



# 1<sup>st</sup> Biodiesel Conference

Ankara - Turkey

10 August 2005

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## “Key Trends in the Development of Biodiesel World-wide”

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Austrian Biofuels Institute – Vienna

[www.biodiesel.at](http://www.biodiesel.at)



## Key development trends observed:

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1. Increasing variety in feedstock availability
2. Increasing efficiency in process technology
3. Stricter parameters for Biodiesel fuel quality
4. Accelerating production development
5. Broad variety in marketing strategy
6. Challenges for further Diesel engine warranties
7. Solid legal framework in Europe pushing the markets
8. Broadening information basis and easier access



## Trend 1: Broader Basis + Lower Cost of Feedstock

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### Vegetable Oils :

**used today :** rapeseed (00), soy, palm,

**new sources:** sunflower (HO), rapeseed (HO, LL,) Linola (LL)

<b>non-food :</b> Acrocomia, Babaçu, Buriti, Cornus, Jatropha, Palmiste, Pongamia,
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**Recycling Oils:** “McDonalds option”, trap grease

**Animal Fats:** beef tallow, lard, rendering fats

- ➔ supporting biodiversity - plenty of non-food oilseed plants are available
- ➔ overcoming barriers: sufficient supply of feedstock from food and as non-food crops within international strategic partnerships



## The feedstock opportunity for developing countries:

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Feedstock reserves for Biodiesel production are increasing constantly as a number of so far not utilised non-food oil-bearing crops are identified as suitable for production of Biodiesel, e.g. Babaçu, Buriti, Cornus, Pinhão manzo (Jatropha curcas), Palmiste.

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These feedstock sources are professionally investigated in Brazil, China, India and South African and other South American countries.

(source: "ABI" 14.02.2005)

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Additionally those feedstock sources are renewable and grow every year again.

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The technologies of their commercial plantation are just at an early stage of development and look promising.

(source: "Biodiesel-Courier" 14.02.2005)

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## In Egypt, commercial plantings have begun in dry conditions and marginal soils

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# Jatropha curcas L.

A hardy plant, well adapted to arid or semi-arid conditions. Low fertility and moisture demand. Grows on stony, shallow or even calcareous soil. Propagated through seed or cuttings. Tolerate to scanty to heavy rainfall 2500 plants per hectare. Yield 2-3 tons / ha (5th year).

(Study by Agro-Forestry Federation – Maharashtra (1991) )

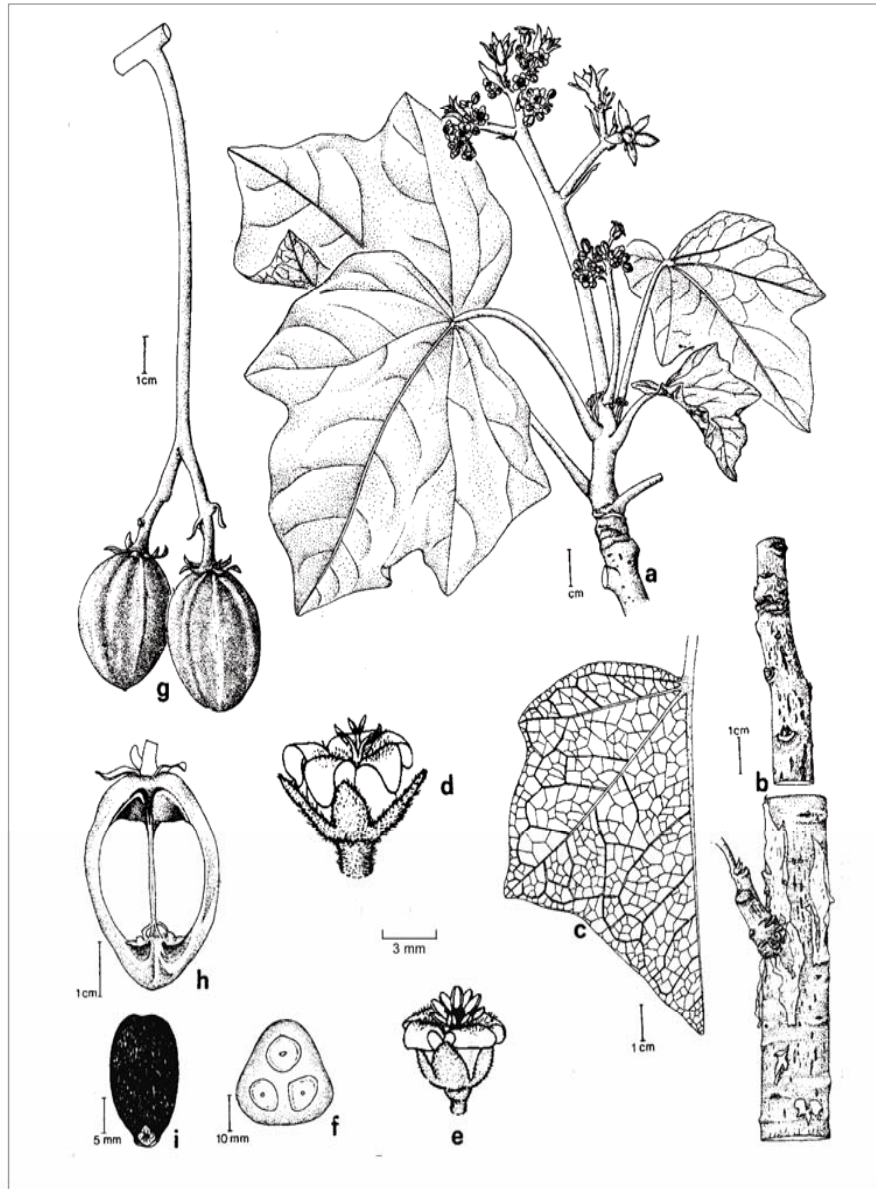


Fig. 2. Important parts of the physic nut: a - flowering branch, b - bark, c - leaf veinature, d - pistillate flower, e - staminate flower, f - cross-cut of immature fruit, g - fruits, h - longitudinal cut of fruits; a - c and f - h from Aponte 1978; d and e from Dehgan 1984 (reprinted with permission).

# Los tres ejes de producción de aceite de coco con miras al biodiesel

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Para justificar la implementación de una planta continua de biodiesel contemplamos tres ejes de acción:

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## Selection of blends needs careful consideration

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### Fatty Acid (FA) pattern of selected oilseeds:

FA in %	00 - rapeseed	LL - rapeseed	HO-sunflower	Jatropha curcas	Acrocomia totali
6:0					8
8:0					5
12:0					45
14:0					18
16:0	4	4	3	14	11
18:0	2	2	4	8	3
18:1	60	61	83	34	8
18:2	21	28	4	43	
18:3	11	3	4	1	
20:1		1	1		
22:1	1				
total satur.	7	6	6	5,5	91
Iodine-no.	117	111	83	106	16
oxygen %	10,8		10,7	11,0	16,7



## 2 extreme strategies:

1. Focus on just one single fatty acid: high-oleic
2. Focus on a broad band scope of fatty acids of different chain length from various sources

### To be determined:

- CFPP, Cetane, MJ/kg,
- engine performance,
- boiling line, viscosity

## The “ideal” Biodiesel ?

## Various strategies in “constructing” a new and high performance Biodiesel are possible

Chain length - Saturation level	HO-sunflower in %	1/3 Paraguay nut + 1/3 HO-sunflower + 1/3 HEAR in %
6:0		0,3
8:0		2,0
10:0		1,7
12:0		16,3
14:0		6,0
16:0	3,3	5,0
16:1	0,1	
18:0	3,6	2,7
18:1	90,5	37,4
18:2	2,6	6,4
18:3		2,0
20:0		0,3
20:1		3,0
22:0		
22:1		16,3
total sat. %	6,9	30,4
IV	82	63
Oxygen %	10,8	10,9



## Trend 2: Biodiesel process technology has become very efficient

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- Level of yields obtained during the process reaction should be not less than 99%.
- Reducing cost by increased flexibility to handle multi-feedstock oils and fats - including high FFA (free fatty acids) feedstock.
- Utilising flexible process control and multi-feedstock recipes.
- Installing a reliable quality assurance systems (EN14214).
- Produce at practically no waste.

