Biodiesel Markets in the World

Trends & Future Developments

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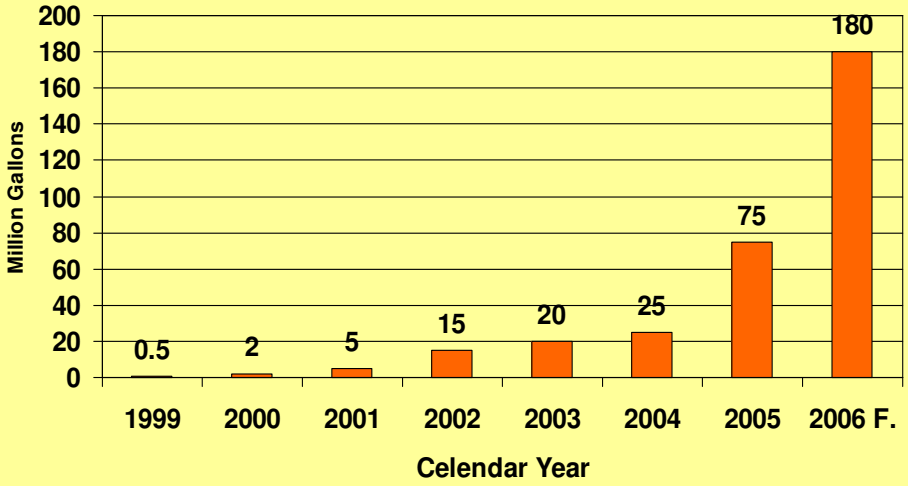
- Biodiesel Markets
- Drivers, Opportunities & Threats
- Trends & Future Development
- Conclusions

Global Biodiesel development

- EU in driving seat
- US following fast
- Many other countries join the production and commercialization route: Malaysia & Indonesia; Argentina & Brazil; China; India; ...
- Total production capacity:
  - Today: 7-8 MMT
  - 2009: 16 MMT expected
  - 2020: > 25 MMT?

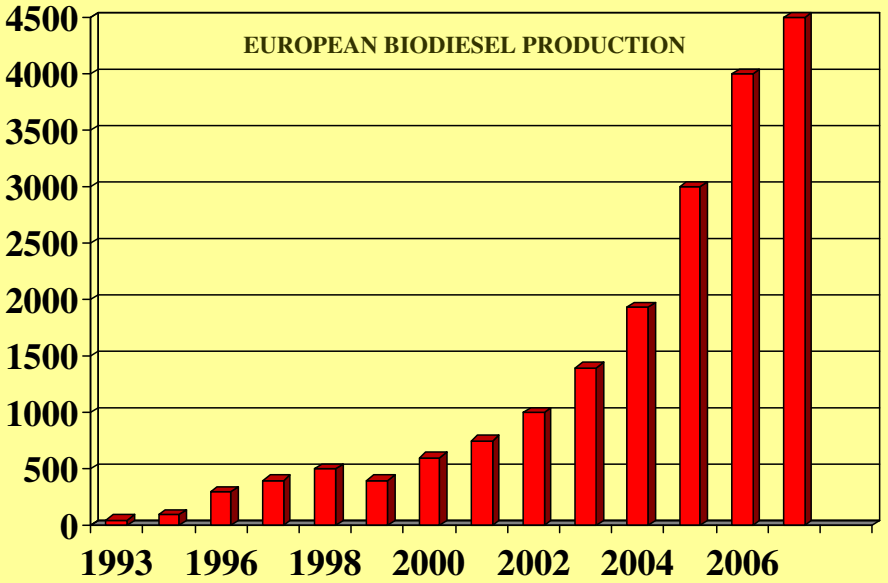
Snapshot view of the World Biodiesel Market



USA – SLOW START (Incentives since 2005)

CAPACITY: ~1.7MMT growing to 3.6MMT by 2008

80% based on Soybean Oil; consolidation and bigger projects



EUROPE – LARGEST BIODIESEL PRODUCER & USER

Capacity will double from 2005 to 2008

Based on Rapeseed Oil and growing use of Soybean Oil and (some) Palm oil

MALAYSIA & INDONESIA – AMBITIOUS PROGRAMS based on Palm oil

MALAYSIA (5MMT capacity end of 2007); INDONESIA (1.55MMT by 2008)

BRAZIL, ARGENTINA based on Soy and Sunflower seed oil (3 MMT in 2008)

