

# BIO ETHERS

THE ADVENT OF COBLENDING  
HARVESTING THE ETBE ETOH SYNERGY

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Board Member of Italian Biofuels Technology Platform  
Chairman Biofuels of European Fuel Oxygenates Association*

***Italian Stakeholders Meeting on Biorefineries***

***IEA Bioenergy Task 42***

*Tortona - Italy - 4 April 2011*



FEDERCHIMICA

AISPEC

GRUPPO FONTI RINNOVABILI



## BioFuels: 3 Key Entities



**Italian  
Biofuels  
Technology  
Platform**

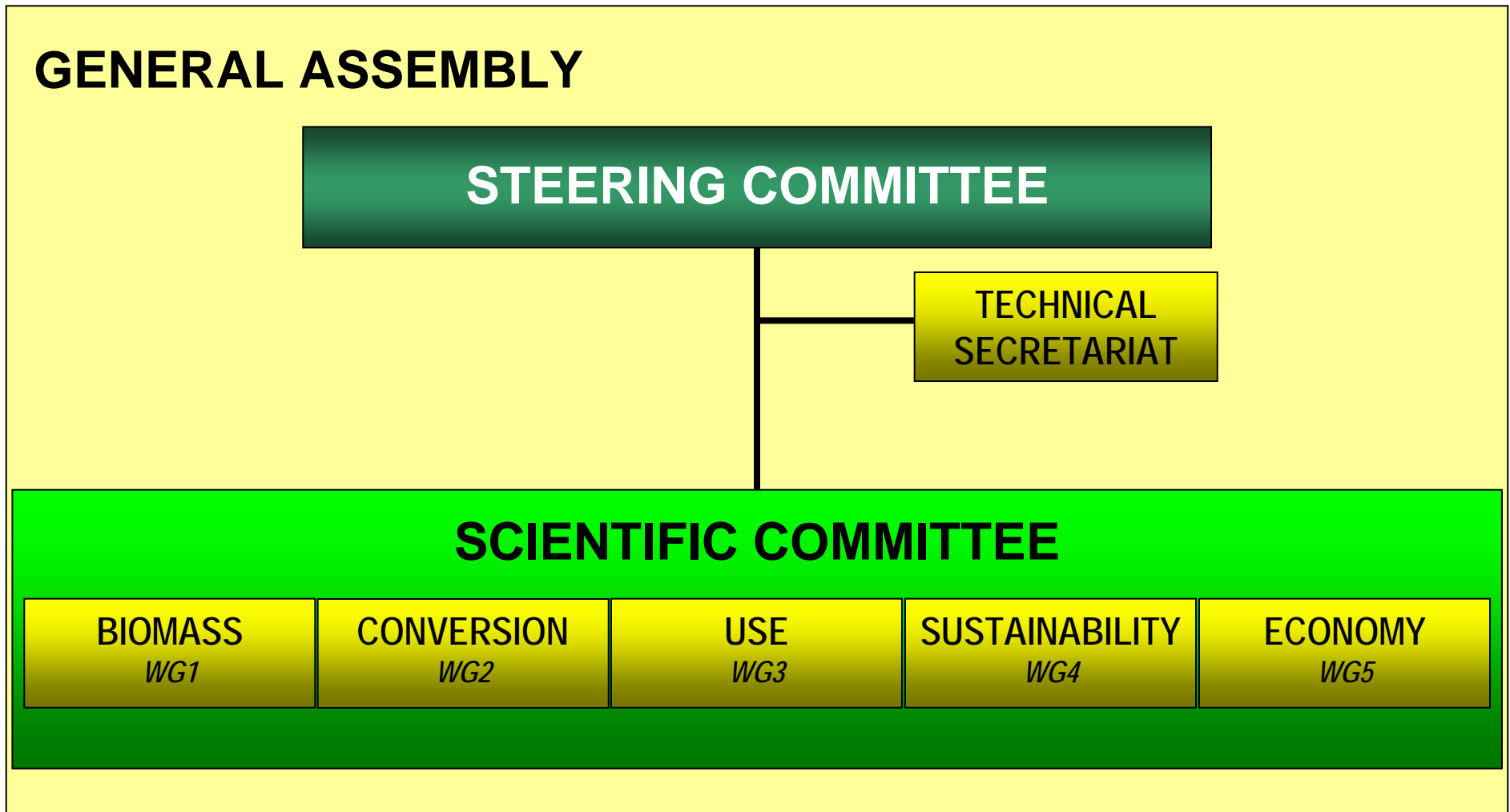
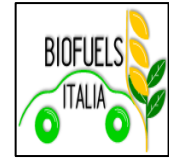


**Italian  
Chemical  
Industry  
Federation**



**European  
Fuel  
Oxygenates  
Association**

# Italian Bio-fuels Platform: Organizational Structure



# Federchimica and Italian Chemical Industry



Federchimica is the **National Federation of Chemical Industry**.