➔ Only the efficient Biodiesel producers will succeed

➔ **overcoming barriers: sustainable and profitable production by utilizing existing and proven process technologies for quick implementation !**



## Trend 2: Beside process technology site selection is crucial

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- **Extent in exploiting synergies of existing industrial areas:**
  - **Chemical industry park (methanol)**
  - **Oilseed crushing plant**
  - **Shared personnel and maintenance cost**
- **Low transport cost locations:**
  - **Sea or river harbour**
  - **Train connections**



**Biodiesel production sites with synergies have an advantage**



## Trend 3: Assured high Biodiesel quality is to be or not to be !

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The Biodiesel standard development has come a long way:

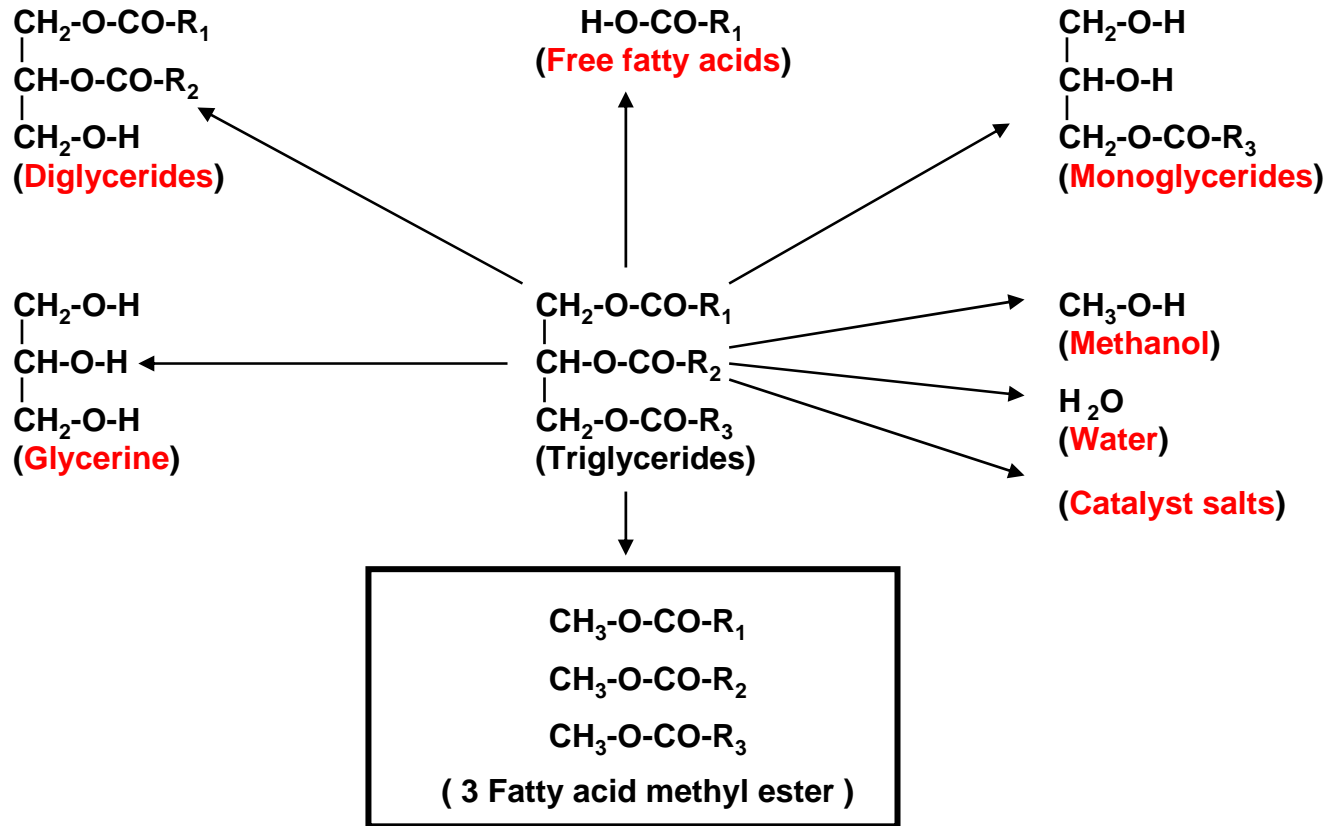
- Austria 1991: ON C 1190 for RME
- Austria 1997: ON C 1191 for FAME
- Germany 1997: DIN 51.606 for FAME
- USA 2002: ASTM - D 6751-02 FAME
- Europe 2003: **EN14214** for FAME  
(together with VW, DC, Peugeot, Bosch, Shell, Total, etc.)
- Australia 2003: Min. of Environment: synthesis EU & US

➡ overcoming barriers: accurate Biodiesel quality assures market acceptance

➡ overcoming barriers: adopt existing and accepted standards



## Biodiesel as renewable energy is derived from oils and fats of vegetable or animal origin





## **Trend 3: Biodiesel quality is not static and develops further**

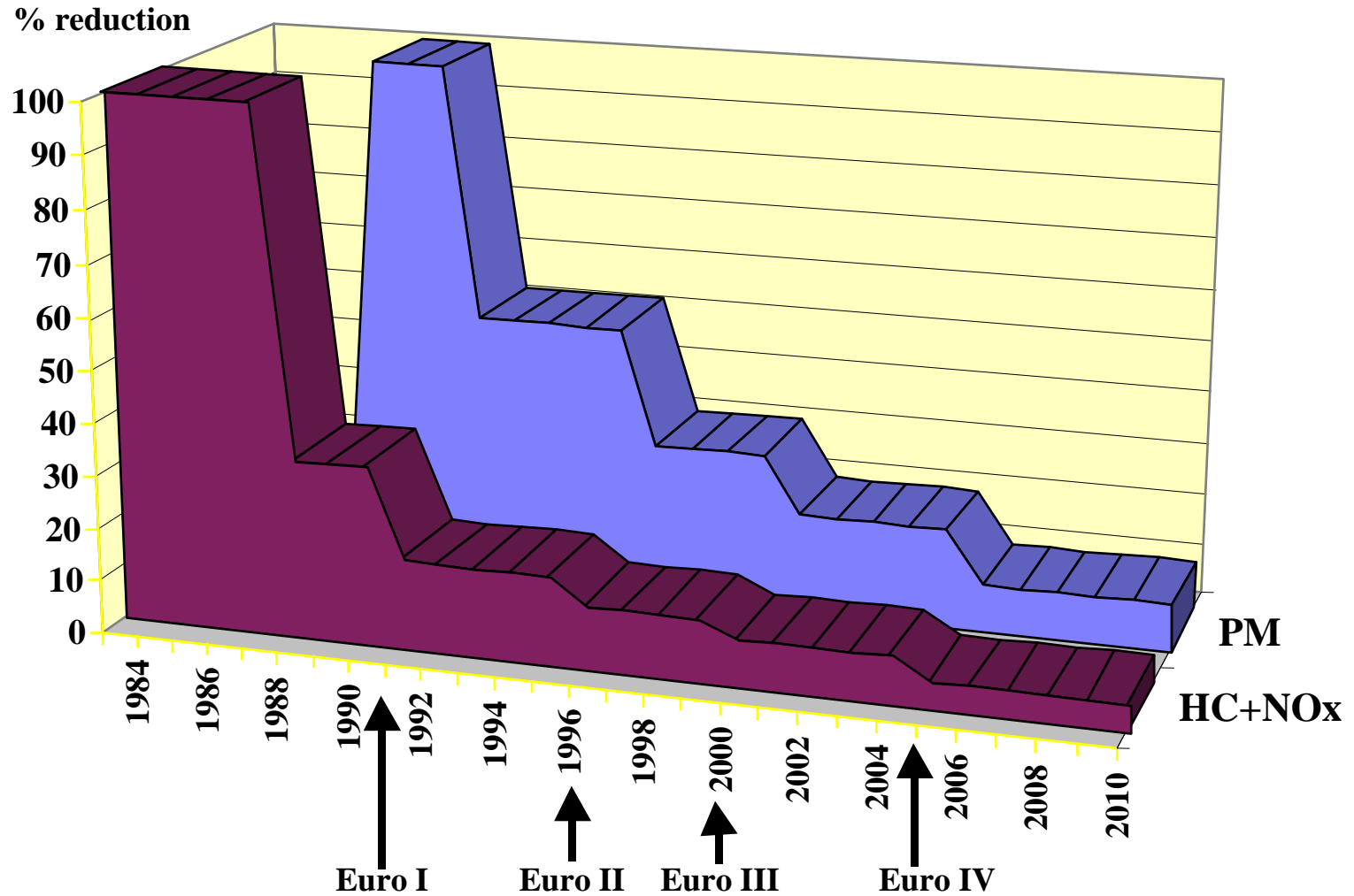
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Today's triggers for further Biodiesel fuel standard development:

1. **Legally enforced emission reduction**
    - **Directive on Fuel Quality**
    - **Greenhouse gas reductions**
  2. **Forcing industry into more sophisticated engine and fuel injection management with highest precision**
  3. **Triggering significantly increasing demands for higher fuel quality - regardless whether fossil or bio**
- ➡ **Joint development with Diesel engine producers is needed**
- ➡ **overcoming barriers: establish close cooperation between key market stakeholders internationally**

