



WRA 2005 - 6th European Fuels Conference

BIODIESEL

2nd Generation Technology

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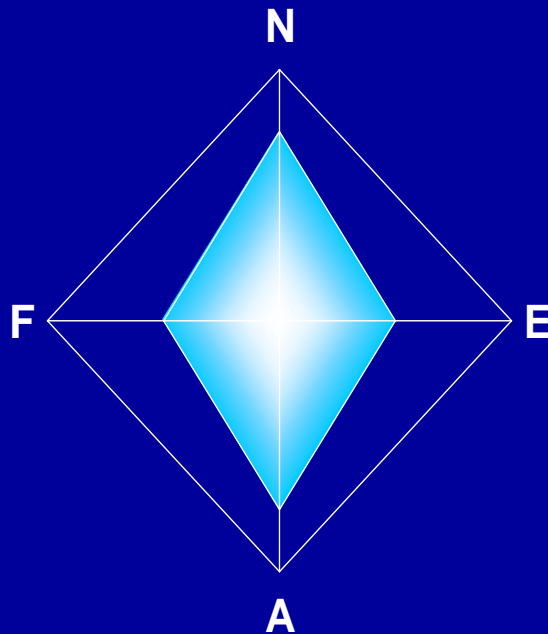
- Presentation of IFP
- Biodiesel drivers & market trends
- Transesterification principles
- Original esterification process
- New esterification process
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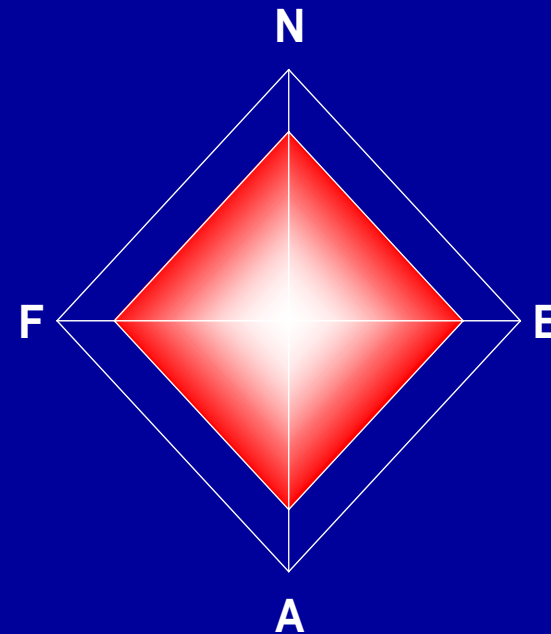
- **Independent Industrial R&D center**
 - E&P, Refining & Petrochemicals, Engines & Energy
 - 1800 peoples in Rueil-Malmaison & Solaize (test facilities)
 - Commercial subsidiaries AXENS, PROSERNAT, ...
- **Refining & Petrochemicals**
 - Developing clean and economical Processes & Products for the production of current & future fuels (and petrochemicals bases) from Oil, Gas, Coal & Biomass.

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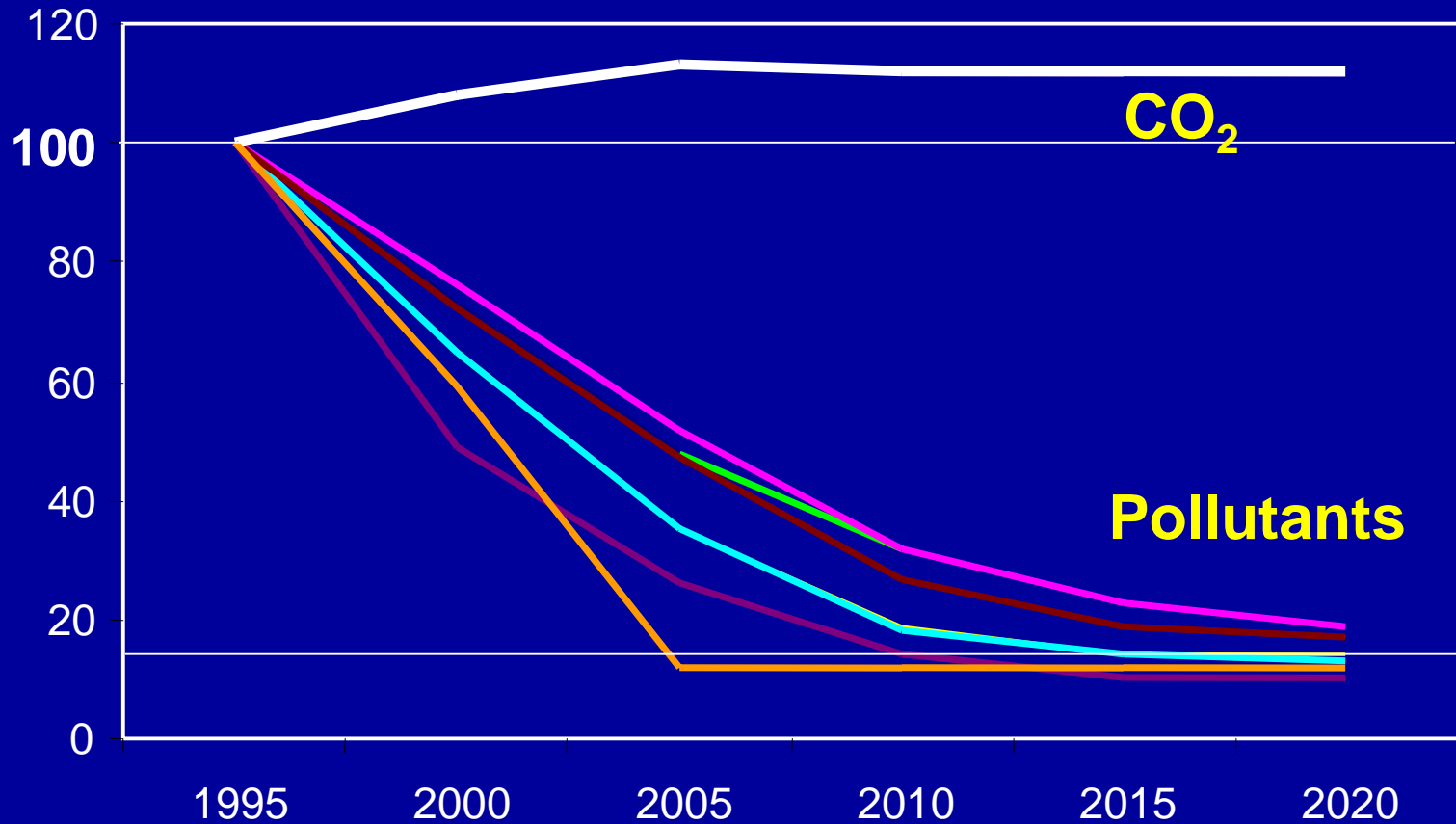
- A = Agricultural (land availability, climate, supply/demand imbalance)
- N = National (energy security, employment)
- E = Environmental (GHG emissions, local pollution)
- F = Fuels (dependence on diesel imports, new specifications)