## **Chemical Industry Italy:**

- Enterprises **2900**
- Production Units **3500**
- Turn-over (2009) (G€) **46**
- Employees **119.000**

## **Federchimica:**

- Member Companies **1.300**
- Employees **90.000**
- Sector Groups **41**
- Associations **16**
- Enterprises w/i GFR **18**

Federchimica is member of **Confindustria** and **CEFIC**

[www.federchimica.it](http://www.federchimica.it)

# Renewable Sources Group<sup>[\*]</sup> of Federchimica: Represented Activities

Renewable Sources <sup>[*]</sup> 18 Enterprises as per March 2011		
Energy Uses	Non-Energy Uses	
Bio-Fuels, and Bio-Components for Fuels, Production	Transformation of Renewable Raw Materials	Chemicals for Renewable Energy Industry
- [bio-alcohols (ethanol, butanol)]	- Additives, Chemical Intermediates	- Biomass
- [bio-ethers (ETBE, TAEE)]	- Starch and Derivatives	- Wind power
- [bio-esters (FAME, FAEE)]	- Biorefineries	- Geothermal
- [BTL (Biomass To Liquid)]	- Oleochemicals	- Hydroelectric
	- Polimers	- Sea energy
	- Bio-cosmetics	- Solar
(complementary) Production of Energy from Renewable Sources		
- Vegetable Oils		
- Bio-gas		