CHINA, INDIA, KOREA, THAILAND, COLUMBIA, TURKEY, …

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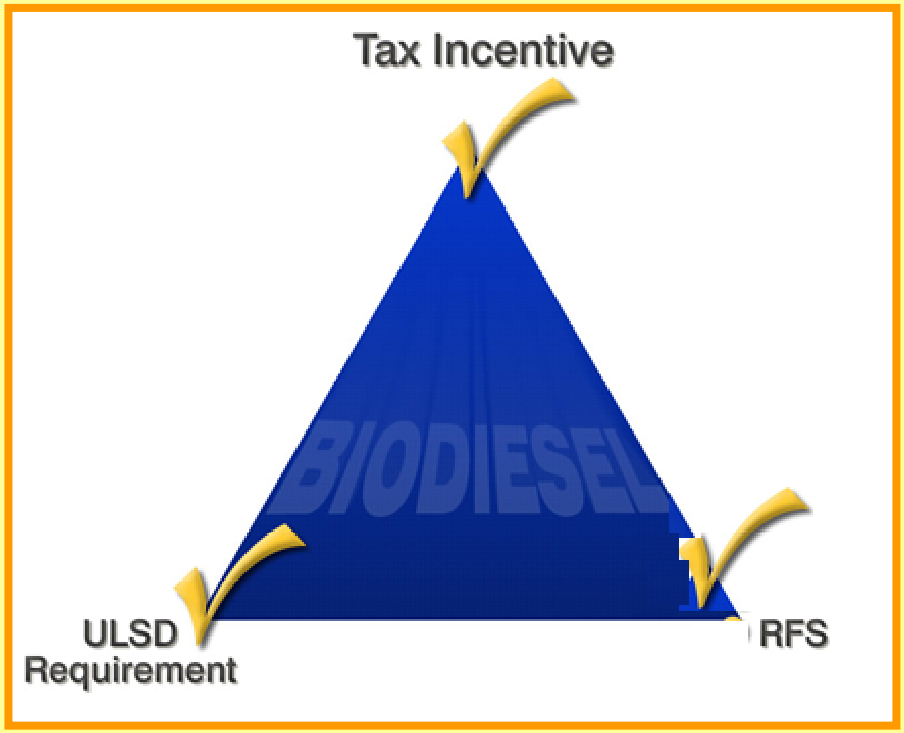
The Biodiesel Opportunity

Tax incentive compensating for cost difference with fossil diesel

High fossil petrol price



Technical Advantages:

Lubricity in Ultra Low Sulfur Diesel

Reduced Emissions

Renewable Fuel Standards

- EN 14214
- ASTM D 6751
- Testing

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Biodiesel in the EU

- Directive 2003/30/EC, May 20, 2003
  - The promotion of the use of biofuels or other renewable fuels for transport
- Target:
  - 5.75% of transport energy is bio-based in 2010
  - Mandatory 10% in 2020 (in preparation)
- Objectives:
  - Promoting biofuels to replace diesel or petrol for transport
  - Meeting climate change commitments
  - Environmentally friendly
  - Security of supply
  - Promoting renewable energy sources

EU: Detaxation and Energy Premiums for Oilseed Crops

- Detaxation: taxes on diesel fuel in Europe are on average about $450/m³ (€326 to 417 per MT)

⇒ pump price of diesel ≈ the same level as the biodiesel price without tax

- Energy crop premiums for direct use in energy generation
- Creating extra income for farmers
  - Originally coupled to the production of vegetable oil on set-aside land
  - Today also with Energy premiums supporting production
  - Growing world demand creates interesting business opportunities

Towards an EU Energy Policy

EC proposals – January 10, 2007

- "Road Map on Renewable Energies"
  - Mandatory target of 20% of all energy for 2020
  - 10% Market share of biofuels by 2020
  - Sustainable production of biofuels
  - New EU legislation on heating & cooling energy sources
  - National Action Plans on how to achieve the targets
- Revision of Directive 98/70 on Fuel Quality
  - Reduction of 1%/yr of CO_2 emissions from fuels (2010-2020)
  - In practice: 1.5%-1.7% biodiesel consumption decrease per year
- Revision of Directive 2003/30 (biofuels)
  - Umbrella Directive on renewable energies (summer 07)
  - Main issues: support policies, policy mix, assessment of CO_2 impact
- Biofuels are the cornerstone of the EU proposed Common Energy Policy

Impact of Proposals and Road Map

- 10% target for transport fuel = 25-28 MMT in 2020
- End of national detaxation schemes?
- Revision of the Directive on Fuel Quality: strengthens the impact
- Positive conclusions of the European Council
  - Rapid implementation should follow
  - Policies and standards to be adapted in the next months
- Increase B5 to B10 for common transport use
  - Without extra labelling
  - Without creating a separate biodiesel market!
  - How will car and fuel manufacturers react?

Biodiesel in the EU: Supply vs. Demand

- Assuming there are no feedstock limitations
- Overcapacity in the short/medium term
- Scenario A (biodiesel/bioethanol 50:50)
  - Ongoing excess capacity
  - After 2010: biodiesel demand-capacity gap decreases
- Scenario B (biodiesel/bioethanol 70:30)
  - From 2007: biodiesel demand-capacity balanced
  - After 2010: further capacity needed
- *Problem?: present cap on 5% blend in EN590 spec*

	2005	2006	2007	2008	2009	2010	2011	2012
Targets by Directive (%)	2.00	2.75	3.50	4.25	5.00	5.75	7.00	9.00
Scenario (A) kT	2.90	4.90	6.60	8.20	9.70	11.60	14.00	16.00
Scenario (B) kT	2.90	4.90	***9.24***	***11.48***	***13.58***	***16.24***	***19.60***	***22.40***
Plant Capacity (kT)	3.80	7.20	10.10	12.10	15.50	***17.00***	***19.00***	***21.00***