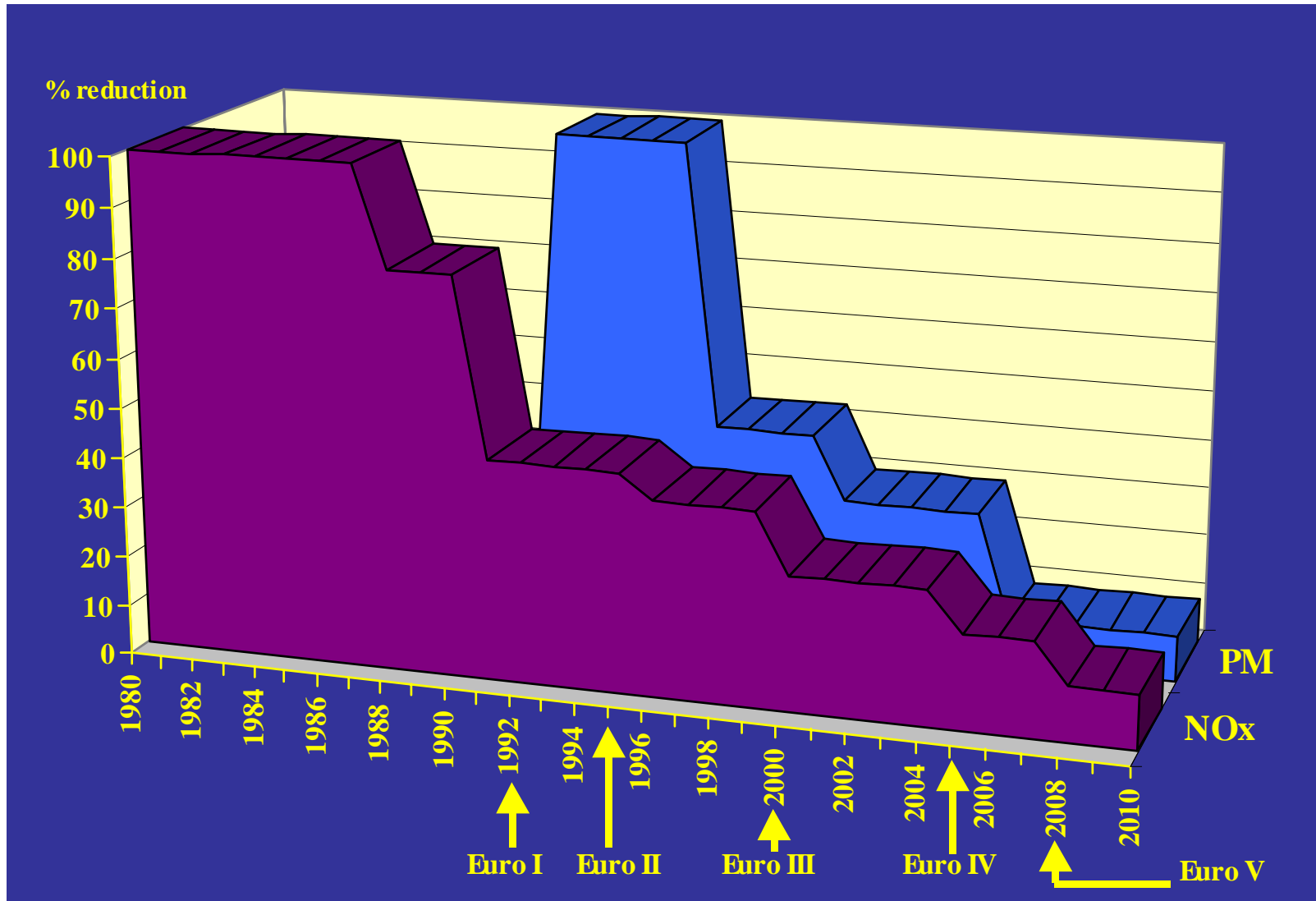


# Diesel cars





# Heavy-duty vehicles





## Trend 3: The Biodiesel standard is highly sophisticated

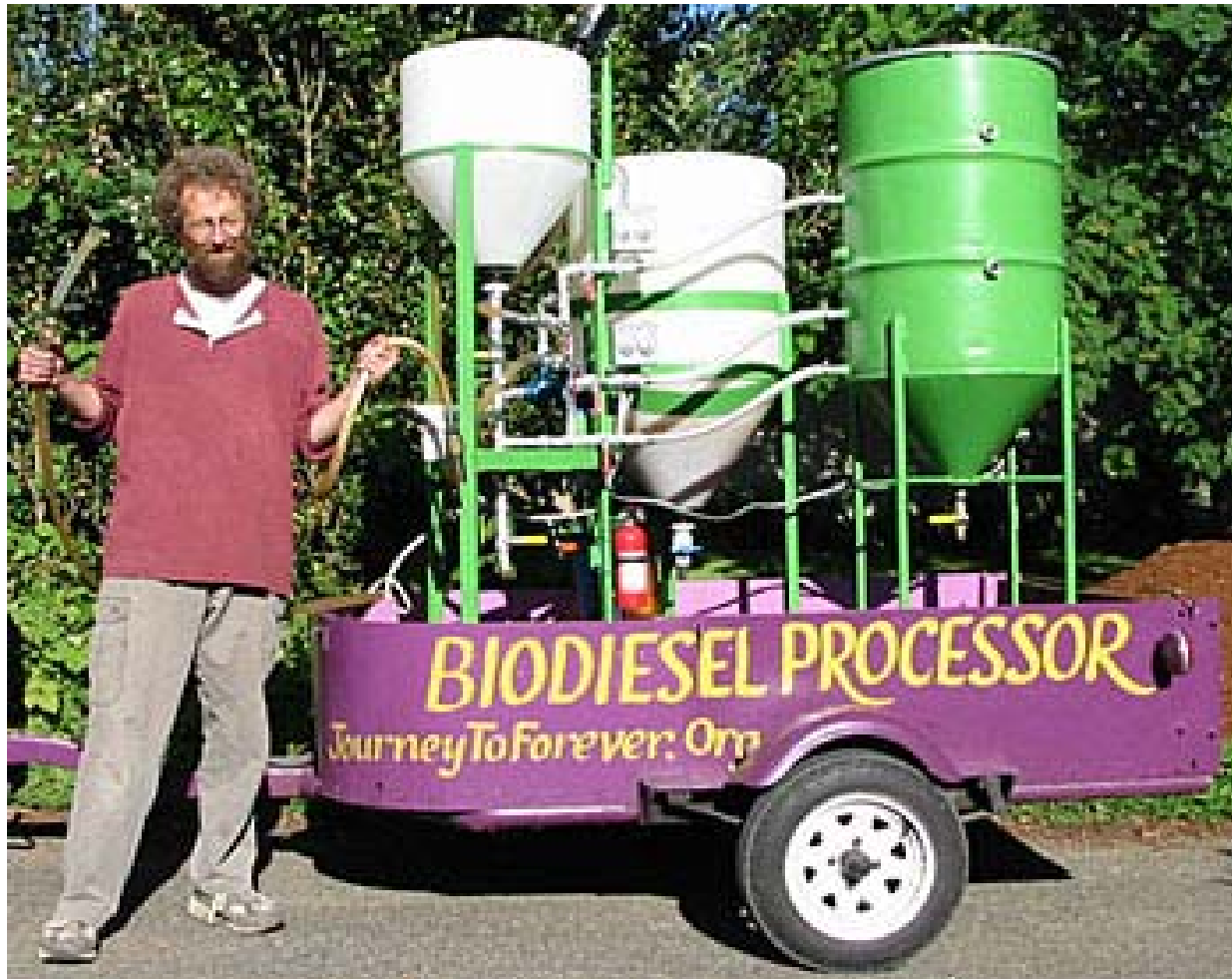
pr EN 14214 Fatty-acid-methyl-ester (FAME)		22.10.02
Parameter	Range	Unit
Ester content	≥96.5	%m/m
Density at 15°C	860 – 900	kg/m <sup>3</sup>
Viscosity at 40°C	3.5 – 5.0	mm <sup>2</sup> /s
Viscosity (-20°C)	≤ 48	mm <sup>2</sup> /s
Flash point	≥110	°C
CFPP	see EN590	°C
Sulfur content	≤ 10.0	mg/kg
CCR / 10% distill. residue	≤ 0.30	%m/m
Cetane number	≥ 51.0	-
Sulfated ash	≤ 0.02	%m/m
Water content	≤ 0.05	%mg/kg
Total contamination	≤ 24	mg/kg
Copper corrosion (3h at 50°C)	class 1	rating
Oxidation stability	≥ 6.0	h

Thermal stability	?	h
Storage stability	-----	----
Acid number	≤ 0.50	mg KOH/g
Iodine number	≤ 120	-
Polyunsaturated methyl esters: C 18:4 +	≤ 1.0	%m/m
Linolenic acid methyl ester	≤ 12.0	%m/m
Methanol content	≤ 0.20	%m/m
Monoglyceride content	≤ 0.80	%m/m
Diglyceride content	≤ 0.20	%m/m
Triglyceride content	≤ 0.20	%m/m
Free glycerol	≤ 0.02	%m/m
Total glycerol	≤ 0.25	%m/m
Group I metals (Na/K)	≤ 5.0	mg/kg
Group II metals (Ca-Mg)	≤ 5.0	mg/kg
Phosphorus content	≤ 10.0	mg/kg