EU 1990's



EU 2000+

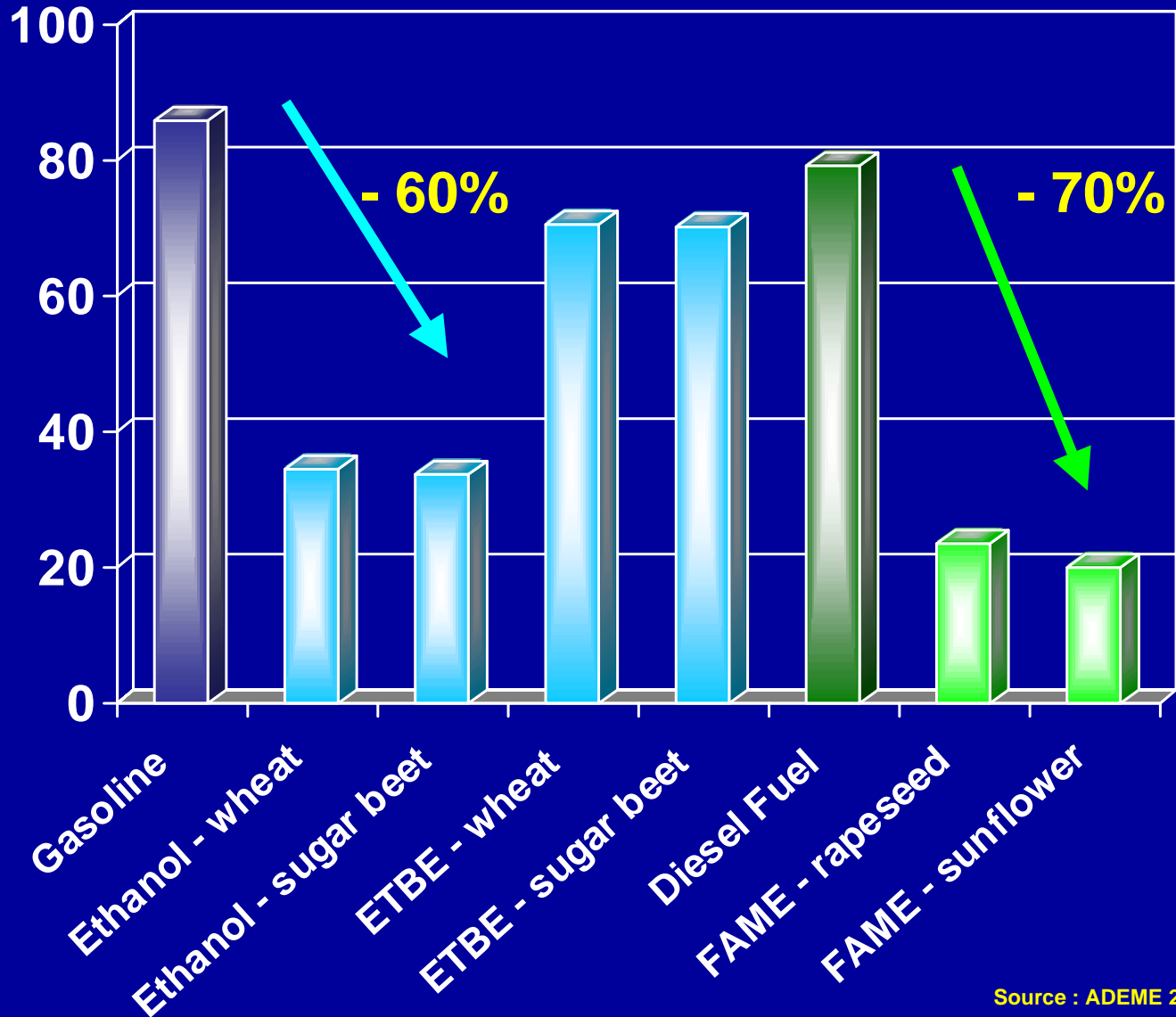


— CO — NO_x — NMVOC, VOC
— Benzene — PM — CO₂ — SO₂

PM = particulate matter
 NMVOC = non-methane, volatile organic carbon compounds

GHG Emissions Biofuels vs. Conventional Motor Fuels

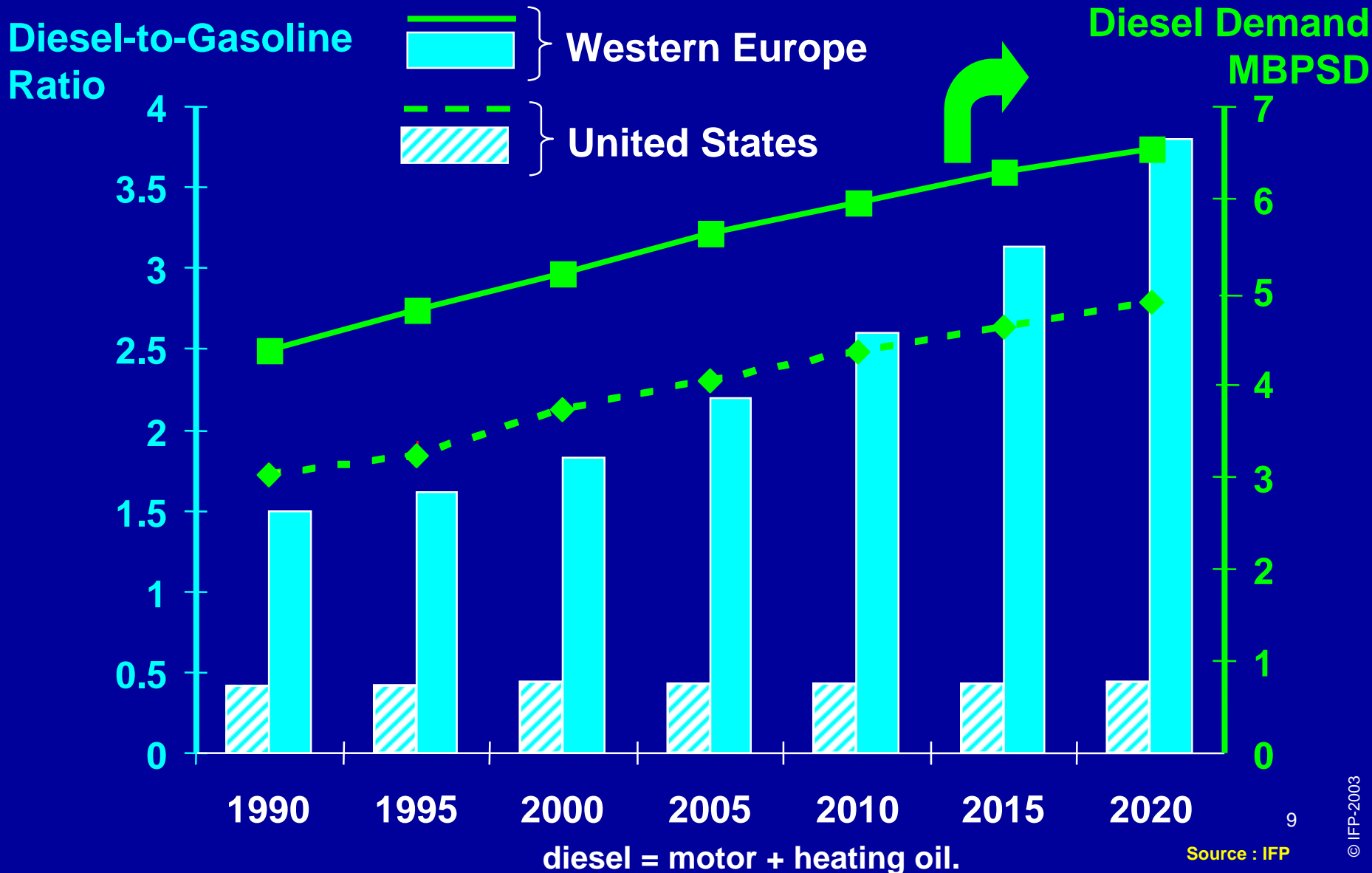
g CO₂ / MJ



Fuels used
pure →



Comparing Diesel Demand and Diesel-to-Gasoline Fuel Ratios



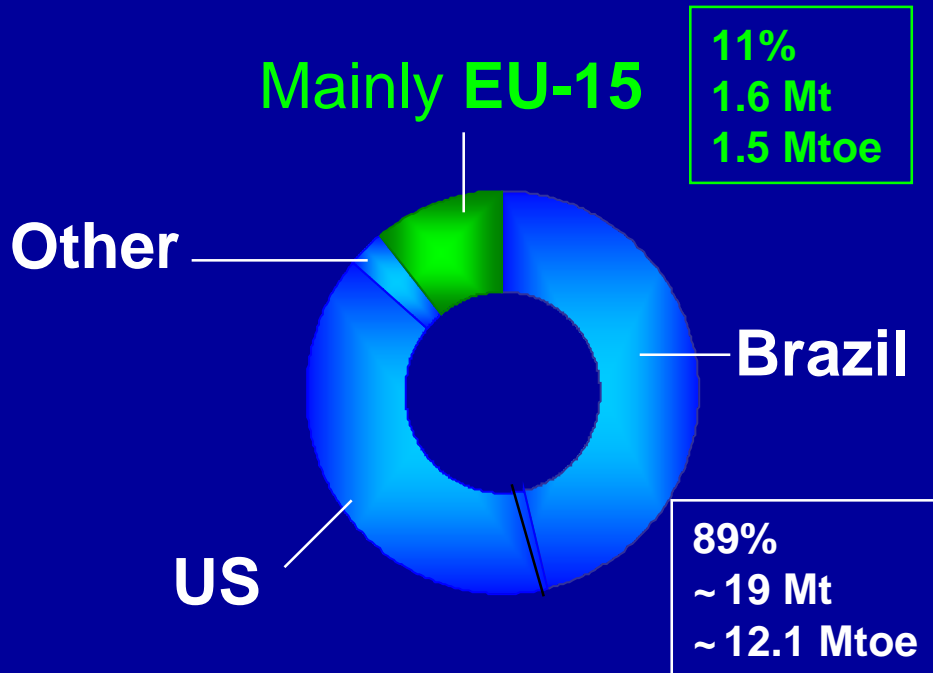


