilers. Due to the increased demand for biodiesel globally, palm oil has become an excellent feedstock for its production. In fact, we probably overlooked the biofuel concept, so that we are now facing challenges in Europe. I think, ladies and gentlemen, we still believe that food is the main business for palm oil.

The MPOB started producing palm-based biodiesel in 1982. Extensive research led to the production of biodiesels which meet international specifications such as EN14214 and ASTM D6751. The biodiesel produced from this pilot plant in 1985 was successfully tested in most of the engines on commercial buses without any problems. The MPOB has now scaled up and further improved the technology. Three commercial plants based on MPOB technology are now in operation, including one in South Korea. The other four are in various stages of construction.

The MPOB has also developed petrotechnologies for the production of winter grade biodiesel, and extraction of micronutrients from palm methyl ester.

The MPOB has also set up various pilot plants created to produce biodiesel and high-value products. We hope to commercialize some of these products over the next few years. In the case of palm oil and palm methyl ester, we not only have the MPOB technology for biodiesel but also the micronutrients, which represent high added-value for the industry.

Ladies and gentlemen,

climate change demands an urgent global response. As a remedy, biofuels have taken centre stage. They are seen as a means to achieve the objective of fueling our vehicles and powering our factories while producing minimal greenhouse gas pollution. The 2003 European Union Biofuel Directive demands that all member States should aim to have 5.75 percent of transportation run by biofuels by 2010. The EU leaders at the Climate Change Summit in Brussels in March 2007 agreed to slash carbon dioxide emission by 20 percent from the 1990 levels by the year 2020. Climate change was also the highlight of the recent G8 Summit and even President Bush has performed a U-turn in his climate change stance this month. So we have now got support from the Americans in terms of moving ahead in the direction of biofuels.

Then there is the demand for biodiesel or ethanol, which will increase the demand for palm, rapeseed, soya bean and corn. The EU leaders have acknowledged that there will be insufficient land in Europe for rapeseed cultivation to meet biodiesel demand by 2010.

In the United States, farmers tried to cash in on the rush for ethanol by growing corn at the expense of soya bean. The move brings the food vs. fuel debate into sharp focus, as more arable land in the United States is being used for fuel crops than for food at a time when the global demand for food is increasing greatly to boost wealth and meet the needs of a rising global population.

There is also an allegation that biodiesel cannot be considered to be a green fuel because we carry out indiscriminate deforestation in order to plant oil palm. It is claimed that this not only contributes to global warming but also drives wildlife away from its natural habitats. The truth, however, ladies and gentlemen, is that in all palm cultivation in Malaysia, sustainable palm oil practices have been advocated, in fact, since 1970. We have been growing sustainable oil palm since 1970. There is a balance between economic needs and preservation of forest areas for conservation of biodiversity. Of the total land area of almost 33 million hectares, 65 percent is under forest cover. Agriculture is 19 percent. Almost two thirds ~~of~~ or 12 percent, equivalent to four million hectares, are under oil palm.

In contrast, agricultural land accounts for 70 percent of the total area in developed countries, while forest cover comprises between 10 and 30 percent.

This is the issue today. In the tropics, in the other countries and in Malaysia we still have 60 to 70 percent of forest cover and only 12 to 20 percent under agriculture.

Of course, ladies and gentlemen, we are not going to make the same mistake as has been made in other countries. Biofuels will reduce greenhouse gas emissions, only where the plants are grown and processed correctly. As palm oil producers, we understand that sustainability is an issue close to the hearts of the European and United States governments and industries. To ensure that palm oil is produced in a sustainable manner, the Round Table on Sustainable Palm Oil, RSPO, has developed a set of principles and criteria for sustainable palm oil production.

Ladies and gentlemen,

the government and industry are certainly behind the concept of sustainable palm oil and we support RSPO.

In the thrust of MPOB research on biofuels, we shall be using the abundant lignocellulosic biomass by-products generated by the industry. Such research will include the production of bioethanol, briquets from oil palm fibre, bio-oils from pyrolysis, gas from gasification and biomass-to-liquid fuels. The MPOB and industry are also embarking on harnessing methane gas from palm oil mills and effluent ponds as fuel to produce energy. Such efforts, besides maximizing international waste products, have also contributed to a reduction in global warming. This project is also eligible for carbon credits under the Kyoto Protocol Clean Development Mechanism.

Ladies and gentlemen,

I am very happy that we are able to hold this conference at a time when the issues of biofuels, global warming and others are taking centre stage.

Through the efforts of the co-organizers, we have managed to put together 25 oral presentations and over 20 posters covering wide areas ranging from global developments in biofuels, the production of biofuel feedstocks, supply and demand, and the economics and sustainability of biofuels to production technology and applications of various types of biofuel.

On behalf of MPOB and our joint organizers, I wish to thank all the speakers, especially the chairpersons, participants from the staff of the MPOB, the Ministry of Plantation Industries and Commodities, and UNIDO, for all your efforts in organizing this Conference.

In conclusion, I wish to thank again the honourable Minister of Plantation Industries and Commodities, Malaysia, Datuk Peter Chin Fah Kui, for officiating at the Conference.

Thank you.

Dr. Kandeh K. Yumkella
Director-General
United Nations Industrial Development Organization
Austria

REMARKS
(transcript)

Dr. Kandeh K. Yumkella
Director-General, United Nations Industrial Development Organization (UNIDO), Austria

Honorable Mr. Peter Chin Fah Kui,
Minister for Plantation Industries & Commodities,

Dr. Michael Dosim Lunjew,
Secretary-General for Ministry of Plantation Industries & Commodities,

Mr. Sabri Ahmad,
Chairman of Malaysian Palm Oil Board,

Dr. Mohd Basri Wahid,
Director-General of Malaysian Palm Oil Board,

Excellencies, distinguished guests,

Ladies and gentlemen,

It is an honor for me to be here at this Conference during my first official visit to this great country. The first time I came to Malaysia was 10 years ago, in 1997, on the occasion of the Asia-Africa Business Forum that the Government of Japan organized in Kuala Lumpur under the auspices of the Tokyo International Conference on African Development or TICAD. And after the opening of that event, my next interest was to find out who in the audience was from the Malaysian Palm Oil Board, then the Palm Oil Research Institute of Malaysia, and the Ministry of Agriculture, because as an agricultural economist and a West African visiting Malaysia for the first time and knowing that Malaysia is the world's largest producer and exporter of palm oil, my main curiosity was oil palm. I immediately started networking with people who knew a lot about the oil crop after the opening of the Forum.

Being from West Africa means that for me, oil palm is part of my heritage. Oil palm is what I saw every day as a child when I was growing up because that is what we had growing wild around us. The fact is that we use palm oil for cooking food all over West Africa and Central Africa and without it, we have to turn to coconut oil. But what has constantly been readily available is oil palm. That is why, whenever I visit Malaysia or whenever I talk about oil palm, I always want to know more about it and how Malaysia has succeeded in industrializing it.

We feel very honored that we can collaborate with the Ministry of Plantation Industries and Commodities and the Malaysian Palm Oil Board at this important Conference. As UNIDO's contribution, we have made an effort to enrich this event by bringing a number of top-notch international experts to share their insights and experiences with us from a global perspective. Our speakers will discuss sustainability issues on the production of biofuels and their feedstocks. They will also talk about the role of governments and other public sectors, as well as regulatory frameworks in dealing with biofuels in the context of sustainable development. At the same time, we wanted to share this great opportunity and valuable information with the people who want to know more about biofuels and Malaysia's success for the alleviation of poverty in their own countries by utilizing the available resources. In this connection, we have sponsored Africans and people from other parts of Asia to this Conference.

Our collaboration here underscores the importance we attach to the clean, green, industrial development that indeed leads to the alleviation of poverty. We are convinced that you cannot alleviate poverty without creating jobs and incomes. We are convinced that you cannot fight poverty today, in the twenty-first century, in a globalized world, without helping countries to move to higher value products or services. And we see today that what Malaysia has done with oil palm will open up opportunities for developing countries, particularly the impoverished ones in West and Central Africa, where oil palm almost certainly originated.

Oil palm is primarily food, secondly a commodity for income generation and thirdly, today, thanks to Malaysia's innovativeness, energy. It is an important biofuel as well. We see this as an opportunity and feel that we should study it seriously. We are all very aware of the environmental impacts as well. We believe that we should promote development of this product in a sustainable way, in addition to sustainable innovations to help lift people out of poverty in other parts of the world.

I came here 10 years ago, thanks to the sponsorship under the Japanese initiative in the Asia-Africa Business Forum that I mentioned earlier. Ten years later, we now see oil palm becoming even more important. I remember visiting one of the exhibitions that the Malaysian Palm Oil Board had organized at that time. Six years ago, I came back with a group of Nigerian ministers and experts and we visited the Malaysian Palm Oil Board again. The exhibits there started with Africa and the Board's members were very frank. They said that when they had wanted to switch from rubber and been looking for a commodity to replace it with, they had sent their delegations to Africa. I do remember a professor in the group of Nigerians who had been the Planning Minister for Nigeria in the 1960s and said he had actually helped to receive a Malaysian delegation to Nigeria at that time. To me, it was important that the Malaysians told the Nigerians that story because in today's globalized world we have to be open-minded. We have to look for best practices, good technologies and global knowledge systems and see what we can take and adapt. The Malaysians were willing to come to us in Africa 40 years ago to look for germ plasma. I am sure they are open-minded enough to allow the Africans to come to Malaysia to learn how to use that same commodity today to alleviate poverty in their countries. That is the spirit of this Conference. South-South cooperation is important. We see oil palm today as a bridge for Asia-Africa cooperation. You should understand why I use this bridge analogy. In my village today, because we do not have a good road infrastructure, we still use palm tree trunks as planks across ponds.

I have been told by my friends in Latin America that they are already growing oil palm and producing palm oil. I do not want somebody to come out with a big study 10 years from now on how the Africans missed the opportunities with sustainable biofuels. There are many publications about how Africa missed the green revolution, in which the Asians did well. I think we also have an opportunity for triangular cooperation, where we can put more effort into research and development to see how we can do this sustainably, without jeopardizing food security. I believe that it can be done. Mankind has shown that with creativity we can beat Darwin and I believe that we have this opportunity here once more.

This morning we were talking about Vitamin E in oil palm. It was one of the world's leading researchers on aerobic rice who, with Japanese funding and using rice from the International Rice Research Institute (IRRI) in the Philippines, discovered a new way of growing rice. Maybe, in a similar sense, with joint effort and collaboration with donor countries, we will in fact be able to make palm oil even more enriching to help us deal with diseases and not only with fuel. We want to look at practical strategies in the hope that through triangular cooperation, support from the EU, Japan and other countries, we will be able to transfer some of these best practices to countries that need them.

I am very grateful to the Government of Malaysia. I have had very good meetings with the Minister for Natural Resources and Environment and the Minister for International Trade and Industry. I am going to meet additional ministers during the next couple of days because I am looking beyond oil palm. I always look to Asia, as it has the best record of alleviating poverty over the last 50 years. Examples are China, India, Malaysia, Indonesia, Thailand and a few others. For me this Conference is not a one-off event. We will continue our collaboration to show how we are promoting a sustainable partnership with Malaysia, so that others can benefit from its experiences.

Thank you again for this opportunity. We can share information, challenge ourselves to look at sustainability standards and trade-offs with food security, and make sure that, at the end of the day, we will be able to define ways in which the rest of the world can benefit from the opportunities biofuels offer.

Y.B. Datuk Peter Chin Fah Kui
Minister for Plantation Industries and Commodities
Malaysia

OFFICIAL OPENING

Y.B. Datuk Peter Chin Fah Kui
Minister for Plantation Industries and Commodities, Malaysia

Y. Bhg. Datu Dr. Michael Dosim Lunjew
Secretary-General,
Ministry of Plantation Industries & Commodities, Malaysia

Dr. Kandeh Yumkella,
Director-General of The United Nations Industrial Development Organisation (UNIDO)

Y. Bhg. Dato' Sabri Ahmad,
Chairman of Malaysian Palm Oil Board

Y. Bhg. Dato' Dr. Mohd Basri Wahid,
Director-General of Malaysian Palm Oil Board

Excellencies, distinguished guests,

Ladies and gentlemen,

Good Morning.

I would like to take this opportunity to thank the organisers for inviting me to officiate the 2007 International Conference on Biofuels. This is a collaborative initiative by the Ministry of Plantation Industries and Commodities, the Malaysian Palm Oil Board (MPOB) and the United Nations Industrial Development Organization (UNIDO).

2. It is also my pleasure to wish a warm welcome to all the participants, especially the foreign delegates to this conference. The year 2007 is a significant year for Malaysia as we will be celebrating the 50th year of independence. In addition, this year has also been designated as Visit Malaysia Year. While you are here in Kuala Lumpur, please take time off to visit and explore our diverse culture and places of historical interest. It is also my sincere hope that your brief sojourn here in Malaysia will be a memorable one.

Ladies and gentlemen,

3. Globally, matters related to energy and environment have increasingly taken centre stage. The issues that are being debated include increase in fossil oil prices and its depleting resources, environmental pollution, global warming, energy security and sustainability. All these have resulted in more attention being given to the search for alternative forms of energy which are renewable and environmentally friendly, and at the same time economically viable. With these constraints, biofuel offers one of the best alternatives that could meet these criterions.

4. Taking a historical perspective, the first generation of biofuel was primarily derived from food crops such as sugar cane, corn and vegetable oils. Biofuels from these

crops include ethanol and biodiesel, which have successfully been implemented in Brazil, the European Union (EU) and the United States. The production and use of biofuel as an alternative energy has now created urgent issues which have to be addressed if its further utilization is to be enhanced and promoted. These include their impact on the commodity prices, the choice between food and non food use, government support and subsidies, sustainability of production, biofuel quality and engine compatibility.

5. As an alternative approach towards other feedstock usage and to allay concerns on food prices, intensive research and development is being done on the development of second generation biofuels based primarily on biomass. This feedstock will not compete with the food industry. However, the pertinent issue is that the technologies for the use of non-food based feedstocks is still being developed and is expensive. These include the production of cellulosic bioethanol and biomass-to-liquid fuels (BTL) for use in petrol engines.

Ladies and gentlemen,

6. It is evident that the success of any biofuel initiative is contingent on the availability of an enabling framework which includes policies, and legal and fiscal regulations. This is especially so when the cost of production of biofuel vis-a-vis fossil fuels is not competitive. Perusal of policies on the use of biofuel should not be premised at protecting the environment at higher cost. In this context, the initiative by the European Union in taking the lead in mandating the use of biofuel based on environmental concerns and complimented with specific targets for its member countries is a positive move. In the EU, the current target is 5.75% of transport fuels are to be based on biofuel by 2010, and it is proposed that this target be increased to 10% by 2020. These efforts are commendable and in tandem with measures especially by the developed countries in taking the lead towards reducing global warming.

7. The positive move by the EU needs to be supported by an appropriate and sufficient supply of biofuel. However, due to its domestic constraints, there is a need to import biofuel from other sources including from developing countries to meet its targets on biofuel utilisation. Developing countries which have sufficient resources in the form of vegetable oil production such as Malaysia and others should be allowed to produce and export such biofuel to these countries.

8. However, recent moves by the importing countries, which include seeking a balance between sustainable practices and market opening, may not create the opportunity to supply the additional biofuel to meet the said objectives outlined. Importing countries are increasingly questioning the sustainability of palm oil production and its use for biofuel. This include allegations by certain quarters, in particular the non-governmental organisations, by associating palm oil production with destruction of rainforests and orangutan habitats, loss of biodiversity, destruction of peat land with the resultant increase in greenhouse gas emissions. Not withstanding these unsubstantiated allegations, the demand for palm oil has steadily increased, as indicated by the sharp increase in the price, currently fetching above RM2,600 per tonne, which has doubled the price compared to the same period last year.

Ladies and gentlemen,

9. I would like to reiterate here that "Malaysia is not destroying rainforests for palm oil production". We have not cleared rain forest for oil palm plantations for the past 10 years. We are focusing on increasing the production of palm oil through increased

productivity by consistently replanting old palms with new high yielding clones and adopting good agronomic practices. Our production is therefore sustainable. We will continue to engage environmentalists and various stakeholders to assure them that our practices are sustainable. In ensuring that the oil palm industry grows in harmony with nature, we have formulated initiatives, policies and practices to balance between "development need" and the need to "preserve the environment". We are committed to ensuring that whatever we do now is not at the expense of the environment and our future generations. In fact, when Malaysia first embarked on research and development on biofuel in 1980s, one of the objectives was to develop an environmentally friendly alternative fuel.

Ladies and Gentlemen,

10. Being one of the world's largest producers of palm oil, the palm oil industry in Malaysia is spearheading the biofuel thrust in Malaysia. The National Biofuel Policy was launched in March last year. The policy encourages the production of biofuel, primarily from palm oil for export and the use of palm biofuel blended with petroleum diesel locally. We have approved 92 licences to set up biodiesel plants where currently four are commercially in production while three are undergoing production trials. Given the increase in the price of palm oil, the biodiesel industry in Malaysia is confronted with issues of sustaining economic scale of the biofuel production. I believe that those who are involved in the palm biofuel business are fully aware of the nature of commodity price that are influenced by supply and demand, and the vagaries of the weather. It is imperative that the industry strategise and adopt biofuel technology that is economically viable yet producing high value added products to offset the cost.

Ladies and gentlemen,

11 We have taken steps to facilitate domestic development of the biofuel industry by formulating the Malaysian Biofuel Industry Act 2006. The Act which is scheduled for implementation in early 2008 will allow for orderly development and regulation of the industry. In addition, the Act also allows the Government to mandate the use of biofuel for any activity in this country.

12. Besides producing palm oil, the oil palm industry also generates a huge amount of biomass in the form of fibres, shell, empty fruit bunches, oil palm trunks and oil palm fronds. These may be utilised directly to produce energy or used as feedstock to produce second-generation biofuel. The government is encouraging research and development in this area to further explore the potential of these feedstocks for biofuel, hence and contributing towards further development of the renewable energy sector..

Ladies and gentlemen,

13. Apart from promoting and complimenting global attention to biofuel, including opportunities, issues and challenges, this conference is aptly organised to look at these issues and beyond by exploring possible solutions to elevate the potential of biofuel as a major source of renewable energy. I am happy to note that with the cooperation of UNIDO, we have been able to put together a host of local and international speakers to deliberate on these issues.

14. This international conference on biofuels is organised to coincide with the Malaysia International Commodity Conference and Showcase 2007 (MICCOS). MICCOS is a premier event on commodities organised by the Ministry of Plantation Industries

and Commodities to showcase the latest technological breakthroughs, formulations and products. This biennial event focuses on enhancing the commodity sector, especially in the context of its contribution to the national economy, environment and versatility of products available for both food and non food applications.
Ladies and gentlemen,

15. Lastly, I wish you all a fruitful discussion and hope that this conference will be able to crystalise and propose measures that would be able to further facilitate and develop the biofuel industry sector. At the same time, I would also like to remind all the participants, especially those from overseas to make available time to enjoy the sights and sounds of Kuala Lumpur. This city offers its own uniqueness and charm, and I strongly urge all of you to explore these so that you can take back memorable experiences.

With that note, and with great pleasure, I declare open the 2007 International Conference on Biofuels.

Thank you.

Dr. Yasuhiro Daisho
Professor
Waseda University
Japan

KEYNOTE SPEECH

SUSTAINABLE BIOMASS FUELS AS ALTERNATIVES TO OIL

Yasuhiro Daisho
Waseda University, Japan

When we discuss fuels or energy for transportation, I wish to emphasize that air pollution control is a critical issue of immediate concern. While gasoline vehicle emissions are reaching almost zero levels at present as a result of sophisticated electronics and fuelling systems, as well as after-treatment systems such as three-way catalysts, we expect more stringent emission regulations to be introduced in the very near future for diesel engine vehicles in Japan, the USA and EU. In compliance with such anticipated regulations, further reduction of emissions of Particulate Matters (PM) and NOx has to be achieved by around 2010 to ensure air quality in large cities in particular. Developing and motorizing countries will be following suit soon afterwards. In this connection, three key technologies – combustion technology, fuel technology and after-treatment technology – have to be systematically optimised in order to improve emissions and efficiency in spark ignited and diesel engines.

From the viewpoint of fuel technology, besides the characteristics conducive to cleaner emissions, a number of other requirements have to be satisfied for an alternative fuel to become viable. Its supply has to be adequate, reliable and sustainable on a long-term basis. There has to be a lower or no negative impact on the environment or human health on a Well-to-Wheel basis, including emissions of CO_2. Its price must be affordable. It also has to be compatible with existing engines, vehicles and refuelling infrastructures and it should meet fuel quality standards. Biofuels, produced from certain feedstocks, appear to be promising alternative fuels as they satisfy most of the requirements above.

World energy demand in the transportation sector will be continuously increasing in the future and sufficient energy will be needed to meet increasing demand. In line with the trend, it is expected that biomass based fuels are going to be used more and more in the future to replace conventional fuels such as gasoline and diesel. For production of bioethanol, sugar as well as starch from sugar cane, sugar beet, corn, wheat, sorghum, cassava and so forth are currently used as the main feedstocks. Biodiesel is presently produced from the oil of rapeseed, palm, sunflower, soybean or jatropha by transesterification. As a second generation technology, a hydrogenation process has been developed to convert crop oil into diesel-like hydrocarbon fuel utilizing the existing petroleum oil refinery plants.

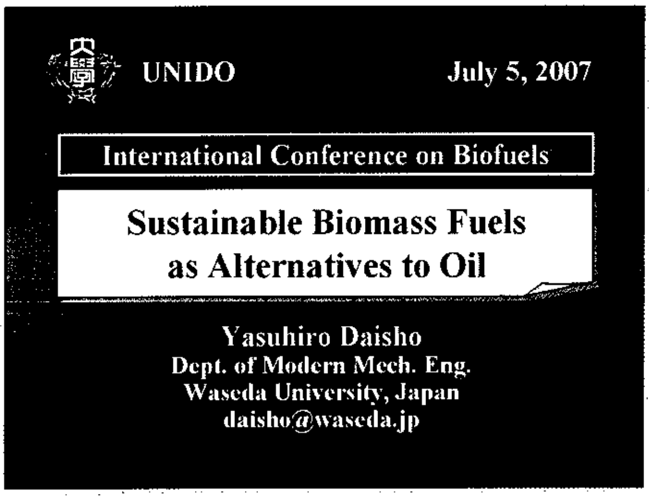
However, there is certain concern voiced about possible competition of crops for food use and crops for fuel use. The future biofuel scenario is very likely to be dictated by technological breakthroughs. "Biorefinery" technologies are under development and include Bio-to-Liquid (BTL) production processes. The emerging technologies produce fuels and chemicals from cellulosic biomass such as crops, wood, grass and agricultural wastes. Renewable energy is of great significance to the world and biorefinery technology has the potential to meet a large proportion of future energy demand. Well-to- Wheel or life cycle analyses are vital, as are R&D and demonstration activities focusing on the mitigation of both oil dependence and global warming.

We have a number of options for future vehicle fuels, ranging from fossil fuels to renewables, including biomass, waste residues, solar, hydraulic, wind and geothermal energies. And we are going to have four different types of vehicles in the future: spark ignited engine vehicles, compression ignition engine vehicles, fuel cell vehicles and electric vehicles. The choice may depend on the fuels that are available locally.

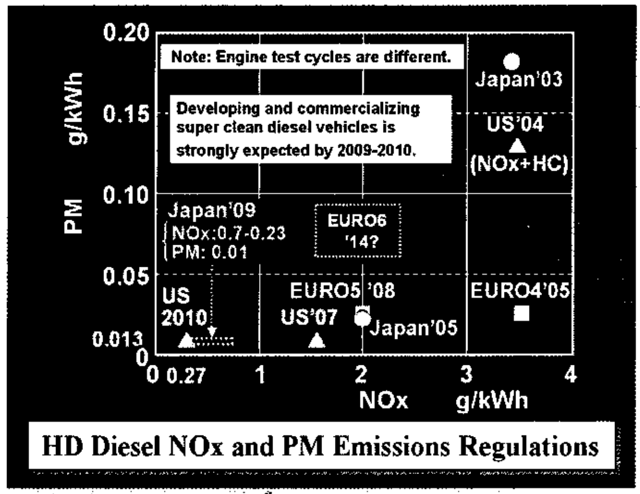
I think the air pollution problem will be overcome around 2010 or later and, in policy and R&D areas, increasing attention will be directed toward fuels or energy that address the global warming problem and are from renewable sources.

(daisho@waseda.jp)

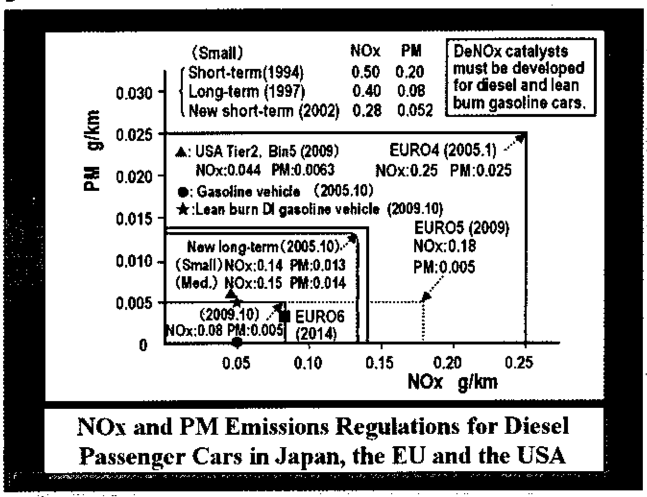
1


UNIDO
July 5, 2007
International Conference on Biofuels
Sustainable Biomass Fuels
as Alternatives to Oil
Yasuhiro Daisho
Dept. of Modern Mech. Eng.
Waseda University, Japan
daisho@waseda.jp

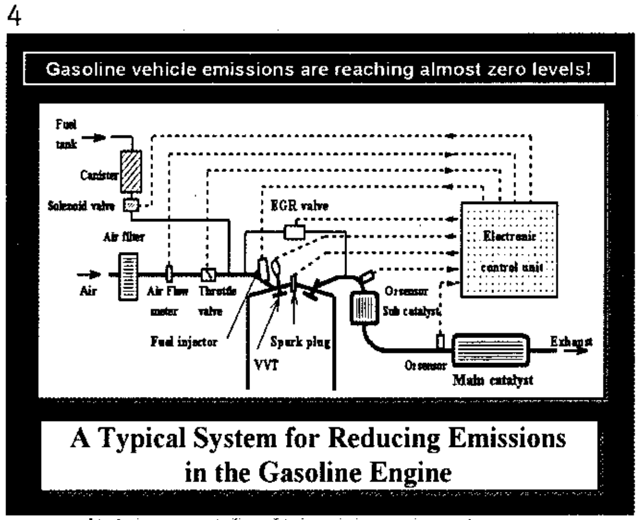
2


Note: Engine test cycles are different.
Developing and commercializing super clean diesel vehicles is strongly expected by 2009-2010.
PM g/kWh
0.20
0.15
0.10
0.05
0.013
0
Japan'03
US'04
(NOx+HC)
Japan'09
NOx:0.7-0.23
PM: 0.01
EURO6
'14?
US 2010
EURO5 '08
US'07
Japan'05
EURO4'05
0 0.27
1
2
3
4
NOx g/kWh
HD Diesel NOx and PM Emissions Regulations

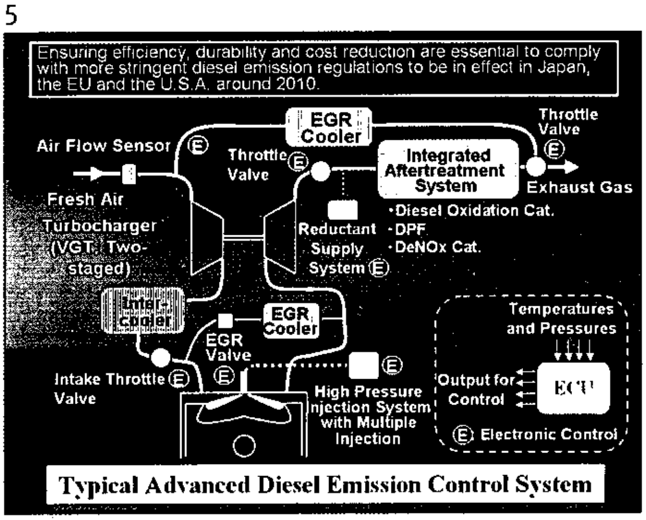
3


(Small) NOx PM
Short-term(1994) 0.50 0.20
Long-term (1997) 0.40 0.08
New short-term (2002) 0.28 0.052
DeNOx catalysts must be developed for diesel and lean burn gasoline cars.
PM g/km
▲: USA Tier2, Bin5 (2009) NOx:0.044 PM:0.0063
EURO4 (2005.1) NOx:0.25 PM:0.025
●: Gasoline vehicle (2005.10)
★: Lean burn DI gasoline vehicle (2009.10)
EURO5 (2009) NOx:0.18 PM:0.005
New long-term (2005.10)
(Small) NOx:0.14 PM:0.013
(Med.) NOx:0.15 PM:0.014
(2009.10) NOx:0.08 PM:0.005
EURO6 (2014)
NOx g/km
NOx and PM Emissions Regulations for Diesel Passenger Cars in Japan, the EU and the USA

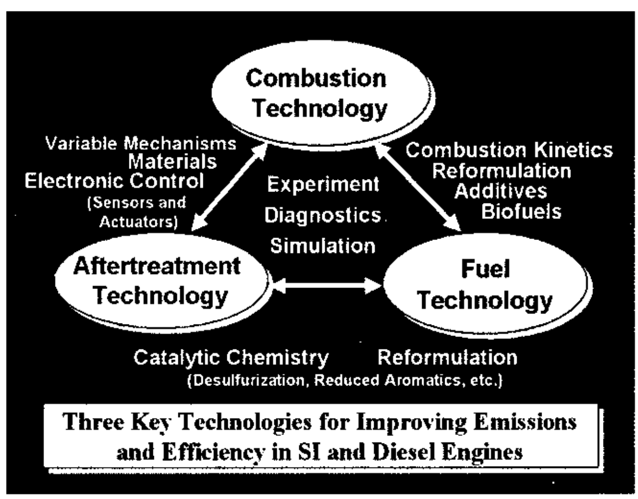
4


Gasoline vehicle emissions are reaching almost zero levels!
Fuel tank
Canister
Solenoid valve
EGR valve
Air filter
Electronic control unit
Air
Air Flow meter
Throttle valve
O2 sensor
Sub catalyst
Fuel injector
Spark plug
VVT
O2 sensor
Main catalyst
Exhaust
A Typical System for Reducing Emissions in the Gasoline Engine

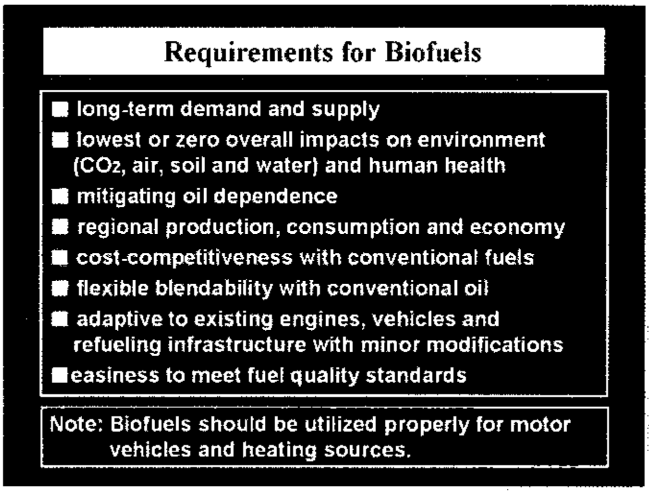
5


Ensuring efficiency, durability and cost reduction are essential to comply with more stringent diesel emission regulations to be in effect in Japan, the EU and the U.S.A. around 2010.
Air Flow Sensor
EGR Cooler
Throttle Valve
Throttle Valve
Integrated Aftertreatment System
Exhaust Gas
Fresh Air
Turbocharger (VGT, Two-staged)
Reductant Supply System
・Diesel Oxidation Cat.
・DPF
・DeNOx Cat.
Inter-cooler
EGR Cooler
EGR Valve
Temperatures and Pressures
Intake Throttle Valve
High Pressure Injection System with Multiple Injection
Output for Control
ECU
Electronic Control
Typical Advanced Diesel Emission Control System

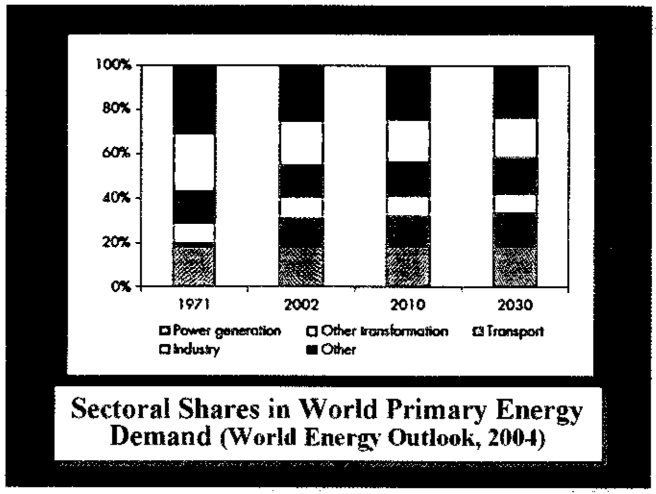
6


Combustion Technology
Variable Mechanisms
Materials
Electronic Control
(Sensors and Actuators)
Combustion Kinetics
Reformulation
Additives
Biofuels
Experiment
Diagnostics
Simulation
Aftertreatment Technology
Fuel Technology
Catalytic Chemistry
Reformulation
(Desulfurization, Reduced Aromatics, etc.)
Three Key Technologies for Improving Emissions and Efficiency in SI and Diesel Engines

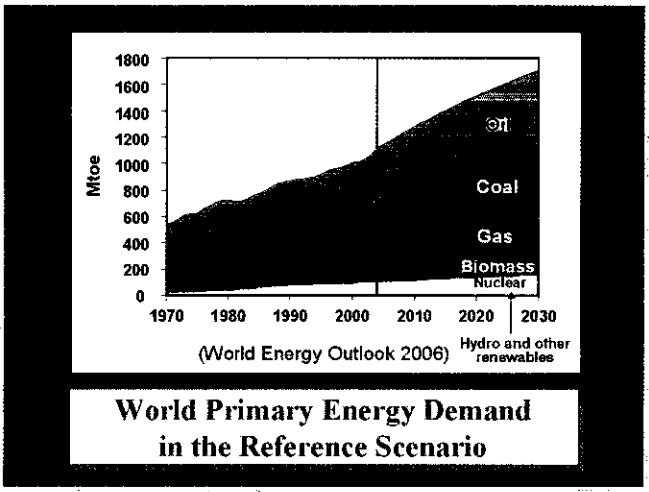
7


Requirements for Biofuels
long-term demand and supply
lowest or zero overall impacts on environment (CO2, air, soil and water) and human health
mitigating oil dependence
regional production, consumption and economy
cost-competitiveness with conventional fuels
flexible blendability with conventional oil
adaptive to existing engines, vehicles and refueling infrastructure with minor modifications
easiness to meet fuel quality standards
Note: Biofuels should be utilized properly for motor vehicles and heating sources.

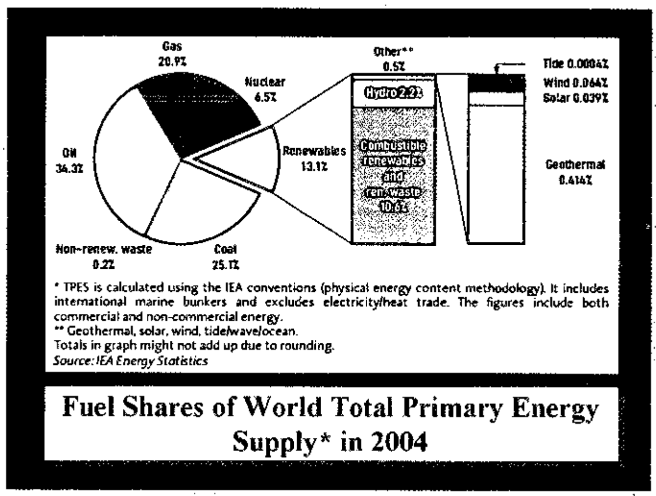
8


100%
80%
60%
40%
20%
0%
1971
2002
2010
2030
Power generation
Other transformation
Transport
Industry
Other
Sectoral Shares in World Primary Energy Demand (World Energy Outlook, 2004)

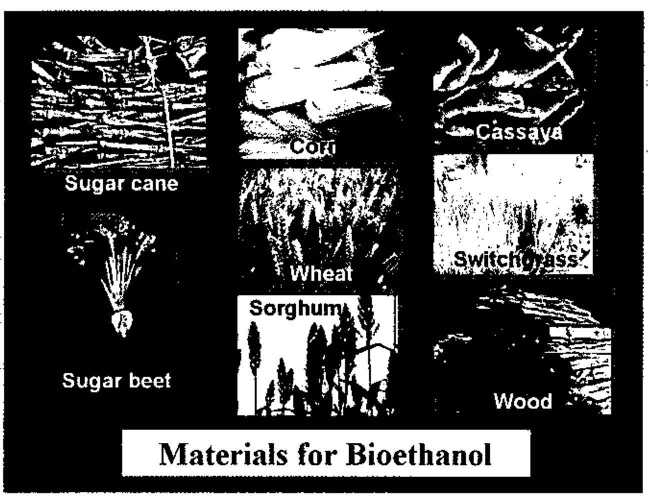
9


1800
1600
1400
1200
1000
800
600
400
200
0
Mtoe
Oil
Coal
Gas
Biomass
Nuclear
1970
1980
1990
2000
2010
2020
2030
(World Energy Outlook 2006)
Hydro and other renewables
World Primary Energy Demand in the Reference Scenario

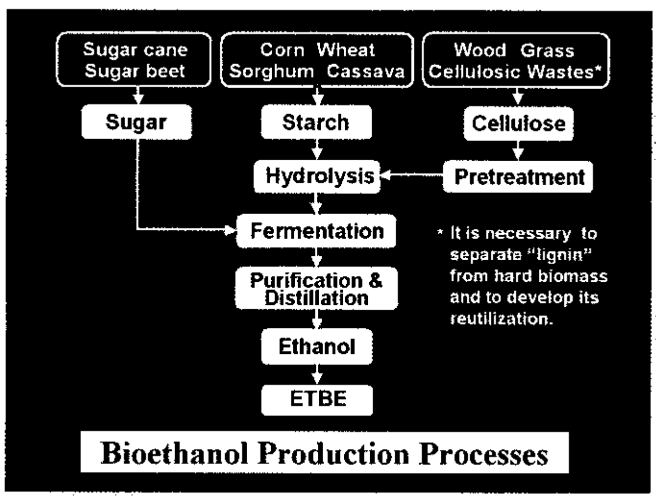
10


Gas 20.9%
Other** 0.5%
Nuclear 6.5%
Hydro 2.2%
Tide 0.0004%
Wind 0.064%
Solar 0.039%
Oil 34.3%
Renewables 13.1%
Combustible renewables and ren. waste 10.6%
Geothermal 0.414%
Non-renew. waste 0.2%
Coal 25.1%
* TPES is calculated using the IEA conventions (physical energy content methodology). It includes international marine bunkers and excludes electricity/heat trade. The figures include both commercial and non-commercial energy.
** Geothermal, solar, wind, tide/wave/ocean.
Totals in graph might not add up due to rounding.
Source: IEA Energy Statistics
Fuel Shares of World Total Primary Energy Supply* in 2004

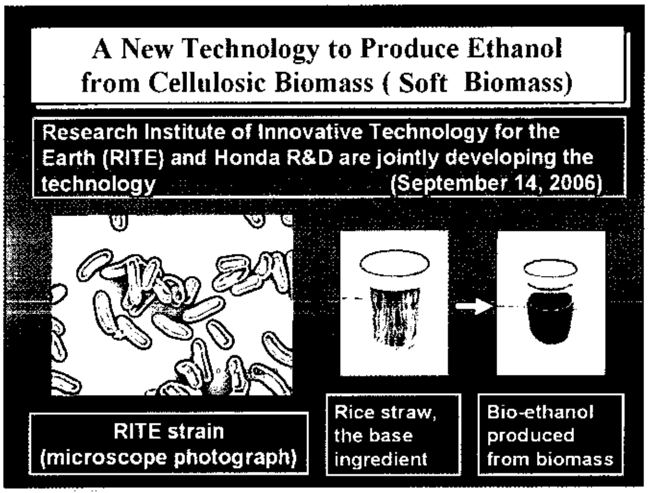
11


Sugar cane
Corn
Cassava
Wheat
Switchgrass
Sugar beet
Sorghum
Wood
Materials for Bioethanol

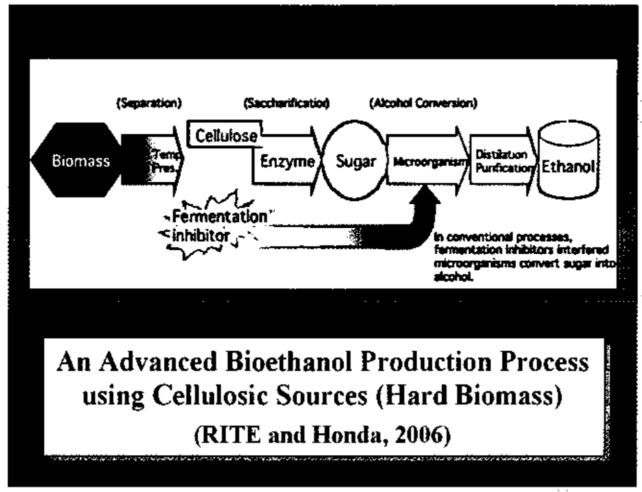
12


Sugar cane Sugar beet
Corn Wheat Sorghum Cassava
Wood Grass Cellulosic Wastes*
Sugar
Starch
Cellulose
Hydrolysis
Pretreatment
Fermentation
Purification & Distillation
Ethanol
ETBE
* It is necessary to separate "lignin" from hard biomass and to develop its reutilization.
Bioethanol Production Processes

13



14



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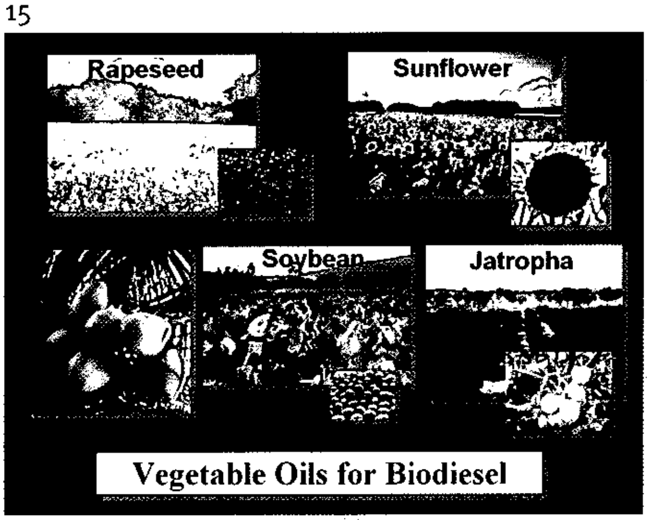

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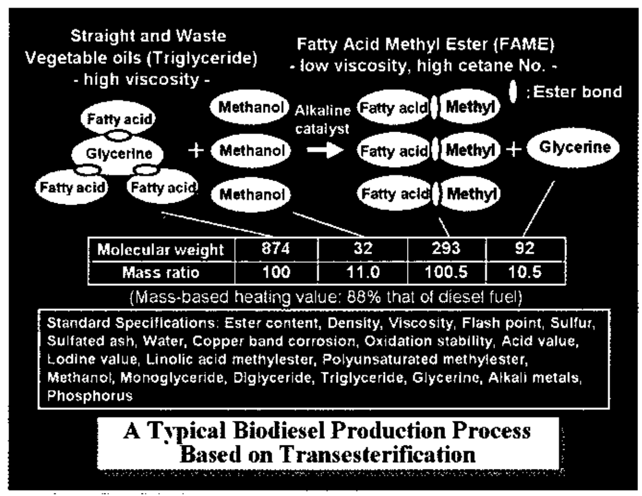

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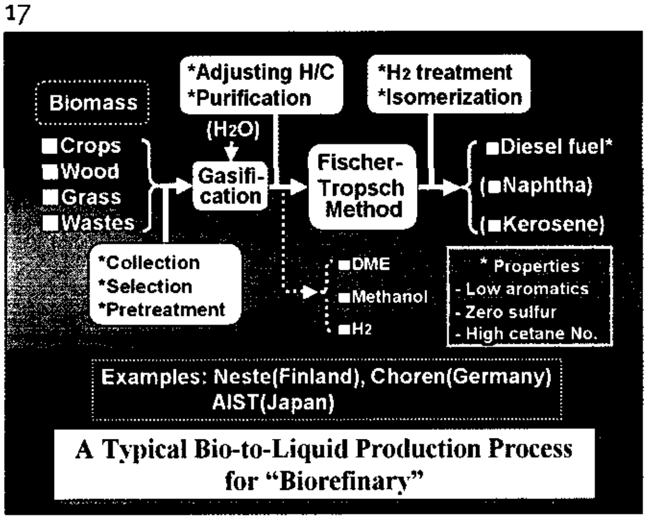
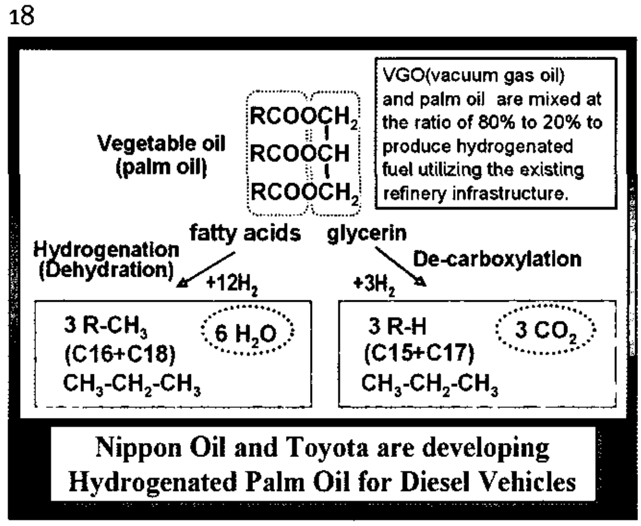


18



19

Future "Biorefinary" Technology

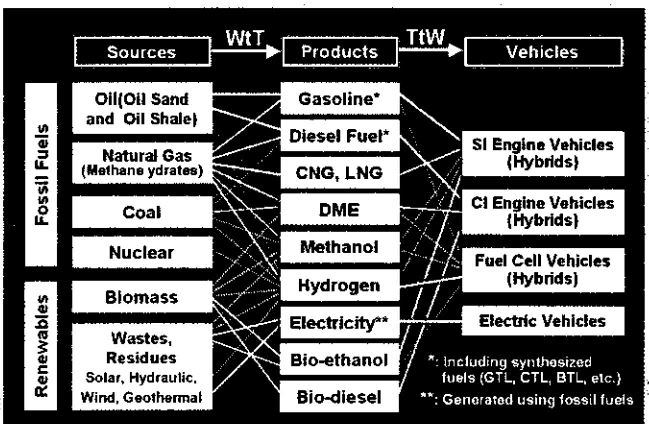
- "Biorefinery" utilizing biomass feedstocks has potential to meet a large proportion of future energy demand.
- Dedicated sources meeting biorefinery requirements must be developed.
- The overall production efficiency must be maximized while the costs must be competitive with the conventional fuels.
- Potential environmental impacts of biorefineries must be analyzed and prevented in advance.

20

Policies and RD&Ds for Biofuels

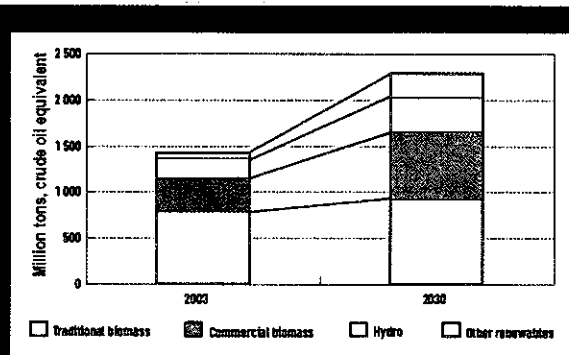
- Research, development and demonstration activities are required before commercializing and disseminating biofuels for vehicle and heating applications.
- Such activities should focus on mitigating both oil dependence and global warming.
- "Well-to-Wheel" or life cycle analyses are necessary for utilizing biofuels.
- Establishing biofuels' quality standards is essential to prevent engine and vehicle trouble as well as to comply with emissions regulations.
- Significant contributions should be made to motorizing countries, providing them with information on advanced vehicle and biofuel technologies.

21



Sources and Products for Future Vehicle Fuels

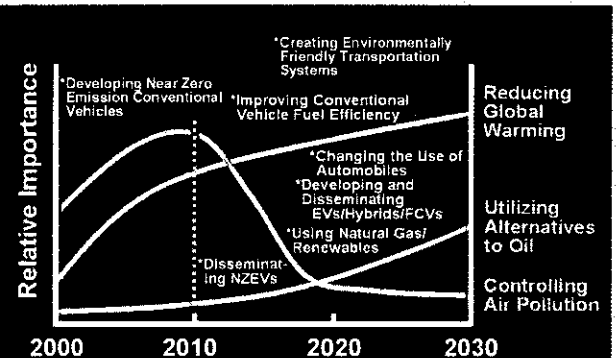
22



Present and Future Renewables in the World

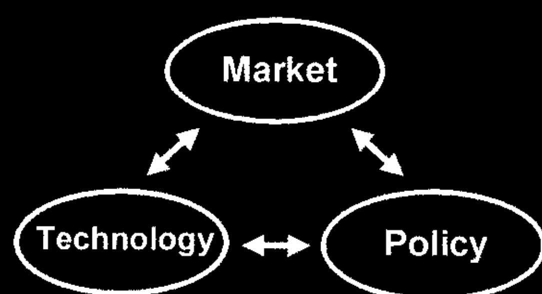
(World Energy Outlook, IEA, 2005)

23



Relative Importance of Policy and R&D for Future Vehicles and Fuels

24



Collaboration for Developing and Disseminating Biofuels

Session Chairperson
Mr. Heinz Leuenberger
Director
United Nations Industrial Organization,
Austria

SESSION 1-1:

ROLES OF PUBLIC SECTOR PLAYERS IN GLOBAL BIOFUELS MARKET

Sergio Miranda-da-Cruz
United Nations Industrial Development Organization, Austria

By the end of the present century, biomass, traditional and modern, may evolve from the present level of 11% to some 25% of the world energy matrix. According to this scenario, 70% of the world energy matrix in 2100 will be provided by renewable energy sources including biomass and only 25% from non-renewable energy sources such as oil, natural gas and coal, which compares with 13% and 80.5% respectively in 2006.

Although the precise figure in the long-term is still dependent on future technologies for the different energy sources and carriers, the short-term market for bioenergy, in particular for biofuels (ethanol and biodiesel), is expected to grow from 75 billion litres in 2007 to 170 billion litres annually in 2015, with ethanol representing some 70% of the total, and biodiesel the rest. Biofuels, which today are mostly consumed in local markets, are expected to become major commodities to be traded worldwide if enabling conditions are in place.

Since sustainable production and use of biofuels are linked to the reduction of carbon emissions and to the adequate management of available arable land, their production and trade, if properly conducted, can effectively respond to two important challenges in the years to come: The mitigation of climate change and the reduction of social and economic disparities. In addition to reduction of sulphur oxide and sulphate emissions, the emission of 2.6 tonnes of CO_2 equivalent can be avoided for every cubic meter of ethanol used as fuel for transportation in lieu of petroleum fuel to address the global warming problem. The social benefits include the cost effective creation of jobs, compared to investments in other industrial sectors, in order to reduce poverty.

The potential for sustainable and financially feasible production and distribution of biofuels will depend essentially on technology advancement and ultimately on productivity growth, which will be driven, preferably, by the private sector. However, the public sector will have a major role in this process by establishing the enabling conditions for the markets for these potential world commodities to become a reality. Technology advancement and continuous productivity increase depend on investments in three areas of an economy which are sources of public goods: R&D (Research and Development), education, and infrastructure, with their final utilization defined by the ability of the public sector to create a pro-productivity business environment.

Public sector players are, therefore, expected to create the required conditions for the biofuels market to grow through the establishment of proper policies, which can be divided into five groups: Allocation policies to ensure the right structure for expenditure on R&D, education and infrastructure; stabilization policies to minimize macroeconomic shocks; re-distribution policies to support the demand for education and the corresponding development of the required human resources; micro-policies to suppress market distortions and to stimulate production, and occasionally, demand policies to consolidate the consumption of the "new" commodities.

The UN in general and UNIDO in particular can cooperate with national public sector players by transferring the knowledge required for designing and implementing the above-mentioned policies, which, in fact, should be continuously monitored, revised and adjusted in order to reach the final objectives. In addition, they can be instrumental in assisting the public sector specifically in the field of energy planning and implementation of national energy strategies oriented towards a strict monitoring of their respective energy matrices with focuses on two fronts: (a) a decrease in energy intensity, particularly in activities linked to industrial production, and (b) an increase in the contribution of local renewable energy to limit growth of fossil fuel use, local pollution and global greenhouse gas emissions.

(S.Miranda-da-Cruz@unido.org)

1

"Roles of Public Sector Players in Global Biofuels Market"

S. Miranda-da-Cruz
Director, Agro-industries & Sectoral Support Branch

Int'l Conference on Biofuels

Kuala Lumpur – MALAYSIA

5-6 July 2007

2

"Roles of Public Sector Players in Global Biofuels Market"

1. **The Global Market for Biofuels;**
   - World Energy Matrix (Present & Future);
   - Global, Energy & Biofuels Trade;
2. **Roles of Public Sector Players;**
   - Environmental & Social Challenges & Benefits;
   - Technology & Productivity Growth;
3. **Possible UN/UNIDO Role;**
4. **Conclusions.**

3

Executive Summary

(1) By the end of present century **biomass** ***may*** evolve from **11** to some **25**% of the **world energy matrix**;

(2) Although the precise figure will depend on future **technologies**, the short-term market for **ethanol & biodiesel** shall grow from **75** (*2007*) to **170 billion litres** (*2015*) with **70**% **ethanol** & **30**% **biodiesel**;

(3) For the **biofuels market** to become **global, public sector players** are expected to **create** the required **conditions** through the **establishment** of proper **policies**, which can be summarized in ***five*** **groups**;

(4) The **UN/UNIDO** can assist **national public sector players** in **designing & implementing** the required **policies** & their **energy strategies** for increasing **Energy Efficiency** & the use of **Renewable Energy**.

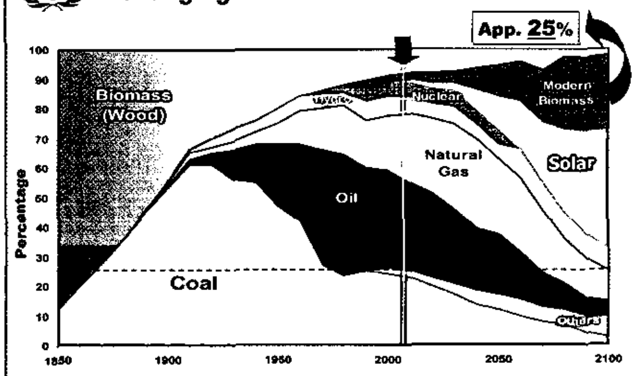
4

"Roles of Public Sector Players in Global Biofuels Market"

1. **The Global Market for Biofuels;**
   - World Energy Matrix (Present & Future);
   - Global, Energy & Biofuels Trade;
2. **Roles of Public Sector Players;**
   - Environmental & Social Challenges & Benefits;
   - Technology & Productivity Growth;
3. **Possible UN/UNIDO Role;**
4. **Conclusions.**

5

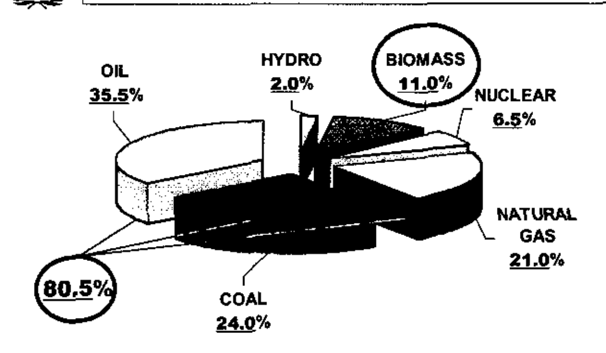
...the world energy patterns (1850-2100) are changing towards renewable sources...



Source: Based on original work of N. Nakicenovic, A. Grübler and A. McDonald, 1998

6

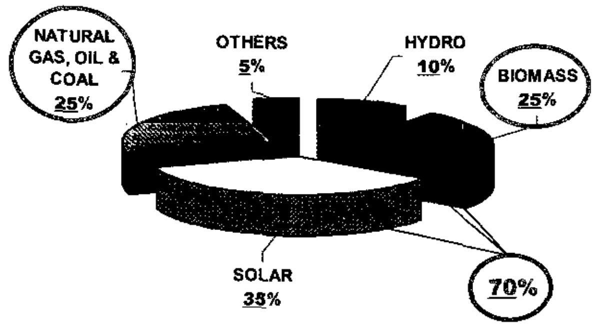
...& biomass in the world energy matrix is expected to grow from 11% in 2006...



Source: UNIDO Analysis based on different sources – (Approximate Figures)

7

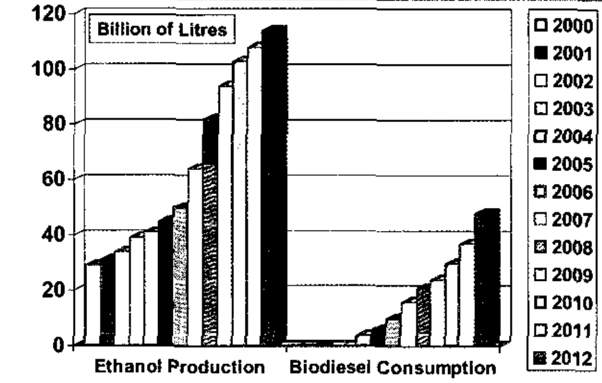
...to **25%** of the *world energy matrix* in 2100...



Source: UNIDO Analysis based on different sources – (Approximate Figures)

8

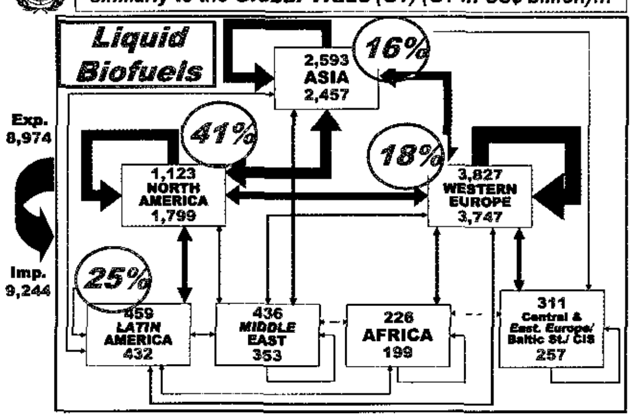
...the world *biofuels* market shall grow from 75 to some 170 billion litres in 2015...



Source: UNIDO Analysis based on different sources – (App. Figures)

9

...but the *biofuels market* shall still be *concentrated*, similarly to the *Global Trade* (GT) (GT in US$ billion)...



Source: UNCTAD 2004; UNIDO-BO Analysis – (app data)

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"Roles of Public Sector Players in Global Biofuels Market"

1. **The Global Market for Biofuels;**
   - World Energy Matrix (Present & Future);
   - Global, Energy & Biofuels Trade;
2. **Roles of Public Sector Players;**
   - Environmental & Social Challenges & Benefits;
   - Technology & Productivity Growth;
3. **Possible UN/UNIDO Role;**
4. **Conclusions.**

11

...the main ***challenge*** for the successful ***production*** & ***trade*** of ***biofuels*** is in the ***sustainability*** of the whole industry, in particular of its ***environmental*** & ***social*** aspects, & the ***definition*** of the corresponding ***standards*** cannot be made without the decisive role of the ***public sector players***, including the ***UN***...

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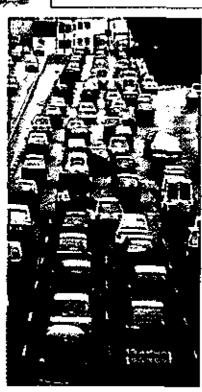
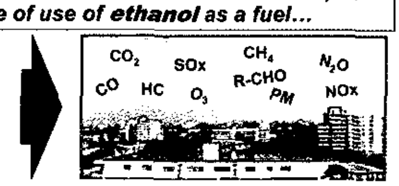
...but there are also *environmental benefits*, as in the case of use of *ethanol* as a fuel...





(i) Vehicles → Important Source of Air Pollution in Urban Areas;
(ii) ETHANOL → Fast & Cost-effective Way to Reduce Air Pollution;
(a) Replaces additives containing heavy metals;
(b) Smaller sulphur oxide & sulphate emissions;
(c) Negligible particle emissions;
(d) Reduces carbon monoxide & carbon emissions. Avoids emissions of:
2.6 tonnes CO_2 equiv./m^3 of fuel ethanol;

Source: UNICA, Br. (2004); Macedo et alli. (2005)

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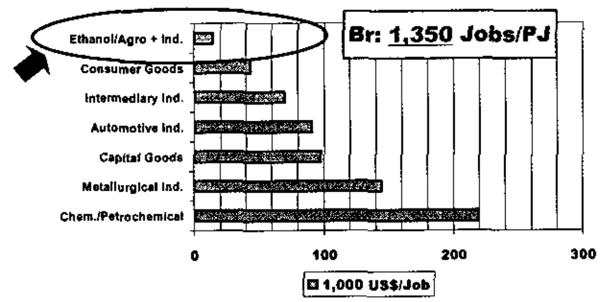
*...& **social benefits** as the example shown for the **cost of Job creation** in selected **industrial sectors** in Brazil in 2001...*



Source: Goldemberg, 2002

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*...however the **global biofuels market** will be established only if **production** takes place **worldwide** & the **industry** proves itself able to **continuously** advance **technologically** for **productivity growth**...*

*...process that although driven preferably by the **private sector**, the **public sector players** shall also bring a major **contribution**...*

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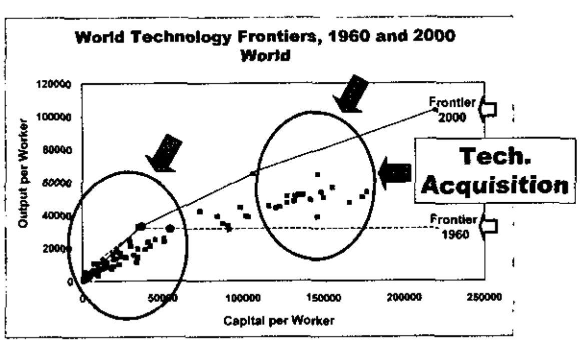
*...but before proceeding with the **challenges** in **productivity growth** one can look into the **shift** of the "**World Technology Frontier**" over **time**...*



Source: UNIDO – Isaksson, 2005

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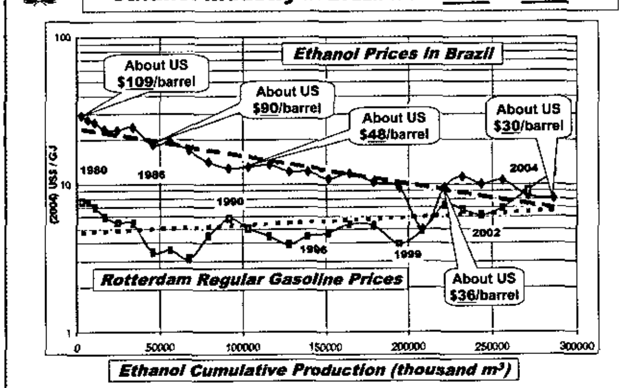
*...as the case with the **productivity growth** of the **ethanol industry** in Brazil from 1980 to 2005...*



Source: Goldemberg, 2006 updated from Goldemberg et al, 2003

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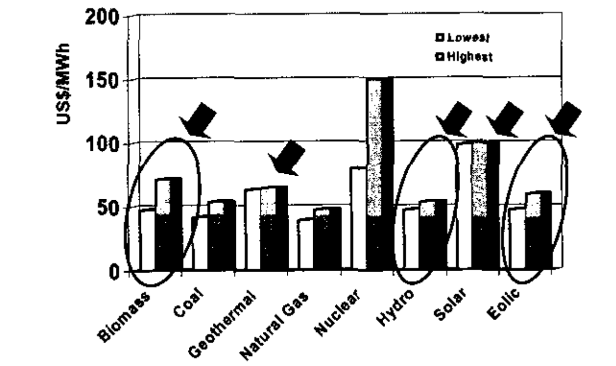
*...**biomass** is not the cheapest source of energy but it has concrete **conditions** to be **competitive internationally**...*



Source: Based on document from "S. Francisco Sugar Mill (2000)"; UBO Analysis

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*...the **potential** for **advancing technologically** & also for **continuously increasing productivity** is defined by **investments** in three areas of an economy: (i) **R&D**; (ii) **education**; & (iii) **infrastructure**, which are sources of **public goods**...*

*...but it is not enough: the actual degree of **utilization** of this **potential** is defined by the **ability** of the **public sector** to create a **pro-productivity business environment**...*

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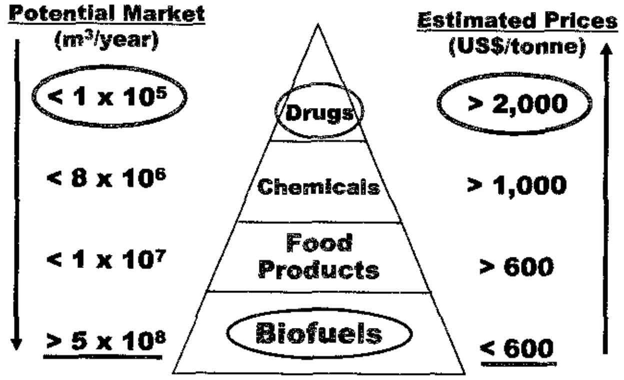
…& this is carried out with the ***establishment***, by the ***public sector***, of the proper ***policies***, which can be summarized in ***five*** groups…

One Example

1. **Allocation policies** to set the right structure of expenditures on ***R&D***, ***education*** & ***infrastructure***
2. **Stabilization policies** to minimize macroeconomic shocks
3. **Re-distribution policies** to support the demand for education & development of the required human resources for this **specific industry**
4. **Micro-policies** to suppress **market distortions, lack of information** & to stimulate **production** of the **chain**
5. And occasionally, **demand policies** to consolidate the **consumption** of the "new" **commodities**

20

…the feasibility of the ***biodiesel*** industry depends also on results of ***R&D*** throughout the whole ***chain***…



Source: Kühner, D., *Consult Bio*. Presentation made in October 2006, Panama City

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…but the ***maximization*** of the ***productivity performance*** of a ***country*** & of an ***industry*** as the case of the ***biofuels***, would take ***more than*** a ***collection*** of ***policies***…

…it would need a ***permanent framework*** in which an array of ***policies*** would be ***continuously adjusted*** according to the ***distance*** from the ***objective***, while ***maintaining*** internal ***consistency*** & a ***convergence*** drive towards the ***objective***…

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…the ***UN***, in general, & ***UNIDO*** in particular, can cooperate with the ***national public sector players*** by ***transferring*** the required ***knowledge*** for ***designing*** & ***implementing*** the ***five*** listed ***groups*** of ***policies***, since they have experience in dealing with ***macro*** & ***micro*** (***industry***) aspects of a ***production process***…

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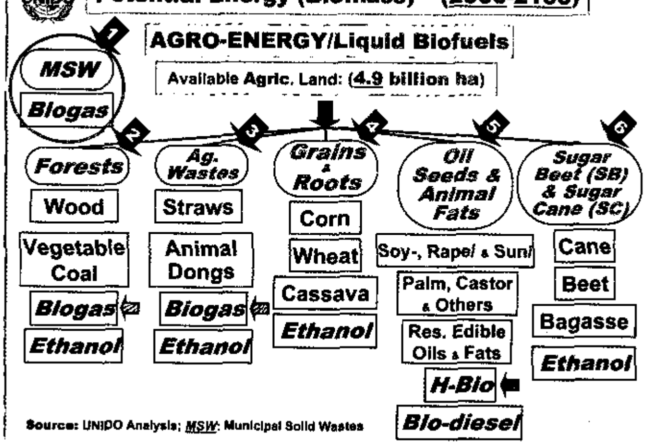
Potential Energy (Biomass) – (2000-2100)



Source: UNIDO Analysis; *MSW*: Municipal Solid Wastes

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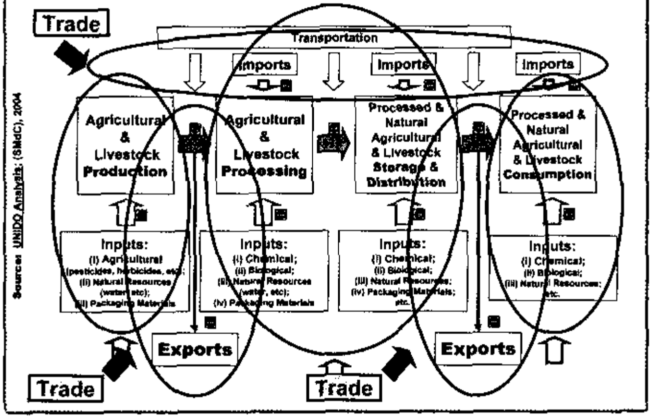
*...because **production** & **trade** of most **biofuels** fall within a **complex** & **integrated** production **chain**...*



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*...in addition, the **UN/UNIDO** can assist the **public sector** specifically in the **planning & implementation** of **national energy strategies** for a strict **monitoring** of their **energy matrices** with focus on the increase of: **(i) energy efficiency (EE)**; & **(ii) renewable energy (RE)** to **mitigate** the effects of **climate change...***

Source: UNIDO Staff Working Paper, 2006. **EE**: Energy Efficiency; **RE**: Renewable Energy

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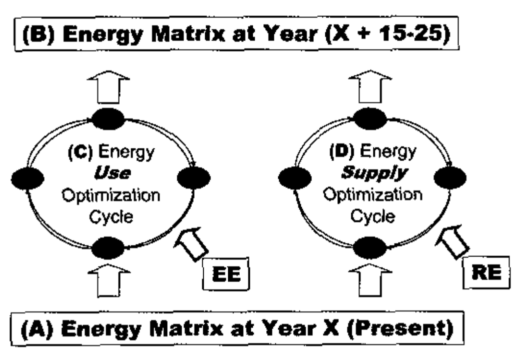
...since strict monitoring of national energy matrices will be the most critical challenge to __all__ countries...



Source: UNIDO Staff Working Paper, 2006. **EE**: Energy Efficiency; **RE**: Renewable Energy

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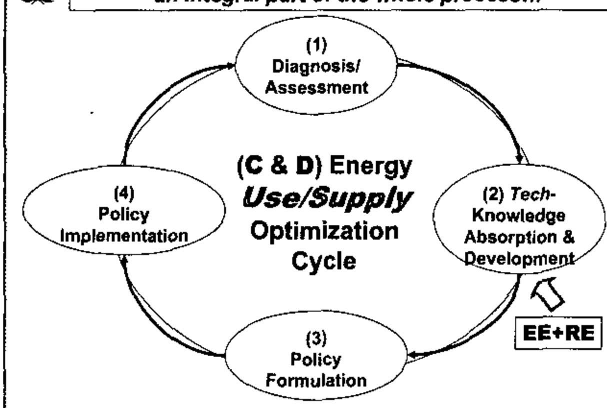
*...& **RE**, including the production of **biofuels** will be an integral part of the whole process...*



Source: UNIDO Staff Working Paper, 2006. **EE**: Energy Efficiency; **RE**: Renewable Energy

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Conclusions (I)

(1) By the end of the present century **biomass** (traditional & modern) may evolve from ***__11__*** to some ***__25__%*** of the **world energy matrix**;

(2) Although the precise figures will depend on future **technologies** for the different energy **sources & carriers**, the **short-term market** for **ethanol & biodiesel** is expected to grow from ***__75__*** *(2007)* to ***__170__*** **billion litres** *(2015)* with ***__70__%*** **ethanol** & ***__30__%*** **biodiesel**;

(3) Biofuels, which are mostly **locally consumed products** shall become major **int'l commodities** (but w/ trade still concentrated within traditional trade blocks);

➡

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Conclusions (II)

(4) Since **sustainable** *production* & *use* of **biofuels** are linked to the **reduction** of **carbon emissions** & to adequate **management** of arable **land**, their promotion may be linked to: **(i) mitigation of climate change**; & **(ii) reduction of social & economic disparities;**

(5) The potential for sustainable & **financially feasible production & distribution** of **biofuels** will depend on **technology advancement & productivity growth**, driven **preferably** by the **private sector** but guided by the **public sector players** to establish the **enabling conditions** for the **market** to become a **reality**;

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Conclusions (III)

(6) Technology advancement & productivity growth depend on **investments** in ***three*** areas of an economy: (i) **R&D**; (ii) **Education**; & (iii) **Infrastructure**;

(7) But the **final utilization** of these **three** sources of **public goods** is defined by the **ability** of the **public** ***sector*** *to create a* ***pro-productivity business*** **environment**;

(8) Public sector players are, therefore, expected to **create** the required **conditions** for the **biofuels market** to become **global** through the **establishment** of proper **policies**, which can be summarized in ***five*** **groups**;

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Conclusions (IV)

(9)

1) **Allocation policies** (R&D; Education & Infrastructure);
2) **Stabilization policies** (minimize macroeconomic shocks);
3) ***Re-distribution policies*** *(development of human resources)*;
4) **Micro-policies** (suppress market distortions);
5) **Demand policies** (consolidate consumption);

(10) The **UN/UNIDO** can cooperate with **national public sector players** by **transferring** the **knowledge** required for **designing & implementing** the above-mentioned sets of **policies**, which, in fact should be **continuously revised & adjusted** in order to **converge** to the **final objective**;

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Conclusions (V)

(11) In addition, the **UN/UNIDO** can **assist** the **national public sector players** in the **planning & implementation** of their **energy strategies** oriented towards a **strict monitoring** of their "**Energy Matrices**" with focus in ***two*** areas;

(12) ...a **radical improvement** of **Energy Efficiency (EE)** of their most critical **energy systems & sectors** (in terms of consumption), & the **sustainable** use of **energy resources** [through the promotion of **Renewable Energy (RE)** including **biofuels**].

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UNIDO

Thank you

Sergio MIRANDA-da-CRUZ
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SESSION 1-2:

BIOFUELS REGULATORY FRAMEWORKS GLOBAL OUTLOOK

Wang Zhongying
Center for Renewable Energy Development, China

This presentation gives an overview of the global market for biofuels and then deals with development goals, national regulatory frameworks, emerging challenges that biofuel development is facing, and a snapshot of experiences that selected countries have so far had.

The world production of both ethanol (38 billion liters) and biodiesel (6 billion liters) increased in 2006 compared with 2005 (33 and 4 billion liters respectively) and annual biofuel production in 2006 made up about 3% of the 1,500 billion liters of gasoline consumed globally. The biodiesel industry was able to double its production capacity in 2006, predominantly in the US and Europe. Significant expansion of the ethanol industry took place in the US and the EU in 2005. In 2005 the five top ethanol producers were Brazil, the US, China, the EU and India, and the top five in biodiesel were Germany, France, the US, Italy and Austria. New investment in ethanol production facilities succeeded in reaching US$2 billion in 2006, with more than 45 plants under construction in the US and Canada and a major program starting in Brazil that should be able to increase output by 50% by 2009. The investment value of new ethanol production facilities under construction or announced through 2008 is more than US$6 billion in Brazil, Canada, France and the US.

In Brazil, ethanol provided 41% of all motor vehicle (non-diesel) fuel consumed in 2005. Ethanol was blended with 30% of all gasoline sold in the US with 15% of it coming from corn. The ethanol production goal in the US for 2012 is 7.5 billion gallons. In the US, one third of transportation fuel over the next 25 years could come from biofuels. There, "corn is king", although constraints such as the necessity to produce animal feed and sweeteners limit the most optimistic maximum estimates of 15 billion gallons. The future in the US is definitely in the more environmentally friendly cellulose. In the EU, biodiesel from 20% of the rapeseed crop was used to provide 1% of the transportation fuel used in 2005. In the EU, biodiesel has the potential to provide 20-25% of the total needs. China hopes to be producing 2 million tons of ethanol and 0.2 million tons of biodiesel annually by 2010, and 10 million tons and 2 million tons respectively by 2020.