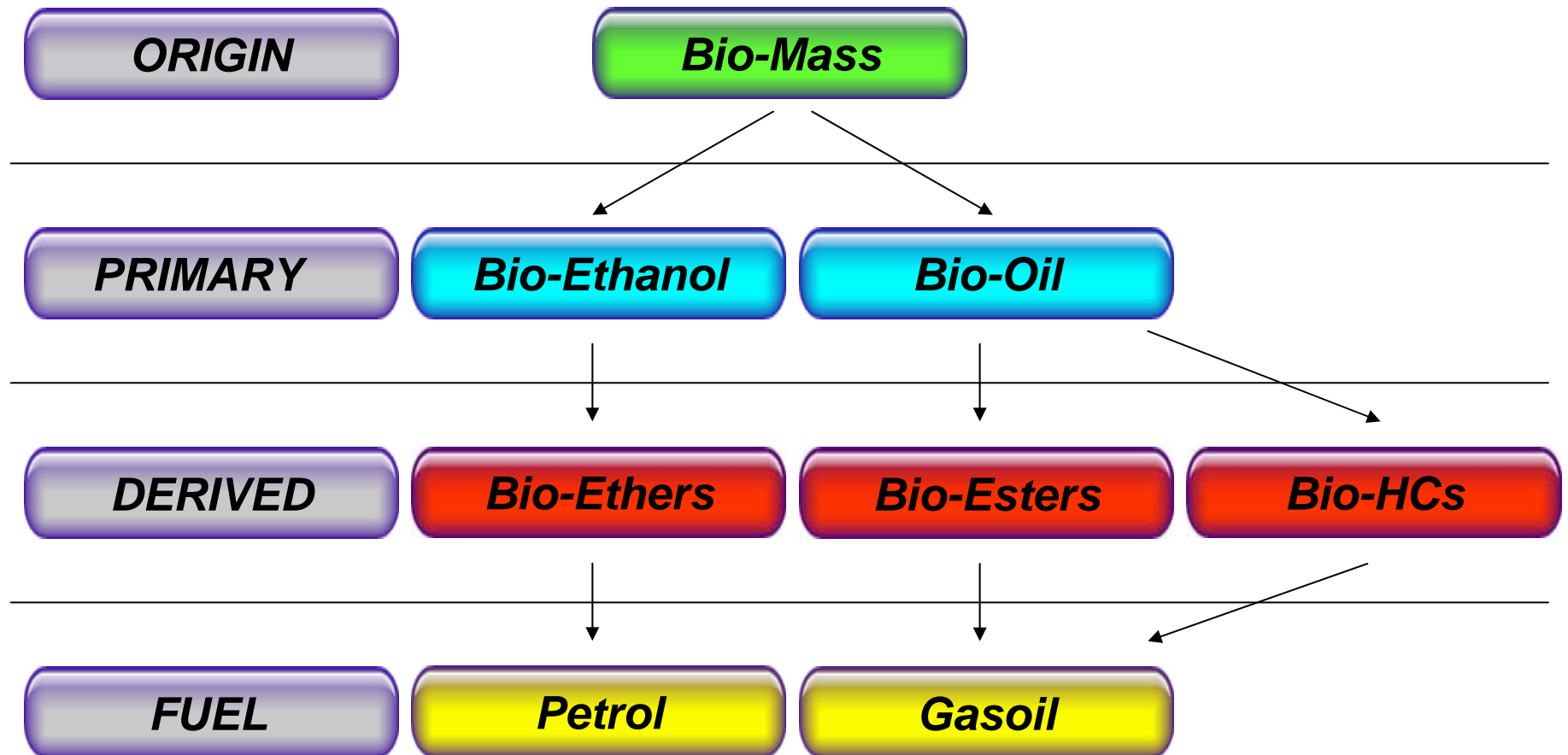
# European Fuel Oxygenates Association



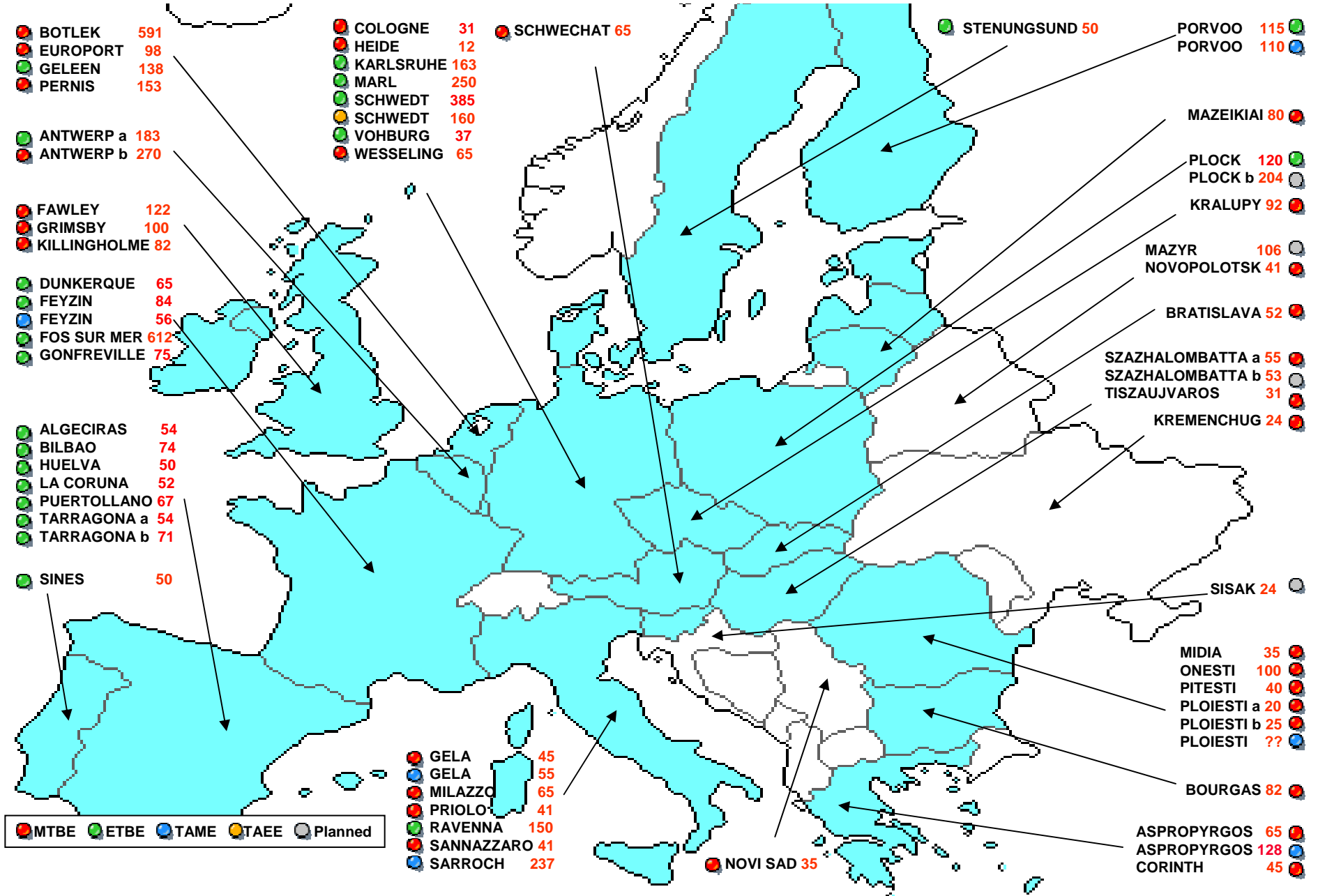
- Non-profit Technical Organisation
- Founded in 1985
- ~ 2/3<sup>rd</sup> of Total EU Etherification Capacity