Biodiesel from a Refiner's Perspective

- Well specified product (EN 14214)
- Easy to blend using existing storage, distribution and marketing facilities for diesel
- Reduces diesel imports (Europe)
- Helps meet new specifications: no sulfur, no aromatics, lubricity improver
- Favorable “net” CO₂ balance

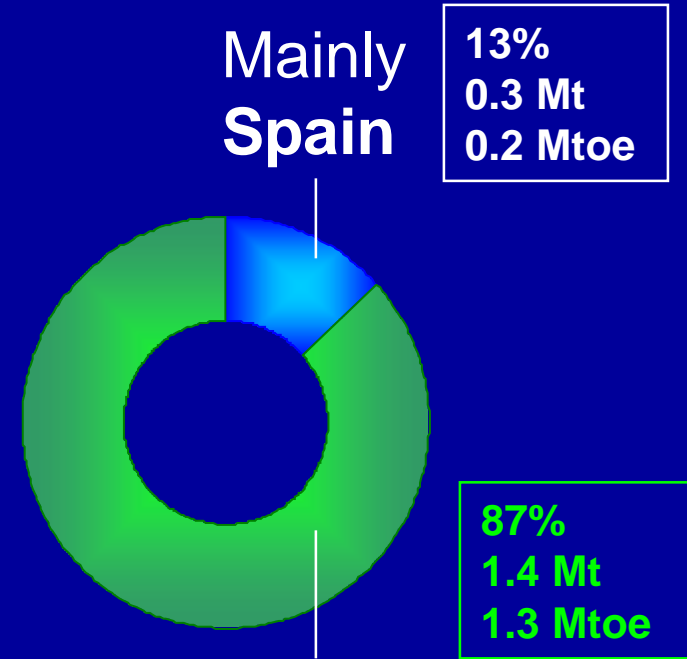
Worldwide and European Biofuel Production (2003 Figures)