The European Dilemma

2005

- Total O&F in Europe: 22.2 MMT **[O&F balance: deficit = 28%]**
  - 15.9 MMT own production
  - 6.3 MMT [O&F as such or as oilseed: imports (7.6 MMT) – exports (1.3 MMT)]
- Biodiesel 3.2 MMT
- Total Diesel 133.5 MMT (transport only; growing!)
- Biodiesel > 2%

2010 (at the same food and diesel consumption level)

- Biodiesel target 2010: 5.75%, or 10-12 MMT
- DIFFERENCE = 7-8 MMT, equivalent with
  - **> 5 million ha extra rapeseed production?**
  - **More imports of O&F for Food or Technical?**

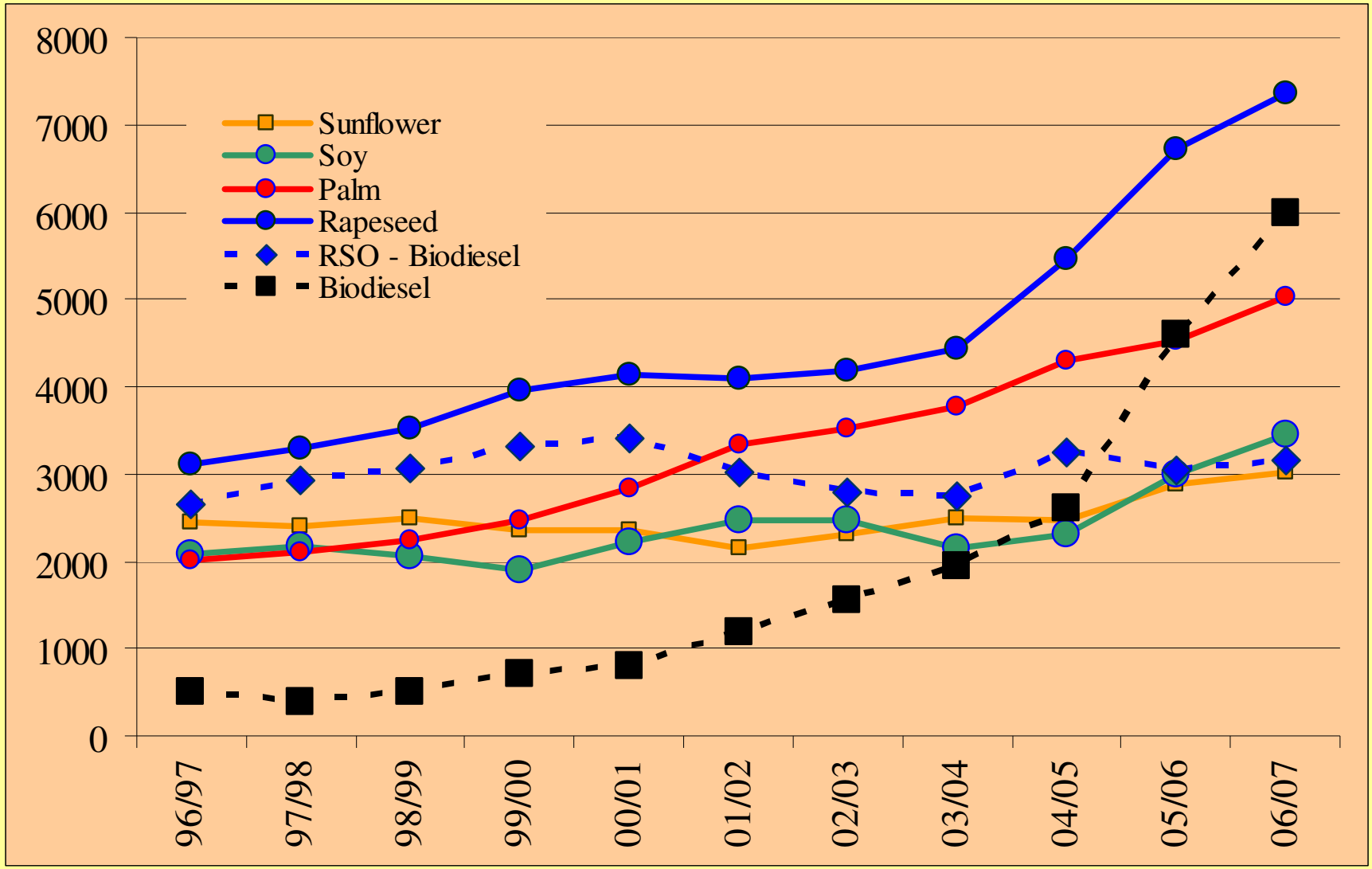
⇨EU-27 O&F balance: deficit will quickly grow to MORE THAN 47%