➔ Further improvements are needed and can be expected



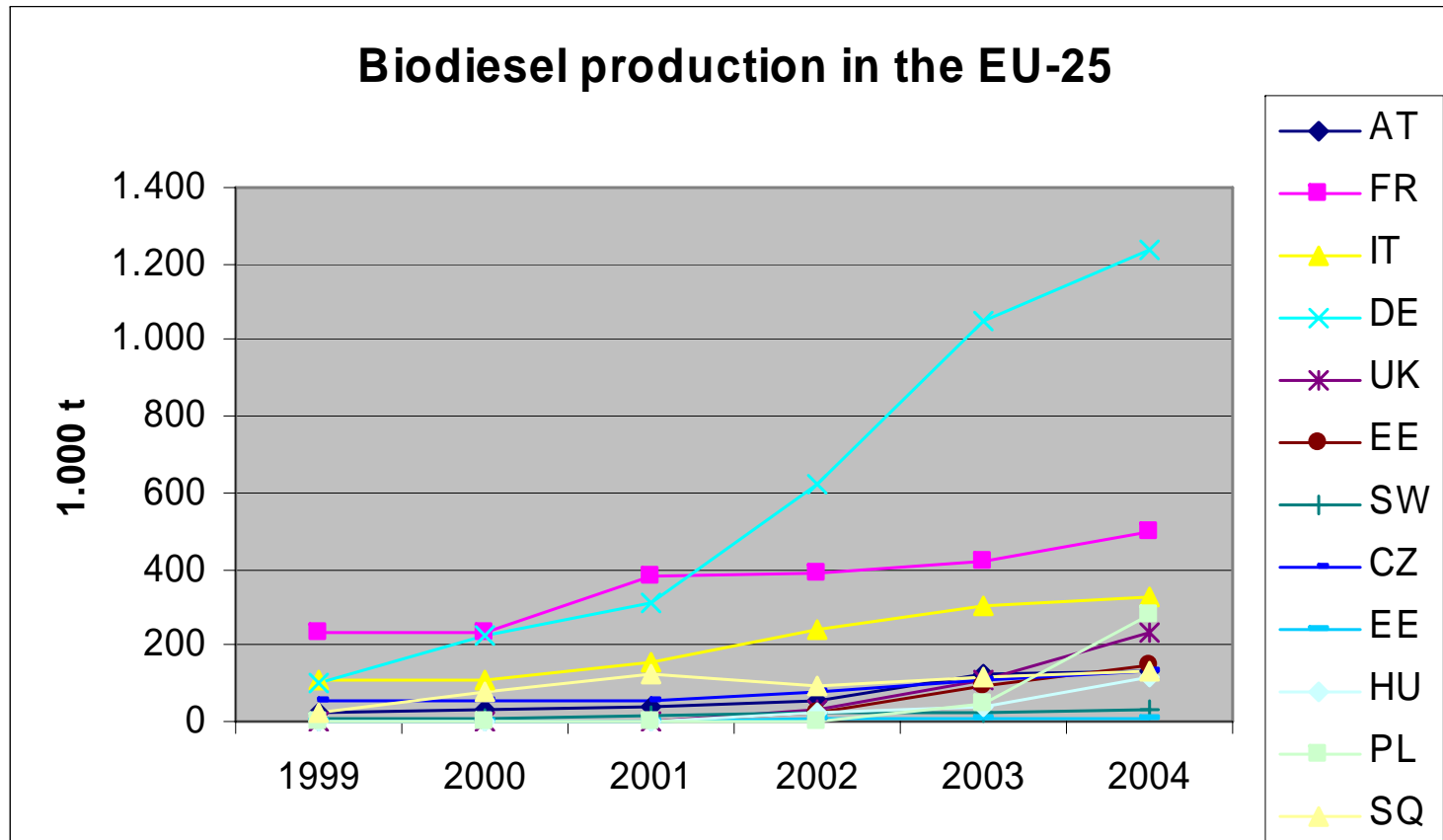
## Biodiesel production development



Small is beautiful (???) but not efficient and not at all economic !!!