Regulatory mandates or targets for blending biofuels have been enacted in at least 30 states and provinces and 8 countries worldwide, most being 10 to 15% for ethanol and 2 to 5% for biodiesel. There are E5 in Canada and Australia, E3 in Japan, E5 to E10 in the US, and E10 in China and Thailand. In Thailand, there are six ethanol plants using sugar (4) and cassava (2) with production targets of 1 million liters/day in 2006 and 3 million liters/day by 2011. There is also E25 in Brazil. Besides the blending ratio, the regulations and policies usually deal with such matters as tax incentives and product standards to encourage production and use. Fuel tax exemptions exist in at least eight EU countries and tax credit for ethanol ($0.51/gallon) and biodiesel ($1.00/gallon) producers in the US. In China, subsidies are available for ethanol production and product standards are in place for both ethanol and biodiesel.

While policy and regulatory frameworks encourage biofuels development, there are issues which need to be properly addressed, including the enhancement of biofuels conversion efficiency, the use of new feedstocks in conjunction with development of new technologies, competition for land and water resources, aquifer depletion and soil erosion, preservation of bio-diversity, and impacts on poor populations (e.g. food price hikes).

(wzhying@public.bta.net.cn)

1

Bio-fuels Regulatory Frameworks Global Outlook

Wang Zhongying
CRED of ERI, NDRC, CHINA
William Wallace
NDRC/UNDP/GEF Project
China

July 5, 2007

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Contents

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Global Market Overview

- Production of ethanol was 38 billion liters in 2006, up from 33 billion liters in 2005
- Production of biodiesel was 6 billion liters in 2006, up from 4 billion liters in 2005
- Together, annual biofuels production compares to about 3% of the 1,500 billion liters of gasoline consumed globally
- Ethanol provided 41% of all (non-diesel) motor vehicle fuel consumed in Brazil in 2005
- Ethanol was being blended with 30% of all gasoline sold in the United States

Source: Eric Martinot, Renewables Global Status Report 2006 Update

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Global Market Overview (continued)

- New investment in ethanol production facilities could reach $2 billion in 2006, with more than 45 plants under construction in the U.S. and Canada and a major program starting in Brazil that could increase output by 50% by 2009
- The investment value of new ethanol production facilities under construction or announced through 2008 is more than $6 billion in Brazil, Canada, France, and the U.S.
- Ethanol industry expanded significantly in U.S. and Europe in 2005
- Biodiesel industry could double production capacity in 2006, mostly in U.S. and Europe

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Global Market Overview (continued)

- Brazil: Ethanol has 40% share of light fuels market in 2005
- USA: Ethanol has 2% share of light fuels market using 15% of corn production in 2005
- USA: Potential for 1/3 of transportation fuel in 25 years
- EU: Biodiesel from 20% of rapeseed crop used to provide 1% of transportation fuel in 2005
- EU: Potential for 20-25% of transportation fuel use
- New investment from Archer Daniels Midland, Cargill, Daimler-Chrysler, DuPont, and Shell for biofuels production
- Ford, General Motors, Volkswagen will increase production of flex fuel vehicles

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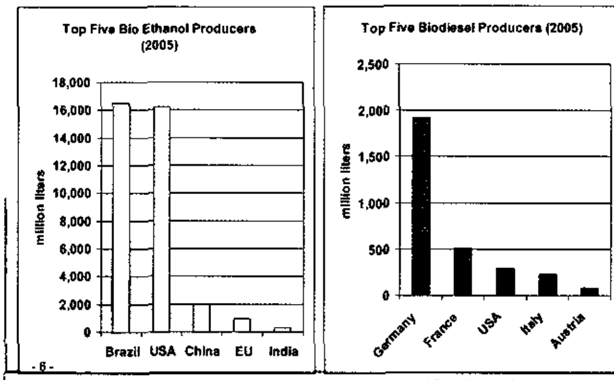
Global Top Production of Bio Fuels



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CRED 可再生能源发展中心

Development goals for biofuels

- EU: Biofuel targets
  - 2% for 2005 (1.4%)
  - 5.75% for 2010
- EU biomass production potential (Mtoe)
  - 2010: 186-189
  - 2020: 215-239
  - 2030: 243-316

Source: EU Biomass Action Plan

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Development goals for biofuels

- US: Ethanol
  - 2006: 4 billion gallons (4.2 billion gallons in 2005)
  - 2012: 7.5 billion gallons
  - Corn is king
    - Most optimistic estimates: 15 billion gallons maximum (10% of current fuel demand)
    - Constrained by demand for corn in other markets (animal feed, sweeteners)
    - Poor energy balance and carbon benefits
  - The future is cellulosic
    - Potential for 30 billion gallons from prairie grasses
    - Additional opportunities from trees, ag residues, garbage
    - Better energy balance & carbon reductions, fewer impacts from farming

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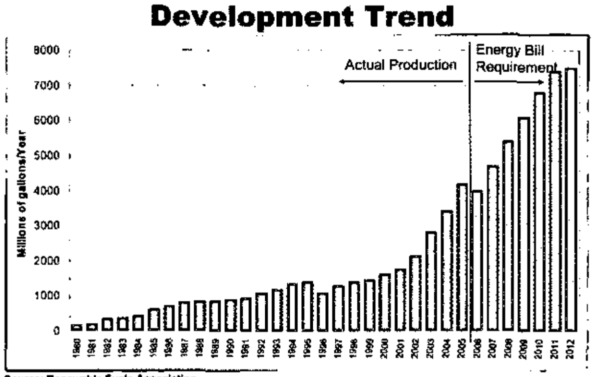
U.S. Fuel Ethanol Outputs and the Development Trend



Source: Renewable Fuels Association

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Development goals for biofuel

- China
  - 2010
    - Bio-ethanol: 2 million tons
    - Bio-diesel: 200,000 tons
  - 2020
    - Bio-ethanol: 10 million tons
    - Bio-diesel: 2 million tons

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Major regulations and policies by world

- Blending biofuels with gasoline and diesel
- Tax incentives
- Government purchasing policies, market creation
- Biofuel compatible infrastructures and technologies
- R&D for crop research, technology development, feedstock handling
- Education and outreach
- Reduction of subsidies where counterproductive
- Reduce investment risk of advanced production facilities
- Reduction of market supports in tandem with market development

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Major regulations and policies by world (continued)

- In 2005-2006, several countries dramatically stepped up biofuels targets and mandates.
- Mandates for blending biofuels into vehicle fuels have been enacted in at least 30 states/provinces and 8 countries worldwide. Most are 10-15% for ethanol and 2-5% for biodiesel.
- Fuel tax exemptions exist in at least 8 EU countries, most enacted during 2005-2006, including France, Germany, Greece, Ireland, Italy, Spain, Sweden, UK. Most are 100% tax exemptions.
- Tax credit for ethanol and biodiesel producers in the US (~12-15 cents/liter).
- Brazil has been the world leader in promoting biofuels. All gasoline must be blended with ethanol and gas stations sell both pure ethanol and ethanol blends.

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Major regulations and policies by world (continued)

- Low-level blends of ethanol and gasoline in gasoline vehicles
  - E5 in Canada and Australia
  - E3 in Japan
  - E5.7-E10 in the U.S.
  - E10 in China, Thailand
  - E25 in Brazil
- Low-level blends of biodiesel and diesel in diesel vehicles
  - B2-B20 in different countries
- E0-E85 in Flexible-fuel vehicles (FFVs)
- Bio-hydrogen in Fuel cell vehicles with bio-hydrogen
- A fiscal support for biofuel development
- An organization for implementing national strategies

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Major regulations and policies by countries

- EU
  - Fuel tax exemptions
  - Biofuels obligations
  - A system of certificates
    - The minimum sustainability standards
    - Amendments to the "biodiesel standard"
  - The vehicle market
    - Encourage public procurement of clean vehicles
      - Developing a legislative proposal
  - Cross-cutting issues
    - The energy crop scheme
    - The waste framework legislation
    - To establish national biomass action plans for Member States

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Tax Exemptions for Biofuels in EU-25 in 2005

	Reduced tax	No tax
Austria		✓
Czech	✓	
France	✓	
Finland	Research vehicles	
Germany		✓
Hungary		ETBE planned
Italy		✓
Poland		✓
Portugal		planned
Sweden		✓
Spain		✓
Slovakia	planned	
United Kingdom		✓

Source: National reports of member state governments 2005

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Major regulations and policies by countries (continued)

- US
  - Federal renewable fuel standard (RFS)
  - $0.51/gallon incentive for ethanol
  - $1.00/gallon incentive for biodiesel
  - Oxygenate mandate
  - E85 filling stations
  - State RFS and incentives
  - Cellulosic policy
    - Extra credits in RFS
    - $150 million commercialization grants
    - Implementing R&D

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Major regulations and policies by countries (continued)

- China
  - E10 in 9 provinces
  - Subsides (around US$160/ton for ethanol)
  - Standards on bio-ethanol product
  - Standard for bio-diesel product

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Major challenges for biofuels development

- Conversion efficiencies and use of new feedstocks; technology development
- Competition for land and water resources
- Aquifer depletion and soil erosion
- Loss of biological diversity (e.g. tropical rain forests)
- Resource utilization to drive up food prices
- Impacts on poor populations

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The Role of Biofuels Affected by the Amount Land Available and the Amount of Oil Used

Country	Land Area, 10^3 km^2	Population, Million	Arable Land, 10^3	Arable Land per 10^3 people km^2	Oil Use, million barrels a day
USA	9,161	296	1,752	5.92	20.0
China	9,326	1,306	1,436	1.10	6.3
Japan	374	127	46	0.36	5.6
Germany	349	82	118	1.44	2.7
India	2,973	1,080	1,617	1.50	2.3
Canada	9,093	32	451	14.09	2.2
Brazil	8,457	186	588	3.16	2.1
France	545	60	183	3.05	2.1
The U.K.	241	60	57	0.95	1.7
Spain	499	40	130	3.25	1.5
Thailand	511	65	150	2.31	0.9
Australia	7,617	20	499	24.95	0.8
Pakistan	778	162	216	1.33	0.4
Sweden	410	9	27	3.00	0.4

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Experiences

- The success story of USA
  - Tax incentives and investment driving market
  - Ethanol capacity increased 2.6 billion liters in 2005
  - Investment in 2005 new ethanol plants was 1 billion USD
  - New investment in 2006 likely to be 2.6 billion USD for plants to be constructed by end of 2008
  - In 2005 there were 95 operating plants with production capacity of 16.4 billion liters/year
  - In 2006 about 44 plants were being constructed or expanded

Source: Eric Martinot, Renewables Global Status Report 2006 Update

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Experiences (continued)

- The success story of Brazil
  - World's leading ethanol producer for several years
  - In 2005 total of 300 operating plants with 80 added in 2005
  - New national plan to increase sugar cane production by 40% by 2009 and increase ethanol production by 5 billion liters per year
  - New investment to exceed 3 billion USD in new plants through 2008

Source: Eric Martinot, Renewables Global Status Report 2006 Update

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Experiences (continued)

- Progress in India
  - India is largest producer of sugar in the world and is fifth largest *producer of ethanol primarily from sugar*
  - In 2005/6 India produced 2.2 billion liters of alcohol mainly for industrial use and spirits
  - In 2005/6 India produced 200 million liters of ethanol for E5 blending with gasoline (mandated since 2003)
  - Currently experimenting with E10
  - In 2006 about 120 distilleries producing ethanol for transportation fuel and about 300 total operating plants for all alcohol production (3.2 billion liters capacity for alcohol)
  - Emerging biodiesel production based on Jatropha

Source: USDA Foreign Agricultural Service

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Experiences (continued)

- Progress in Thailand
  - One of fastest growing markets in Asia
  - Goal is to replace MTBE in gasoline, use E10
  - Tax exemption for ethanol production and income tax waiver for investors ***first eight years***
  - Production base of six plants using sugar (4) and cassava (2) with production targets of 1 million liters/day 2006 and 3 million liters/day by 2011

Source: Press release Novozymes, September 25, 2006

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Experiences (continued)

- The success story of Europe:
  - World's leading regional producer of biodiesel
  - Biodiesel production quadrupled between 2000 and 2005; 80% increase from 2004 to 2005
  - Mid-2006 EU had operating capacity of 6 billion liters per year
  - EU proposed target of 8% by 2015
  - Biofuels tax exemption in France, Germany, Greece, Ireland, Italy, Spain, Sweden and UK and others (previous slide)
  - New blending mandates in Germany, B4.4 and E2 in 2005 and Italy, 1% ethanol and biodiesel blending

Source: Eric Martinot, Renewables Global Status Report 2006 Update

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Experiences (continued)

- The success stories of France, Germany, Spain and Sweden:
  - A fiscal support for biofuels guaranteed for a long term
    - Tax exemption
      - France: for a limited volume of biofuels
      - Germany: a full tax exemption for unlimited volumes of biofuels
- An organization for implementing the strategies of the introduction of biofuels
  - France and Germany: Agriculture sector

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Experiences (continued)

- Malta, the UK and the Netherlands:
  - A modest tax exemption: cost-effective biofules
    - Encourage to make use of waste oil
    - Start a biofuel market at minimal costs
- The presence or creation of an end-user market for biofuels
  - Petrol company involve
  - Car manufacture involve

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Conclusions

- Biofuels currently about 3% of world gasoline transportation fuel use (2005)
- Ethanol production doubled between 2000 and 2005
- Biodiesel production growth in 2005 was about 60% (due to EU)
- Ethanol and biodiesel have potential to supply up to 25-30% of transportation fuels in several high oil use regions and 100% of transportation fuels in several developing countries
- New technologies, e.g. conversion of ligno-cellulosic feedstocks to ethanol, to capture full potential of biofuels
- Potential for damage to environment and food supplies must be avoided during ramp up in biofuels development

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Conclusions (continued)

- Biofuels development should be done with consideration of:
  - no effect on domestic food production for domestic use;
  - no increase in pressure on farmland and forest biodiversity;
  - no increase in environmental pressure on soil and water resources;
  - no plowing of previously unplowed permanent grassland;
  - a shift towards more environmentally friendly farming, with some areas set aside as ecological stepping stones;
  - the rate of biomass extraction from forests adapted to local soil nutrient balance and erosion risks.
- To establish the related regulations for protecting the world sustainable development in the same time with encouraging biofuel development.

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SESSION 1-3:

BIOFUELS OPPORTUNITIES AND CHALLENGES: DEVELOPING COUNTRY PERSPECTIVE

Mariano S. Salazar
Department of Energy, the Philippines

This presentation focuses on the policy framework of the Philippines for biofuels, an emerging industry which I believe will be a competitive force on the international market in coming years, and on the opportunities and challenges associated with it.

The government has developed the Philippine Energy Plan to address its energy sector goals to ensure a more sufficient, stable, secure, accessible and reasonably priced energy supply and to pursue cleaner and efficient energy utilization. Aggressive development of renewable energy through the use of biomass is part of the five-point reform package contained in the Plan and geared toward energy independence.

The Biofuels Bill was signed on January 12, 2007 to become the Republic Act 9367 (RA 9367) or the Biofuels Act of 2006. Its main objectives are to reduce dependence on imported oil, increase economic activity and boost employment in rural areas, improve energy efficiency and contribute to improving air quality. It mandates the use of biodiesel and bioethanol blended fuels. Three months after the Act had become effective, it became mandatory to blend 1% locally sourced biodiesel (B1), and two years afterwards, 5% locally sourced bioethanol (E5) will be compulsory. With B1 and E5, we expect displacement of 78 million liters of fossil diesel or a foreign exchange saving of US$50 million in 2007 and 255 million liters of gasoline or US$184 million in 2008 respectively.

The blends may be increased to B2 in two years and to E10 in four years if determined feasible. These minimum blend requirements apply to the whole transport sector, including marine and rail transport. The power and industrial sectors are also covered. The entire program is comprehensive and is going to run for 5 years. In May 2007, the Implementing Rules and Regulations (IRR) of Republic Act 9367 were published.

The Act also offers incentives. Among them are tax savings, including VAT exemption, exemption from wastewater charges, zero specific tax on local or imported biofuels components and government financial assistance. These are without prejudice to enjoying applicable incentives and benefits under other existing laws and regulations, which include income tax holidays (ITH), additional deductions for taxable income for labour expenses, duty exemption on imported capital equipment and so forth.

The initial focus is on coconut oil and sugarcane as the main feedstocks for biodiesel and bioethanol respectively. However, development of other feedstocks has been under way including jatropha, cassava and sweet sorghum. To meet the E5 target, some 64,000 ha of land is required if it is sugarcane based, and so for this purpose the Sugar Regulatory Administration (SRA) has identified about 65,000 ha for conversion from sugar to bioethanol. More than enough refinery capacity is currently available for meeting the B1 target and superfluous capacity exported.

There are challenges that biofuels face. The cost of biofuels is higher than that of petroleum fuels. Thus it is necessary to reduce the production cost by, for example, constructing facilities where other high-value products can also be produced, as in the coconut industry, or incorporating co-generation capabilities to cover in-house energy requirements. Deforestation and excessive use of pesticides or loss of biodiversity have to be prevented. In this connection, new technologies have to be developed to improve crop yield and biofuel production. Our program also attempts to address the displacement of food crops for biodiesel, and to this end, jatropha, which grows in marginal lands not suitable for food production, and crop wastes or grass are being looked at.

In concluding my presentation, I wish to express our hopes for the development of a South-South dialogue and cooperation with other developing countries towards a regional biofuels plan.

(msalazar@doe.gov.ph)

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The Government of the Philippine Republic

BIOFUEL OPPORTUNITIES and CHALLENGES: DEVELOPING COUNTRY PERSPECTIVE

Mariano S. Salazar
Undersecretary
Philippine Department of Energy

International Conference on Biofuels
July 5-6, 2007
Putra World Trade Center, Malaysia

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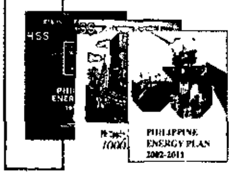
PHILIPPINE ENERGY PLAN FRAMEWORK

MACRO-ECONOMIC GOALS

- Economic growth
- Poverty alleviation
- Market-based industry



ENERGY SECTOR GOALS

- Ensure more sufficient, stable, secure, accessible & reasonably priced energy supply
- Pursue cleaner & efficient energy utilization & cleaner energy technology applications
- Cultivate strong partnership & collaboration with key partners & stakeholders
- Empower and balance the interest of the energy publics

3

The Government of the Philippine Republic

ENERGY INDEPENDENCE AGENDA

- ***Increase reserves of indigenous fossil fuels***
- ***Aggressively develop renewable energy potential***
- ***Increase use of alternative fuels***
- ***Form strategic alliance with other countries***
- ***Strengthen and enhance energy efficiency and conservation program***

4

Philippine Biofuels Policy Framework

- measure to help address energy security (especially in light of oil supply security concerns and the impact of oil price increases)
- basic policy framework
  - public policy to establish mandatory market and standards to jumpstart private sector investments in production and infrastructure support facilities
  - establish policy framework and support facilities to ensure security of feedstock supply and investments in supply infrastructure

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The Biofuels Bill
signed into law on Jan 12, 2007 as RA9367

- Objectives
  - i. To reduce the Philippine's dependence on imported oil
  - ii. To increase the economic activity in the country and boost employment
  - iii. To improve energy efficiency
  - iv. To contribute in improving air quality
- Mandates minimum blend into all diesel and gasoline fuels for as follows:
  - i. 1% biodiesel within 3 months from effectivity of the Act
  - ii. 5% bioethanol within 2 years from effectivity of the Act
- Future increase in mandatory blends to be determined by the Biofuels Board

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Biofuels Program Targets

- Target per major feedstock
  - 5% - 10% ethanol blend with gasoline for vehicles by 2010
  - 1% - 2% CME blend with diesel fuel for vehicles in 2010
  - viability study for jatropha curcas potential as a biodiesel

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Pursuing Biofuels Use in Various Fronts

A) The Biofuels Act of 2006 mandates the use of Biofuels in the:

1. Transport sector

2. Power or Industrial Fuel Sector - tests were conducted
   - DOST's Romblon CME tested at Tablas NPC Diesel Plant
   - Establishing separate standards for industrial use
   - Renewable Energy Bill is expected to encourage use of renewable energy to power generation systems

B) Alternative fuel for cooking - innovative stoves being developed locally that can use biomass residues, biogas, coal briquettes, plant oil or used cooking oil

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Potential Fuel Displacement

- **Biodiesel**

Scope	Blend	Diesel Displacement *(million liters)*	FOREX Savings *(million US$)*
Nationwide	1%	78 (2007)	50
	2%	173 (2010)	110
	2%	209 (2015)	133

- **Bioethanol**

Blend	Gasoline Displacement *(million liters)*	FOREX Savings *(million US$)*
5%	255 (2008)	184
10%	565 (2010)	406
	721 (2015)	519

Assumptions:

Diesel price: P32/liter. Gasoline price :P36/liter

Exchange rate: P50/$

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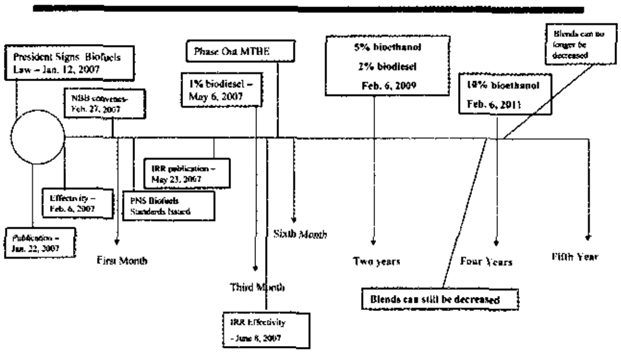
National Biofuels Program

Timeline of implementation



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Incentives under the Biofuels Law

- **Specific Tax** on local or imported biofuels component per liter of volume shall be zero. Gasoline and diesel fuel component shall remain subject to the prevailing specific tax rates
- **Value Added Tax**- Sale of raw material used in the production of biofuels shall be exempted from VAT
- **Water Effluents** - all water effluents, such as but not limited to distillery slops from the production of biofuels used as liquid fertilizer and for other agricultural purposes are considered "reuse" and therefore exempt from wastewater charges under Section 13 of R.A. No. 9275, Phil. Clean Water Act

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Incentives under the Biofuels Law

- Financial Assistance - Government financial institutions accord high priority to extend financing in activities involving production, storage, handling and transport of biofuel and biofuel feedstock including the blending of biofuels with petroleum, as certified by DOE

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Incentives for Biofuels Projects

- The production and utilization of biofuels is an activity covered by the Investment Priority Plan being an alternative fuel for the transport sector and a major component of the "Alternative Fuels Program" of the DOE. - source, BOI

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Incentives for Biofuels Projects

Under EO 226

- Income tax holiday
  - New registered pioneer firms : 6 years from operations
  - New registered non-pioneer firms: 4 years from commercial operations
  - Expanding firm: 3 years from commercial operations or expansion
  - Notes: Pioneer firms - biofuel projects with investments of over P1billion
  - Non-pioneer firms- biofuels projects with investments below P1 billion
- Additional deductions from taxable income for labor expense

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Incentives for Biofuels Projects

Under EO 226

- Duty-exemption on imported capital equipment, spare parts and accessories
- Exemption from contractor's tax, whether national or local
- Tax credit for taxes and duties paid on supplies, raw materials and semi-manufactured products used in the manufacture, processing or production of its export products
- Exemption from wharfage dues and any export tax, duty impost and fee-for non traditional export products by registered enterprise

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Incentives for Biofuels Projects

Under RA 7196 or the PEZA Law:

- ITH or exemption from corporate income tax for 4 yrs
- After the ITH period, option to pay 5% tax on gross income, in lieu of all national and local taxes
- Exemption from duties and taxes on imported capital equipment, spare parts, supplies and raw materials
- Domestic sales allownce equivalent to 30% of total sales
- Exemption from wharfage dues and export taxes, imposts and fees
- Other incentives under EO 226, as may be determined by PEZA Board

Under RA 9337 or R-VAT Law:

- Zero percent (0%) Rate for Ethanol and CME

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Bioethanol Program

Actions completed/ongoing

Policy Action/Program Activities

- Technical, economic & pricing study on production and use
- Promulgation of standards and accreditation procedures (ongoing)
- Multi-sector/inter-agency linkages

Supply Infrastructure

- Bioethanol imports (encouraged by reduction in tariffs)
- Blending facilities/distribution network: use of existing downstream oil industry infrastructure
  - voluntary E10 blend available at pump since Aug 2005
  - E10 available in all 104 *Seaoil* stations nationwide and in 4 *Flying V* and 31 *Shell* stations in Metro Manila

Technology

- Laboratory and engine testing
- Availability of flexi-fuel vehicles
  - incentives: reduction in tariffs via EO
  - investments: Ford Philippines FFV plant online by 2008

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Bioethanol Program

Activities needed for 5% -10% gasoline blend by 2010

Required Policy Action

- Biofuels Act signed on 12 Jan 2007

Supply Infrastructure

- Bioethanol production capacity
  - i. required production capacity: 25 plants of 30 million lis/yr capacity each

Blend	Bioethanol Reqts, in million li.	Addl Plants Reqd (*Inv Reqt*)	Cane Hectarage Reqd 1/	Reqd Cane Yield Improvement 2/
E5 (Yr 1-2)	268	9 (US$ 260 M)	63,810	17%
E10 (Yr 3)	565	9 (US$ 260 M)	135, 000	35%
E10 (Yr 8)	721	7 (US$ 200 M)	171,667	43%

Notes: 1/ Assuming no yield improvement. 2/ Assuming no additional area planted to sugarcane

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Bioethanol Program

Activities needed for 5% -10% gasoline blend by 2010

ii. Bioethanol capacity

- 794 million liters per year potential bioethanol producers; (30 million- liter NDC-Bronzeoak plant operational by end 2008)
- Petron committed to purchase 500,000 liters/day of capacity from Bronzeoak
- Conversion of existing sugarmills will take 6-8 mos; greenfield facilities to take 18- 24 mos

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Bioethanol Program

Activities needed for 5% -10% gasoline blend by 2010

- Blending facilities and distribution network: reliance on existing downstream oil industry facilities
- Supply of feedstock, with initial focus on sugar-based ethanol
  - For *expansion*: SRA surveyed areas totaling ***194,596 hectares***. Independent firms surveyed areas totaling ***102,000 hectares***
  - Areas for *conversion* (100% shift from sugar to ethanol) as dedicated ethanol districts totaling ***65,519 hectares***

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Bioethanol Program

Activities needed for 5% -10% gasoline blend by 2010

Technology
- technology compatibility and further engine testing
- capacity building for vehicle maintenance and repair

Development of other bioethanol feedstock
(e.g.,cassava, sweet sorghum)
- research and development for compatible technology
- promulgation of standards
- supply chain and feasibility
- additional land area required

IEC and Market Development
- Tri-media campaign, consultations, seminars

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Total Existing Plantation Hectarage

Feedstock Type	Area Planted (hectares)	Feedstock Yield (thousand metric tons)	Bioethanol Yield (million liters)	Production Cost (Php)/ MT feedstock	Equivalent Cost of Bioethanol (Php)
Sugarcane*	389,421	23,981	1636	1300-1400	33.52-35.93
Corn**	2,442,000	5,254	2102	6940-7500	39.72-41.76
Cassava	205,755	1,641	295	3000-3500	40.62-43.62
Sweet Sorghum	Under study	na			

Bureau of Agricultural Statistics – DA ; Sugar Regulatory administration – SRA : *2003 data for sugar cane
** 2005 data for corn
Productivity assumptions:
Sugarcane: 1 ha. = 60 MT , 1 MT = 70 liters Ethanol
Corn: 1MT = 400 liters Ethanol
Cassava: 1 MT = 180 liters/ bioethanol

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Biodiesel Program

- ***Two possible bio-diesel feedstock***
  - Coco-Biodiesel or Coco Methyl Ester (CME): 1% to 2% CME blend with diesel fuel for vehicles by 2010
  - Jatropha Methyl Ester (JME): Targets to be set after viability and pilot study
- **CME is commercially available while JME is in its pilot testing stage**

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Biodiesel Program

Completed and ongoing activities

Policy Action/Program Initiatives
- Passage of the Biofuels Act of 2006
- Technical, economic & pricing study on production & use
- Standards promulgation in May 2003
- Accreditation procedures in place
- MC 55 mandated use of 1% CME by Volume in the diesel requirements of government vehicles in *Feb 2004*
- LGUs, particularly, Baguio, Isabela, and Davao, issued a resolution encouraging the use of CME by all its motorists.

Technology
- Laboratory and engine testing
- Numerous studies conducted

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Biodiesel Program

Completed and ongoing activities

Supply Infrastructure
- CME biodiesel supply available locally
- *Refinery capacity already* meets B1 req'ts; excess capacity exported at the moment
- Blending facilities/ distribution network: will use existing downstream oil industry infrastructure
- Pre-blended 1% CME or B1 available in dispensing pumps

BIODIESEL PRODUCTION CAPACITY
(million liters/year)

Accredited Biodiesel Producers	
Chemrez Inc.	75.00
Senbel Fine Chemicals Inc.	72.00
Romtron Philippines	0.30
Freyvonne Milling Services	15.60
Golden Asian Oil International, Inc.	30.00
*Mt. Holly Coco	4.00
*Pure Essence	60.00
Sub-Total	256.90

*Note: * = provisional accreditation*

Biodiesel Producers for Accreditation	
Atson	24.00
Lion Chemical Corp.	6.00
Sub-Total	30.00

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Biodiesel Program

Activities needed for 1% - 2% diesel blend by 2010

Required Policy Action
- Biofuels Act signed on 12 Jan 2007

Supply Infrastructure
- Biodiesel supply available locally
- Existing downstream oil industry infrastructure may be used as blending facilities/distribution network

Supply of Feedstock

Year	Blend	Biodiesel Requirement (million li/year)
2007	1%	78
2009	2%	168
2010	2%	173
2015	2%	209

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Biodiesel Program

Activities needed for Higher Biodiesel Blends by 2010

Technology
- technology compatibility and further engine testing
- capacity building for vehicle maintenance and repair

Development of other possible feedstock (e.g.,jatropha)
- research and development for compatible technology
- promulgation of standards
- supply chain and feasibility
- additional land area required

IEC and Market Development
- multi-media campaign, consultations, seminars

27

CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
Cost of biofuels higher than petroleum fuels	Construct Biofuel production facilities with cogeneration capability for plant's in-house energy requirements; Biofuel facilities that can produce other high value products
Increased biofuel production may lead to deforestation, excessive use of pesticides/fertilizers, loss of diversity	Develop new technologies to improve crop yield and biofuel production

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CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
Limited availability of biofuel-ready vehicles	Car manufacturers should produce cars that can use pure or blended biofuels
Biofuel crops displacing food crops in productive lands, hence, compromising food security	Develop biofuel feedstocks such as Jatropha that grows in marginal lands not suitable for food production

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CHALLENGES AND OPPORTUNITIES

CHALLENGES	OPPORTUNITIES
Biofuel crops displacing food crops in productive lands, hence, compromising food security	Accelerate development of other biofuel feedstocks such as crop wastes, grass or municipal waste

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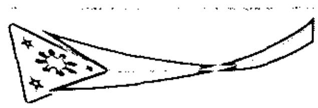

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Thank You and Mabuhay!

SESSION 1-4:

PRODUCT QUALITY & STANDARD SPECIFICATIONS OF BIOFUELS: ISSUES AND DEVELOPMENT

Candace Vona
Hart Energy Consulting, USA

Hart Energy Consulting's International Fuel Quality Center (IFQC) is a provider of market and regulatory data and analyses on both conventional and alternative fuel qualities to organizations all over the world, while the IFQC's Global Biofuels Center (GBC) acts as a central, non-biased source of verified information on the rapidly growing biofuels industry.

Energy security is the number one driver to facilitate growth of global biofuels, followed by supply and sustainability pressures on fossil fuels. Biofuels are not really a threat to the fossil fuel industry but a synergistic opportunity for both sectors to work together to meet the growing demand for transportation. Alternative fuels accounted for only 4% of world transportation fuel demand in 2005, with ethanol comprising 23% and biodiesel 4%.

It is vital that a quality standard be set that guarantees the protection of equipment and engines in which the fuel will operate. A standard is necessary to establish regional and global trade in biofuels and so-called "first generation" biodiesel in particular, but should not preclude potential new sources of low-cost feedstocks. This presentation analyses and presents experience from around the globe of establishing and maintaining a suitable biofuels quality standard.

The quality of biofuels produced depends on the feedstock available and used, e.g. soya for biodiesel and corn for ethanol production in North America. Sugar cane is used to produce ethanol in Brazil. In both Asia and Brazil there are many types of feedstocks for the production of biodiesel. Current blending limits for biofuels are indicated by country on the slides. Ten percent blending is usual with ethanol (E10), while biodiesel limits vary considerably, from two percent (B2) to B100 in some cases.

In the U.S. it has been found that at least half the biodiesel samples on the market were not meeting the basic standard in place, which demonstrates that to have a standard is one thing, but it is also essential to have a fuel quality monitoring system in place to make sure that the standard is actually met.

The EU introduced the biodiesel standard EN14214, which was very thoroughly developed on the basis of the primary feedstock in Europe, rapeseed, but precludes the use of several other potential feedstocks. An ethanol standard known as EN15376 is in the pipeline. In the U.S., biofuel standards are set by the American Society of Testing and Materials (ASTM) and it is essentially not mandatory to follow the standard. However, it is mandatory to follow the federal standard for the finished gasoline and diesel blends.

Asia is not a one-policy region for conventional fuels and certainly not for biofuels. However, conventional fuel quality mainly follows European standards and biodiesel quality has followed a similar path. The 15 member countries at the 2nd East Asia Summit in the Philippines signed the "Cebu Declaration on East Asian Energy Security," working towards harmonization of standards and free trade in biofuels. There are other initiatives underway to discuss a harmonized standard, led by the Asia Pacific Economic Cooperation (APEC) Biofuels Taskforce and the tri-partite discussions between Brazil, Europe and the U.S.

Essentially, Brazil is leading the way in creating a global biofuels market, starting with ethanol. Brazil is also calling for harmonization of ethanol specifications, bringing about such benefits as growth in the international market, turning fuel ethanol into an energy commodity, easier quality assurance, product certification and traceability standardization, as well as wider product acceptance. There is also the "second generation" biofuels debate, which will have some effect on the standards already in place.

In conclusion, performance-based standards are necessary to ensure that biofuels are fit for vehicles, compatible with fossil fuels and can be handled in existing distribution systems.

(info@ifqcbiofuels.org)

1

Product Quality & Standard Specification of Biofuels: Issues and Development

Candace Vona
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Kuala Lumpur, Malaysia, July 5-6
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2

Presentation Overview

- About the GBC
- Drivers and Feedstocks
- Global Overview of Biofuel Standards and Blending Limits
- Technical Issues Affecting Quality
- Overview of EU, US and Asian Biofuel Standards
- Quality Issues and Future Developments
- Conclusion

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3

Who Are We ?

HART — Upstream

Downstream

Hart Energy Consulting

World Refining & Fuels Conferences

Newsletters

FUEL

Multi Client

Single Client

ISEE

- Government Affairs
- Refining Studies
- Fuels Studies
- Feasibility Studies
- Etc

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What is the Global Biofuels Center?

- Provides global data, analysis and reports covering the following topics:
  - Production and consumption of biofuels
  - Existing and planned production facilities and capacities
  - Fiscal policy and incentives
  - Vehicle technology developments as related to biofuels
  - Biofuels legislative and regulatory policy
  - Emerging technologies
  - Biofuel quality specifications and regulations.
- Consultants serve as a resource, facilitator, networker for our members
- Provides a neutral forum to discuss current issues through members-only Briefings, Webinars and other forums
- NOT an advocacy group! We do not take positions but strive to present the best information available on the global biofuels market!

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Global Biofuels Center Membership

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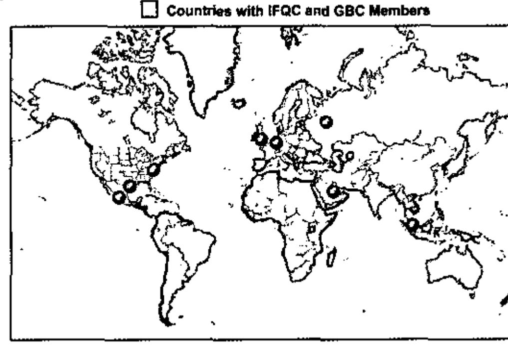
IFQC & Global Biofuels Center: Membership and Coverage Global!

☐ Countries with IFQC and GBC Members



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Common Drivers Facilitating Growth of Global Biofuels

- ❑ Energy security = #1
  - Poverty reduction & rural job creation #2
  - National security
  - Climate change
  - Air quality improvement
  - MTBE & Lead switch out; octane enhancement
- ❑ Global Energy Demand to grow 40% by 2020 = supply & sustainability pressures!
  - Refining Capacity saturated
  - Crude & product supply constraints = record high prices
  - More petroleum use leads to increased GHG emissions
  - CO2 impact on Climate Change
  - Carbon Credit Trading Opportunities for biofuels

Observations:

- ✓ Drivers are cross-cutting issues that affect developed and developing countries alike
- ✓ Biofuels can generally be used in the existing liquid fuel infrastructure
- ✓ Conventional vehicles easily adapted for biofuel use in most cases

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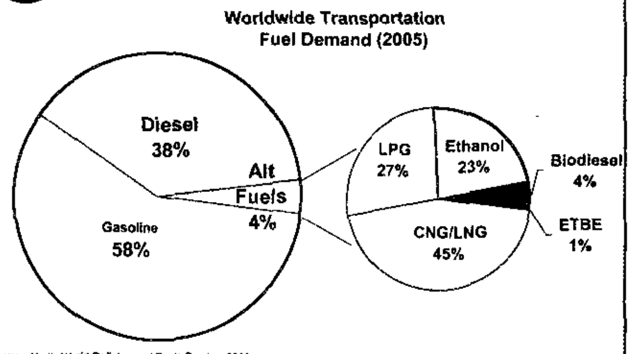
Biofuels v. World Transportation Fuel Demand



Source: Hart's World Refining and Fuels Service, 2006

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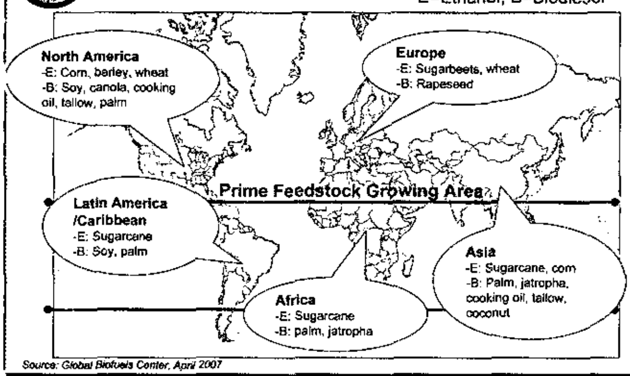
Common Biofuels Feedstocks

E=Ethanol, B=Biodiesel



Source: Global Biofuels Center, April 2007

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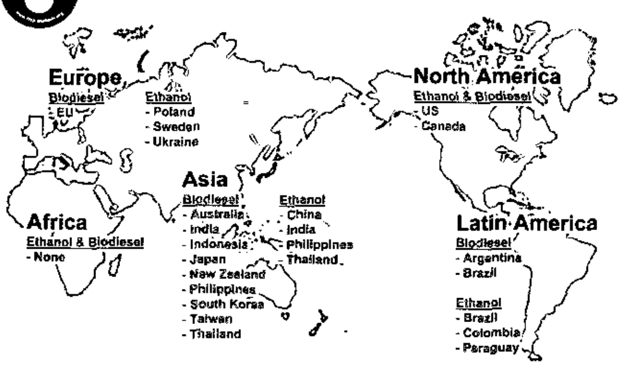
Countries With Biofuel Standards



Source: Global Biofuels Center, June 2007

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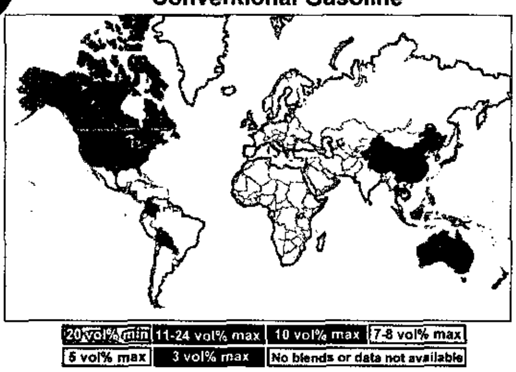
Current Ethanol Blending Limits for Conventional Gasoline



20 vol% min | 11-24 vol% max | 10 vol% max | 7-8 vol% max | 5 vol% max | 3 vol% max | No blends or data not available

Source: Global Biofuels Center, March 2007

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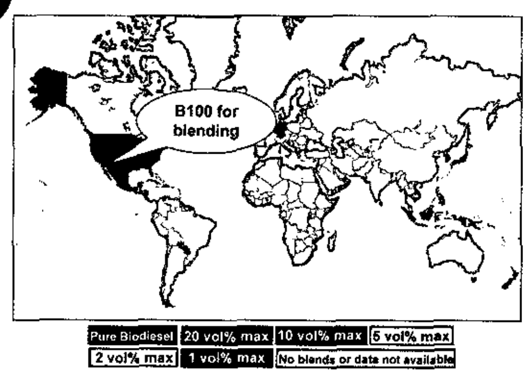
Current Biodiesel Blending Limits



Pure Biodiesel | 20 vol% max | 10 vol% max | 5 vol% max | 2 vol% max | 1 vol% max | No blends or data not available

Source: Global Biofuels Center, March 2007

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Technical Issues Affecting Quality
Examples Abound Globally!

- **Labeling**

Sampling in the U.S. found at least half of biodiesel samples out of spec for the basic standard in place!

- **Must enable vehicles to meet emission rules**
- **Permeation issues related to ethanol**
- **Ethyl sulfate issue related to ethanol**
- **Corrosion & acid value**
- **Injector fouling**

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EU Biodiesel Standard

- CEN Task Force worked on a Biodiesel specification - EN 14214: 2003 (FAME)
  - methyl ester based on knowledge of existing oils, mainly rapeseed, sunflower
  - involved experts from Auto, Oil, Agricultural industries
  - fuel can be used at 100% in adapted vehicles, or as a blend component in conventional diesel fuel
    - ✓Used up to 5 vol %(B5) in EN590 diesel fuel
    - ✓Used up to 20 vol% (B20) & 30 vol% (B30) in captive fleet
    - ✓Used as a finished fuel 100 vol% (B100) in Germany for adapted vehicles

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EU Bioethanol Standard Progress

- CEN Taskforce working on European ethanol standard since 2004, now practically finished:
  - known as pr EN 15376
  - involves experts from Auto, Oil, Agricultural industries
  - specifies ethanol as a blending component at up to 5 vol%
  - many new measurement standards developed
  - takes into account specific requirements of ethanol distribution and use in Europe:
    - ✓**low water content**
    - ✓**range of non-harmful denaturants**
    - ✓**level of impurities that will not harm exhaust gas treatment systems when used at up to 5%**
  - Draft Standard to be released Summer 2007

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Future Trends for EU Biofuels Standards

- Engine technology is being driven to high levels of sophistication due to:
  - customer expectations for drivability power, low maintenance
  - reduced fuel consumption / CO_2 (130 mg CO_2/km by 2012)
  - increasingly severe exhaust emissions regulations (Euro 5 & 6)
  - more space for vehicle occupants / less space for engines
  - down-sizing engines
- The Auto Oil Programs have shown that engines are sensitive to fuel quality. So engine progress must be matched by progress in fuel quality to adapt fuels to engine needs.
- The presence of biological components add an extra set of fuel characteristics that may compromise good engine drivability and durability.

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US Biofuel Standards

- The American Society for Testing and Materials (ASTM) sets standards for
  - Denatured fuel ethanol (ASTM D 4806-06a)
  - Biodiesel (ASTM D 6751-06b)
- E85: seasonally adjusted to ensure proper starting and performance in different geographic locations
  - California sets its own specifications for E85
- No approved B100 specifications; generally not recommended by manufacturers for use in existing engines
- ASTM D 6751 is the specification for biodiesel fuel blendstock (B100) for blending up to 20 vol%
- The Defense Energy Support Center (DESC) already had its own B100 specifications prior to the adoption of ASTM D 6751
  - Difference between DESC specifications and ASTM D 6751 is that DESC requires blend components to meet separate specifications for both the diesel fuel under ASTM D 975 and D 6751, as well as to adhere to DESC's blending procedures

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Asian Biofuel Standards

- Diverse, not a "one-policy" region
- Conventional fuel quality mainly follows EN standards; biofuel quality also similar path
- Japan: JAMA/METI findings that neither ASTM nor CEN biodiesel standards are acceptable standards for Japan because of oxidation stability, corrosion and acid value
- Promoting biofuels through international and regional cooperation:

  1. ***Asia-Pacific Economic Cooperation (APEC) Biofuels Taskforce (2006)***
     - To carry out two projects in 2007:
       - ✓ Establish "Guidelines for the Development of Biodiesel Standards in the APEC Region"
       - ✓ Establish "Alternative Transport Fuels Policy Options for APEC Economies"
  2. ***2nd East Asia Summit (Philippines, January 2007)***
     - 15 member countries signed the "Cebu Declaration on East Asian Energy Security"
     - Working toward harmonization of standards and free trade in biofuels

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Comparison of Biodiesel Specifications

BIODIESEL (alphabetical)	CANADA	EU	JAPAN	PHILIPPINES	US
	CAN/CGSB-3.520-2005 (1)	EN 14214:2003 (1)	Voluntary	PNS 2020:2003 (1)	ASTM D 6751-06b (1)
Biodiesel Type	Type A-LS / Type B-LS (2)				S15 / S500
Year of Implementation	***2005***	***2003***	***March 2007***	***March 2004***	***2006***
Cetane Number, min	*40*	*51*	*51*	*42 (2)*	*47*
Ester content, wt%, min	-	96.5 (2)	96.5	-	-
Sulfur, ppm, max	500	10	10	500	15 / 500 (2)
Density at 15°C, kg/m³, min-max	-	860 - 900	860 - 900	-	-
Viscosity at 40°C, cSt, min-max	1.3 - 3.6 / 1.7 - 4.1 (3)	3.5 - 5.0	3.5 - 5.0	2.0 - 4.5	1.9 - 6.0
Flash point, °C, min	40 (4)	120	120	100	130
CCR, 100%, wt%, max	-	-	-	0.05	0.05
10%, wt%, max	*0.10*	*0.3*	*0.3*	-	-
Water and sediment, vol%, max	0.05	-	-	0.05	0.05
Water, ppm, max	-	500	500	-	-
Ash, wt%, max	0.01	0.02	0.02	0.02 (3)	0.02 (3)
Total contamination, ppm	-	24	24	-	-
Copper corrosion (3hr at 50°C), max	No. 1	Class 1	Class 1	Class 3	No. 3
Acid value, mg KOH/g, max	0.01	0.5	0.5	0.5	0.5
Methanol, wt%, max	-	*0.2*	*0.2*	-	-
Monoglycerides, wt%, max	-	0.8	0.8	-	-
Diglycerides, wt%, max	-	0.2	0.2	-	-
Triglycerides, wt%, max	-	0.2	0.2	-	-
Free glycerides, wt%, max	-	0.02	0.02	0.02 (2)	0.02
Total glycerine, wt%, max	-	0.25	0.25	0.24 (2)	0.24
Linoleic acid methyl esther, wt%, max	-	12	12	-	-
Polyunsaturated methyl esther, wt%, max	-	1	1	-	-
Iodine number, max	-	120	120	-	-
Phosphorus, ppm, max	-	10	10	10	10
Alkali, (Na+K), ppm, max	-	5	5	-	-
Metals, (Ca+Mg), ppm, max	-	5	5	-	5
Distillation T90, °C, min-max	290 / 360 max	-	-	360 max	360 max
Cold Filter Plugging Point, CFPP, °C, max	-	+5 to -44 (3)	(1)	-	-
Oxidation stability at 110°C, hour, min	-	6	(1)	-	3
Sodium & potassium, combined, ppm, max	-	-	-	-	5
Cloud Point °C	-	-	-	Report	Report (4)

⇧ ⇧ (EU, JAPAN)

More stringent than the others!

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Comparison of Fuel Ethanol Specifications

FUEL ETHANOL (alphabetical)	BRAZIL	CHINA	INDIA	SWEDEN	U.S.
	ANP Regulation	GB 18350:2001 (1)	IS 15464:2004 (1)		ASTM D 4806-06c (1)(2)
Fuel Ethanol Type	Anhydrous (1)			Anhydrous / Hydrated (1)	Denaturated ethanol
Year of Implementation	***Jan. 2002***	***April 2001***	***2004***	***Current***	***2006***
Ethanol, vol.%, min	99.3	92.1	99.5	99.8 / 95.8	92.1
Water, vol%, max	-	0.8	(2)	0.3 / 6.5	1 (3)
Density at 20°C, kg/m³, max	791.5	789 - 792	796	790 / 808.4	-
Flash point, °C, max	-	-	-	+12	-
Refractive Index, R2°, min	-	-	-	1.3618 / 1.3630	-
Gum, solvent washed, mg/100ml, max	-	5	-	-	5.0
Chloride, mg/l (ppm), max	-	32	-	-	40 / 32
Copper content, mg/l (ppm), max	0.07	0.08 (2)	0.1	-	0.1
Methanol, vol.%, max	-	0.5	(3)	0.002	0.5
Acetic Acid, g/l, 100% EtOH, max	0.03	0.056	0.03	0.0025 (2)	0.007 / 0.056
Aldehydes, g/l, 100% EtOH, max	-	-	0.06	0.0025 (2)	-
Amyl Alcohol, g/l, 100% EtOH, max	-	-	-	0.05	-
Non-volatile matter, g/100ml, max	-	0.005	0.005	0.01	-
Color, APHA, max	-	-	-	5 (2)	-
Denaturant, vol% min-max	3.0 (5)	1.96 - 4.76 (3)	(4)	-	1.96 - 4.76 (4)
Sulfur, ppm, max	-	-	-	-	30
Electrical Conductivity, µS/m, max	500	-	300	-	-
Appearance	-	*Clear & Bright*	*Clear & Bright*	Clear without particles	Clear & Bright
pH	-	6.5 - 9.0 (4)	(5)	-	6.5 - 9.0

⇧ (SWEDEN)

More stringent than the others!

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Bioethanol Quality Issues

Positive	Negative / Concerns
✓Higher O2 content (better combustion and lower emissions) ✓Octane booster	✓ Increased volatility (RVP): evaporative emissions impact ✓ Water content increased corrosion of components water separation, engine damage ✓ Higher solvency: materials compatibility and permeability ✓ Residual acidity ✓ External Contamination ✓ Valve deposits/ additive compatibility (E85) ✓Sulfates (fuel metering systems, cause filter plugging and injector fouling)

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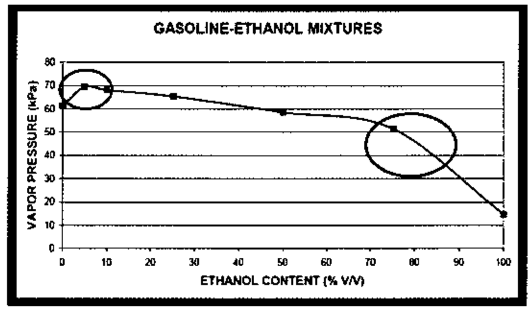
RVP and Ethanol Content in Gasoline



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Biodiesel Quality Issues

Positive	Negative / Concerns
✓Lubricity ✓Cetane	✓Increases nitrogen oxides emissions ✓ Higher solvency: Problem of materials compatibility and permeability ✓Physical state of biodiesel component depends on **feedstock**: Rapeseed : liquid @ 0°C - Palm oil: solid @ 0°C, iodine levels (rapeseed: 110-115, soja 125-140mg) ✓**Cloud point and cold flow**: impact on CFPP and additive performance (cold weather conditions) ✓**Oxidation stability:** increases deposits in engines and in storage ✓Higher boiling components: potential to enter lubricant system ✓Ash and other contaminants picked up in manufacturing and transport

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International Conference on Biofuels Standards Conclusions:

- Ensure "fit for purpose" performance
- One standard or separate for low & high blends (eg. E85)?
- No discrimination of feedstock without technical reason
- Enable designing new vehicle technologies to meet today's and tomorrow's emissions
- Reliable quality requirements
- Differing manufacturing and distribution, vehicle mix and equipment
- Stable reference materials
- Effects on lubricants; use of additives
- Simple and harmonized test methods. Test methods suitable for all feedstock & reflecting fuel performance
- Cloud point and cold flow important for biodiesel
- Improved oxidation stability (test) needed for biodiesel
- Ash and other contaminants picked up in manufacturing and transport

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Trend: Global Trade of Biofuels? *Brazil Leading the Way...*

- Driving the creation of a global biofuels market – mainly on ethanol, but will include biodiesel as well.
- Brazilians calling for harmonization of ethanol specifications, bringing about following benefits:
  - Key for international market growth
  - Key for turning fuel ethanol into an energy commodity
  - Easier quality assurance
  - Product certification & traceability standardization
  - Wider product acceptance
- Also calling for lifting of tax barriers that are preventing growth of global trade market, e.g., U.S. tariff
- International Biofuels Forum
- U.S.-Brazil Partnership: What's it all about?

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Trend: "Second-Generation" Biofuels *Example: Renewable Diesel*

- Example: Renewable diesel, green diesel or biomass-to-liquids (BTL)
- Tests are showing:
  - ➢ Higher quality diesel fuel: free of sulfur and aromatics, very high cetane
  - ➢ Uses diverse feedstocks, can help avoid "food v. fuel"
  - ➢ Fits into distribution and logistics infrastructure
  - ➢ Reduces exhaust and GHG emissions
  - ➢ No storage issues
  - ➢ First plant being built by Neste Oil/Total in Porvoo, Finland
- Accepted as biodiesel in Europe and Brazil, but not the U.S.

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Conclusions: Ensuring Biofuel Product Quality

Standards are necessary to ensure that biofuels are fit for purpose for vehicles, fuels and fuel distribution systems!

- **Ethanol:**
  - Standards:
    - EU standard for higher blend (E85)
    - US- Ethyl sulfate issue pending before ASTM
  - Consumer Confidence:
    - Japan: Gaiax incident – litigation – lack of consumer confidence
    - Australia: Lack of consumer confidence
    - Brazil: Adulteration
  - EU: RVP and permeation issues being discussed
- **Biodiesel:**
  - Japanese METI findings that neither ASTM nor CEN standards are acceptable standards for Japan because of oxidation stability, corrosion and acid value.
  - EU: EN14214 iodine issue, stability issues reported by refiners, AGQM founded to survey quality. New EU EBB system
- **Global Trading and Standards Harmonization**
- **Second Generation Biofuels**

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THANK YOU !

http://www.ifqc.org

http://www.ifqcbiofuels.org

http://www.hartwrfs.com

ISEE http://www.hart-isee.org

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SESSION 1-5:

BIOETHANOL: THE BRAZILIAN EXPERIENCE

Osvaldo Kawakami
Petrobras Tokyo Office, Japan

Petrobras is an integrated Brazilian energy company operating from upstream to downstream in the oil and natural gas sectors and has gone into the field of renewable energy, including bioethanol and biodiesel.

The Brazil Ethanol Program started back in the 1920s when a car was tested to see if it would operate on fuel containing 10 percent blended ethanol. In 1929 a car was driven the 500 km from Sao Paulo to Rio de Janeiro without any problems on 100 percent bioethanol produced commercially in Brazil. Two oil shocks in the 1970s – at a time when the country was an oil importer – stimulated Brazil's search for a solution with alternative fuels that might be available domestically in a country with enough arable land to cope with growing needs for energy as the country developed. In 1979 Brazil started to produce the car that could run with 100% ethanol engines (Fiat). Now, Brazil is the biggest exporter of bioethanol in the world and the second biggest producer of bioethanol, only after the USA.

Constant technology development led to the launching in 2003 of the Flex Fuel Vehicle (FFV), which can run on 100% gasoline or 100% bioethanol or any mixed proportion of the two. Brazilian consumers now have a choice of fuels at the gas station. During the year from May 2005 to April 2006, one million new FFVs were sold in Brazil and FFVs accounted for almost 80 percent of the new cars sold in the month of April 2006. Soon, FFVs will comprise 90% of total car sales in Brazil.

Some people argue that Amazon rain forest is being destroyed as more ethanol is being produced from sugar cane. I do not believe this to be the case because in fact Brazil's sugar production is focused on the states of São Paulo, Alagoas, Parana, Minas Gerais and Mato Grosso and not on the Amazon rain forest area, as the slide shows.

Why is sugar cane used so extensively as a feedstock for ethanol? It is simply because the energy balance is best with it. More specifically, with 1 unit of energy input, sugar cane grown in Brazil can be converted into ethanol that has 8.3 units of energy. If corn produced in the USA is converted into ethanol, with 1 unit of energy input, only 1.3 to 1.8 units of energy output results. There is a significant difference in the energy balance in favor of sugar cane as the feedstock relative to other kinds. Besides, the cost of producing one liter of ethanol from sugar cane in Brazil is U$0.20, whereas in the USA and India it is more than US$0.30 and more than US$0.50 in Europe.

Some argue that bioethanol should also be produced in Japan. However, land there costs 20 times or even more than land in Brazil. Brazil has about 90 million hectares of land available to develop new plantations, with low negative impact on the environment and ecology. It makes more economic sense for Japan to buy bioethanol from Brazil rather than producing it domestically. Petrobras has been investing in the construction of pipelines and marine terminals to ensure reliable transportation of bioethanol for export.

There are countries that are endowed with biomass resources and wish to start production of bioethanol in a sustainable way, thus reducing dependence on imported fossil oil. Petrobras possesses experience, knowledge and technology and is open to transfer technology. Therefore it has been establishing strategic partnerships with those countries, which include Indonesia, Mozambique, Chile, Colombia, Italy, Tanzania, Angola and others, to help them achieve their wishes.

(osvaldo-kawakami@petrobras-japan.com)

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Sustainable Transport Fuel 2007

PETROBRAS

Agenda:

- PETROBRAS Overview;
- The Brazilian Ethanol Program;
- Feedstock resources and prospects;
- Brazil the hub for bioethanol production in the world;
- Final Remarks;

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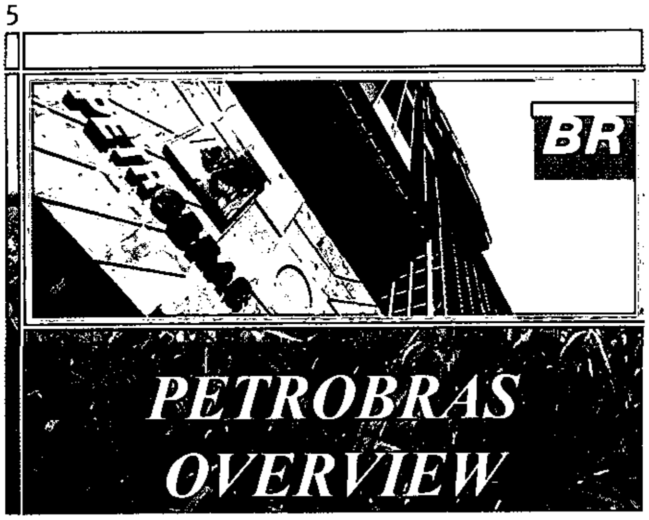

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Integrated Energy Company

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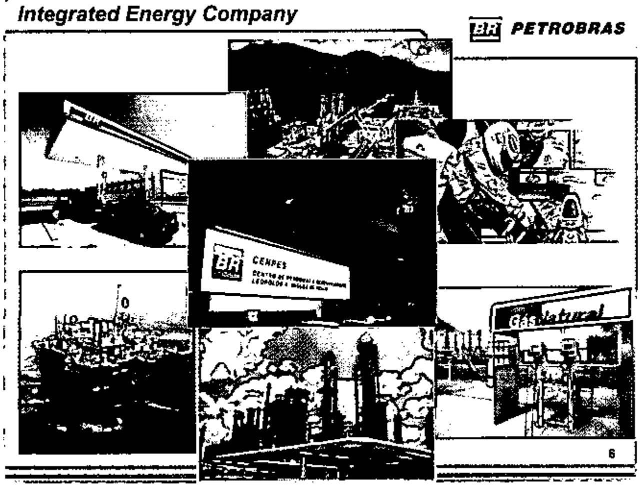

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PETROBRAS in the world

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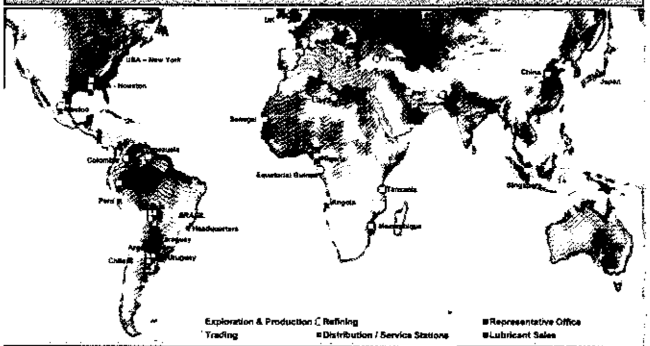

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PETROBRAS in Numbers

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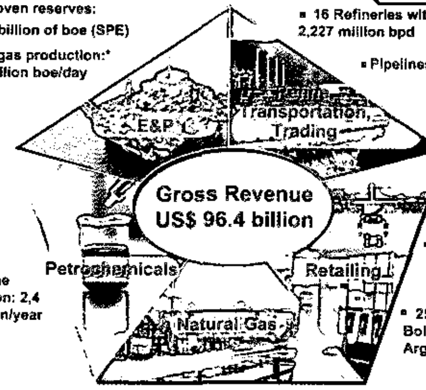
- proven reserves: 13.7 billion of boe (SPE)
- oil and gas production:* 2,297 million boe/day
- 16 Refineries with a capacity of 2,227 million bpd
- Pipelines: 30.318 km
- 6,154 gas stations in Brazil (33% of retail market)



- ethylene production: 2,4 million ton/year
- 727 gas stations in Argentina
- 25% of retail market in Bolivia and 14% in Argentina
- gas sales: 32 million m³/day

*Brazil and abroad

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THE GLOBAL COMPACT

- Launched in 2000, the Global Compact is the world's largest voluntary corporate citizenship initiative. It involves upwards of 3,000 institutions, more than 100 countries and some 50 networks that seek to promote the Pact's principles nationally, regionally, and internationally. The Global Compact brings business together with UN agencies, labor, civil society and governments to advance universal principles in the human rights, labor standards, environmental protection, and anti-corruption areas

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PETROBRAS AND THE GLOBAL COMPACT

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THE GLOBAL COMPACT

GC Board Members in 2007

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Vice Chairmen Talal ABU- GHAZALEH	Chairman and CEO, Talal Abu-Ghazaleh Organization, Egypt

Members:

Sir Mark MOODY-STUART	Chairman, Foundation for the Global Compact Business
José Sergio Gabrielli de AZEVEDO	President and CEO, Petrobras, Brazil
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Ntombifuthi MTOBA	Chair of the Board, Deloitte, South Africa
B MUTHURAMAN	Managing Director, Tata Steel, IndiaMads
OEVLISEN	Adjunct Professor, Copenhagen Business School Chair, Lego, Denmark
Hiroyuki UEMURA	President, Mitsui Sumitomo Insurance Co., Japan

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BRAZILIAN ETHANOL PROGRAM

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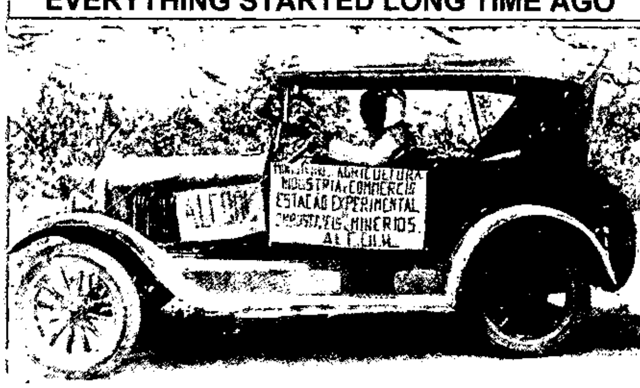
EVERYTHING STARTED LONG TIME AGO



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Why ethanol became a fuel in Brazil?

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First car operating 100% ethanol (Fiat) – 1979 →

- Brazil was an oil importer
- The two oil shocks had an enormous impact in the Brazilian economy
- Looking for an alternative and internal solution
- Development demands energy consumption
- Arable lands availability

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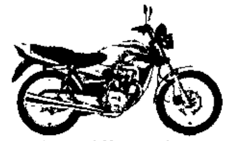
FUEL ETHANOL USE IN BRAZIL

National / Imported Vehicle E100 or E20/E25 or FFV



National Motocycle or Imported E20/E25

National or Imported Boats E20/25

Aviation – E100

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Ethanol use in Brazil

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Fuel Ethanol Program Evolution

70's	80's	90's	00's	Future
Ethanol Program Implanted (BLENDS)	Gasohol and Ethanol Cars (2nd oil shock)	Program of Emission Controls (PROCONVE)	Gasohol and Flex fuel Cars	Renewable Hydrogen

Program for oil imports reduction → Environmental Benefits

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Ethanol addition into gasoline

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- 1930 blending depending of the harvest yield
- 1979 20% v/v addition variable
- 1980 20% v/v addition continuously
- 1982 increase to 22% v/v continuously
- 1988 reduction to 18% in some regions
- 1993 blending by law (22% v/v)
- 2001 blending between 20 to 24% v/v (*)
- 2002 law fixing the addition of 20 min. to 25% max. v/v*
- 2003 launched flex-fuel-vehicles (FFV)

(*) in accord to ethanol availability

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Ethanol: Learning Curve

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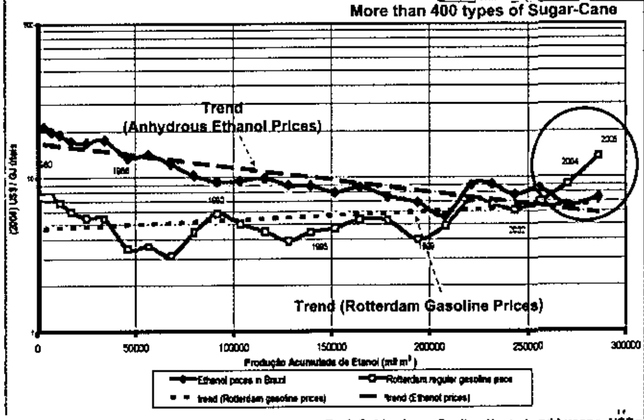

Prof. Goldemberg; Coelho; Nastari and Lucon – USP

18

Flex Fuel Vehicles in Brazil

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- Good conditions to produce ethanol
- Ethanol Producers and Government are interested
- Consumers want to decide which fuel to use at the gas station
- Government and Consumers are aware of pollution and renewable fuels
- Automobile producers are interest in producing
- FFV vehicle start to sell in April 2003

TOYOTA FIAT RENAULT Mercedes-Benz

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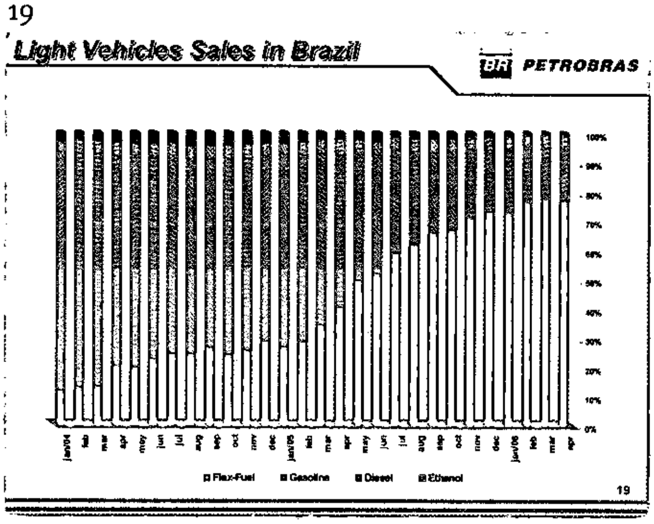

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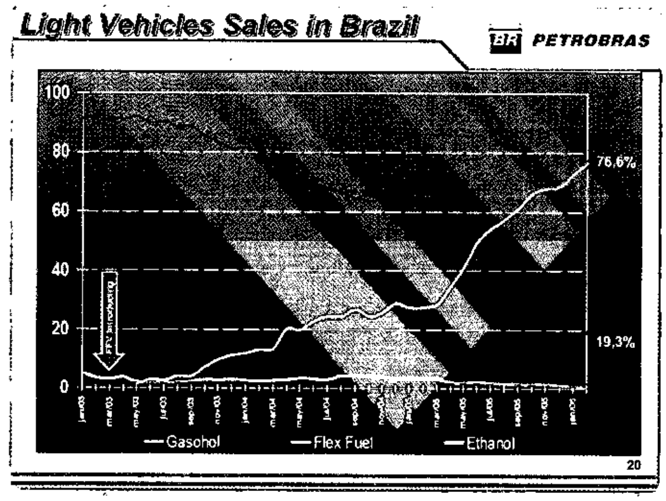

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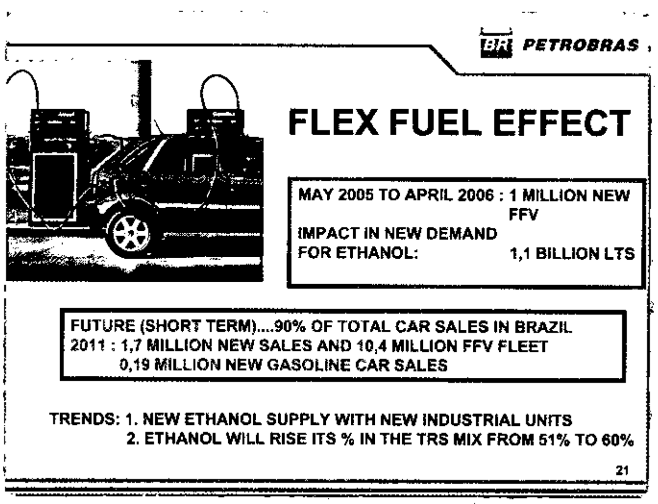

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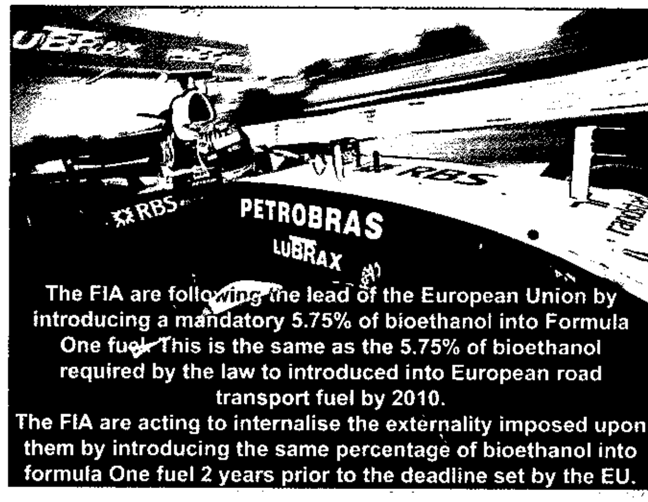

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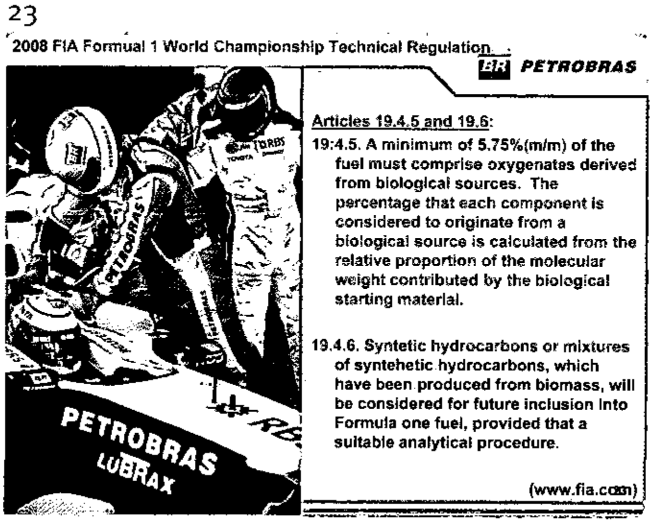

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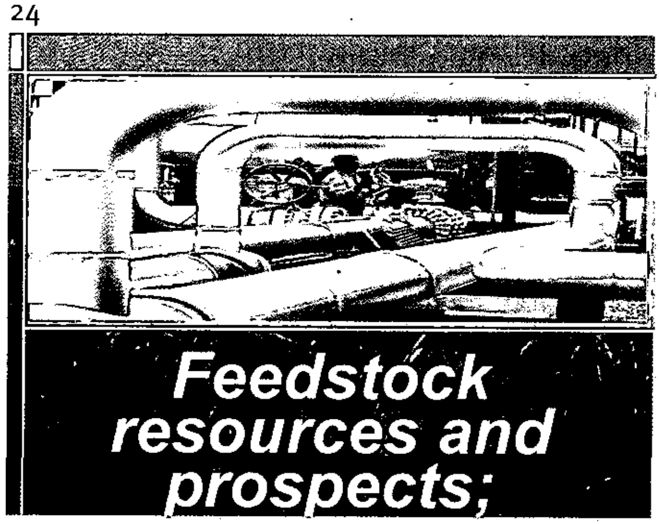

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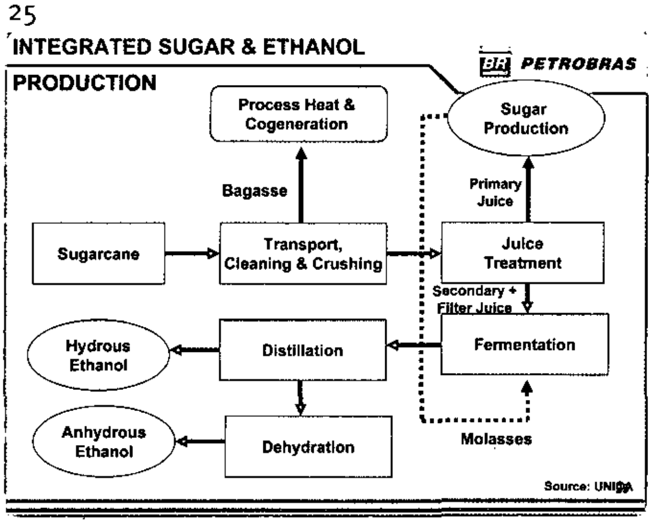

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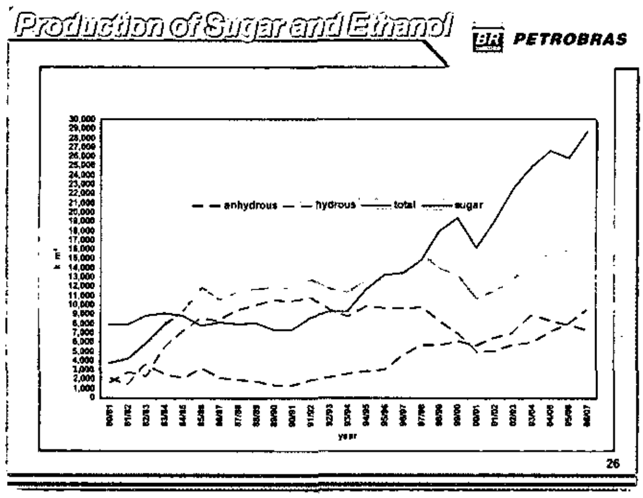

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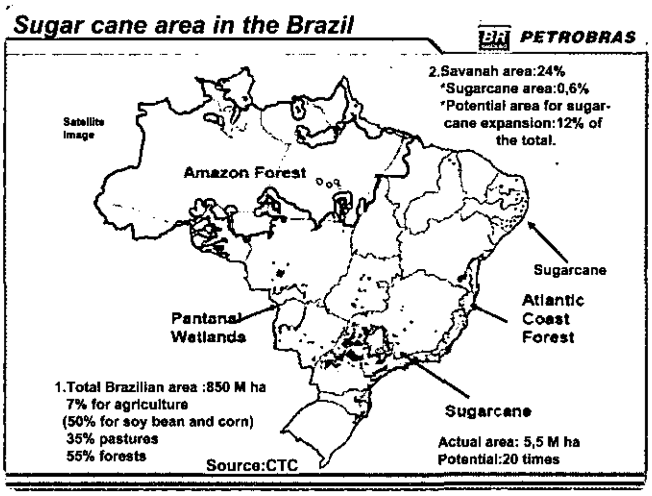

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Feedstock resource and prospects PETROBRAS

Raw Material Comparison

Raw Material	Energy Output / Energy Input
Wheat	1.2
Corn	1.3 – 1.8
Sugar Beet	1.9
Sugar Cane (under Brazilian production conditions)	8.3

In the IPCC Intergovernment Panel on Climate Change meeting at Bangcok on May 04th~06th 2007, it was recognized the advantage of the Sugar Cane over the corn as raw material for Ethanol production.