> World



> Less than 1%
of global fuels
supply

> EU-15



Biodiesel

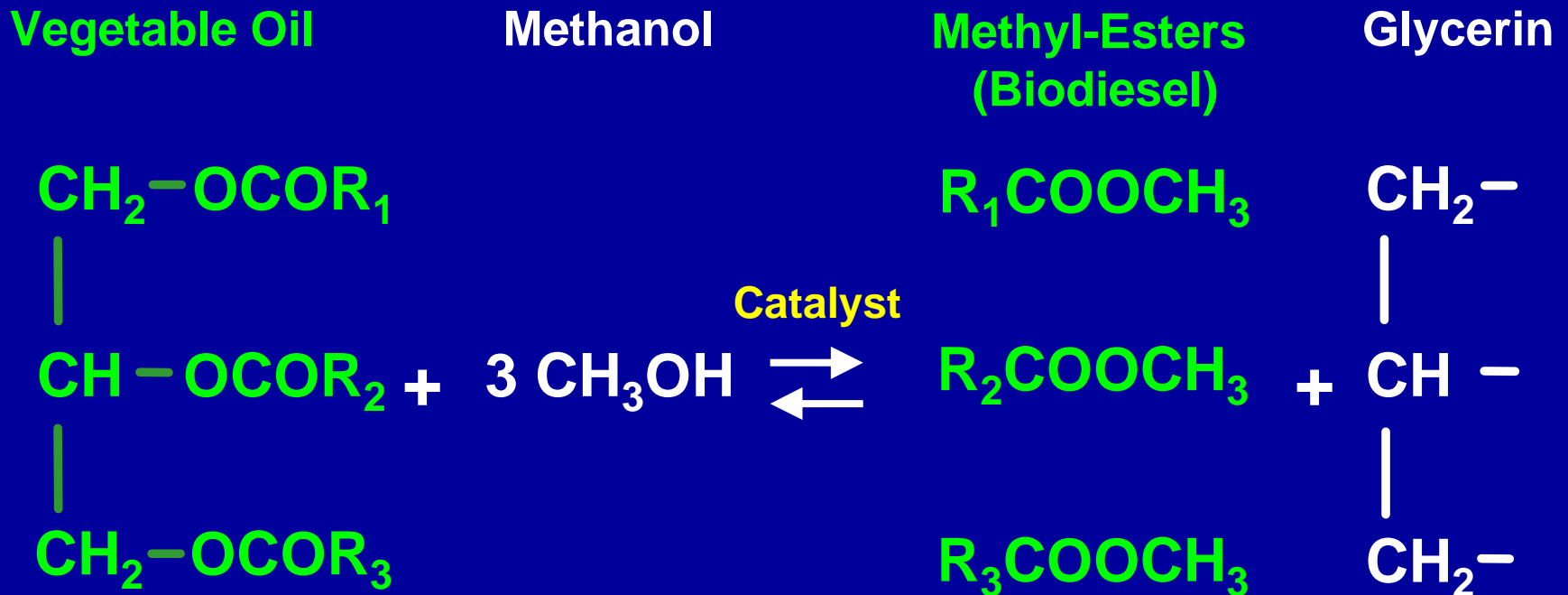
Ethanol

Mainly
Germany
France
Italy

- “Member States should ensure that a minimum proportion of biofuels and other renewable fuels is placed on their markets”
- Reference value for these targets (calculated on the basis of energy content, of all gasoline and diesel fuels)
 - 2% by 31 December 2005
 - 5.75% by 31 December 2010
- The European Commission will review the progress made by Member States in 2005

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- Original Esterfip process
- New Esterfip-H process
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A Three-Step, Catalytic, Reversible Reaction



	Diesel (EN 590)	RME	FAME (EN14214)
Density 15 °C, kg/m ³	< 845	880	860 - 900
Flash Point, °C	> 55	>120	> 120
Distillation, °C	T95 <360	323 – 342	-
Cetane number	>51	49-50	>51
Sulfur, ppm	< 50	< 1	<10
PAH, wt %	< 11	0	-

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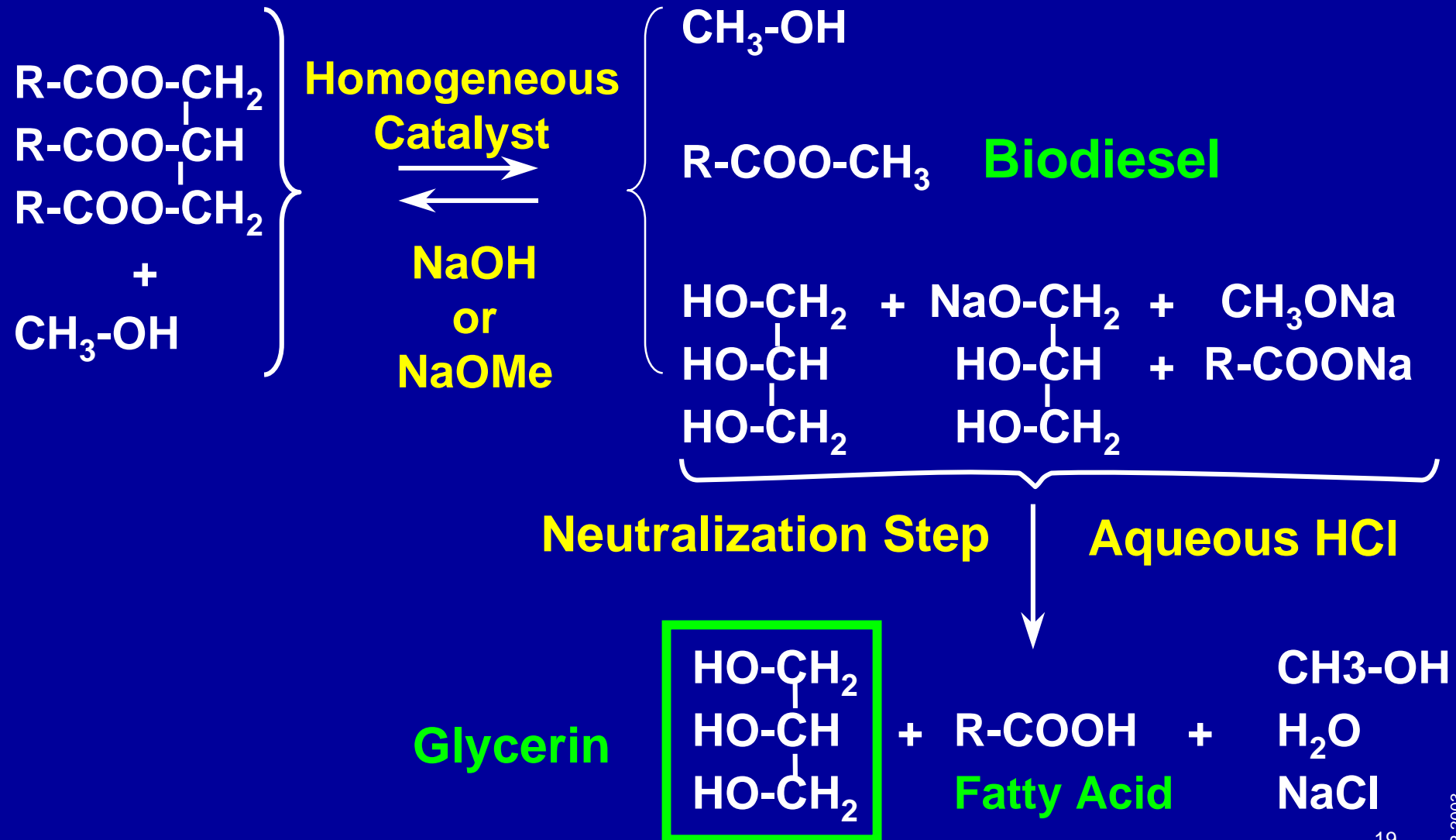