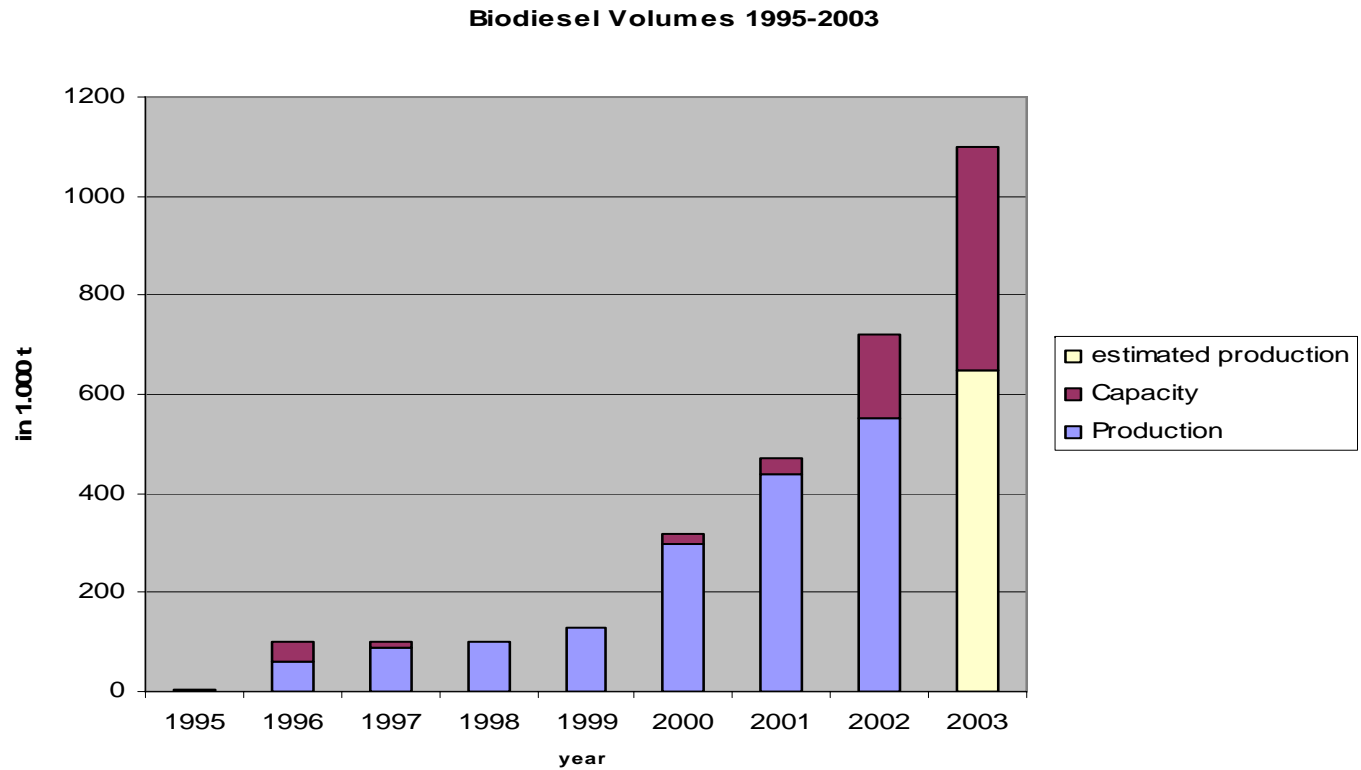


## Trend 4: European Biodiesel production is growing fast





## Germany: Biodiesel Volumes 1995 - 2003





## Germany: MUW Bitterfeld - 150.000 t (rapeseed)



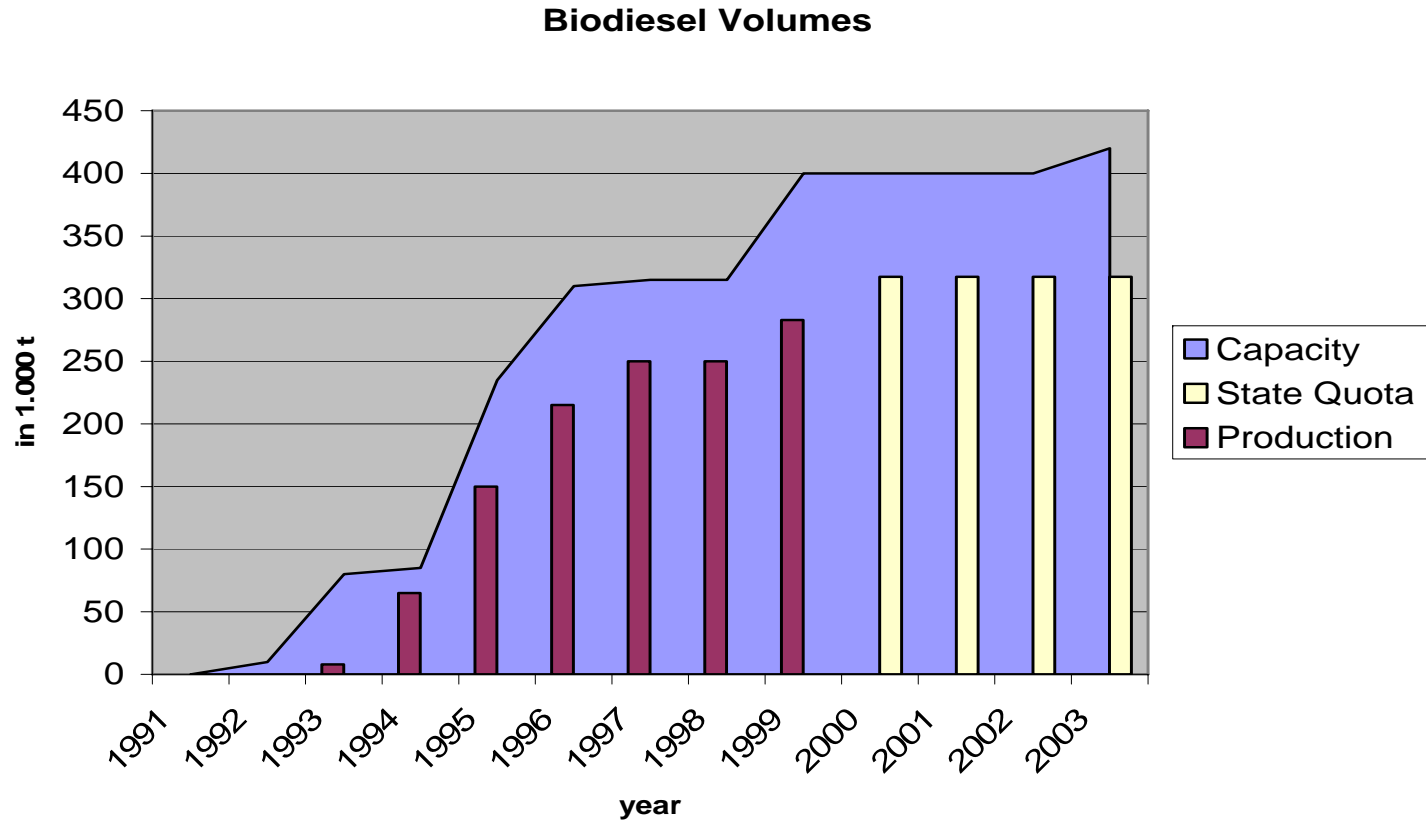


## Germany: MUW Bitterfeld

- Capacity: 150.000 t
- Process: CD
- Marketing: member of AGQM
- Feedstock: fully refined rapeseed oil
- Site: chemical industry park, rail
- Financing: regional gov. + European support



## France: Biodiesel volume development





## France: Diester / Grand Couronne - 250.000 t



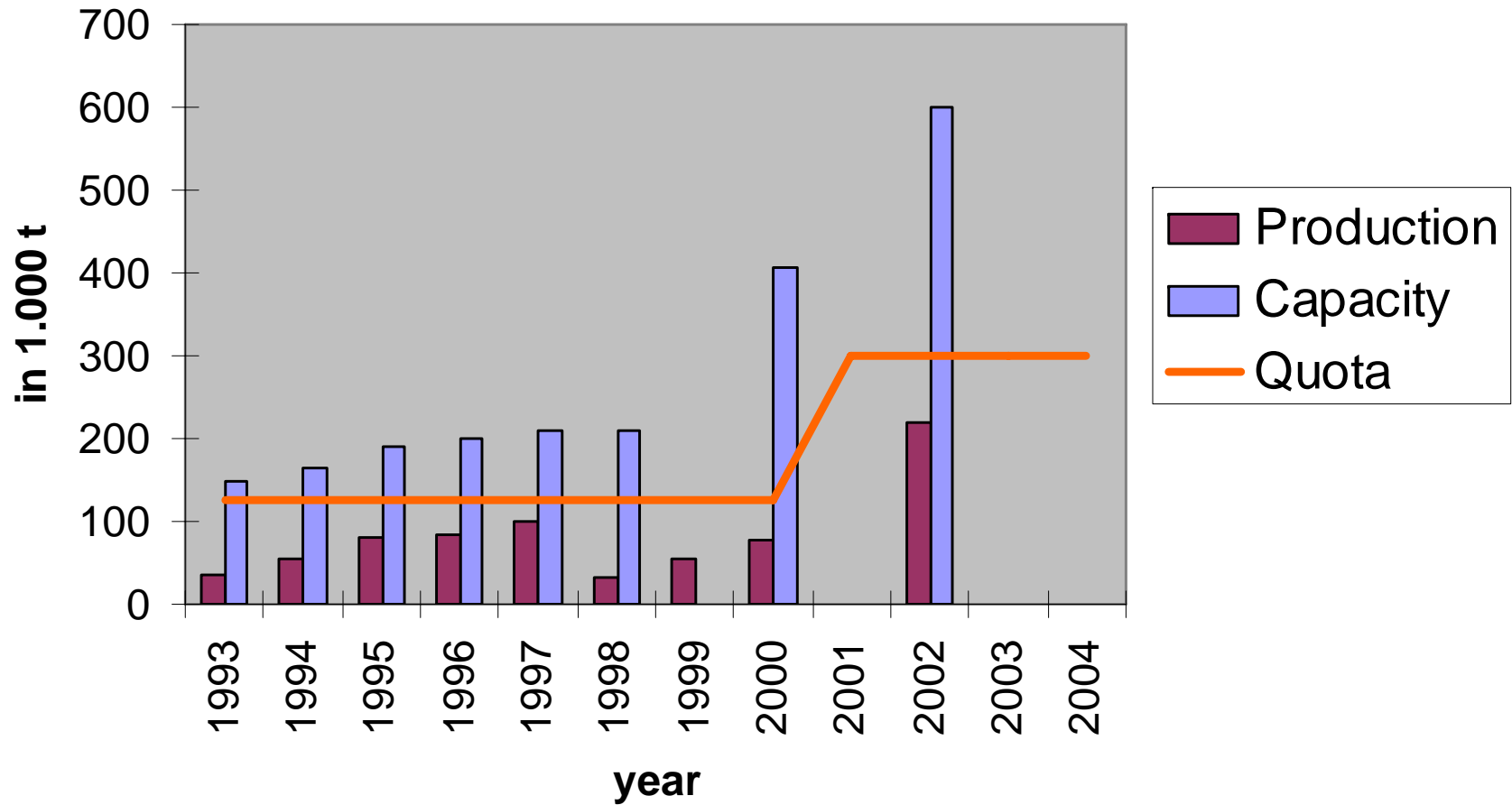


## **France: Diester / Grand Couronne - 250.000 t**

- **Capacity:** 250.000 t
- **Process:** Henkel
- **Marketing:** direct to refineries (Total, Shell)
- **Feedstock:** fully refined rapeseed oil
- **Site:** sea harbour, oil mill, refineries by pipeline
- **Financing:** n.a.