Prof. Dr. Isaia Macedo - UNICAMP

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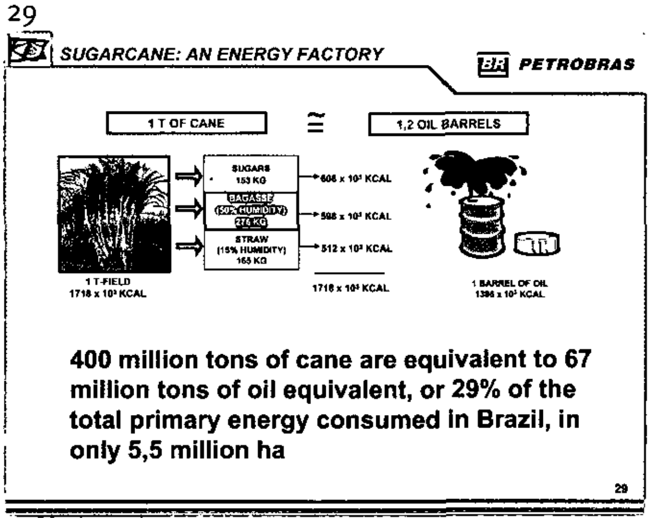

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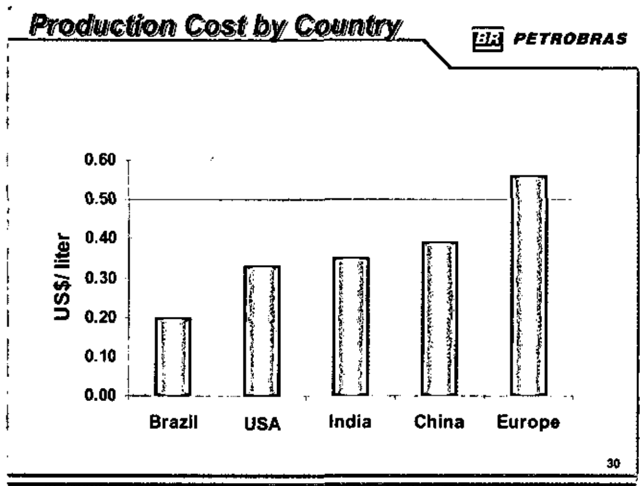

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Adequate Soil and Climate for Sugar Cane Production in Brazil >>>Including Irrigation System<<<

Source: UNICAMP/CT

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Development of new Regions

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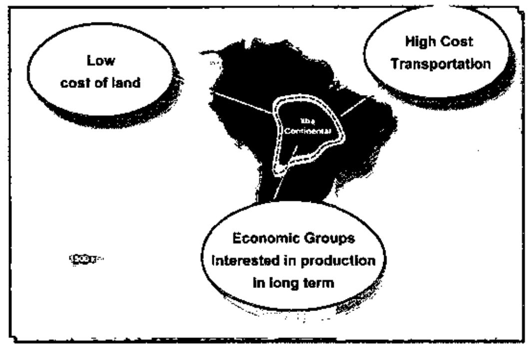

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Land use in Brazil

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Type	Area (Mha)
Total Country	851
Native Amazon Forest	370
Secondary Amazon Forest and Others	180
Native Forests	6
Pasture	197
Temporary Cultures	59
Permanent Cultures	7.6
Available land	263
Available land with low impact (*)	90

Souces: FAO, 2002 and Embrapa(*)

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BIOENERGETIC COMPLEX

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- Sugar Cane plantation;
- Ethanol Industry;
- Biodiesel Industry;
- Thermoelectric Power plant;
- Carbon Credit;

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Petrobras Marine Terminals

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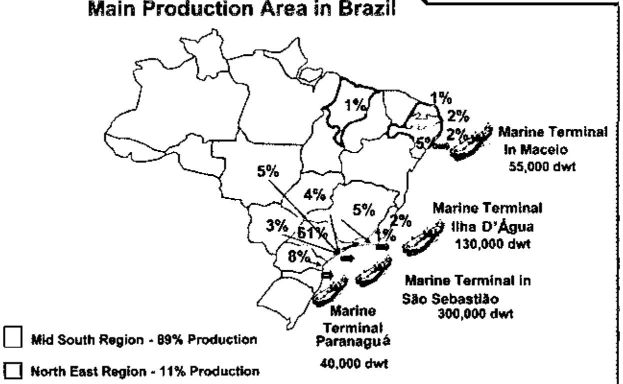
Main Production Area in Brazil



Source: Brazilian Government

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Ilha DÁgua MarineTerminal

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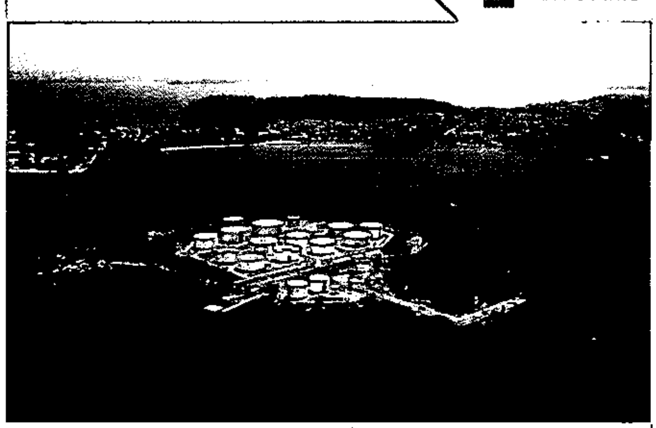

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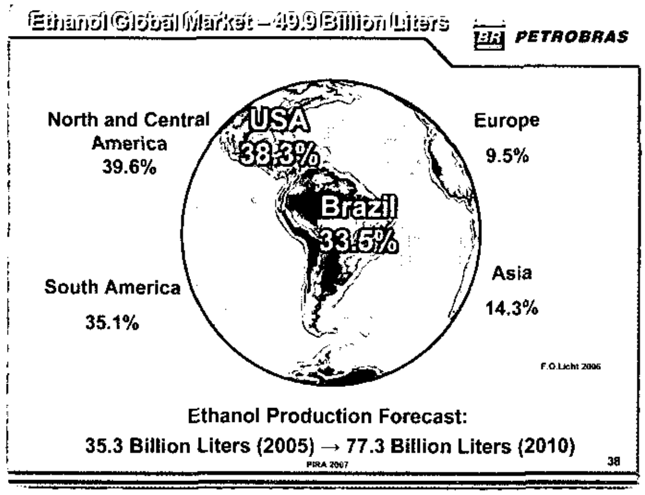

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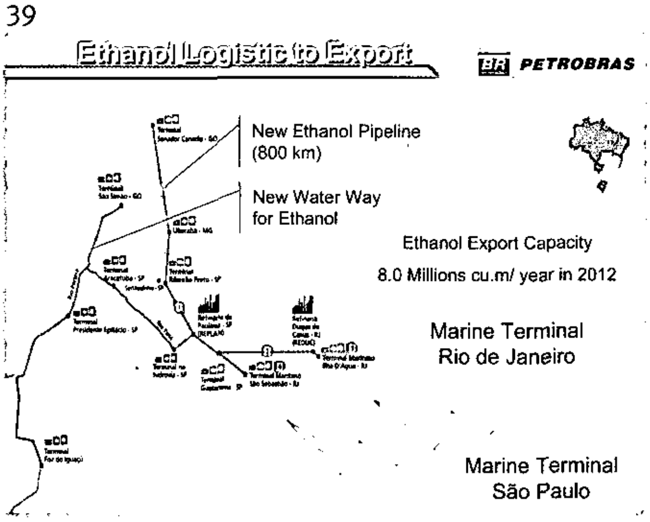

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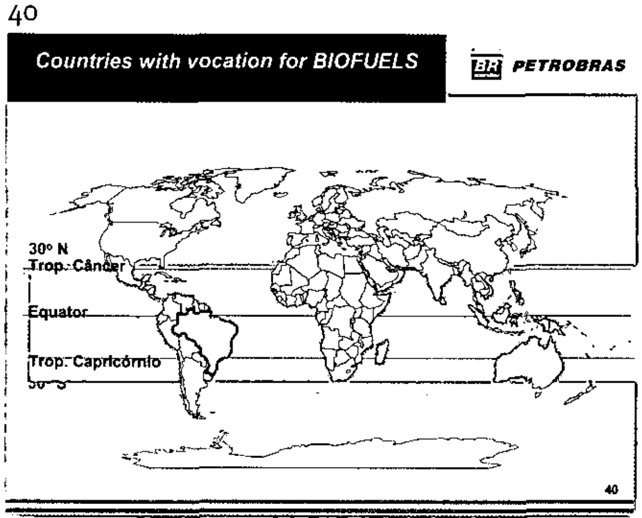

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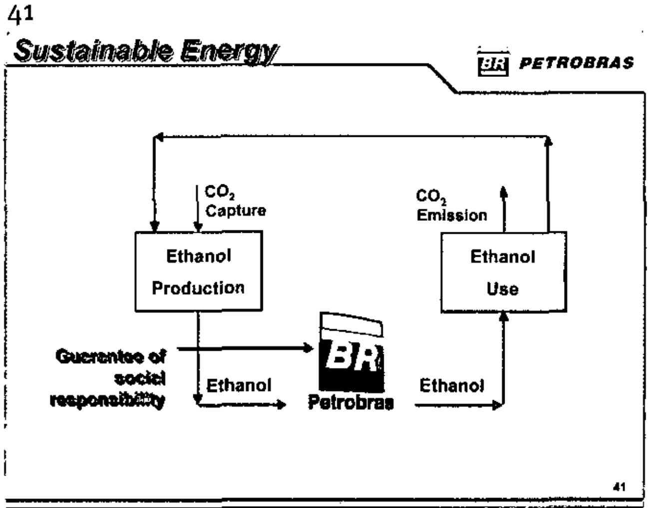

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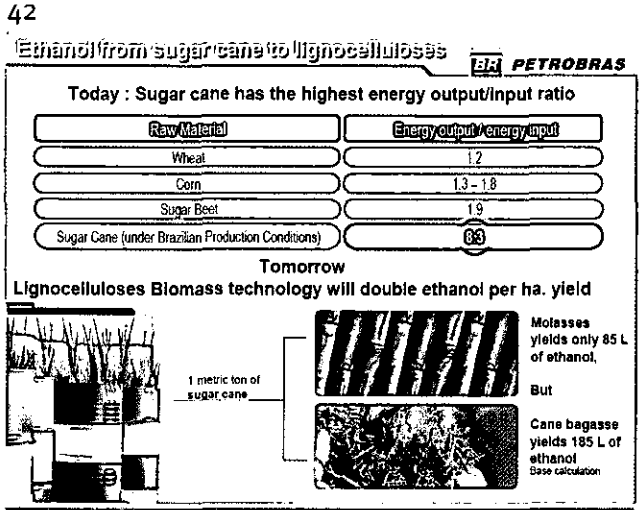

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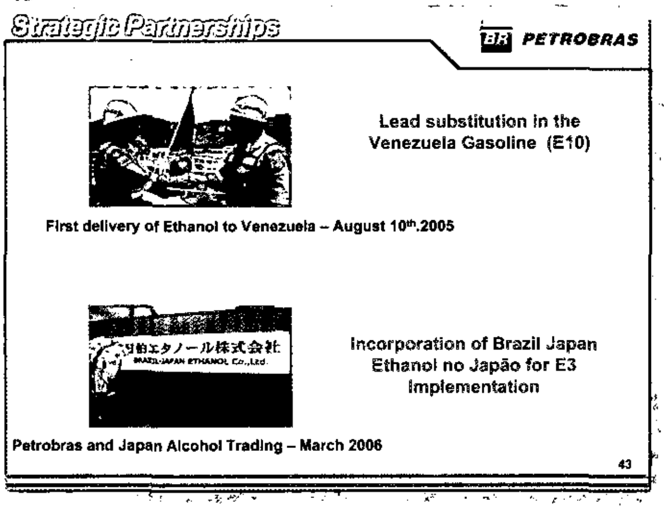

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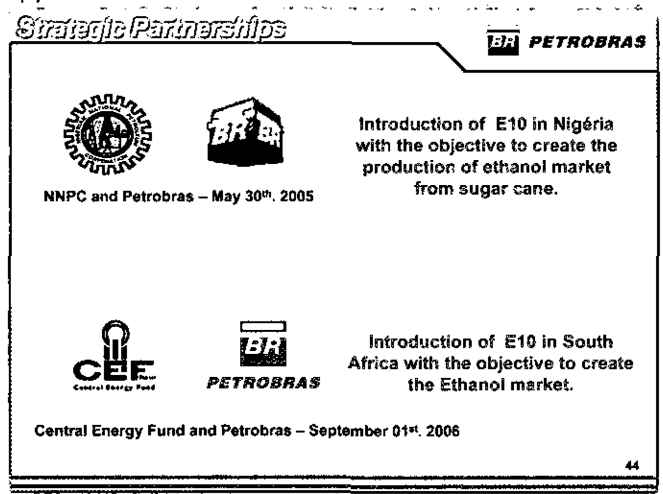

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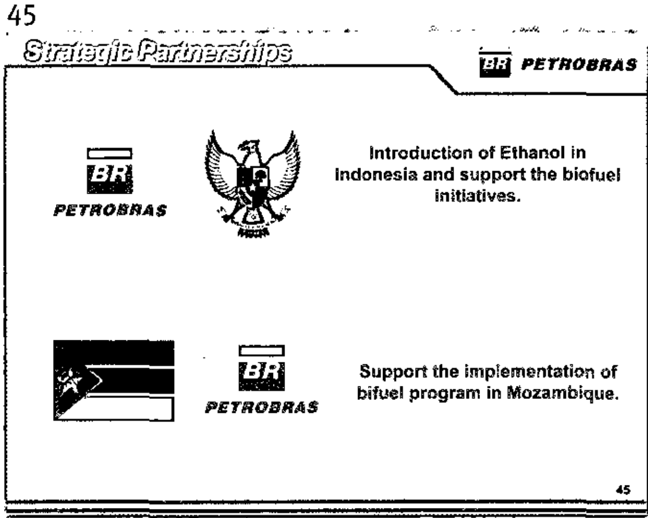

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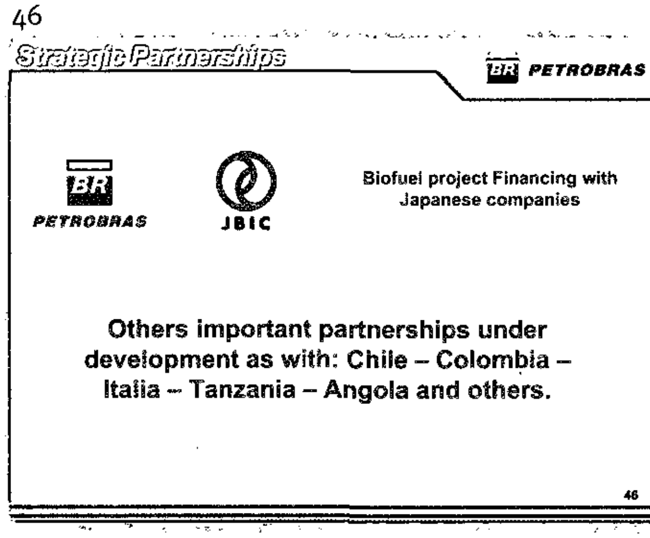

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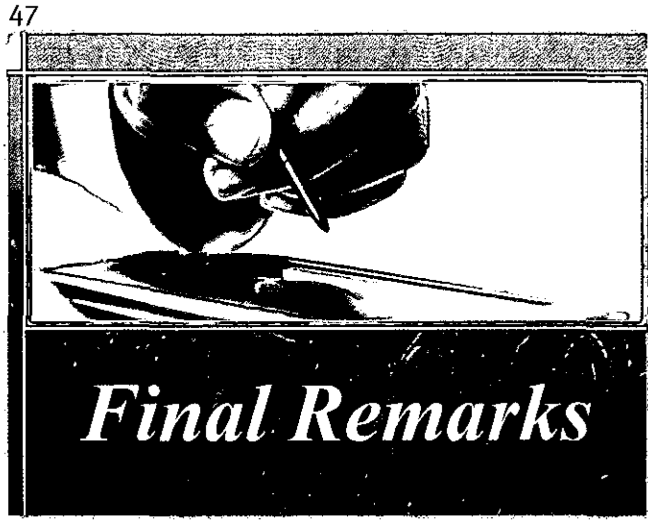

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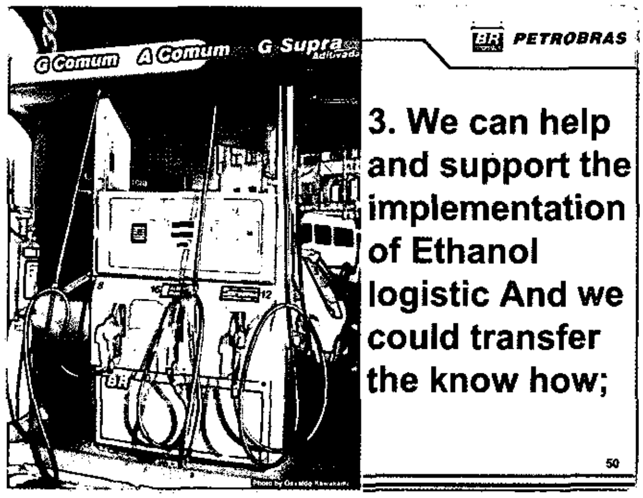

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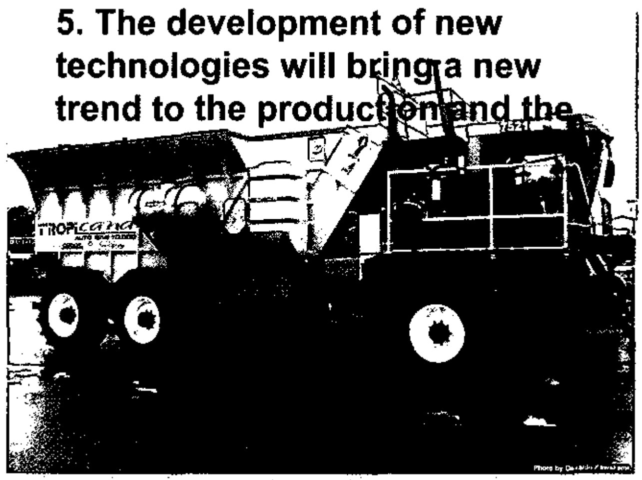

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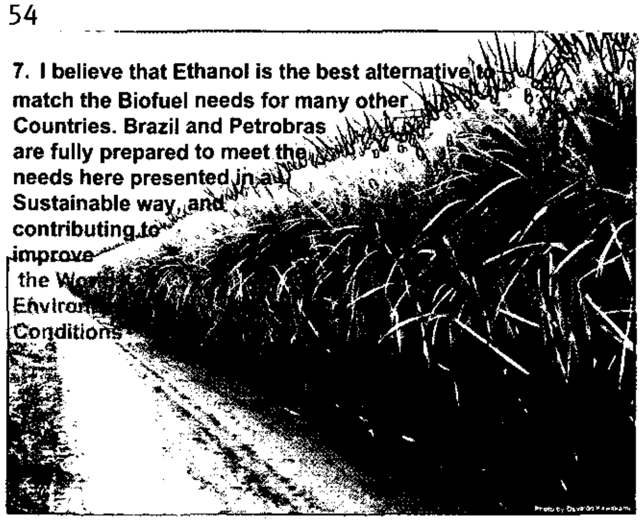

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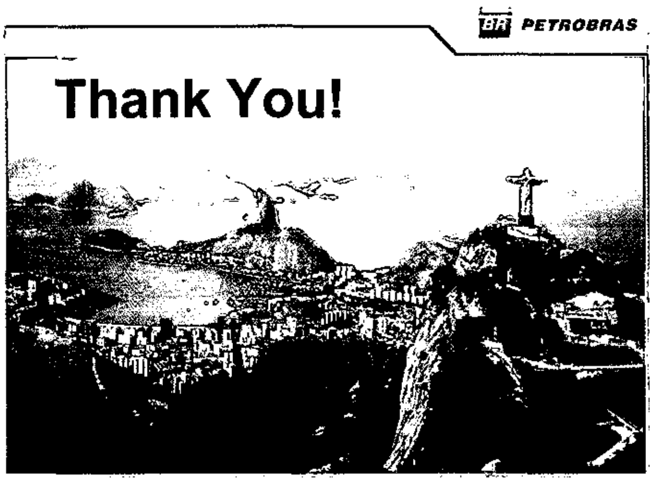
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Thank You!

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SESSION 2 - SUPPLY, DEMAND, ECONOMICS AND SUSTAINABILITY OF BIOFUELS

Session Chairperson

Tan Sri Datuk Dr. Augustine S.H. Ong

President

Malaysian Oil Scientists and Technologies Association, Malaysia

SESSION 2-1:

THE FUTURE IMPACT OF BIOFUELS ON WORLD AGRICULTURE

James Fry
LMC International Ltd., UK

The aim of this presentation is to consider the four main respects in which the development of biofuels has affected the world agricultural economy so far and how it will affect it in the future:

1. the behaviour of agricultural product prices and their links with fuel prices,
2. the competition between food and fuel uses of agricultural products,
3. the implications of alternative biofuel crop choices for land use, and
4. policy dilemmas and inconsistencies.

There is a close relationship between world sugar, Brazilian ethanol and Brent crude prices, as Brazil has effectively pulled world sugar and fuel markets together. Brazilian sugar mills switch their production frequently between sugar and ethanol, the effect being the linking of the two sets of prices. Unlike with sugar, though, a biofuel link has not yet tied most vegetable oil prices to crude oil prices except for rapeseed oil, which exhibits the closest link among the vegetable oils. Biodiesel demand is not yet large enough to influence the entire structure of product prices, but this may be changing.

As far as the food versus fuel split is concerned, the fuel uses of the vegetable oils have been growing around the world since 1999 more than their food uses. There are as yet no commodities in which the biofuel share is more than 50%. Rapeseed oil, however, is approaching a point where one third of its worldwide output is destined for fuel uses owing to heavy use in Europe. Empirically, a threshold of 10% of world output destined for biofuel use seems to be the point at which vegetable oil and crude mineral oil prices start to move closer together, with only sugar and rapeseed oil above this percentage.

Alternative choices of biofuel crops are going to affect the demand for extra land for biofuels due to differences in yield. If you want to minimize the world's land requirements in pursuit of higher blendings, you go for the most efficient crops: sugar cane for ethanol and oil palm for biodiesel. If a 5% ethanol blend is to be achieved in 2015 by expanding only the area for sugar cane, 14.4 million ha more of global cane areas will be needed. This is well below the 37 million extra hectares needed to meet the 5% target if all carbohydrate crops share proportionately in the growth. If a 5% biodiesel blend is to be achieved in 2015 by focusing solely on oil palm, an extra 10.6 million ha will be needed. This is to be compared with the 47 million ha needed if all the oil crops share proportionately in the growth.

There are inconsistencies in government policies regarding biofuels in the major markets. As an example, the EU's hostility to palm biodiesel is well known, while it is perfectly happy to use palm oil in food, and also a lack of concern regarding the sustainability of its own rapeseed farming. GM foods have to be labelled in the EU but there are no labelling rules for GM crop-derived biodiesel – a further inconsistency.

Finally, key conclusions: Oil prices are becoming more closely linked with fuel prices. This is because of the competition between food and fuel uses of oilseed products. The dilemma is the difficult choices emerging in land use: should the world focus on the most productive biofuel crops or consider much larger arable crop area increases worldwide? Policy is not yet consistent in major markets.

(analysis@lmc.co.uk)

1

The Future Impact of Biofuels on World Agriculture

Presentation to
2007 MPOB International Biofuel Conference
Kuala Lumpur, July 2007
By Dr James Fry
LMC International Ltd, Oxford, UK
Www.Lmc.co.uk

2

Outline of the Presentation

1. The behaviour of agricultural product prices and their links with fuel prices
2. The competition between food and fuel uses of agricultural products
3. The implications of alternative biofuel crop choices for land use
4. Policy dilemmas and inconsistencies

3

Links Between Agricultural Product Prices and Fuel Prices

4

Learning from Other Commodities

- Let us start by examining whether there is yet evidence that vegetable and mineral oil prices have become tied to one another.
- Before doing so, it is valuable to review the *experience of the agricultural product with the* longest history of a major biofuel programme; this is sugar.
- The experience of the fuel use of ethanol from sugar extends all the way back to the mid-1970s, when Brazil began its cane-based fuel ethanol programme, *Proalcool.*

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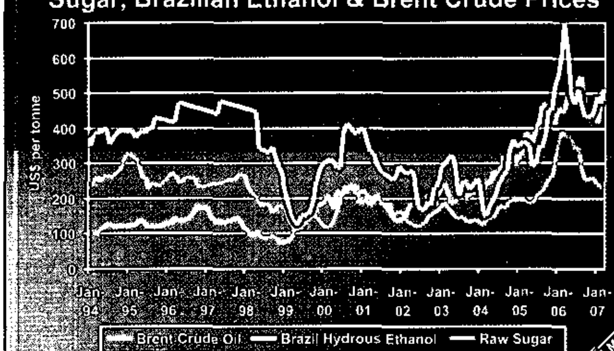
Note the Close Relationship Between World Sugar, Brazilian Ethanol & Brent Crude Prices



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Sugar: Brazil Shows How Links Develop Between Biofuel and Product Markets

- Brazil's sugar and ethanol markets have been increasingly liberalised over the past decade.
- The result has been that Brazil has effectively pulled world sugar and fuel markets together, switching cane juice from the less profitable outlet to the more profitable product.
- Brazilian sugar mills switch their production frequently between sugar and ethanol, and the effect has been to link the two sets of prices.

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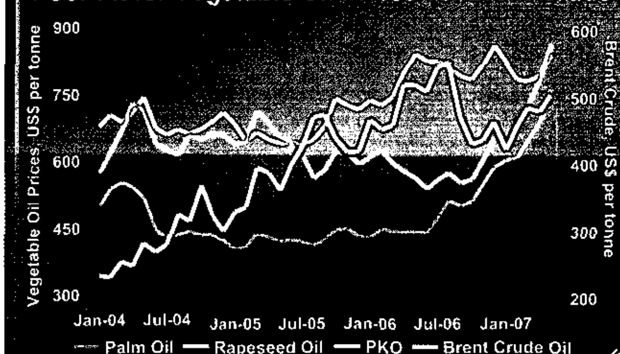
Poor Fit for Vegetable Oil Prices vs. Brent Crude



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Comparing Oil and Fuel Prices

- Unlike with sugar, a biofuel link has not yet tied most vegetable oil prices to crude oil values.
- Rapeseed oil has the closest link among the oils, thanks to the growth of EU biodiesel use.
- For oils as a whole, biodiesel demand is not yet large enough to influence the entire structure of product prices, but this may be changing.
- Our task today is to assess how the boom in biofuels will affect agriculture, in general, and the vegetable oil sector in particular.

9

Competition Between Food and Fuel Uses of Agricultural Products

10

Biofuels are Taking Much of the Growth in World Vegetable Oil Demand

- There are no commodities – yet – in which the demand for biofuel represents the majority of total sales (though rapeseed oil is approaching a point where one third of its worldwide output is destined for fuel uses).
- When one focuses, however, on the food vs. fuel split in the growth in world demand, it is apparent that food is already having to struggle to keep pace with the new biofuel outlets for vegetable oils.

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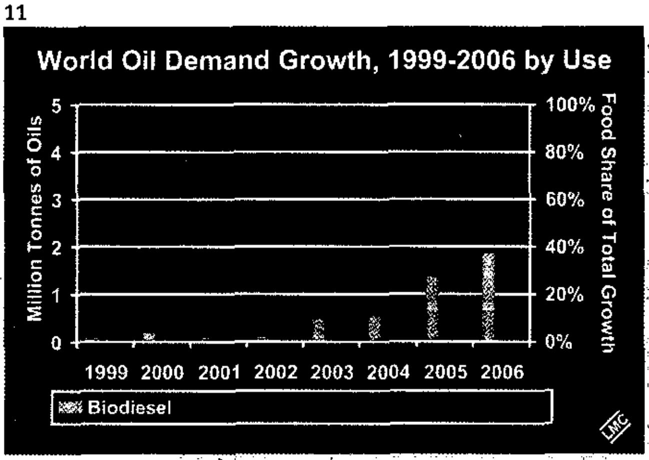

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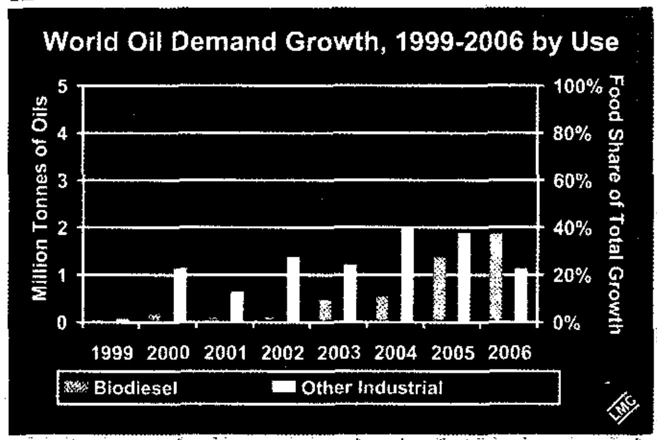

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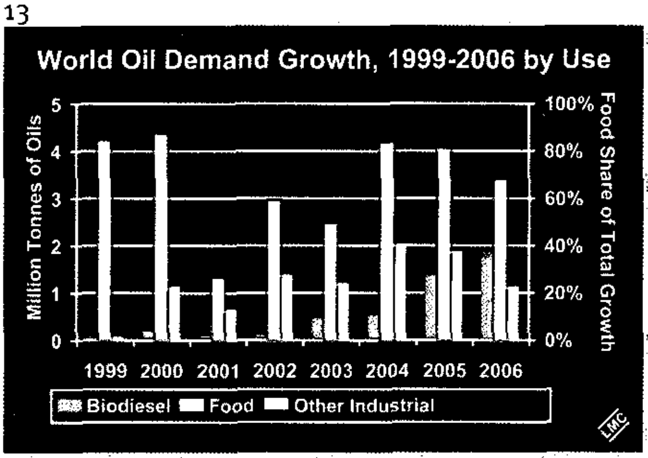

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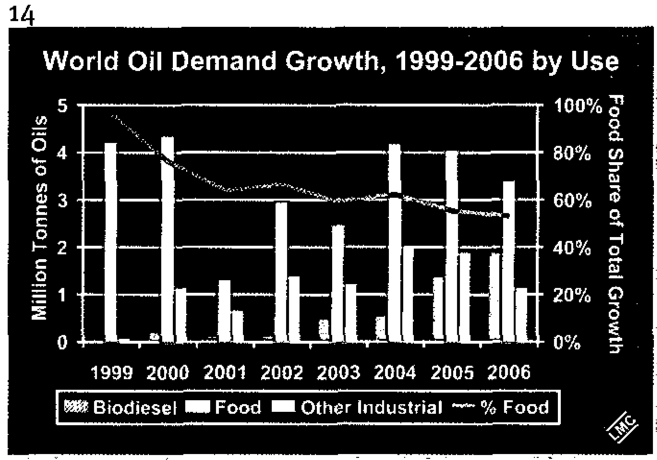

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Vegetable Oil Demand Growth

- An increasing share of global demand growth for vegetable oils has arisen from biodiesel and other industrial end-uses.
- These industrial uses include oleochemicals, the direct burning of oils, the blending of vegetable oils in diesel fuel and animal feed.
- (It might be argued that oleochemicals should be treated as a fuel-related demand, since they compete directly with petrochemical products.)
- By 2006, food uses of oils accounted for barely half of the entire growth in world oil demand.

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Links Between Oil and Fuel Prices

- We have seen that there is, so far, no close relationship between most vegetable oil prices and crude mineral oil prices.
- In the next few diagrams, we shall investigate whether there is any evidence that prices of these two very different forms of oil are starting to move closer to one another.
- We shall also analyse whether there is a threshold level for biofuel demand – as a share of total product demand – above which product and fuel prices are aligned with one another.

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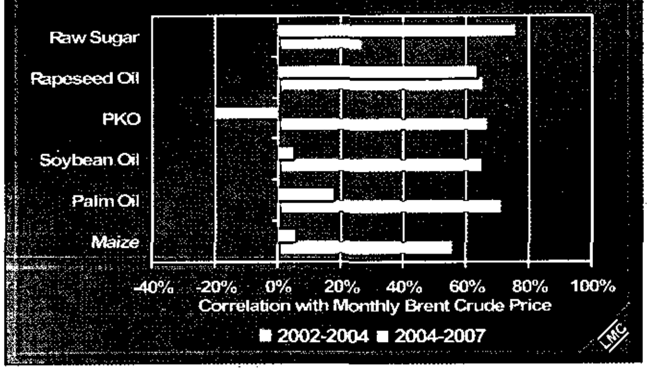
Let's Compare Correlations Between Product & Brent Crude Prices in 2002-04 & 2004 to Mid-2007



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Commodity-Fuel Price Correlations

- We see that since fuel prices started their surge in 2002, the prices of the major commodities used to make biofuels have displayed widely differing correlations with fuel prices.
- A puzzling feature of the comparison of the data for 2002-2004 and 2004-June 2007 is that the correlation coefficients were generally much worse in the latter period; yet this was when fuel prices reached their highest levels.
- Rapeseed oil is the only vegetable oil to reveal a close correlation with fuel prices.

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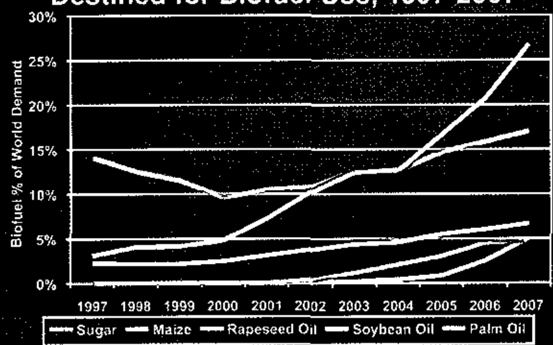
Shares of World Output of Various Products Destined for Biofuel Use, 1997-2007



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What is the Threshold Where Fuel and Product Prices Become Linked?

- Whereas rapeseed oil prices now seem to be fairly closely linked to energy prices, CPO prices are not, nor are the prices of other oils.
- It is interesting that PKO prices also show few signs of close links to fossil fuel prices, despite the importance of oleochemical use.
- In trying to discover a possible threshold, <u>10% of world output destined for biofuel use seems to be the tipping point, with only sugar and rapeseed oil yet above this percentage.</u>

21

The Implications of Alternative Biofuel Crop Choices for Land Use

22

Past Growth in Crop Areas Worldwide

- It is valuable to remind oneself of the growth in the yields and areas of the major food crops in the recent past; therefore, let us examine the trends over the 15 years from 1991 to 2005.
- Adding together the main carbohydrate crops (grain, sugar and cassava), total output grew more slowly than yields, and so areas declined.
- For the oil crops, demand/output rose much faster than yields; therefore the area planted to these crops worldwide expanded rapidly.

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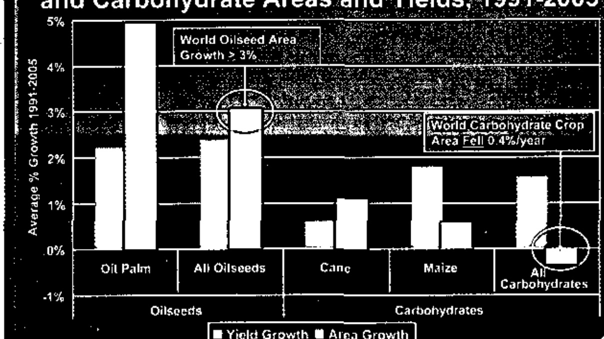
FAO Data on Average Growth in World Oil Crop and Carbohydrate Areas and Yields, 1991-2005



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Areas Needed for 5% Biofuel Blends in 2015

- 5% global blending targets for both ethanol in petrol and biodiesel in transport diesel do not seem ambitious, in view of the policies in major end-use countries, like the EU and US.
- In the next slides, I consider the impact of (a) sharing the extra areas among all crops, or (b) *concentrating on the most productive crops*, and thus minimising the need for extra land.
- The base case for this comparison is that of a standstill in biofuel blending rates after 2005.

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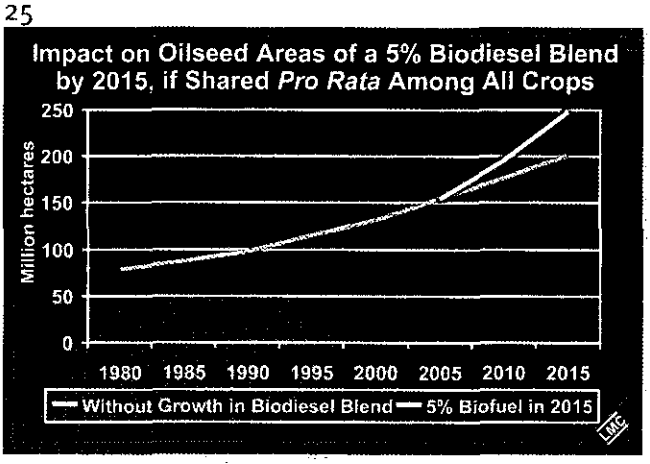

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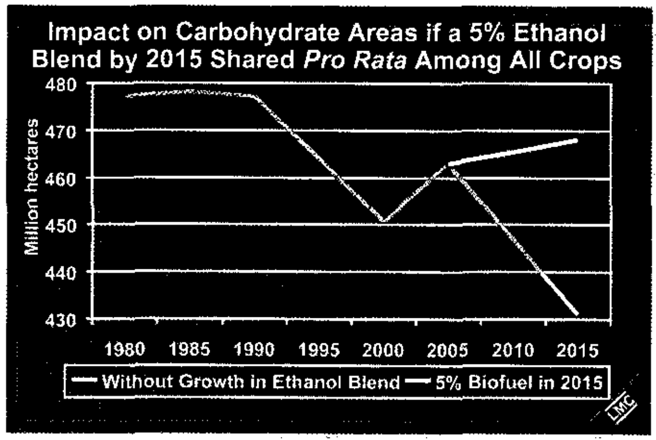

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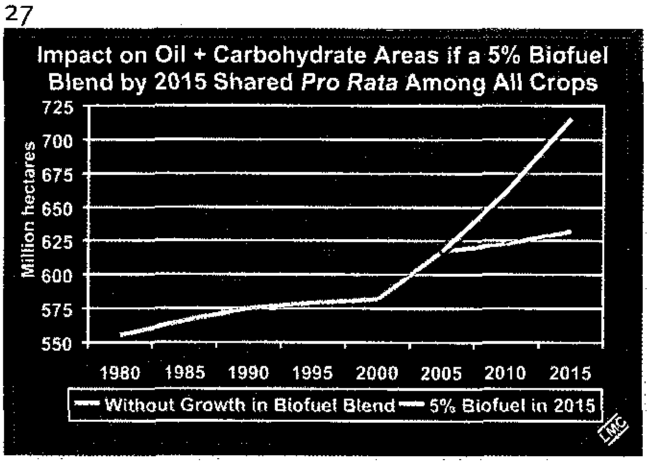

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Areas Needed for 5% Biofuel Blends in 2015

- If a 5% biodiesel blend is met by raising areas in equal proportions for all oil crops, 93 million hectares of extra oilseed land will be needed in 2005-15, on top of 154 million hectares in 2005.
- Without more biodiesel, the extra area needed to meet the growth in food demand would be only half as great (47 million hectares).
- The total area for carbohydrate crops with a 5% ethanol blend in 2015 would be 468 million hectares, as against 463 million in 2005.
- However, the carbohydrate crop area would fall 32 million hectares to 431 million in the base case, in which ethanol blends do not rise after 2005.

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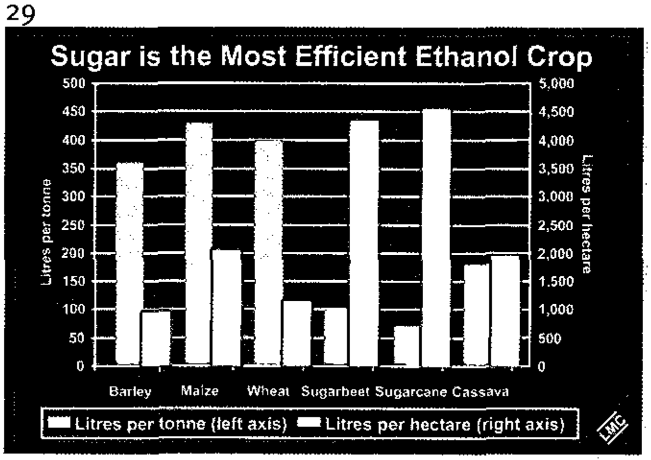

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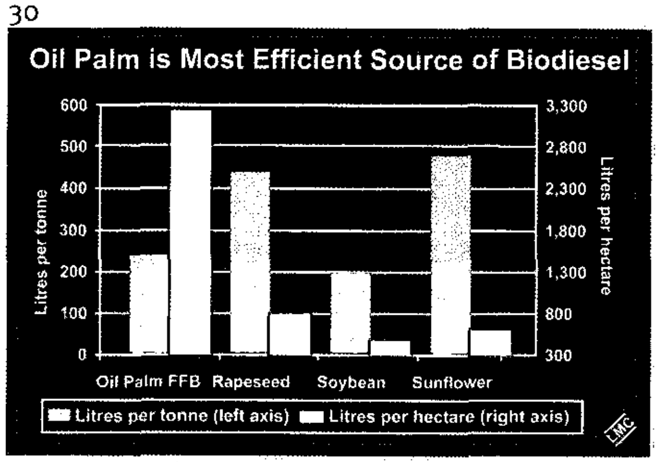

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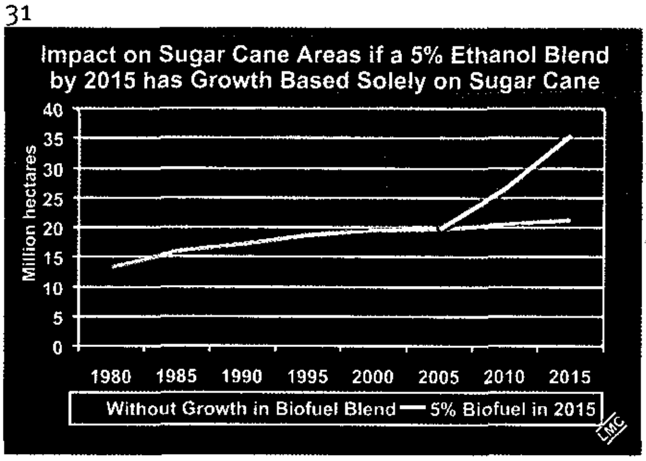

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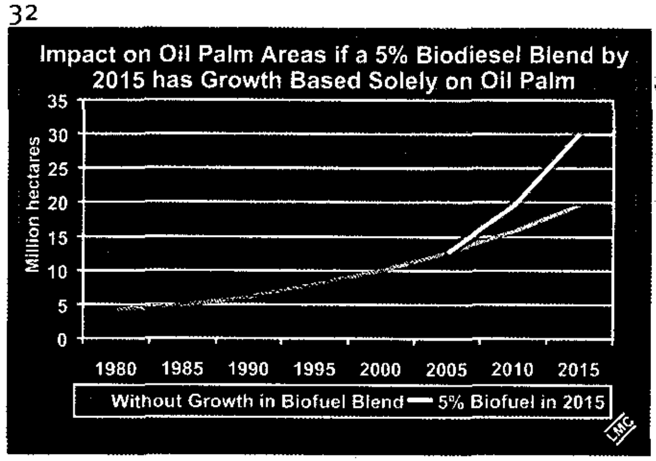

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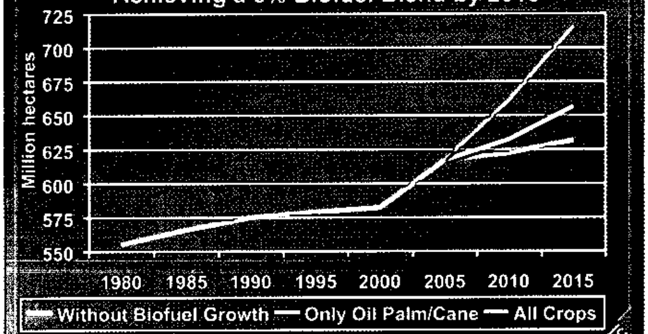
Impact on Total Crop Areas of Alternative Means of Achieving a 5% Biofuel Blend by 2015



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Minimising New Areas Needed for Biodiesel

- If the 5% biodiesel blend is met by focusing solely on oil palm, the world oil palm area would rise from 12.6 million hectares in 2005 to 30.2 million in 2015 (compared with a 2015 total area of 19.6 million hectares in the base case).
- In other words, an extra 10.6 million hectares would be needed for the higher biodiesel blend.
- This 10.6 million hectare expansion is to be compared with the 47 million hectares needed if all oil crops – soybeans, rapeseed, etc. – share proportionately in the growth.

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Minimising New Areas Needed for Ethanol

- If a 5% ethanol blend is met by expanding only the area under sugar cane, the most productive carbohydrate crop, global cane areas would rise from 19.7 million hectares in 2005 to 35.5 million in 2015.
- This compares with a 2015 cane area of 21.1 million hectares in the base case , i.e., 14.4 million hectares of extra sugar cane land would be needed to achieve a 5% ethanol blend.
- This is well below the 37 million extra hectares needed to meet a 5% target if all carbohydrate crops share proportionately in the growth.

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Policy Dilemmas and Inconsistencies

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EU Policy Inconsistencies - 1

- The EU and its member states are far from consistent in their policies towards biofuels.
- An example of such inconsistency is their hostility to the use of palm methyl ester, accusing it of failing to meet sustainability criteria.
- Yet, the same governments seem unconcerned about the sustainability of their own rapeseed farming, in spite of ample evidence that many EU farmers are not adopting good farming practices; for example, many EU rapeseed farmers are now failing to follow the once every four or five years practice recommended for rotations with other crops.

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EU Policy Inconsistencies - 2

- While the EU is getting more hostile to palm biodiesel, it seems happy to use palm oil in food, as a TFA-free oil to replace rapeseed oil diverted to biodiesel.
- EU labelling rules for GM foods mean that neither soy oil nor Canadian canola oil is consumed much as a food; this forces users to rely heavily on palm oil.
- However, there are no EU labelling rules for GM crop-derived biodiesel; so we get the inconsistent position that oils unacceptable in one use (GM oils in food) are perfectly acceptable in another (namely biodiesel).
- One sees that pragmatism is often more important than consistent principles in EU policy-making.

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The US Biodiesel Policy Dilemma

- US biodiesel policy was designed to give strong support to local production and consumption.
- The method adopted to give this support, a $1 per US gallon tax credit for biodiesel blenders, has instead become one of the main potentially destabilising problems in today's market.
- This is because the credit is given to blenders without any restrictions on either the origin of the biodiesel that is eligible for the blending credit or its destination after blending.

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"Splash and Dash"

- The US blending credits have given rise to a new and highly opportunistic business: "splash and dash".
- This is where an importer brings a tanker containing biodiesel into the US and then adds a splash of fossil diesel to the biodiesel, to receive the blending credit, before making a dash across the Atlantic to the EU.
- Splash and dash also applies to exports of biodiesel made in the US itself and blended locally.
- The volumes of biodiesel imported into the US and of B99 (99% biodiesel/1% fossil diesel blends) making their way to the EU have both risen rapidly in recent months, as may be seen in my final diagram.

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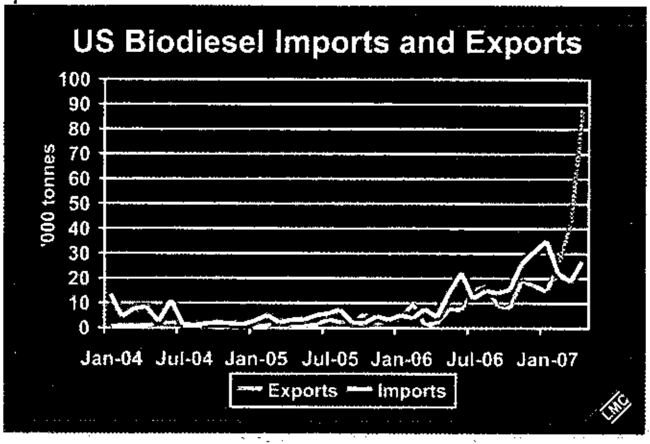

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Key Conclusions

1. Oil prices are becoming more closely linked with fuel prices
2. This is because of the competition between food and fuel uses of oilseed products
3. Difficult choices are emerging in land use: should the world focus on the most productive biofuel crops (like oil palm) or consider much bigger arable crop area increases worldwide?
4. Policy is not yet consistent in major markets.

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If you would like a copy of this presentation, please email me at Jfry@Lmc.co.uk

Acknowledgements: Thanks to FAO, IMF, Oil World, USDA and World Bank for data

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SESSION 2-2:

SUPPLY, DEMAND, ECONOMICS AND SUSTAINABILITY OF BIOFUELS

Amintha Weerawardena
Rabobank International, Malaysia

Rabobank International has an established Food and Agribusiness Research and Advisory known as FAR, which is its global knowledge provider. FAR consists of professionals covering all major food and agribusiness sectors who execute fundamental research in 14 of the world's major food and agriculture countries.

The biofuels sector is driven by key motives such as energy security consideration to diversify sources and address volatile crude prices and environmental concerns such as global warming. Assisting further in the biofuels demand is the support by political legislation such as the 1992 Common Agriculture Policy (CAP) reform in the EU aimed at downstream expansion, income generation and rural area development. In promoting biofuels, many EU countries are providing reduced excise duties for biodiesel and bioethanol. In addition, the support from the car industry enables biofuels to be blended with gasoline or cars to be adapted, as well as providing carbon credit trading opportunities for biofuels.

Rabobank has concluded that the additional world vegetable oil demand by 2010, compared with 2005, will be 13 million metric tons for food and 18 million metric tons for biodiesel, to make the total demand 127 million tons per year. As the feedstock for biodiesel, rapeseed is expected to dominate with a 40-45% share, followed by soybean with 20-25%, palm oil with 25-30% and other oils with 5-10%. Where will this palm oil share come from? Malaysia and Indonesia, the key players in this field, are likely to fill the needs. A SWOT analysis of palm oil reveals that, while it has the highest oil yield per hectare, it is economically and environmentally suitable. Furthermore there is 8 million ha of grassland available in Indonesia for expansion of cultivation. Moreover, sourcing palm oil form this region requires certification to ensure that it is from a sustainable production source, in order to be eligible for incentives such as tax exemptions and subsidies when entering foreign markets. This may be considered a weakness, and in addition threats will come from conversion of primary forests, social conflicts with indigenous people and competition with production for food.

Jatropha may be an alternative, with global hectarage of, reportedly, 175,000 ha, which seems unsubstantiated and inclusive of areas in planning stages for the next ten years. Actual figures for jatropha hectarage would be 10,000 ha in Indonesia and India, 1,000 ha in Thailand, the Philippines and some parts of China, 1,000 ha in Africa and 100 ha in Malaysia. Investors' constraints are lack of confidence in its technology and management, and its low yield compared to oil palm, though jatropha may be positioned as a good smallholder crop.

All the vegetable oils have been increasing in price in recent years but palm oil is actually no longer much cheaper than soybean or rapeseed and has also risen in price compared to crude oil. There may be uncertainty as to whether it will be advisable to go into biodiesel business under oil markets such as these. Global biodiesel production could reach 24 million metric tons by 2010 and the EU's share will decrease from 75% in 2005 to 40%. Singapore, Malaysia and Indonesia are poised to be large exporters in Asia, with Malaysia the world's number-one palm based biodiesel producer. Sustainability will remain of the utmost importance and the role of governments critical in sustaining the growth of the industry.

The world's population is projected to increase from 6.5 billion to 9 billion by 2050 and world energy demand is expected to double over the next 50 years. World food demand is also expected to double as the consumption of oils and fats is expected to average at 35kg per capita by 2050 or a volume of 315 million metric tons , while individual income will grow in developing countries as well, signifying greater purchasing power. Under such conditions, it is clear that global biodiesel initiatives will drive future demand for vegetable oils. Nevertheless, biofuel from crops will never replace conventional fuel entirely, renewable fuel can be a bigger part of the energy mix.

(amintha.weerawardena@rabobank.com)

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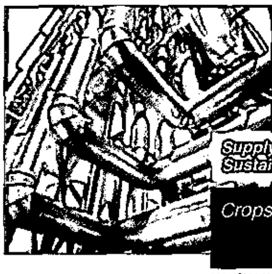

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Supply, Demand, Economics and Sustainability of Biofuels

Crops Oil Market Outlook for Biofuels

AMINTHA WEERAWARDENA
(amintha.weerawardena@rabobank.com)
Manager, Strategic Advisory & Research
Rabobank International
5 July 2007

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That's why we keep getting straight A's

- One of the world's safest Banks – **AAA rated**
- **Established as an agricultural cooperative**
- **Remains dedicated to Food & Agribusiness**
- World's 20th largest bank by Tier 1 capital
- **Voted #1 for sustainability in Europe**
- 1,544 offices in 43 countries
- Largest financial services group in the Netherlands
- 9 million private individuals and corporate clients
- Assets at 31 Dec '06 of €556 bln
- Total income of €10 bln & net profit of €2.3 bln

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"Rabobank Group aspires to be the best food & agri bank, with a strong presence in the world's major food & agriculture countries."

Rabobank 2006 Annual Report

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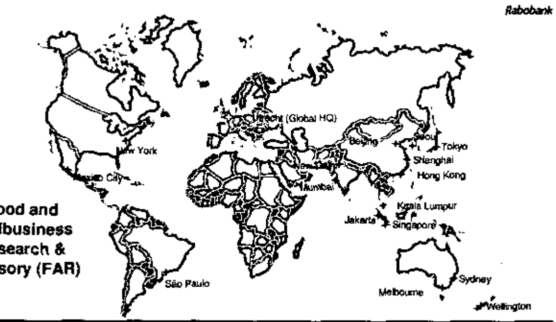
Food and Agribusiness Research & Advisory (FAR)



Global FAR team has 80 members in 14 countries

5

FAR Asia Covers all Major Food and Agribusiness Sectors Throughout the Chain

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- Agricultural Chemicals
- Agricultural Equipment
- Animal Feed
- Animal Protein incl. seafood
- Baby Food
- Beverages
- Cotton
- Dairy
- Edible Oils
- Fertilizers
- Food Ingredients

- Food Processing Equipment
- Food Retail
- Foodservice
- Forestry
- Fresh Produce (Fruits and Veg.)
- Grains and Grain-based products
- Rendering
- Rubber
- Starch
- Sugar and Sugar-based products
- Wool
- and more...

Inputs → Productio n → Procureme nt & Processin g → Distributio n → Food retail / Food service → Consumer

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Great variety of motives and support measures for the biofuels sector

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Drivers and motives

- Energy security:
  - Diversification of energy sources
  - Volatility of crude prices
- Environmental concerns:
  - Kyoto protocol
  - CO2 emissions/ Global Warming
- Agriculture support:
  - Agriculture income
  - Downstream expansion
  - Rural development

International Energy Agency (IEA) estimates
- 50% increase in global demand for oil over the next 25 years
Propelled by growing industrialisation of China, India, Brazil, Indonesia, Mexico, CIS & other emerging markets
- US$4 trillion in new investments & infrastructure is needed to keep demand out-stripping supply

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Support measures

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- Political/ Legislation
  - Indicative/mandatory targets
  - Reduction in excise duties
  - Quotas
  - Quality standards for fuel
  - Requirements/restrictions for feedstock use
  - Direct subsidies
  - Import/export tariffs
- Agriculture support
  - Many regions, e.g. EU CAP reform
- Car industry
  - Warranty for car engines at various blends. Conventional cars easily adapted
- Carbon Credit Trading opportunities for biofuels

Eg. Netherlands has excise duties as follows: US$0.8 per litre for Biodiesel & US$1.4per litre for ethanol

1992 Common Agriculture Policy (CAP) reform:
oilseed production for non-food purposes encouraged on set-aside land
Objective:
i) creating positive employment and domestic supports to agriculture and farmers (poverty reduction & rural job creation)
ii) local production advantages

ii) Great willingness among politicians and society leaders to encourage less dependence on fossil fuels particularly on OPEC.

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Region with highest potential to export bio-crops include :

Asia:
Biodiesel-Palm, jatropha, coconut
Ethanol-Sugarcane, corn

North America:
Biodiesel-Soybean,canola
Ethanol-Corn, barley, wheat

Africa:
Biodiesel-Palm, jatropha
Ethanol- Sugarcane

Latin America/Carribean:
Biodiesel-Soybean,Palm
Ethanol-Sugarcane

Europe:
Biodiesel-Rapeseed
Ethanol-Sugarbeets,wheat

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World Vegetable Oil Production
(mil MT)

	1980-81	2005-06
Palm	4.9	34.8
Soya bean	9.8	33.9
Rape seed	3.9	16.6
Sunflower seed	4.6	10.2
Groundnut	*2.3*	*5.0*
Cotton seed	2.9	4.6
Palm Kernel	0.5	4.2
Olive	1.9	2.3
Coconut	2.8	3.5
Total	33.6	115.1

(Palm, Soya bean, Rape seed 1980-81: 23.2, 69 %; 2005-06: 95.5, 83 %)

- World production: + 75% in 25 years!
- World Population: + 42% same period

Source: Oilworld

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Forecast: World Demand for Oils & Fats

Year	Population (billion)	Avg. per capita intake (kg)	Demand (mil mt)	Increment (%)
2005	6.54	21.4	149	-
2010	7.00	25.0	175	18
2015	*7.40*	*27.0*	*200*	*15*
2020	7.80	30.0	234	17

♣ Demand driven by :
- Population,
- Prosperity.

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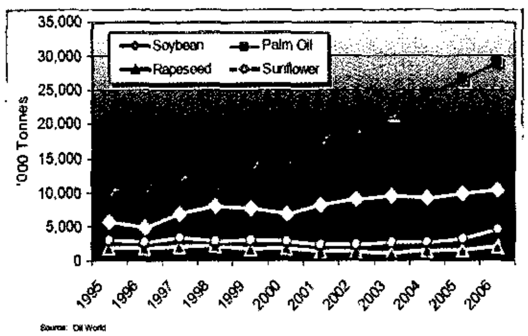
Export Trend of Major Oils



Source: Oil World

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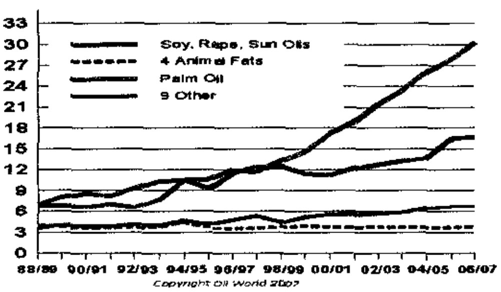
17 Oils & Fats : World Exports



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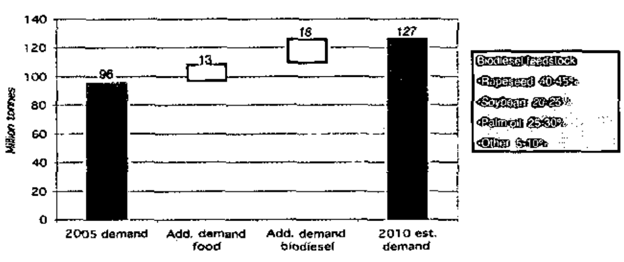
Considerable potential impact on global vegetable oil demand.....



Source: Rabobank analysis 2007 based on FAPRI and own research

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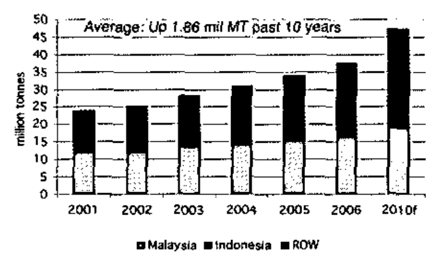
Palm Oil Supply and Growth



Source: Rabobank analysis on Oil world

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SWOT Analysis for PO as bio-crop

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Strengths

- High Specific oil yield per hectare
- High calorific value
- Favourable chemical composition
- Suitable from both economic and environmental aspect
- Raw material must be produced sustainable and should be carbon neutral.i.e. net result of producing and burning the fuel shld leave atmospheric carbon dioxide level unchanged.

Weaknesses

- Requires certification to ensure it is sourced from a sustainable production for eligibility for incentives such as tax exemptions and subsidies

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Opportunities

8 million ha of *Imperata* grassland or *lalang* land in Indonesia. i.e idle land

Threats

Conversion of primary forests
Social conflicts with indigenous ppl
Competition with local food production

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Other Oil Crops: Jatropha

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-Global Acreage reported : 175,000ha
-Reported Figures are unsubstantiated and are inclusive of those figures in the planning stages for the next ten years.

-Actual numbers of Jatropha hectarage would be as follows:

Indonesia and India -10,000ha
Thailand, Philippines and some parts of China -1000ha
Africa-10,000ha
Malaysia- 100ha

-Investors constrains are lack of confidence in technology and management as compared to oil palm. Yield is low. Grows on marginal land. Positioning as a good smallholder crop.

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Palm oil is the most competitive energy crop for biofuels

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Feedstock	Oil yield / ha	1 ton biodiesel to vegetable oi	ha equivalen
Rapeseed EU25	1.18	1	0.85
Soybean Oil	0.49	1	2.02
Palm Oil	4.05	1	0.25
Sunflower Oil	0.62	1	1.63

- Palm oil has the highest oil yields
- Less land required for the production of 1 tonne of biodiesel from palm oil

Source: Rabobank analysis

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...sustaining high price levels of vegetable oils

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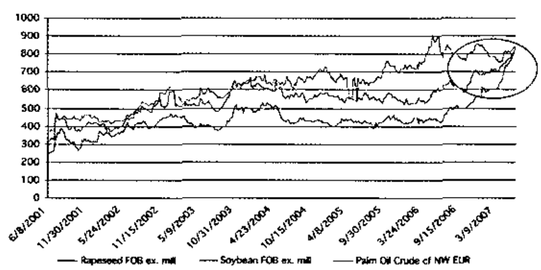

- Quantum leap in palm prices!

Source: Bloomberg

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Volatility in crude prices create boom & doubt periods for investors.....

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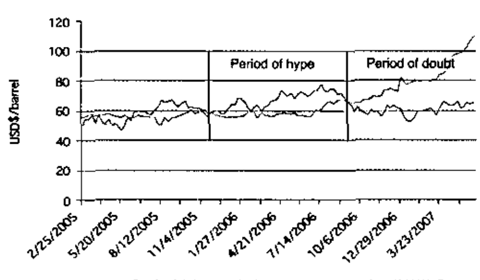

Source: Bloomberg

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Global biodiesel production could reach >24 million tonnes by 2010

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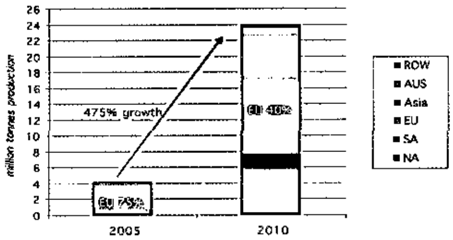

- EU share of decreasing
- Asia and North America to become potentially large producers
- Much uncertainty remains!

Source: Rabobank analysis, April 2007

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How big is Asia's appetite for Biodiesel?

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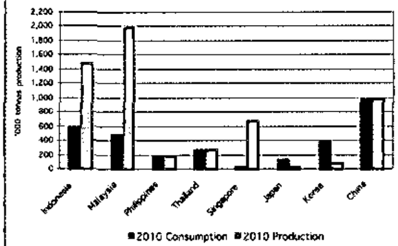

- Singapore, Malaysia and Indonesia poised to be large exporters
- Philippines and Thailand will step up domestic production
- Japan, S. Korea and China do not have sufficient feedstock for biodiesel production

Source: Rabobank analysis, May 2007

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How much of the planned biodiesel projects will materialize?

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Country	2006	2007	2008	2006-08	Realistic Estimation
	Million Metric Tonnes per Annum				
Malaysia	0.15	2.20	1.80	4.15	2.00
Singapore	0.15	1.15	0.50	1.80	0.70
Indonesia	0.37	1.20	1.80	3.37	1.50
Total	0.67	4.55	4.10	9.32	4.20

- Expansions plans in Malaysia, Indonesia and Singapore will total approx 10-12 million tonnes of biodiesel production potential
- Malaysia: Poised to become number one palm based biodiesel producer in the world
- Singapore: Strategic positioning in the petrochemical and logistics cluster
- Indonesia: Ambitious targets driven by private sector investments
- Less than half of announced plans will be constructed!!!

Source: Rabobank / RSPO

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Managing sustainability: A fine balance!

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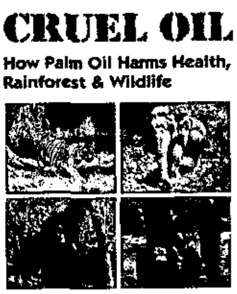
- Pressure of NGOs and consumer groups
- Environmental impact of feedstock expansion
- Food vs. Fuel demands driving up prices
- EU leading the way in developing sustainability criteria



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OUTLOOK

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- Global biodiesel initiatives will drive the demand for vegetable oils
- Role of government is critical in sustaining the growth of the industry
- Demand of vegetable oils will continue to grow as food and biodiesel demand increase
- Growing demand for biodiesel will likely overcome some of the short-term restrictions on palm oil

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OUTLOOK

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- The human race is expected to swell from the present 6.5 Bn to 9 Bn by 2050.
- Current utilization:
  crude mineral oil = 85 Mn barrels/day
  edible oils and fats = 2.8 Mn barrels/day
- World energy demand to double in next 50 years.
- World food demand expected to double next 50 years.
- Incomes will grow in developing countries, this means greater purchasing power.
- O&F consumption expected to average 35kg per capita by 2050 or 315 mil MT, – double the current consumption

- Biodiesel crops can never replace conventional diesel entirely, but renewable fuel can be a bigger part of the energy mix.

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RABOBANK LAUNCHED SOUTHEAST ASIAN BIODIESEL REPORT

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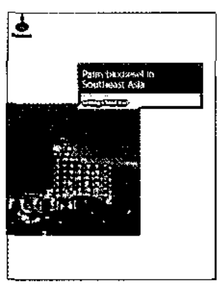

Thursday, 5 July 2007
10.30am at the
Putra World Trade Centre (PWTC)

Author : Ms Cherie Tan

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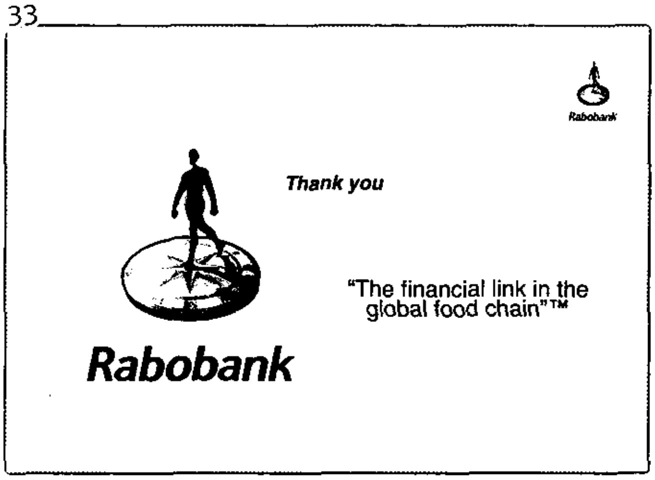
Rabobank
Thank you
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SESSION 2-3:

BIODIESEL: THE MALAYSIAN INVESTORS' PERSPECTIVE

U.R. Unnithan
Carotino Sdn Bhd, Malaysia

This presentation deals with the current global and Malaysian biodiesel scenarios and endeavors to suggest a way forward. Global energy demand is expected to grow by 50% by 2030 and the transport sector will remain the main driver for this increase. Biofuels, accepted to address both the greenhouse gas (GHG) problem and reduction of dependence on fossil oil, are estimated to constitute only 0.2% of the total sources of energy by that date, however, and even if there were substitution of 2% of global diesel, 50% of the total global oils and fats that we have today would be required.

For the next 10 years, first generation biofuels from vegetable oil sources will continue to be the most practical way of incorporating biofuels as a strategy to achieve the above goals. The EU, with its progressively growing targets, has taken a leading role in increasing the mandatory use of biofuel blends to 10% post-2010, rapeseed being the main feedstock. Increases are, however, built around subsidies.

Among the raw materials available for biodiesel, palm oil has competitive advantages: its oil yield is 5 to 10 times higher than that of rapeseed or soybean, and it is also less susceptible to the vagaries of the weather. Its energy output/input ratio is 9.6 compared to 3 for rapeseed and 2.5 for soybean, and it offers the potential to maximize value addition of its by-product, neutraceuticals. Different oil feedstocks produce biodiesel of varying characteristics and its cold filter plugging point (CFPP) of +15°C is a weakness of palm oil. Nonetheless, MPOB succeeded in developing the technology for -15°C to -21°C winter grade palm diesel.

The Malaysian initiative to develop palm oil based biodiesel can be traced back to 1982, when lab-scale R&D was started by the Malaysia Palm Oil Board (MPOB). However, even in 2002, the objective of the first commercial plant was to extract the more attractive neutraceuticals rather than PME, which was produced as a mere by-product with less commercial value except as a feedstock for oleochemicals. Thereafter, the fact that it had become a promising renewable, clean form of energy initiated a rush for licenses for investment. The government then issued 92 licenses, which added up to as much as 6 million tons a year of biodiesel production capacity.

Since June 2006, however, the industry has been facing huge challenges in terms of negative margins and tariff and non-tariff barriers, and is now at a crucial stage. The price of crude palm oil (CPO) today stands at RM2,500 per ton relative to RM1,400 a year ago and most Malaysian plants which purchase CPO at market price and produce palm biodiesel lose US$120 to $180 per ton. Agricultural subsidies in large markets like the EU and the US distort the real competitive situation in the global market. There is also a sustainability issue where it is alleged that Malaysia's palm oil is produced at the expense of forest and wildlife habitats. In fact, forests are not being destroyed at all in Malaysia, as 63.6% of the forest areas remain intact, which is significantly more than in some of the developed countries. So far, only 3 plants with a total capacity of about 1 million tons have materialized out of 92 licenses issued.

To sum up the way forward, palm biodiesel needs to establish a global reputation, with its use in Malaysia mandated to combat GHG emissions and an Asian market created to reduce dependence on fossil fuel. At the same time, technology and economic aspects need to be benchmarked to meet the most stringent global specifications and maximize value addition of the unique, valuable by-products of palm oil.

(dir@carotino.com)

1

Biodiesel : The Malaysian Investors' Perspective

U.R.Unnithan
Carotino Sdn Bhd

2007 International Conference on Biofuels,
PWTC, Kuala Lumpur
July 5 & 6, 2007

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Presentation Outline

- The Global Scenario
- Why Palm Biodiesel?
- The MPOB Initiative
- Malaysian Bio-diesel Scenario
- Palm Bio-Diesel- Challenges, opportunities and Risks
- Palm Bio-Diesel- The Way forward

3

The Global Scenario

- Global Energy demand is expected to grow by 50% by 2030
- Transport sector would remain the main driver for increase in energy demand

4

The Global Scenario

Primary Energy	%
All Sources	100.0
Traditional Bio-Mass	9.0
Large Hydro	5.7
New Renewables (Elect)	1.2
New Renewables (Heat)	0.7
New Renewables (Biofuels)	0.2

Global Energy Supply 2004,Source: Eric Martinol et al(Nov 2005), Renewables 2005 Global Status Report. Washington DC: World watch Institute

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The Global Scenario

- 2% of Global Diesel Fuel Substitution would require 50% of Global oils & fats
- German Bio-diesel capacity has increased from 65,000 mt in 1995 to 2.35 M mt in 2005 and is currently 4.0 M mt.
- Rapeseed Oil is the main feedstock for Bio-diesel in Europe and Soya Oil is the main feedstock in the US.
- EU Directive: Use of Biofuels -2% by 2005 and 5.75% by 2010. The EU parliament is now working on increasing this to 10%
- EU market built around Subsidies
- There is a great push in the USA with US$1/gallon tax incentive
- Brazil & Argentina have also embarked on an aggressive Biodiesel program
- Malaysia & Indonesia have taken the lead in Asia

6

U.S Biodiesel Scenario

- Seeing a rapid growth in Biodiesel consumption – from 0.5 Million gallons in 1999 to 75 Million gallons in 2005 and expected to grow to 650 Million gallons by 2015
- App. US$810 M investment in Biodiesel plants will be required to match the demand between 2006 & 2015

Source: National Biodiesel Board, USA

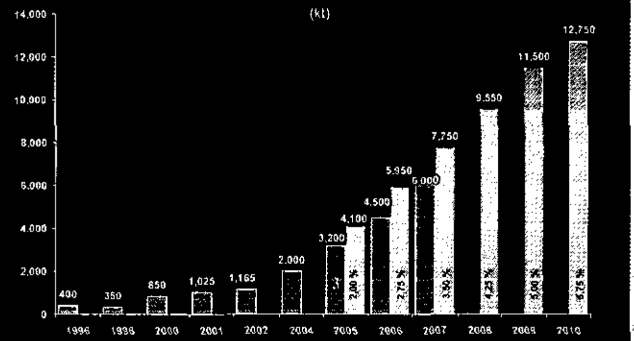
7

Biodiesel EU-Production/Consumption

Compared to targets set by the EU

(reduced to diesel consumption only)

(kt)



8

Why use Palm Biodiesel and Palm Biofuel?

- Made from renewable resources
- Biodegradable
- Can be produced in short amounts of time
  (for example: one growing season) whereas nonrenewables, like fossil fuels, take 40 million years or more to be produced.
- Reduces emissions of carbon monoxide (CO) by approximately 50% and carbon dioxide by 78.45% compared to petroleum diesel
- Free of Sulphur

9

Why Choose Palm for Biodiesel?

- **Palm oil is the most productive oil bearing plant species.**
- **The yield of Palm Oil per unit area is 5 and 10 times higher than rapeseed and soybean respectively.**
- **Palm oil is less susceptible to the vagaries of the**

10

The Malaysian Initiative

Development of MPOB Palm Bio-fuel Program

- Idea first conceived and start of lab-scale R&D - 1982
- MPOB Pilot Plant built – 1984

MPOB Palm Biodiesel Pilot Plant

11

Current Malaysian Bio-diesel Scenario

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Bio-diesel Licensing in Malaysia

Date	Applied	Approved	Capacity, mt
July 2007	>100	92	6,000,000(potential)
Dec 2004	3	3	18,000
Dec 2002	2	2	6,000
Dec 2000	1	1	3,000

Currently about 1,000,000 mt/yr capacity set up

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Bio-diesel Experience

- First MPOB Technology based pilot plant built in 2002- primarily for Neutraceutical extraction. Palm Methyl Ester was a by-product then!!!
- Stabilized pilot plant and started commercial production by August 2002(3,000 TPA)

Carotino PME Pilot Plant

14

The MPOB initiative

- MPOB awarded licenses to build 3 x 60,000 mt/yr Palm Biodiesel Plants in December 2005
- Carotino, Golden Hope and FIMA selected to build the 3 plants
- Construction of the first plant at Pasir Gudang, Johor started in December 2005 and was completed by May 2006

15

The World's First Integrated Palm Biodiesel Plant.

- MPOB together with Carotino commercialized The World's First Integrated Palm Biodiesel Plant by June 2006.
- YAB Prime Minister Dato' Seri Abdullah Haji Ahmad Badawi officially opened the Plant on Aug 15, 2006
- Bulk Shipments started in Aug 2006
- This plant has now been expanded to 180,000 TPA.