Available Options

a. Produce more rapeseed
b. Import more rapeseed
c. Export less rapeseed
d. Import more RSO
e. Export less RSO
f. Less RSO for other applications
g. Increase % biodiesel produced from soybean, sunflower seed, palm oil, and recycled O&F
h. Import biodiesel

- Initially: a to f
  - Depends on price and availability of rapeseed/ rapeseed oil on the world market
  - (a) limited potential; (f) difficult for other users (food, feed, tech)
- Today: g & h
  - Other oils could easily be used in blends
  - This requires more research (incl. engine tests)
  - Recycled oils don't fit well on the mass fuel market
  - More feasible at high RSO price
  - This requires investments in biodiesel plants in other countries

European O&F Market



Source: Oil World Statistics, Hamburg

U.S. Biodiesel Incentives

- Energy act of 2005: $1 per gallon or $294 per MT for biodiesel made from virgin oils and fats
  - Tax incentive for biodiesel made from inedible animal fats and used vegetable oils is $0.50 per gallon
- This is equal to $42 per barrel (159.2 liters)

Biodiesel in the U.S.: Opportunity for Vegetable Oils & Fats

2006/07: Total O&F in U.S.A.: 16.9 MMT

= 15.4 MMT own production + 1.5 MMT [O&F: imports (2.7 MMT) – exports (1.2 MMT)]

And additionally: - 5.8 MMT O&F equivalent [oilseeds: exports as 28 MMT SB and other oilseeds]

Of which:

Only 1-1.2 MMT Biodiesel

Consolidated O&F Balance for the US is down to 25% surplus (from more than 45% just two year ago)

Biodiesel in Oil Supply Side Countries

Malaysia & Indonesia

- Huge investments in capacity ongoing (>6 MMT in 2008!)
- Based on palm oil methyl esters with limited use in colder climate
- Creates new outlets for local oil products
- Very competitive price at current oil price level

Brazil & Argentina

- More diverse investments in capacity ongoing (> 3 MMT in 2008!)
- Based on soybean oil and some sunflower seed oil methyl esters
- Creates new outlets for local oil products
- Competitive price at current oil price level

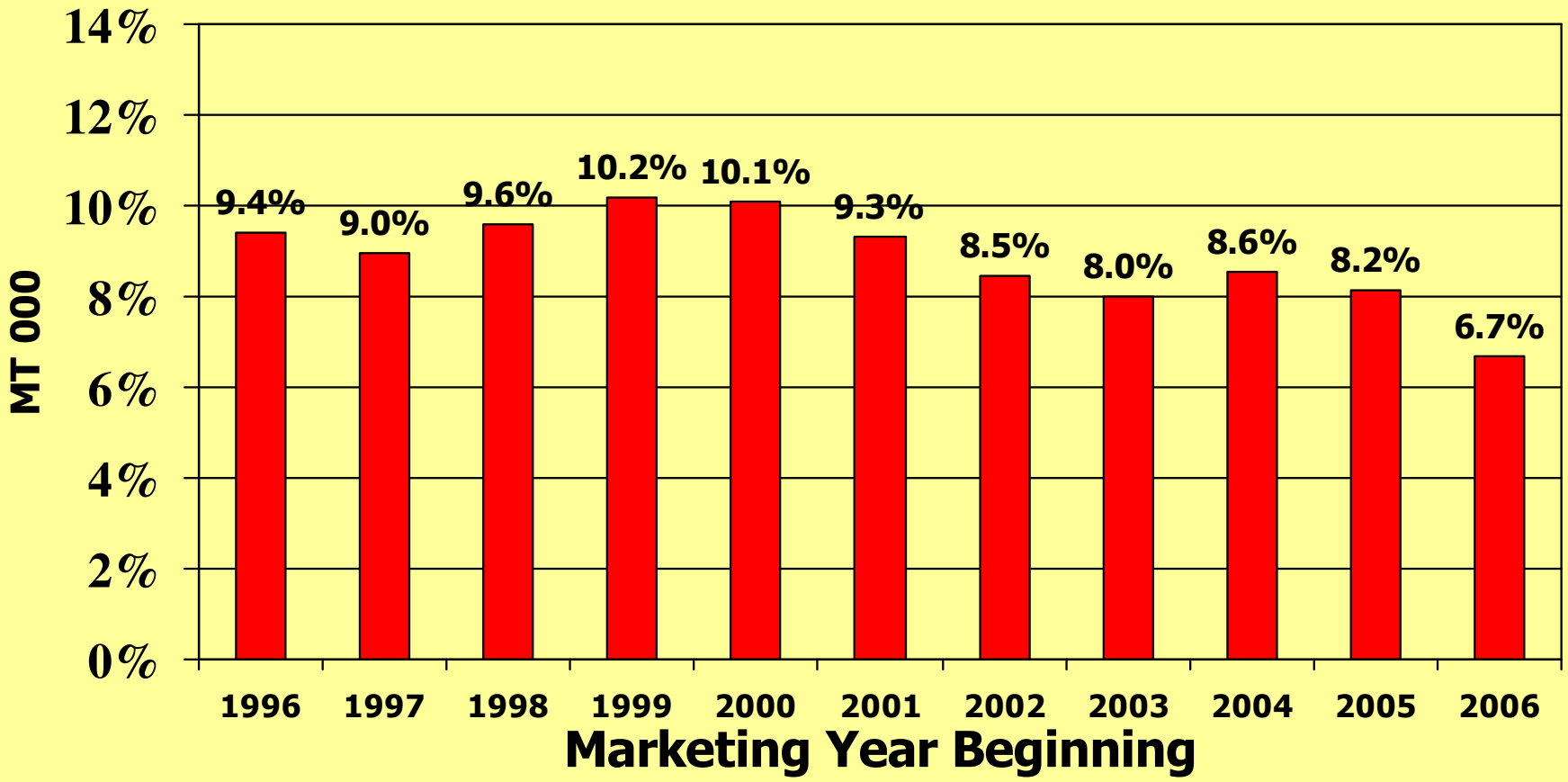
Export directed production surfing on tax incentives in importing countries (DETs on export side!)