## Italy: Biodiesel volumes 1993-2002





## Italy: Fox-Petroli – 120.000 t MFS



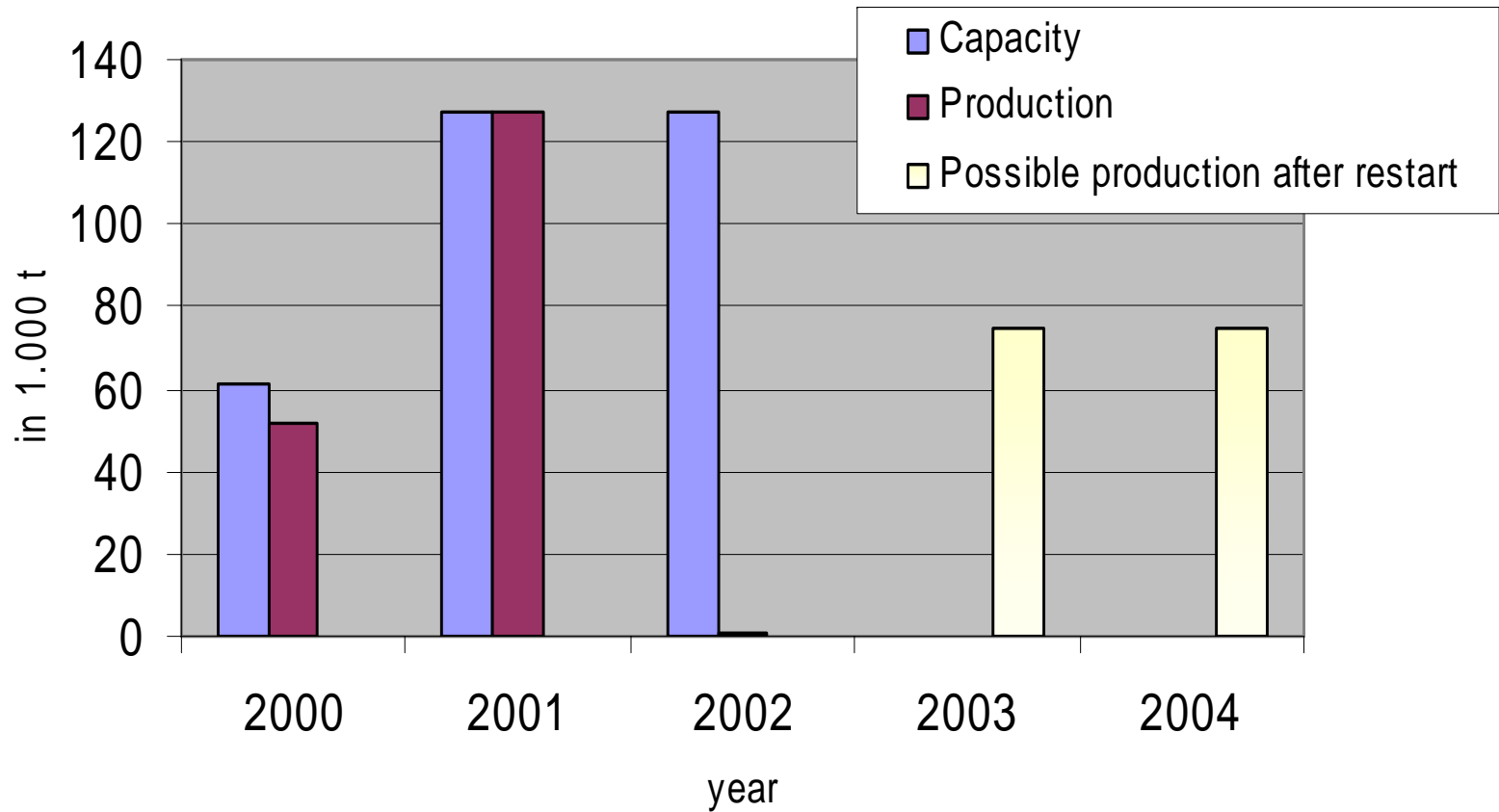


## Italy: Fox-Petroli – 120.000 t

- Capacity: 120.000 t
- Process: own
- Marketing: trademark “BioFox”
- Feedstock: rapeseed oil, soy oil
- Site: sea harbour, industry park, refinery
- Financing: n.a.



## Slovakia: Biodiesel Volumes





## Slovakia: EkOil – 50.000 t (rapeseed + recycled oils)





## Austria: Energea - 40.000 t FAME (recycled oils)

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## Austria: Energea – 40.000 t

- Capacity: 40.000 t
- Process: Energea - "Continuous Trans Esterification Reactor" - CTER-process
- Quality: EN 14214 or better
- Marketing: contractors
- Feedstock: any recycled oil and fat (high FFA)
- Site: flexible multi-feedstock pilot plant
  - 260.000 t in Northeast England in construction
  - 40.000 t in Perth/Australia



## Trend 5: Marketing strategy *could* improve profitability

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Typical market segments – with the opportunity to obtain legally enforced usage in e.g.:

- **City Transport (public and commercial transport of persons and goods): ... .. less harmful emissions**
- **Smog Regions : ... .. less harmful emissions**
- **Rivers & Lakes : ... .. fast biodegradability**
- **Drinking Water Areas: ..... zero toxicity**
- **Greenhouse Gases: ..... overall reduction**



**overcoming barriers: appropriate marketing assures long-term profitability**

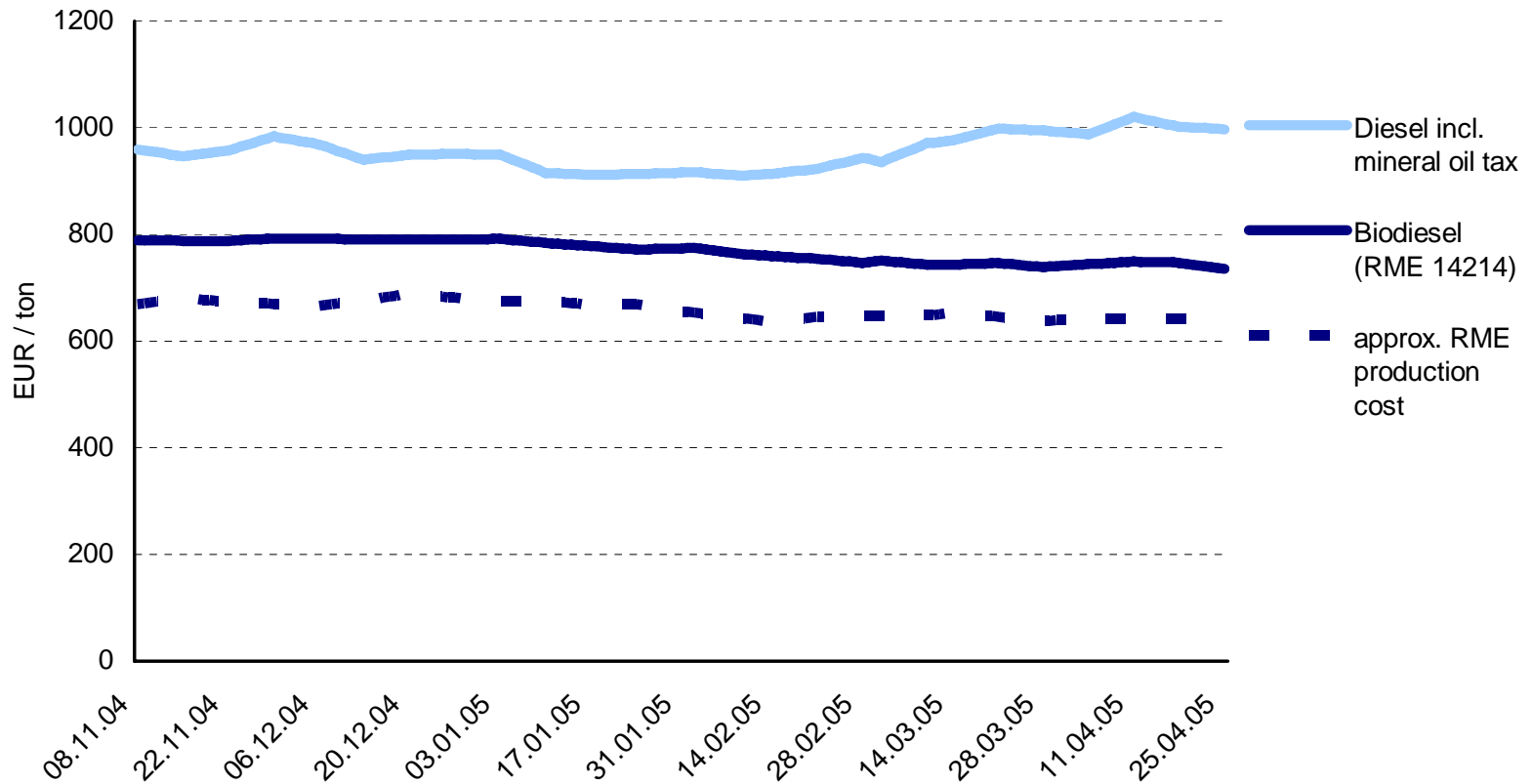


## A typical market segment: the city bus fleet





## Biodiesel selling price is determined by feedstock cost and not by the Diesel price (Germany)





- ➔ With increased usage in blends Biodiesel may disappear from the public fuel pump in most European countries



## Trend 6: Increasing challenges to obtain Diesel engine warranties

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Up till now: broad acceptance but also fierce resistance

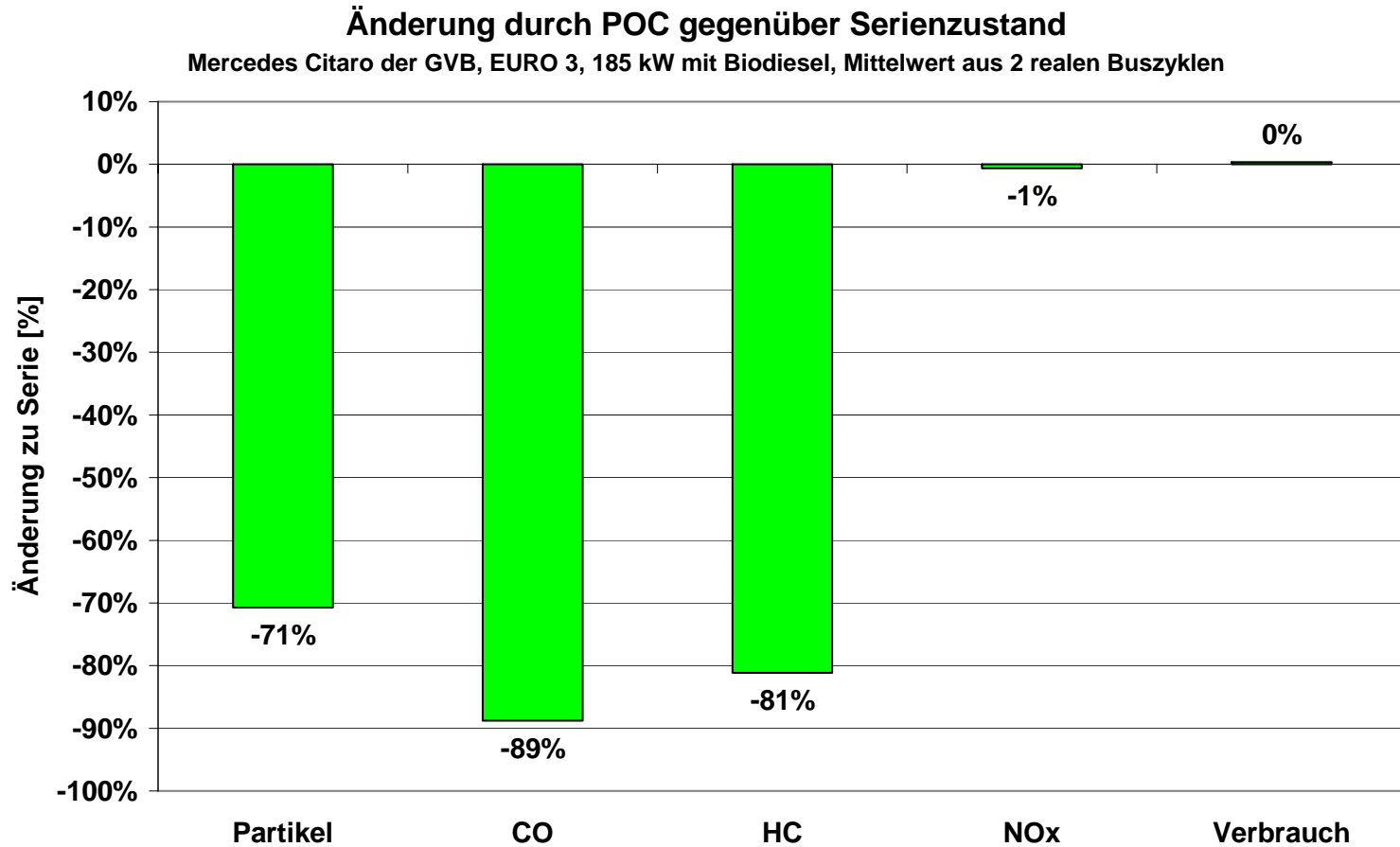
- **Tractors:** Case, Ford, John Deere, Steyr, Valmet
- **Trucks & buses:** MAN, Mercedes
- **Cars:** Audi, Citroën, Daimler-Chrysler, Mercedes, Peugeot, Volkswagen, etc.
- **Boats:** Deutz, Faryman, Steyr Marine
- **HD:** Caterpillar, Komatsu, Kubota