16

Winter-grade Palm Diesel Technology

- MPOB developed technology for -15°C to -21°C CFPP palm diesel.
- Inputs from Pilot Trials proved to be crucial for large scale plant optimization

17

30,000 TPA Winter Grade PME Plant

- Winter grade plant successfully commissioned in July 2006
- Commercial shipments started in Nov/Dec 2006
- This is the world's first such facility

MPOB/Carotino 30,000 TPA Winter-grade PME Plant

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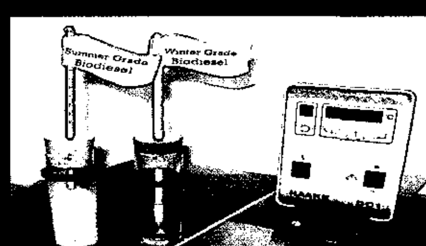
Regular & Winter Grade PME



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Commercial Winter Grade Palm Biodiesel

20

Change in market conditions

- In June 2006, CPO was RM 1400/MT and Crude Oil US$78 per barrel. Profitability around US$60-100/MT of PME
- In July 2007, CPO is > RM 2500/mt and Crude Oil is around US$71 per barrel
- The US$/RM Exchange was 3.8 in June 2006 and it is around 3.45 in July 2007
- Overall impact has been very negative on profitability of the Palm Biodiesel business. In the current market conditions PME producers will lose US$120-180/MT

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Palm Biodiesel-Technological Challenges

1.Technological Challenge

- Meeting Stringent EN14214/ASTM D 6751 Specs
- High CFPP
- Technology Risks-cheaper and better technologies

22

Technology Opportunities

- Raise the bar on quality even further
- Higher oxidative stability of Palm Bio-diesel to be capitalized
- Winter Grade Technology to be harnessed for global reach
- Improve manufacturing efficiencies through innovation

23

Palm Biodiesel-Marketing Challenges

2. Market Risks

- Fluctuating Crude Oil & CPO prices
- Cheaper sources of raw material- Jatropha
- Change in Specification
- Overcapacity-dumping of Prices
- Raw material availability
- Foreign Exchange Risk

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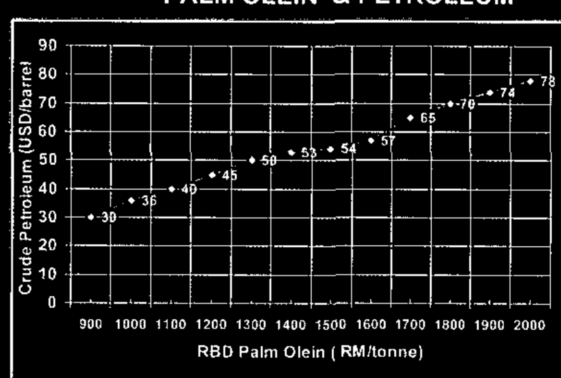
COMPETITIVE PRICES OF RBD PALM OLEIN & PETROLEUM



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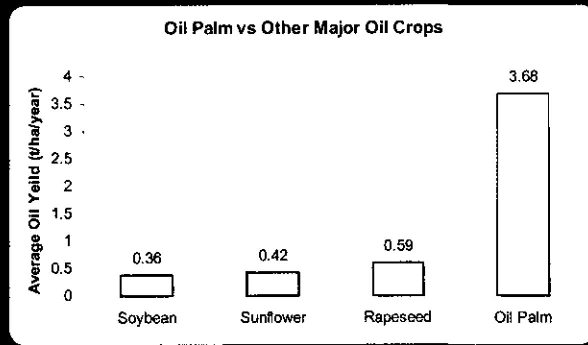
Palm Biodiesel- Marketing opportunities

- Take advantage of Palm's competitiveness as the highest yielding oil crop by leveraging on vertical integration
- Differentiate through Branding and value addition
- Develop tailor made new applications to extend usage from traditional uses
- Develop a local market to avoid Forex exposure

26

Sustaining the Earth



Source: Malaysian Palm Oil Council. Oil Palm ....Tree of Life. 2006

27

Palm Biodiesel-Environmental challenges

- Issue of Sustainability
- Negative image for Palm Bio-diesel- alleged destruction of rain forests
- Food vs. Fuel debate

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Palm Bio-diesel-Environmental Opportunities

- Present the facts on Malaysian Forest management
- Popularize the facts on Malaysian Oil Palm Plantations as a planted forest
- Increase domestic usage of Palm Bio-diesel to justify our role in reducing GHG emissions

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The concept of the Planted Forest

- Rain forests are not being destroyed for oil palm cultivation at the expense of wildlife habitats
- Some 64% of forest, including some of the oldest virgin rain forests remain intact
- Together with agricultural tree cover(Oil Palm & rubber)- 83% of Malaysia's land mass is green
- 4.05 million ha out of a total of 6.2 million ha used for food and economic crops is Oil Palm

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Forest Areas in Selected Countries

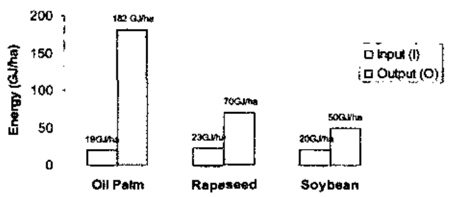
Country	% Forest Area	Total Forest Area (mil ha)	Total Land Area (mil ha)
France	28.3	15.55	55.01
Sweden	66.9	27.53	41.16
Germany	31.7	11.08	34.9
Malaysia	**63.6**	**20.89**	**32.86**
UK	11.8	2.85	24.09
Brazil	57.2	477.7	835.56
Argentina	12.1	33.02	273.67
USA	33.1	303.09	915.89
Denmark	11.6	0.5	4.31

Source: FAO, Global Forest Resource Assessment 2005

31

Energy Balance for Palm, Soybean & Rapeseed Oils

Oil palm is the most efficient crop,with the highest energy output:input ratio



Oil	Oil Palm	Rapeseed	Soybean
GJ/ha	9.6	3.0	2.5

In absolute terms, oil palm also requires the lowest input of pesticides, fertilizers and fuel for unit production of oil.

Source: UP Berhad

32

Palm Biodiesel-Political Challenges

- Can EU subsidies for Bio-diesel be sustainable?
- German Govt. has already imposed from Aug 2006 €0.1/litre tax on BD 100 and €0.15 on BD blends
- Increase in tax on BD 100 by €0.09/litre every year until the tax reaches the full €0.45/litre imposed on petroleum diesel has already been imposed.
- A second round of tax increase on biodiesel is due to be imposed in Jan 2008(Reuters, July 4, 2007)
- 55% of German Biodiesel capacity is currently idle. Sales of B100 in the B100 market have almost totally stopped in Germany.(Reuters, July 4, 2007).RME industry already " Fears Death in Stages".
- Tariff/Non Tariff Barriers on Palm Diesel to protect domestic markets in EU & USA?
- USA imposes 4.6% import duty on Malaysian PME whereas Indonesian PME is duty free.
- B99 exports from USA seriously affecting both PME & RME producers.
- Several new restrictions being planned based on sustainability issues.

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Political Opportunities

- Ideal environment for Malaysia to take a lead in Asia in implementing mandatory Biodiesel usage
- If no Govt. support is provided, many of the new Biodiesel ventures will go under. This will not augur well for FDI in Malaysia.
- Malaysia needs to consider establishing guidelines along the US/EU model.
- Establish Malaysia as a center of excellence for Palm Bio-diesel application
- Collaborative efforts in Asia to improve Energy Security just like the EU and US initiative

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Palm Biodiesel-The Way Forward

- Establish a global reputation for palm bio-diesel by mandating its use in Malaysia and establishing commitment to combat GHG emissions
- Benchmark technology and economical aspects of Biodiesel production with latest developments in the field around the world.
- Meet the most stringent Global Specification for Bio-diesel and improve on it.
- Maximize value addition of by products-Carotenes, Vitamin E and Crude Glycerine
- Create an Asian market to reduce dependence on fossil fuel

35

THANK YOU

SESSION 2-4:

GLOBAL METHANOL AND BIODIESEL – LINKED FOR BETTER OR WORSE

Mark Berggren
Methanol Market Services Asia, Singapore

An unprecedented fly-up in methanol prices occurred in late 2006 and early 2007, partly due to the increasing use of methanol for non-traditional fuel applications. Many biodiesel players are rightly concerned about the stability of methanol prices as a result. This presentation reviews global markets for methanol and focuses on the Asian region, giving the Methanol Market Services Asia (MMSA) outlook and rationale on these matters. MMSA, which is based in Singapore, is independent and has many years of consulting experience for clients with an interest in methanol.

The fates of the methanol and biodiesel markets are intertwined in many ways, with a large amount of methanol production capacity increasing in China and Southeast Asia, which will be reliant on the development of new sources of methanol demand such as biodiesel. Methanol supply is growing faster than demand, especially in Asia, which, however, is still greatly dependent on methanol from the Middle East and Chile. North America and Europe rival Asia as net importers, while currently, South American exports are threatened.

In March 2007, methanol prices spiked but the speaker does not think that this is going to repeat itself because capacity is growing faster than demand. Methanol, with its massive potential, is getting pulled into the energy pool and can be used in a number of ways. Quite a lot of methanol is being blended into gasoline for use in conventional engines in China, though not all of such blending is legal. It is cheap relative to gasoline and specifications for the latter are not always enforced. In addition to its main uses in the production of formaldehyde and methyl tertiary butyl ether (MTBE), which is still popular in Asia and the Middle East, methanol is being considered for dimethyl ether (DME) and as a replacement for naphtha, changes which could radically alter its demand landscape.

However, in China at present, methanol appears to be in greater supply than demand. Malaysia and Brunei also have large plants in the pipeline. What China is using to do this is its abundant coal resources. Thus Asia, surprisingly, has been an even larger manufacturer of methanol than the Middle East over the last few years. MMSA forecasts a need for the Middle East to export more methanol in the future, as biodiesel producers will be looking for suppliers.

MMSA predicts a need for about 1.2 million metric tons of methanol as the feedstock for biodiesel by 2012, which is equivalent to 3 to 4% of the current total global demand. As the long-term global methanol pricing floor is set by the cost of production in China, the high profit margins of 2007 will have diminished greatly by 2009, when capacity expansion will have materialized. Over the last 10 years, methanol price behaviour has exhibited moments of competitiveness against fuel oil but has spiked whenever demand growth has quickened.

Vegetable oil market cycles have up till now been independent of crude oil, with biodiesel from palm oil occasionally exhibiting a slight cost advantage over petroleum diesel in Southeast Asia. The co-product, glycerine, looks oversupplied, but low prices are driving interest in new processes.

It may be concluded that China's new market development is critical to meeting the large growth in supply and that new, competitive, Southeast Asian and Middle Eastern supply will be en route by the end of 2008. The disadvantages of coal-based production appear lessened and biodiesel producers should be able to rely on the methanol supply with the caveat that suppliers vary.

(services@methanolmsa.com)

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Global Methanol & Biodiesel - Linked For Better or Worse

Mark Berggren
Managing Director
Methanol Market Services Asia (MMSA), Singapore
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Prepared for the MPOB Biofuels Conference
Kuala Lumpur
July 5-6, 2007

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MMSA – Global Insight, Asian Perspective™

- Many Years of Consulting Experience
- Based in Singapore
- Multi-Client Services
  - Methanol and Derivative Analysis
    - Methanol, Acetic Acid, Formaldehyde, MMA in global detail
  - Methanol Notes™
    - Topics of relevance in brief 5X/month
- Project Services
  - Market and Technical Due Diligence Support
  - Bankable Project Assessments
  - Valuation
  - Many others
- IMPCA Asian Methanol Conference Co-organizer
  - 10th: May 9-11, 2007, the Regent, Singapore
  - 11th: May 20-22, 2008, Kuala Lumpur
- Petrochemical Training
  - Petrochemical Planning Basics

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3

Today's Topics

- An unprecedented fly-up in methanol prices occurred in late '06 and early '07
- Partially due to the increasing use of methanol in non-traditional fuel applications
- Many biodiesel participants are rightly concerned about stability of methanol prices as a result
- The fates of methanol and biodiesel markets are in many ways intertwined
  - A large amount of capacity issuing in China and Southeast Asia will be reliant on the development of new sources of methanol demand such as biodiesel

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Today's Topics

- Methanol Supply: sources of growth globally and in Asia
- Methanol Demand: traditional and alternative fuels sources
- Supply, Demand, and Trade balances through 2012
- Methanol Price expectations and rationale
- Methanol and Biodiesel
  - Will there be enough methanol to support growth? Yes
  - Glycerine – looks oversupplied, but low prices driving interest in new processes
- Conclusions

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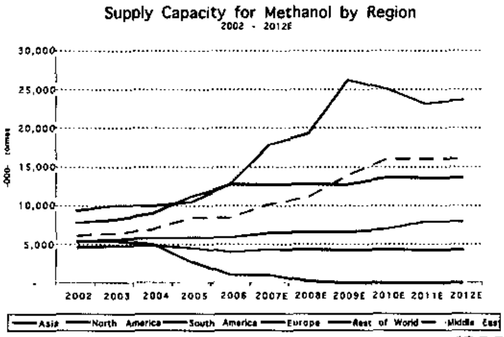
Methanol Capacity is Growing Faster than Demand, Especially in Asia

Supply Capacity for Methanol by Region
2002 - 2012E



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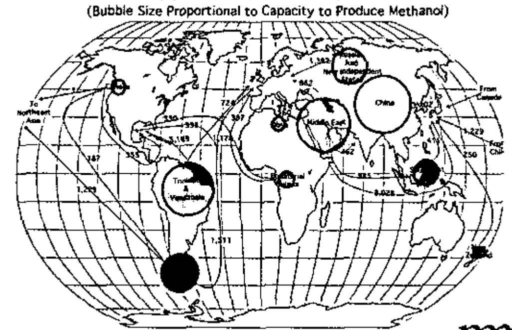
Asia Still Highly Reliant on Middle East & Chile Methanol Molecules

2006 Methanol Trade Flow
(Bubble Size Proportional to Capacity to Produce Methanol)



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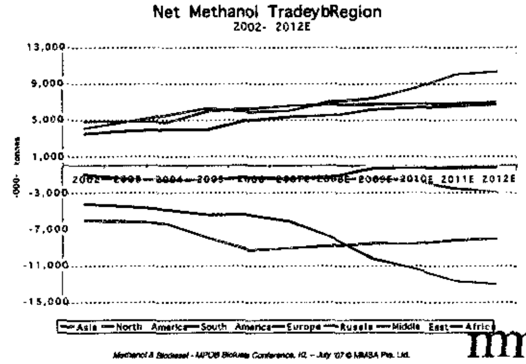
North America, Europe Rival Asia as Net Importers – South American Exports Threatened



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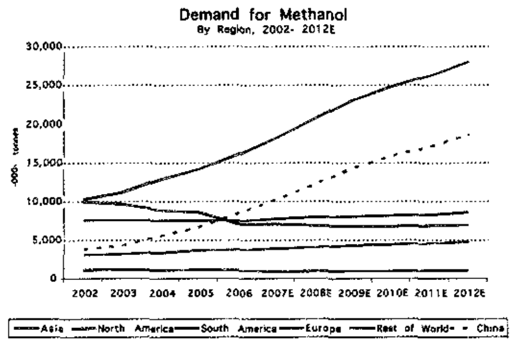
Global Methanol Demand Centered in Asia, China



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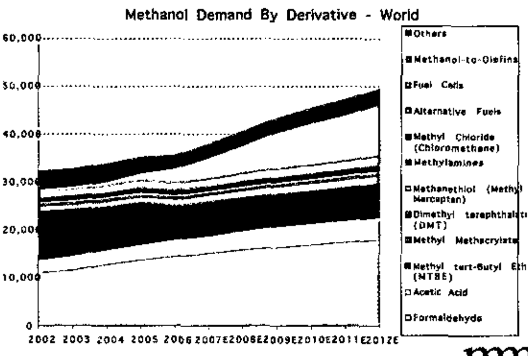
Methanol has Found its Way into the Massive Potential of the Fuels Pool



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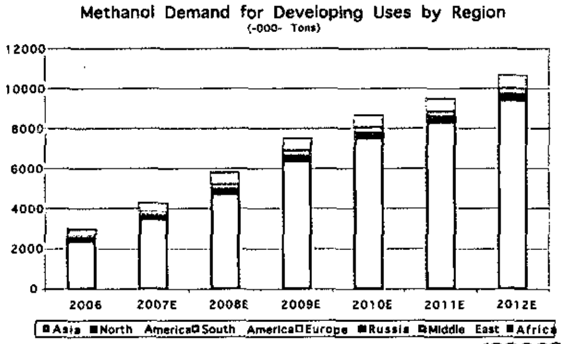
China, Via Methanol, Seeking to Lever Abundant Coal Resources



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- *Conclusions*

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Asian Balance Now Lengthening

Methanol Production Capacity Serving Asia, 2007E

Within Asia		External to Asia		
Country	Capacity to Produce (Million metric tons)	Country	Capacity to Produce (Million metric tons)	Supply to Asia (Million metric Ton
China	14.77	Saudi Arabia	5.41	2.71
Indonesia	1.05	Iran	3.12	1.56
Malaysia	0.79	Qatar	0.83	0.29
New Zealand	0.52	Bahrain	0.47	0.24
India	0.53	Oman	0.40	0.28
Others	0.22	Others (Chile, Russia)	8.46	1.77
Total Asia	17.88	Total External	18.69	6.84

Total Available Capacity for Asia:
24.7 million metric tons
Demand, Asia, 2007E:
18.2 million metric tons
Required Nameplate Operating Rate, Asian Capable Methanol Assets:
73.7%

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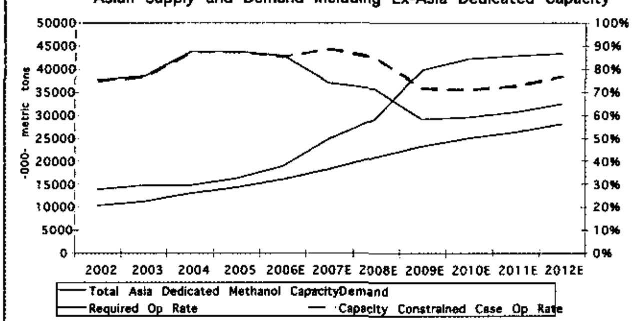
Yet Operating Rates Sensitive to Timing of New Capacity Additions



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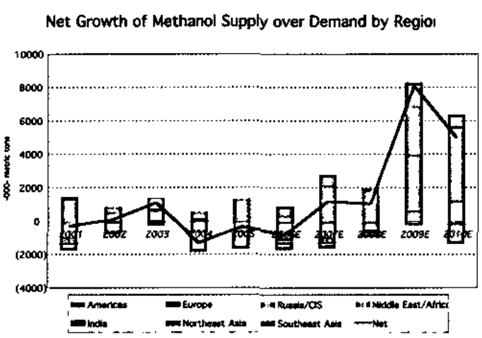
Methanol Supply in 2009 Appears Problematic



- Since 2001, several years of "supply management" lead by New Zealand, North American high cost production rationalizations
- Rash of China, Middle East, and SEA new capacity to emerge
- Today's new China project could be rationalized not too long thereafter unless new applications develop (DME, MTO, Gasoline blends, biodiesel)

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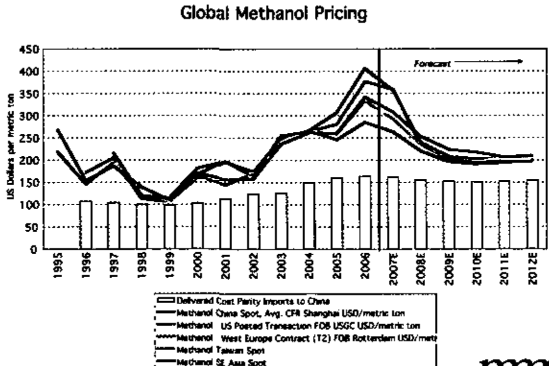
Long Term Pricing Floor Set by Cost of China Production – Margins to Diminish



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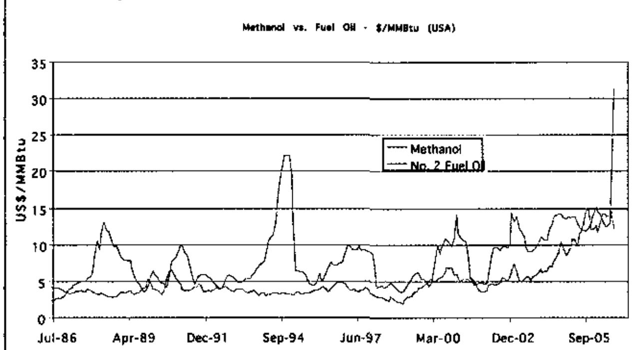
Methanol Exhibits Moments of Competitiveness, But *Spikes When Demand Growth Quickens*



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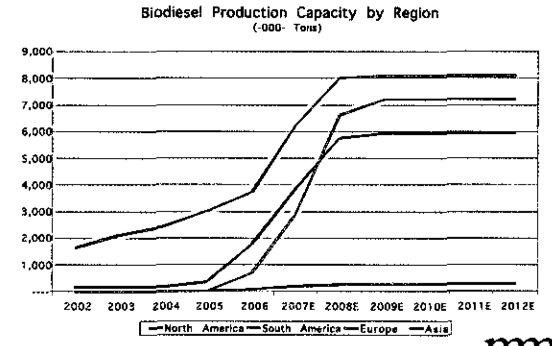
Big Plans For Biodiesel Reliant on So Far High Government Supports



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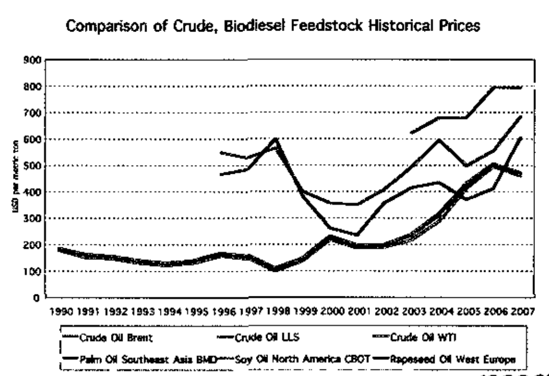
Vegoil Market Cycles Have Been Independent of Crude



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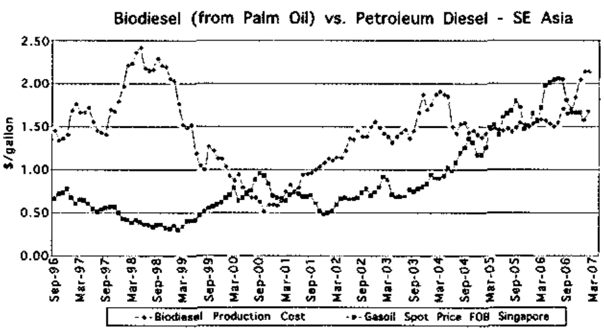
Biodiesel from Palm Oil in SEA Occasionally Exhibits Slight Cost Advantage



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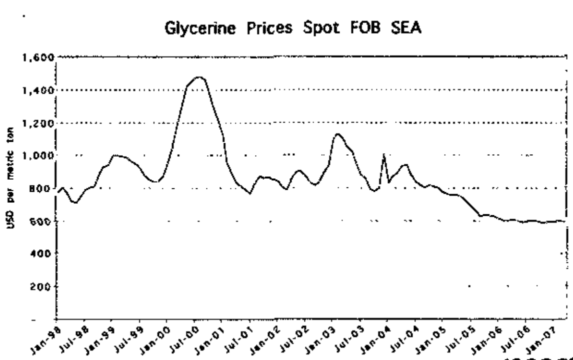
Co-Product Glycerine Well Oversupplied, Prices Have Adjusted Accordingly



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Conclusions

- Supply and Demand Growth in China is Fastest, Largest Globally
- China new market development is critical to meeting large growth in supplies
- New, Competitive Southeast Asia and Middle East Supply en Route by end 2008
- Coal Based Production - Its Disadvantage Looks Lessened
- Biodiesel Producers Should Be Able to Rely on Methanol Supply – Warning: Suppliers Vary

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SESSION 2-5:

LIFE CYCLE ASSESSMENT OF BIOFUELS - AS RELATED TO GREENHOUSE GAS EMISSIONS

Ralph Sims
International Energy Agency (IEA), France

The Summary for Policy Makers (SPM) of the Intergovernmental Panel on Climate Change (IPCC)'s Fourth Assessment Report came out in May 2007 after extensive reviews by independent and government experts to provide unbiased, current knowledge about climate change. The speaker was the co-ordinating Lead Author for the Energy Supply chapter of the Fourth Assessment Report – Mitigation.

The following are some of the key points from the SPM: Between 1970 and 2004, global greenhouse gas emissions continued to increase by 70% despite all the prevention efforts made since 2001. Under current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow from 2000 to 2030, varying from 25 to 90% depending on scenario. In the long term, mitigation efforts and investments over the next two to three decades will have a major impact on opportunities to achieve lower stabilization levels. Delayed emission reductions significantly constrain the opportunities to achieve lower stabilization levels and increase the risk of more severe climate change impacts. In the context of climate change, potential is the amount of mitigation that could possibly be realized over time. Climate policies that impose a real or implicit price of carbon, or carbon price, for the emission of 1 ton of CO_2 into the atmosphere could motivate producers and consumers to invest in low-carbon technologies. Thus, long-term GHG mitigation potential depends on effective carbon prices. Carbon prices should reach US$20-80 per tCO_2eq to achieve stabilization at around 550 ppm CO_2eq by 2030. Several slides are shown to illustrate projected sector potentials above the baseline scenario by 2030 depending on the carbon prices. The vertical line indicates the range of potentials depending on assumptions and the height of the column indicates the median value in the range as well as the regional distribution in the scenario.

Biomass resources are crosscutting, over the various sectors, Industry, Agriculture, Forestry or Waste and may be converted into bioenergy for use by Energy supply, Transport, Buildings and Industry. Against the projected CO2 emissions from transportation fuels by 2030, vehicle efficiency improvements could reduce 1600 to 3500 Mt CO2 from the projection, while there is a possibility of an increase if oil shale, oil sands, heavy oils, coal-to-liquids etc are used. Biofuels have the potential to contribute at around US$20~50/tCO2 eq avoidance to gain a 5 to 10% share of road transport fuel by 2030 with potential emission reductions in the range of 600 to 1000 Mt CO2 displacing oil products. The IEA Medium Term Oil Market Report 2007 indicates, however, that the economics of the 1st generation biofuels are uncertain and raises doubts as to whether an ambitious supply growth scenario will be realized by 2012. Life Cycle Analyses (LCA) of GHG abatement potential of 1st generation biofuels are shown on two slides relative to petroleum gasoline and diesel, wide ranges of potential being observed due to different assumptions as well as uncertainty regarding input parameter values. LCA conclusions generally indicate that high GHG savings from biofuels result when:

- sustainable biomass yields are high
- fossil fuel inputs are low
- biomass is converted efficiently to biofuels
- the biofuel is combusted efficiently in vehicle engines.

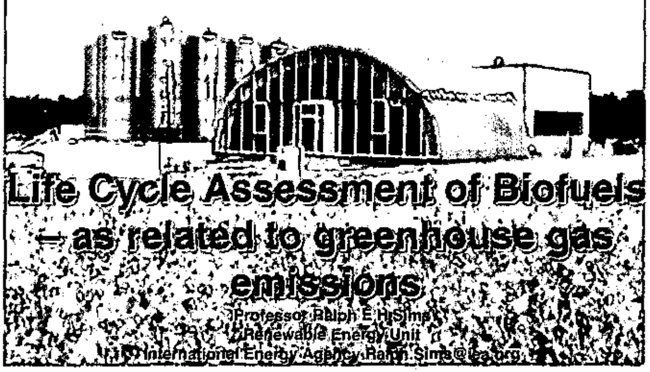
However, biofuels from seeds and grain provide only modest GHG mitigation benefits and can offer modest levels of oil displacement in the long term due to inefficient land use, unless the whole plant can be used. LCA results need careful interpretation with respect to the many variables involved and a standard LCA methodology needs to be adhered to.

(Ralph.Sims@iea.org)

1

International Conference on Biofuels

Kuala Lumpar, 3-4 July, 2007



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Aims for the next 30 minutes

- Outline the IPCC process with regard to the recent 4th Assessment Report
- Provide an overview of the key points from the Summary for Policy Makers.
- Give emphasis to biofuels and the transport sector.
- Consider the role of LCA in determining the cost and potentials of 1st and 2nd generation biofuels.

IPCC

3

IPCC 4th Assessment Report

- Aim is for the report to be used by policy makers so it reviews the current knowledge without bias- and must be non-policy prescriptive.
- Three year process.
- Assessment of published literature to bring the scientific information into one place.
- Extensively reviewed by independent and government experts.
- 27 paragraph Summary for Policy Makers approved line-by-line by all IPCC member governments in Bangkok, May 1- 4.
- Full Report and Technical Summary – to be released in September must support the SPM statements. (Google: "IPCC + Mitigation")

IPCC

4

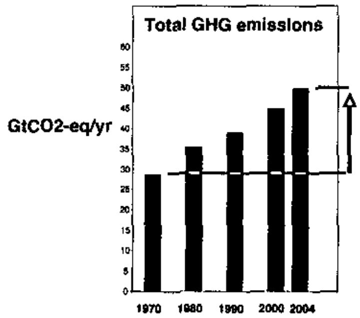
The people

- 168 Lead Authors:
  - 55 from developing countries
  - 5 from EITs
  - 108 from OECD countries.
- 85 Contributing Authors
- 485 Expert Reviewers

IPCC

5

Between 1970 and 2004 global greenhouse gas emissions continued to increase



+70%

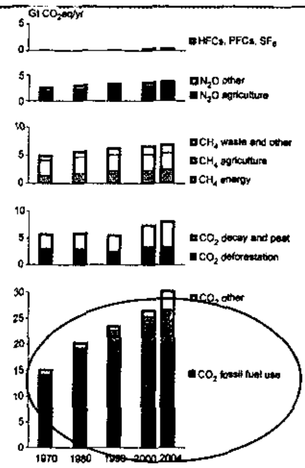
In spite of all the policies, all the technologies, and the high energy prices since 2001, GHG continue to accelerate.

IPCC

6

Energy related carbon dioxide is the largest contributor at around 60% of total emissions.

CO_2 emissions have grown by 80% since 1970 and 28% since 1990, mainly from high growth in the energy supply and transport sectors.



IPCC

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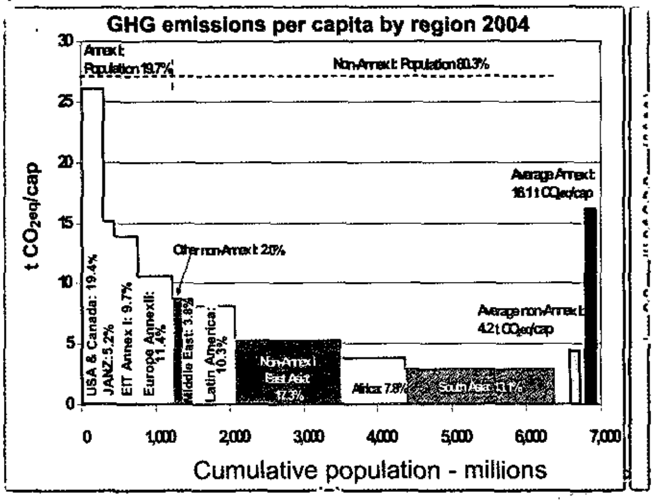

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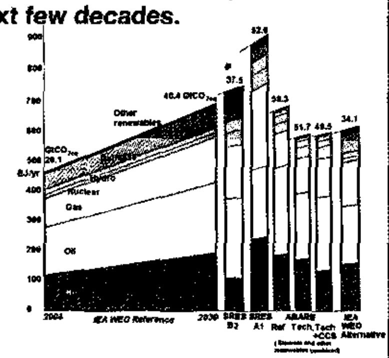
Under current climate change mitigation policies *and related sustainable development practices*, global GHG emissions will continue to grow over *the next few decades.*

IPCC SRES, ABARE and IEA WEO scenarios all show increased GHG emissions from 2000 to 2030, varying between +25-90 %



9

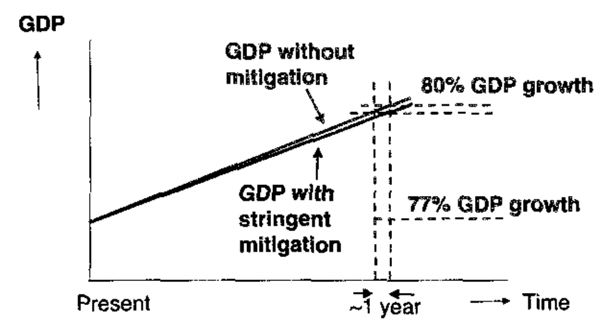
Long term mitigation after 2030

Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels.

Stabilisation levels		Global mean temperature increase at equilibrium °C	Year GHG need to peak	GDP reduction in 2030	Reduction in 2050 CO2 emissions compared to 2000
ppm CO2	CO2-eq				
350- 400	445 – 490	2.0 – 2.4	2015	>3%	-85 to -50
400- 440	490 – 535	2.4 – 2.8	2020	~ 3%	-60 to -30
440- 485	535 – 590	2.8 – 3.2	2030	~ 2%	-30 to +5
485- 570	590 – 710	3.2 – 4.0	2020 - 2060	0-1%	+10 to +60
570- 660	710 – 855	4.0 – 4.9	2050 - 2080		+25 to +85
660- 790	855 –1130	4.9 – 6.1	2060 - 2090		+90 to +140

10

Illustration of GDP cost numbers over next 30 years or so



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An effective carbon-price signal could realise significant mitigation potential in all sectors

- *Policies that provide a real or implicit price of* carbon could create incentives for producers and consumers to significantly invest in low-GHG products, technologies and processes.
- Such policies could include economic instruments, government funding and regulations.
- For stabilisation at around 550 ppm CO_{2eq} carbon prices should reach US$ /20-80 tCO_{2eq} by 2030
- At these carbon prices large shifts of investments into low carbon technologies including biofuels can be expected.

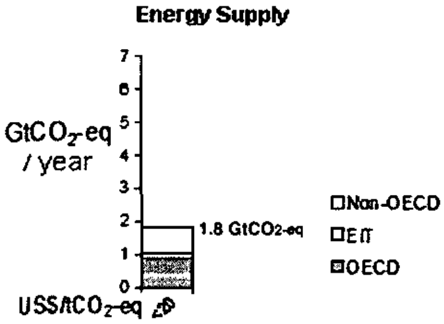
12

What does US$ 20/ tCO_2-eq mean?

- Crude oil: ~ + US$ 10/ barrel
- Diesel/gasoline pump price:+ US$ 0.05 /litre
- Electricity:
  - from coal-fired plant: ~ + US$ 0.02 /kWh
  - from gas-fired plant: ~ + US$ 0.005 /kWh

13

Energy supply economic potentials above the baseline by 2030 as a function of carbon price up to US$ <20 / t CO_2 -eq.



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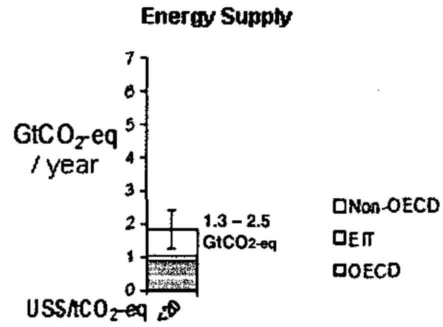
Range of economic potentials above the baseline by 2030



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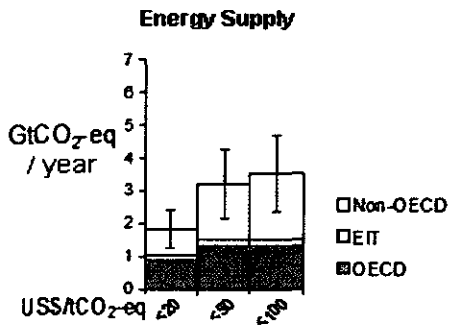
Economic potentials above the baseline by 2030 as a function of carbon prices of US$ <20, 50 and 100 / t CO_2 -eq.



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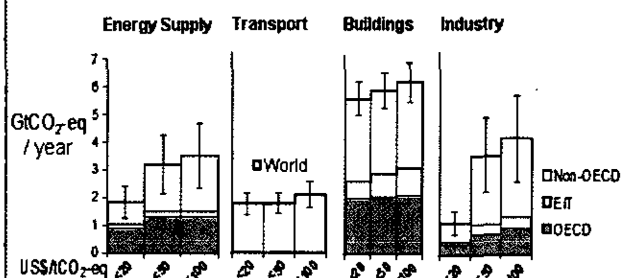
Sectoral economic potentials above the baseline by 2030 as a function of carbon prices of US$20, 50 and 100 / t CO_2 -eq.

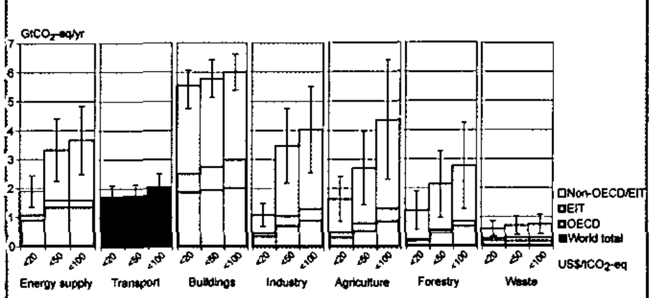


Notes: Emissions from electricity use are counted in the end-use sectors.

Transport not split into regions because of international aviation fuel.

17

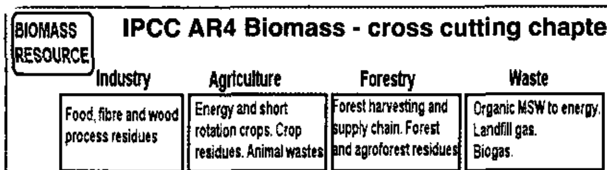
All sectors and regions have the potential to contribute



Note: Estimates do not include non-technical options, such as lifestyle changes.

18

IPCC AR4 Biomass - cross cutting chapters



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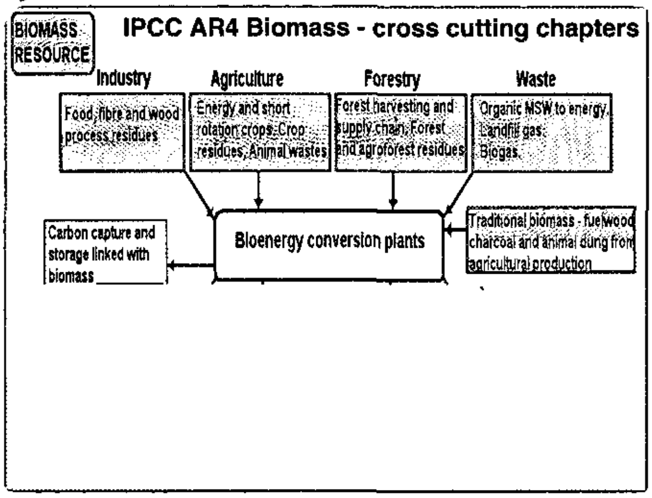

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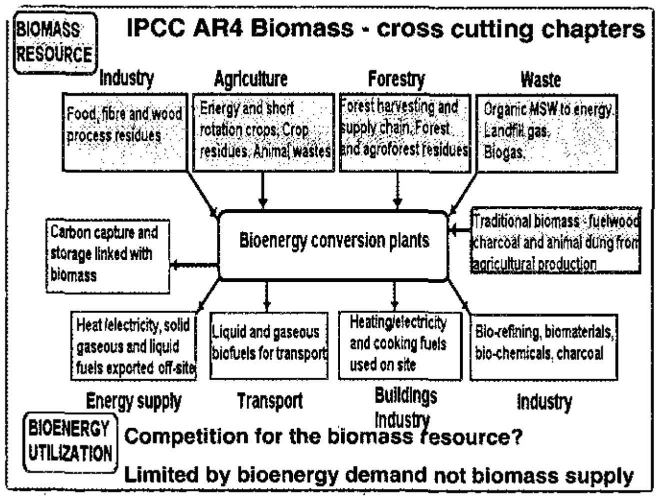

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Key mitigation technologies and practices: a) currently commercially available and b) projected to be commercialized by 2030.

<u>Transport</u>

a) More fuel efficient vehicles; hybrid vehicles; cleaner diesel vehicles; 1st generation biofuels; modal shifts from road transport to rail and public transport systems; non-motorised transport (cycling, walking); land-use and transport planning.

b) 2nd generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries etc.

Many mitigation options provide good economic potential in the transport sector but their effect may be counteracted by high growth and strong consumer preferences.

Biofuels could provide 5-10% of road transport fuel by 2030.

IPCC

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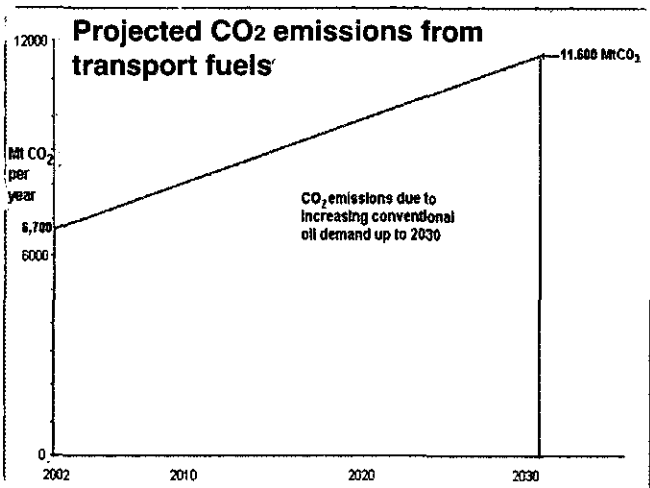

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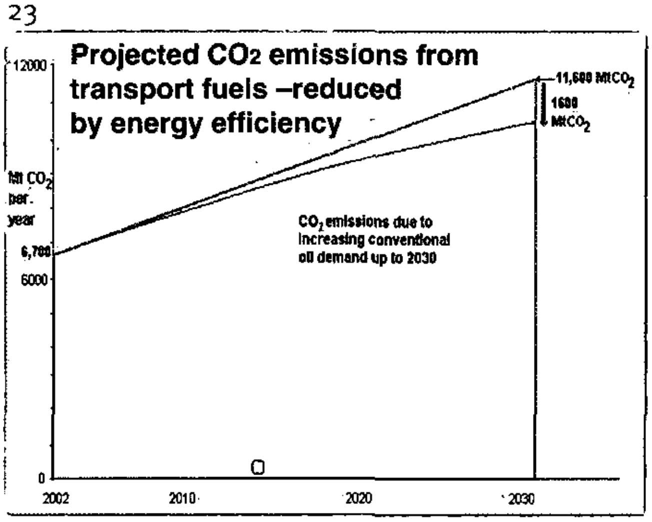

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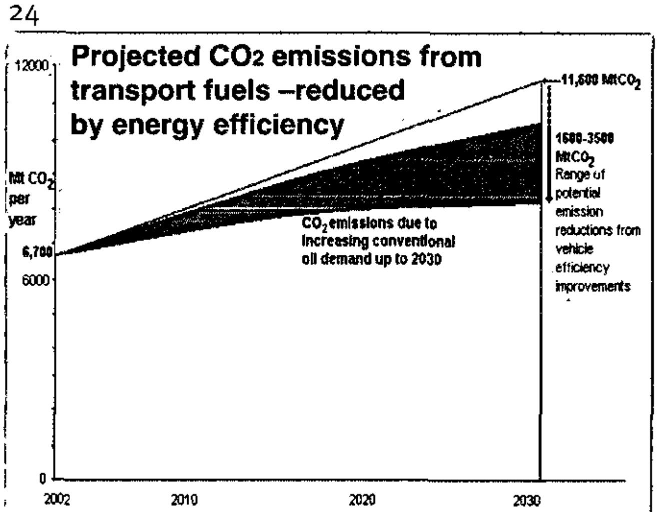

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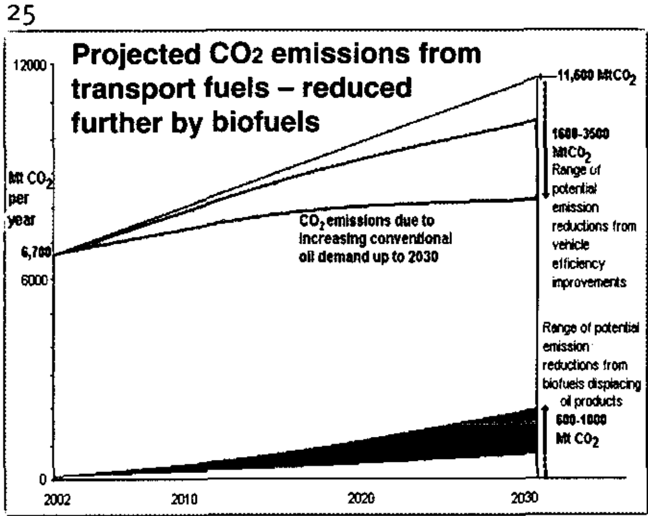

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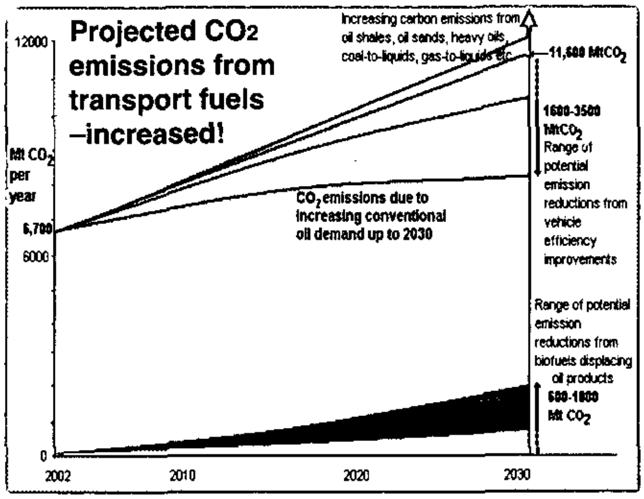

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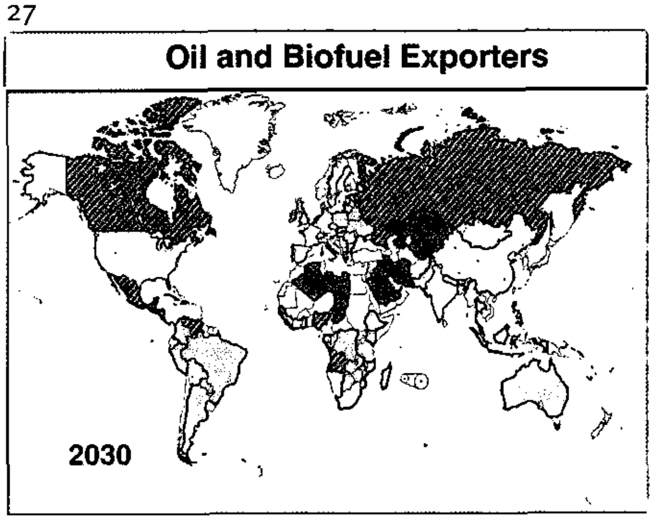

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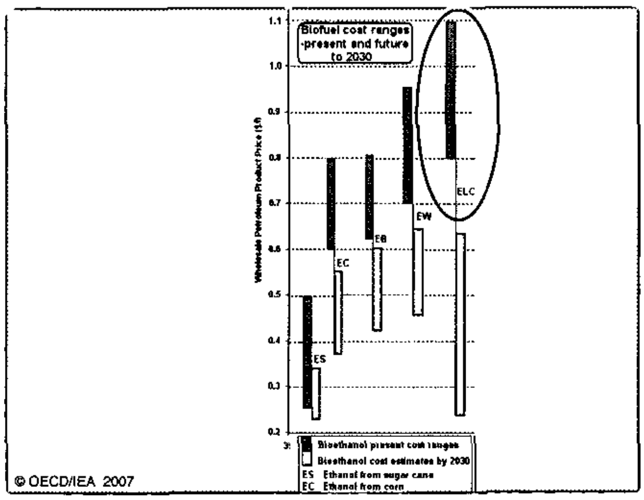

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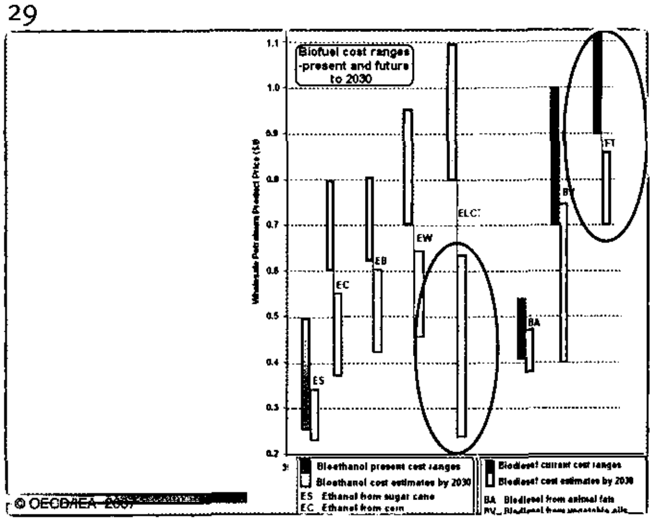

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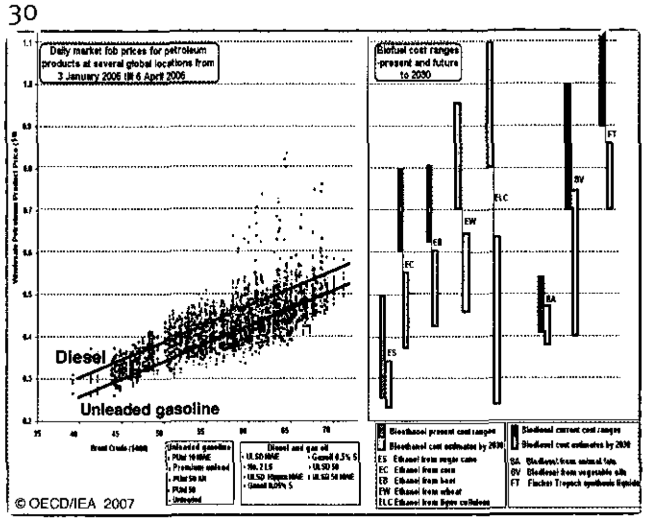

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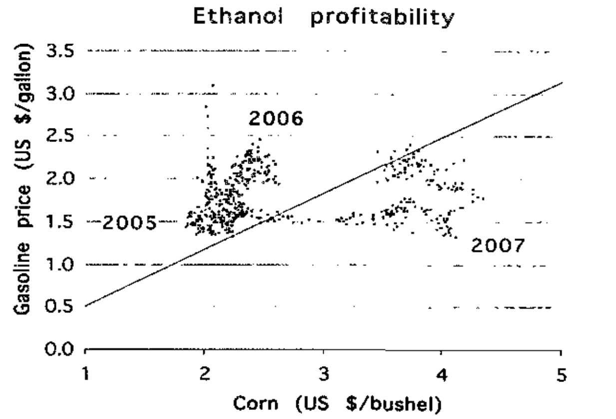
IEA Medium Term Oil Market Report

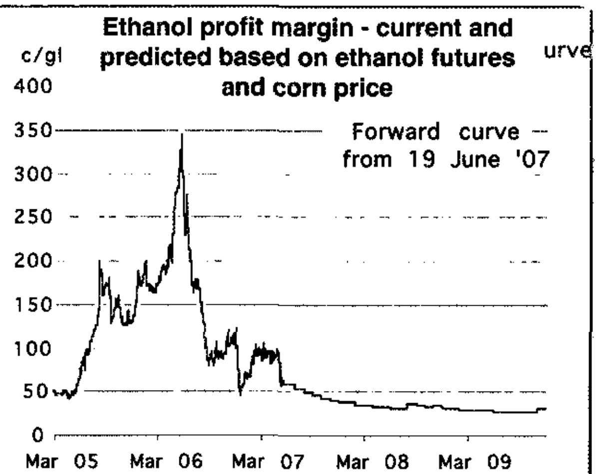
"Despite political enthusiasm and support for what is seen by some to be a potential solution to dependence upon imported oil, the depletion of fossil fuels and growing carbon emissions, the economics of 1st generation biofuels are uncertain and raise doubts as to whether ambitious supply growth scenarios will be realised."

32



The links between oil price, ethanol price and corn price affect profitability for the biofuels industry.

33



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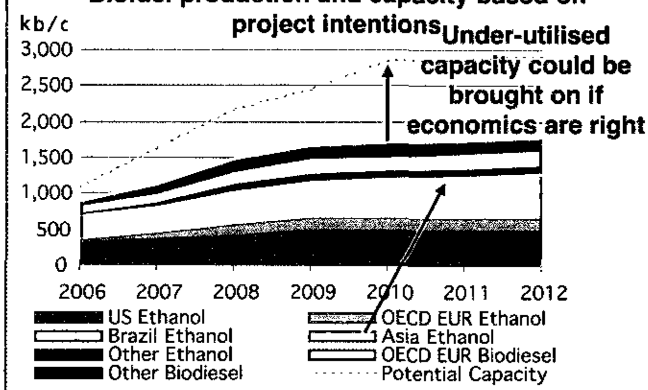
IEA Medium Term Oil Market Report.

Biofuel production and capacity based on project intentions



Production capped in 2009 except for Brazil.

35

IEA Medium Term Oil Market Report

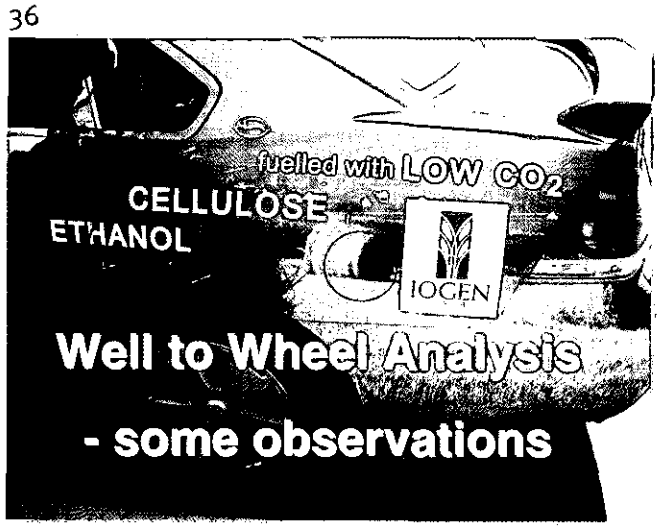
"Doubts are greatest concerning realisation of all announced projects in the Asia-Pacific region.

Of a total biofuels production capacity of 604 kb/day by 2012, only around one third will be realistically produced by 2009.

Of this around 70 kb/day will come from China and 20-25 kb/day will each come from India, Thailand, Australia, Indonesia and Malaysia.

Doubts exist over the sustainability of production and high palm oil prices making mandatory blending requirements look less certain."

36



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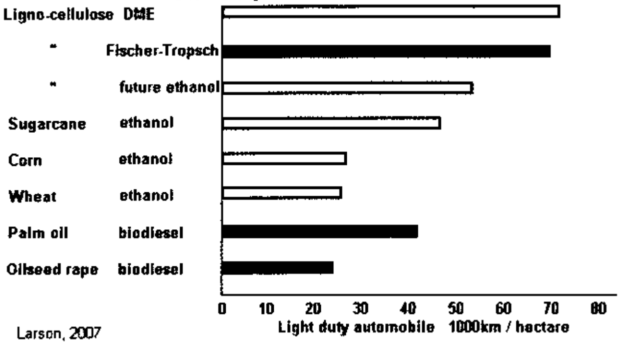
1st generation biofuels produced from 1 hectare of land can be used to drive a car 25,000 – 45,000 km whereas 2nd generation could travel further /ha.

Note: Co-products not included.



38

Life Cycle Analysis.

Uncertainty around input parameter values and different assumptions made lead to variations.

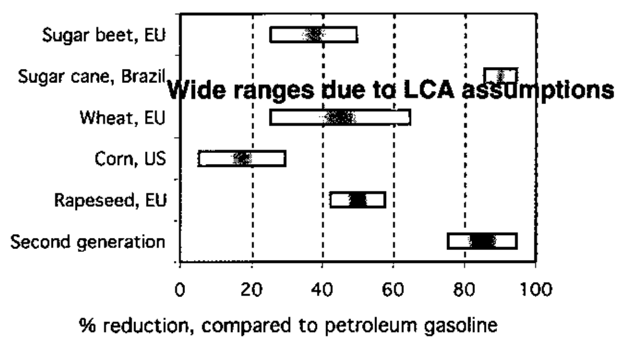
- Type of biomass and sustainable yield /ha / yr;
- Soil types and change in carbon content;
- Land use options and water restrictions;
- Fertiliser and agri-chemical input requirements;
- Harvest, storage and transport methods;
- Co-products and their substitution potential;
- Performance of conversion technologies;
- Vehicle fuels that the biofuels will displace;
- Competing uses for the biomass produced.

Standard LCA methodology needs to be adhered to.

39

Biofuels greenhouse gas abatement potential

Well-to-wheel emission reductions



40

GHG emission reduction potential from corn

1 ha corn produce 10 t grain plus 5 t dm stover.

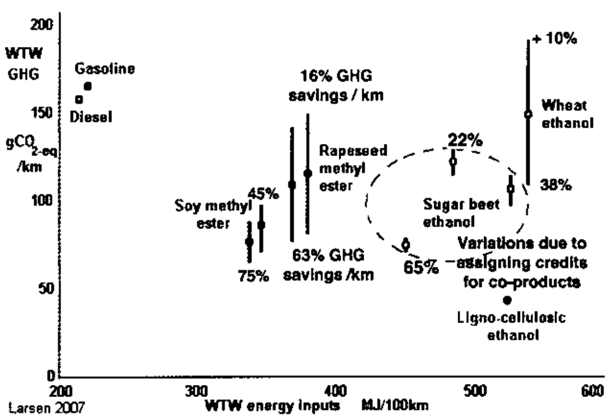
A) 4000l/ha ethanol substitutes for 2500 l gasoline.
Avoids around 1.5 t CO_2 emissions.

B) Stover has energy content of around 100GJ.
Substitutes for 4 t coal and avoids 10.5 t CO_2.
TOTAL 12 t CO_2 avoided.

C) Burn whole corn plant for heat:
14 t dm /ha with energy content around 280 GJ.
Substitutes for 11 t coal.
28.4 t CO_2 avoided.

41

Diversity in LCA results - a European study



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LCA conclusions

High GHG savings from biofuels result when:

- sustainable biomass yields are high;
- fossil fuel inputs are low;
- biomass is converted efficiently to biofuel;
- the biofuel is combusted efficiently in vehicle engines.

Biofuels from seeds and grain provide only modest GHG mitigation benefits and can only offer modest levels of oil displacement in the long term due to inefficient land use unless the whole plant can be used.

43

In Summary

Energy related GHG emissions continue to increase.

Stabilising at around +2°C is still desirable but becoming very difficult to implement.

Instead now try for 50% emission reductions below 2000 levels by 2050.

Biofuels have good potential to contribute at around US$ 20 - 50 /t $CO_{2\text{-eq}}$ avoidance to gain a 5 – 10% share of global road transport fuels by 2030.

Uncertainties about conflicting LCA results, GHG mitigation variations, crop yields, 2nd generation biofuel technologies and costs, land use, and sustainable production need careful interpretation.

SESSION 2-6:

OVERVIEW OF RECENT DEVELOPMENT IN SUSTAINABLE BIOMASS CERTIFICATION

Martin Junginger
Copernicus Institute for Sustainable Development, Utrecht University, the Netherlands

Increasing fossil fuel prices, growing environmental concerns over their use and considerations regarding the security and diversification of the energy supply have driven the increased use of biomass worldwide. However, the production of biomass energy crops and the removal of biomass residues from forest and agricultural systems for energy production can also result in negative ecological impacts, changing land-use patterns, socio-economic impacts and GHG emissions. In such situations, setting standards and establishing certification schemes are possible strategies that can help ensure that biofuels are produced in a sustainable manner. Certification is the process whereby an independent third party assesses the quality of management in relation to a set of predetermined standards.

The objective of this presentation is to give a comprehensive review of initiatives on biomass sustainability criteria and certification. It first discusses recent developments in the creation of certification systems in the Netherlands, the EU, the UK and Germany as of June 2007.

In the Netherlands, a project group named Sustainable Production of Biomass was established in 2006, involving various stakeholders in the development of a system of sustainability criteria for the production and conversion of biomass for energy, fuels and chemistry. The framework report was published in April 2007 and presented to the Dutch government. On the supra-national level, the European Commission (EC) is active in the development of biomass certification. In January 2007 the EC made proposals for a new Energy Policy for Europe, including a renewable energy roadmap proposing a binding 20% target for the overall share of renewable energy by 2020 and a binding 10% target for the share of biofuels in petrol and diesel in each Member State by 2020, to be accompanied by the introduction of a sustainability scheme for biofuels. The EU is now drafting proposals to incorporate these targets into legislation. In June 2007 the UK government published methodologies for carbon reporting and a framework for sustainability reporting for biofuels within the Renewable Transport Fuel Obligation (RTFO). The UK and Dutch governments are cooperating on the development of sustainability requirements, beginning with bilateral discussions in 2006 and leading to joint activities and a common approach to many issues. In Germany, the Biofuel Quota Act came into force in 2007, including a provision that empowers the government to establish sustainable requirements for biofuels that are eligible to participate in the quota system. The German Renewable Energy Act will be under revision in 2008 and introduction of sustainability requirements is expected.

Potential barriers as well as boundary conditions are then identified to discuss the challenges to be looked at in the development of biomass certification systems. The viewpoints of NGOs, industry, national governments and international bodies are also stated. It may be concluded that, among a wide rage of initiatives undertaken by various stakeholders toward the development of sustainability standards and certification systems, there seems to be a general consensus that it is important to include economic, social and environmental criteria in them. However, differences in the stringency and in the extent and level of detail of these criteria are recognizable, due to varying interest and priorities.

The second set of slides deals with the topic, "A Greenhouse Gas Balance of Palm-Oil-Based Electricity Production", to illustrate results of a recent study on the GHG balance of electricity produced in a natural gas power plant in the Netherlands using crude palm oil (CPO) and palm fatty acid distillate (PFAD) produced in Kalimantan, Malaysia. It was concluded that they can exhibit substantial GHG reductions, but also that large net GHG emissions are possible if oil palm is planted on sensitive land such as natural rainforest or peat land.

(H.M.Junginger@uu.nl)

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IEA Bioenergy

Overview of international developments in sustainable biomass production and certification

Martin Junginger

With contributions from Jinke van Dam, André Faaij (Utrecht University), Gustavo Best, Ingmar Jürgens (FAO), Uwe Fritsche (Oeko-institut), Kees Kwant (SenterNovem) and A. Bauen (E4tech)

Updated results of IEA Bioenergy Task 40 Deliverable 5

International Conference on biofuels, UNIDO/MPOB, 5-6 July 2007, Kuala Lumpur, Malaysia

2

IEA Bioenergy Task 40: Sustainable International Bioenergy trade

Presentation overview

1. Background: the need for sustainability criteria and certification
2. Overview of current developments in
   1) the Netherlands
   2) the EU
   3) the UK
   4) Germany
3. Barriers and boundary conditions of certification systems for biomass
4. Strategies for implementation
5. If time allows: Initiatives from private parties & international bodies
6. Concluding remarks

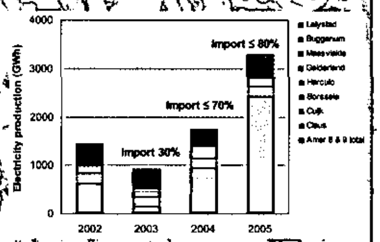
5 cm

3

IEA Bioenergy Task 40: Sustainable International Bioenergy trade

Background: the need for sustainability criteria

- Growing bio-energy demand and international supply chains create unique opportunities for biomass producing regions.
- Example: renewable electricity production in the Netherlands using (mainly imported) biomass (wood pellets, agro-residues, vegetable oils)



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IEA Bioenergy Task 40: Sustainable International Bioenergy trade

Background: the need for sustainability criteria

- Increasing demand is causing rapid expansion of biomass production
- NGO's and increasingly European governments call attention to negative side-effects of rapidly expanding commodities such as palm oil in Malaysia and Indonesia, or soy cultivation in Argentina, also ethanol from sugarcane under investigation
- Overexploitation should be avoided and sustainability criteria implemented

5

IEA Bioenergy Task 40: Sustainable International Bioenergy trade

Developments in the Netherlands

- Establishment of a project group Sustainable production of biomass, beginning of 2006
- *Assignment:* Formulation of testable criteria which can be applied in policy instruments for biofuels and electricity production
- Consultation of stakeholders to ensure public support
- Specific working groups for further development of indicators

5 cm

Source: E. Lammers / K. Kwant, SenterNovem

6

IEA Bioenergy Task 40: Sustainable International Bioenergy trade

Main stakeholders involved

Cefetra
Ministerie van Economische Zaken
Electrabel
SenterNovem
VROM
essent
Buitenlandse Zaken
Cargill
Natuur en Milieu
n(o)vib Oxfam Netherlands
Rabobank
Shell

Source: E. Lammers / K. Kwant, SenterNovem

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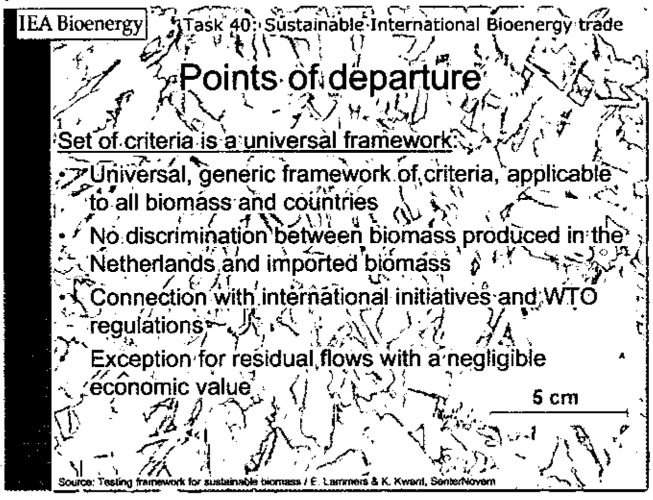
IEA Bioenergy
Task 40: Sustainable International Bioenergy trade
Points of departure
Set of criteria is a universal framework:
• Universal, generic framework of criteria, applicable to all biomass and countries
• No discrimination between biomass produced in the Netherlands and imported biomass
• Connection with international initiatives and WTO regulations
• Exception for residual flows with a negligible economic value
5 cm
Source: Testing framework for sustainable biomass / E. Lammers & K. Kwant, SenterNovem

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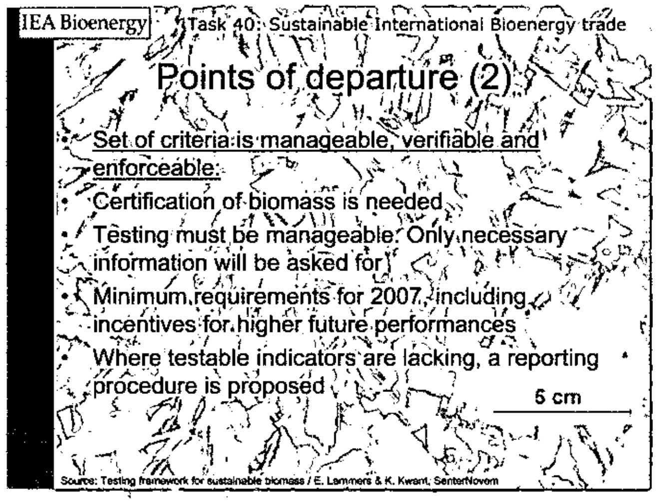
IEA Bioenergy
Task 40: Sustainable International Bioenergy trade
Points of departure (2)
Set of criteria is manageable, verifiable and enforceable:
• Certification of biomass is needed
• Testing must be manageable. Only necessary information will be asked for
• Minimum requirements for 2007, including incentives for higher future performances
• Where testable indicators are lacking, a reporting procedure is proposed
5 cm
Source: Testing framework for sustainable biomass / E. Lammers & K. Kwant, SenterNovem

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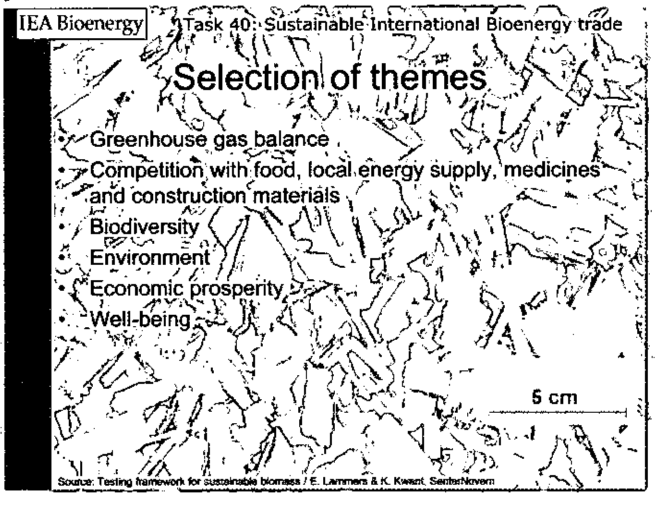
IEA Bioenergy
Task 40: Sustainable International Bioenergy trade
Selection of themes
• Greenhouse gas balance
• Competition with food, local energy supply, medicines and construction materials
• Biodiversity
• Environment
• Economic prosperity
• Well-being
5 cm
Source: Testing framework for sustainable biomass / E. Lammers & K. Kwant, SenterNovem

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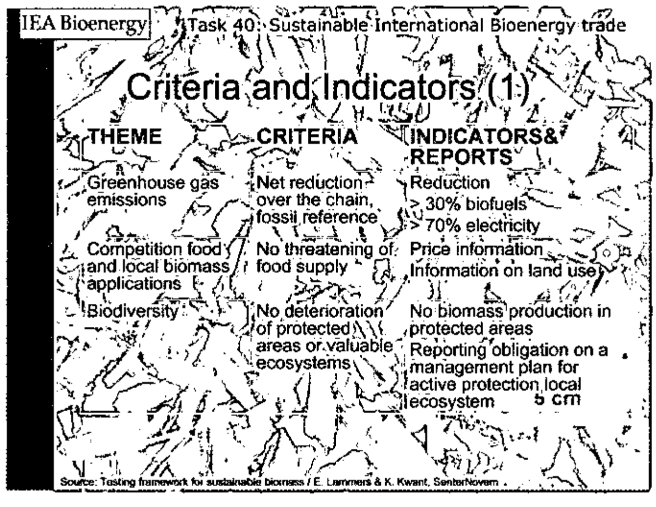
IEA Bioenergy
Task 40: Sustainable International Bioenergy trade
Criteria and Indicators (1)
THEME
CRITERIA
INDICATORS& REPORTS
Greenhouse gas emissions
Net reduction over the chain, fossil reference
Reduction > 30% biofuels > 70% electricity
Competition food and local biomass applications
No threatening of food supply
Price information
Information on land use
Biodiversity
No deterioration of protected areas or valuable ecosystems
No biomass production in protected areas
Reporting obligation on a management plan for active protection local ecosystem
5 cm
Source: Testing framework for sustainable biomass / E. Lammers & K. Kwant, SenterNovem

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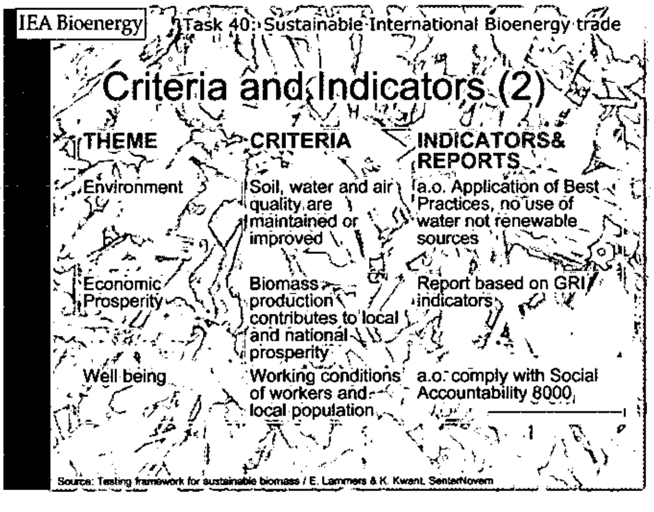
IEA Bioenergy
Task 40: Sustainable International Bioenergy trade
Criteria and Indicators (2)
THEME
CRITERIA
INDICATORS& REPORTS
Environment
Soil, water and air quality are maintained or improved
a.o. Application of Best Practices, no use of water not renewable sources
Economic Prosperity
Biomass production contributes to local and national prosperity
Report based on GRI indicators
Well being
Working conditions of workers and local population
a.o. comply with Social Accountability 8000
Source: Testing framework for sustainable biomass / E. Lammers & K. Kwant, SenterNovem

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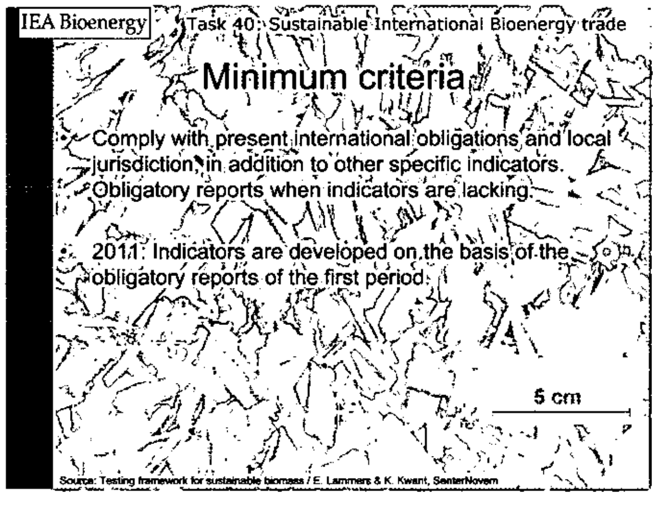
IEA Bioenergy
Task 40: Sustainable International Bioenergy trade
Minimum criteria
• Comply with present international obligations and local jurisdiction in addition to other specific indicators.
• Obligatory reports when indicators are lacking.
• 2011: Indicators are developed on the basis of the obligatory reports of the first period.
5 cm
Source: Testing framework for sustainable biomass / E. Lammers & K. Kwant, SenterNovem

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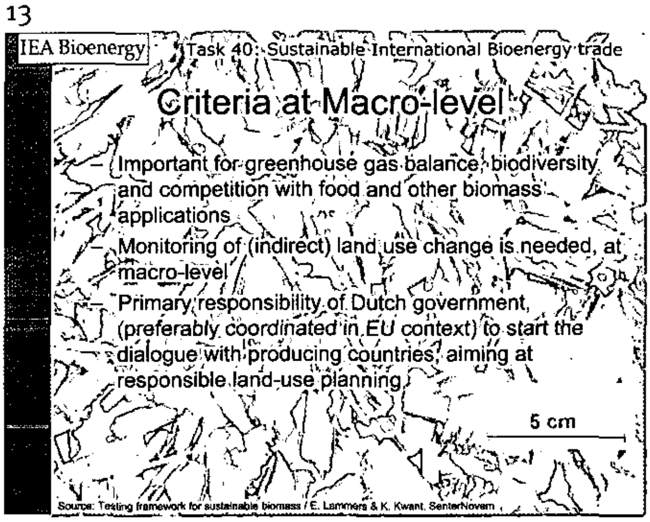
IEA Bioenergy
Task 40: Sustainable International Bioenergy trade
Criteria at Macro-level
– Important for greenhouse gas balance, biodiversity and competition with food and other biomass applications
– Monitoring of (indirect) land use change is needed, at macro-level
– Primary responsibility of Dutch government, (preferably coordinated in EU context) to start the dialogue with producing countries, aiming at responsible land-use planning
5 cm
Source: Testing framework for sustainable biomass / E. Lammers & K. Kwant, SenterNovem

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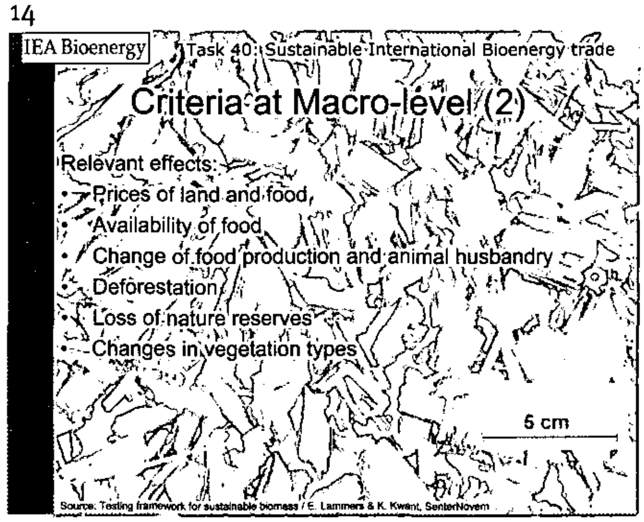
IEA Bioenergy
Task 40: Sustainable International Bioenergy trade
Criteria at Macro-level (2)
Relevant effects:
• Prices of land and food,
• Availability of food
• Change of food production and animal husbandry
• Deforestation
• Loss of nature reserves
• Changes in vegetation types
5 cm
Source: Testing framework for sustainable biomass / E. Lammers & K. Kwant, SenterNovem

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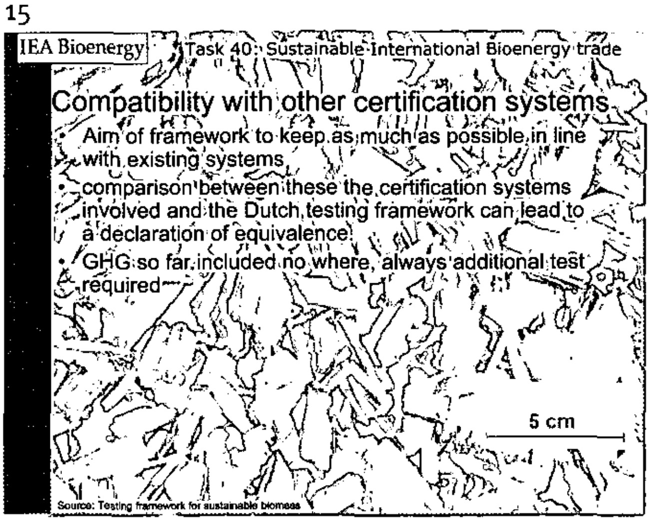
IEA Bioenergy
Task 40: Sustainable International Bioenergy trade
Compatibility with other certification systems
• Aim of framework to keep as much as possible in line with existing systems
• comparison between these the certification systems involved and the Dutch testing framework can lead to a declaration of equivalence
• GHG so far included no where, always additional test required
5 cm
Source: Testing framework for sustainable biomass

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Compatibility with other certification systems

CRAMER CRITERIA	SAN/RA:	RSPO	RTRS Basel	EUREPGAP	FSC:	SA 8000	IFOAM
1 Greenhouse gas balance							
1a Net emission reduction compared with fossil reference, inclusive of application, is at least 30%. Here a strong differentiation of policy instruments is assumed, in which for instance a better performance would lead to more financial support.							
2. Competition with food, local power supply, medicines and building materials							
2a Insight into the availability of biomass for food, local energy supply, building materials or medicines.							
3.1 Biodiversity The installation of biomass production units will not be at the expense of protected or vulnerable biodiversity							
3a No deterioration due to biomass production of biodiversity in protected areas.							
3b No deterioration of biodiversity by biomass production in other areas with high biodiversity value or vulnerability.							
3c No installation of biomass production units in regions where biodiversity has recently been decreased due to conversion.							P
3.2 Biodiversity: The management of biomass production units will contribute towards the conservation or strengthening of biodiversity							
3.2a Concrete contribution towards the maintenance or recovery of biodiversity at or around biomass production units in natural	P		P	P			P
4. Prosperity							
4A Insight into possible negative effects on the regional and national economy.	P	P	P		P		
5 Social well-being No negative effects on the well-being of the employees and local population, taking into account:							
5a Working conditions of employees		P		P	P		P
5b Human Rights		P	P		P		P
5c Property rights and rights of use	P						P
5d Insight into the social circumstances of local population						P	
5e Integrity							
6.1 Environment: In the production and processing of biomass, the soil, and the soil quality must be retained or even improved.							
6.1 a In the production and processing of biomass best practices must be applied to retain or improve the soil and soil quality.				P	P		
6.1 b In the production of biomass crop residues are used for multiple purposes	P	P					P
6.2 Environment: In the production and processing of biomass ground and surface water must not be depleted and the water quality must be maintained or improved.							
6.2 a In the production and processing of biomass best practices must be applied to restrict the use of water and to retain or improve ground and surface water quality.				P	P		P
6.2.b In the production and processing of biomass no use must be made of water from non-renewable sources.				P			
7. Legislation: Biomass production will take place in accordance with relevant national laws and regulations and international treaties.							
7a No violation of national laws and regulations that are applicable to biomass production and the production area.							
7b No infringement of relevant international treaties			P				P

Source: Testing framework for sustainable biomass

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Status & follow-up activities 2007+

- Framework report published in April 2007 and presented to the Dutch government
- Implementation of these guidelines over the coming months and years, taking into account (inter)national legislation and EU developments
- *Working groups on a.o. GHG methodology still working*
- Testing set of criteria (finalized summer 2007)
- Pilot projects in coming years
- Research to further underpin indicators
- Supporting the private sector in starting the certification process

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Developments in the EU

Sustainability requirements & certification of biofuels (for transportation) first mentioned in:

- Biomass action plan (2005): "addressing the issue of a system of certificates… complies with minimum sustainability criteria to count towards the targets"
- and the EU strategy for biofuels (2006): "examine how biofuel use can count towards CO_2 reduction …. work to ensure the sustainability of biofuel feedstock cultivation in the EU and third countries"

5 cm

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Proposed sustainability framework

In January 2007, the EC made proposals for a new Energy Policy for Europe, proposing

- A binding 20% target for renewable energy in 2020
- A binding 10% target for the share of biofuels in 2020

-> This proposals will include a biofuels sustainability framework

-> proposal for new legislation due in November 2007

-> public consultation April-June 2007

5 cm

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Proposed sustainability framework

The framework will at least cover three themes:

- Minimum level of GHG savings compared with fossil fuels, from production to actual use. Percentage under debate
- No use of peatlands/wetlands/other land types with high soil carbon for biofuel production. Definition in preparation
- No high biodiversity areas. Definition in preparation

After the public consultation round, possibly more themes will be included.