<http://www.foa.eu>

**Bio-Ether (ETBE) is for Petrol**  
**what Bio-Ester (FAME) is for Gasoil**

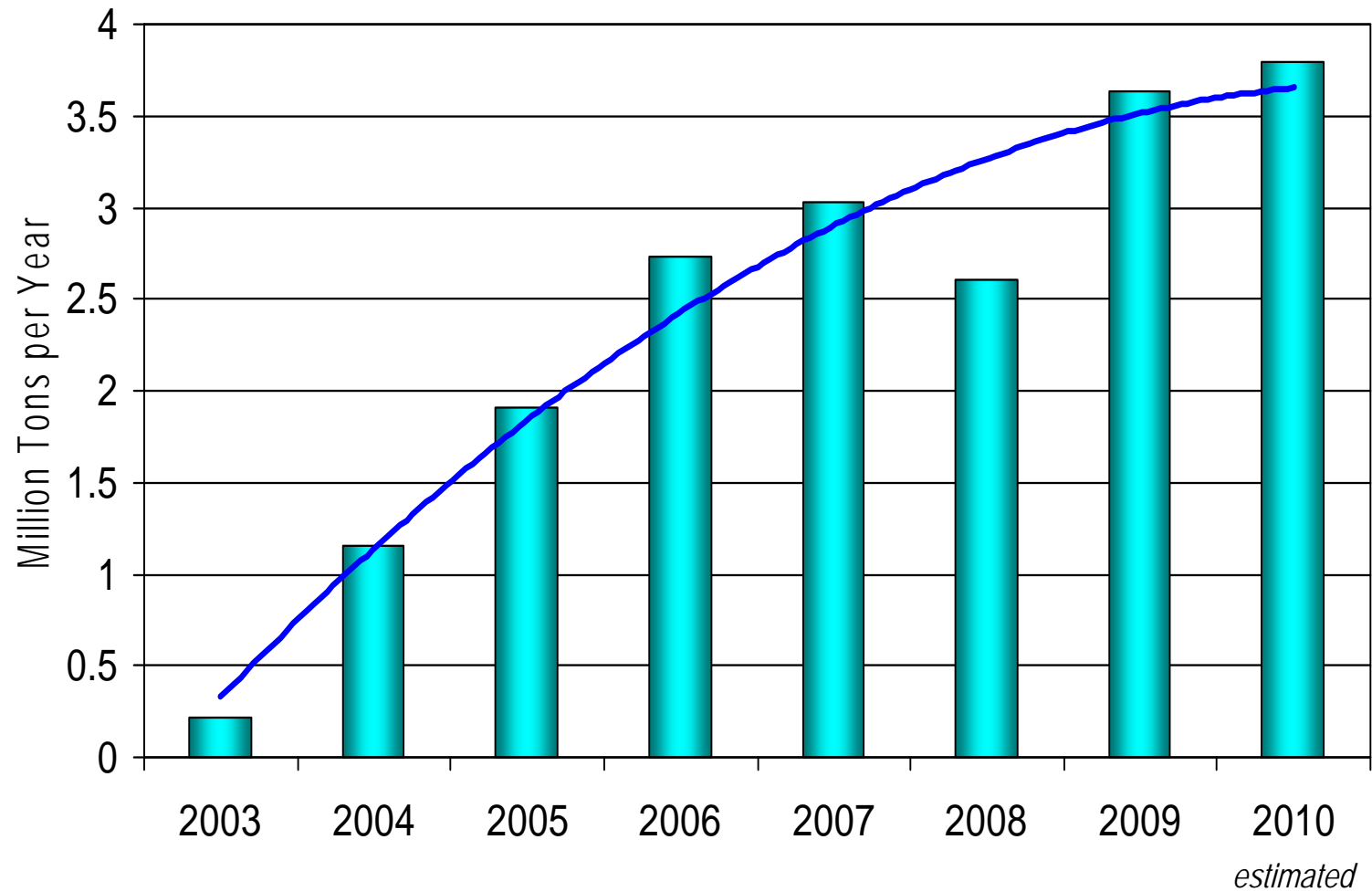


# European Fuel-Ethers Production Capacities 2010 (KT/Y)





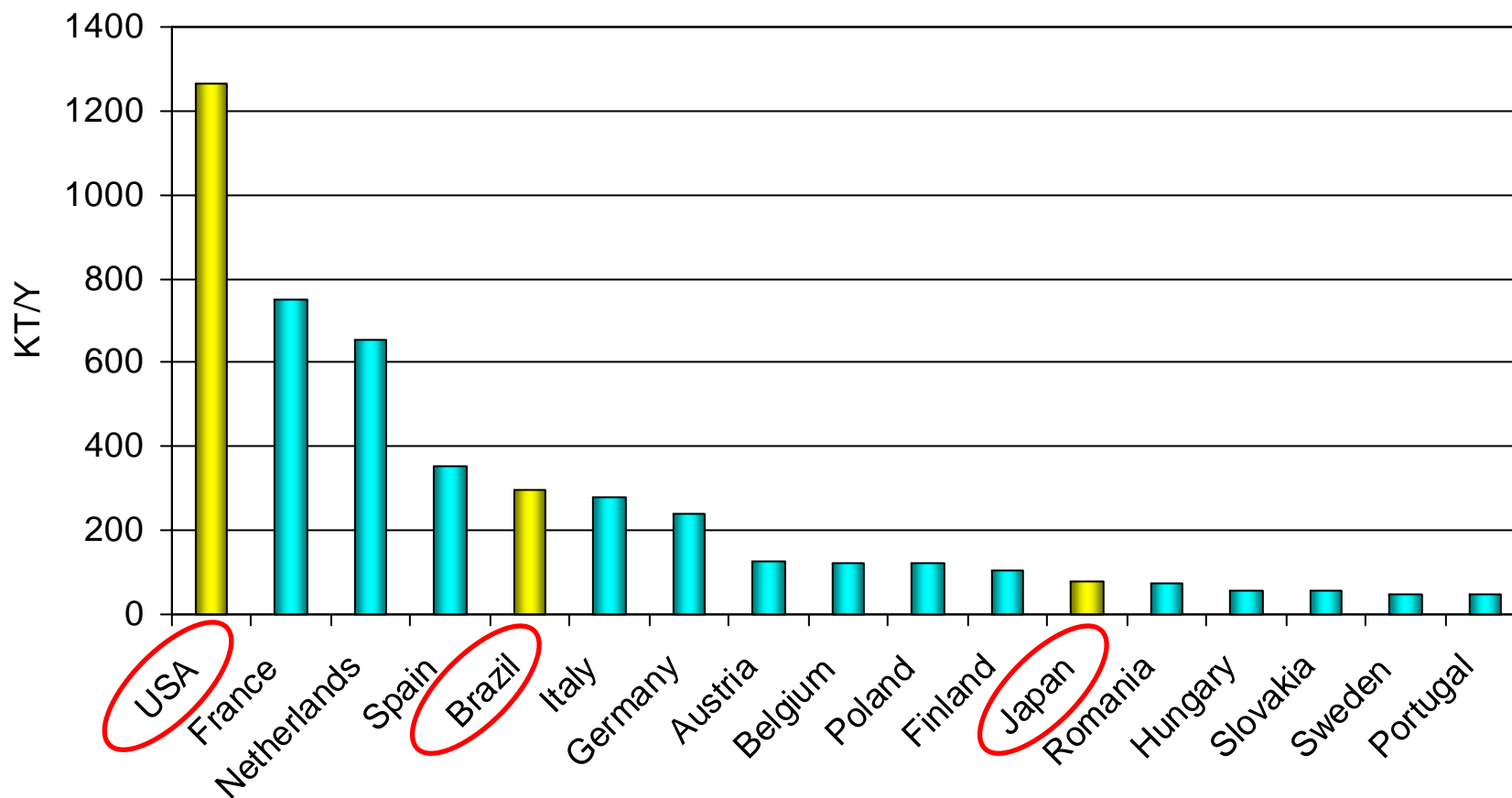
# ETBE Consumption EU 2003 - 2010



Source: EFOA