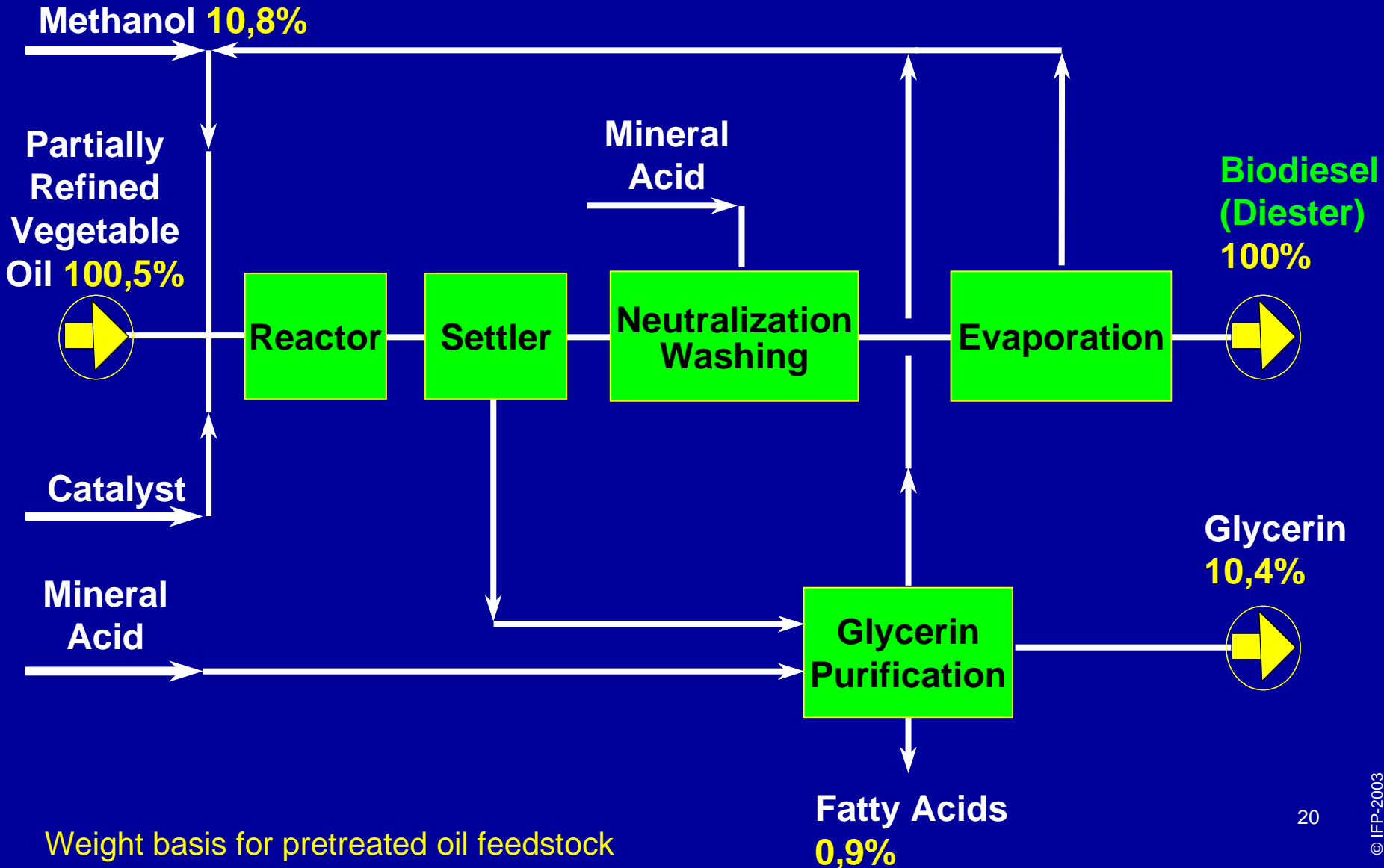
Esterification Process Milestones

- 1984 Lab research initiated
- 1987-1989 Pilot operations
 - Preliminary trials and operating conditions screening
 - Process validation
 - Methyl ester production for captive fleet tests
- 1992 **Esterfip**, first commercial reference (Compiègne, France) with initial capacity = 20 000 t/y
- 1997 Debottlenecking of **Esterfip** unit
 - Present capacity = 90 000 t/y