5 cm

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Proposed sustainability framework

Furthermore:

- The legislation will seek to promote 2nd generation biofuels
- While EU has capacity to meet biofuel target through domestic production, some imports are preferred to aid developing countries
- The choice whether only biofuels for transport or all biomass for energy should be included, is still debated
- Actual implementation in MS probably earliest from 2011 onwards (rough guess)

5 cm

* Source: www.planetark.com, 25 May 2007, citing Paul Hodson.

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Further developments in the EU

> International Conference on Biofuels on 5-6 July (i.e. today!), with a.o. Commision president Barosso, Pres. Lula, Commissioners Piebalgs, Mandelson, Dimas and Michel and ministers from EU, Africa and Asia

> Debates will be addressing five key issues: policies to support biofuels, development of international trade in biofuels, environmental risks and benefits of production and use, biofuels and developing countries and research activities in biofuels.

5 cm

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Further developments in the EU

- DG TREN: Tender for sustainability criteria and certification systems for biomass production started (expected results end of the year)
- Revision the fuel quality directive / inclusion of sustainability criteria
  - Reducing GHG performance by 1%/ year from 2011 onwards
  - Possibly including also other sustainability criteria
  - Under debate in the European Parliament in September 2007

5 cm

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Developments in the UK

- In November 2005, the Renewable Transport Fuel Obligation (RTFO) announced
- Commence in April 2008, target 2.5% by volume renewable fuels, rising to 5% in 2010/11
- Fuel supplied should have an annual GHG saving of 40% over fossil fuels in 2008/09, 50% in 2009/10 and 60% in 2010/11
- In June 2007, methodologies for Carbon Reporting under the RTFO and a framework report on sustainability reporting within the RFTO published
- Sustainability requirements similar (somewhat less strict) to NL criteria
- Public consultation round started

5 cm

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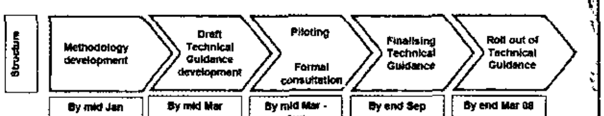
Developments in the UK

Carbon Reporting Project (E4tech)	Sustainability Reporting Project (Ecofys)

- **Objectives**
  - **To develop a robust, practical & cost-effective methodology for:**
    - The consistent quantification of GHG savings for biofuels from different fuel chains
    - Sustainability reporting of fuels from diverse origins
  - **To develop & disseminate technical guidance to enable companies to apply the requirements effectively**



* Source: A. Bauen, E4tech, 15th European Biomass Conference, Berlin, 9thMay 2007.

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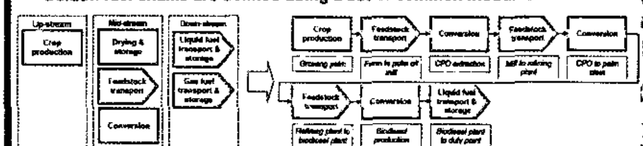
Developments in the UK

- **Default fuel chains are defined using a set of common modules**



- **Default values will exist for all data required to calculate the carbon intensity of a fuel chain**
  - Carbon intensity can be reported without any knowledge of actual fuel chain data or with limited qualitative information e.g. feedstock, origin
- **<u>Qualitative</u> information can be used to provide a more accurate representation of the fuel chain**
  - Selected defaults: energy configuration; mode of transport; cultivation practices
- **<u>Any quantitative</u> data that is known can be used to more accurately reflect fuel chain (e.g. biodiesel plant's NG consumption is known)**

* Source: A. Bauen, E4tech, 15th European Biomass Conference, Berlin, 9thMay 2007.

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Developments in Germany

- German Biofuel Quota Law (in force since 1/2007) → Ordinance for sustainability requirements (mandatory!), expected for Summer 2007; consultation between ministries (BMU and BMELV), harmonization with NL+UK+EU ?
- German Renewable Energy Law (EEG) → revision in 2008, taking into account sustainability requirements for biomass (biogas, liquid biofuels used for power); revision prepared by Ministry for Environment (BMU)
- German bioenergy industry (biodiesel, biogas, 2nd generation biofuels) interested in sustainabilty (as regards imports)
- German Ministry for Agriculture (BMELV) sponsors FAO project on "food vs. fuel" (started mid-April 2007, runs until 2009)
- BMU/BMELV contribute to G8 GBEP

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Potential barriers and boundary conditions

- Sense of urgency – international production & trade is growing fast
- But, with too many initiatives on various levels, a danger of fragmentation and incompatible certification systems exists – prevent proliferation of standards
- Stakeholder involvement in producing countries often neglected, especially smallholders

5 cm

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Potential barriers and boundary conditions

- Compliance with WTO rules and international treaties
- Some sustainability criteria may actually conflict with each other
- Additional costs of meeting the sustainability criteria (and cost of certification) will have to be evaluated
- Inclusion of not enough/soft criteria will result in "greenwashing" (fear of NGO's)
- Inclusion of too many criteria will may in fact create new market barriers (fear of industry and producers)
- Monitoring of compliance crucial, otherwise the "cheaters" may win (fear of both NGO's and industry)

5 cm

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Mandatory certification not the only option

Several policy tools/strategies to pursue the sustainability:

- Certification: Only biomass that is certified according to criteria derived from sustainability principles is allowed to be imported
- Product-Land Combinations: Only biomass from regions that comply with sustainability principles allowed for import
- Government decides which products/regions are eligible for government support
- Regionalization: In this strategy, Europe utilizes its own biomass resources before importing biomass from developing countries
- Self-regulation: code-of practice defined by parties involved in production and trade

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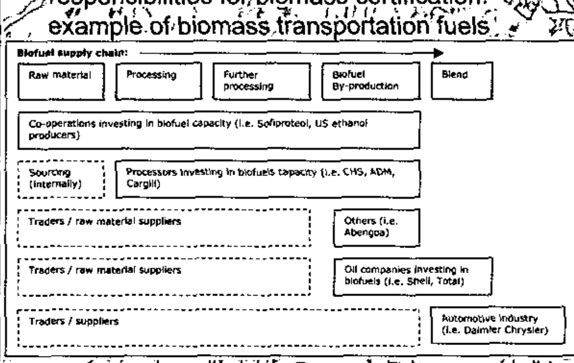
Different companies with different focus and responsibilities for biomass certification: example of biomass transportation fuels



Source: M. van Vaals, 2006

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Initiatives for biomass from private parties

Essent: Green Gold Label standard

Development of GGL started in 2002; 1st certificate in 2004

Certification and supply chain monitoring program for acceptance of sustainable biofuels (sustainable forest and plantation management; fertilizer use; replanting programs; plant mass balance, cleanliness, storage and shipping)

Executed by independent certifying &inspection company (Control Union) and independent inspection company (Peterson Bulk Logistics)

Electrabel:

- Label for wood pellets
- Mainly focussing on energy and GHG emissions; cm
- Also FSC criteria included

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Viewpoints of NGO's

NGOs make an appeal to assure that increased bio-energy production should not lead to environmental and socio-economic harm, at the same time seizing the opportunities for sustainable development

Common points of attentions from NGO's:

- Conversion of land use; depending on spatial distribution & cultivation practices, bioenergy production could lead to loss of biodiversity and further degradation of soils and water bodies;
- (indirect) competition between land use for food production and land use for bioenergy production;
- Land ownership should be equitable and land-tenure conflicts should be avoided;
- Labour conditions, right of children & human health impacts

5 cm

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Int bodies: FAO

- FAO International Bioenergy Platform (IBEP) - reference framework for analysis of sustainable bioenergy and bioenergy/food security nexus
- Bioenergy and Food Security Project (FAO/Germany Trust Fund)
- State of Food and Agriculture (SOFA) 2008 on Bioenergy
- Multi-donor trust fund for country support under development
- FAO Technical Consultations
  - April 2007 - Focus: Food Security and Analytical Framework
  - July 2007 - Focus: Socio-Economic Impacts
  - October 2007 - Focus: Bioenergy and Food Security
- Bioenergy and Food Security (BEFS) Project, USD 3.7 million, 2007-2009
- Broadening FAO knowledge base through bioenergy management system (April 2007) and the establishment of the International Bioenergy Information System (IBIS)
- Strengthening of public-private partnerships
- Monitoring and mapping of bioenergy activities globally

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International bodies & initiatives

UNEP activities include:
- Certification of Biomass Project (with WWF and others)
- Lead development of a collective programme on bioenergy sustainability under the G8's Global Bioenergy Partnership GBEP
- sustainability criteria for production of biomass for liquid biofuels with DaimlerChrysler and other stakeholders

IEA Bioenergy Task 40 on sustainable international bio-energy trade, workshops and studies on biomass criteria and certification options

Round tables on sustainable palm oil (RSPO) and soy (RTRS), multi-stakeholder initiatives focussed on specific product, though not specifically for biomass to energy

5 cm

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Concluding remarks (1/2)

- Currently, initiatives are growing like mushrooms; risk of 'proliferation of standards' -> better international coordination between initiatives required to improve *coherence and efficiency in the development of* biomass certification systems'
- Lack operational indicators & verifiers-> gradual development of certification systems with learning (through pilot studies and research) and expansion over time, linked to the development of advanced methodologies can provide valuable experience, and further improve the feasibility and reliability of biomass certification systems

5 cm

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Concluding remarks (2/2)

- First time that governments actually try to set sustainability criteria for a commodity -> Implications for food products, fodder, materials etc.
- Varying degree of concern: palm oil / soy-bean oil most debated, while many agricultural residues and wood pellets are approved by (almost) all stakeholders
- Many methodological issues remain to be resolved, e.g. impacts on food security and biodiversity on the macro-level

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IEA Bioenergy Task 40: Sustainable International Bioenergy trade

Thank you for your attention!

- An earlier draft of this overview study available at: www.bioenergytrade.org
- Publication in a special IEA Bioenergy Task 40 issue of Biomass & Bioenergy in 2007, currently under review

Info UK: http://www.dft.gov.uk/consultations/open/rtforeporting/

Info NL: http://www.senternovem.nl/EnergyTransition/Downloads/Index.asp

Info EU: http://ec.europa.eu/energy/res/consultation/biofuels_en.htm

1

A Greenhouse Gas Balance of Palm-Oil-Based Electricity Production

International Conference on biofuels, UNIDO/MPOB, Kuala Lumpur, 5-6 July 2007

Birka Wicke, Veronika Dornburg,
Andre Faaij, Martin Junginger
Copernicus Institute, Utrecht University

2

Introduction

- Discussion of sustainability issues of palm oil
- Attempts to verify sustainability:
  - RSPO, international
  - RTFO, UK
  - Cramer Commission, NL
- 1 Cramer Criterion is GHG balance: bio-electricity must reduce GHG emissions by at least 50% to 70% compared to a fossil reference electricity system

⟹ Case study on GHG balance of electricity from Malaysian CPO and PFAD (Sabah, Malaysia)

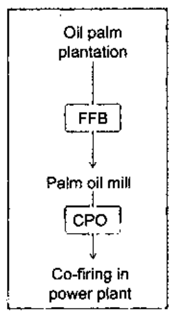
3

CPO-Based Electricity

System boundaries:

- from OP Plantation (Kalimantan, Malaysia)
- to NG power plant (the Netherlands)

CPO Production Chain



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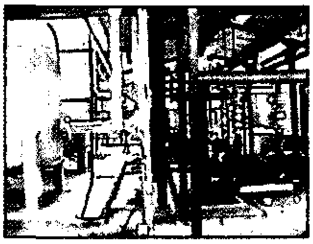
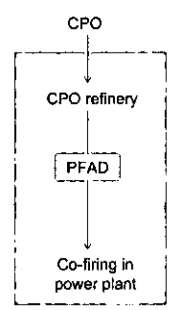
PFAD-Based Electricity



- Main product of CPO refining: RBD palm oil
- PFAD - by-product
- Transported to NL
- Co-fired with NG

PFAD Production Chain



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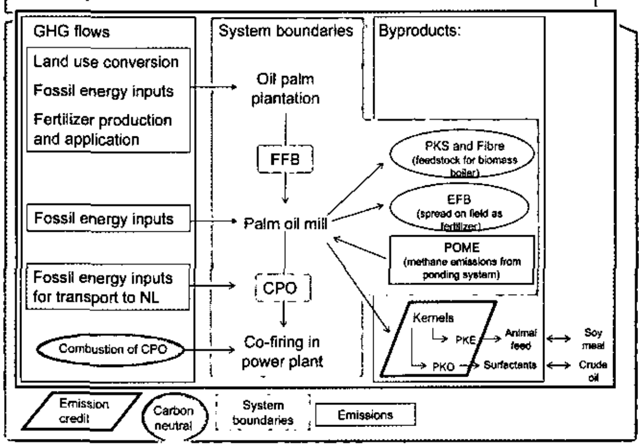
Methodology I

"Cradle-to-Grave" emissions

based on Cramer Commission methodology (Bergsma et al. 2006) (final methodology still under development)

6

Components of GHG Balance of CPO Chain



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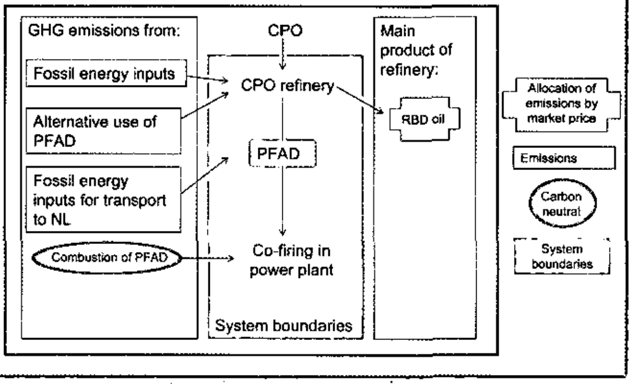
Components GHG Balance of PFAD Chain



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Methodology II

5 fossil electricity reference systems: Specific NG power plant, modern natural gas, coal, Dutch average electricity production, European average electricity production

GHG emissions reductions are calculated by comparing emissions of 1 kWh from the palm oil electricity chain to 1 kWh from a fossil electricity chain

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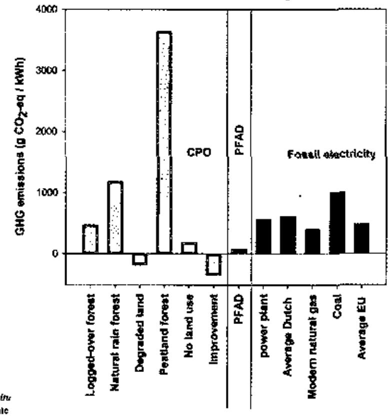
GHG Emissions from Palm-Oil-Based Electricity vs. Fossil Electricity



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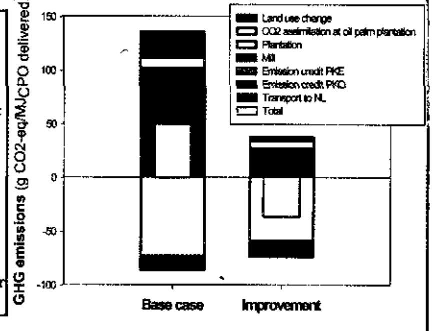
Management Improvements

- Planting oil palm on degraded land
- Collection of POME biogas in a closed anaerobic digester and production of electricity
- Improved FFB yields
- Reduced inorganic fertilizer application by applying POME sludge after treatment



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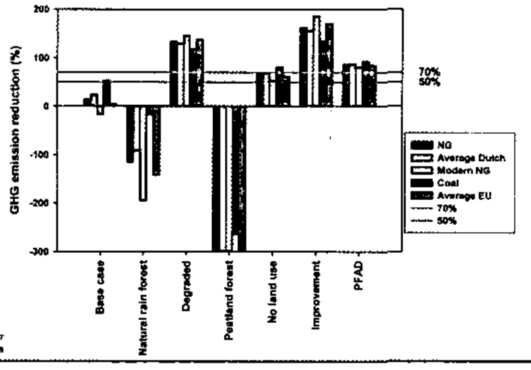
GHG Emission Reductions: *Comparison with different fossil reference systems*



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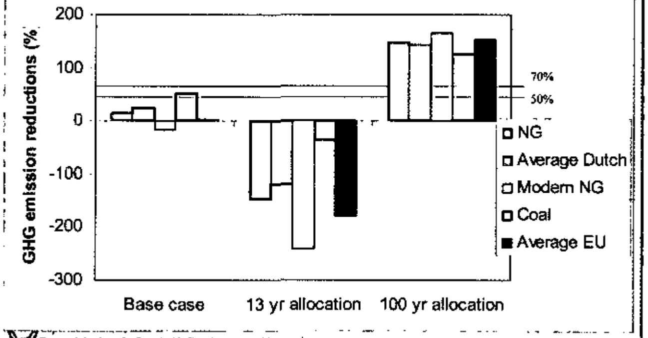
GHG Emission Reductions: Methodological Issues



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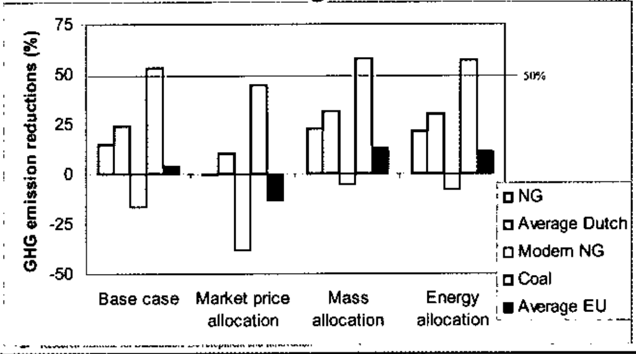
GHG Emission Reductions: Methodological Issues



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Discussion

- Allocation of emissions from land use change: time period is important
- Allocation vs. system extension: limited impact on results, only in those cases that are already borderline

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Discussion

- *Different fossil reference systems:* low impact on reaching emission targets, only in borderline cases
- Sensitivity: land use conversion (above ground biomass and soil carbon) most sensitive while emission factors for fertilizer production have only little effect on results

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Conclusions

- PFAD can already at present fulfill GHG emission reduction targets of Cramer Commission, but are not the "silver bullet" because of limited availability and underlying methodological assumptions
- CPO from previously natural rainforest and peatland have a negative GHG balance compared to fossil reference systems

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Conclusions

- From a GHG reduction perspective: new oil palm plantation development should ideally take place on degraded land: large emission reductions and even a net CO_2 uptake can be achieved
- Other improvements in management of the plantation and mill can increase this emission reduction even further

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THANK YOU

Comments or Questions?

Session Chairperson
Dr. James Fry
Managing Director
LMC International Ltd,
UK

SESSION 3-1:

FEEDSTOCK PRODUCTION IN PERSPECTIVE

Gustavo Best
Food and Agriculture Organization (FAO), Italy

FAO is the largest UN agency, its mandate being to deal with poverty and bring about rural development through agriculture, forestry and fisheries. Bioenergy is one very important issue that the organization has been dealing with.

The first issue I am going to discuss is potential feedstocks for biofuels. Benchmarking of the energy output/input ratio depending on feedstock sends us the very important message that it is not only feedstocks but also where they are produced, i.e. in what eco-systems, that matters. It follows that the nature of the eco-system in which a crop can grow becomes a critical factor in identifying optimal feedstocks from the many possibilities tabulated on the four slides. Competitiveness in production costs according to feedstock is another important consideration. A graph is presented to illustrate indicative parity prices of the first generation technology ethanol vs. gasoline indexing to petroleum crude oil (US$/BBL) and gasoline (US$/liter) produced from different feedstocks. Bioenergy potential varies from region to region and Africa is considered to be the one likely to have the largest potential by the year 2050, followed by Latin America and the Caribbean, the CIS and Baltic States, North America and Oceania. As to the type of biomass, it is thought that energy crops from current agricultural land will be the largest source by the year 2050, followed by energy crops from marginal land, forest residues, agricultural residues, dung and organic wastes. Global biofuel production, including second generation technology, could experience a five-fold increase by 2025.

The second issue I intend to discuss is potential impacts from various angles. The possible impacts on international commodity prices are tabulated, assuming the case where 10 million tons of a certain crop is used for biofuel production. One example estimates a 10% increase in sugar price in such a situation. The following three slides identify the potential impacts that each activity in the production process is likely to have on environmental, biological and social matters, the food security issue, for example, being one of the last-mentioned.

The third issue I am covering is the responses of FAO and UN Systems at large to this situation. Over the period 2006-2007, FAO received requests for technical assistance from 25 countries regarding subjects related to biofuels, thus indicating enormous interest globally in bioenergy. To react to growing requests and demands internationally, FAO has developed certain tools and initiatives. Woodfuel Integrated Supply/Demand Overview Mapping (WISDOM) is a tool for highlighting and determining woodfuel priority areas which can be merged with other interrelated socioeconomic and environmental issues. A further tool is the International Bioenergy Platform (IBEP), in which FAO collaborates with other organizations in the area of bioenergy and where food security assessments are currently key issues. FAO also hosts the Global Bioenergy Partnership to work on the issues of sustainability criteria, trade, evaluation and methodologies for greenhouse gas emissions, and the strengthening of public-private partnerships. Its flagship publication, State of Food and Agriculture (SOFA), will be dedicated to bioenergy in 2008.

UN Energy is a group of international agencies such as FAO, UNIDO, UNDP and the

World Bank, which focuses jointly on bioenergy and in May 2007 published Sustainable *Bioenergy: A Framework for Decision Makers, dealing with both positive and negative* aspects of the topic and offering recommendations. Its message to policy makers is to remind them of the importance of informed decisions and to point out that they should not go fast into large bioenergy projects without thoroughly examining the implications, as damage could in some cases immensely outweigh the benefits.

(bestgustavo@hotmail.com)

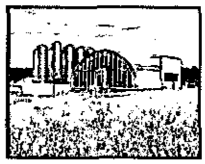
Feedstock Production in Perspective 1

International Conference on BIOFUELS

UNIDO/Kuala Lumpur July 5 - 7, 2007

Gustavo Best

FAO

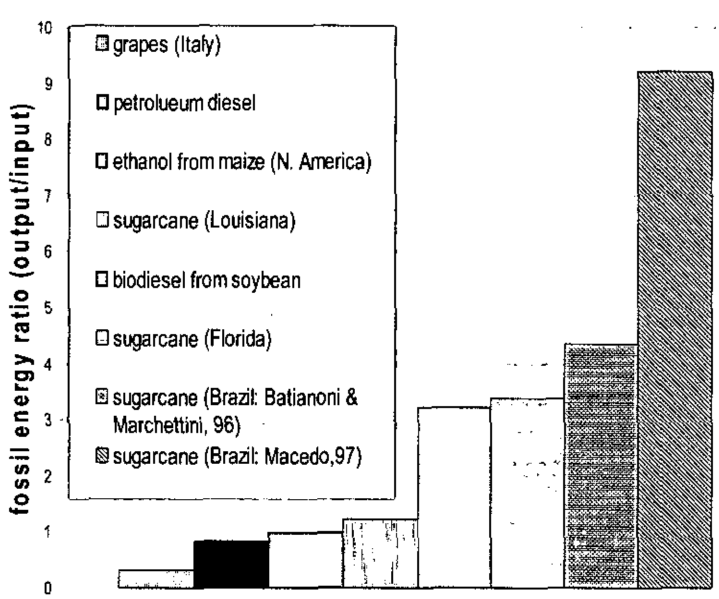


Bioenergy is about people, resources and knowledge

Three Issues 2

- **Potential feedstocks** which and how much ?
- **Impacts** Commodity prices, Society, Environment Economy
- **Requests and responses** FAO and UN-Energy

3



4

Preliminary Crop Type	Crop Requirements Preliminary Assessment of Biofuels Feedstock			
	Soil	Water	Nutrients	Climate
Cereal	less disruption of soil; very constant yield; humus balance is negatively influenced by annual removal of straw	–	medium	moderate
Hemp	deep soil with good water supply, pH balance between 6 and 7	some moisture the entire season	moderate, no pesticide needed	varied environmental conditions, preferably warmer climates
Jatropha	undemanding, does not require tillage	can be cultivated under both irrigated and rain-fed conditions	adapted to low fertility sites and alkaline soils, but better yield can be achieved if fertilisers are used	Tropical and subtropical but also arid and semiarid.
Maize	soil should be well-aerated and well-drained	efficient user of water	require high fertility and should be maintained continuously	temperate to tropic conditions

5

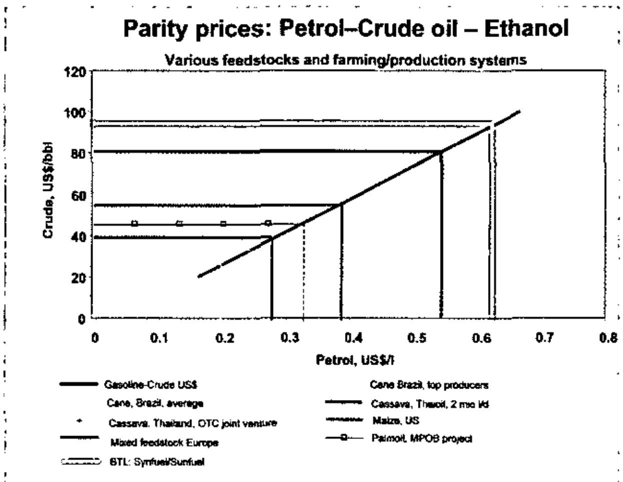
Miscanthus	good water supply, brown soils with high humus percentage, optimum pH between 5.5 and 7.5	crucial during the main growing seasons	low	adapted to warmer climates but fairly cold-tolerant
Oil Palm	good drainage; pH between 4 and 7; soil flat, rich, and deep	even distribution of rainfall between 1,800 and 5,000 throughout the year	low	tropical and subtropical climate with temperature requirement of 25–32°C
Poplar	deep, moist soil, medium texture, and high flood tolerance	High, irrigation may be needed	high	arctic to temperate

6

Potato	deep, well drained, friable, well-aerated, porous, pH between 5 and 6	high; irrigation required	high fertiliser demand	optimum temperature of 18–20°C
Rapeseed	mild, deep loamy, medium texture, well drained	600 mm minimum yearly precipitation.	similar to wheat	sensitive to high temperatures, grow best between 15 and 20°C
Rice	needs permeable layer and good drainage	very high, grown in flooded fields	relatively high input of fertilisers, very intensive systems	constant temperatures in tropical areas, optimum around 30°C
Sorghum	light-to-medium textured soils, well-aerated, well-drained, and relatively tolerant to short periods of water logging	shows a high degree of flexibility towards depth and frequency of water supply because of drought resistance characteristics	very high nitrogen feeding crop	optimum temperatures for high producing varieties are over 25°C

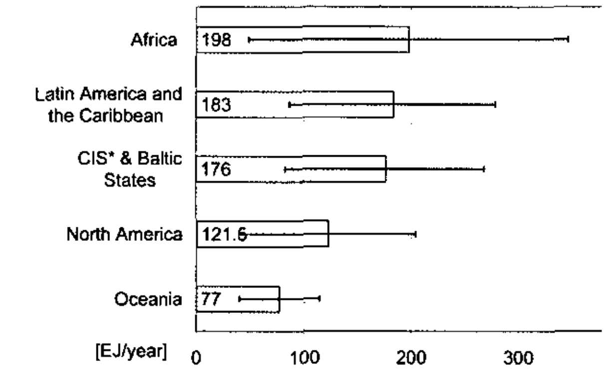
					7
Soybean	moist alluvial soils with good organic content, high water capacity, good structure, loose soil	high	optimum soil pH of 6 to 6.5	tropical, subtropical, and temperate climates	
Sugarbeet	medium-to-slightly heavy texture, well drained, tolerant to salinity	moderate, in the range of 550 to 750 mm/growing period	adequate nitrogen is required to ensure early maximum vegetative growth, high fertiliser demand	variety of temperate climates	
Sugarcane	does not require a special soil type, but preferably well-aerated with a total available water content of 15 percent or more	high and evenly distributed through the growing season.	high nitrogen and potassium needs but at maturity, the nitrogen content of the soil must be as low as possible for a good sugar recovery	tropical or subtropical climate	
Sunflower	grown under rain-fed conditions on a wide range of soils	varies from 600 to 1,000 mm, depending on climate and length of total growing period	moderate	climates ranging from arid under irrigation to temperate under rain-fed conditions	
Switchgrass	ranging from prairies to arid or marsh	drought-resistant and very-efficient water use	low	warm-season plant	
Wheat	medium textures	high	high	temperate climates, in the sub tropics with winter rainfall, in the tropics near the equator, in the highlands with altitudes of more than 1,500 m, and in the tropics away from the Equator where the rainy season is long and where the crop is grown as a winter crop.	
Willow	sandy, clay, and silt loams	substantial quantities of water	significant nutrient uptake	can tolerate very low temperatures in winter, but frost in late spring or early autumn will damage the top shoots.	

Competitiveness by feedstock 8



Josef Schmidhuber (2005)

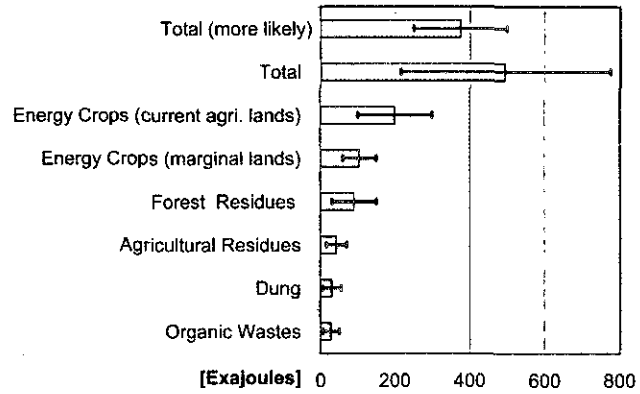
Bioenergy potential per region: **different scenarios, year 2050 Exajoules/yr** 9



Source: Juergens and Mueller *forthcoming 2007*, based on data from WWI 2006)

10

Bioenergy potential per type of biomass: **different scenarios, year 2050 Exajoules/yr**

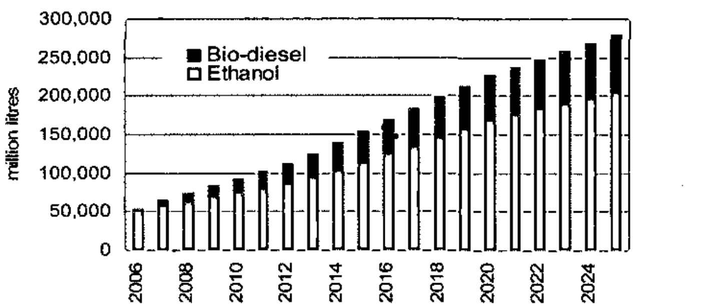


Source: Juergens and Mueller *forthcoming 2007,* based on data from Faaij 2006

11

Global bio-fuel production could expand 5-fold by 2025

- Sustained high prices of crude oil projected provide an additional incentive to expand bio-fuel output – beyond the levels stipulated by policy – as long as retail excise tax relief for bio-fuels remains



Source: Adam Prakash
EST, FAO

12

Cross links: Impacts on international commodity prices

	An additional 10 million tonnes of ...				
	Sugar	Maize	Sugar and Maize	Soybeans and Maize	Sugar, Maize and Soybeans
Corresponding energy [biofuels]	0.195 EJ	0.087 EJ	0.282 EJ	0.167 EJ	0.349 EJ
Commodity	... used for biofuels would change international prices (percent) in the long-run by :				
Sugar	+9.8	+1.1	+11.3	+2.3	+13.8
Maize	+0.4	+2.8	+3.4	+4.0	+4.2
Vegetable oils	+0.3	+0.2	+0.2	+7.6	+7.8
Protein	+0.4	-1.2	-1.2	-8.1	-7.6
Wheat	+0.4	+0.6	+0.9	+1.8	+2.0
Rice	+0.5	+1.0	+1.2	+1.1	+1.4
Beef	+0.0	+0.2	+0.2	+0.4	+0.4
Poultry	+0.0	-0.4	-0.4	-2.1	-2.0

13

ENVIRONMENTAL IMPACTS		IMPACT-CAUSING ACTIVITIES								
		Production and supply of agricultural inputs (fertilizer, fuel, machinery)	Production of biomass for energy (forestry or agriculture)	Collection of biomass by-products of existing processes	Production of liquid biofuel (ethanol, methanol, biodiesel)	Transportation of biomass waste and/or energy crops	Transportation of liquid biofuel	Use of liquid biofuels (combustion)	International trade of biomass and liquid biofuels	Research and development in the area of liquid biofuels
Climate (GHG emissions balance)		1•	•		•	•	•	•		
Soil	Structure and stability (erosion)		3•	•						
	Quality (bio-chemical)	2•	•	•						
Water	Water quality (bio-chemical)	•	•		4•					
	Water extraction potential (quantitative)	•	•		•					
Air quality (points of production and use of biofuels, and materials transport routes)		•	•		•	5•	•	11•		

14

Biological impacts	IMPACT-CAUSING ACTIVITIES								
	Production and supply of agricultural inputs (fertilizer, fuel, machinery)	Production of biomass for energy (forestry or agriculture)	Collection of biomass by-products of existing processes	Production of liquid biofuel (ethanol, methanol, biodiesel)	Transportation of biomass waste and/or energy crops	Transportation of liquid biofuel	Use of liquid biofuels (combustion)	International trade of biomass and liquid biofuels	Research and development in the area of liquid biofuels
Terrestrial ecosystems and biodiversity		•							
Marine ecosystems and biodiversity		[illegible]							
Agricultural biodiversity		7•						•	•

15

Social Impacts	IMPACT-CAUSING ACTIVITIES								
	Production and supply of agricultural inputs (fertilizer, fuel, machinery)	Production of biomass for energy (forestry or agriculture)	Collection of biomass by-products of existing processes	Production of liquid biofuel (ethanol, methanol, biodiesel)	Transportation of biomass waste and/or energy crops	Transportation of liquid biofuel	Use of liquid biofuels (combustion)	International trade of biomass and liquid biofuels	Research and development in the area of liquid biofuels
Land-use pattern		8•	•	•					
Rural/agricultural employment and income (level and stability)		9•	•	•	•				
Food security (effective access to food for the most vulnerable)		10•	•	•	•				
Public health							[redacted]		
Global scientific and technical knowledge base		13•		•					•
Global economy and terms of trade		[redacted]							

16

Country Requests, Period 2006-2007 Distribution by Region and Requests

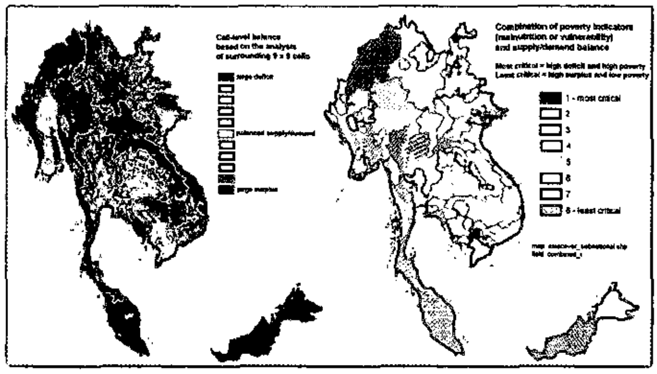
Region	Countries	Share (Percent)
Latin America	11	44
Africa	7	28
Asia	6	24
Europe	1	4
Total	25	100

Technical Area/Crop	Request Type
Wood fuels and other bioenergy sources	Mapping resources for decision making under TCP
Biodiesel from Jatropha	Comments on concept note to develop a link with Indian programme to set up own biofuel programme
Palm oil, Rapeseed oil, Biodiesel, (Chernobyl areas)	Technical assistance for socioeconomic assessment of opportunities

17

Wood energy & poverty in South East Asia

- WISDOM as a tool in visualizing WE deficit areas and linkages with poverty



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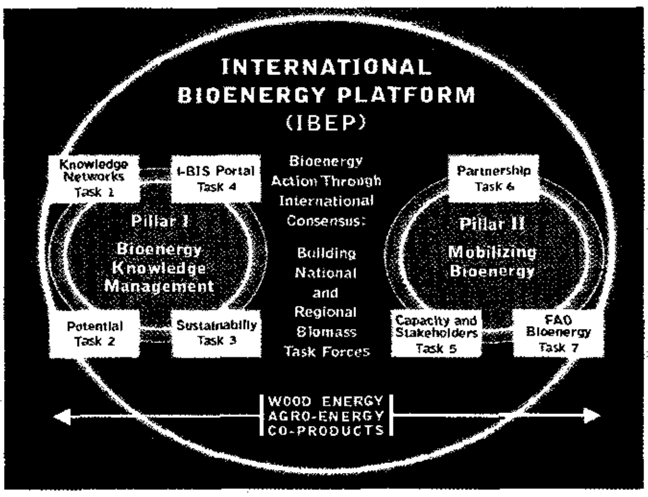


19

Int bodies: FAO – variation of Junginger

- FAO International Bioenergy Platform (IBEP) - reference framework for analysis of sustainable bioenergy and bioenergy/food security nexus
- Bioenergy and Food Security Project (FAO/Germany Trust Fund)
- Technical assistance requests (35 countries)
- Multi-donor trust fund for country support under development
- FAO Technical Consultations
  April 2007 - Focus: Food Security and Analytical Framework
  July 2007 - Focus: Socio-Economic Impacts
  October 2007 - Focus: Bioenergy and Food Security

20

FAO – Continued

- Global Bioenergy Partnership - GBEP (a G8+5 Initiative – Secretariat hosted at FAO
  - Workplan: sustainability criteria
  - Trade
  - GHG emission methodologies
  - Strengthening of public-private partnerships
- Broadening knowledge base through an International Bioenergy Information System (IBIS)
- Monitoring and mapping of bioenergy activities globally
- State of Food and Agriculture (SOFA) 2008 on Bioenergy

21

22

- Bioenergy was identified as a clear area of work for UN-Energy
- UN-Energy is a collaborative framework far all UN bodies active in the field of energy

23

The document is the result of an intense consultation process with all UN-Energy members.

UN-Energy thanks the World Watch Institute for its very important contribution in the creation of the document

24

- The paper first sets the role of bioenergy in the overall global energy context.
- it discusses 9 key sustainability issues
- indicates possible implementation issues
- it concludes with a framework of action at the national and international levels.

25

- The 9 key issues it considers include:
  - Poverty
  - Health
  - Food security
  - Agriculture
  - Agro industry
  - Environment
    - Water
    - Climate change
    - Biodiversity
  - Finance
  - Trade, Energy security and foreign exchange balances

26

Some highlights

27

The economic, environmental and social impacts of bioenergy development must be assessed carefully before deciding if and how rapidly to develop the industry and what technologies, policies and investment strategies to pursue.

28

"Unless new policies are enacted to protect threatened lands, secure socially acceptable land use, and steer bioenergy development in a sustainable direction overall, the environmental and social damage could in some cases outweigh the benefits"

29

"...... crops that require high fossil energy inputs and valuable land, and that have relatively low energy yields per hectare, should be avoided......."

This also implies low or negative energy balances

30

Governments and others should encourage the use of sustainable bioenergy production and management practices.

......international certification scheme, including green house gas verification, should be set up to ensure that bioenergy products, and biofuels in particular, meet environmental standards all the way from fields to fuel tanks ....

31

On food security.......

- the availability of adequate food supplies could be threatened by biofuel production
- food access could be compromised by higher basic food prices
- increased bioenergy feedstock demand....(could) drive the poor and food insecure into even greater poverty.

32

- BUT the biofuel market offers a new and fast-growing opportunity for agricultural producers and could contribute significantly to higher farm incomes.
- AND could support productivity growth in agriculture or other sectors with positive implications for food availability and access.

33

To some extent it shows how the food security risks are the mirror image of the opportunities

34

Some technical suggestions

" crops for energy production in rotation with food crops to improve productivity and diversify income (and even better biodiversity ?)"

" cascading" of biomass over time, using biomass materials for different uses and then recycling the wastes to energy"

35

On policy impacts

- Policy limiting imports of (more efficiently produced) biofuels imports
- Policy mandating the blending of biofuels with fossil fuels at home

Can divert more land than necessary from food production

36

In relation to farmers

- need to assess winners and loosers (even within rural areas);
- large biocompanies controlling the full chain; producers of feedstock might get less benefits;

"At their best, liquid biofuel products can enrich farmers by helping to add value to their products....

at their worst, concentration of ownership could drive poorest farmers off their land and into deeper poverty."

37

On the type of future bioenergy systems

A mix of production types

1. dominated by large, capital-intensive businesses
2. farmer co-ops that compete with large companies
3. liquid biofuels are produced on a smaller scale and used locally

38

One of the key challenges of biofuel policy development is to

" effectively navigate the chaotic and often manipulated markets in which they operate"

(i.e. energy and agriculture)

39

Opportunities

Economic development
- mobilizes investment in rural areas
- generates new infrastructure and business opportunities
- generates income

Social benefits
- new livelihood opportunities
- increases access to modern energy services
- improving quality of life

Environmental advantages
- promotes resource conservation and ecosystem rehabilitation
- climate change mitigation through use of cleaner fuels
- opens opportunities for marginal/degraded land rehabilitation

SESSION 3-2:

EMERGING SUSTAINABLE FEEDSTOCK: THE TREE BORNE OILSEEDS

N. Vedaraman[a], Sukumar Puhan[b], G. Nagarajan[b], K.C. Velappan[a]
[a]Chemical Engineering Department, Central Leather Research Institute, India
[b]International Combustion Engineering Division, Faculty of Mechanical Engineering, Anna University, India

In recent times the world has been confronted with an energy crisis due to depletion of resources and to increased environmental problems. Increasing energy demand is a major issue, especially for transportation, as increased mobility, changing lifestyles and migration of people to cities for employment have taken place. Oilseeds provide a unique platform for the production of biodiesel that can replace non-sustainable petroleum and other fossil fuels for our energy needs. Of the alternative fuels, biodiesel obtained from vegetable oils looks promising as an eco-friendly alternative to diesel fuel.

Although soyabean, palm, rapeseed, sunflower and other oilseeds are useful feedstocks in other countries, India has some problems with increasing production of cultivated oilseeds because of its limited land area and irrigation facilities. However, there are numerous trees yielding oilseeds in forest regions in this country which can produce a substantial amount of seeds and in turn oils, which can be used for biodiesel production.

This presentation deals with the preparation of biodiesel from different oilseeds obtained from Indian forests such as mahua, sal, neem, karanja and jatropha, which are under-utilized although their potential is very high. The reasons for current under-utilization are the small amount of collection due to lack of infrastructure, alongside delays in cash disbursements to the drivers. Organized collection will satisfy part of our energy needs.

India needs 52.33 million tons of diesel for 2006-7 and 66.90 million tons for 2011-12. A 5% blend would require 2.62 million tons of biodiesel and an area of 2.19 million hectares in 2006-7 and 2.79 in 2011-12 if it is to be produced entirely from jatropha. If we look at diesel in the agricultural sector as a merely part of the total demand, we currently operate about 6 million diesel-operated pump sets consuming about 8 million tons of diesel, which will require about 7 million hectares of land if we are going to replace it entirely with jatropha-based biodiesel.

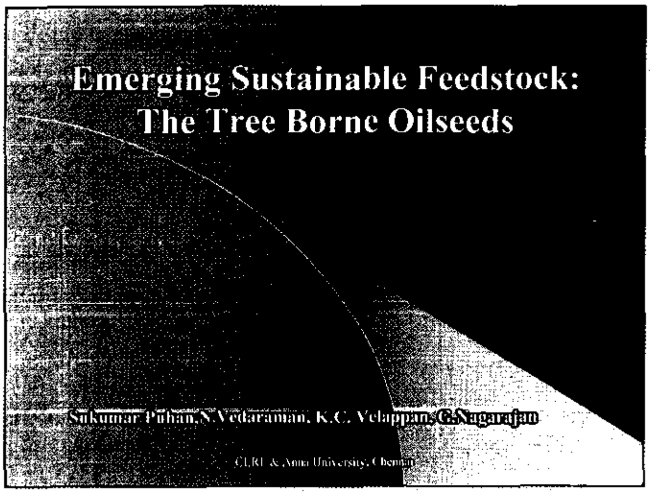
India's carbon emissions, like China's, are high, i.e. about 250 million metric tons of carbon in 2001. Free diesel for agriculture and transportation for the poor is the desire of Government agencies but the question remains as to whether this is in fact feasible. I believe that it will be possible by 2012 if the sales price of a carbon credit is anywhere between US$67 and US$357 by that point, as predicted. If we assume a mid value for carbon credit, i.e. US$ 250 per ton CO_2, 1 ton of biodiesel usage is equivalent to 3 ton CO_2 saving which, is equal to carbon credits of US$750. With the current diesel price in India which is about 30-33 Indian Rupees per liter and almost equivalent to the price of biodiesel per liter, free biodiesel will be on the cards.

We tested biodiesel that had been transesterified from tree borne (TB) oilseeds (mahua, sal, neem and jatropha) to find out their fuel properties (heating value, specific gravity, kinematic viscosity, pour and flash points, cetane number) and then in Kirloskar diesel engines. The results were promising, cetane numbers being higher than that of diesel, flashpoints quite high, thermal efficiency similar to that of diesel, CO emissions significantly lower (30-40%), hydrocarbon emissions reduced by 40-50% and NOx by 5-10% except with jatropha, but CO_2 slightly higher.

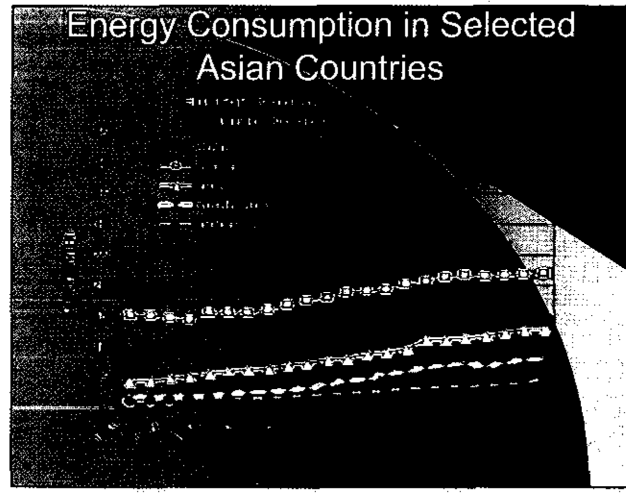
Thus it may be concluded that bio-energy is essential for the Indian sub-continent, as substitution by alternative fuels will have a significant impact on both the economy and the environment, as well as contributing to the mitigation of global warming.

(nvedaraman@yahoo.co.in)

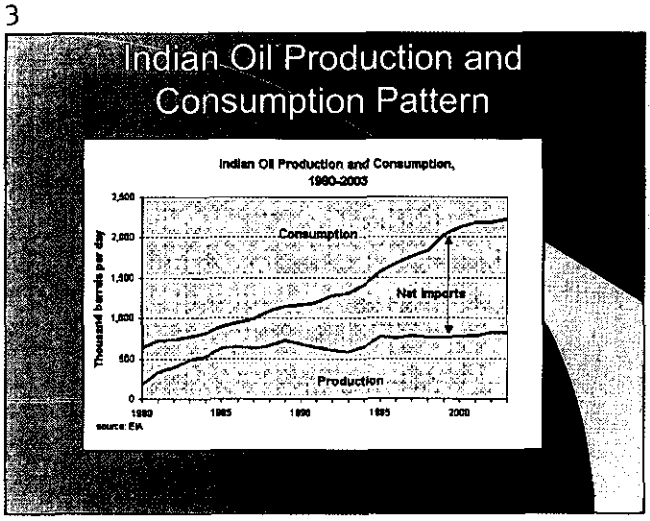
1


Emerging Sustainable Feedstock:
The Tree Borne Oilseeds
Sukumar Puhan, N.Vedaraman, K.C. Velappan, G.Nagarajan
CLRI & Anna University, Chennai

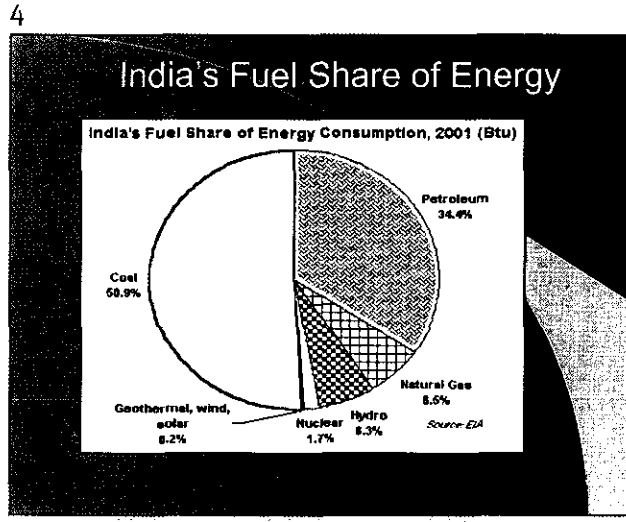
2


Energy Consumption in Selected Asian Countries

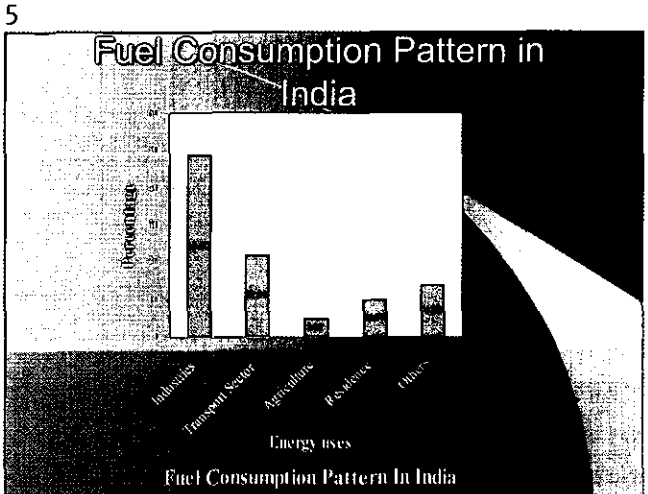
3


Indian Oil Production and Consumption Pattern
Indian Oil Production and Consumption, 1980-2003
Thousand barrels per day
2,500
2,000
1,500
1,000
500
0
1980
1985
1990
1995
2000
Consumption
Net Imports
Production
source: EIA

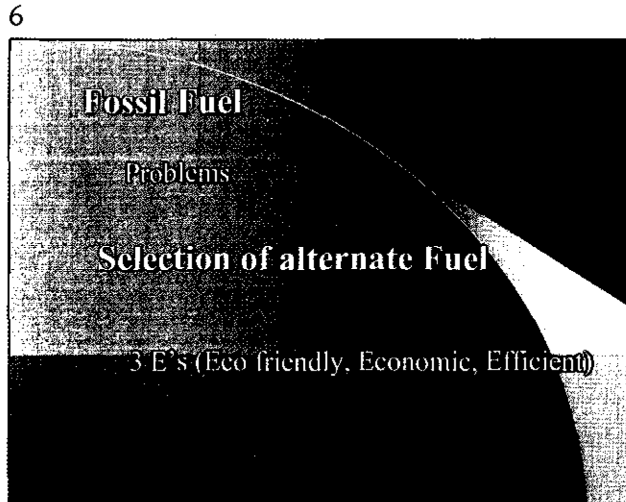
4


India's Fuel Share of Energy
India's Fuel Share of Energy Consumption, 2001 (Btu)
Petroleum 34.4%
Coal 50.9%
Natural Gas 8.6%
Geothermal, wind, solar 0.2%
Nuclear 1.7%
Hydro 5.3%
Source: EIA

5

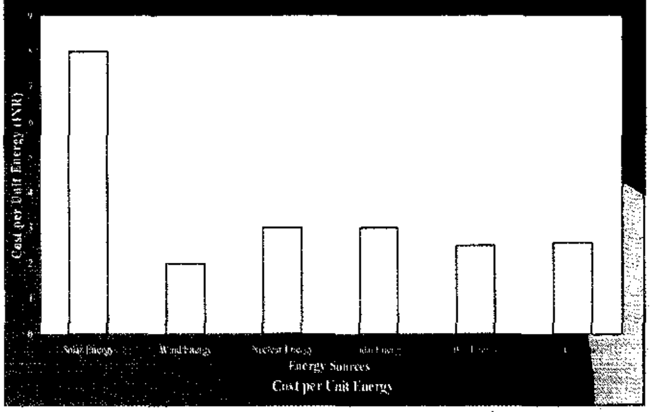

Fuel Consumption Pattern in India
Percentage
Industries
Transport Sector
Agriculture
Residence
Others
Energy uses
Fuel Consumption Pattern In India

6


Fossil Fuel
Problems
Selection of alternate Fuel
3 E's (Eco friendly, Economic, Efficient)

7

Unit Cost of Energy



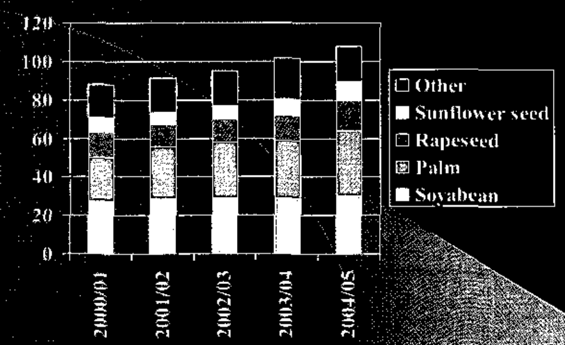
8

Vegetable Oil Based Fuel

- Advantages
- Problems

9

Worldwide Feedstocks For Biodiesel Production (in Lakh tonnes)



10

Cultivated Area of Oilseed Plants

Country	Oilseed area (Lakh ha)	% of world oilseed area	Yield Tons/ha
USA	359.8	18.94	2.1
India	320	16.84	0.89
China	280.1	14.74	1.84
Brazil	225.1	11.85	2.45
Argentina	162.4	8.55	2.32
Canada	58.6	3.09	1.55
Russia	54.5	2.86	1.00
Pakistan	35.9	1.89	1.05
France	18.5	0.97	2.69
Germany	13.1	0.69	2.83
UK	5.4	0.28	3.33

11

Self Sufficiency in Vegetable Oils

Year	Domestic Availability	Oil in thousand tonnes		Self sufficiency (%)	Per capita consumption (kg/head/year)
		Imports	Consumption		
1990-91	4877	526	5403	90	5.5
1996-97	6170	1417	7587	81	8.0
1998-99	5685	2622	8307	68	8.5
2000-01	5504	4177	9681	57	9.4
2002-03	5540	4266	10096	55	9.5

12

Land Resources in South Asian Region

Country	Total land area (sq. km)	Share of agriculture lands	Share of forest land	Waste land
Bangladesh	146991	60.2	5.9	-
Bhutan	40372	17.4	59.8	-
India	3.05 million	60.0	17.4	20.9
Sri Lanka	65610	32.5	29.6	-
Maldives	200000	-	-	-
Nepal	274620	25.3	36.7	33
Pakistan	770880	22.2	2.4	73.9

13

Estimated and Actual Production of Oils From TB Oil Seeds of Forest Origin (Lakh Tonnes) in India

Oilseed	Botanical name	Potential	Utilization	Utilization (%)
Sal	Shorea robusta	60-70	2-3	3.33-4.28
Neem	Melia azadiracta	4.30	1.15	26.74
Karanja	Pongamia pinnate	1.4	0.25-0.3	17.86-21.43
Mahua	Madhuca indica	4.3	0.7-0.85	16.27-19.77

14

Reasons For Lower Collection

- Lack motivation
- Infrastructure
- Delay in disbursement of money

15

Fatty Acid Composition of Non-Traditional Oils

Fatty acids / Oils	Mahua	Sal	Neem	Jatropha
Palmitic C16:0	23.7 %	4.5 %	14%	15.6 %
Stearic C18:0	19.3 %	44.2 %	16.5%	6.7 %
Arachidic C20:0	-	6.3 %	2.0%	0.2%
Oleic C18:1	43.3 %	42.2 %	55.5%	42.6%
Linoleic C18:2	13.7 %	2.8 %	11.5%	33.9 %
Linolenic C18:3	-	-	-	0.2 %

16

Uses of Mahua

- Against skin diseases, rheumatism and headache
- Flowers:Liquors
- Timber:Construction , furniture , sports goods and musical instruments

17

Uses of Sal

- Timber : Ship building, railway sleepers
- Bark : Tanning Material
- Resin : For Paints, shoe polish and carbon paper

18

Uses of Neem

- Seed`Oil : Cure of skin infection, liver disorder, cough, wound, leprosy
- Gum :Stimulant and tonic
- Bark and Fruits : For fever as tonic
- Leaves : Against Fever, chicken pox and small pox
- Timber: Used for building cots and furniture etc.

19

Uses of Jatropha

- Seed Oil : insecticide, skin diseases, repellent for flies for cattle
- Latex: siddha medicine
- Stem/branches : Dental application

20

Gestation, Productive Period And Employment In Tree Borne Oilseed Plantations

S.No	Oilseed	Seed harvesting	Gestation period (Years)	Productive life (Years)	Employment (Man day/ha)
1	Jatropha	September-December	< 1	50	250
2	Karanja	Throughout the year	3-10	100	125
3	Mahua	August - September	10	80	120
4	Neem	June-August	5-6	>50	50
5	Sal	May- July	25-30	120	80

21

Petrodiesel and Biodiesel Demand and Area Required Under Jatropha

Year	Petrodiesel demand Lakh tons	Biodiesel 5% blend Lakh tons	Area for 5% blend Lakh ha	Biodiesel 10% blend Lakh Tons	Area for 10% blend Lakh ha	Biodiesel 20% blend Lakh tons	Area for 20% blend Lakh ha
2006-07	523.3	26.2	21.9	52.3	43.8	104.7	87.6
2011-12	669.0	33.5	27.9	66.9	55.8	133.8	111.9

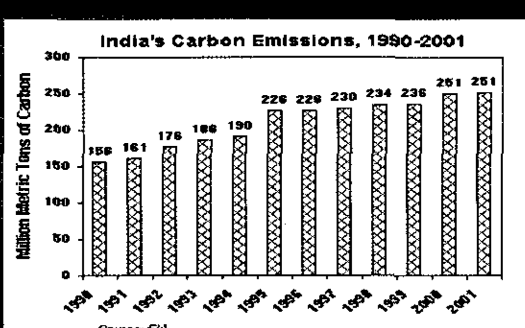
22

Biodiesel Potential In Agricultural Sector

Pump Sets	Numbers (In millions)	Fuel requirement (million ton)	Area Required for Jatropha *Cultivation* (Mha)
Diesel	6	8	6.7

23

Indian Carbon Emissions



24

Carbon Credit

Bio-Diesel For Agriculture and Transportation - A Myth or Reality?

25

Properties of MOME, SOME,NOME,JOME

Properties	MOME	SOME	NOME	JOME	Diesel
Heating Value (MJ/Kg)	42	41	41	42	45
Specific Gravity	0.875	0.87	0.87	0.886	0.83
Kinematic Viscosity cSt	5	5.2	5.2	5.5	2.6
Pour Point	18	9	10	-4	6
Flash Point	170	160	165	120	65
Cetane Number	55	52	51	52	42

26

The Engine Used

- Kirloskar
- single cylinder and four stroke
- constant speed (1500 rpm)
- direct injection (D.I) diesel engine

27

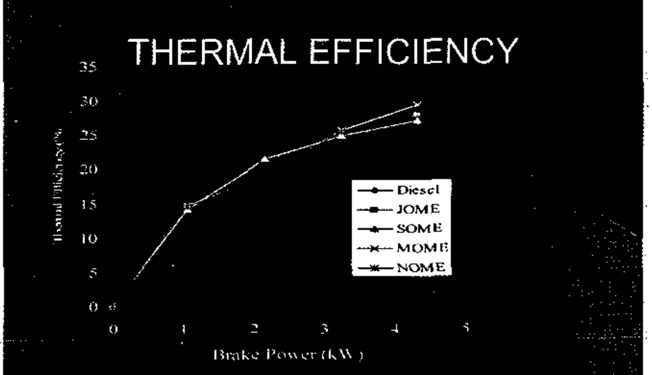


Fig.1 Variation of Thermal Efficiency With Brake Power

28

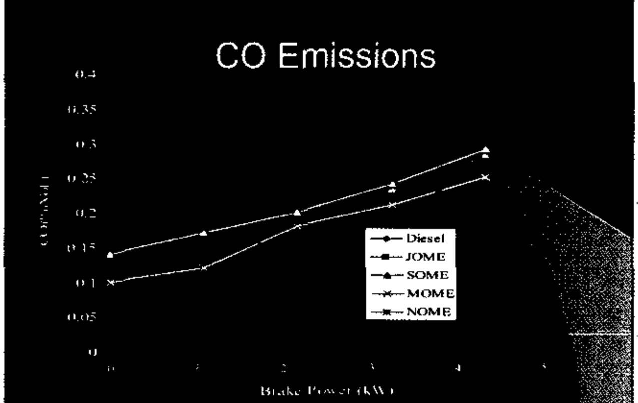


Fig.2 Variation of CO With Brake Power

29

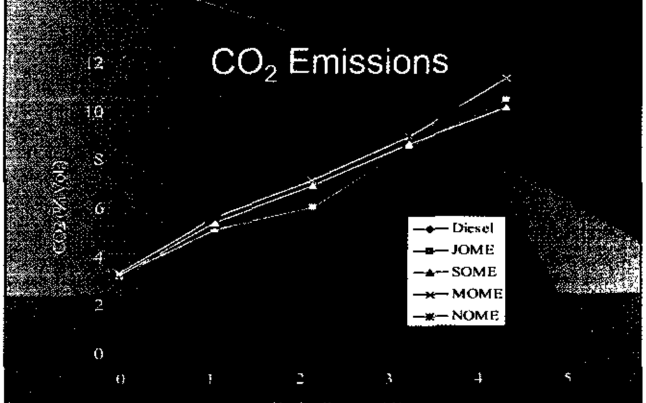


Fig.3 Variation of CO2 With Brake Power

30

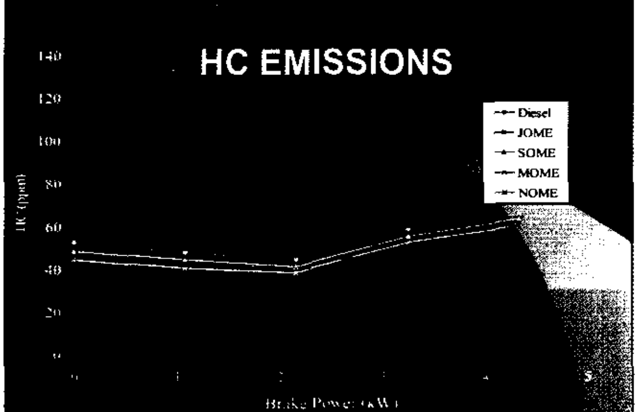
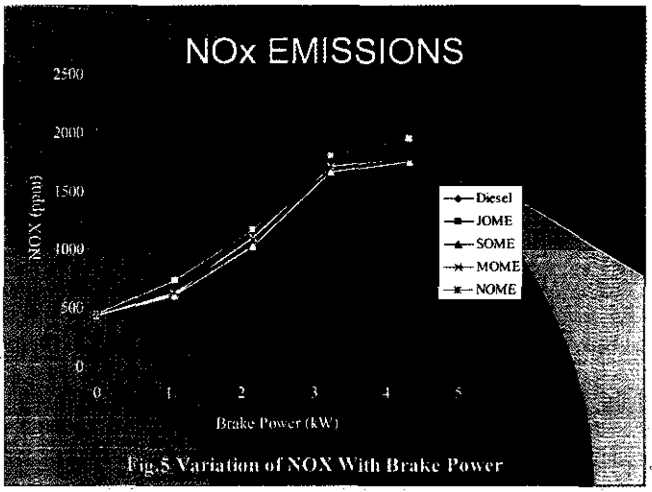
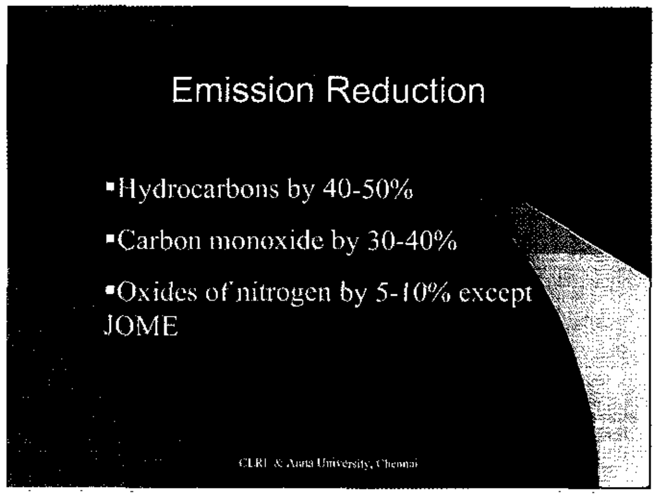


Fig.4 Variation of HC With Brake Power

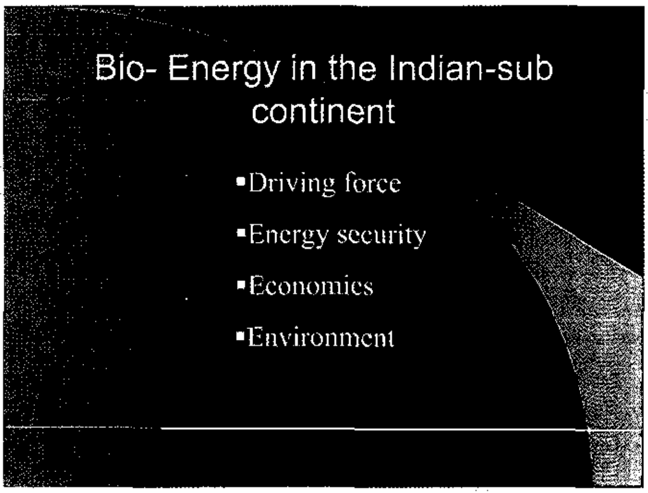
31


NOx EMISSIONS
2500
2000
1500
1000
500
0
NOX (ppm)
0
1
2
3
4
5
Brake Power (kW)
Diesel
JOME
SOME
MOME
NOME
Fig.5 Variation of NOX With Brake Power

32


Emission Reduction
▪Hydrocarbons by 40-50%
▪Carbon monoxide by 30-40%
▪Oxides of nitrogen by 5-10% except JOME
CLRI & Anna University, Chennai

33


Bio- Energy in the Indian-sub continent
▪Driving force
▪Energy security
▪Economics
▪Environment

34


THANK YOU

SESSION 3-3:

RENEWABLE RESOURCES FROM OIL PALM FOR THE PRODUCTION OF BIOFUELS

Mohd Basri Wahid,
Malaysia Palm Oil Board, Malaysia

In 2006 Malaysia produced 15.88 million tonnes of crude palm oil (CPO), 1.95 million tonnes of crude palm kernel oil (CPKO) and 2.20 million tonnes of palm kernel cake (PKC), from about 4.2 million hectares of land. These products may be exported as they are or further processed before exporting. Currently, these three products constitute the main marketable and valuable commodities of the oil palm but in their production a voluminous amount of biomass is simultaneously produced. Palm biomass has great potential as alternative renewable energy and constitutes 90% of the plant, only 10% being converted to oil.

The biomass from the palm oil mills includes empty fruit bunches (EFB), palm fibres and palm shell. In 2006, we had 17.4 million tonnes (wet) of EFB, 10.3 million tonnes (wet) of palm fibres and 4.36 million tonnes (wet) of palm shell, a good source of biomass for processing into energy. Another source of energy from palm oil mills is Palm Oil Mill Effluent (POME) subjected to anaerobic digestion. The resources from the mills can, as a whole, be translated into energy of 56.3 million barrels of oil equivalent (BOE) with 19.4 million BOE from EFB, 20.8 million BOE from fibre, 13.0 million BOE from shell and 3.1 million BOE from POME.

Fronds from the estates are regularly trimmed during felling, offering another source of energy at the rate of 9.7 tonnes per hectare (dry weight basis) if this can be exploited. In Malaysia 80,000 hectares are replanted annually, as 25-year-old palms need to be replaced because their yield has diminished and they have become too tall to be harvested efficiently. When the palms are felled, the chipped trunks are left to decompose in the fields at the rate of 37 tonnes per hectare (dry weight basis). Trunks and fronds have a slightly lower calorific value than EFB, fibre and shell. The Malaysian Palm Oil Board (MPOB) have done some work in formulating the biomass into briquettes or pellets as a solid energy for burning which can be sent abroad, but if it is going to be used locally, it can either be compacted into bales or pulverized to reduce transportation costs.

One of the major types of biofuels that can be used in the transportation sector is bioethanol, which is conventionally produced from plant starch or sugar. Recently, however, the use of lignocellulose as a feedstock has been actively promulgated. MPOB is also working on the development of technology to convert the lignocellulosic oil palm biomass to ethanol, the critical aspect being the need to find suitable enzymes or microbes to break down the lignin. Preliminary assessment indicated that palm biomass has the potential to be converted into bioethanol, which could be exported or used to replace a portion of the gasoline requirement in Malaysia. Trunks appear to be the best feedstock from palm biomass, with the highest yield of 451 liters of bioethanol per tonne of trunks, followed by EFB, fronds and fibres.

In conclusion: Oil palm biomass is readily available at present in abundance throughout the year and currently suitable as solid fuel. However, its composition has potential as a second generation feedstock, not only for bioethanol but also for other types of energy, e.g. biomass to liquid, biomass to gas and so on. The use of biomass obviates the food vs. fuel issue as it is a by-product from the existing palms.