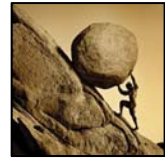


## Global ETBE Nameplate Capacity 2010



Few new “non-EU” ETBE producers entered the market scene

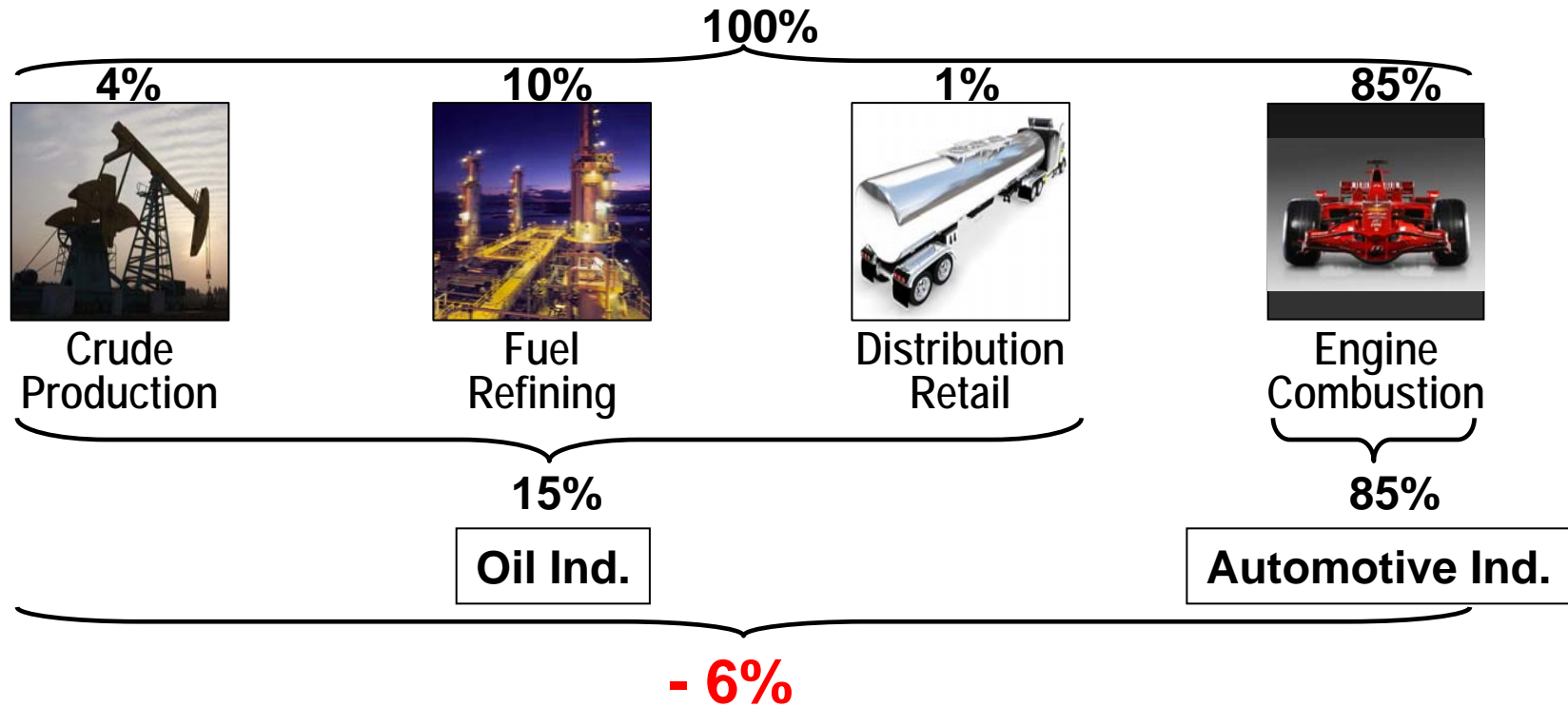
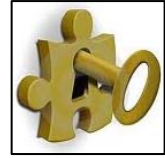
# RED & FQD EU Directives Challenge