➡ Close cooperation with the car industry is necessary to obtain support

➡ **overcoming barriers: synergy by cooperation with key stakeholders**



## Biodiesel in new Particulate–Oxidation-Catalyst reduces PM to Euro IV level





## Trend 7: European Directive as strong impulse for fast expansion

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### Supportive legislative framework for Europe

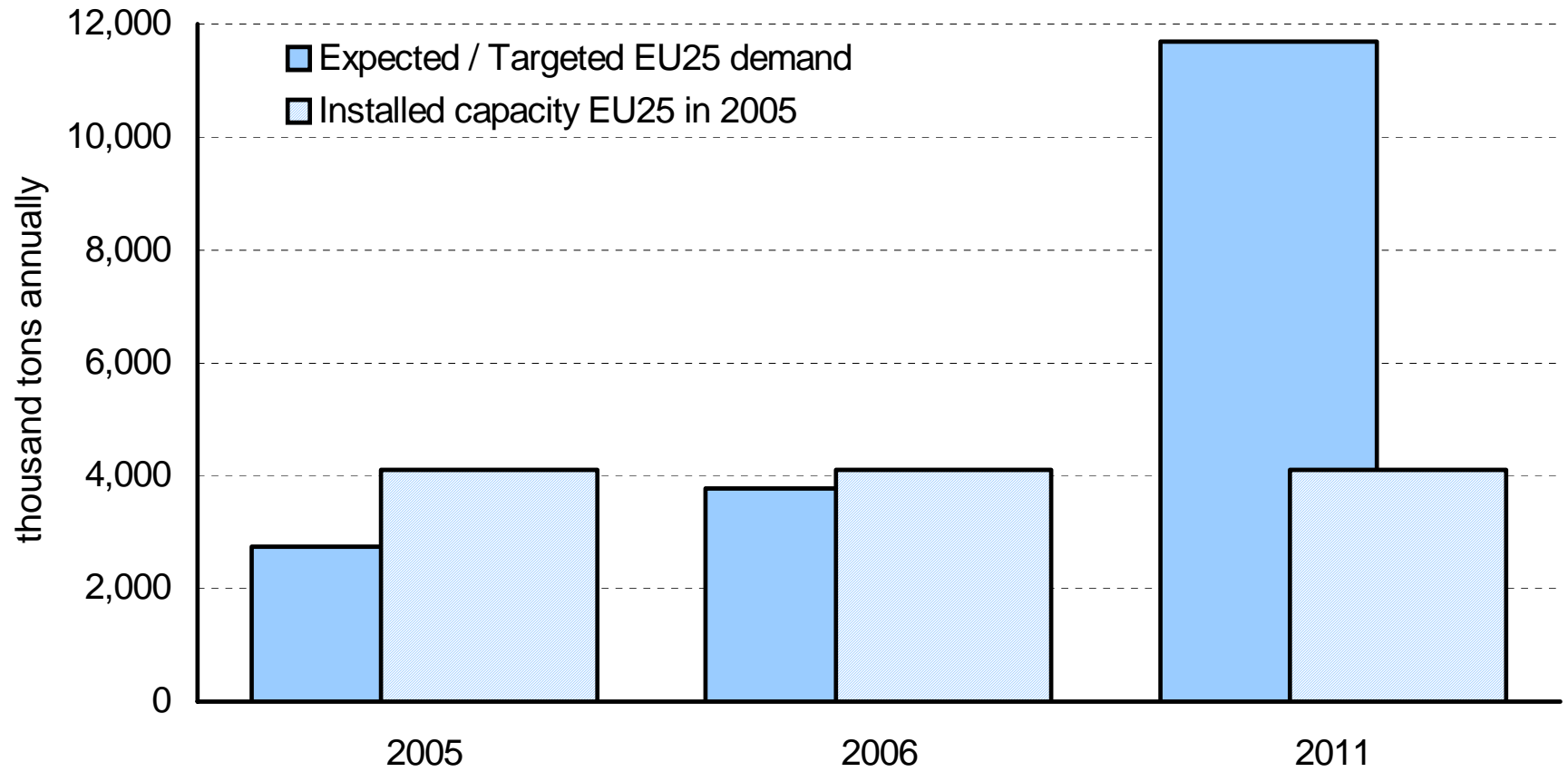
- **EC Directive for the Promotion of Liquid Biofuels:**  
**Semi-obligatory market shares :**
  - 2 % by 2005
  - 5,75 % by 2010
- **EC Directive for the Quality of Fuels**
- **EC Directive on Taxation of Fuels**

➡ European legislation is pushing the markets thus creating import opportunities for non-European countries with feedstock potential

➡ **overcoming barriers: intelligent legislation creates attractive market conditions**



## EU Biodiesel targets need additional Biodiesel capacity



source: Eurostat, TotalFinaElf, Verband Deutscher Biodieselhersteller



## Trend 8: Information availability has increased significantly

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### Recently published Austrian Biofuels Institute studies:

1. “World-wide Review of Biodiesel Production” CD-ROM
2. “Best Case Studies of Biodiesel Production Plants in Europe”
3. “Review on Biodiesel Standardisation World-wide” CD-ROM
4. “Clean Transport for Modern Cities” - DVD
5. Websites of interest:
  - [www.biodiesel.at](http://www.biodiesel.at)
  - [www.blт.bmlfuw.gv.at](http://www.blт.bmlfuw.gv.at)