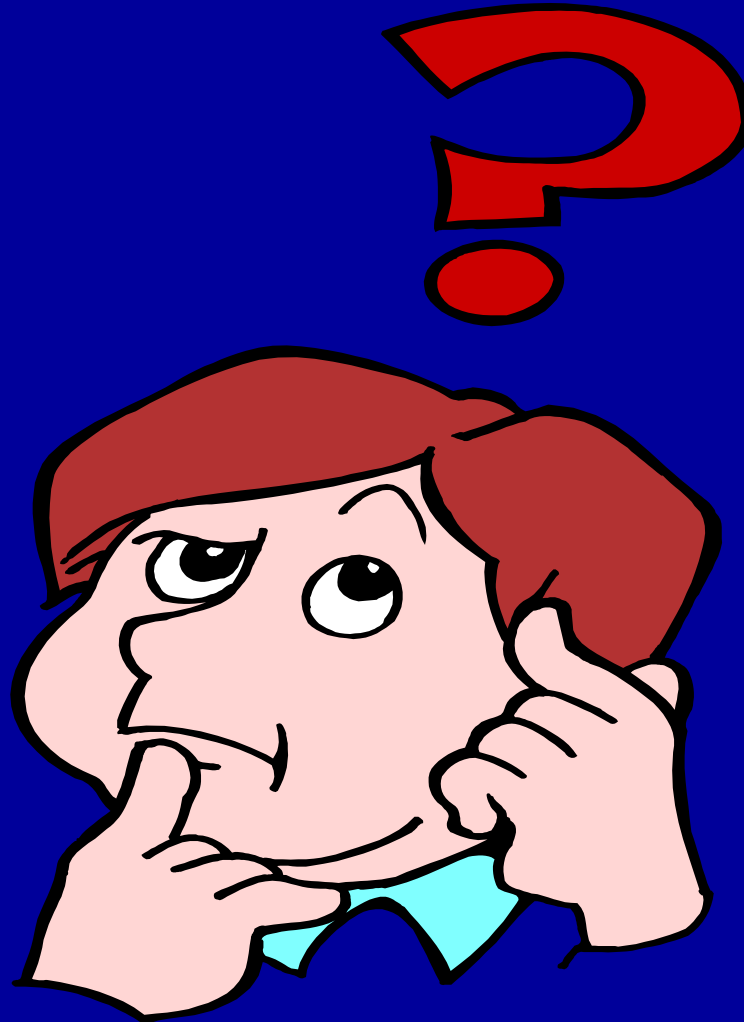
- Plant in Compiègne, France
- Capacity: 90 000 tons per year (x4 since start-up in 1992)