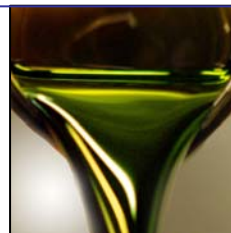
Frame ( <i>fuel-related</i> )		
	Renewable Energy Directive	Fuel Quality Directive
Type	Bio-energy Incorporation in Fuels	CO <sub>2</sub> Savings across Fuel Production and Supply Chain
Focus	Product	Process
Value	10%	6%
How?	High % of Bio-components	
		CO <sub>2</sub> Effectiveness of Bio-components
	<i>Other actions? (CCS, energy efficiency, etc.)</i>	
Challenge	Consumer Acceptance of High-Bio Grades	
	Existing Vehicle/Engines Operability	
	Bio-component Quality/Quantity Availability	
	Fuel Specifications Limits	
	Financial Implications (Costs/Economics)	
	No Short-term Economically Affordable Alternatives	
Must	Full Exploitation of Bio-related Existing Fuel Specification Limits	
	Harvesting Synergetic "Non-linear" Effects of Bio-components	
	Minimizing Logistics & Optimizing Investments	

# RED: GHGs Emissions Reduction & Fuels

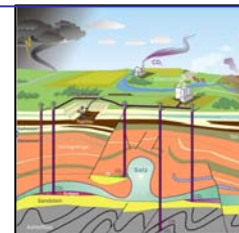
- 6% a big Challenge: Bio-fuels Key !