Strong growth will take away more O&F from the World Market

Global ENDING STOCKS to USE

(Ratio for Soybean Oil)

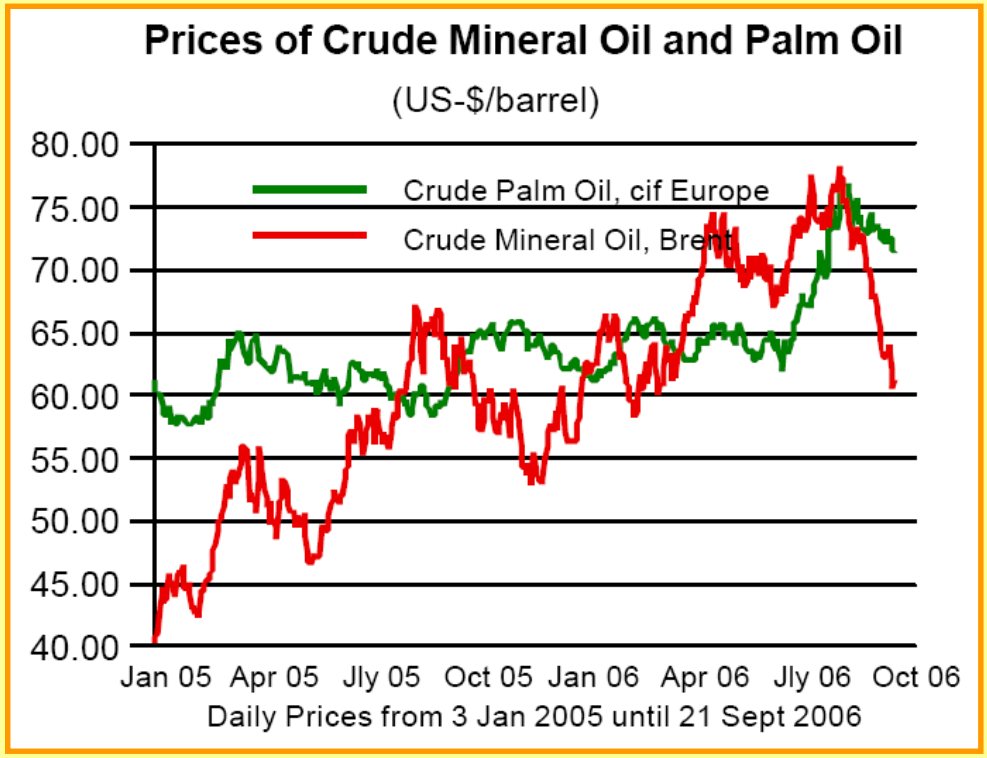
Lowest ratio forecasted for 2006/07 since 1974/75



Source: John C. Baize and Associates

World Oil Prices: a new Paradigm

- ¬ Since summer 2005 Palm Oil (and Rapeseed Oil) price are directly linked to mineral oil price (in EU); Soybean Oil linked since summer 2006 (EU & US)
- ¬ Since Spring 2007, all major oil listed at real energy price corrected for tax incentives
- ⊕ Mandatory mixing of biodiesel makes vegetable oil prices less susceptible to the volatility of energy prices



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	31 May 2007	Oct-Apr 06/07	Oct/Sep 05/06
Palm oil crude cif N.W. Europe	**825**	**596**	**452**
Palm oil RBD Malaysia fob	830	561	416
Palm oil crude Indonesia fob	790	394	543
Palm olein RBD Malaysia fob	835	569	422
Palm olein RBD Malaysia cif Rotterdam	**905**	**631**	**489**
Palm stearin RBD Malaysia fob	805	523	393
Palm stearin RBD Malaysia cif Rotterdam	**875**	**586**	**460**
Soybean oil Dutch fob ex-mill	**817**	**697**	**573**
Soybean oil Brazil fob	761	625	475
Soybean oil Argentina fob	740	620	469
Rape oil Dutch fob ex-mill	**840**	**802**	**770**
Rape oil Hamburg fob ex-mill	**840**	**805**	**771**
Sunoil EU fob N.W. European ports	**870**	**716**	**635**
Sunoil Argentina fob	786	634	544
Sunoil fob Black Sea	790	637	549
Cotton oil US PBSY fob Gulf	909	710	669
Corn oil US fob Midwest	728	614	555
Corn oil US fob Gulf	810	694	638