(basri@mpob.gov.my)

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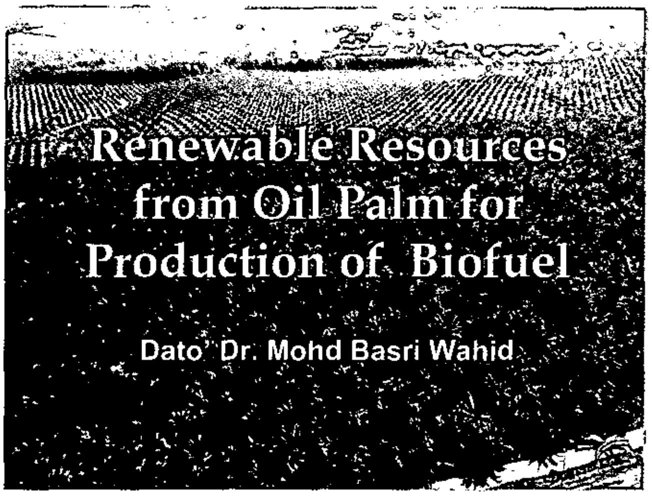
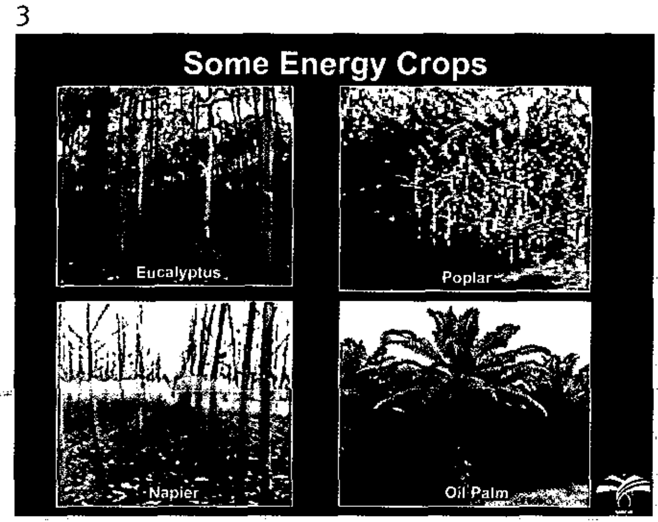


2

Content

- Introduction: Energy plants
- Sources, types and quantities of palm biomass
- Characteristics and potential as alternative renewable energy
- Availability
- Potential as biofuel
- Conclusion

3



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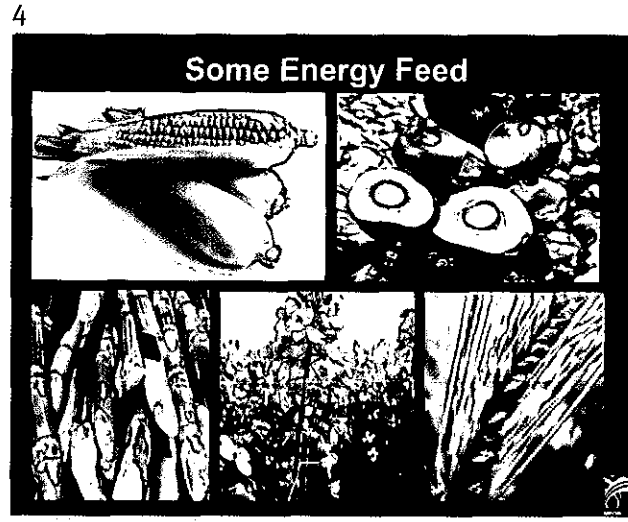

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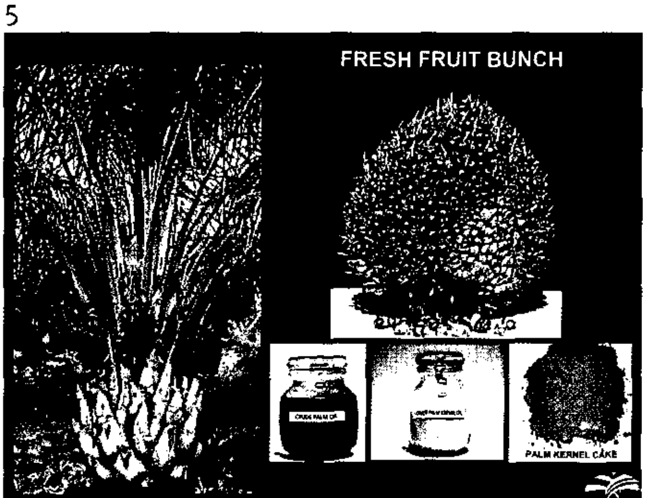

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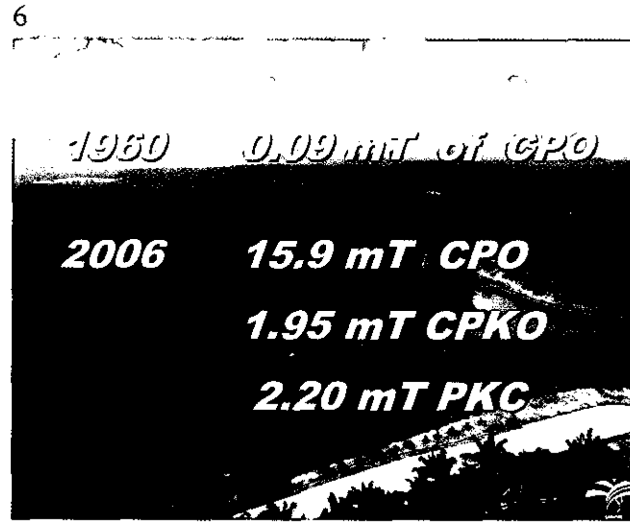

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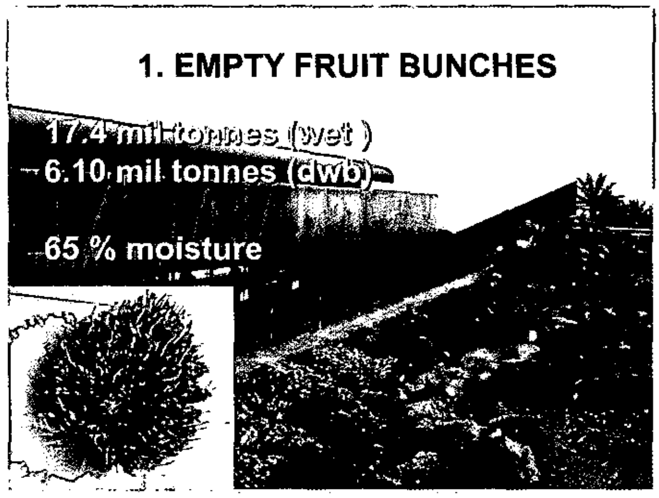

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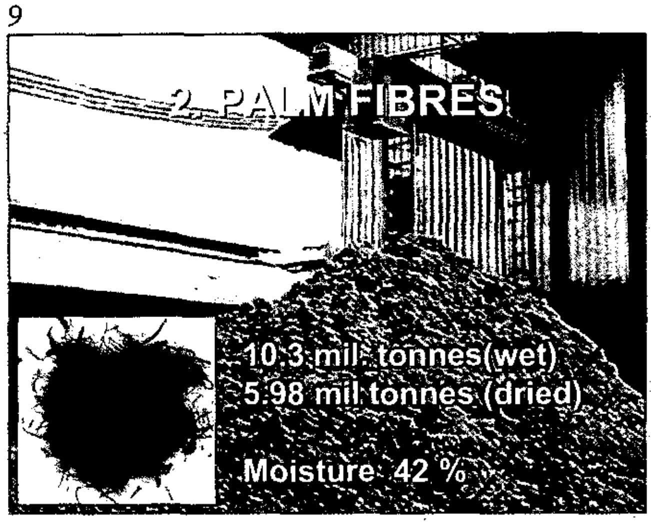

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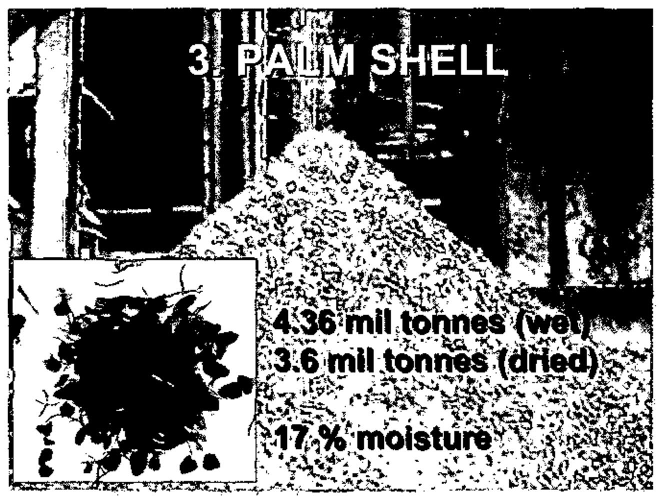

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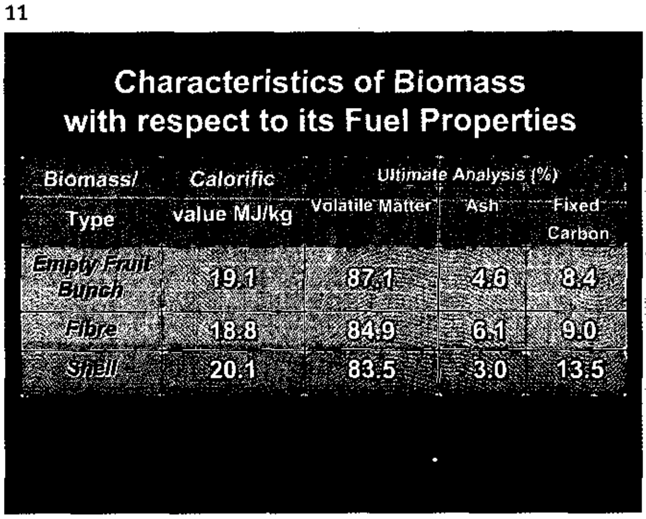
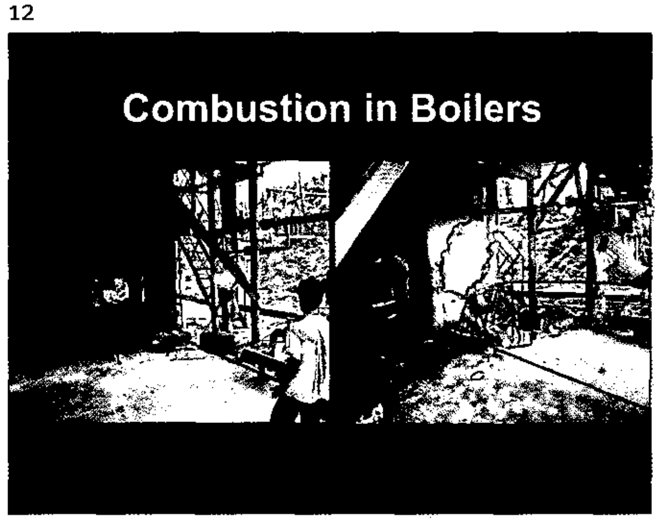


Characteristics of Biomass with respect to its Fuel Properties

Biomass/ Type	Calorific value MJ/kg	Ultimate Analysis (%)		
		Volatile Matter	Ash	Fixed Carbon
Empty Fruit Bunch	19.1	87.1	4.6	8.4
Fibre	18.8	84.9	6.1	9.0
Shell	20.1	83.5	3.0	13.5

12



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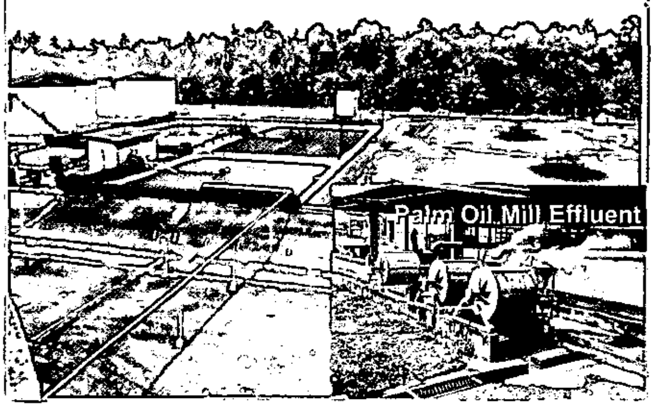
TREATMENT SYSTEM OF POME



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BARREL OF OIL EQUIVALENT (mil)

• EFB	19.4
• Fibre	20.8
• Shell	13.0
• Effluent	3.1

Computed based on calorific values

15

16

CHIPPED TRUNKS

17

FRONDS

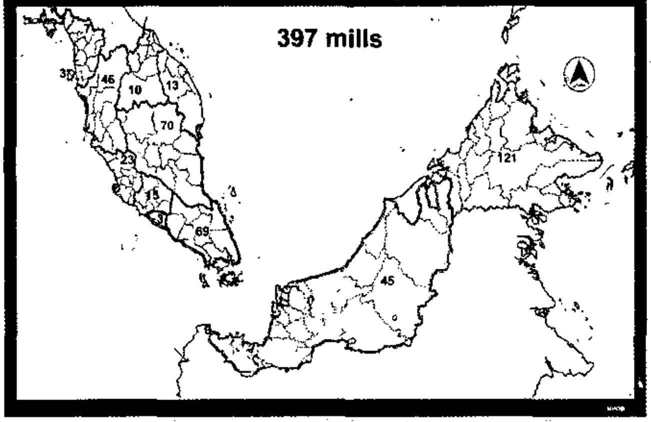
18

Characteristics of Biomass with respect to its Fuel Properties

Biomass/ Type	Calorific value MJ/kg	Ultimate Analysis (%)		
		Volatile Matter	Ash	Fixed Carbon
Trunk	17.5	86.7	3.4	9.9
Frond	15.7	85.1	3.4	11.5

19

Availability



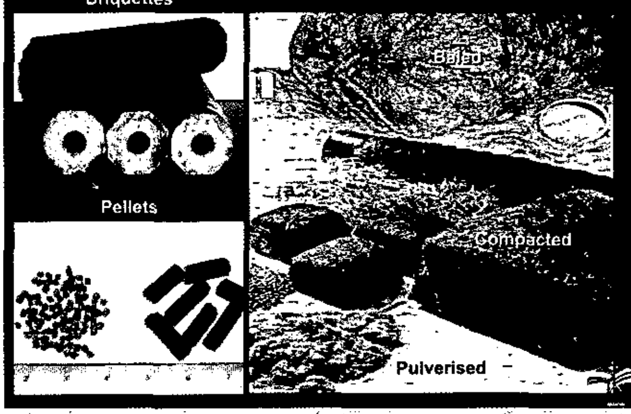
20

LOCATION OF MILLS IN MALAYSIA AND ITS OPERATIONAL CONSISTENCY (2006)

State	Number of Mills	Milling Hours per month	Milling Capacity Utilization Rate, per month %
Johor	67	427	93
Kedah	6	364	108
Kelantan	10	305	69
Melaka	3	436	99
N. Sembilan	15	393	85
Pahang	69	377	88
Perak	3	313	73
P. Pinang	43	430	103
Selangor	21	418	92
Terengganu	12	389	76
P. Malaysia	249	401	90
Sabah	112	406	96
Sarawak	36	352	92
Sabah/Sarawak	148	393	95
MALAYSIA	397	398	92

21

Biomass in various forms



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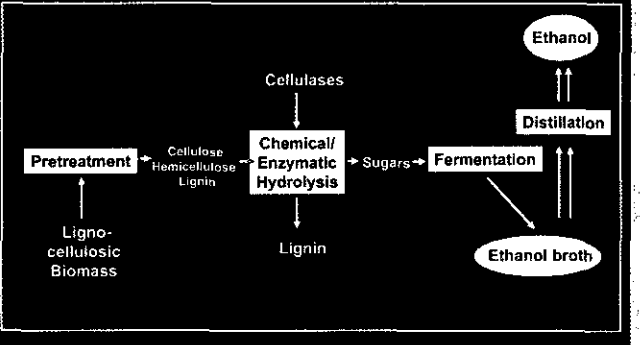
Conversion to Bioethanol



23

POTENTIAL ETHANOL FROM BIOMASS (dwb)

Biomass	EFB	Trunks	Fronds	Fibres
Glucose *g/g*	0.43	0.65	0.47	0.23
Xylose *g/g*	0.26	0.12	0.24	0.18
Ethanol *l/tonne*	388	451	377	225

Source: DTU.Density of EtOH at 0.789 g/ml
0.5g ethanol/g glucose
0.35g ethanol/g xylose

24

BIOETHANOL POTENTIAL AS REPLACEMENT OF PETROLEUM

Feedstock	mil. tonne (dwb)	mil. litres	% Replacement# (v/v)
EFB*	6.10	2,366	24
Fibres*	6.0	1,345	14
Trunk**	9.0	4,059	47
Frond**	2.4	904	9

*Amount based on FFB processed in 2006
**Amount projected to be available in 2008
#Based on petroleum use of 9,787 mil. litres in 2005

25

CONCLUSION

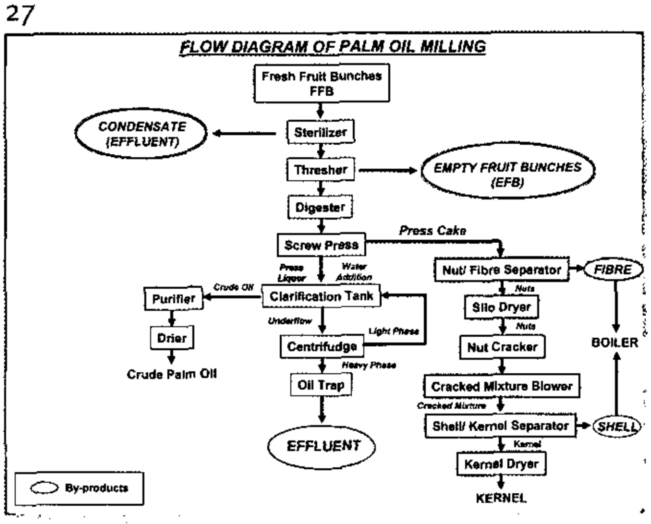
- Readily available and at present in abundance throughout the year.
- Suitable as solid fuel.
- Composition has potential as second generation feedstock for bioethanol.
- Depends on existing palms and thus does not conflict land/food use.
- Need to interface logistics of collection, pre-treatment, environmental impacts, agronomics, economics and its competition with other energy alternatives.

26

MPOB

Thank You

27



SESSION 4 - PRODUCTION TECHNOLOGIES AND APPLICATIONS: BIOFUELS FROM OILS AND FATS

Session Chairperson

Dato' Dr. Mohd. Basri Wahid

Director General

Malaysian Palm Oil Board

Malaysia

SESSION 4-1:

MPOB PALM BIODIESEL PRODUCTION TECHNOLOGIES

Choo Yuen May, Cheah Kien Yoo, Ma Ah Ngan, Harrison Lau Lik Nang,
Yung Chee Liang, Rusnani Abd. Majid, Andrew Yap Kian Chung, Ng Mei Han, Puah Chiew Wei, Yahya Hawari & Mohd Basri Wahid
Malaysian Palm Oil Board (MPOB), Malaysia

The current biodiesel production technologies are predominantly based on the transesterification reaction of vegetable oils and fats with methanol using homogeneous base catalysts such as sodium methylate (sodium methoxide), sodium hydroxide or potassium hydroxide. The Malaysian Palm Oil Board (MPOB, then the Palm Oil Research Institute of Malaysia or PORIM) initiated the palm biodiesel program in 1982 by starting laboratory scale R&D. The production technology the MPOB patented to produce palm biodiesel was scaled up to a 3,000 tons per annum continuous pilot plant, which has been in operation since 1985. The biodiesel produced from this pilot plant has been used for various field trials, the most comprehensive and exhaustive one having been conducted in collaboration with Mercedes Benz of Germany in the early 1990s.

The increasing demand for palm biodiesel from the EU in 2004 prompted the MPOB to scale up its production technologies to a commercial level. Since then, there have been three commercial plants built using the MPOB's technologies (each with 60,000 tons per annum capacity): the Carotino biodiesel plant, which has been in production since July 2006, Golden Hope's since May 2007 and FIMA's, which is to be commissioned in September 2007[1]. Four more plants based on MPOB technologies are either under construction or in production: i) a 60,000 TPA plant in Korea commissioned in the cold winter from December 2006 to January 2007 and now in commercial production, ii) a 60,000 TPA plant in Thailand to be commissioned in November 2007[2], iii) a 120,000 TPA plant in Johor, Malaysia to be commissioned in July/August 2007 and iv) a 120,000 TPA plant in Klang, Malaysia, to be commissioned in 2008. One of the limitations of palm biodiesel is its high cold filter plugging point (CFPP +15°C). The MPOB has overcome this limitation by developing a process for the production of low CFPP biodiesel (-18°C) for export. Three commercial plants, each with 30,000 tons per annum, have been built and one is already in commercial production manufacturing low CFPP winter grade palm biodiesel for export from Malaysia.

In the MPOB's palm oil biodiesel process, the fatty acids (FA) are converted to methyl esters by esterification of crude palm oil (CPO) in the presence of a solid acid catalyst. The methyl esters are then converted into biodiesel products and crude glycerol with a concentration of 80-85%, which can be purified to pharma grade glycerine.

1 The date was the estimate at the time of the Conference and its commissioning actually took place in March 2008.

2 The date was the estimate at the time of the Conference and its commissioning is expected to take place within this year.

The esterification section is not necessary if refined, bleached and deodorized (RBD) palm oil is used instead of CPO. To produce good quality biodiesel, it is crucial to control certain parameters. Three slides illustrate the process- and feedstock-related parameters. They are followed by a few slides to show you the key fuel properties of normal and winter grade palm biodiesel, together with information on the cetane numbers of biodiesels from different feedstocks and that of mineral diesel. The MPOB's biodiesel production technologies are optimized for palm oil and palm oil products and are simple and proven, as they have more than 20 years of experience. The biodiesel produced meets international specifications such as EN 14214 and ASTM D6751.

The palm methyl esters contain other value-added downstream products such as palm phytonutrients, e.g. carotenoids, Vitamin E, phytosterols, squalene, coenzyme Q and phospholipids. Therefore, valuable phytonutrients worth about US$970 per ton are lost for every ton of methyl ester burned. The MPOB's palm biodiesel technologies are ready for commercial exploitation of these value-added products.

(choo@mpob.gov.my)

1

2007 International Conference on Biofuels, 5-6 July 2007, PWTC, KL.

MPOB PALM BIODIESEL PRODUCTION TECHNOLOGIES

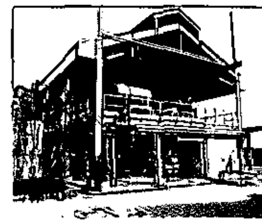
Choo Yuen May, Cheah Kien Yoo, Ma Ah Ngan, Harrison Lau Lik Nang, Yung Chee Liang, Rusnani Abd. Majid, Andrew Yap Kian Chung, Ng Mei Han, Puah Chiew Wei, Yahya Hawari & Mohd Basri Wahid

M P O B

2

Development of MPOB Palm Biodiesel Technology

- Idea conceived – 1981
- Lab scale R&D – 1982
- Continuous Pilot plant (3,000 TPA) built and commissioned – 1985



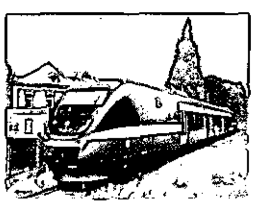
MPOB Palm Biodiesel Pilot Plant

M.P.O.B.

3

Development of MPOB Palm Biodiesel Technology

- Produces palm biodiesel for stationary engine testing and field trial (1985-1995)
- Most exhaustive field trial was conducted with Mercedes Benz (1990-1994)
- Palm biodiesel (B100) is used as fuel for passenger trains in Europe



M.P.O.B.

4

Development of MPOB Palm Biodiesel Technology

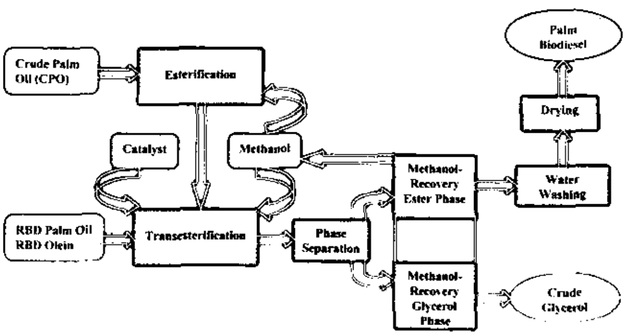
- 1st commercial small scale plant (3,000 TPA) started production by August 2002 (Carotino)
- Scaling up to 60,000 TPA in 2005.
- Developed winter fuel technology (2001) and scaling up to 30,000 TPA in 2005.
- Developed technologies for phytonutrients and scaled up to pilot plant.

Small scale commercial Plant, 3000 TPA (Carotino)

M.P.O.B.

5

MPOB Palm Biodiesel Process



M.P.O.B.

6

Esterification Section

- Can handle FFA up to 30%
- Solid acidic catalyst: ion exchange resins
- Fixed bed reactor filled with solid catalyst
- Reaction temperature: 80 °C
- Reaction pressure: 3 kg/cm^2
- FFA content of reactor effluent: <0.5%
- Catalyst deactivation: phospholipids and trace metals.

M.P.O.B.

7

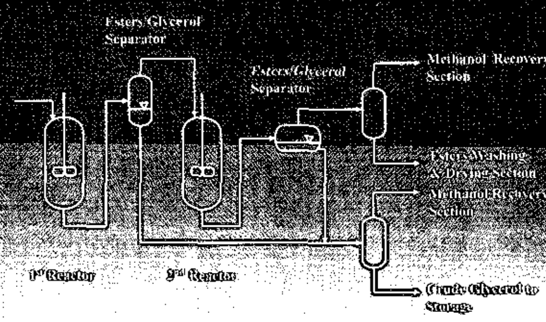
Transesterification

- For a continuous process, the reaction is carried out with a series of continuous stirred tank reactors (CSTR).
- To achieve high conversion:
  - Good quality feedstock (low FFA and moisture)
  - Separate glycerol from esters after each stage of reaction
  - Excess methanol
  - Good mixing of reaction mixture.

M.P.O.B.

8

Process flow diagram for transesterification and esters/glycerol separation



M.P.O.B.

9

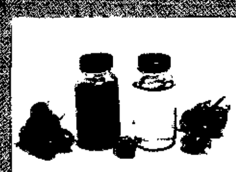
Biodiesel and Glycerol Purification

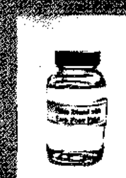
- Biodiesel
  - Water washing – to remove traces of glycerol, soap and catalyst.
  - Drying – moisture content <500 ppm
  - Waste water – meet Malaysian DOE specifications
- Glycerol
  - Crude glycerol concentration: 80 - 85%
  - Can be purified to Pharma. Grade.
- Methanol Recovery – excess methanol is recovered and purified to >99.85%.

M.P.O.B.

10

Development of Low Pour Point Palm Biodiesel

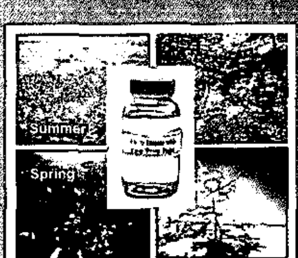

Palm Biodiesel (Crude / Distilled Palm Oil Methyl Esters)


Low Pour Point Palm Biodiesel

M.P.O.B.

11

Seasonal Pour Point Requirement of Biodiesel



Season	Pour Point (°C)
Spring	-10
Summer	0
Autumn	-10
Winter	-20

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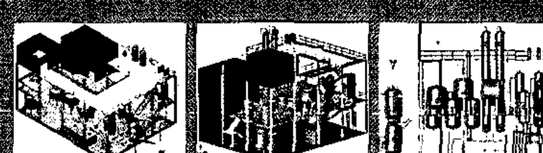
MPOB Commercial Palm Biodiesel Plants



- MPOB + 3 Commercial Partners – to build 3 commercial plants in Malaysia.
- Each plant consists of a 60,000 TPA normal biodiesel plant and a 30,000 TPA winter fuel plant.
- All these plants were built using MPOB Technologies

M.P.O.B.

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Status of MPOB Commercial Palm Biodiesel Plants

Normal Grade – 60,000 TPA of Feedstock
Winter Grade – 30,000 TPA of Feedstock

1. MPOB-Carotino Biodiesel Plant: Completed and in full commercial production since July 2006
2. MPOB-Golden Hope Biodiesel Plant: Completed and in full commercial production since May 2007.
3. MPOB-FIMA (TiTian Asli) Biodiesel Plant: Expected to be commissioned by Sept 2007

M.P.O.B.

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Status of Other Palm Biodiesel Plants Using MPOB Technology (Normal Grade)

1. Enertech, Korea	60,000 TPA (Lipochem)	Commissioned – January 2007
2. Carotino, 2nd plant, Johor	120,000 TPA (Lipochem)	Expected com: July-Aug 2007
3. New Biodiesel Plant, Thailand	60,000 TPA (Oiltek)	Expected com: Nov 2007
4. EEM, Pulau Indah, Klang.	120,000 TPA (Lipochem)	Expected com: 2008

EEM: Everlast Environment Management

M.P.O.B.

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MPOB 1st Commercial Normal Palm Biodiesel Plant at Carotino Sdn. Bhd.

CFPP: 15°C (Normal Grade)

M.P.O.B.

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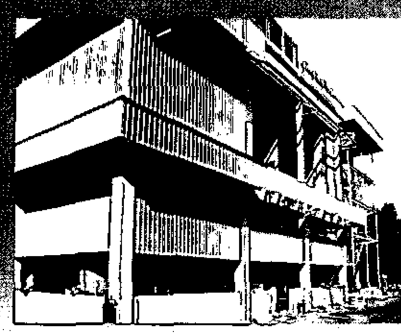
Winter Grade Palm Biodiesel Plant at Carotino Sdn. Bhd. (Capacity: 30,000 TPA)



CFPP: -18°C to -21°C (Winter Grade)

M.P.O.B.

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Setting up QC Laboratory for Biodiesel Anaylsis at Carotino, Sdn. Bhd., Johor

M.P.O.B.

18

Launching of World 1st Integrated Commercial Normal and Winter-grade Biodiesel Plant at Carotino Sdn. Bhd. (August 2006)

M.P.O.B.

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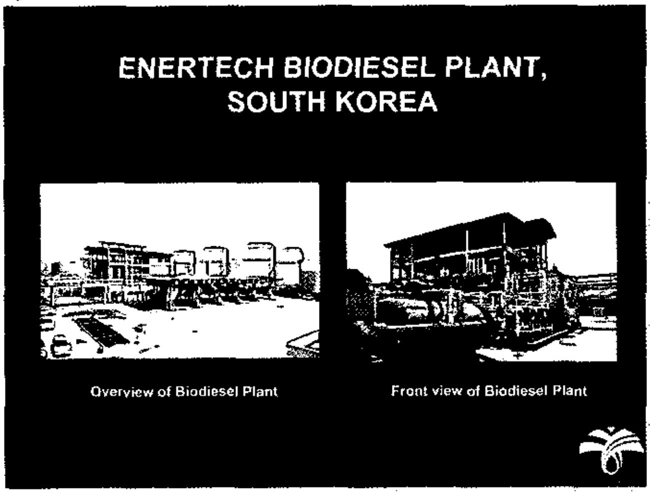

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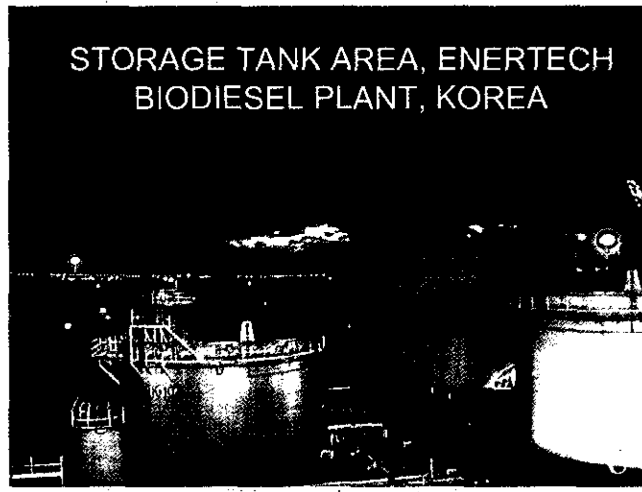

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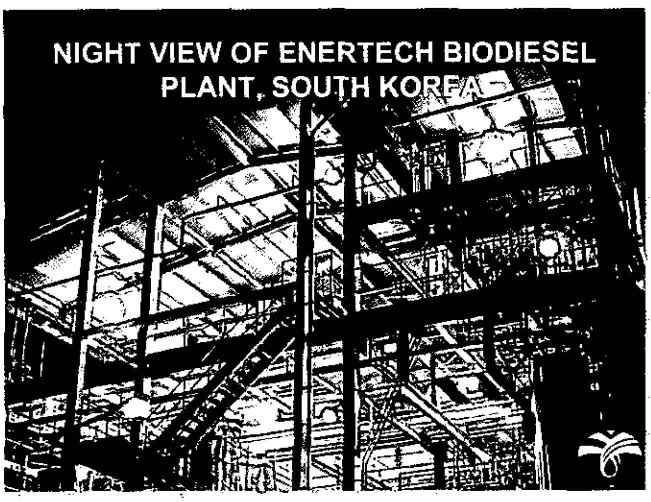

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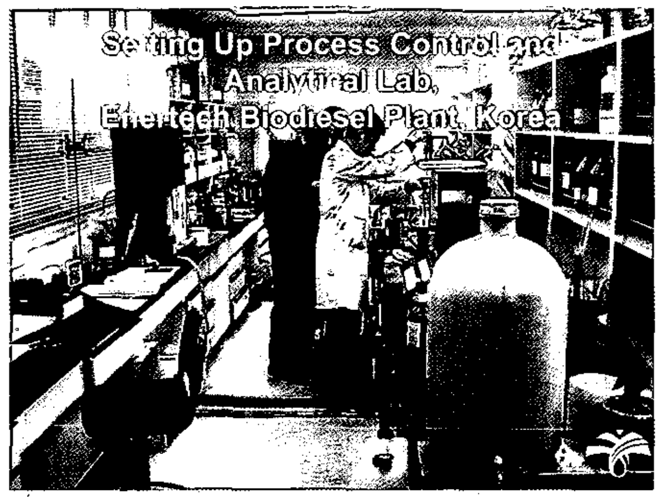

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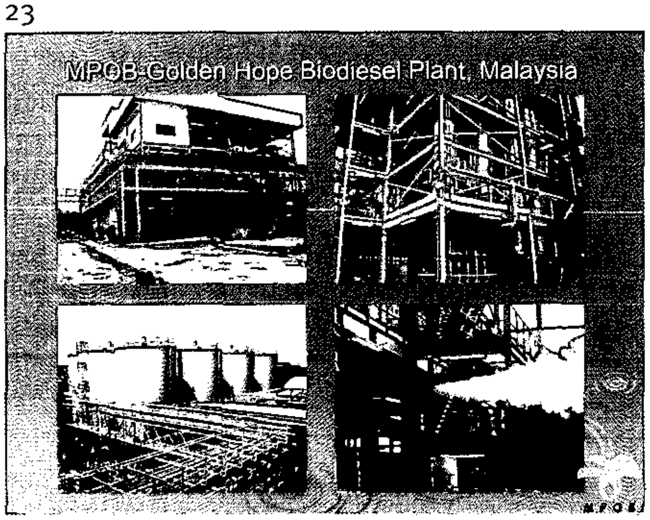

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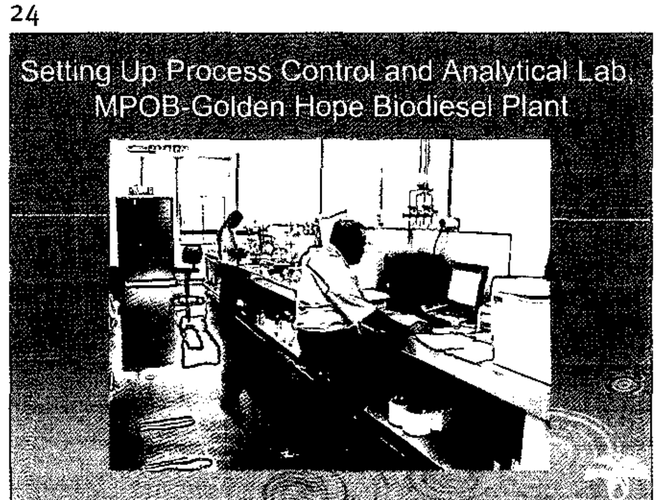

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MPOB Biodiesel Plant Feedstock Specifications

Specification	RBD Palm Oil	RBD Olein
FFA (as palmitic) %	0.1 max	0.1 max
Moisture & Impurities %	0.1 max	0.1 max
IV (Wijs)	50 to 55	56 min
Melting Point (AOCS Cc-25)	33 - 39 °C	24 °C min.
Colour (5 1/4" Lovibond cell)	3 Red max.	3 Red max.

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Process Related Quality Parameters

Ester Content	➢ Conversion ➢ Raw materials – unsaponifiable matters
Free Glycerol	➢ Insufficient washing ➢ Hydrolysis of mono-, di- and triglycerides during storage
Mono-, Di-, Triglycerides and Total Glycerol	➢ Conversion ➢ Reverse reaction
Acid Value	➢ Quality and types of feedstocks ➢ Use of mineral acid in process
Water content	➢ Insufficient drying ➢ Absorbing moisture during transportation / storage

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Process Related Quality Parameters

Content of Phosphorus	➢ Types of feedstocks ➢ Use of phosphoric acid
Content of Alkali and alkalian-earth Metals	➢ Catalyst residues, Na & K ➢ Quality of washing water, Ca & Mg
Methanol	➢ Insufficient washing and drying
Flash point	➢ Residual methanol and other solvents

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Feedstocks Related Quality Parameters

IV, linolenic acids and polyunsaturated esters	➢ Tend to polymerize and decrease oxidative stability ➢ EN limit IV 120 excludes soybean and sunflower oil.
Oxidative stability	➢ Polyunsaturated ester - unstable ➢ Palm Biodiesel – stable
Cold temperature properties – CP, PP & CFPP	➢ Long chain saturated esters – unfavorable cold temperature properties
Cetane number	➢ Ignition quality of biodiesel ➢ Increased with carbon chain and decreased with number of double bonds

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Key Fuel Characteristics of Normal and Winter Grade Palm Biodiesel

Property	Palm Biodiesel (Normal Grade)	Palm Biodiesel (Winter Grade)	Petroleum Diesel
Density at 15°C (kg/L) ASTM D4052	0.875	0.882	0.853
Sulfur Content (% wt) IP 242	< 0.04	< 0.04	0.10
Viscosity @ 40°C (cSt) ASTM D445	4.5	4.6	4.0
Pour Point (°C) ASTM D97	+15	-21	+15
Flash Point (°C) ASTM D93	174	153	98
Cetane Number ASTM D613	62.4	57	55.2
Gross Heat of Combustion (kJ/kg) ASTM D2332	40,335	39,160	45,800
Conradson Carbon Residue (% wt) ASTM D198	0.02	0.01	0.14

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Fuel Properties of Palm Biodiesel (Normal and Winter Grade)

Property	Unit	EN 14214	ASTM D6751	Palm Biodiesel
Ester Content	% m/m	96.5 min	-	>98.5
Sulfur Content	mg/kg	10 max	15 max	<10
Carbon Residue (on 10% distillation residue)	% m/m	0.30 max	-	0.2
Carbon residue	% mass	-	0.05 max	-
Sulfated Ash	% m/m	0.02 max	0.02 max	<0.01
Cetane Number	-	51.0 min	47 min	58.2

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Fuel Properties of Palm Biodiesel (Normal and Winter Grade)

Property	Unit	EN 14214	ASTM D6751	Palm Biodiesel
Water & Sediment	% vol	-	0,05 max	<0.05 (Product hygroscopic-very critical)
Water content	mg/kg	500 max	-	100-400 (Product hygroscopic-very critical)
Total Contamination	mg/kg	24 max	-	< 24
Copper Strip Corrosion (3h at 50 C)	Rating	Class 1	No. 3 max	1a
Oxidation Stability, 110°C	hours	6.0 min		> 6 (Crucial Parameter)

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Fuel Properties of Palm Biodiesel (Normal Grade)

Property	Unit	EN 14214	ASTM D6751	Palm Biodiesel
Acid Value	mg KOH/g	0.5 max	0.8 max	0.2-0.4
Iodine Value	g/100g	120 max	-	>51
Linolenic Acid ME	% m/m	12.0 max	-	<0.5
Polyunsaturated (≥ 4 double bonds ME	% m/m	1 max	-	<0.1
Methanol Content	% m/m	0.2 max	-	<0.2

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Fuel Properties of Palm Biodiesel (Normal and Winter Grade)

Property	Unit	EN 14214	ASTM D6751	Palm Biodiesel
Monoglycerides	% m/m	0.80 max	-	Mono: 0.4 – 0.65
Diglycerides	% m/m	0.20 max	-	Di: <0.2
Triglcyerides	% m/m	0.20 max	-	Tri: <0.1
Free Glycerol	% m/m	0.02 max	0.02 max	Crucial parameter from conversion and reverse reaction perspective.
Total Glycerol	% m/m	0.25 max	0.24 max	
Na + K	mg/kg	5.0 max	-	<5
Ca + Mg	mg/kg	5.0 max		<1
Phosphorus	mg/kg	10.0 max	10 max	<10

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Cetane Number of Biodiesel and Mineral Diesel

Palm	62
Coconut	62
Rapeseed	54
Soybean	46
Sunflower	49
Tallow	58
Peanut	54
Mineral Diesel	47

Source: Martin Mittelbach and Claudia Remschmidt, Biodiesel - The Comprehensive Handbook, 2004

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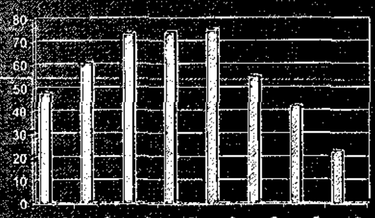
Cetane numbers of fatty acid esters



FAC of Palm Oil Methyl Esters	Carbon Number (%)
C16:0	45
C18:0	5
C18:1	39
C18:2	10
Others	< 1

Source: Martin Mittelbach and Claudia Remschmidt, Biodiesel – The Comprehensive Handbook, 2004

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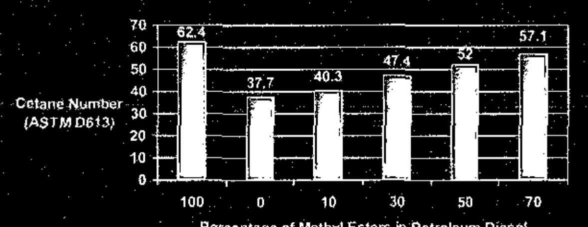
Palm Biodiesel: Cetane Number Improver



Cetane Number:
- Standard measurement of fuel's readiness to auto-ignite at the temperatures and pressures present in the cylinder during fuel injection
- An engine-based test using a special engine produced by the Waukesha Engine Company.

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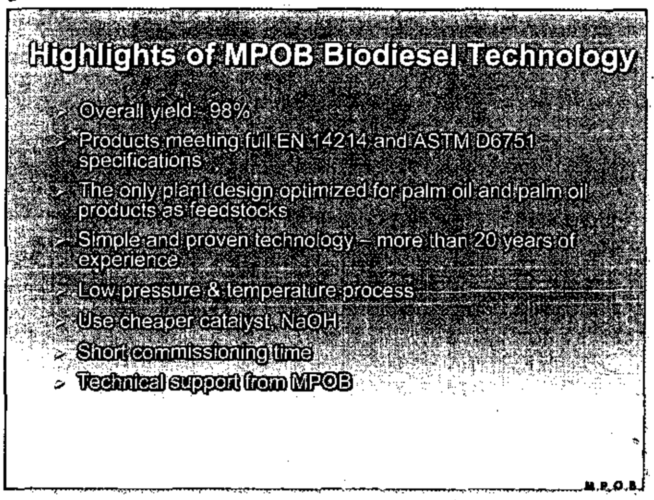

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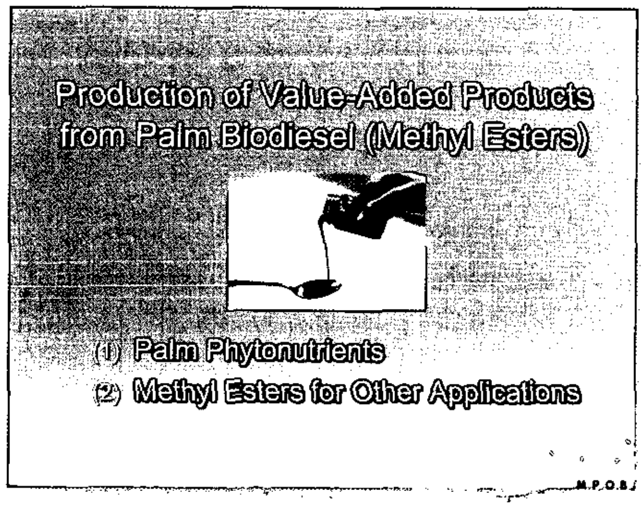

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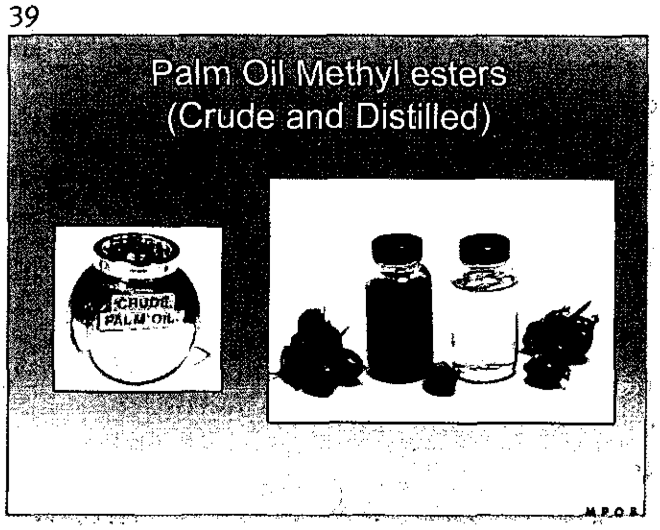

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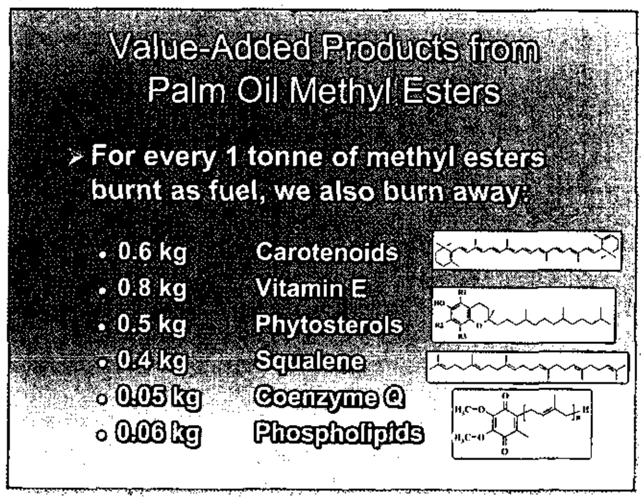

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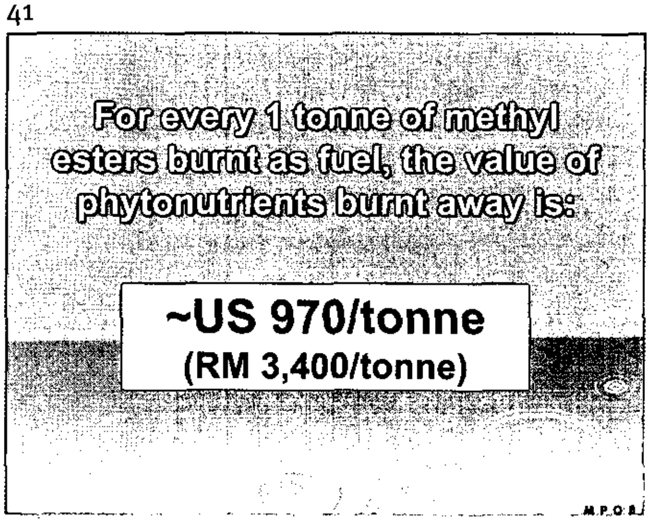

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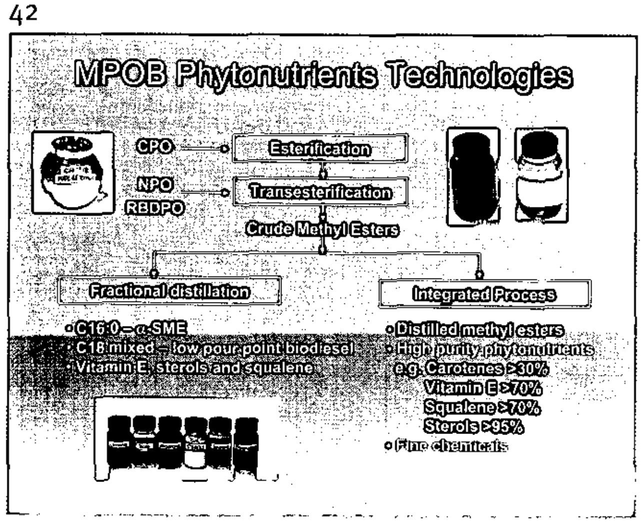

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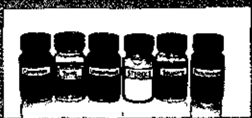
Production of Individual Carotene, Vitamin E & Cholesterol-free Sterol



- High purity (>90%) of the following produced:
  - individual carotene, e.g. α- and β-carotenes, lycopene and phytoene
  - individual vitamin E isomers, e.g. α- and γ-tocopherols, α-, γ- and δ-tocotrienols
  - β-sitosterol

SFC

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Conclusion

- MPOB palm biodiesel technologies (normal and winter grades) have been well proven.
- Both normal and winter grades palm biodiesel produced using MPOB technologies meet EN14214 and ASTM D6751 specifications.
- Malaysia is in the process to set up Malaysian Biodiesel Standard.
- Palm oil methyl esters can be used as feedstock for *various oleochemicals applications.*
- MPOB palm biodiesel technology provides an opportunity to recover value-added palm phytonutrients - MPOB phytonutrient extraction technologies are ready for commercial exploitation.

M.P.O.B.

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Acknowledgement

1. Ministry of Plantation Industries and Commodities, Malaysia
2. Former Director-Generals, MPOB
   (A) Tan Sri Datuk Dr. Augustine Ong S.H.
   (B) Tan Sri Datuk Dr. Yusof Basiron
3. Engineering and Processing Division, MPOB, Director & Supporting Staff of Catalysis & Processing Group, Energy Group & Clean and Emerging Technologies Group
4. Carotino Sdn. Bhd., Golden Hope Biodiesel Sdn. Bhd. and Enertech Co. Ltd.
5. Lipochem Sdn. Bhd.
6. Oiltek Sdn. Bhd.

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Thank you

MPOB

Please log on to MPOB website for more information on biodiesel development ([illegible]) or contact email: [illegible]

SESSION 4-2:

TECHNOLOGY FOR THE EXPLOITATION OF JATROPHA AS RAW MATERIAL FOR BIODIESEL: THE INDIAN EXPERIENCE

B. Jaya Kumar
Nandan Biomatrix Limited, India

After several years of R&D work and pilot scale demonstrations, India is now at the threshold of commercial production of biodiesel using jatropha oil. This presentation will give an overview of the efforts being made to commercialize jatropha biodiesel by different research organizations, central & state governments, public and private sector companies and by our organization, Nandan Biomatrix. The government's biodiesel policy, excise duty exemption, subsidies and grants, the president's vision, the country's energy scenario, the role of biofuels, the availability of unutilized lands for jatropha cultivation and the current status of the biodiesel industry in India will be described.

To make this project successful, an integrated approach is being followed wherein all inter-related activities are being performed to give the best possible results in terms of economic and social benefits for all the stakeholders. The range of activities covered is broadly classified into Backward and Forward Integration.

Backward Integration covers: (i) Agricultural Technology: germplasm accessions, superior selected varieties, plant breeding, suitable methods of propagation, infrastructure such as mist chambers, cool chambers, poly-houses and hardening chambers, and demonstration blocks; (ii) Package of Practices: spacing, irrigation, mulching, optimum fertilizer requirement, inter-culturing, pruning, pests & disease control, harvesting, and storage of seeds; (iii) Symbiotic Activities: intercropping apiculture; (iv) Unique Supporting Activities: technical supervision & guidance, a franchisee network, crop finance, crop insurance, and a buyback arrangement of the produce.

Nandan Biomatrix is developing superior varieties and improved packages of practices and crop monitoring technologies to increase the seed yield and the oil percentage in Jatropha curcas. Extensive research on growth and yield parameters acts as the basic tool for the production of superior varieties. For meeting the objectives of commercial cultivation, best varieties and germplasms have been accessed. Nandan is involved in continuous evaluation of these accessions and the development of superior varieties through plant breeding that results in uniform traits with enhanced yields and therapeutic values. Apart from development of superior varieties, several other factors like irrigation, spacing, nutrient management, pest management, etc influence the crop performance.

Forward Integration covers: (i) oil expelling & solvent extraction, (ii) pretreatment & transesterification, (iii) biodiesel storage and distribution and (iv) valuable byproducts such as biofertilizers, biopesticides, nutraceuticals, pharmaceuticals & glycerine.

The stakeholders are: (i) farmers, (ii) governments, (iii) entrepreneurs, (iv) diesel consumers, (v) financial institutions and (vi) carbon credit companies. Their roles to make the project successful will be discussed.

(info@nandan.biz)

(THE SLIDES OF THIS PRESENTATION ARE NOT AVAILABLE)

SESSION 4-3:

HYDROPROCESSING OF PALM OIL FOR BIOFUEL PRODUCTION

Prabhakar Nair
UOP LLC, USA

The production of renewable fuels is continuing to expand worldwide as a result of increasing petroleum prices, government regulations, and commitments to greenhouse gas reduction. There has been little integration of renewable fuel production within petroleum refineries to date, despite rapidly increasing growth in the demand for renewable fuels. The segregated production of renewable fuel components increases cost, since the existing infrastructure for distribution and production of petroleum-based fuels is not utilized. Renewable fuels will be able to have wider application in meeting the increasing demand for transportation fuels if economic opportunities for blending or co-processing them within traditional petroleum refineries can be developed. UOP LLC and Eni S.P.A. are jointly developing new technology to utilize renewable feedstocks derived from vegetable oils for the production of high quality diesel fuel.

This presentation introduces the new UOP/Eni Ecofining™ Process for Green Diesel production and discusses the advantages it has over other technologies to produce renewable diesel fuel, such as Fatty Acid Methyl Ester (FAME), also known as biodiesel.

Whereas the established route to produce biodiesel today is transesterification of vegetable oils with methanol, resulting in biodiesel, and glycerol as a by-product, the Ecofining™ Process converts vegetable oil to high quality biodiesel with hydrogen. The production facilities can be stand-alone, however, greater synergies can be expected with existing assets and infrastructure if they are located within petroleum refineries. The process is feedstock flexible and any vegetable oil can be fed. If palm oil is used, with 100 units of input, 88~97 units of biodiesel can be produced with superior fuel properties, compatible with both petroleum diesel and conventional diesel engines. Green Diesel has a cloud point of -30ºC to -10ºC and a cetane value of 70-90. These properties make it a premium blending component.

The economics of biofuels are still not good relative to gasoline or diesel when crude is US$50 per barrel, except for ethanol based on sugar cane. The feedstock cost comprises about 80% of the total biofuel production cost and economic viability is feedstock cost driven. Palm oil based biodiesel production breaks even when the crude oil price is $52 per barrel if the palm oil cost is $420 per ton. However, the break-even point varies as the feedstock price changes. When Green Diesel is blended with petroleum diesel, the leverage of its premium quality is exceptionally high and the refinery operating margin is expected to be much higher as compared with the cases of blending with, for example, FAME.

UOP has carried out an intensive co-development program with Eni since 2005 to develop the Ecofining™ process. The basic engineering design for the first commercial plant in Europe has been completed in the second quarter of 2007 and it will start up in early 2009. The life cycle analysis of energy balance and GHG balance indicates positive results in favor of biodiesel, and Green Diesel in particular, relative to petroleum diesel.

Our R&D program includes catalytic cracking of vegetable oil for Green Gasoline and Green Olefins, hydro-processing of pyrolysis oil for Green Gasoline and Green Diesel, and hydro-processing of lignocellulosic wastes for Green Fuels and Green Chemicals. Algae oil productivity is outstanding and could enable an oil route to biodiesel, Green Diesel and JP-8, *military jet fuel.*

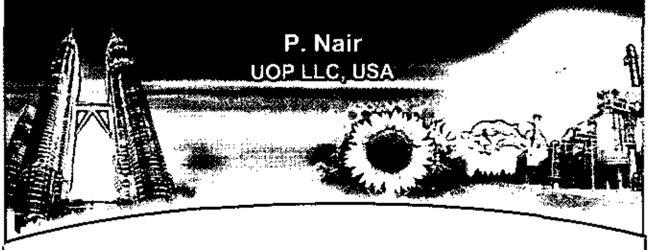
In conclusion: Petroleum refiners are well positioned to play a major role in renewable diesel production. UOP and Eni are licensing the Ecofining™ process, which offers sustainability and better economics. Green Diesel has superior fuel properties. Longer term technology development focuses on the utilization of algae oils and waste biomass.

(Prabhakar.Nair@uop.com)

1

Hydroprocessing of Palm Oil for Bio-fuels Production

P. Nair
UOP LLC, USA



International Conference on Biofuels
Kuala Lumpur, Malaysia
July 5 & 6, 2007

UOP A Honeywell Company

2

UOP Overview

UOP A Honeywell Company

- Leading supplier and licensor of processing technology, catalysts, adsorbents, process plants, and technical services to the petroleum refining, petrochemical, and gas processing industries
- *UOP Technology Furnishes: 60% of the world's gasoline; 70% of the world's modern detergents; 60% of the world's para-xylene*
- Industry leader in developing and providing clean fuel solutions in response to various government directives
- 3400 employees worldwide
- '06 Financials: $1.6 billion sales
- Strong relationships with leading refining and petrochemical customers worldwide
- 70+ processes in 6,000+ units in hydrocarbon processing industry; 300+ catalysts, adsorbents; 31 of 36 refining technologies in use today created by UOP

2003 National Medal of Technology Recipient

Track Record Of Technology Innovation

3

Hydroprocessing Vegetable Oils in Refineries

UOP A Honeywell Company

Drivers
- Petroleum cost and availability
- Mandates and incentives
- GHG emissions

Issues
- Availability
- Costs
- Transportation
- Composition

Need
- Profitable Processing Options

Approaches
- Co-processing options
- Hydrogen generation
- Higher value products

4

Alternate Fuels: Market Drivers & Risks

UOP A Honeywell Company

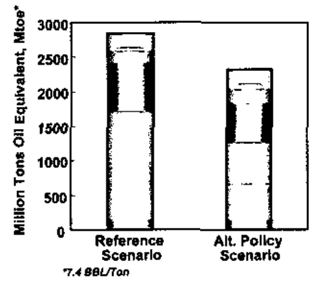
Market Drivers
- **Higher crude prices: longer term projections of >$50/bbl**
- **Geopolitical concerns: security of supply and energy independence**
- **Green House Gas (GHG) emissions reduction**
- **Government policy: mandates and fiscal incentives**
- **Job creation for agricultural sector**

Risks & Uncertainties
- **Crude prices decline significantly**
- **Government policy towards renewables changes**
- **Biomass feedstock availability, cost, lack of distribution channels and rate at which the automotive fleet can be turned over constrain market growth**
- **Technology and innovation breakthroughs do not materialize**

5

2004-2015: *Incremental Global Energy Demand*

UOP A Honeywell Company



	Reference Scenario	Alternative Policy
Biomass waste other renewables	1.7% / yr	1.8% / yr
Hydro	2.5% / yr	2.6% / yr
Biofuels	12.1% / yr	15.1% / yr
Nuclear	1.2% / yr	1.6% / yr
Gas	2.5% / yr	2.0% / yr
Oil	1.7% / yr	1.3% / yr
Coal	2.6% / yr	2.0% / yr
Primary Energy	2.1% / yr	1.7% / yr

Shifting Towards Conservation & Alternatives
Biofuels are Fastest Growing Segment

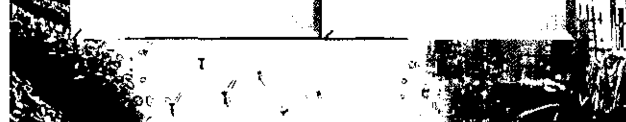
Source: IEA

6

Biorenewables in Oil Refineries

UOP A Honeywell Company

Issues
- Availability
- Costs
- Transportation
- Composition



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Biorenewable Feeds: Costs

UOP A Honeywell Company

Bio Feedstock	*Price ($/bbl)*	*Price ($/gal)*
WTI/Brent Crude	68	1.62
Rapeseed oil (Canola)	89	2.13
Soy oil	75	1.79
Palm oil	62	1.47
Jatropha oil	44	1.05
Pyrolysis oil-high	58	1.39
Pyrolysis oil-low	15	0.35

Palm oil prices have doubled over the past 2 years. Difficult to compete w/petrodiesel at such pricing levels

8

Biorenewable Feeds: Composition

UOP A Honeywell Company

	Crude Typical	*Resid*	*Refined Palm Oil*	*Soy Oil*	*Yellow Grease*	*Pyrolysis Oil*
% C	83-86	84.9	76.7	77.6	76.4	56.2
%H	11-14	10.6	12.7	11.7	11.6	6.6
%S	0-4 (1.8avg)	4.2	<0.0005	.0006	.04	-
%N	0-1 (.1avg)	.3	<0.0003	.0011	.03	.3
%O	-	-	11.4	10.4	12.1	36.9
H/C	1.8-1.9	1.5	1.9	1.8	1.8	1.4
Density	.86(avg)	1.05	0.92	.92	.89	1.23
TAN	<1	<1	1.2	2	30	78
ppm alkali metals	60	6	<10	100	100	100
Heating value kJ/kg	41,800	40,700	39,300	37,200	37,200	15,200

Vegetable oil feedstock present processing challenges

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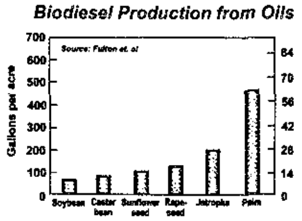
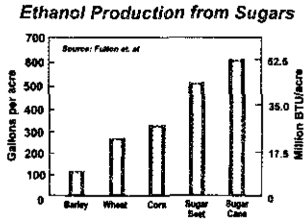
Current Biofuels Production

UOP A Honeywell Company

Biodiesel Production from Oils



Ethanol Production from Sugars



	Soy (million acres)	*Corn (million acres)*
Total US	75	80
20% Gasoline Substitution		130
20% Diesel Substitution	130	

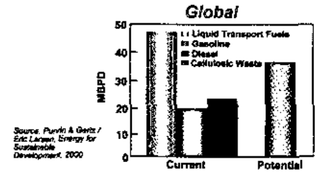
Equivalent to the Land Mass of ~CA, IN, NV, MI

10

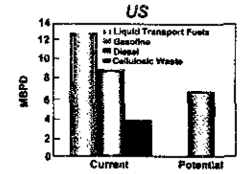
Enablers for a Sustainable Biomass Infrastructure

UOP A Honeywell Company

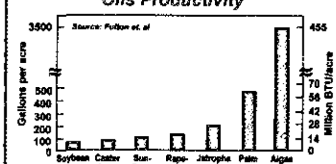
Global



US



Oils Productivity



- Cellulosic waste could make a significant contribution to liquid transportation pool.
- Algal Oils could enable oils route to biodiesel, Green Diesel and JP-8 (military jet fuel).

Increases Availability, Reduces Feedstock Cost
Technology Breakthroughs Required

11

Biofuels Strategy

UOP A Honeywell Company

Fuel Additives / Blends: Ethanol | Biodiesel

Fuels: Diesel | Gasoline

UOP's Bio-Fuels Technology Goals

Identify and utilize processing, composition, and infrastructure synergies to lower capital investment, minimize value chain disruptions, and reduce investment risk.

Generation 1

- Vegetable oils and greases to diesel, gasoline and JP-8 (military jet fuel)
- Flexible, hybrid technologies
  - Capability to process fossil and bio feedstock

Generation 2

- Lignocellulosic biomass and algal oils to fuels
- Process Integration
  - Flexible feedstocks
  - Combined fuel, power and chemicals production

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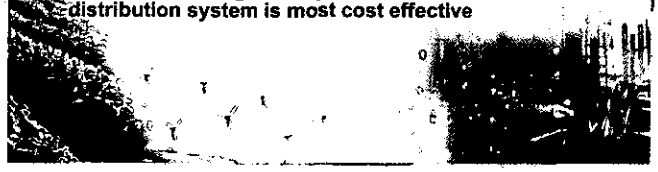
Why Consider Renewable Fuels in Refineries?

UOP A Honeywell Company

- Renewables are going to make up an increasing share of the future fuels pool
- Allows the refiner to control the quality of the renewable blending components required to meet mandates
- Provides a source of high quality diesel blendstock
- Generates future CO_2 credits
- Energy security – utilizes domestic feedstocks
- Using the existing refinery infrastructure and fuels distribution system is most cost effective



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Biorenewables in Oil Refineries

UOP A Honeywell Company

- ...m cost and
- v... ...ability
- ...andates and Inc...
- GHG emissio...

- ...ility
- ...rats
- Transportation
- Composition

Need

- Profitable Processing Options

Approaches

- Stand alone options
- Co-processing options
- Hydrogen generation
- Higher value products

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Biomass Processing Routes

UOP A Honeywell Company

Feed	*Process*	*Product*
Methanol, Vegetable Oil	Biodiesel	Biodiesel, Glycerol
H_2, Vegetable Oil	Ecofining™	Green Diesel
Vegetable Oil	Catalytic Cracking	Green Gasoline, Green Olefins
Pyrolysis Oil	Hydro-processing	Green Gasoline, Green Diesel
Lignocellulosic Waste	Hydro-processing	Green Fuels, Green Chemicals

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Palm Oil Processing Routes

UOP A Honeywell Company

Feed	*Process*	*Product*
Methanol, Palm Oil	Biodiesel	Biodiesel, Glycerol
H_2, Palm Oil	Ecofining™	Green Diesel

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UOP/Eni Ecofining Process Development Objectives

UOP A Honeywell Company

- Joint development of UOP and Eni
- Develop a processing route to convert any vegetable oil to high quality diesel
  - Economic
  - Feedstock flexible
  - Sustainable
  - Leverages refinery assets and infrastructure

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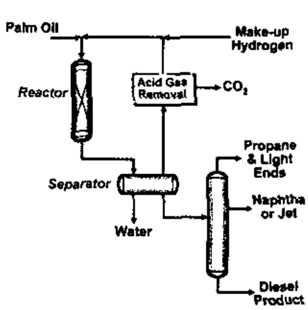
Processing Palm Oil with the Ecofining Process

UOP A Honeywell Company



- Upgrades palm oil using hydroprocessing and isomerization
- Product is an high cetane diesel blending component
- Hydrocarbon product, not an oxygenated compound
- Co-production of propane, naphtha, and high quality jet fuel possible
- Standalone system enables control of cloud point and cetane as well as seasonal variance

Higher Saturate content lends to lower H2 consumption

UOP 4806-29

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Ecofining Process Performance

UOP A Honeywell Company

Feed	
Palm Oil, wt-%	100
Hydrogen, wt-%	1.5-3.8
Products	
Naphtha, vol-%	1-10
Diesel, vol-%	88-97
Cetane Number	> 80
Sulfur, ppm	< 1

Water and CO_2 also produced as deoxygenation products

UOP 4806-22

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Green Diesel Fuel Properties

UOP A Honeywell Company

	Petroleum ULSD	*Biodiesel (FAME)*	*Green Diesel*
Oxygen Content, %	0	11	0
Specific Gravity	0.84	0.88	0.78
Sulfur content, ppm	<10	<1	<1
Heating Value MJ/kg	43	38	44
Cloud Point, °C	-5	-5 to +15	-30 to -10
Distillation, °C	200 to 350	340 to 355	265 to 320
Cetane	40	50-65	70-90
Stability	Good	Marginal	Good

- **Superior fuel properties**
- ***Compatible with petroleum diesel***
- **Compatible with conventional diesel engines**

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Green Diesel Blending Benefits

UOP A Honeywell Company

Diesel Pool Components	*Barrels in Pool*	*Cetane Index*
Kerosene	500	41
Straight Run Diesel	7500	52
Hydrotreated LCO	2000	20
Green Diesel	2346	74
Average Cetane		50

Required Diesel Cetane: 50 min
LCO Quantity Blended: 2000 bbl/day
LCO Uplift ($4.60/bbl): $9200/day
Green Diesel Benefit: *$3.90/bbl*

- **Green Diesel has a high cetane and is similar to GTL diesel**
- **Cold flow properties are controlled by paraffin isomerization**
- **These properties make Green Diesel a premium blending component**
- ***Permits blending low value*** **LCO into ULSD or a reduction in cetane enhancing additives**

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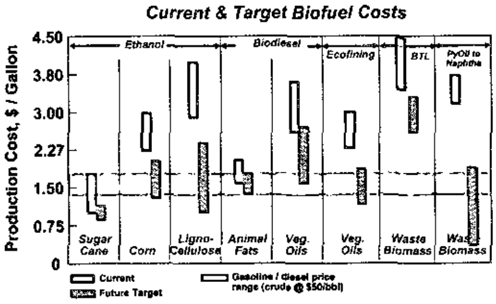
Economics: Current and Future Targets

UOP A Honeywell Company

Current & Target Biofuel Costs



Breakthroughs Required to Create Economically Viable Biofuels Infrastructure

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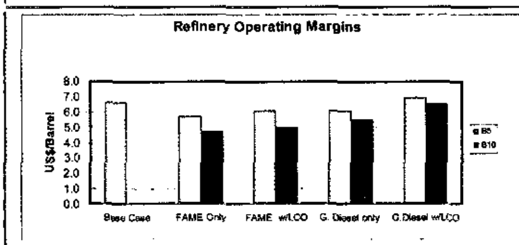
LP Blending Study: Summary for 150 KBPD Refinery

UOP A Honeywell Company

Refinery Operating Margins



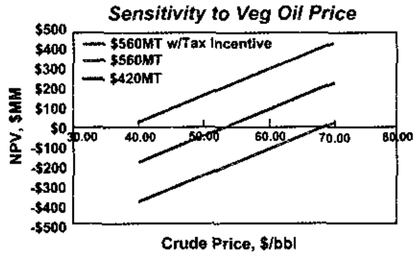
- 150K BPD European Refinery configuration with FCC & HCU
- Refinery processes a mix of Mid-East crudes
- Product slate per EU norms, EN 590 for diesel
- LP Calculates operating margins for base case
- B5 and B10 blends based on purchased FAME/Green Diesel and/or with LCO addition
- LP results show Green diesel blends w/LCO generate highest margins
- LP also shows that margin premium of Green Diesel over FAME is
  - ~$40MM annually for B5
  - ~$80MM annually for B10

23

Ecofining Process Economics

UOP A Honeywell Company

Sensitivity to Veg Oil Price



- **Palm oil ($420/MT, $1.47/gal): Profitable at crude > $52/bbl**
- **Soy oil ($560/M , $1.96/gal): Profitable at crude > $67/bbl**
- **Soy oil w/ $1/gallon subsidy: Profitable at crude > $38/bbl**

Driven by Feedstock Cost

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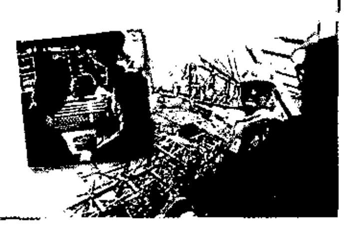
UOP/Eni Ecofining Process Commercialization Status

UOP A Honeywell Company

- **Intensive co-development program with Eni *since 2005***
- **Basic engineering design completed 2Q07**
- **First commercial unit start-up in 2009**

Eni



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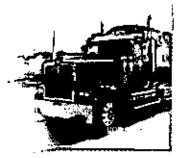
Life Cycle Analysis for Renewables Processing

UOP A Honeywell Company

- Scope: from extraction through combustion (in transportation use)
- Functional Unit: 1 kg of each fuel
  - Assumption: Each fuel performs the same in transportation use
- Primary Focus: fossil energy consumption and emission of GHG, though other impact categories are included



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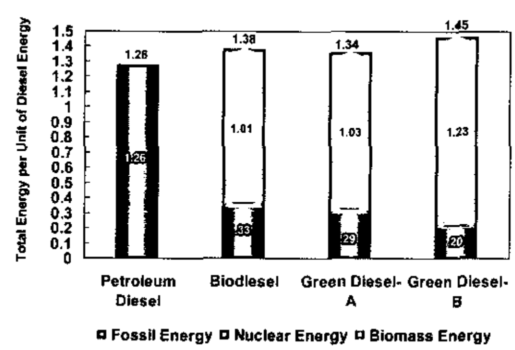
Total Energy Comparison

UOP A Honeywell Company



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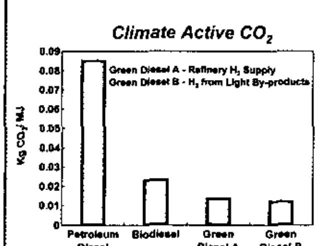
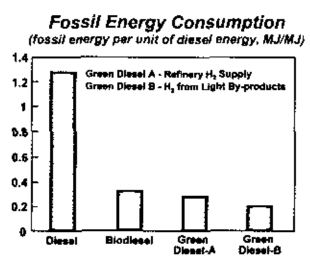
Comparison of Climate Active CO_2 & Fossil Energy Consumption

UOP A Honeywell Company





Ecofining has smallest footprint

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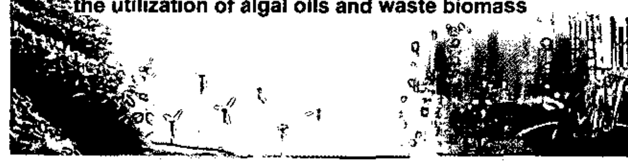
Summary

UOP A Honeywell Company

- Refiners are well positioned to play a major role in renewable diesel production
- UOP and Eni are licensing the Ecofining Process to produce diesel from vegetable oil and greases in refineries
- Green Diesel has superior fuel properties
- The Ecofining Process is more sustainable and has better economics
- Longer term, technology development focused on the utilization of algal oils and waste biomass



SESSION 4-4:

EMERGING TECHNOLOGIES FOR BIOFUELS PRODUCTION AND THEIR ASSESSMENT

S. Miertus[1], S. Arumugam[1], S. Zinoviev[1], P. Fornasiero[2], F. Mueller-Langer[3]
International Centre for Science and High Technology-UNIDO[1], Italy,
University of Trieste[2], Italy
Institute for Energy and Environment[3], Germany

One of the key issues of sustainable industrial development is the transition from fossil to renewable feedstocks in various industrial sectors such as energy, fuel and chemicals production. The need for new and efficient technologies for the production of biofuels as well as bio-based products (chemicals, plastics, etc) is now being recognized, focusing on the second and third generation of biofuels. Opportunities for further development and optimization of biomass to biofuels conversion technologies are represented by the concept of bio-refineries and the process of bio-waste conversion into high value-added products. The integrated approach to biomass exploitation is expected to have a significant impact on both economic and environmental issues.

Although most of the technologies involving the first generation of biofuels starting from crops as feedstocks and leading to the production of bioethanol or biodiesel have already been commercialized, it should be stressed that there is still a great need for technology development and technological innovation, for instance, for better catalysts. Another dimension of development of renewable energy technologies lies in the development of hydrogen from biomass. Hydrogen is widely considered the energy of the future although more time is required for technologies to be developed for commercial use and different systems and infrastructures for distribution and use.

In the second part of this presentation, the concept of assessment of biofuel production technologies is presented. Various technologies can be assessed and compared taking into account their technical characteristics together with their impact on both the economy and the environment. A slide illustrates a comparison of some of the emerging second generation technologies, indicating where the technology stands in its development process, its complexities in development, expected plant capacity when it has been successfully developed and compatibility with the existing distribution infrastructure and use. The decision support tools (DST) for assessment of emerging technologies for biomass conversion are currently under development at the UNIDO International Centre for Science and High Technology (ICS). In particular, a DST concept for assessment of biofuel production technologies is presented. The tentative approach to the development of DST is based on technical, environmental and economic assessment of various scenarios for exploitation of different bio-resources incorporating more than 40 parameters for selection and evaluation of optimal technology.

In the context of assisting developing countries to accelerate their sustainable development, transfer of technology is just as important an issue for ICS as is its development. We see some problems in this area, including a lack of sustainability analysis and scenario planning, a lack of capacity for technology adaptation, technology gaps, patent/licensing fees as barriers, the lack of an integrated approach to technology adaptation and so forth.

In the third part of the presentation, I intend to discuss the component of the ICS program focusing on capacity building and promotion of collaborative projects with developing countries. ICS's mandate is transfer of knowledge in the applied sciences and technologies to developing countries operating in a complementary manner with UNIDO's global programs to ensure synergy. ICS focuses on three technical areas: i) Pure and Applied Chemistry, ii) Earth, Environment and New Materials and iii) High Technology and New Materials. In the ICS program on biofuels and chemicals from renewable resources, the cooperation projects with Malaysia are taking place in the field of emerging technologies for biodiesel production from palm oil, glycerol valorization, and waste biomass exploitation. Other initiatives being promoted included projects on biodegradable plastics from renewable resources in China and assessment of the technologies for the use of local bio-feedstocks in selected African countries.

(Stanislav.Miertus@ics.trieste.it)

1

ICS UNIDO

EMERGING TECHNOLOGIES FOR PRODUCTION OF BIOFUELS AND BIOBASED PRODUCTS & ICS-UNIDO PROGRAM ON RENEWABLES

ICS-UNIDO, Trieste, Italy & IEE, Leipzig, Germany

International Conference on BIOFUESLS,
Malaysia, 5-6 July 2007

2

ICS UNIDO

Content

- Introduction/drivers for green technologies
- Biofuel production technologies (1st, 2nd, and 3rd gen.)
- Biogas/hydrogen technologies
- Biowaste and by-products valorisation
- Comparison of technologies
- Decision Support Tools
- Problems
- ICS-UNIDO biofuel initiatives

3

ICS UNIDO

Technology development drivers

- Displacement of fossil fuel depletion
- Diversification of feedstocks
- Feedstocks renewable in short time (plant and animal)
- Meet Kyoto Protocol
- Integrated development of agriculture and industry
- Improvement of social economic conditions

Problems/Risks : Will be discussed later .