Operations  
Energy  
Efficiency

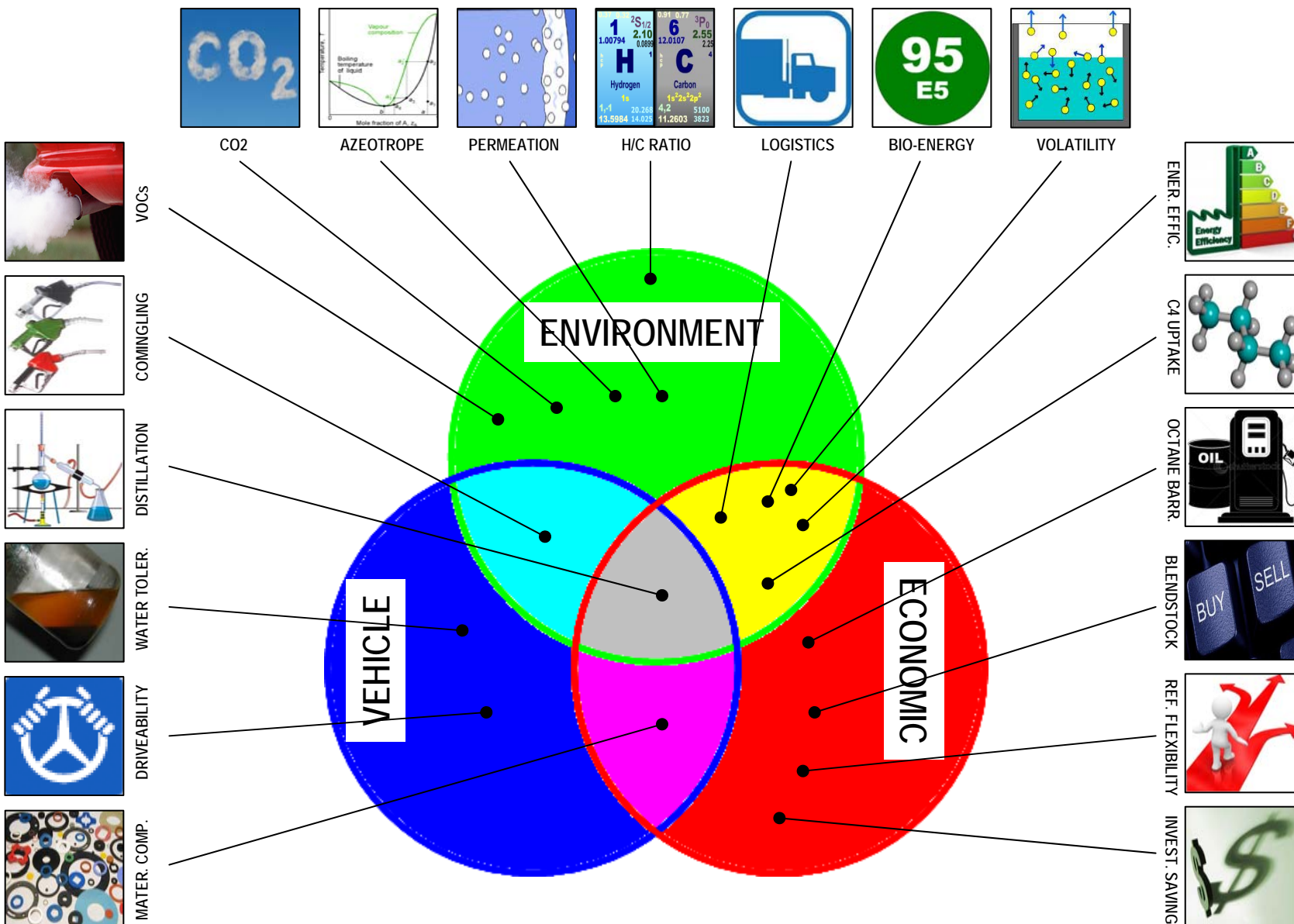


Bio-Fuels  
Blending



Carbon  
Capturing  
& Storage

# ETBE: A Multifaceted Benefits Carrier



# Bio-Ethers Reduce Refinery Operations' CO<sub>2</sub> Emissions



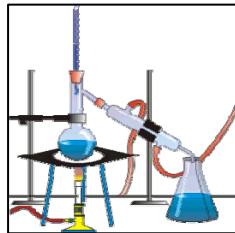
CAUSE ...



... EFFECT



< Vapour pressure



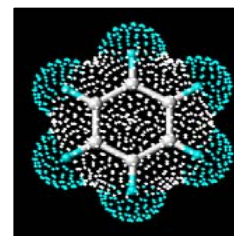
Distillation characteristics



> Octane Contribution



< Carbon Content



< Aromatics



< Refinery Fuel

..on top of that: ETBE has a higher hydrogen/carbon ratio, forming less CO<sub>2</sub> for the same energy delivered to the engine and it reduces fugitive VOC emissions from cars, resulting in lower CO<sub>2</sub> emissions (1 MT VOC ~ 3 MT CO<sub>2</sub>)

# ETBE Reduces CO<sub>2</sub> Emissions



HART July 2007

**Study on Relative CO<sub>2</sub> Savings  
Comparing Ethanol and ETBE  
as a Gasoline Component**

Submitted by:  
Hart Energy Consulting

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**HART**  
Relative CO<sub>2</sub> Savings Comparing Ethanol and ETBE as a Gasoline Component - All rights reserved - Hart Energy Consulting www.hartenergy.com

*“The use of bio-ETBE reduces refining crude-oil need and processing intensity, requires less fuel and, implying relevant petrol composition changes, allows the reduction of carbon factor and lesser CO<sub>2</sub> emissions”*

CE-Delft October 2007

**CE Delft**  
Solutions for  
environment,  
economy and  
technology

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e-mail: ce@ce.nl  
website: www.ce.nl  
KvK 27251086

**ETBE and Ethanol:  
A Comparison of CO<sub>2</sub> Savings**