Source: ISTA Mielke GmbH, Weekly price update, © Copyright 2007

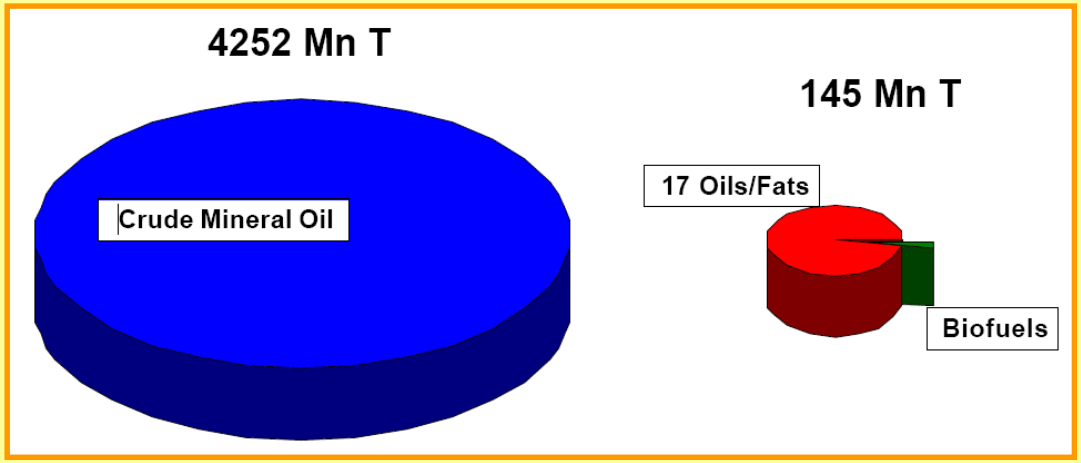
"Growing use of cereals, sugar, oilseeds and vegetable oils to satisfy the needs of a rapidly increasing biofuel industry is one of the main drivers [for the growing demand for agriculture products]" (Joint report by the OECD & FAO)

⇒ FOOD or FUEL debate is heating

Global Oils & Fats supply & demand

- MY 05/06: Oils & Fats supply 145 MMT (includes 35 MMT palm, 35MMT soy, 15MMT rape, other 20 MMT + 30+MMT animal O&F)
- Food consumption grows at 1-2% per year (2 MMT)
- Global O&F production is rising
  - Malaysia & Indonesia continue to increment palm oil production.
  - Large export of soybean oil from US, Argentina and Brazil reduced in near future due to sharp domestic demand.
  - EU25 domestic vegoil production cannot keep pace with the increasing demand but will increase by replacing some grain and acreage (or just the opposite? See Bioethanol planning)
- Short term shortage ⇒ price increase ⇒ decrease demand ⇒ equilibrium.
- Midterm: more optimistic; but corn and soy compete for acres in the US

Another key factor: meal consumption (strongly disturbed supply & demand)



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Future Biodiesel scenario

- **Political support: must remain strong to keep momentum**
  - Energy security
  - Environmental (Kyoto ….)
  - Agricultural diversification
- **Legislation**
  - Biofuel target from 5.75% up to 10% in Europe and other regions
  - Mandatory blending a major driving force
  - B10 specs needed on World Wide Fuel charter level
- **Diesel demand**
  - Increasing “dieselization” in Europe and many other regions ⇒ local diesel shortage
  - Good acceptance as biofuel
  - Move to next generation biofuels
- **Pricing**
  - Ongoing high petroleum prices (above 60 $ barrel)

Future Developments (1): Changing Oils & Fats Supply

- Raw material selection for biofuels expands
- Blending to make best fit at lowest cost is growing
- Biofuel industry competes for same raw materials with the food sector ⇒ food sector suffers, especially in developing countries
- Cost efficiency wins with decreasing incentives
- Quality & specification requirements get more restrictive: need to comply with increasing environmental and performance requirements

Rapeseed and Sunflower Seed Benefit from Biodiesel

- More oil per hectare
  - Soybeans: only 19% oil (500 kg per hectare or less)
  - Rapeseed, sunflower seed: 40-50% oil (1.2-1.6 MT per ha)
- Rising vegoil prices cause greater price benefit to rapeseed and sunflower seed than to soybeans
- Lower additional meal output less disturbing for animal feed market
- Competition with corn for ethanol further shrinks growth potential for soybean oil in US, Brazil and Argentina

➢ Many countries might grow more soft seeds

➢ Countries with superior logistics will win, even with soybean oil

Palm Oil
another Mid-Term Winner

Pro

- More than 4 MT oil per hectare
- Unbeatable low production cost

Contra

- Slow production increase leads to instability in the world market for Oils & Fats
- More suitable for direct energy production; limited use in biodiesel blends
- Questions about sustainability and environmental damage