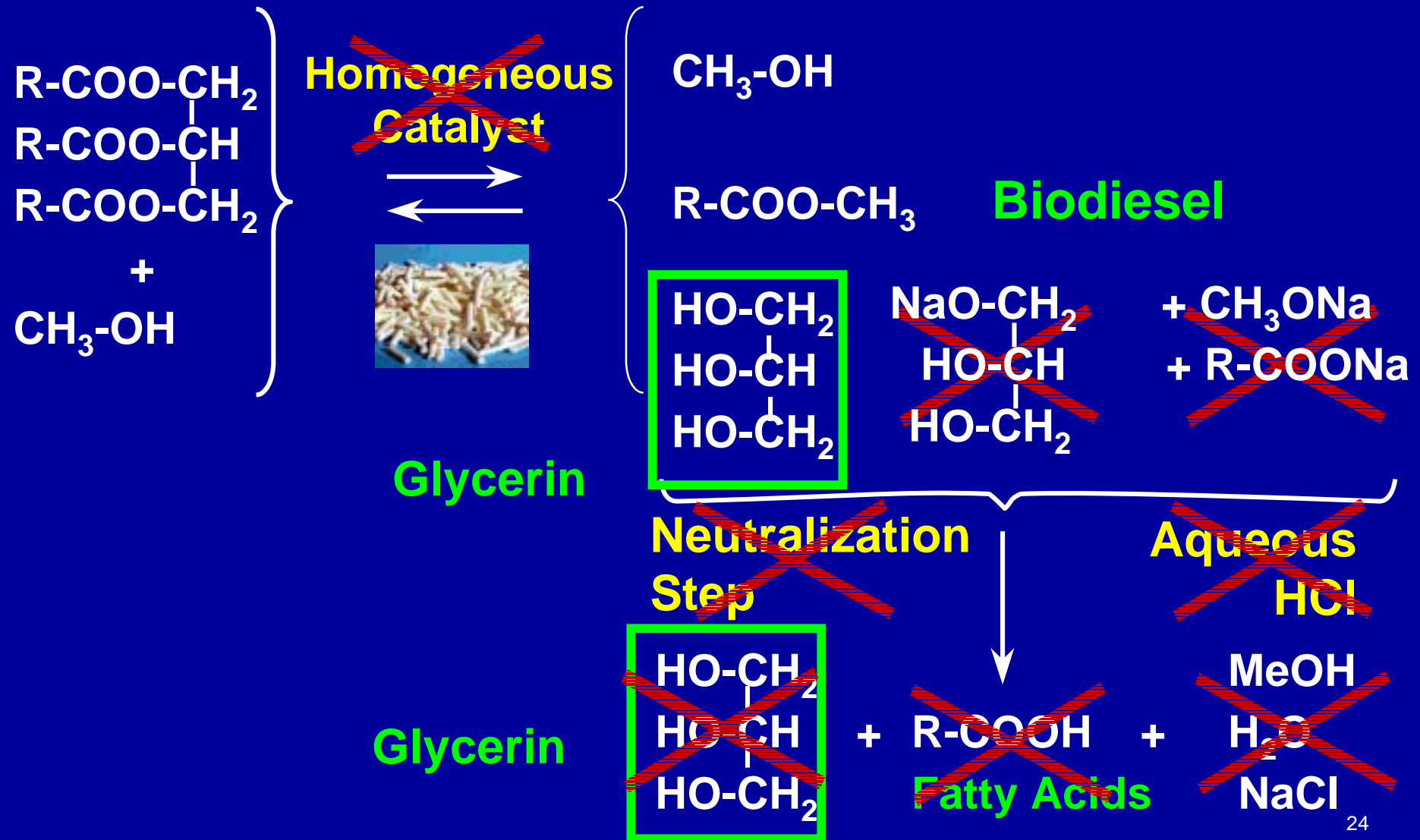


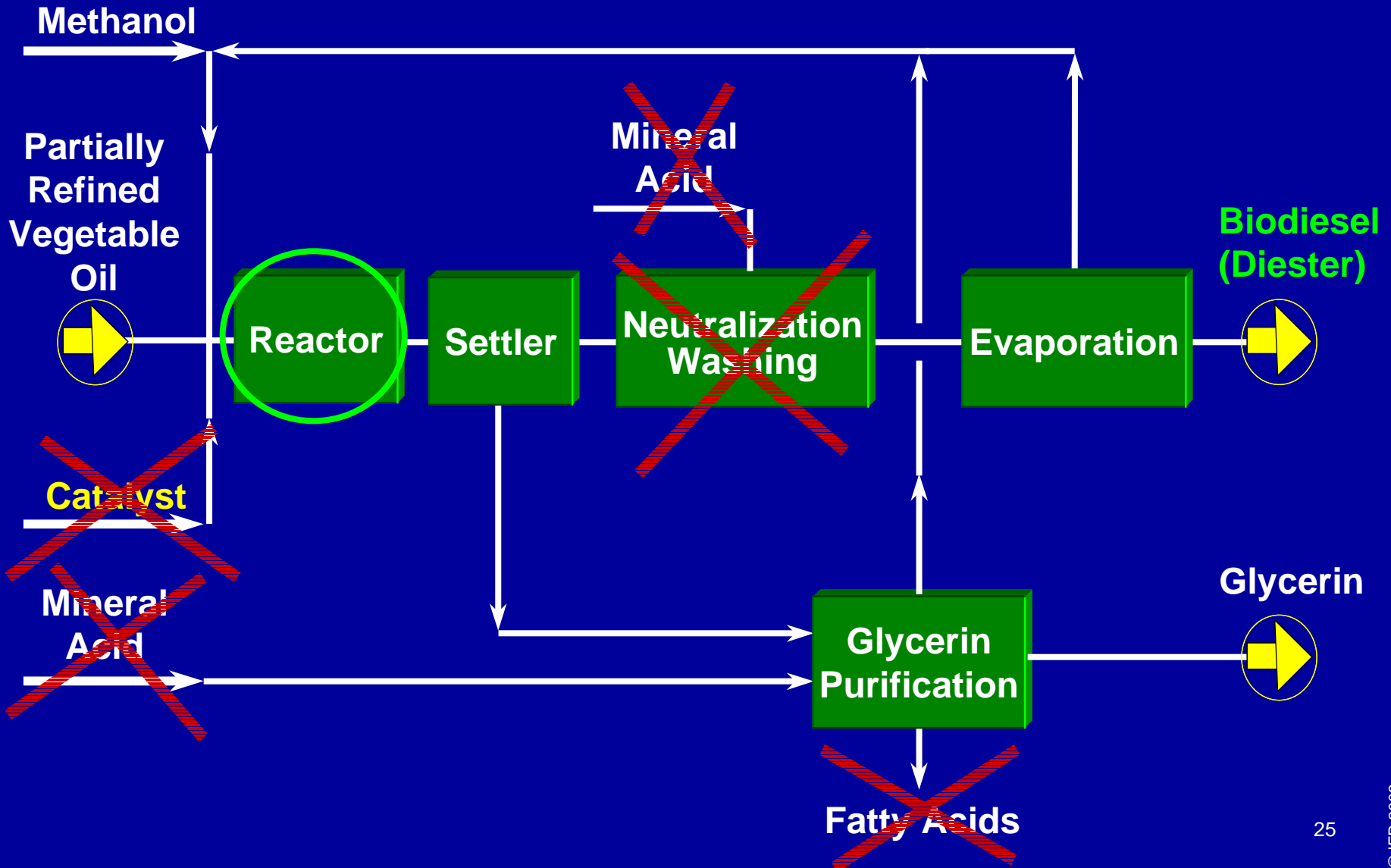


- Semi-continuous technology
- Ideally suited for medium size plants
- Ease of operation: fully automated process
- Simple technology: no centrifugal machines
- Ability to process various vegetable oils



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Heterogeneous Process Highlights

- New continuous technology based on solid catalyst
- Exceptional glycerol purity >98%
- Very high ester yield: close to 100%
- No waste production of low-value fatty acids
- No waste saline streams that require disposal
- No consumption / no handling of chemicals
- Much lower catalyst requirements (per ton of FAME) compared with other processes

- New plant in Sète, France
- Capacity: 160,000 tons per year
- To be commissioned in the 4Q 2005
- **Esterfip-H** selected by Diester Industrie



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- **Biodiesel is an attractive Biofuel**
 - Significant GHG emissions reduction
 - Contributes to meeting new diesel specifications
 - Reduces gasoline/diesel imbalance
- **IFP & AXENS**
 - Over 10 years of experience in biodiesel production technologies
 - New Heterogeneous process : ESTERFIP-H