4

ICS UNIDO

Overview of Biofuel Production Technologies

First Generation of Biofuels

Biodiesel	Biodiesel from energy crops: Methyl ester of vegetable oils, fatty acid methyl/ethyl ester (FAME/FAEE) Biodiesel from waste FAME/FAEE	Oil crops (e.g. rape seed, palm, soy, canola, Jatropha, castor etc) Waste/cooking/frying oil	Cold and warm pressing/extraction & transesterfication (homogeneous, heterogeneous, and bio catalysis) Hydroprocessing
Bioethanol	Conventional bioethanol	Sugar beets, grains	Hydrolysis & fermentation
Pure vegetable oil	Pure plant oil (PPO)	Oil crops (e.g. rape seed, palm, soy, canola, Jatropha, castor etc)	Pressing/extraction Post-treatment
Biogas	Upgraded biogas	(Wet) biomass	Anaerobic digestion

5

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Overview of Biofuel Production Technologies

Second/Third* Generation Biofuels

Bioethanol	·Cellulosic bioethanol	·Lignocellulosic biomass and Residues	Advanced hydrolysis & fermentaion
Synthetic biofuels	·Biomass to liquid (BTL) ·Fischer-Tropsch (FT) diesel ·Synthetic (bio)diesel ·Biomethanol ·Heavier (mixed) alcohols ·Biodimethylether (Bio-DME)	·Lignocellulosic biomass and residues	Flash pyrolysis, gasification, synthesis
Biogas	·SNG (Synthetic Natural Gas)	·Lignocellulosic biomass and Residues	Pyrolysis, gasification
Biohydrogen		Lignocellulosic biomass And Residues	Gasification & Synthesis or Biological Process

*IIIrd Generation refers to the use GMF/Production of biofules

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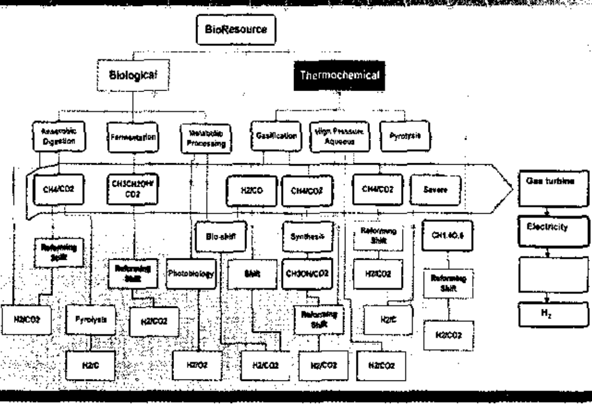
Biogas/Hydrogen production from biomass (Emerging Technologies)



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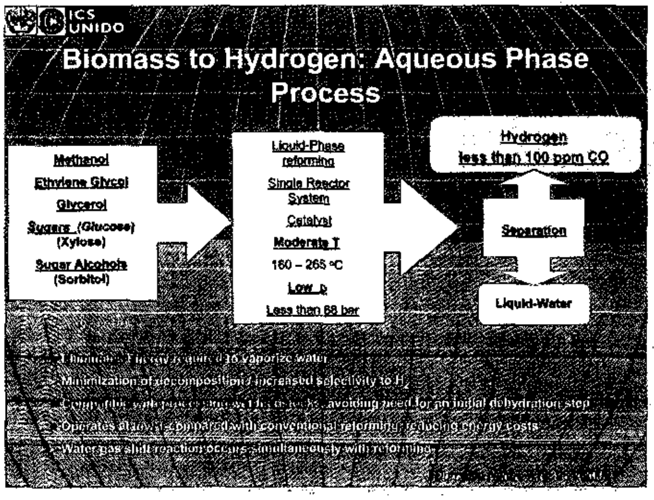

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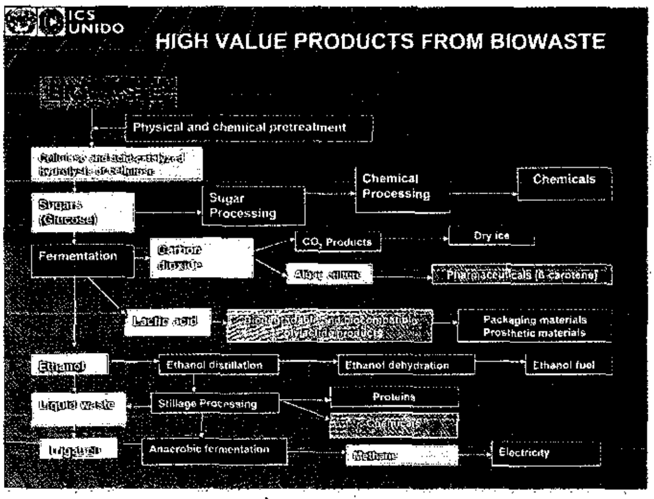

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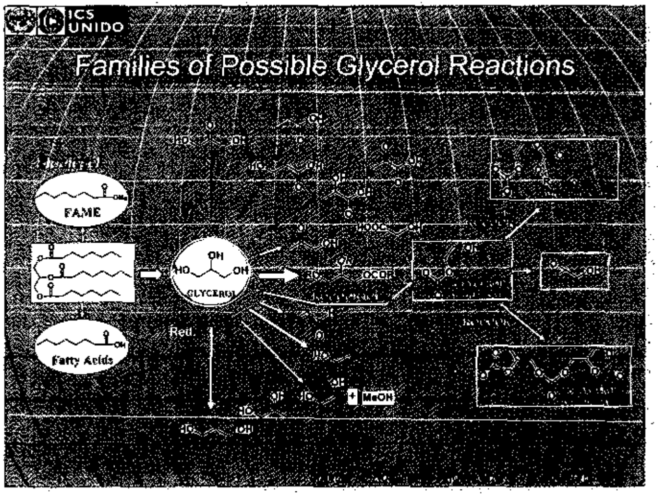

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Comparison of technologies
Technology aspects

	Current stage of development		Techn. Effort[a]	Expected plant capacity[b] [MW_{th}]	Overall efficiency[c] [%]	Distri-bution[d]	Use[d]
Biofuel option 2[nd] generation	Concept / Lab	Pilot/ Demo		10........................1,000	0.................................80		
Liquid							
Bioethanol			++	[illegible]	[illegible]	+++	+++
FT-Fuels			+	[illegible]	[illegible]		
Methanol			++	[illegible]	[illegible]		
Gaseous							
Biogas			++++	[illegible]	[illegible]		
Bio-SNG			+++	[illegible]	[illegible]	+++	+++
Dimethylether			++	[illegible]	[illegible]	++	++
Hydrogen			++(+)	[illegible]	[illegible]	+	+

[a] regarding system complexity (+ less promising....++++ very promising)
[b] related to biomass feedstock
[c] according state of development (many different concepts) only theoretical values
[d] suitability for current distribution and use (+ less promising....++++ very promising)

Many different concepts for biofuel options of the 2nd generation, associated with appropriate benefits and bottlenecks along the pathway.

11

ICS UNIDO

DST concept
Biofuel/biofuel production technology selection criteria

- Technological criteria (energy content, non renewable energy consumed, availability, carbon residue, sulfur content, viscosity, density, efficiency, scale, ...)
- Financial criteria (static, dynamic, risk, ...)
- Environmental criteria (CO_2, CO, NO_x, SO_2, etc.)
- Socio-economic criteria

Technology evaluation is performed within a defined boundary

12

ICS UNIDO

DST for biofuel assessment and selection (AFTUR project – EU/CEE countries)

Considered biofuels:
- Vegetable oils (rapeseed)
- Esters (Rapeseed Methyl Ester – RME)
- Flash pyrolysis oils
- Gasification from wood
- Waste methanization
- Slow pyrolysis (EDITTh process)

- Criteria for assessment (49 criteria total):
  - Technological criteria
  - Environmental criteria
  - Financial criteria (static, dynamic, risk)
  - Socio-economic criteria

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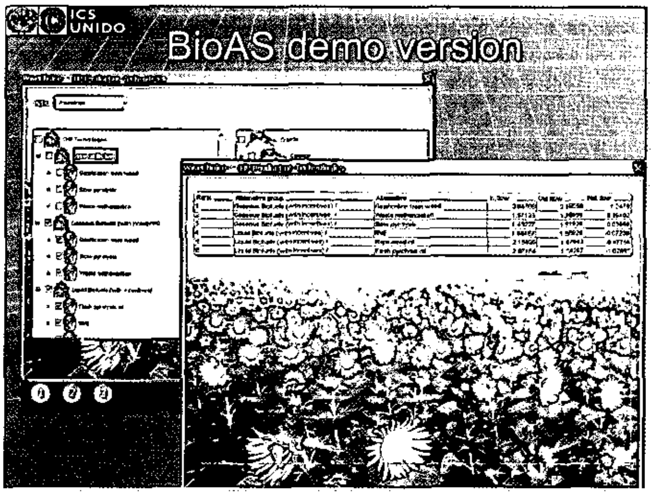

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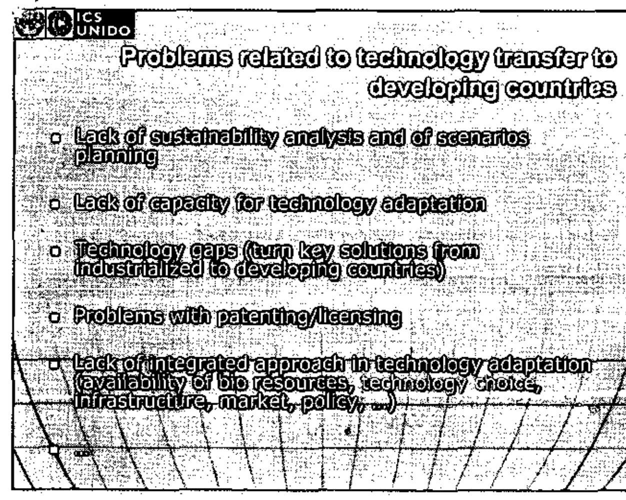

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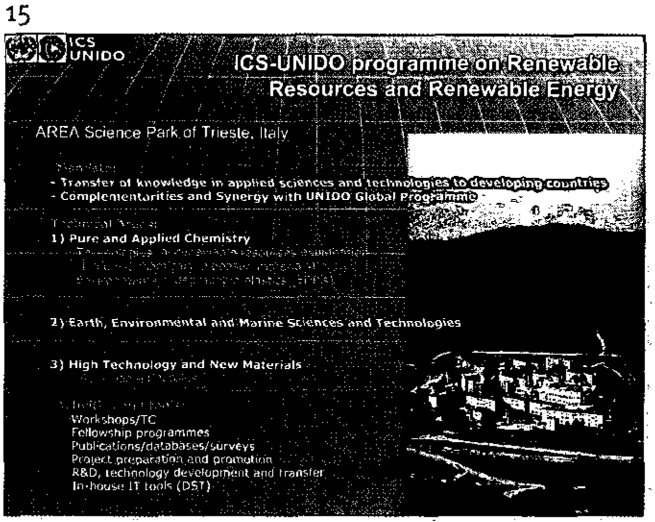

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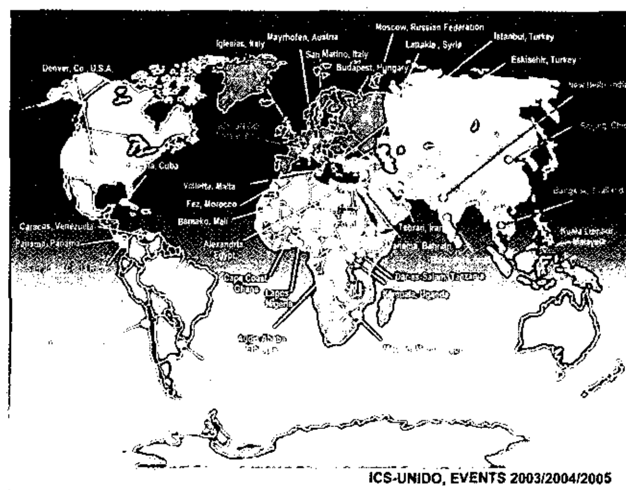

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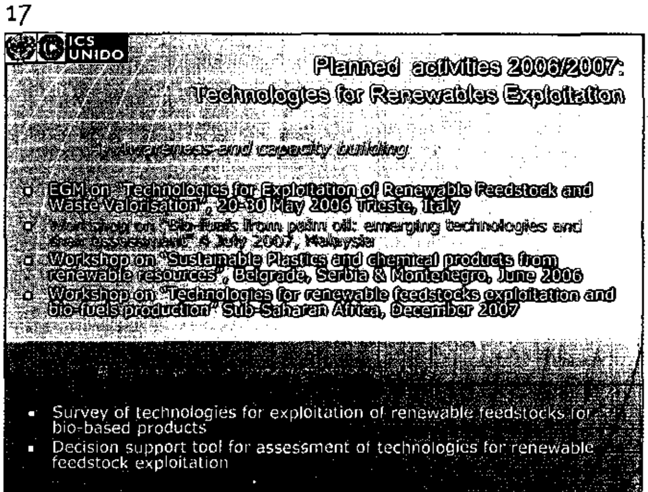

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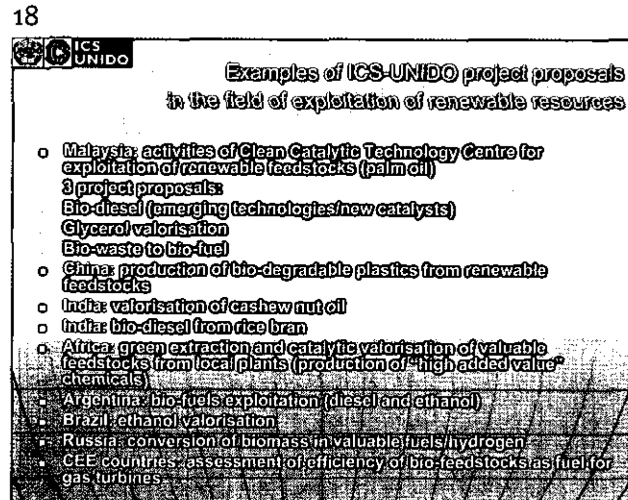

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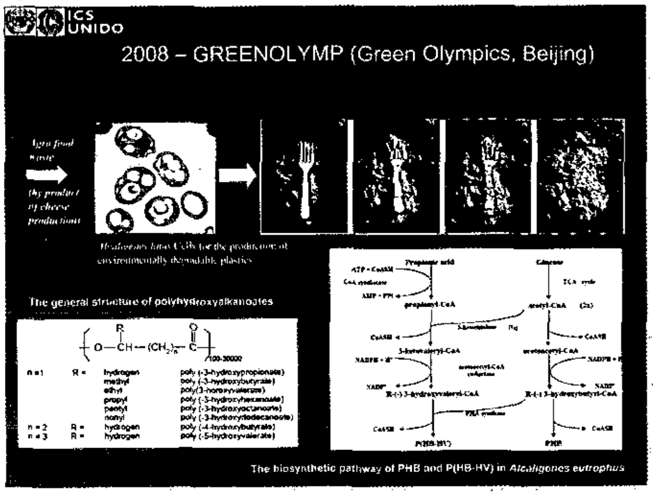
ICS UNIDO
2008 – GREENOLYMP (Green Olympics, Beijing)
The general structure of polyhydroxyalkanoates
The biosynthetic pathway of PHB and P(HB-HV) in Alcaligenes eutrophus

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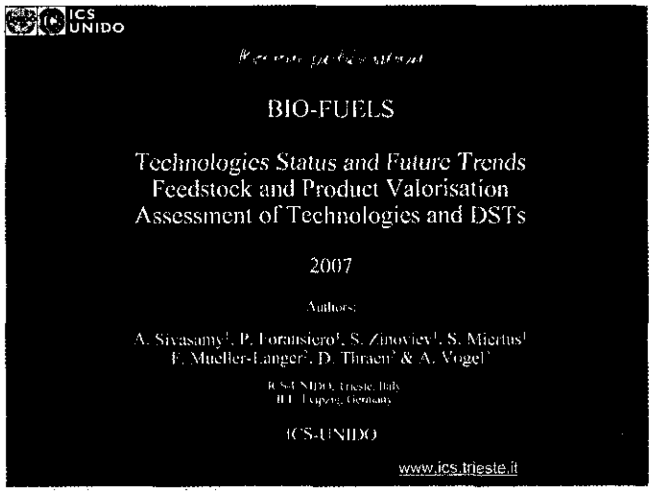
ICS UNIDO
BIO-FUELS
Technologies Status and Future Trends
Feedstock and Product Valorisation
Assessment of Technologies and DSTs
2007
Authors:
A. Sivasamy[1], P. Foransiero[1], S. Zinoviev[1], S. Miertus[1]
F. Mueller-Langer[2], D. Thraen[2] & A. Vogel[2]
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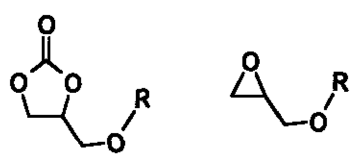
THANK YOU
Stanislav.Miertus@ics.trieste.it
www.ics.trieste.it

SESSION 4-5:

VALORIZATION OF GLYCEROL: TECHNOLOGICAL PERSPECTIVE AND INNOVATIONS

A. Citterio, G. Leonardi and S. Auricchio
Politecnico di Milano, Italy

The growing interest for green fuels derived from vegetable resources (biomass) has opened new relevant problems of "waste products" with related disposal cost. For example, the worldwide surplus of glycerol generated in the biodiesel production resulted in the shutdown of traditional plants that produce or refine glycerol and in the development of environmentally acceptable glycerol combustion processes. Finding value-added alternatives to simple incineration of biofuel by-product would assist with the environmental benefits and economic viability of biofuel manufacture and supply chain, opening several areas for biorefinery opportunities. Material and energy balance of biofuels can be in fact strongly improved by cascade process integration of by-products and residues devising new products and new unconventional energy sources. The complex composition of biofuel feedstocks in this context is an added value allowing to maximize the number and value of products from the biofuel/biorefinery plants. Because the margins on consumer products, pharmaceuticals, and health foods are generally higher than those for industrial products or platform chemicals, the growth market for these processing will probably be in consumer product industries.



In this context, the different potentialities of glycerol as next C3 platform chemical for the biofuel industry is discussed providing a brief overview of recent industrial and research trends. About 1600 uses were identified in the 2005 for glycerol and despite the large differentiation of existing outlets, the development of glycerol demand in these traditional fields depends mainly on final users, whereas is of concern of researchers the identification of new applications. The role of glycerol as green solvent is therefore briefly analyzed and its role as cryoprotecting agent is discussed, then examples of oxidative and reductive chemical or biochemical selective activation of glycerol are presented and green metrics of alternative methods of protection/deprotection of OH group are introduced. New approaches to the syntheses of chiral derivatives from the achiral glycerol are also briefly analysed.

In the second part of this presentation, special emphasis is posed on glycerol activation through insertion of the carbonate or epoxy units in the C3 glyceryl skeleton and subsequent nucleophilic O/O, O/N and O,S substitution. The chemistry of glycerol mono-, di- and tricarbonate is revised and the synthetic potentiality of this class of compounds is discussed, along with a direct approach to the synthesis of glycerol carbonate alcanoates from vegetable oils and glycerol tricarbonate and of monoacylglycerols by selective hydrolysis of these last compounds. A special emphasis is posed on the use of microwave irradiation in the presence of silica gel for selective functionalizations. New strategies to access aminoglycerols, i.e. serinol and isoserinol derivatives, and related oxazolidinones are presented. From these intermediates rape, castor, tallow and coconut fatty acids amides can be developed with good emulsifying performances useful as agrochemical adjuvants, whereas condensation reactions with isocyantes and esters can afford useful polyurethanes and polycarbonates with controlled molecular shape. The potentiality of O-Alkyl derivatives (i.e. glycerol acetals and ketals) as oxygenated additives for diesel fuels to improve performance and reduce particulate is also stressed.

In the third part of the presentation, some key aspects related to the potentiality to obtain glycerol-based linear or hyperbranched polymers are highlighted and the possibility the develop stereocontrolled polyglycerol is discussed starting from isomeric linear diglycerol dicarbonates.

(attilio.citterio@polimi.it)

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2007 International Conference on Biofuels
Kuala Lumpur (Malaysia)
2-4 July 2007

VALORIZATION OF GLYCEROL - TECHNOLOGICAL PERSPECTIVES AND INNOVATIONS

Attilio Citterio
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Via Mancinelli, 7 – 20131 Milano (ITALY)

2

KEY POINTS COVERED

KEY POINTS:

- BIOFUEL COPRODUCTS
- GLYCEROL
  Research and Industry trends.
- GLYCEROL CARBONATES
  Versatile chemistry.
- POLYGLICEROLS
  Uses and derivatives.
- AMINOGLICEROLS
  Perspectives through glycidol.

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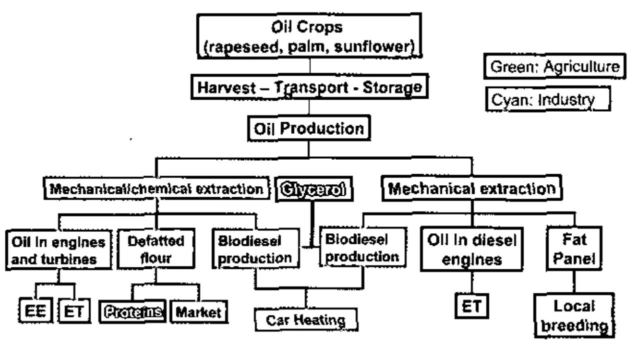
BIODIESEL CHAIN



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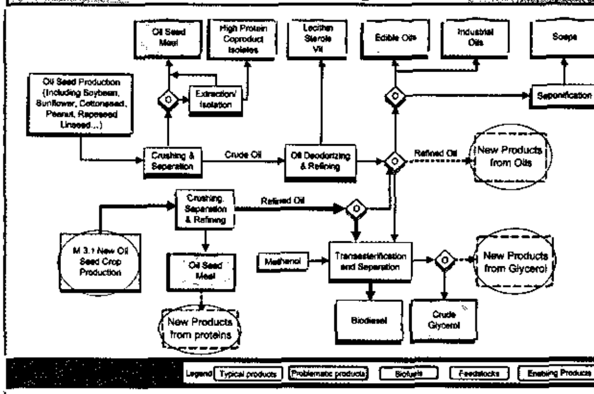
Existing Natural Oil Processing Mill Improvements Pathway to Chemicals



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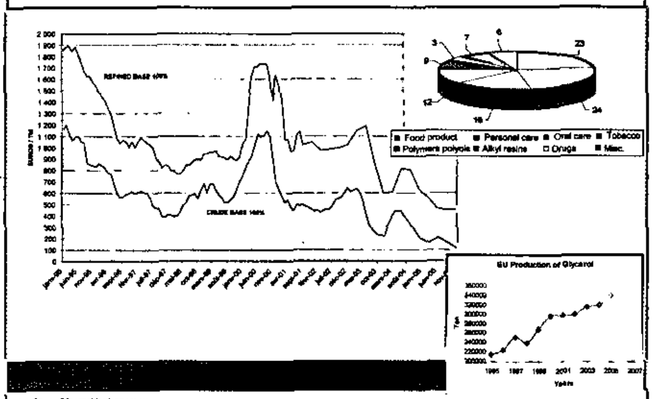
Glycerol Price, UE Production and Uses



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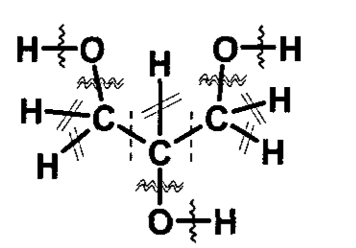
Quite Versatile Chemical



- OH Substitution
  - Etherification
  - Esterification
  - Carbamoylation ...
- Oxidation / dehydr.
  - Ketone
  - Aldehyde
- Subst. / Hydrog.
  - X-substitution
  - C-H bond formation
- C-C fragmentation
  - Reductive
  - Oxidative

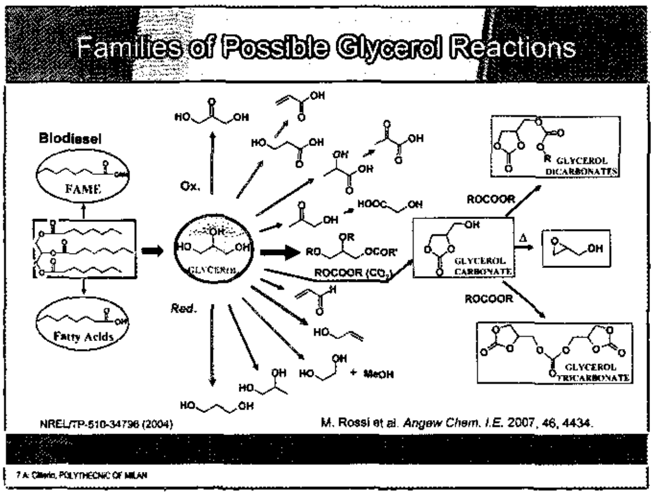
Peculiarity:

- Selectivity in bond activation/ breaking (prim./sec.)
- Cascade reactions (i.e. H_2O elimination)
- **Complex biochemical reactivity (metabolite)**
- Green solvent*

More than 3000 uses: ***chemistry developed mainly on OH substitution, oxidations and eliminations***

*A. Wolfson, C. Dlugy, Y. Shotland *Environ Chem Lett* (2007) 5:67–71

7


Families of Possible Glycerol Reactions
Biodiesel
FAME
Ox.
Red.
Fatty Acids
GLYCEROL
ROCOOR
ROCOOR (CO2)
GLYCEROL CARBONATE
GLYCEROL DICARBONATES
GLYCEROL TRICARBONATE
+ MeOH
NREL/TP-510-34796 (2004)
M. Rossi et al. Angew Chem. I.E. 2007, 46, 4434.
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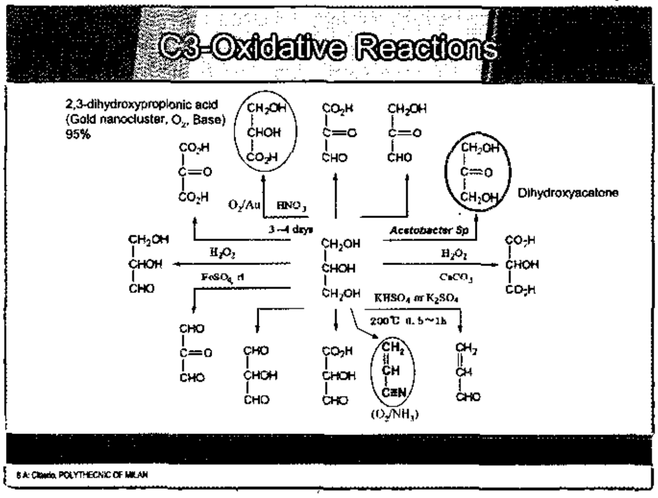
C3-Oxidative Reactions
2,3-dihydroxypropionic acid
(Gold nanocluster, O2, Base)
95%
Dihydroxyacetone
Acetobacter Sp
3~4 days
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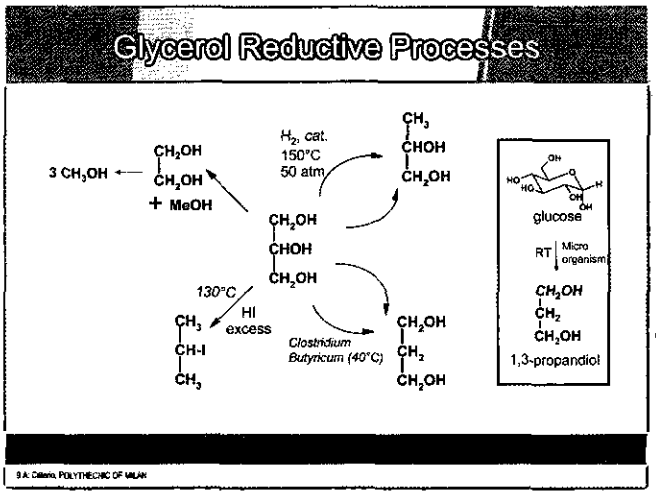
Glycerol Reductive Processes
3 CH3OH
+ MeOH
H2, cat.
150°C
50 atm
130°C
HI
excess
Clostridium
Butyricum (40°C)
glucose
RT
Micro organism
1,3-propandiol
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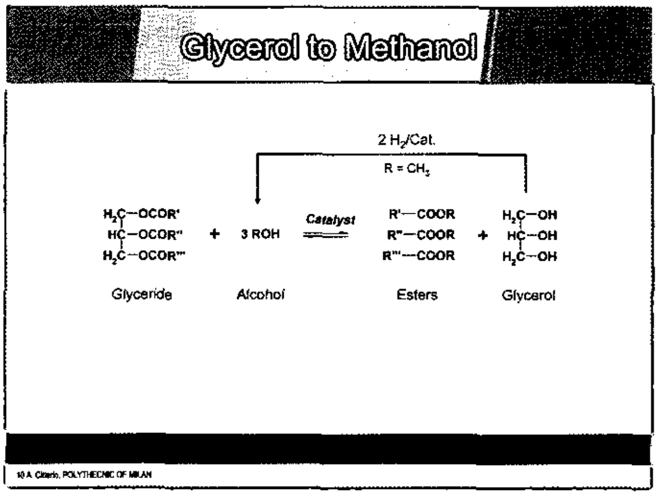
10


Glycerol to Methanol
2 H2/Cat.
R = CH3
Catalyst
+ 3 ROH
Glyceride
Alcohol
Esters
Glycerol
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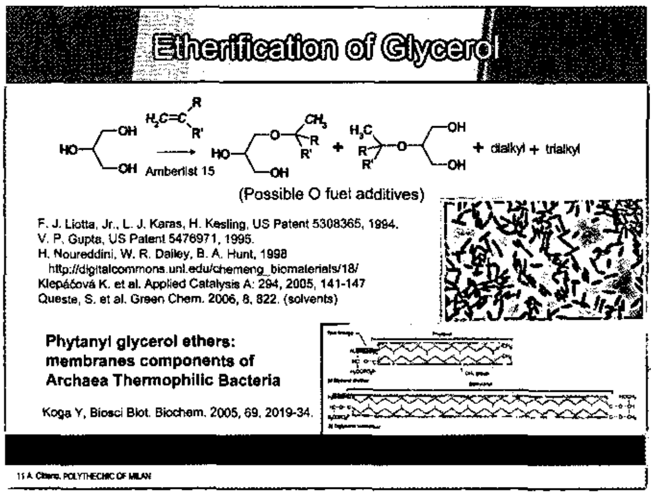
11


Etherification of Glycerol
Amberlist 15
+ dialkyl + trialkyl
(Possible O fuel additives)
F. J. Liotta, Jr., L. J. Karas, H. Kesling, US Patent 5308365, 1994.
V. P. Gupta, US Patent 5476971, 1995.
H. Noureddini, W. R. Dailey, B. A. Hunt, 1998
http://digitalcommons.unl.edu/chemeng_biomaterials/18/
Klepáčová K. et al. Applied Catalysis A: 294, 2005, 141-147
Queste, S. et al. Green Chem. 2006, 8, 822. (solvents)
Phytanyl glycerol ethers:
membranes components of
Archaea Thermophilic Bacteria
Koga Y, Biosci Biot. Biochem. 2005, 69, 2019-34.
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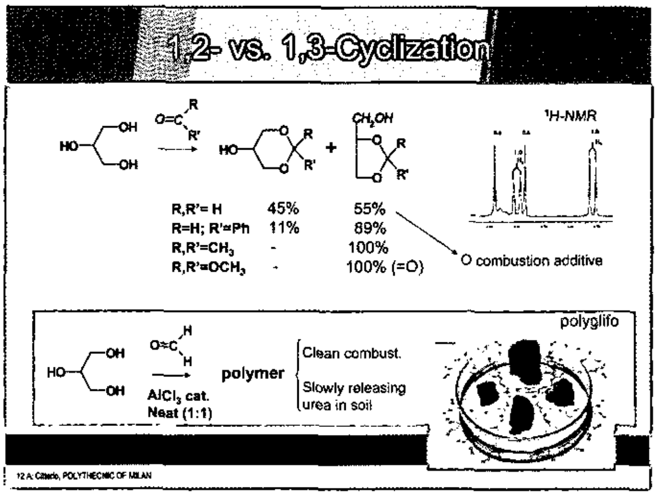
1,2- vs. 1,3-Cyclization
1H-NMR
R,R'= H 45% 55%
R=H; R'=Ph 11% 89%
R,R'=CH3 - 100%
R,R'=OCH3 - 100% (=O)
O combustion additive
polyglifo
polymer
AlCl3 cat.
Neat (1:1)
Clean combust.
Slowly releasing urea in soil
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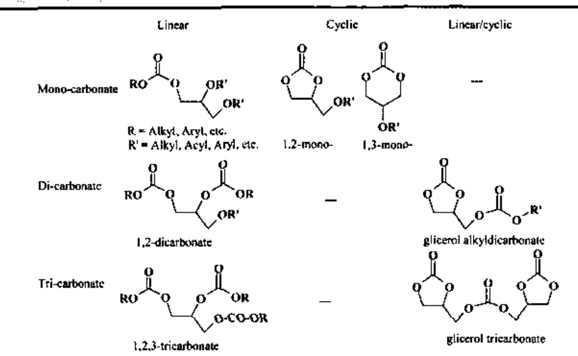
Glycerol Carbonate Family



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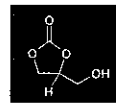
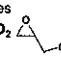
Glycerol Carbonate
(4-hydroxymethyl-[1,3]dioxolan-2-one, GC)



Colorless and odorless liquid
M W, 118.09
Viscosity (cts.), 61.0 a 25 °C
Flash point: > 400 °C
b.p. : 128-131 °C (0,1 mmHg)
DL50: >5000 mg/kg, CL50(fish): 100mg/l*

GC combine two natural resources in a non toxic, eco-compatible compound.

Uses*:

- **Benign solvent (co-formulant)**
- Medical and sanitary field
- Polymer bases for emulsions
- Phenolic resins preparation
- CO_2 separation from gas mixtures
- **Bifunctional intermediates (CO_2 elimination to glycidol)** 

Syntheses:

- **Carbonation** of glycerol (DMC,[1] urea,[2])
- **Carbonation** of glycidol by CO_2
- Oxycarbonylation of glycerol[3]
- Carbonation of epichloridrine
- Deprotection of O-alkylglycerol carbonate
- Reductive dealkylation of O-protected glycerol carbonates

*Huntsman

[1] Bruson, H.; Riener, T. J. Am. Chem. Soc. 1952, 74, 2100. U.S. Patent 2,915,529, 1959. Jp Patent 6-329,663, 1994.
[2] U.S. Patent 6,025,504, 2000. Eu Patent 1,156,042, 2001.
[3] U.S. Patent 5,359,094, 1994. WO04/0528741 A1 (Polimeri Europa); WO02/083626 A2 (Cognis); WO9309111 (Henkel Corp.).
[4] Klein, H.; Marquis, T. (1997) *Coatings world*, 38. Mouloungui, Z.; Pelet S. (2001). *Eur. J. Lipid Sci. Technol.* 103, 216

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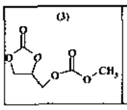
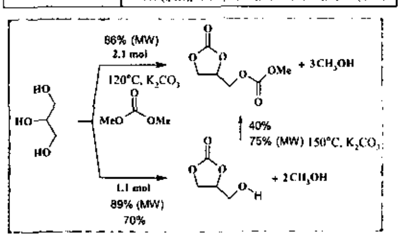
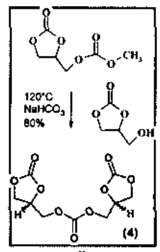
Glycerol Alkyldicarbonate (3) and Glycerol Tri-carbonate (4)

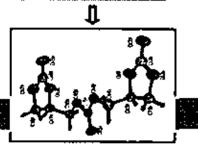
(3)



White colorless and odorless solid
MW : 176
CAS : 76913-29-6
m.p.: 105-106 °C
b.p.: 140-145°C a P= 0,2 mmHg
^{1}H-NMR 400 MHz (($CD_3)_2CO$) δ: 5,123 (m, 1H); 4,686 (t, 1H); 4,484 (dd, 1H); 4,394 (m, 2H); 3,774 (t, 3H).







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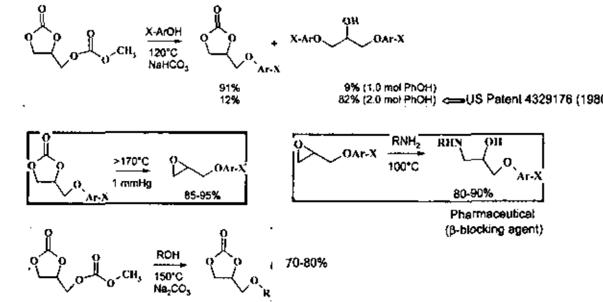
Nucleophilic Substitution on Methylglycerol Dicarbonate



R = Fatty C10-C18

Varka E.M. Et al. Chemistry 2006, 12, pp. 8305-8311.
Blute I. et al. Tensile, surfactants, detergents, 1998, 35, 207

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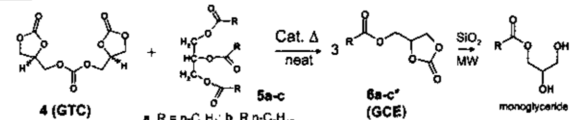
Transesterification of Glycerides by GTC



a, R = n-C_4H_9; b, R n-C_8H_{17}
c, R = fatty acid residue

Compound	Ratio 4:5	T(°C)	Time (h)	Cat. (mol % 5)	6 (Yield %)	Acid No.
6a	1.1	150	4 [12]	$NaHCO_3$(0.5) [-]	72 [6]	1.0
6a	1.1	120	3 (5)	$(n-Bu)_2SnO$ (0.5)	88 (91)	0.2
6b*	1.1 (1.5)	130	12	SnO (0.5)	80 (88)	0.7
6b	1.1	120	4	$(n-Bu)_2SnO$ (0.5)	85	0.3
6c	1.1	140	7	$(n-Bu)_2SnO$ (0.5)	70	1.1

* Previous synthesis
Z. Mouloungui, S. Pelet *Eur. J. Lipid Sci. Technol.* 103, 216 (2001). [GTC prepared from GC and acyl chloride].

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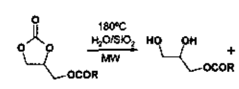
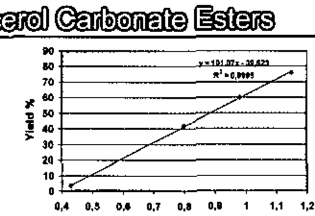
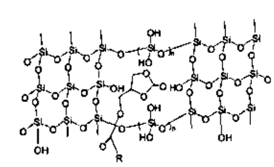
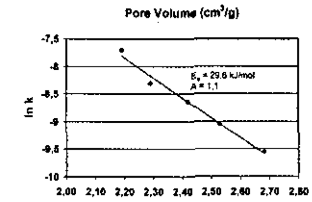
MW-Silica Gel Promoted Selective Hydrolysis of Glycerol Carbonate Esters



$R = C_7H_{15}$
$R = n\text{-}C_{18}H_{37}$







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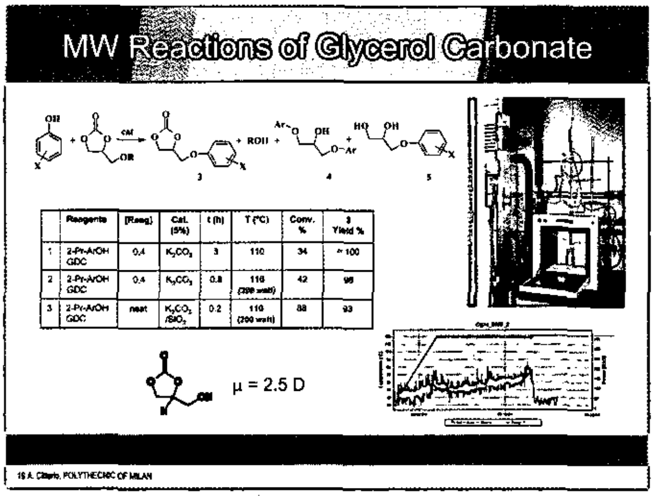
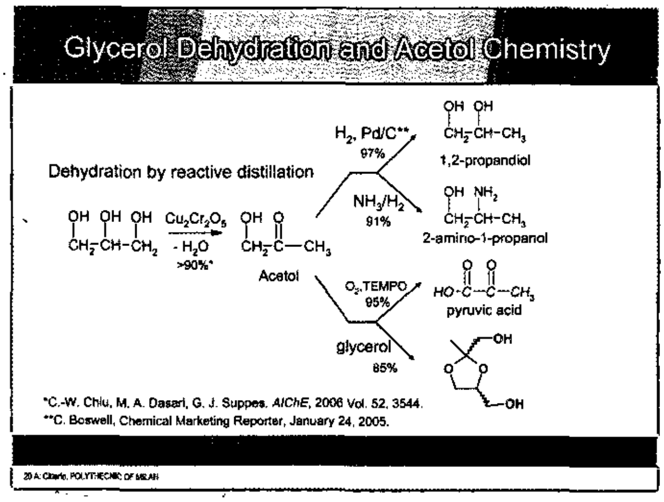
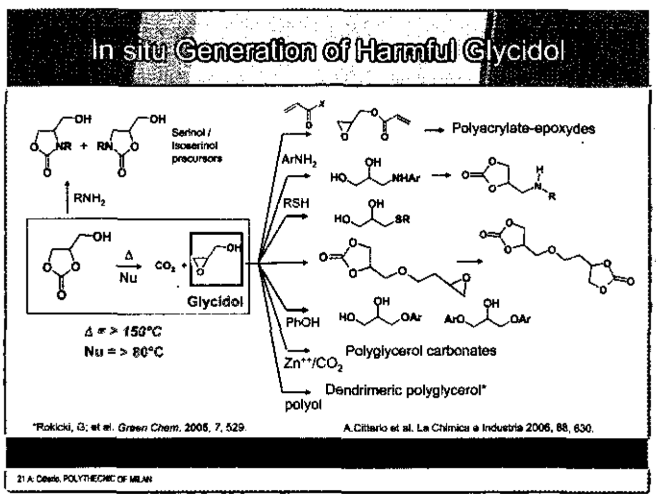


	Reagents	[Reag]	Cat. (5%)	t (h)	T (°C)	Conv. %	3 Yield %
1	2-Pr-ArOH GDC	0.4	K_2CO_3	3	110	34	~100
2	2-Pr-ArOH GDC	0.4	K_2CO_3	0.8	110 (200 watt)	42	95
3	2-Pr-ArOH GDC	neat	K_2CO_3/SiO_2	0.2	110 (200 watt)	88	93

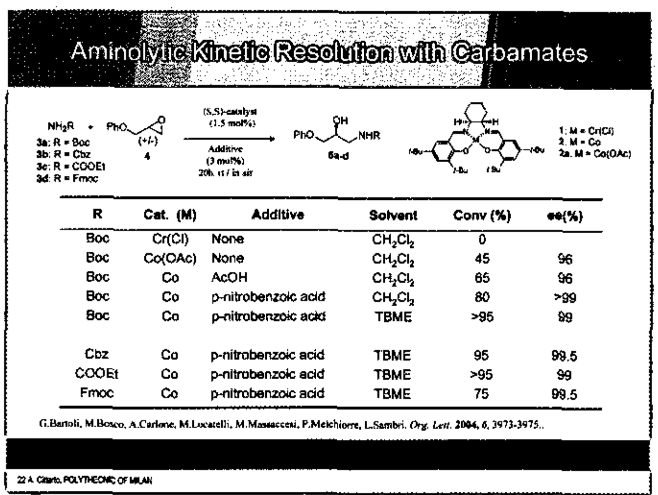
20



21

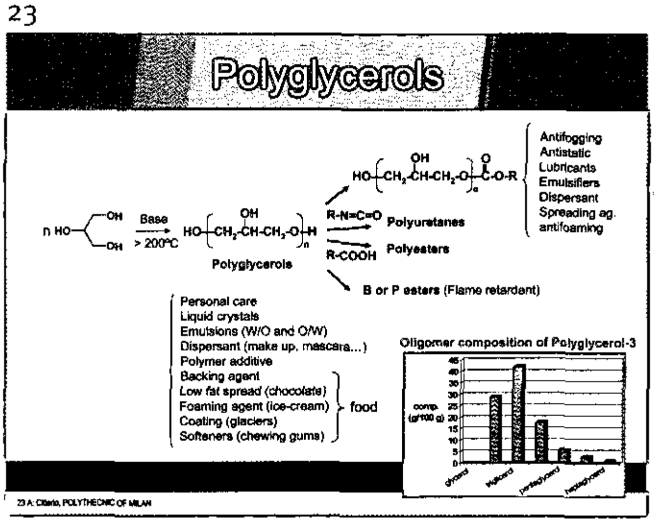


22



R	Cat. (M)	Additive	Solvent	Conv (%)	ee(%)
Boc	Cr(Cl)	None	CH_2Cl_2	0	
Boc	Co(OAc)	None	CH_2Cl_2	45	96
Boc	Co	AcOH	CH_2Cl_2	65	96
Boc	Co	p-nitrobenzoic acid	CH_2Cl_2	80	>99
Boc	Co	p-nitrobenzoic acid	TBME	>95	99
Cbz	Co	p-nitrobenzoic acid	TBME	95	99.5
COOEt	Co	p-nitrobenzoic acid	TBME	>95	99
Fmoc	Co	p-nitrobenzoic acid	TBME	75	99.5

23



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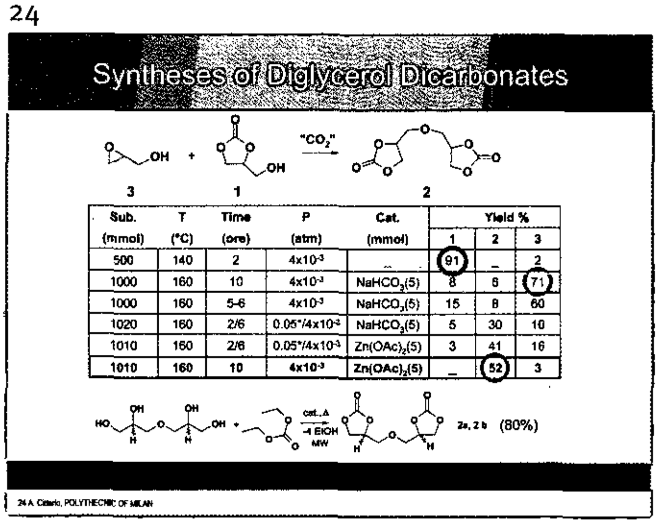

Sub. (mmol)	T (°C)	Time (ore)	P (atm)	Cat. (mmol)	Yield % 1	Yield % 2	Yield % 3
500	140	2	$4x10^{-3}$	–	91	–	2
1000	160	10	$4x10^{-3}$	$NaHCO_3$(5)	8	6	71
1000	160	5-6	$4x10^{-3}$	$NaHCO_3$(5)	15	8	60
1020	160	2/6	$0.05^*/4x10^{-3}$	$NaHCO_3$(5)	5	30	10
1010	160	2/6	$0.05^*/4x10^{-3}$	$Zn(OAc)_2$(5)	3	41	16
1010	160	10	$4x10^{-3}$	$Zn(OAc)_2$(5)	–	52	3

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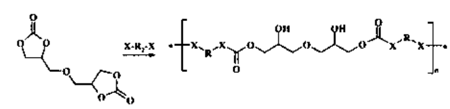
Reactivity of Diglycerol Dicarbonate



Run	X	Catalyst	Time	R	MALDI TOF		
					M_n*	M_w	M_w/M_n
1*	NH_2	-	15	~3	5564	6120	1.39
2*	NH_2	$Zn(O\text{-}iPr)_2$	4	~9	7740	8510	1.10
3*	NH_2	$Ti(O\text{-}iPr)_2$	6	~8	5790	7240	1.25
4*	NH_2	$Al(L)_3$[b]	4	~4	8140	8710	1.07
5*	NH_2	$ZnBr_2$	9	~7	7800	8020	1.13
6**	OH	-	12	2.5	1140	1510	1.33
7**	OH	$Zn(O\text{-}iPr)_2$	4	~7	1580	1820	1.15
8**	OH	$Ti(O\text{-}iPr)_2$	6	~6	1500	1950	1.30
9**	OH	$Al(L)_3$[b]	7	~3.5	1970	2110	1.07
10**	OH	$ZnBr_2$	10	~5	1580	1850	1.17

Reactions were carried out at 80 °C for 1,6-hexanediamine* (X = NH_2) and 120 °C for 1,6-hexanediol** (X = OH) in 1 M dimethoxyethane solutions in closed vessels.

[a]Molecular weights of the product polymers were determined using a Waters 150CV gel permeation chromatograph, equipped with 104, 103, 500, and 100 Å Ultrastyragel columns. THF was used as the eluent, and calibration was performed using polystyrene standards.

[b]The ligand L was synthesised by addition of triphenylmethanol (0.02 mol) at 40°C to a solution triisobutylaluminum (0.01 mol) in toluene during 2h; then adding 1,2-propandiol (0.005 mol) at 40°C and allowing the reaction for other 2h at the same temperature. Evaporation of the solvent and recrystallization from hexane gives the ligand L in 85% yield.

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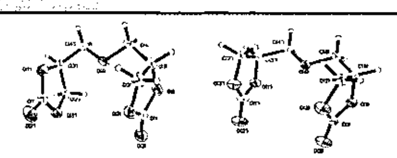
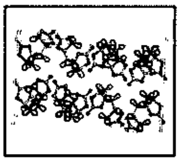
Diglycerol Dicarbonate



R,R-GDC (m.p. 103-4°C) R,S-GDC (m.p. 87-8°C)



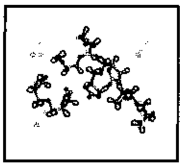


Fig. a: X-Ray single crystals of *d,l*-2c (down) and *meso*-2c' (upper).

d,l-2c: $C_8H_{10}O_7$, Mr = 218.16, m.p. 103-4°C (i-PrOH), orthorhombic, space group Pbca (no. 61), a= 7.8110(10), b = 11.998(2), c = 20.600(3) Å, V = 1930.6(5) Å^3, Z = 8, Dc = 1.501 gcm^{-3}, μ = 1.183mm^{-1}, F(000) = 912; 2206 reflections (1654 unique, R_{int} = 0.1040). The final refinement, for 137 refined parameters and 0 restraints, converged to wR(F^2) = 0.0671 (R_w = 0.1580) for all unique reflections with I > 2σ(I) after merging.

meso-2c': $C_8H_{10}O_7$, m.p. 87-8°C (DME), space group $P2_12_12_1$ (no.19), a = 6.386(5) Å, b =10.031(5)Å, c = 14.889(5)Å, V = 950.8 Å^3, Z = 4, ρ = 1.524g/cm^3 (R_{int} = 0.1425).

Access to stereoordered glycerols?

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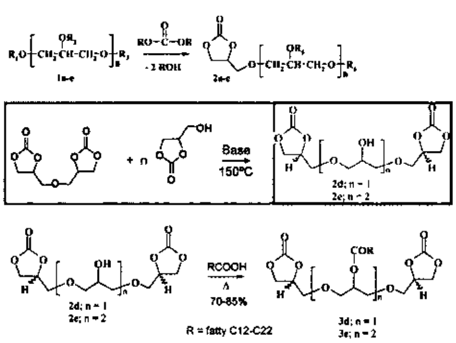
Stereoordered Polyglycerols



Triglycerol dicarbonate
Tetraglycerol dicarbonate

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ACKNOLEDGEMENTS

Research Team

- Prof. Sergio Auricchio
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Thank you

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SESSION 4-6:

THE SUITABILITY OF DIFFERENT BIOGENIC FUELS FOR USE IN MODERN DIESEL INJECTION SYSTEMS

Heinz Stutzenberger
Robert Bosch GmbH, Germany

The necessity to reduce the consumption of fuel in transportation is undoubted. The diesel engine itself contributes to the reduction of consumption by 20-30% relative to gasoline, which leads to reduction of CO_2 emissions of 15-20%. This effect can be further increased by the use of the right diesel fuel of biogenic origin. Biogenic diesel fuels are usually made from oil containing parts of appropriate plants. They differ in the way the pressed oil is treated in the subsequent process steps, which also has a strong influence on the quality of the resulting fuel, as does the plant used for oil extraction. Bosch, which is the world's largest supplier to the automotive industry, develops, produces and sells injection equipment for both gasoline and diesel engines, which uniquely positions the company to interface the fuels and engines. This presentation deals first with the Bosch common rail injection system, followed by a discussion of the characteristics of three different categories of biogenic diesel fuels – plant oil, biodiesel/ fatty acid methyl ester (FAME) and biomass to liquid (BTL) – and their suitability for use in modern fuel injection systems.

Some basic information about the conditions under which an injection system has to work:

- the available injection time of 1.5 milliseconds, which is just about the time available for the discharge of the flash of your camera
- under a pressure of 2,000 bar, which is just about the pressure which would be generated if a medium-sized car parked on your fingernail
- injection quantity of 1 mm^3/stroke, which is just about the volume of a needle head
- 16,000 times per minute for at least 100,000 but mostly for 200-300,000 km.

It is worth remembering that the sliding parts of an injector have clearances of about 2-4 µm, which compares with the diameter of a human hair of about 60µm. To be able to inject and handle fuels under such conditions, the car manufacturers have set up a wish list of fuel characteristics, which may be condensed to a cetane number over 55, a limited amount of aromatics and sulfur in the fuel, good lubricity, no dirt and no water. No admixtures should be allowed, except a maximum of 5% FAME.

Unesterified plant oil can cause deposits on injectors, which deflects the spray direction, reduces the flow, and causes both emission deterioration and torque and power loss. It should be used as refinery feedstock or converted to biodiesel. Although bio diesel/FAME is much more similar to petroleum diesel, problems are encountered regarding its ageing behavior and its increased engine oil dilution. Depending on the choice of feedstocks for biodiesel/FAME, there are certain properties that cannot satisfy the requirements of the EN14214 standard for biodiesel. Synthetic fuels or biofuels of the second generation have characteristics significantly better than petroleum fuels and no negative properties are known up to now.

The following are the conclusions on the suitability of the three different categories of biogenic fuels for use in modern diesel engine injection systems:

- Pure plant oil must not be used in modern injection systems and diesel engines, not even as a blend component in a small quantity
- FAME derived from plant oil can be used, at least in relevant admixture portions, as long as the base methyl ester and the mixed fuel conform with appropriate standards
- BTL offers the chance of a fuel that is superior to mineral oil based diesel and therefore the possibility for comprehensive optimization of the engine, fuel injection equipment and fuel, leading to a significant reduction in engine emissions, even from a modern, low-emission diesel vehicle.

(Heinz.Stutzenberger@de.bosch.com)

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The Suitability of Different Biogenic Fuels for the Use in Modern Diesel Injection Systems

The Suitability of Different Biogenic Fuels for the Use in Modern Diesel Injection Systems

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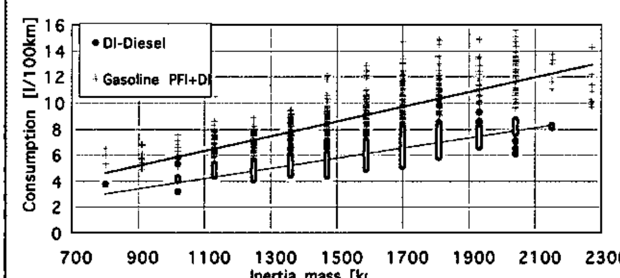
PC Certification Data (EU IV certification at least)



Data Source: Kraftfahrt-Bundesamt (KBA)

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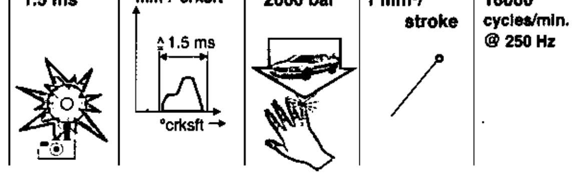
Boundary conditions of Diesel high press. injection

Injection time	Injection characteristic	Injection pressure	min. Injection quantities	Injection frequency
1.5 ms	mm^3/°crksft	2000 bar	1 mm^3/ stroke	16000 cycles/min. @ 250 Hz



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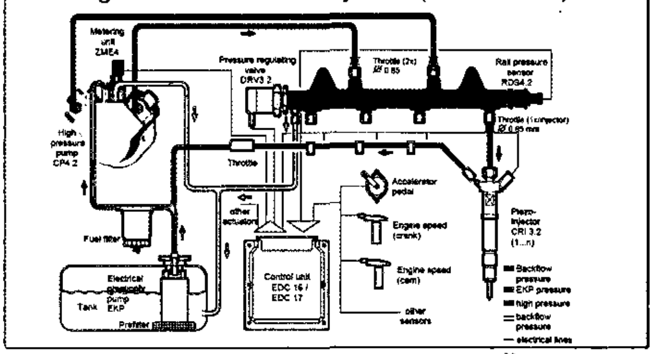
Design of Common Rail System (RB 3. Gen.)



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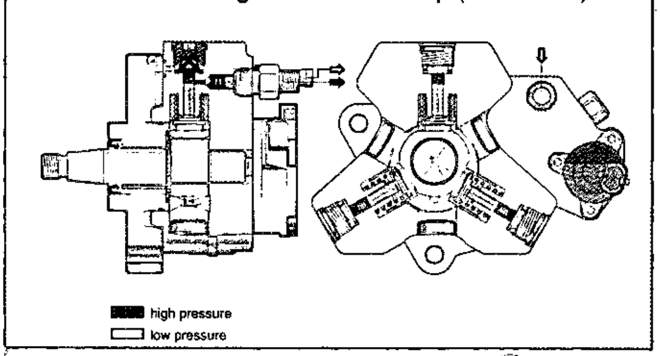
Common Rail High Pressure Pump (RB CP3.2)



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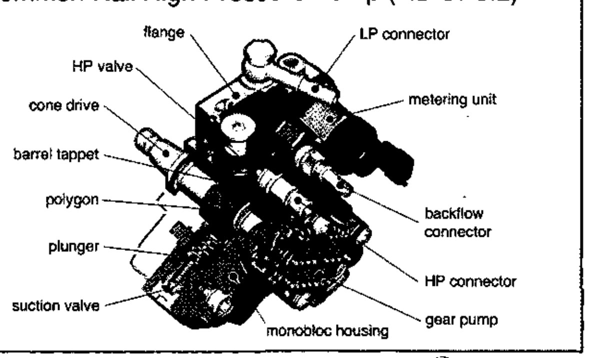
Common Rail High Pressure Pump (RB CP3.2)



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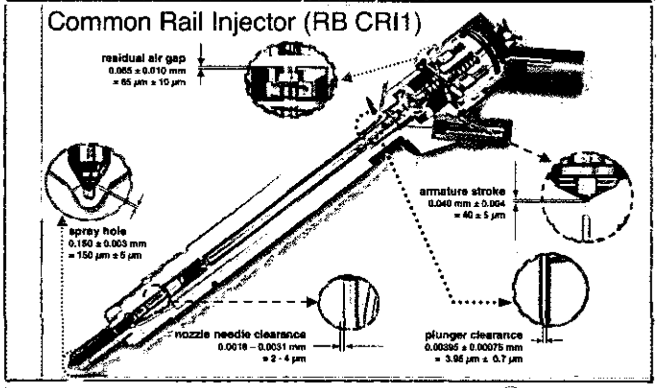
Common Rail Injector (RB CRI1)



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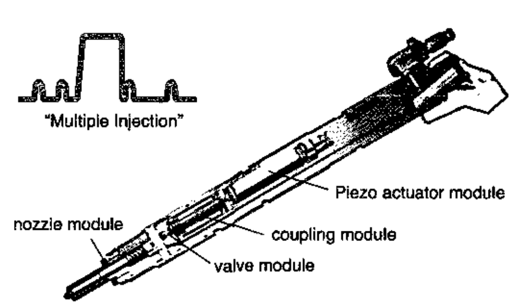
Common Rail Injector (RB Piezo Inline Injector)



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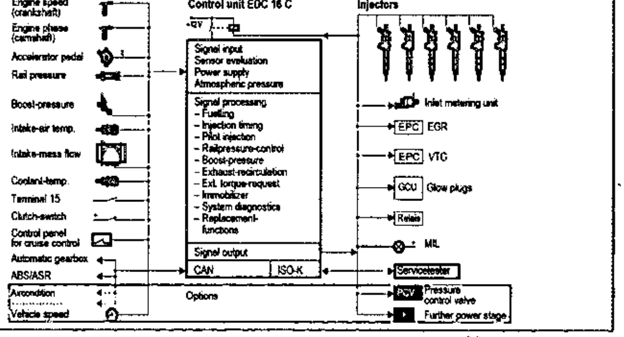
for the Use in Modern Diesel Injection Systems

Engine control with Common Rail System



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The Suitability of Different Biogenic Fuels for the Use in Modern Diesel Injection Systems

Criteria for Good Diesel Fuel Quality (according to ACEA World-Wide Fuel Charter)

1. For Combustion, Efficiency and Emissions
   - Cetane number ≥ 55
   - Total aromatics ≤ 15 %
   - Polycyclic aromatics ≤ 2 %
   - Sulphur content ≤ 10 ppm

2. For Function and Durability of FIE
   - Lubricity, HFRR ≤ 460 µm
   - Dirt / Particles ≤ 10 mg/kg (total contamination)
   - Water ≤ 200 mg/kg, no free water
   - No admixtures (FAME > 5 %, alcohol, ...)

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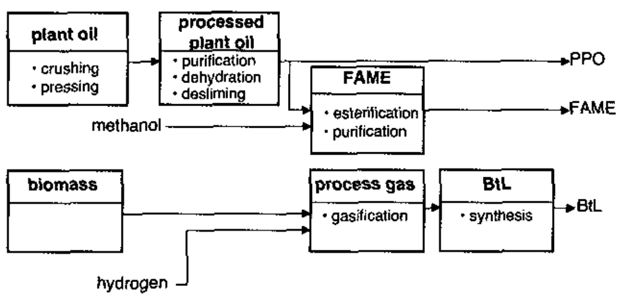
Production of Biofuels for Diesel Engines



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   - biodiesel/FAME (= Fatty Acid Methyl Ester)
   - BtL (= Biomass to Liquid)
4. Summary and conclusions

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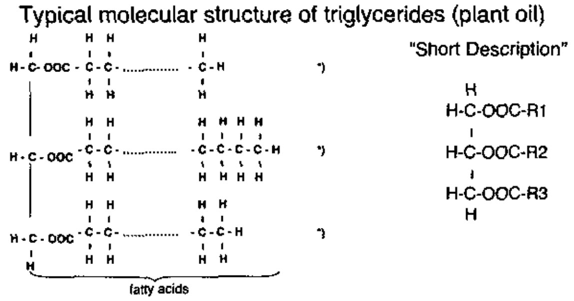
Typical molecular structure of triglycerides (plant oil)



*) typically paraffin chains
- with 6 to 24 carbon molecules
- partly poly-unsaturated (double bonds)
- fatty acid structure depends on raw material / feedstock

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Overview of Standardized Fuel Characteristics

properties	unit	Diesel EN 590 (2005)	Diesel typical german quality 2005/2006	Rape seed oil DIN V 51605 (2006)	FAME EN 14214 (2003)	SynFuels (Bosch investigated samples)
ceten number		≥ 51	49.6 ... 53.3	≥ 39	≥ 51	58 ... 80
density 15°C	kg/m³	820 ... 845	821.3 ... 838.2	900 ... 930	860 ... 900	770 ... 800
total aromatics	% (m/m)	-	18.1 ... 26.5		- (< 0.1)	< 0.1
poly aromatics	% (m/m)	≤ 11	1.1 ... 4.1		- (< 0.1)	< 0.1
sulfur content	mg/kg	≤ 50 2009: ≤ 10	4 ... 17	≤ 10	≤ 10	≤ 2
water content	mg/kg	≤ 200	7 ... 114	< 750	≤ 500	7 ... 26
oxidation stability						
- EN 12205 sludge	g/m³	≤ 25	1 ... 5		-	1 .91
- EN 14112 induction period		-	13 ... >48	> 6.0	≥ 6.0	13 ... >48
lubricity	µm	≤ 460	205 ... 434		- (≤ 460)	330 .580 *
viscosity 40°C	mm²/s	2.0 ... 4.5	2.3 ... 3.4	< 36	3.5 ... 5.0	2.6 ... 3.5
FAME content	% (v/v)	≤ 5.0	< 0.1 ... 5.0		≥ 96.5	< 0.1
distillation		see distillation curve				

* without lubricity additive

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Unesterified Plant Oil in Diesel Engines

- General Problems:
  - bad cold flow behaviour leading to engine stall or filter blockage
  - blends with Diesel fuel not to comply with EN 590
  - dilution of engine oil especially when late injection is applied to enhance after treatment (no evaporation possible because of low volatility)
  - spoiling of after-treatment equipment by plant oil born metals (Ca, P)
- FIE related problems:
  - occurrence of slime caused by reaction of inorganic compounds with fat and leading to filter blockage
  - deposit formation on nozzles and in cylinders caused by long-chain plant oil (triglycerides) and high metal ion content
  - deposit formation by ageing products in pumps and injectors, with consequent function fouling
  - incompatibility with elastic NBR sealings and tubes

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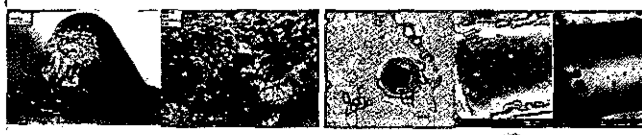
Effects of Unesterified Plant Oils

- plant oils (triglycerides) decompose during evaporation at high temperatures due to their high molecular weight
- *triglycerides containing fuel remaining at the nozzle* causes deposit formation at the nozzle tip and inside the
- therefore strong limitation of the di- and triglyceride content in the European biodiesel fuel (EN 14214) to max. 0.2
- effects of deposit formation in Euro4 and Euro5 nozzles especially high due to reduced sprayhole diameters (150 to 100 μm)



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Summary/Conclusions Plant Oils

- ***deflected spray direction***
- **flow restriction**
  especially at maximum needle lift
- **emission deterioration**
  Euro4 long term guarantee required for 100 000 km (Euro5 160 000 km)
- ***torque and power loss***

unesterified plant oil not viable for modern fuel injection equipment and advanced emission requirements

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Esterification of Plant Oil

```
  H                                      H
  |                                      |
H-C-OOC-R1                             H-C-OH
  |                                      |
H-C-OOC-R2  +  3 CH3-OH  --cat-->      H-C-OH     +  3 CH3-OOC-R1,2,3
  |                                      |
H-C-OOC-R3                             H-C-OH
  |                                      |
  H                                      H
triglyceride           methanol        glycerine          biodiesel
(e. g. rape seed oil)                          (e. g. RapeMethylEster, RME)
```

typical catalysts: NaOH, KOH, alcohylates

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Biodiesel/FAME: Fuel Ageing

- fuel ageing is intrinsic characteristic of biodiesel
- ageing to start after depletion of ageing reserve (induction period IP)
- FIE well suited for the use of biodiesel or blends as long as ageing reserve is not depleted
- FIE not possible to protect from ageing products
  - organic acids (corrosion
  - polymer deposits (malfunction
- mean system temperature to be main driver of ageing velocity (10 degr. C to reduce ageing stability by factor 2!)
- ageing stability of desulphurized fuel reduced if not properly counteracted

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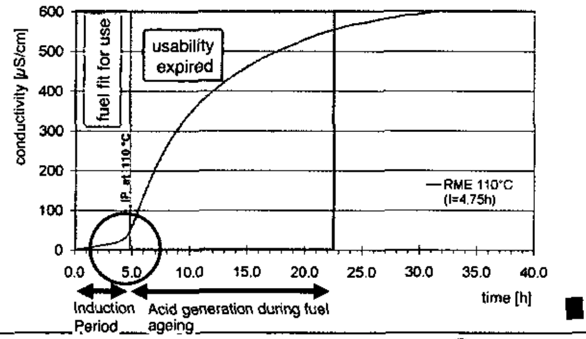
Induction Period and Ageing Potential Determination



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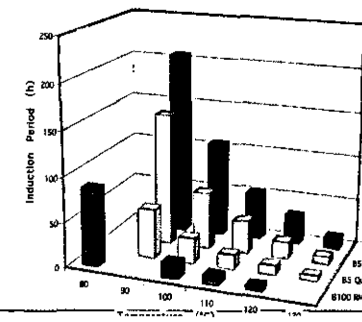
Ageing Characteristics of Diesel, B5 and B100

Rancimat EN 14112



important: ageing velocity doubled in case of 10 °C temperature increase

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Biodiesel/FAME: Engine Oil Dilution

- driven by different boiling behaviour
- **drastically increased when late post injection for DPF regeneration is necessary**
- consequences:
  - increase of engine oil level
  - **engine oil ageing**
    - deterioration of tribological oil characteristics
    - overload of oil additivation
    - deposit generation on piston rings
    - catalyst failures
    - fouling of blow-by and ventilation system
    - fouling of brake booster vacuum pump

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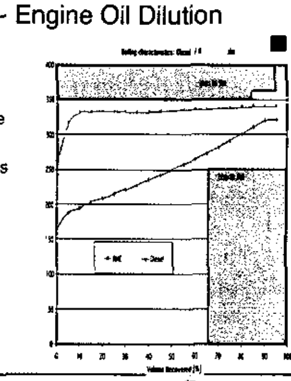
Biodiesel Low Volatility - Engine Oil Dilution

- diesel particulate filter (DPF) required in order to reduce passenger car emissions
- DPF regeneration by means of late post-injection
- higher entry into engine oil and less evaporation via crankcase ventilation
- deterioration of engine oil quality



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FAME Feedstock Composition

Composition	Unit	Rapeseed Oil ME low erucic	Rapeseed Oil ME high erucic	Soybean Oil ME	Palm Oil ME	EN 14214
C 12:0	% m/m	-	-	-	0.5	
C 14:0	% m/m	-	-	-	1 - 2	
C 16:0	% m/m	3 - 5	2 - 4	11 - 12	40 - 48	
C 18:0	% m/m	1 - 2	1 - 2	3 - 5	4 - 5	
C 18:1	% m/m	55 - 65	14 - 18	23 - 25	37 - 46	
C 18:2	% m/m	20 - 26	13	52 - 56	9 - 11	
C 18:3	% m/m	8 - 10	8 - 10	6 - 8	0.3	≤12
C 20:0	% m/m	-	1	-	0.3	
C 20:1	% m/m	1 - 2	7 - 9	-	-	
C 22:0	% m/m	0.5	-	-	-	
C 22:1	% m/m	-	45 - 52	-	-	
C 24:1	% m/m	-	1	-	-	

Source: Biodiesel - the Comprehensive Handbook

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FAME Properties Depending on Feedstock

Properties	Unit	Rapeseed Oil ME low erucic	Rapeseed Oil ME high erucic	Soybean Oil ME	Palm Oil ME (POME)	EN 14214
Density 15°C	kg/m_	875 - 900	877 (20°C)	884 (20°C)	859 - 875	860-900
kin. Viscosity 40°C	mm_/s	3.50 - 5.00	-	3,05 - 4,08	4,30 - 6,30	3.50 - 5.00
Cloud Point	°C	-3 to 1	0	-2 to 2	13 - 16	-
CFPP	°C	-19 to -8	-	-2	9 - 11	0 / -10 / -20
Iodine value	g Jod/ 100g	96 - 117	98 - 108	121 - 143	53 - 57	≤120
Flash point	°C	153 - 179	-	141 - 171	155 - 174	≥120
Cetane number		49 - 62	-	45 - 55	50 - 70	≥51

Source: Biodiesel - the Comprehensive Handbook

POME B100 : Fuel delivery problems at low temperature

POME B100 and blends: Filter clogging at low temperature

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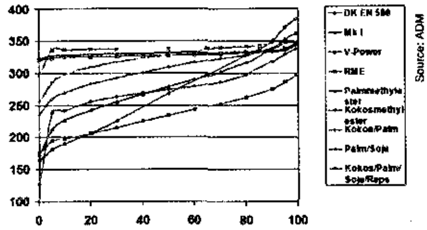
FAME Feedstock Boiling Characteristics



- Large volume biodiesel feedstock show boiling points between 330 and 340 °C, not diesel-like boiling curves.
- No means to reduce the boiling point of FAME by chemical means except hydrogenation.

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The Suitability of Different Biogenic Fuels
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Summary/Conclusions Biodiesel/FAME

- risks associated with biodiesel/FAME:
  - ageing products (acids, polymers) in FIE
  - engine oil dilution
  - ash generation in exhaust gas
- usage possible, but preferred as admixture component
  - at blend rates not larger than 10% for area-wide use
  - with ageing stability of
    - 6h minimum in the neat FAME
    - 20h minimum in fuel mixture (measured by EN14112 modified)
  - eventually adoption to different climates necessary
  - higher blend rates only possible under monitored conditions (storage time, ageing stability, fleet management,...)

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The Suitability of Different Biogenic Fuels
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XtL (= BtL, CtL, GtL)

- XtL Diesel Fuel exhibits properties largely in compliance with the demands of *a modern fuel injection system, but partly different to Diesel according to* EN590 (density) or field quality (cetane number)
- combustion related properties are better than those of conventional Diesel due to missing aromatics and sulphur components
- for optimum results an adaption of engine calibration is necessary when pure XtL is used
- for low blend rates no calibration adaption is necessary, but lower advantages to be expected under these conditions (preferred short and mid-term solution from Bosch point of view)
- for an area-wide release intensive fleet testing is necessary to assure long term durability of the injection equipment
- XtL to offer chance for comprehensive optimization of engine, FIE and fuel for homogeneous Diesel combustion processes

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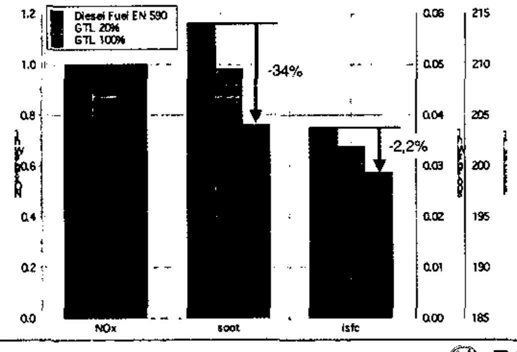
ESC Test Result Estimation at NOx=1g/kWh



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The Suitability of Different Biogenic Fuels
for the Use in Modern Diesel Injection Systems

Summary / Conclusions XtL

- fuel characteristics equal or significantly better compared with mineral oil based fuel
- no negative properties known up to now, if lubricity is adjusted
- fit for use as admixture component and as neat fuel if validated
- chance for comprehensive optimization of engine, FIE and fuel with target to reach significant emission improvements for special applications (e.g. fleets in megacities)

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The Suitability of Different Biogenic Fuels for the Use in Modern Diesel Injection Systems

Summary / Conclusions

- plant oil
  - not suited for use in modern Diesel engines, mainly because of deposits in FIE and cylinders and of filter blockage caused by slime
  - use as refinery feedstock or conversion to biodiesel
- FAME/biodiesel
  - suited as admixture component up to 5 - 10%
  - higher portions risky as ageing stability of mixture reduced (risk of corrosion and deposits in FIE), only possible under monitored conditions
- BtL
  - suited as admixture and as neat fuel with potential to significantly improve engine emissions by comprehensive optimization of engine, FIE and fuel (durability of FIE not yet proven, but no problems expected)
  - preferred solution for use of large quantities of biofuel

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SESSION 5 - PRODUCTION TECHNOLOGY AND APPLICATIONS: BIOFUELS FROM BIOMASS

Session Chairperson
Dr. Choo Yuen May
Deputy Director General
Malaysian Palm Oil Board
Malaysia

SESSION 5-1:

PRODUCTION OF BIOGAS FROM PALM OIL MILL EFFLUENT

Anhar Suki
Golden Hope Plantations Sdn Bhd., Malaysia

This presentation deals with Golden Hope Plantations Berhad's experience in the field of biogas production from palm oil mill effluent (POME). Since the seventies, the palm oil industry has been using anerobic digestion for treatment of POME before the effluent is discharged outside the milling plant. Environmental regulations in the past necessitated treatment of the effluent as a matter of compliance. Today, however, it is the Clean Development Mechanism (CDM) under the Kyoto Protocol regime that has made the palm oil industry reassess the treatment system with regard to the possible capture and utilization of the methane in the biogas from POME. As methane is one of the greenhouse gases causing global warming, reduction of its emission may lead to the awarding of carbon credits, which can be sold to bring in extra income to those undertaking such reduction projects.

In Malaysia, about 50 million tons of biomass, as well as POME, are left over per year as more palm oil is produced. More than 80% of the palm oil mills use a ponding system for treatment of POME that is emitting biogas. At a 50 metric tons/hour palm oil mill operated by Golden Hope, about 25 m^3 of biogas (consisting of 60% methane and 40% CO_2) is produced from 1 ton of POME. With this biogas, it is possible to generate 1040 kWe of power. We may thus be awarded carbon credits of about 28,000 tons of CO_2 equivalent per year. These are referred to as Certified Emission Reductions (CER), which may be sold for US$140,000 at a price of US$5 per ton. The price of carbon credits depends on the point at which they are sold in the project cycle.