Food vs. Fuel: alternative oils for fuel

- Recycled O&F and paper mill Tall oil valorization
- Mamona: seed with 40 to 60% oil; production around 1,5 MMT per year; leading producing areas are India, China and Brazil.
- Algae: experiments confirm a crude oil content of about 35%.
- Jatropha: used as a fuel oil, high attention in India, Maleysia, the Philippines and Egypt, up to 40% oil content, inedible

- Intensive R&D needed to optimize the supply chain, logistics, crushing, and use of products and by-products

Future developments (2):

Standards for international biodiesel trade

- Solid base = fair trade base

  Based on solid international standards
- The European biodiesel industry is threatened by US B99.9 unfair export subsidies to Europe
- B99.9 exports also threaten the worldwide development of biodiesel
  - Price distorting effect has a strong negative effect on European as well as world biodiesel market prices
  - Paid by US government (temporarily?)
- Argentinean and Malaysian DETs are a potential additional threat

Future Developments (3): Level of FAME must go up

WORLDWIDE FUEL CHARTER
SEPTEMBER 2006

		Diesel type I		Diesel type II		Diesel type III		Diesel type IV	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Cetane Number		48		51		53		55	
(Cetane Index)		(45)		(48)		(50)		(52)	
Density	kg/m³	820	860	820	850	820	840	820	840
Viscosity	mm²/s	2	4.5	2	4	2	4	2	4
Sulfur content	ppm		2000		300		50		10
Total aromatics	%m/m				25		20		15
Polyaromatics	%m/m				5		2		2
T95	°C		370		355		340		340
Flash point	°C	55		55		55		55	
Carbon residue	%m/m		0.3		0.3		0.2		0.2
CFPP	°C	Max. ≤ the lowest expected ambient temperature							
Water content	ppm		500		200		200		200
Oxidation stability	g/m³		25		25		25		25
FAME content	%v/v		5		5		5		None
Total Acid Number	mg KOH/g				0.08		0.08		0.08

FAME = ASTM 6751 or EN 14214

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Biodiesel Standards

Specification		EN 14214:2003	ASTM D6751-07a	EN 590:1999
Applies to		FAME	FAAE	Diesel
Density 15°C	g/cm³	0.86-0.90		0.82-0.845
Viscosity 40°C	mm²/s	3.5-5.0	1.9-6.0	2.0-4.5
CFPP / Cloud Point	°C	CFPP: country/season specific	Cloud point: report	CFPP: country/season specific
Oxidation stability	hrs;110°C	6 hours min	3 hours min	N/A (25 g/m³)
Cetane number		51 min	47 min	51 min
Iodine value		120 max		
Linolenic acid ME	% mass	12 max		
C(x:4) & greater unsaturated esters	% mass	1 max		

Only major technical specifications are displayed

Biodiesel Cost Optimizer ®

Least Cost Biodiesel Composition Calculation

Biodiesel Cost Optimizer model

A biodiesel blend cost optimization tool

This program is a stand-alone license to IDB.