Easy access to a wide field of Biodiesel know-how



overcoming barriers: broad communication - e.g. this conference

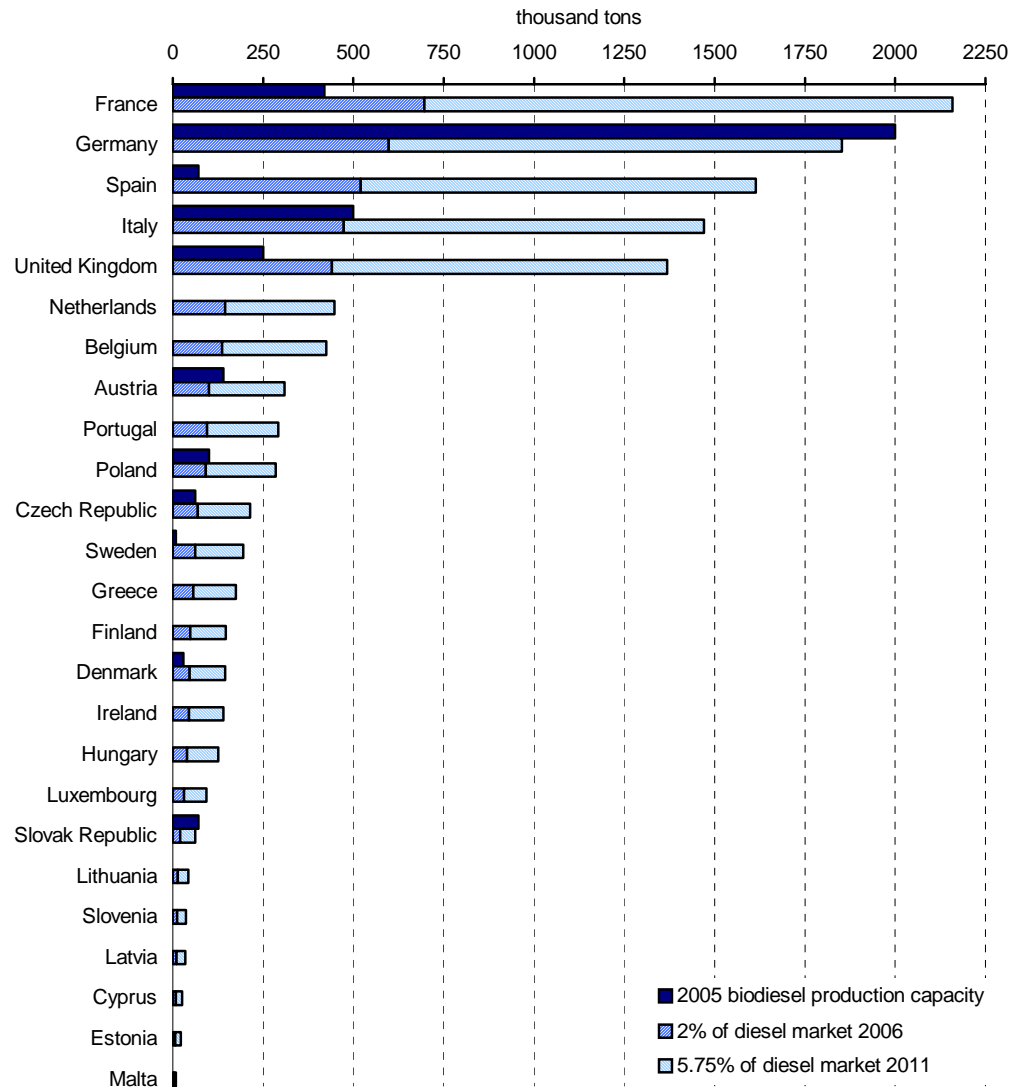


# Back up slides

1. European Union-25 by state
2. Food oil production world
3. Food oil prices world

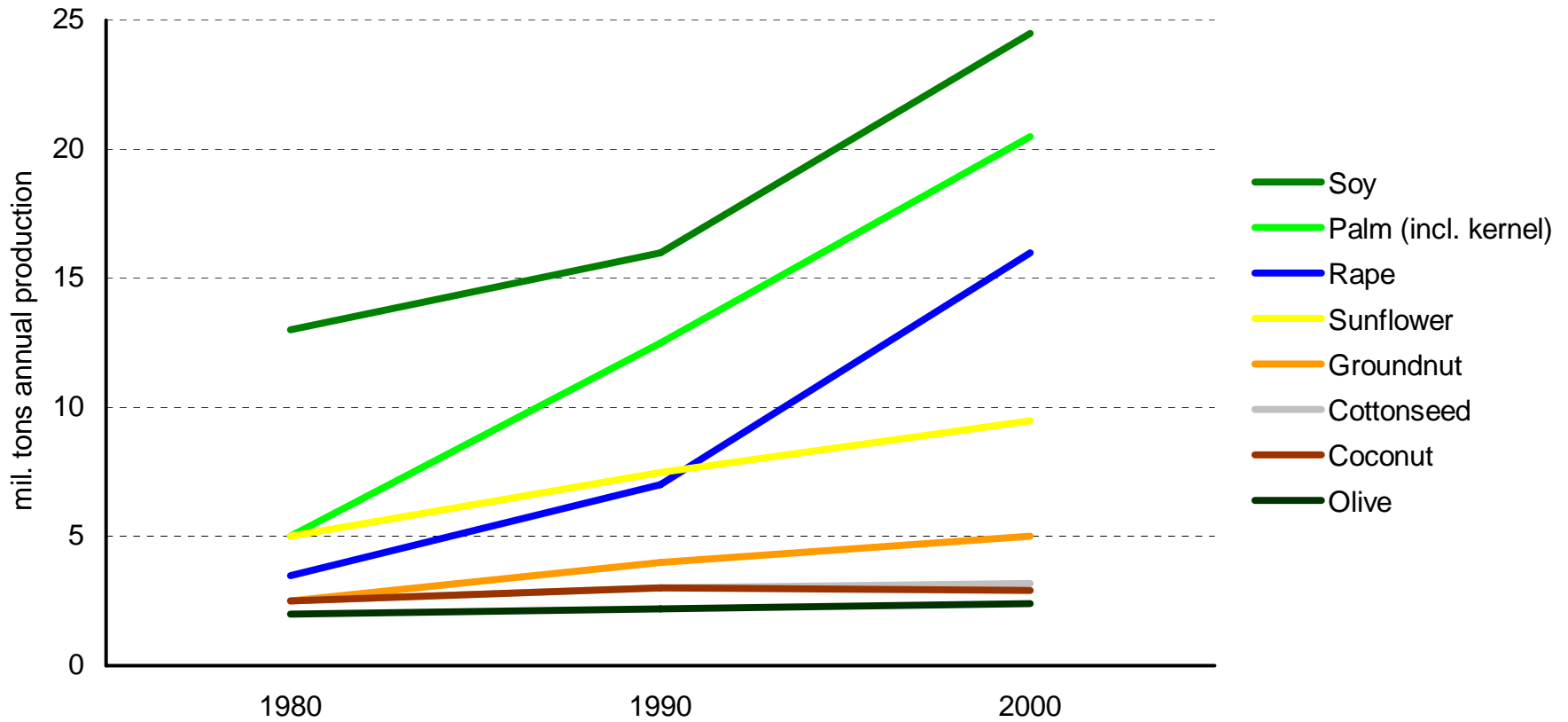


## Biodiesel capacity and EU targets by country





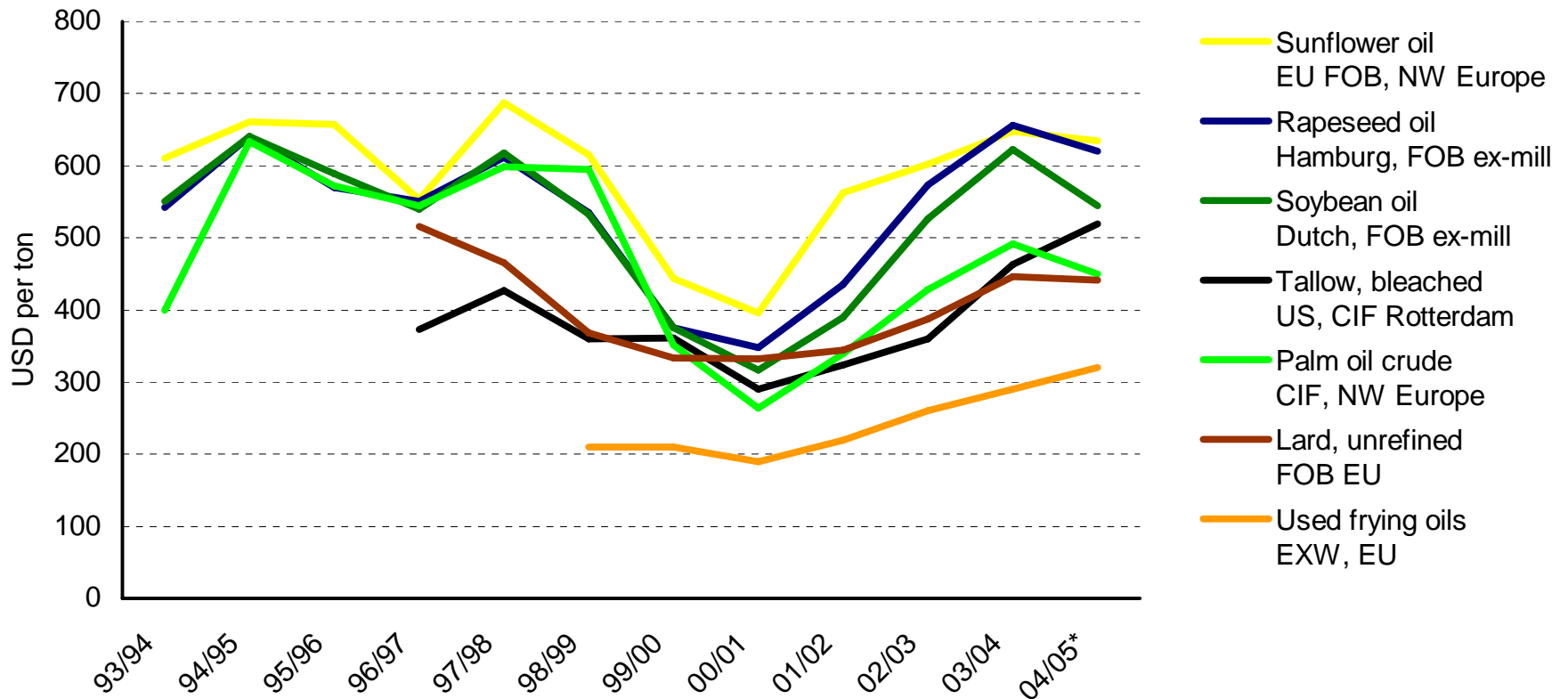
## Global fresh edible oil production



source: Rabobank



## Edible oil price development



\*: forecast

source: Oleocom, Matif, CBoT



**Austrian Biofuels Institute**

[www.biodiesel.at](http://www.biodiesel.at)