There are five options for the utilization of the biogas captured and treated: 1) power generation with 800 kW micro turbine (project cost: RM4.0-5.5 mill or $1.1-1.6 mill), 2) power generation with 800kW gas engine (RM4.0-5.5 mill or $1.1-1.6 mill), 3) direct burning in boiler (RM2.0-3.5 mill or $0.6-1.0 mill), 4) flaring (RM2.0-3.5 or $0.6-1.0 mill) and 5) conventional lagoon (RM0.4-0.6 mill or $0.1-0.2 mill). One example from one of the Golden Hope mills where a tank digester system is installed is the capture of *methane gas for direct burning in a boiler. It costs RM3.3 mill or $0.9 mill and reduces* emission by 28,770 tons CO_2 equivalent per year, worth RM503,475 or $143,850 p.a. The Internal Rate of Return (IRR) is 12% and its payback period 7.0 years. We have a further option we are now evaluating, which is whether to install a micro turbine (160kW) at the cost of RM1.2 mill or $0.34 mill or a biogas diesel engine of either 280 kW at RM0.29 mill or $0.08 mill, or 1000 kW at RM0.97 mill or $0.28 mill.

For the future, we have been developing a better anerobic digester system in collaboration with Nagaoka University of Technology, Tohoku University, SIRIM and Ebara. It is a reversible flow digester system which basically maintains biomass in the center of the reactor and reduces the washout to have a retention time of 10 days. With this technology, 90% of the chemical oxygen demand (COD) can be removed and biogas is produced at the rate of 23-25 m^3 per ton of POME. We have a pilot plant of 200 tons capacity. There are some slides that illustrate systems that other mill owners have adopted inside or outside Malaysia. At Golden Hope we not only implement the anerobic digester system for collection of biogas as an improvement to the process, but also use a composting system.

The company has always considered biomass as a resource rather than as waste and used it for various purposes.

(asuki@goldenhope.com)

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Production of Biogas from Palm Oil Mill Effluent

Golden Hope

Dr. Anhar Suki

Golden Hope Plantations Berhad

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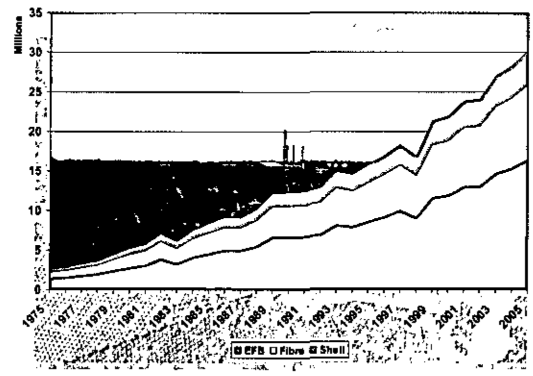
Biomass production (mt/yr)

Golden Hope



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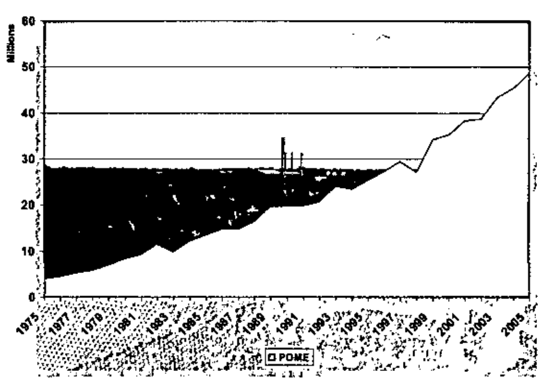
POME production (mt/yr)

Golden Hope



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Biomass: Resource - Usage

Golden Hope

- EFB – abundant source of biomass with various utilization (compost, pulp & paper, fiberboard, fiber mats)
- Fiber – boiler fuel, surplus being used for compost, composite material
- Palm shell – boiler fuel, various utilization for activated carbon, carbon source for cement
- Mill have used biomass for COGEN and Organic Fertilizer for a long time

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PALM OIL MILL EFFLUENT (POME)

Golden Hope

- 1960s, POME Treatment was not satisfactory.
  - BOD 20,000mg/l COD 50,000mg/l
- 1970s, introduction of Environmental Quality Act 1974 stringent BOD & COD standard
  - BOD 5,000mg/l → 2,000mg/l → 100 mg/l → 20mg/l → zero discharge
- 1980s, usage of better anaerobic digestion method, capturing of biogas & utilization not successful
- Present, renewed view POME as source of renewable energy for power generation and/or fuel in the boiler
- Waste a resource misplace in time and location

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POME Treatment - current

Golden Hope

- More than 80% of palm oil mill using pond system for treatment of POME
- Pond system is cheaper though require longer retention time for the bacteria to breakdown the organic matters
- Require large land area
- Methane generated at the anaerobic pond not captured & escape to the atmosphere
- Inefficient method of treating the POME, no utilization of biogas

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Effluent Treatment Plant

- Open anaerobic pond
- Methane escape to atmosphere
- Inefficient process
- Large area
- Failure of anaerobic pond process (plc)

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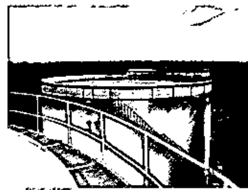
Effluent Treatment Plant



- Open top anaerobic tanks
- Methane escape to atmosphere
- Digester tank covering process to capture the biogas

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ETP – Development

- DOE regulatory requirement resulting higher standard for POME treatment
- Awareness on environmental and safety issue amplify palm oil industry responsibility to better treat the waste generated by the mill
- Knowledge and availability of machinery and equipment for biogas utilization to generate power
- Kyoto Protocol – Clean Development Mechanism, promote development of biomass energy project that is not viable as stand alone project

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Kyoto Protocol

- Kyoto Protocol (1997) stipulates that the industrialized countries (Annex 1) must reduce the emission level of GHG by 5% below year 1990 levels by the years 2008 to 2012.
- Malaysia is a non Annex 1 Party Country. Malaysia signed the Kyoto Protocol in 1997 and ratified it on 4 September 2002.
- Kyoto Protocol entered into force on 16 February 2005.

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Kyoto Protocol

- Clean Development Mechanism (CDM) is a mechanism under Kyoto Protocol which regulate Annex I (developed) countries to mitigate their greenhouse gas emissions.
- Purposes of CDM:
  - It provides a mechanism for non-Annex I countries (e.g. Malaysia) to take part in establishing a sustainable development
  - To assist Annex I countries in achieving their reduction commitments at lower cost.
  - To provide Annex I countries with flexibility for achieving their emission reduction targets; by allowing them to make carbon credits.

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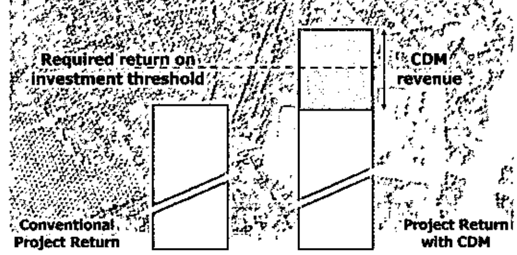
CDM impact at project level

- The CDM cash flow increase the Internal Rate of Return (IRR) of the project making it more attractive for investor.
- Objective : Reasonable return



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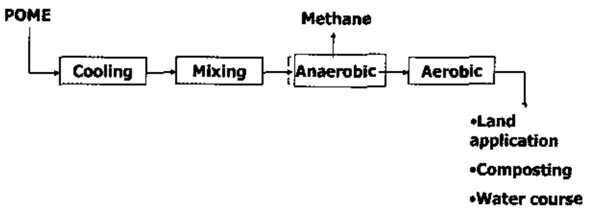
ETP – Biogas production

- Present ETP system (Majority)



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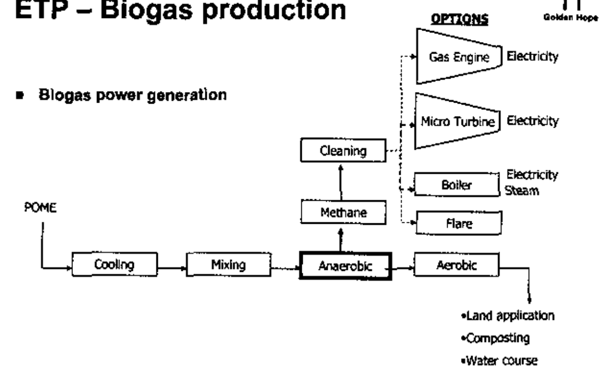
ETP – Biogas production

- Biogas power generation



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Biogas Plant

- Mill capacity = 50 mt/hr
- Biogas production at 25 m^3/mt POME
- Biogas = 60% CH_4 + 40% CO_2
- H_2S content = 1000-4000 ppm
- Potential power generation = 1040 kWe
- Potential CO_2 reduction equivalent= ~28,770 mt/yr
- Potential income from CDM = ~RM500 k/yr (at CER price assuming USD 5/mt CO_2)
- Project cost
  OPTIONS
  - Biogas Generation + Micro Turbine (800 kW) = RM 4.0 – 5.5 million
  - Biogas Generation + Gas Engine (800 kW) = RM 4.0 – 5.5 million
  - Biogas Generation + Direct burning in Boiler = RM 2.0 – 3.5 million
  - Biogas Generation + Flaring = RM 2.0 – 3.5 million
  - Conventional Lagoon = RM 0.4 – 0.6 million

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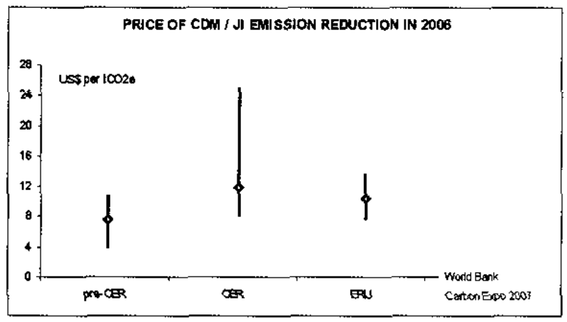
CERs PRICE



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Biogas plant – Potential income from CDM

Mill capacity (mt/hr)	CH_4 production (mt/yr)	CO_2 equivalent (mt/yr)	Income from CDM (@USD5/mt CO_2) (RM/yr)	Income from CDM (@USD7/mt CO_2) (RM/yr)
30	820	17,220	301,350	421,890
50	1,370	28,770	503,475	704,865
90	2,460	51,660	904,050	1,265,670
120	3,280	68,880	1,205,400	1,687,560

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WOM POME Biogas Plant

- Retrofit project to existing WOM ETP
  - Biogas Generation (digester tank covered) + Direct Burning in Boiler
  - Flaring system included (for excess biogas)
- Project Cost: RM 3.3 million
- CO_2 reduction equivalent = 28,770 mt/yr
- Payback period = 7.0 years
- IRR = 12 %
- OPTION (additional investment)
  - Electricity Generation - microturbine(160kW) = RM 1.2 million
  - Biogas/ diesel engines - 280kW … RM290K
    1000kW … RM970K

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WOM POME Biogas Plant

Golden Hope

- Pre-treatment tank
- Control room
- Covered digester tank

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RABR Pilot Plant Project WOM

Golden Hope

- Reversible Flow Anaerobic Baffled Reactor, 200m^3 capacity (4 x 50m^3 ABR)
- Collaboration with Nagaoka University of Technology, Tohoku University, SIRIM, Ebara
- Repetitions of forward and reverse flow of POME at designated HRT (10 days) to preserve bacteria in the RABR reactor
- 90% COD removal is achievable
- Biogas production at 23 – 25 m^3/mt POME
- Running at mesophilic / thermophilic temperature

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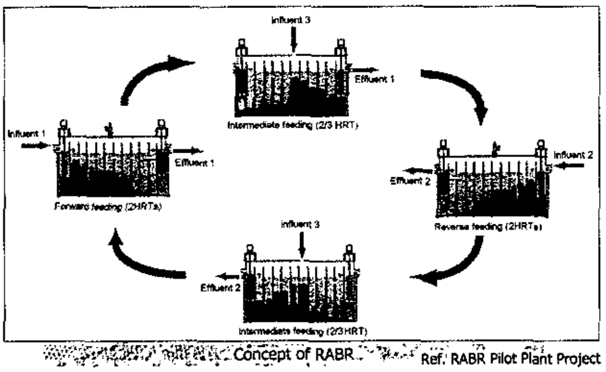
RABR Pilot Plant Project WOM

Golden Hope



Concept of RABR

Ref. RABR Pilot Plant Project

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RABR Pilot Plant Project WOM

Golden Hope

RABR

Raw tanks

Biogas storage & flaring unit

Ref. RABR Pilot Plant Project

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Other system – covered pond

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- Covered anaerobic pond for capturing of biogas
- Cost to cover pond varies eg. RM 300k – 450k/pond (est. RM80/m^2). RM3.5m for complete system

Pic ref. AES Agri Verde

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Other system

Golden Hope

- Digester tanks
- Mesophilic & thermophilic process
- Double membrane storage tank

Ref. Banlev Biogas Plant, Denmark

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Covered lagoon-type digester project for a 3000-sow farrow-to-finish swine production facility in Thailand; CleanThai, Inc, Bangkok, Commissioned July, 2001

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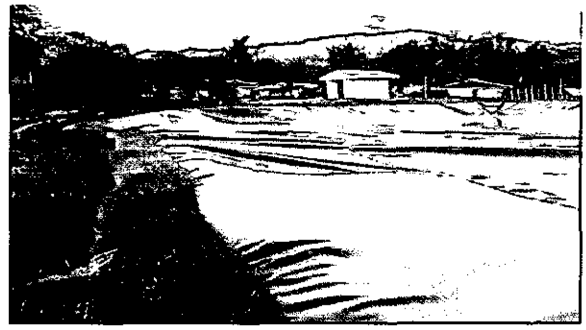
Covered lagoon-type digester project for a 900-sow farrow-to-finish swine production facility in the Philippines; PhilBio, Inc, Manila, Commissioned March 2001.



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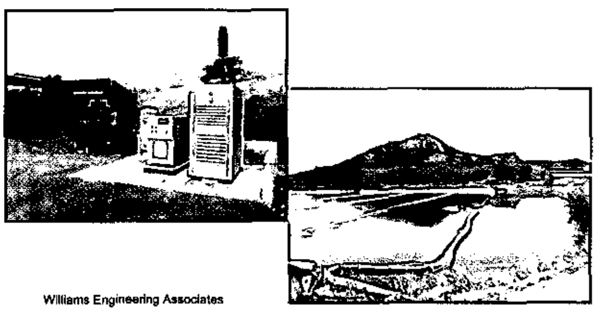
Covered lagoon methane recovery system for 200-cow dairy including a 30 KW microturbine for electrical production at the Cal Poly dairy; Commisioned Summer, 2001.



Williams Engineering Associates

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Other system – All in one tank

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- All in one digester tank with biogas holder
- Compressed biogas storage tank (with activated carbon)
- 25 X tank capacity

Ref. Yamada Biogas Plant, Japan

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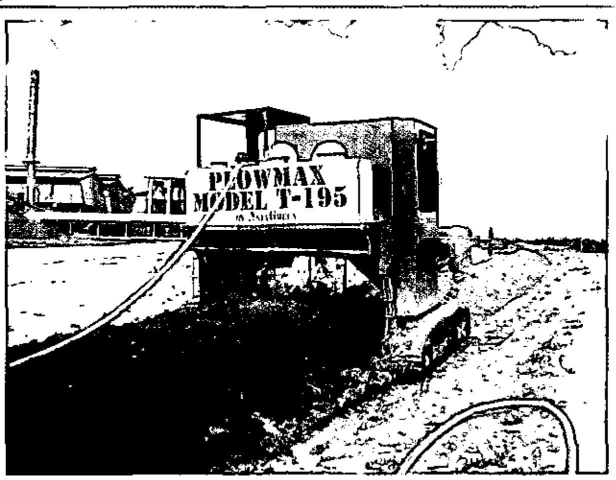

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Golden Hope

Thank you

M Faisal 2007

SESSION 5-2:

TECHNOLOGY FOR EXPLOITATION OF WASTE FROM PALM OIL PRODUCTION: GASIFICATION/PYROLYSIS

Ferrucio Trifirò
University of Bologna, Italy

Nowadays, biomass is an important source for the supplementation of declining fossil fuels. There are three routes for chemical conversion of biomass: thermo-chemical, biochemical or chemical technologies. The thermo-chemical route includes combustion, pyrolysis and gasification of biomass. Combustion is oxidation at a temperature higher than 1000°C with excess of oxygen, while pyrolysis refers to the thermal degradation of biomass at 300-650°C to a liquid, a gas and a solid in the absence of an oxidizing agent. Gasification involves partial oxidation at a high temperature, between 650°C and 900°C, resulting in the formation of a gas that consists mainly of carbon monoxide, hydrogen, methane and carbon dioxide.

The gasification of biomass wastes produces non-condensible gas and an ash residue. Unfortunately, various contaminants normally remain, which is a major challenge for gasification. The contaminants causing trouble are particulate, alkali metals, tars and catalyst poisoning species. The three objectives of the process are therefore to produce the gas, clean it by removing the contaminants, upgrade it to syngas and then to transform to liquid fuels.

The main parameters of the gasification process are: temperature, pressure, the type of gasifier and the type of catalysts or bed material used inside the gasifiers. The properties required of the catalysts include: the ability to remove tars and to reform methane to a syngas, resistance to deactivation, ease of regeneration and economy. The performance of typical catalysts is discussed on a slide. Professor Trifiro and his team are working on an European project on the sixth framework program called CHRISGAS to establish a technology to produce a clean, hydrogen-rich, synthesis gas by gasification of biomass, using a new type of catalyst resistant to deactivation by the contaminants.

Pyrolysis of biomass always produces a liquid called bio-oil or pyro-oil, a gas and a solid residue of char and ash. Flash, fast and slow pyrolysis are the main processes involved, flash being the most efficient. Heating rates and liquid fractions vary considerably in each of these, although the operating temperature range of 500°C-600°C is the same for all three processes. Catalysts are also used in pyrolysis to reduce the tar content in the gasification bed and in the gas cleaning reactor. Compared with petroleum diesel, bio-oil contains only about half as much carbon and hydrogen but large amounts of oxygen and water, which is a great drawback. The oil is immiscible with diesel and has a low ignition temperature. The organic acids in it are highly corrosive and char in the liquid can block injectors or erode turbine blades. The oil is also unstable and has a very unpleasant odor.

Thus, it is very important to upgrade the bio-oil resulting from pyrolysis because of the unfavourable properties mentioned above. There are two ways to upgrade bio-oil: catalytic hydrotreating or steam reforming. Bio-oil can be used to extract chemicals, produce transport fuels after upgrading, produce power and heat or for gasification. Coupled pyrolysis-gasification offers advantages because it is relatively free of contaminants. Excessive gas cleaning is therefore not required in the gasifier, thus reducing the cost of biomass transport.

To sum up, four alternatives exist for producing fuel by thermal conversion of palm oil waste: production of bio-oil, upgrading of bio-oil to obtain a fuel equivalent to petroleum light oil, gasification of bio-oil and further chemical transformation of the gas, and, finally, direct production of gas and further chemical transformation to obtain Fischer-Tropsch diesel, hydrogen or di-methyl ether (DME).

(ferruccio.trifiro@unibo.it)

1

Technologies for explotation of wastes from Palm oil production Thermochemical platform : pyrolysis and gasification

Ferruccio Trifirò

Dipartimento di Chimica Industriale e dei materiali

University di Bologna, Italy

2

Content of the lecture:

I **Gasification of biomass**

II **Pyrolysis of biomass**

III **Pyrolysis + Gasification**

3

Chemical conversion technologies

- Herbaceous crops
  - Annual
  - Perennial
- Tree crops

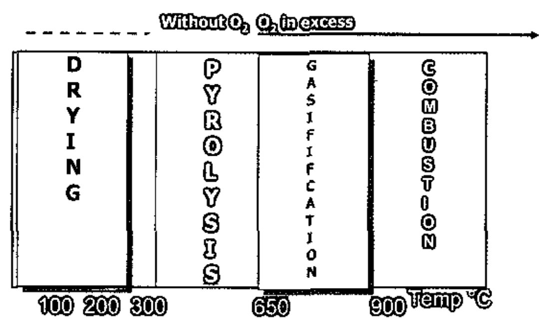
Ligno-cellulosic → Thermo-chemical conversion (combustion, pyrolysis, gasification); Bio-chemical conversion

Carbohydrate → Bio-chemical conversion (bio-gasification, fermentation)

Oils → Chemical conversion (esterification)

4

Thermochemical conversions



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Thermochemical conversions

Combustion and co-firing with fossil fuel

CHP (Combined Heat & Power) produces heat (E_{th} = 40-50 %) and power (E_e = 25-35 %).

Gasification

Partial oxidation at high temperature with the formation of a gas mainly consisting of CO, H_2, CH_4, CO_2

Pyrolysis

Thermal degradation of biomass in the absence of an oxidizing agent to a liquid, a gas and a solid.

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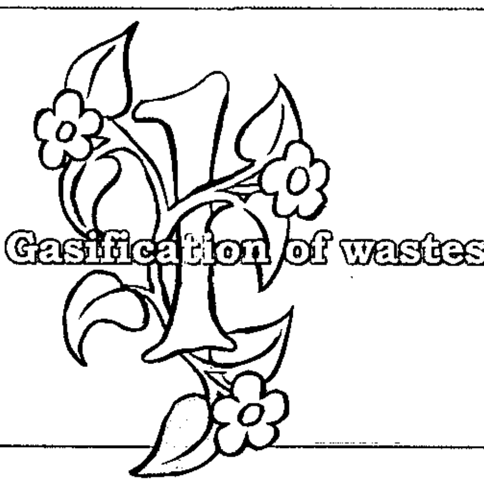

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Products of gasification

Ideally, the process produces only a non-condensable gas and an ash residue.

However, incomplete gasification of char and pyrolysis of tars produce a gas containing several contaminants such as particulate, tars, alkali metals, fuel-bound nitrogen compounds and an ash residue containing some char.

8

Objectives of gasification

1) To produce a gas

2)To clean a gas

3) To upgrade a gas to syngas and to liquid fuels or to hydrogen or to produce energy directly in a turbine

9

Components of gas after the gasifier

CH_4 (7-10%)

light hydrocarbons (2-4%)

CO (10-13%)

H_2(10-13%)

CO_2(25-30%)

H_2O (35-45)%

Ash(0,1-2%)

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Pollutants present in bio-gas

1)Particulate(ash,char and fluid bed materials)
2) Alkali metals (sodium and potassium compounds)
3)Tars (high molecular weight hydrocarbons and aromatics)
4) Catalyst poisoning species(HCl,HCN,NH_3 and H_2S)

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Gasification's main parameters

-Temperature: gasification is generally carried out at 750-800°C,.

-Pressure: all the gasifier types can be operated at either atmospheric or elevated pressure.

-Type of gasifier (fixed, fluid bed, entrained flow bed...)

Type of catalysts or of bed material used inside the gasifier

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Catalysts inside the gasifier

Should have the following properties:

1. effective in the removal of tars
2. capable of reforming methane
3. resistant to deactivation as a result of carbon fouling and sintering
4. easily regenerated
5. resistant to abrasion and attrition
6. be cheap

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Catalysts inside the gasifier

1)Sand, magnesite (MgO) or magnesium carbonate: do not crack tars.

2)Dolomite ($MgCO_3$, $CaCO_3$): is very active in cracking tar (if a little amount of iron is present in the ore almost 100% of removal is achieved), it is not active in reforming methane.

3)Ni on pretreated olivine (Mg,Fe,Ca)2(SiO4) plus Al, Cr) performs very well both in tar removal and reforming of methane, good resistance to abrasion;

4) Co or Ni on magnesite (MgO): performances comparable to Ni on olivine;

5) Rh/CeO2/SiO2: the most active but not so stable inside the gasifier, promising system for a subsequent tar cracker unit.

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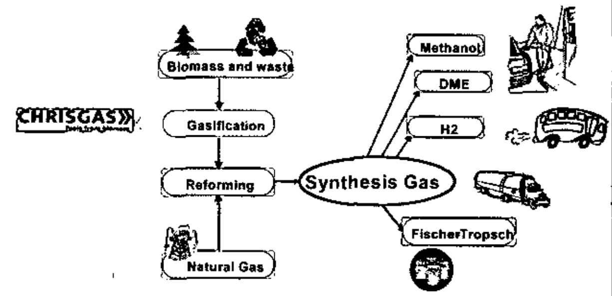
CHRISGAS

Clean Hydrogen rich Synthesis Gas



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Pyrolysis of biomass

Thermal degradation of biomass in the absence of an oxidizing agent

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Products of Pyrolysis

Pyrolysis always produces:

1) a liquid (pyro-oil, bio-oil)

2)a gas

3)a solid residue (char and ash). Ash consists of inorganic compounds (alkali and heavy metal salts ...) and is the waste product of pyrolysis.

The yields in these different products not depend on the biomass fed, but only on the pyrolysis process.

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The products of Pyrolysis

1) The liquid (bio-oil, pyro-oil) is an homogenous mixture of organic compounds (sometimes even > 500!) and water in a single phase with fuel properties.

2)The gas has a medium heating value and can be used internally to provide process heat, re-circulated as an inert carrier gas or exported for example for feed drying.

3)The solid (char) is similar to coal and it may be sold or used internally to provide heat for the process.

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Bio – oil properties

Property	Pyrolysis Oil	Diesel	Heavy Fuel Oil
Density at 15°C (Kg/m³)	1220	854	963
% C	48.5	86.3	86.1
% H	6.4	12.8	11.8
% O	42.5	0.0	0.0
% S	0.0	0.9	2.1
Viscosity at 50°C (cSt)	13	2.5	351
Flash point (°C)	66	70	100
Pour point (°C)	-27	-20	21
Ash (wt.%)	0.13	<0.01	0.03
S (wt.%)	0.0	0.15	2.5
Water (wt.%)	20.5	0.1	0.1
LHV (MJ/kg)	17.5	42.9	40.7
Acidity (pH)	3	-	-

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[illegible]

1) Immiscibility. Due to its high water content, the pyrolysis oil is not miscible with fossil fuels.
2) Low Ignition. The high water content is also detrimental for ignition.
3) Corrosion. Organic acids in the oils are highly corrosive.
4) Erosion. Char in the liquid can block injectors or erode turbine blades.
5) Instability. Over time, the reactivity of some components in the oils leads to formation of larger molecules (polymerization) that result in high viscosity.

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Pyrolysis Processes

i) Flash pyrolysis: a heating rate of 10000 °C/s and a rapid quenching of the vapors (vapors residence time of a few hundreds milliseconds) maximize the liquid fraction up to 80 % respect to the dry feed;
ii) Fast pyrolysis: heating rate of 300 °C/min; gaseous fraction 20-30 %; liquid fraction 50-60 %; solid fraction 20-30%;
iii) Slow pyrolysis: heating rate of 30 °C/min; liquid fraction is below 50 %; driven to equilibrium, the cracking reactions maximize the production of char and incondensable compounds.

The operating temperature range of 500-600 °C is the same for all the processes.

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Catalysts in Pyrolysis

Most of the research works on biomass pyrolyis concern two types of catalysis:
-1) [illegible] with the biomass to reduce the tar content in the gasification bed;
-2)using the catalyst in a specific hot gas cleaning reactor ([illegible]
3)an attractive option is then to insert the catalyst inside the wood matrix [illegible] Using this method, the catalytic material is highly dispersed in the biomass and freshly renewed when it is introduced into the reactor.

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Catalysts in Pyrolysis

[illegible] ...) and $ZnCl_2$ directly added to the biomass by wet impregnation or by dry mixing increased the yield in H_2 significantly but also increased the yield in the solid fraction and decreased the yield in bio-oil..
-2)Pioneer studies highlighted that [illegible]. The pore size (shape selectivity) and the acidity (depending on Si/Al ratio) of the catalyst affected the formation of organic compounds.

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Upgrading of Bio – oil

Some upgrading methods:

1) [illegible] are used to improve the stability of the pyrolysis oil, by removing oxygen and water thus increasing the burning properties.

[illegible] means pyrolysis processes carried out into a reactive atmosphere, i.e. hydrogen, to directly obtain an upgraded bio-oil.

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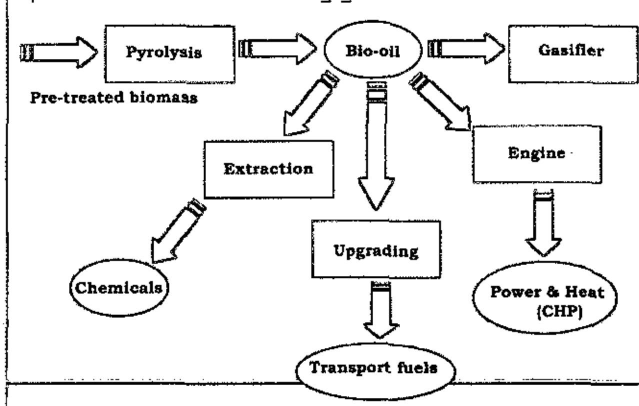
Bio – oil applications



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Coupled pyrolysis -gasification

- Many small reactor of pyrolysis a centralized gasification reactor
- Advantages
- 1)Pyrolysis oil is relatively free of contaminants, so in the gasifier excessive gas cleaning may be avoided
  2) It is possible to decrease the cost of transport of biomass

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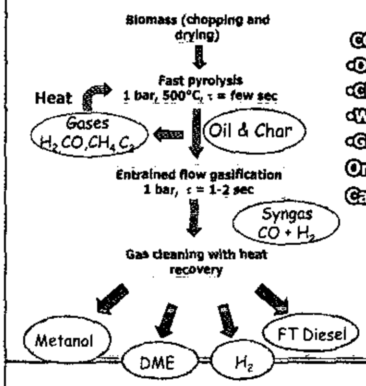
Pyrolysis and gasification



COMPOSITION

- Organics (C4-C5, BTX..) 60%
- Char 16%
- Water 11%
- GAS (CH_4, CO, H_2) 13%

Organics + CHAR 75-80%

Can go to gasification

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Conclusions

We have four alternatives in order to produce fuel by thermal conversion of waste of palm oil

1) production of bio-oil
2) up-grading of bio-oil petroleum like oil
3) gasification of bio oil and further chemical transformation of the gas (upgrading)
4) production directly of gas and further chemical transformation(upgrading)

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Credits

The financial support of the EC 6th Framework Programme (CHRISGAS Project contract number: SES6-CT2004-502587), the Swedish Energy Agency, and the Swedish Research Council are gratefully acknowledged.

Thanks to my co-workers involved in BTL:
Simone Albertazzi (Ph.D.), Francesco Basile (Prof.)

THANK YOU

SESSION 5-3:

DEVELOPMENT OF CELLULOSIC BIOETHANOL

Franziska Müller-Langer
Institute for Energy and Environment, Germany

Within the worldwide discussion with regard to energy supply security and climate change, as well as technological and economic issues, bioethanol for transport has taken center stage as a promising option. Current bioethanol production, depending on the region, is focused on the use of sugar and starch feedstocks such as sugar cane, maize and cereals. More than 50 million m^3 of bioethanol was produced in 2006, 75% of which came from the United States and Brazil. Europe's total production amounted to approximately 4.5 million m^3, primarily in France and Germany. The existing production facilities are based on biochemical alcoholic fermentation technologies, which are matured and commercially available with very different concepts and capacities. This presentation gives an introduction to the key technological, environmental and economic aspects of first versus second generation bioethanol from a European perspective.

Three kinds of feedstocks may be utilized to produce bioethanol – containing sugar (beets or sugar cane), starch (cereals or maize) or lignocellulose (woody/herbaceous residues and energy crops). First generation technologies convert sugar or starch into glucose, which is then fermented, distilled and purified to produce very clean bioethanol. However, the current strong demand will unavoidably require the use of lignocellulosic feedstocks for future bioethanol production. Under second generation technologies, there are three paths to convert lignocellulosic feedstocks into bioethanol: firstly, biochemical or fermentation, secondly, thermo-chemical or gasification and thirdly, pyrolysis plus gasification.

But what actually is lignocellulosis and what challenges are involved in using it for the fermentation process? Lignocellulose consists of cellulose, hemicellulose, lignin and other substances. The second generation technologies that employ fermentation consist of sections for mechanical treatment, pre-hydrolysis, separation, cellulose hydrolysis, C5/C6 sugar fermentation, distillation and final purification. Emerging technologies already exist for the pre-hydrolysis and cellulose hydrolysis sections. For the former, liquid hot water technology and ammonia fiber technology are considered promising and for the latter, enzymatic hydrolysis. There are some obstacles (bottlenecks) in the biochemical or fermentation process, such as the high energy demand for mechanical pre-treatment, high enzyme consumption, trade-offs between the costs of cellulase production, a lack of effective enzymes and the need for development of suitable anerobic micro-organisms.

Another second generation technology is the thermo-chemical conversion or gasification of lignocellulosic feedstocks. Various obstacles still exist in this process. Biomass gasification is still more or less at the R&D stage. In addition, not every gasifier is suitable for every type of biomass. The gas also needs to be cleaned but not all the technologies for this step are mature yet.

The economic aspects of the biochemical or fermentation process are listed on a slide to show that both capital investment and operating costs are higher for investments based on second generation technologies. This is partly because of the greater complexity of the technologies and the cost of the enzymes. Thus, one of the main obstacles to be overcome is reduction of the total production costs. From the environmental aspect, second generation technologies further reduce greenhouse gas emissions and provide better returns on non-renewable primary energy relative to first generation technologies.

There are no plants operating commercially using second generation technologies. However, pilot plants are up and running in Canada (Iogen), the Netherlands (Nedalco), Spain (Abengoa), Denmark (Elsam A/S), Sweden (EU NILE Project), as well as in the USA, as shown on the slides. It is hoped that the challenges will be met and the development of efficient second generation technologies completed so that bioethanol will be commercially produced in these ways in the future.

(franziska.Mueller-langer@ie-leipzig.de)

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Institut für Energetik und Umwelt
Institute for Energy and Environment

International conference on biofuels
Session 5: Production technology and applications: biofuels from biomass

DEVELOPMENT OF CELLULOSIC BIOETHANOL
An overview from the European perspective

Franziska Müller-Langer, Daniela Thrän
Kuala Lumpur, 6th July 2007

Institut für Energetik und Umwelt gGmbH, Torgauer Str. 116, D-04347 Leipzig, www.ie-leipzig.de

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Agenda

1. Bioethanol market
2. Characteristics of bioethanol production
   - 1st versus 2nd bioethanol generation
   - *Technical, economic and environmental aspects*
3. Overview of exemplarily concepts and demonstration plants
4. Conclusions

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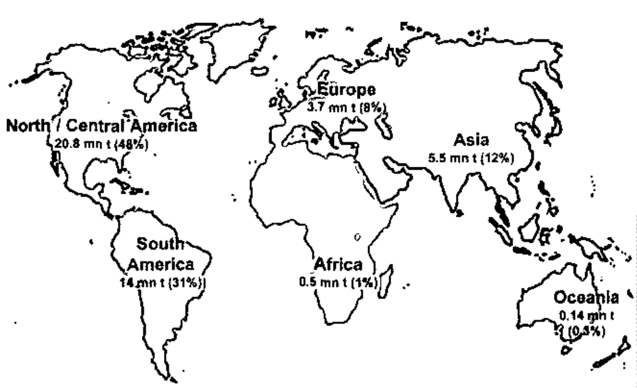
Bioethanol market
Global production 2006



Data sources: Ethanol industry outlook RFA 2007

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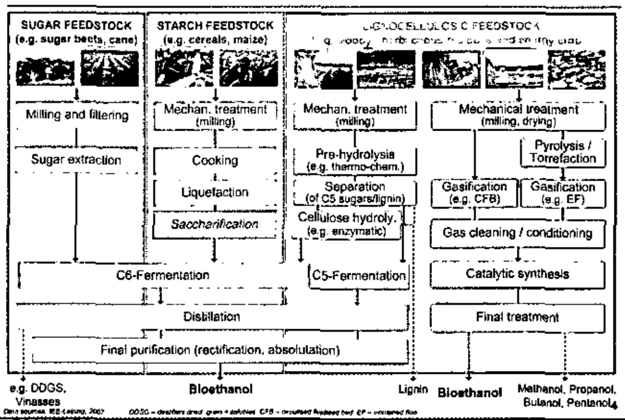
Characteristics of bioethanol production
Key process steps of 1st and 2nd generation



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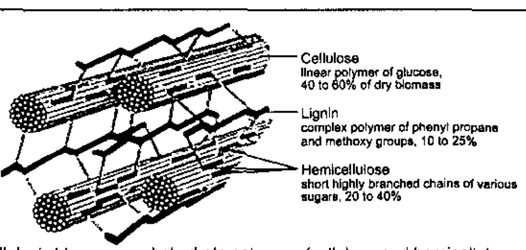
Characteristics of bio-chemical ethanol production
Lignocellulosic biomass treatment



- Lignocellulosic biomass: carbohydrate polymers (cellulose and hemicellulose polysaccharides), lignin and a remaining part (acids, salts, minerals)
- Thus, lignocellulosic biomass treatment for bioethanol production is comparatively more complex than for sugar and starch biomass
  - Removal of lignin ➲ not biodegradable, use e.g. as combustible by-product
  - Hydrolysis (saccharification) of cellulose and hemicellulose into simple sugar components C5 (pentose such as xylose, arabinose) and C6 (hexose or glucose) that can be fermented

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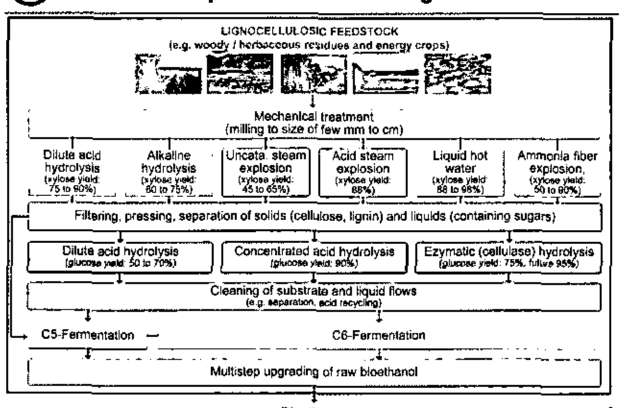
Characteristics of bio-chemical ethanol production
Comparison of technologies



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Characteristics of bio-chemical ethanol production
Comparison of concepts

	CHARACTERISITICS
SHF separate hydrolysis fermentation	-Replace of cellulose acid hydrolysis with cellulase enzyme hydrolysis -C6 and C5 fermentation in series or in parallel
SSF simultaneous saccharification/ fermentation C6	-Consolidates cellulose hydrolyses with C6 fermentation ➲ reduction of reactors -Basically available
SSCF simultaneous saccharification/ co-fermentation C5/C6	-Consolidates cellulose hydrolyses with C6 and C5 fermentation -Pilot scale
CBP consolidated bioprocessing	-Cellulase production and fermentation in one reactor -Use of anaerobic microorganism -Currently at basic research

Data sources: Zhang, 2007, Hamelinck, 2004

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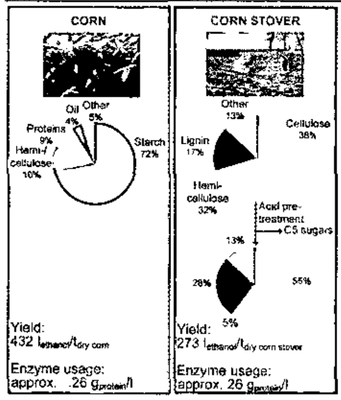
Characteristics of bio-chemical bioethanol production
Bottlenecks of technologies



- High energy demand for mechanical pre-treatment of lignocellulosic biomass, e.g. for acid hydrolysis
- Currently large amounts of enzymes are required to produce sugar and lignin
- Trade-off between cellulase production costs and costs of hydrolysis/fermentation
- Effective enzymes (e.g. cellulase, xylanase, glucosidase) to simutaneously hydrolyse cellulose and hemi-cellulose into C5 and C6-sugars
- Development of suitable anaerobic microrganism

Data sources: e.g. Novozymes, 2007

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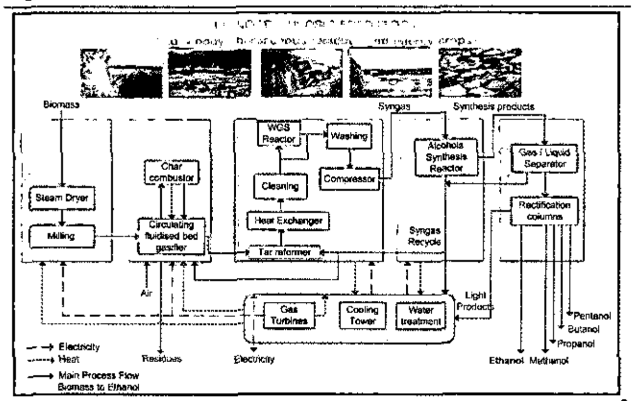
Characteristics of thermo-chem. bioethanol production
Synthetic bioethanol (example)



Data sources: Sterner, 2006, Abengoa, 2007, IEE Leipzig, 2007

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Characteristics of thermo-chem. bioethanol production
Bottlenecks of technologies

Gasification & gas treatment

- All concepts for synthetic biofuels in R&D stage; development of biomass gasification so far primarily focused on CHP, less on synthesis gas production
- No gasification technology is a piori suitable for biomass; selection strongly depends on properties of biomass feedstock ➲ quantities of gas impurities depend on type of gasifier; particularly removal of e.g. tars and particles, alkalis
- Wet gas cleaning (e.g. Rectisol) well proven for large-scale coal gasification
- Hot gas cleaning offers benefits in terms of efficiency and sewage avoidance; but not all elements are of matured technology
- Application of basically available and matured technologies (e.g. steam reforming, water gas shift) for achieving the required H_2/CO ratio of the synthesis gas; so far only limited experiences for required scale

Synthesis & fuel treatment

- Limited experiences regarding „green" synthesis gas and expected plant scale
- Requirement of productive synthesis catalysts making the process economically feasible (high conversion and ethanol selectivity)
- Development of separation technology for alcohols mixtures

Data sources: IEE Leipzig, 2007, Abengoa, 2007

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Characteristics of bio-chemical bioethanol production
Economic aspects

	1st GENERATION		2nd GENERATION		
Feedstock	Molasses	Corn	Straw	Straw	Wood
Plant location	Germany	Germany	Germany	Netherlands	U.S.
Capacity	60,000 m³/a	200,000 m³/a	215,000 m³/a	190,000 m³/a	198,000 m³/a
Total capital invest.	30 mn €	150 mn €	235 mn €	325 mn €	235 mn US$
Production costs	€/l	€/l	€/l	€/l	US$/l
Capital	0.05	0.11	0.12	0.19	0.18
Other				0.06	
Operation	0.09	0.15	0.12	0.12	0.25
Enzymes		0.01	0.22	0.04	0.05
Feedstock	0.29	0.26	0.24	0.14	0.10
Credit by-products	~0	-0.08	~0		-0.02
Total (net)	*0.42*	*0.45*	*0.70*	*0.55*	*0.56*
Total (net) fuel eq.	*0.65*	*0.69*	*1.08*	*0.84*	*0.86*

- Real enzyme conversion cost (costs per liter ethanol) is very difficult to estimate ➲ depends on feedstock types, pre-treatment processes, efficiency of C5/C6 enzymes
- Estimated average enzyme cost about 1 USD/gal EtOH (0.35 €/l) with associated ethanol cost of 3 USD/gal (approx. 1 €/l) ➲ further reduction in enzyme costs

Data sources: IEE Leipzig, 2006/07, TU Delft 2006, Novozymes, 2007

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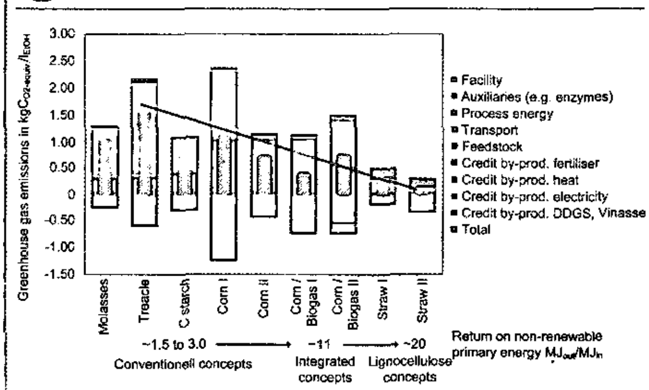
Characteristics of bio-chemical bioethanol production
Environmental aspects



Data sources: Schmitz, 2005, IEE Leipzig, 2006

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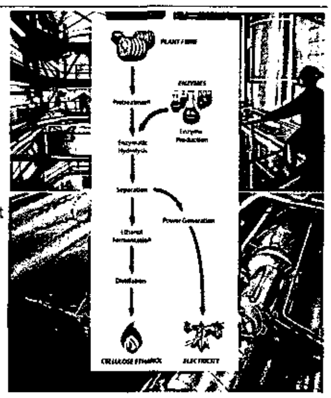
Overview of existing concepts and demonstration plants Iogen, Canada

- Demo plant in Ottawa, Canada
- Fuel capacity:3,000 m³/a (2.4 t/a) using wheat, oat, and barley straw ➲ start up in 2004, upgrading in 2006
- Modified steam explosion pretreatment and patented enzyme
- Use of lignin in a CHP that generates the energy needed to run the demonstration facility
- Use of cellulosic EtOH for its own fleet of 13 vehicles and fleet vehicles of two Canadian government departments
- Plan to license its technology for first commercial plant of expected fuel capacity of 75,000 m³/a (approx. 60 kt/a) using corn stalks and cereal straws ➲ potential sites: north central Saskatchewan, east central Alberta, and southeast Idaho



Datasource: Iogen 2006/07

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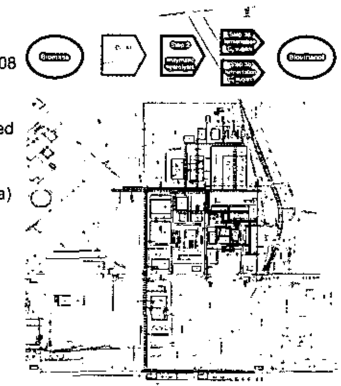
Overview of existing concepts and demonstration plants Royal Nedalco, the Netherlands

- Nedalco has announced to build a bioethanol plant in Sas van Gent, Netherlands ➲ operational end 2008
- Running on wheat residues containing C5 sugars and using a patented yeast that it has developed itself that can convert xylose (hemicellulose) into bioethanol
- Plant capacity: 200 mn l/a (158 kt/a)
- Investment: 150 million €



Datasource: Royal Nedalco, 2007

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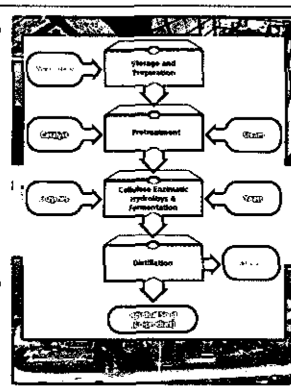
Overview of existing concepts and demonstration plants Abengoa, Spain

- Pilot scale plant in York, (Nebraska, US) ➲ evaluation of novel biomass fractionations, processes and valorisation of all process streams
- Demonstration plant in Babilafuente (Salamanca, Spain) ➲ evaluation of the upscaling to commercial stage
- Focus on enzymatic hydrolysis technology
  - R&D on biological deconstruction of biomass to produce defined enzyme mixes for each specific case
  - Advance in the sugar fermentation to ethanol through the engineering of microbial systems
- Development on thermo-chemical bioethanol production via gasification and synthesis ➲ focus on synthesis catalysts development



Babilafuente biomass-to-ethanol plant (Source: Abengoa, 2006/2007)

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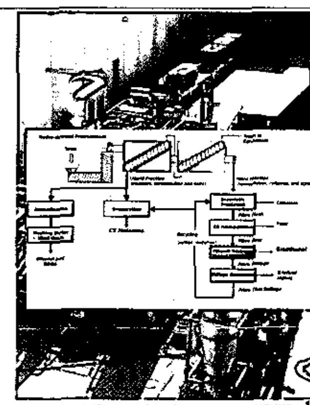
Overview of existing concepts and demonstration plants ELSAM A/S, Denmark

- Pilot plant demonstrating the complete process from straw to ethanol built on Fynsvaerket (power plant of Elsam A/S) within the frame of a large EU-project
- Capacity:1000 kg/h (straw reception, mechanical treatment and thermal pretreatment) ➲ start up in 2005
- Operation period: more than 600 hours



Pilot plant at power plant Fynsvaerket in Odense, Denmark (Source: ELSAM A/S, 2006)

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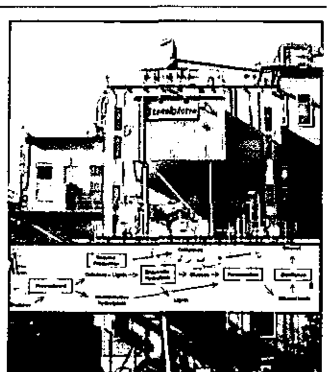
Overview of existing concepts and demonstration plants EPAB / ETEK / SEKAB, Sweden

- Pilot plant demonstrating the complete process from forestry residues to ethanol built on Örnsköldsvik within the frame of the EU-project NILE "New Improvements for Lignocellulosic Ethanol"
- Capacity: 300 to 400 l/d (approx. 2 t/d dry matter) ➲ start up end of 2006
- continues operating ethanol production inclusing two-steps dilute acid- and/or enzymatic hydrolysis
- Investment: 22 Mio. €
- Owned by holding companies of Umeå University and Luleå University of Technology (EPAB)
- Use of ethanol in bus fleets



Pilot plant at power plant in Örnsköldsvik, Sweden (Source: NILE, 2006)

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Conclusions

- Currently more than 50 million m³ of bioethanol were produced worldwide in 2006 (leader Brazil and the U.S.)
- Fermentation technologies for sugar and starch crops (1st generation) are very well developed ➲ limits, e.g. crops with high value for food application
- Use of lignocelluloses promises a larger non-food crop variety (e.g. woody and herbaceous residues and energy crops) ➲ larger capacities and in future lower costs are expected at favourable environmental effects
- Basically technologies for lignocellulosic biomass conversion to bioethanol are available ➲ three main regions have a start in cellulosic ethanol: U.S., China, EU, end of 2006 approx. 13 pilot/demo plants
- 2nd gen. demo plants (bio-chemical) are often planned as annex plants to 1st gen. plants ➲ currently no commercial operating lignocellulosic bioethanol plant
- To obtain economic performance at commercial scale a number of R&D and technological breakthroughs is required, e.g.
  - For bio-chemical plants: production of efficient and cheaper enzymes and microorganism for C5 fermentation
  - For thermo-chemical plants: similar to all BtL-fuels regarding the whole production chain
- Broader market implementation of commercial large-scale plants after 2010

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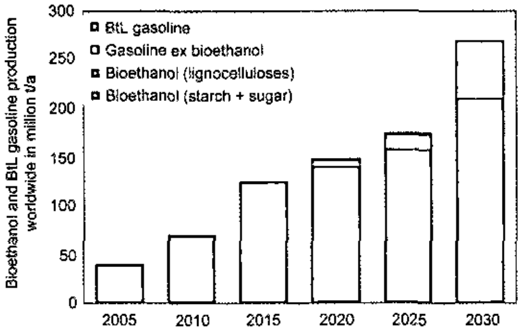
Outlook



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DEVELOPMENT OF CELLULOSIC BIOETHANOL

An overview from the European perspective

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SESSION 5-4:

BIOMASS TO LIQUID FUELS: SHARING EXPERIENCE

Colin Chin and Eric Holthusen
Shell Global Solutions (Malaysia) Sdn Bhd, Malaysia

The presentation covers the energy challenge, the development of liquid hydrocarbon fuels and how biofuels can help to meet the challenge.

The number of vehicles on the road worldwide has increased from 80 million in 1950, emitting up to 70 million tons of carbon into the atmosphere, to 900 million in 2000, emitting at least one gigaton. Over two billion vehicles are projected by 2050, with emissions amounting to two to three gigatons. The major challenge is how to supply energy for transport and industrial use in environmentally and socially responsible ways. Liquid hydrocarbons have fueled transport over the past 100 years and have evolved to meet the increasing demands of consumers and society, resulting in better performance and compliance with emission requirements. However, whilst emissions of pollutants such as NO_x, carbon monoxide and hydrocarbons have all gone down considerably; CO_2 emission remains steadily high (e.g. in Europe).

Biofuels are made from biomass, which is plant matter or organic waste and generally produce less CO_2 over the life-cycle compared to gasoline or diesel. The exact amount of CO_2 produced varies according to the feedstock and the manufacturing process used. First-generation biofuels are derived from food crops and can be used in today's cars and trucks at low concentrations such as 5%[1] or 10%[2] without engine modification, whereas modified vehicles are necessary for high concentrations such as B100[1] or E100[2]. The main challenges for first generation fuels are vehicle compatibility, lower energy density, economic, environmental, as well as social sustainability issues.

Second generation biofuels are derived from biomass residues and seen as the sustainable fuels of the future as they do not compete with food resources and have a far more favourable greenhouse gas balance. While Shell is a leading distributor of first generation biofuels, it is focusing its efforts on second generation biofuels, one of which is Biomass to Liquids (BTL). Shell's expertise in gas-to-liquid technology via Fischer Tropsch synthesis enables it to convert gas from various sources into synthetic liquid fuels, hence the term "XTL" where X could be G for Gas, C for Coal and B for Biomass. The company has a gas-to-liquid plant in Sarawak, Malaysia, using the Fischer-Tropsch synthesis process to convert natural gas to liquid fuel. The properties of Shell's XTL fuels are identical irrespective of source, and far exceed the requirements of the EN590 specification for diesel. XTL contains no sulfur, has a cetane number of over 75, has a lower carbon/hydrogen ratio and a very high calorific value. Its benefits have been demonstrated by Shell in both heavy and light duty vehicle trials as well as on the racetrack.

---

1 Diesel engines

2 Gasoline engines

The concept of Shell BTL fuel is the combination of the advantages of its XTL fuel and the use of sustainable biomass feedstocks which gives a reduction of up to 90% in greenhouse gas emissions on a well-to-wheels basis compared with fossil diesel. Shell, in collaboration with Choren Industries, has therefore been researching the production of synthetic diesel from biomass residues such as wood industry waste and forest and agricultural residues. Integrating the expertise of Choren's gasification and Shell's Fischer-Tropsch, the Carbo-V® BTL process has been developed to produce a premium quality synthetic diesel which is fully compatible with conventional hydrocarbon diesel engines and carbon neutral at the same time. The first industrial-scale (Beta) plant, with a capacity of 15,000 tons per year, is under construction in Germany and expected to start up in 2008. A full-scale commercial (Sigma) plant of 200,000 tons per year is under planning.

(Colin.Chin@Shell.com)

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Biomass to Liquid Fuels

Shell Global Solutions (Malaysia) Sdn. Bhd.

MPOB International Conference on Biofuels

5-6[th] July 2007

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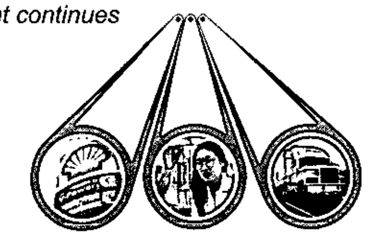
Shell. The evolution of movement continues



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(j) legislative, fiscal and regulatory developments including potential litigation and regulatory effects arising from recategorisation of reserves,(k) economic and financial market conditions in various countries and regions; (l) political risks, project delay or advancement, approvals and cost estimates; and (m) changes in trading conditions. All forward-looking statements contained in this presentation are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Each forward-looking statement speaks only as of the date of this presentation Neither Royal Dutch Shell nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this document. The United States Securities and Exchange Commission (SEC) permits oil and gas companies, in their filings with the SEC, to disclose only proved reserves that a company has demonstrated by actual production or conclusive formation tests to be economically and legally producible under existing economic and operating conditions. We use certain terms in this presentation, such as "oil in place" that the SEC's guidelines strictly prohibit us from including in filings with the SEC. U.S. investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575 and disclosure in our Forms 6-K file No, 1-32575, available on the SEC website www.sec.gov. You can also obtain these forms from the SEC by calling 1-800-SEC-0330.

4

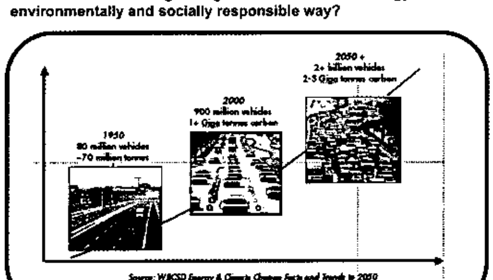
Content overview

- **The energy challenge and the development of liquid hydrocarbon fuels**
- **How Biofuels will help to meet the challenge**
  - Biofuel options
  - Shell-CHOREN BTL process
  - Shell BTL fuels
- **Conclusion**

5

The Energy Challenge:

- **How can we meet the growing demand for secure energy in an environmentally and socially responsible way?**



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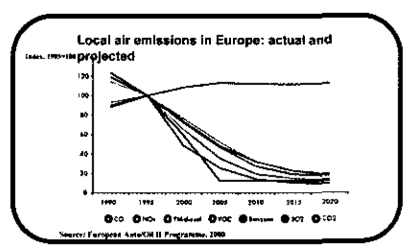
Liquid hydrocarbons have fuelled movement for over 100 years. Fuels have evolved to meet increasing demands of consumers and society...

- High energy density
- Wide range of products
- Technology and infrastructure established
- Cost-effective

Additive technology:
- Improve performance
- Greater flexibility



Cleaner road transport fuels have enabled the introduction of cleaner vehicle technologies

7

Introduction to biofuels

- **Made from biomass – plant matter or organic waste**
- **Generally produce less CO_2 over life-cycle compared to gasoline/diesel**
- **Vary by feedstock, manufacturing process, CO_2 production and cost**
- **Can be used in today's vehicles at low concentration blends with petrol/diesel**
- **Higher concentrations typically require modified vehicles**
- **Can contribute to increased energy security and economic development**

First generation biofuels made from food crops e.g. rapeseed, soyabeans

Second generation biofuels made from agriculture /forestry residues e.g. straw, woodchips

Challenges / limitations:
- Lower energy density
- Typically more expensive
- Sustainability issues (first generation biofuels)

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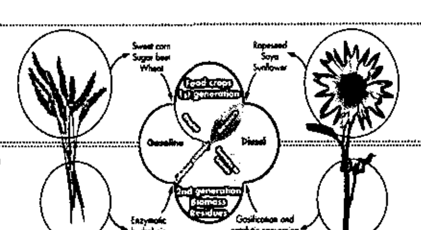
Shell has invested in leading biotechnology companies to help commercialise second generation biofuels

First generation biofuel

Second generation biofuel



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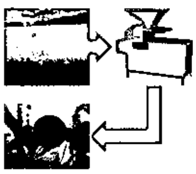
Biofuels options for Diesel

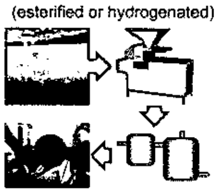
0th generation
Straight vegetable oil



Not approved by OEMs

⇨ **unsuitable**

1st generation
biofuels from food crops (esterified or hydrogenated)



EN 590 allows 5% vol in Diesel; some modified engines approved by OEMs for higher concentrations, including 100% ⇨ **suitable**

2nd generation
biofuels from crop residues and wood

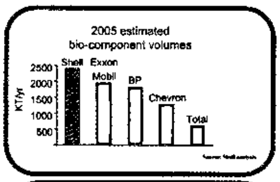
Fully compatible with Diesel, same properties as XTL

⇨ **Superior performance**

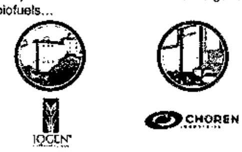
10

Shell is a leading distributor of first generation bio-fuels and we're investing in second generation biofuels that offer greater benefits...

- Distributed biofuels for over 30 years
- A leading biofuel distributor today
- Sold over 3.5 billion litres biofuel in 2006 – enough to avoid ~3.5 million tonnes CO_2

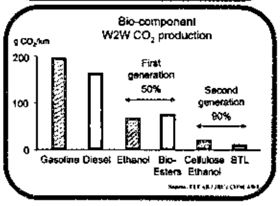


Shell is investing in R&D and bio-technology companies to commercialise second generation biofuels...



Cellulose Ethanol from straw

Biomass to Liquids (BTL) from woodchips



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Biomass to Liquids - using XTL technology for biomass

- **Biomass to Liquids (BTL) fuel is identical synthetic product to Gas to Liquids (GTL) fuel**
- **BTL offers significant reductions in local emissions as well as significant reductions in W2W CO_2 production**
- **Shell's leadership in XTL and BTL is widely recognised**

In 2005, Shell and Volkswagen scientists were awarded the **Professor Ferdinand Porsche Prize** for advancements in automotive engineering for their work in XTL and BTL development.

Right: Dr Wolfgang Warnecke (Shell)

Left: Dr Wolfgang Steiger (VW)

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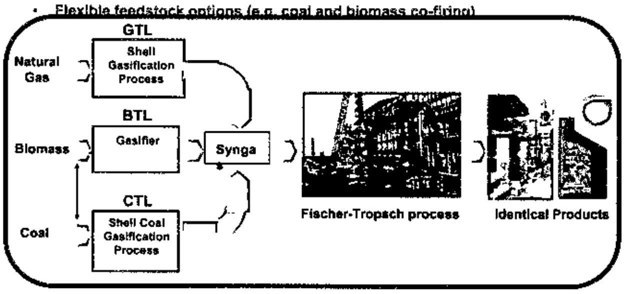
XTL – Synthetic fuel from gas, coal and biomass

- **XTL Synthetic fuel refers to liquids from gas (GTL), coal (CTL) and biomass (BTL)**
- **Products from gas, coal and biomass are identical**
- **Flexible feedstock options (e.g. coal and biomass co-firing)**



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Reasons for XTL

- **Excellent fuel properties (next slide)**
- **Supply diversifcation**
  - It is a gas-derived, rather than an oil-derived product, thus providing strategic diversification of energy supply.
- **XTL fuel can provide a bridge to future fuels and technologies, as:**
  - It is an enabler for new ultra-efficient exhaust filter devices.
  - It can be used in diesel-electric hybrid vehicles.
  - Auto makers can utilize it to develop improved engines and drive-trains
  - XTL technology provides a platform for development of Biomass to Liquids (BTL) and Coal to Liquids (CTL) products with identical chemical composition.

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Properties of XTL fuels

- **Properties and benefits of XTL fuels**
  - Colourless,
  - Odourless
  - Virtually free of suphur and
  - Virtually free of aromatics.
  - High cetane number (75-80)
  - Significantly reduces local emissions (PM, NOx, CO, HC)
  - Compatible with existing compression ignition engines and diesel infrastructure
  - Readily biodegradable
  - Generally a less toxic product than refinery diesel fuel

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Properties of Shell XTL

Property		EN590 spec. for Diesel	XTL (neat)	Implications
Sulphur content	ppm	50	⇩ zero	better performance with sulphur sensitive after-treatment systems
Density	kg/m³	820 to 845	⇩ 760	Higher volumetric fuel consumption**
Cetane		51	⇧ >75	Better ignition Better combustion
C/H ratio		~6.5*	⇩ 5.7	Lower engine out CO_2 emissions Lower engine out emissions
Calorific value	MJ/kg	~42.5*	⇧ 43.5	Lower gravimetric fuel consumption**

* Typical value (not specified in EN590)

**The combination of low density and high calorific value leads to a small increase in volumetric fuel consumption

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Shell GTL trials

Shell has demonstrated the benefits of GTL Fuel in heavy and light duty vehicle trials and on the race track!

UK: Toyota

- 3 month trial with 10 unmodified Toyota Avensis cars
- Compared to "zero sulphur" diesel (10 ppm S):
  - 73% reduction in hydrocarbons,
  - 94% reduction in CO,
  - 25% reduction in PM

UK: London Bus

- 3 months on 507 bus, which ran at peak hours

Germany: Volkswagen:

- 25 Volkswagen Golf cars for five months
- Emissions compared to Euro-3 light duty engine
  - 25% lower particulates,
  - 6% lower nitrogen oxides,
  - 63% lower hydrocarbons, and
  - 91% lower carbon monoxide.
  - Will comfortably meet the stringent future Euro 4 emission limits

France: Le Mans

- In 2006 and 2007 the Shell V-Power Diesel race fuel, containing GTL, powered the Audi R10 TDI to victory LeMans

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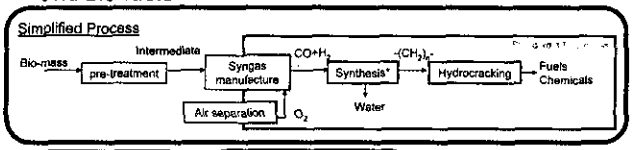
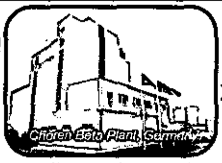
Shell BTL fuel combines advantages of Shell XTL fuel and bio-fuels





BTL/Diesel blends

BTL offers reduced emissions and can be used in existing infrastructure.

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Biomass to liquids

- **BTL gives up to 90% reduction in greenhouse gas emissions on a well to wheels basis compared to fossil diesel**

Source: GM well-to-wheel analysis of energy use and greenhouse gas emissions of advanced fuel/vehicle systems – A European study

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Source of biomass

- **Supply of biomass for could come from:**
  - agricultural biomass,
  - forestry biomass and
  - biogenic waste and recycling substances,
  - wood-processing industry and farms (straw).
- **In the long term, the raw materials will increasingly come from agricultural sources around the plant because**
  - It is easiest to expand biomass production on farmland.
  - Transportation costs can be lower

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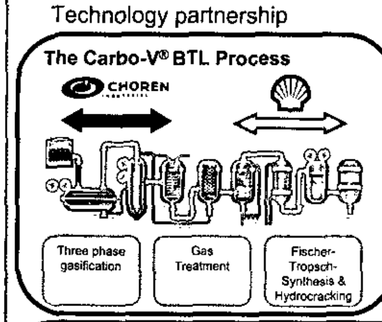
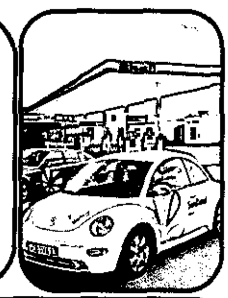
Technology partnership





Shell's* partnership with CHOREN is working to make Biomass to Liquid fuel a commercial reality…

* Shell holds a minority stake in CHOREN Industries

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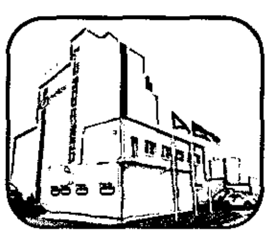
CHOREN BTL plants

- **Pilot plant**
  - 2,000 tons/year since October 2003 – 2005 (non-Shell FT technology)
- **First industrial-scale (Beta) plant to be built in Freiberg, Saxony (Germany)**
  - 15,000 tons/year
  - Utilizes 75,000 tons/ of woodchips and straw
  - 2008 start up
- **Full-scale commercial (Sigma) plant**
  - 200,000 tons/year
  - Under development



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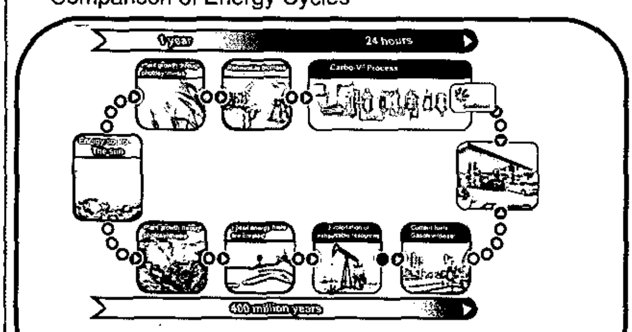
Comparison of Energy Cycles

CHOREN



Following nature's example – but much faster!

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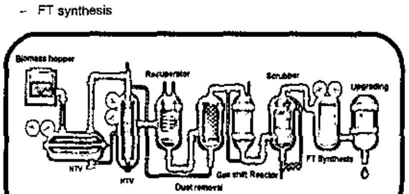
The Carbo-V® BTL Process

- **The Carbo-V® BTL Process is a three-stage gasification process involving the following sub-processes:**
  - low temperature gasification,
  - high temperature gasification and
  - endothermic entrained bed gasification.
  - FT synthesis



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The Carbo-V® BTL Process

- **First stage (low temperature gasification/pyrolysis)**
  - Biomass is continually carbonized through partial oxidation with air or oxygen
  - Temperatures around 400 and 500 °C
  - Products: gas containing tar (volatile parts) and solid carbon (char).
- **Second stage (high temperature gasification)**
  - Gas is post-oxidized hypostoichiometrically using air and/or oxygen
  - Temperature: above the melting point of the fuel's ash (around 1400°C)
  - Product: hot gasification medium.
- **Third stage (endothermic entrained bed gasification)**
  - Char is ground down into pulverized fuel
  - Pulverized char and hot gasification medium react in the gasification reactor to produce raw synthesis gas
  - After treatment the raw synthesis gas is used as a combustible gas for generating electricity, steam and heat or as a synthesis gas for producing synthetic diesel.

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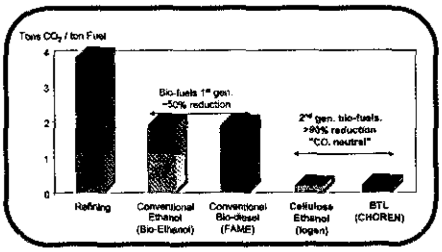
Shell BTL and CO_2



(Shell, EU GM LBST Report, Concawe Bio-fuel Report 2002)

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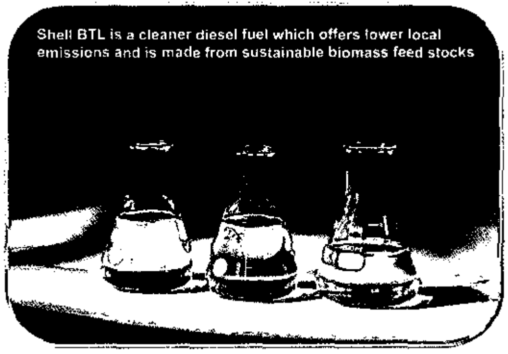
Conclusion



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Disclaimer statement

Shell Global Solutions is a network of independent technology companies in the Shell Group. In this presentation, the expression 'Shell Global Solutions' is sometimes used for convenience where reference is made to these companies in general, or where no useful purpose is served by identifying a particular company.

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Thank You !

Session Chairperson
Datu Dr. Michael Dosim Lunjew
Secretary General
Ministry of Plantation Industries and Commodities
Malaysia

SESSION 6:

Chairperson:
Michael Dosim Lujnew, Ministry of Plantation Industries and Commodities, Malaysia

Panelists:
Kandeh Yumkellah, United Nations Industrial Development Organization, Austria
Gustavo Best, Food and Agriculture Organization, Italy
James Fry, LMC International Ltd., UK
Anhar Suki, Golden Hope Plantations Sdn Bhd., Malaysia

Summary:

Under the moderation of Mr. Dosim Lunjew, the panelists were each asked to express their views regarding the theme of the session, "Is it a sustainable and viable business?", for about ten minutes per person. After that, the floor was opened for a question and answer session. Eleven questions were entertained during the time allowed. It is *unfortunate that it is not possible to provide a comprehensive record of this session* here, due to a technical problem encountered. However, the panelists' views were more or less in line with the speech or presentations they had made prior to this session. It is suggested that interested readers may refer to their speech or presentations. The panel discussed the conditions that sustain the biofuels business, such as choice of the right feedstock, the right land to be used and so forth. In this connection, there was a remark by a panelist that "We must make biofuels sustainable" instead of asking if this business is sustainable. One panelist mentioned that with government support around the world, the business is viable but not as easy as it once looked. Another commented that biofuels can be produced and supplied sustainably and the question here should rather be whether or not there is a sustainable demand for them at the right price.

ACEA	Advisory Committee on Environmental Aspects
AR4	Fourth Assessment Report
ASTM	American Society for Testing and Materials
BD	Biodiesel
BioAS	Bio Software Application System
BOD	Biochemical Oxygen Demand
BOE	Barrels of Oil Equivalent
BOI	Board of Investments (Philippine authority)
BtL/BTL	Biomass-to-Liquid
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFB	Circulized Fluidized Bed
CFPP	Cold Filter Plugging Point
CH ratio	Carbon Hydrogen Ratio
CHP	Combined Heat and Power
CME	Coco Methyl Ester
CNG	Compressed Natural Gas
CO_2 eq	Carbon Dioxide equivalent
COD	Chemical Oxygen Demand
COGEN	Cogeneration
CP	Cloud Point
CPKO	Crude Palm Kernel Oil
CPO	Crude Palm Oil
CSTR	Continuous Stirred Tank Reactors
CtL/CTL	Coal-to-Liquid
DDGS	Distillers Dried Grain and Solubles
DG TREN	Directorate-General for Energy and Transport
DI	Direct Injection
DIN	Deutsches Institut für Normung (German Institute for Standardization)
DME	Dimethyl Ether
DOE	Department of Energy
DPF	Diesel Particulate Filter
DST	Decision Support Tools
dwb	dry weight basis
E&P	Energy and Petroleum
EBB	European Biodiesel Board
ECU	Electronic Control Unit
EE	Energy Efficiency
EFB	Empty Fruit Bunch
EGR	Exhaust Gas Recirculation
EIT	Economies in Transition
EO	Executive Order
EPAB	Eskilstuna Plåtförändring AB
ERI	Energy Research Institute
ETBE	Ethyl Tertiary Butyl Ether
ETEK	Etanolteknik AB
EtOH	Ethanol
ETP	Effluent Treatment Plant
EU	European Union
FAME	Fatty Acid Methyl Ester
FAO	Food and Agriculture Organization
FAR	Food & Agriculture Research & Advisory
FDI	Foreign Direct Investment
FFA	Free Fatty Acids
FFB	Fresh Fruit Bunch
FFV	Flex Fuel Vehicles
FIE	Fuel Injection Equipment
FIMA	Food Industries of Malaysia
FOB	Free on Board
FOREX	Foreign Exchange
FT diesel	Fischer-Tropsch diesel
GBC	Global Biofuels Center
GBEP	Global Bioenergy Partnership
GCE	Glycerol Carbonate Ester
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GRI	Gas Research Institute
GT	Global Trade
GtL/ GTL	Gas-to-Liquid
HC	Hydrocarbon
IBEP	International Bioenergy Platform
IBIS	International Bioenergy Information System
ICS	International Center for Science and Technology
IE	Institute for Energy and Environment
IEA	International Energy Agency
IFQC	International Fuel Quality Center
IMPCA	International Methanol Producers and Consumers Association
IPCC	Intergovernmental Panel on Climate Change
ITH	Income Tax Holiday
JME	Jatropha Methyl Ester
JOME	Jatropha Oil Methyl Ester
KBPD	Thousand Barrels per Day
kWe	Kilowatt Electricity
Lakh	hundred thousand

LCA	Life Cycle Assessment
LNG	Liquified Natural Gas
LPG	Liquified Petroleum Gas
ME	Methyl Ester
MMSA	Methanol Market Services Asia
MOME	Mahua Oil Methyl Ester
MPOB	Malaysian Palm Oil Board
MSW	Municipal Solid Waste
MTBE	Methyl Tertiary Butyl Ether
MtOH	Methanol
MW	Molecular Weight
NG	Natural Gas
NOME	Neem Oil Methyl Ester
NOx	Nitrogen Oxides
OECD	Organization for Economic Cooperation and Development
PC	Passenger Car
PED	Primary Energy Demand
PETROBRAS	Petróleo Brasileiro S.A.
PFAD	Palm Fatty Acid Distillate
PKC	Palm Kernel Cake
PKO	Palm Kernel Oil
PM	Particulate Matter
PME	Palm Methyl Ester
PO	Palm Oil
POME	Palm Oil Mill Effluent
pp	pour point
ppm	parts per million
QC	Quality Control
R&D	Research and Development
RABR	Reversible Flow Anerobic Baffled Reactor
RBD	Refined, Bleached and Deodorized
RFS	Federal Renewable Fuel Standard
RITE	Research Institute of Innovative Technology for the Earth (Japan)
RM	Malaysian Ringgit
RSPO	Round Table for Sustainable Palm Oil
RVP	Reid Vapor Pressure
SEA	South East Asia
SEKAB	Svensk Etanolkemi AB
SI	Spark Ignition
SIRIM	Standard and Industrial Research Institute of Malaysia
SOME	Sal Oil Methyl Ester
SRA	Sugar Regulation Administration
SRES	Special Report on Emissions Scenarios
SWOT	Strengths, Weaknesses, Opportunities and Threats
TB	Thousand Barrels
TBME	Tert-Butyl Methyl Ether
tCO_2	tonnes of CO_2 equivalent
TPA	Tons per annum
TtW	Tank-to-Wheels
ULSD	Ultra-Low Sulfur Diesel
UNIDO	United Nations Industrial Development Organization
UOP	Universal Oil Products
WE	Wood Energy
WISDOM	Wood Fuel Integrated Supply/Demand Overview Mapping
WTO	World Trade Organization
WtT	Well-to-Tank
WtW	Well-to-Wheel
XtL/XTL	(Biomass, Gas or Coal)-to-Liquid

Index

The symbol "~" is used to substitute for the wording of the main entry in order to avoid having to repeat that wording in sub-entries.

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