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Biodiesel Cost Optimizer

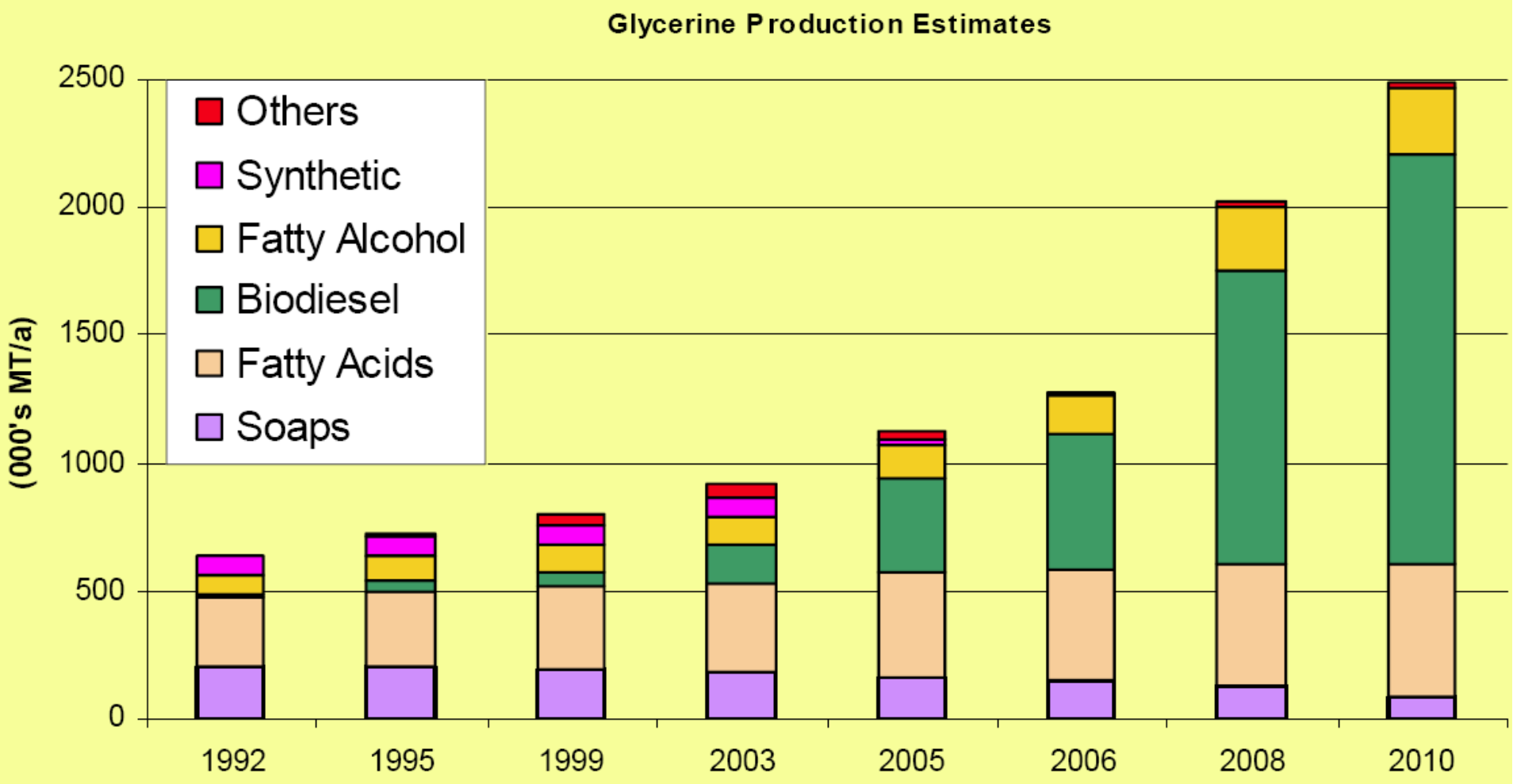
- Biodiesel based on raw material blends can be much more economic than pure RME or pure SME and still comply with EN14214 or ASTM 6751
- In summer conditions almost any raw material can be used for FAME production
- Oxidation stability of the final product will affect raw material choice (corrected with antioxidants!)
- In winter, CFPP constraints will limit raw material choice, but B5 or B10 allows plenty of flexibility
- Always: lowest cost blend of the day

Future developments (4): Glycerine needs new markets

- Increasing crude glycerine supply ⇒ oversupply leads to low market prices ⇒ new market opportunities and new activities.
- Traditional usage (pharmaceutical, food, cosmetics) is only growing at 2 to 3% per year
- New chemical use, e.g.
  - Glycerin as feedstock to produce renewable propylene glycol
  - Producing epichlorydrin
  - Use as antifreeze
- Feed: R&D succeeded in finding optional nutritional ratios in animal feed (blend with molasses)
- Energy:
  - Use as fermenting agent ⇒ biogas
  - Burn in high efficiency steam/turbine ⇒ green electricity

World glycerine market

(source HB International)



Future developments (5): The sustainability debate

- Most biofuels bring environmental benefits
  - More Life Cycle Analysis (LCA) data needed
  - Many studies exist, often contradictory
- Tackle problems like:
  - Deforestation (Round Table for Sustainable PO/SBO)
  - High-GHG production techniques (palm oil)
  - FOOD or FUEL debate

Future developments (6): The Next Generation Biofuels

- Move to second-generation biofuels
  - Bio-alkanes with higher technical performance, and better cost efficiency
  - Thermal cracking of blended oils or fats with petroleum before refining has started; it may be a more long-term solution
  - Fischer Tropsch synthesis of linear and branched alkanes
  - BTL & GTL technology
- Pro:
  - Longer-term sustainability
- Contra:
  - Surplus refinery and transesterification capacity will need new use, e.g. supply RBD market for O&F

Biomass, Biogas and BTL/GTL

- Increasing investment in the development of by-product valorization in the energy sector:
  - Direct energy generation: e.g. glycerol; O&F by-products, but also DDG, straw and cellulosic fractions
  - Via intermediate processes such as fermentation to biogas (methane) or to ethanol
- BTL/GTL: Transforming biomass or biogas to liquid fuels with high performance characteristics (e.g. using Fischer Tropsch transformation to alkanes)
- Synthetic high-quality "designer" fuels based on lignocellulose and other Agriculture & Food Industry byproducts

Conclusions (1)

- Massive investments in production capacity underway doubling world capacity to 16 MMT in 2009 and highly probably above 25 MMT by 2012
- Vegetable oil supply will go through ups and downs but midterm markets will find equilibrium
- Non-food new feed stocks are a long-term strategic option
- Glycerin oversupply was pushed to look for alternative usage; some are very promising
- Strong government support and mandatory targets support further development

Conclusions (2)

- Legislation and Standardization needs harmonization and efficient and effective support mechanisms
- Biodiesel may change into more synthetic fuels based on Oils & Fats or other feedstocks
- Sustainability is driver for next generation fuels
- Current investments may lead to a new market paradigm for crude and RBD oils after the biodiesel era

Muchas Gracias

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