Report  
Delft, October 2007

Author(s): Harry Croezen  
Bettina Kampman  
Gerdien van de Vreede  
Maartje Sevenster

*“This study indicated that, when bio-ETBE is used, the resulting modification of refinery operations determine a significant reduction of greenhouse gases emissions”*

IFEU August 2008

**ifeu**  
Institut für Energie-  
und Umweltforschung  
Heidelberg gGmbH

**Bioenergie aus Getreide  
und Zuckerrübe: Energie-  
und Treibhausgasbilanzen**

Endbericht (Kurzversion)

Im Auftrag des  
Verbandes Landwirtschaftliche  
Biokraftstoffe e.V. (LAB), Berlin

Heidelberg, 13. August 2008

*“Best results by far are obtained when ethanol is converted to bio-ETBE.  
The use of ETBE can allow the saving of 4 times the primary energy required to produce its fossil alternative.  
IFEU recommends to exploit the whole potential of bio-ETBE”*

# ETBE CO<sub>2</sub> Performance Studies: **References**



Study on Relative CO<sub>2</sub> Savings Comparing Ethanol and ETBE as a Gasoline Component  
Hart Energy Consulting  
*July 2007*



ETBE and Ethanol: A Comparison of CO<sub>2</sub> Savings  
CE-Delft  
*October 2007*

[http://www.ce.nl/publicatie/etbe\\_and\\_ethanol%3A\\_a\\_comparison\\_of\\_co2\\_savings/715?PHPSESSID=37ad2bd9915bcf5711aed6292578b595](http://www.ce.nl/publicatie/etbe_and_ethanol%3A_a_comparison_of_co2_savings/715?PHPSESSID=37ad2bd9915bcf5711aed6292578b595)



Bioenergy from grain and sugar beet: Energy and greenhouse gas balances  
IFEU - Institute for Energy and Environmental Research Heidelberg  
*August 2008*

<http://papers.sae.org/2009-01-1951>

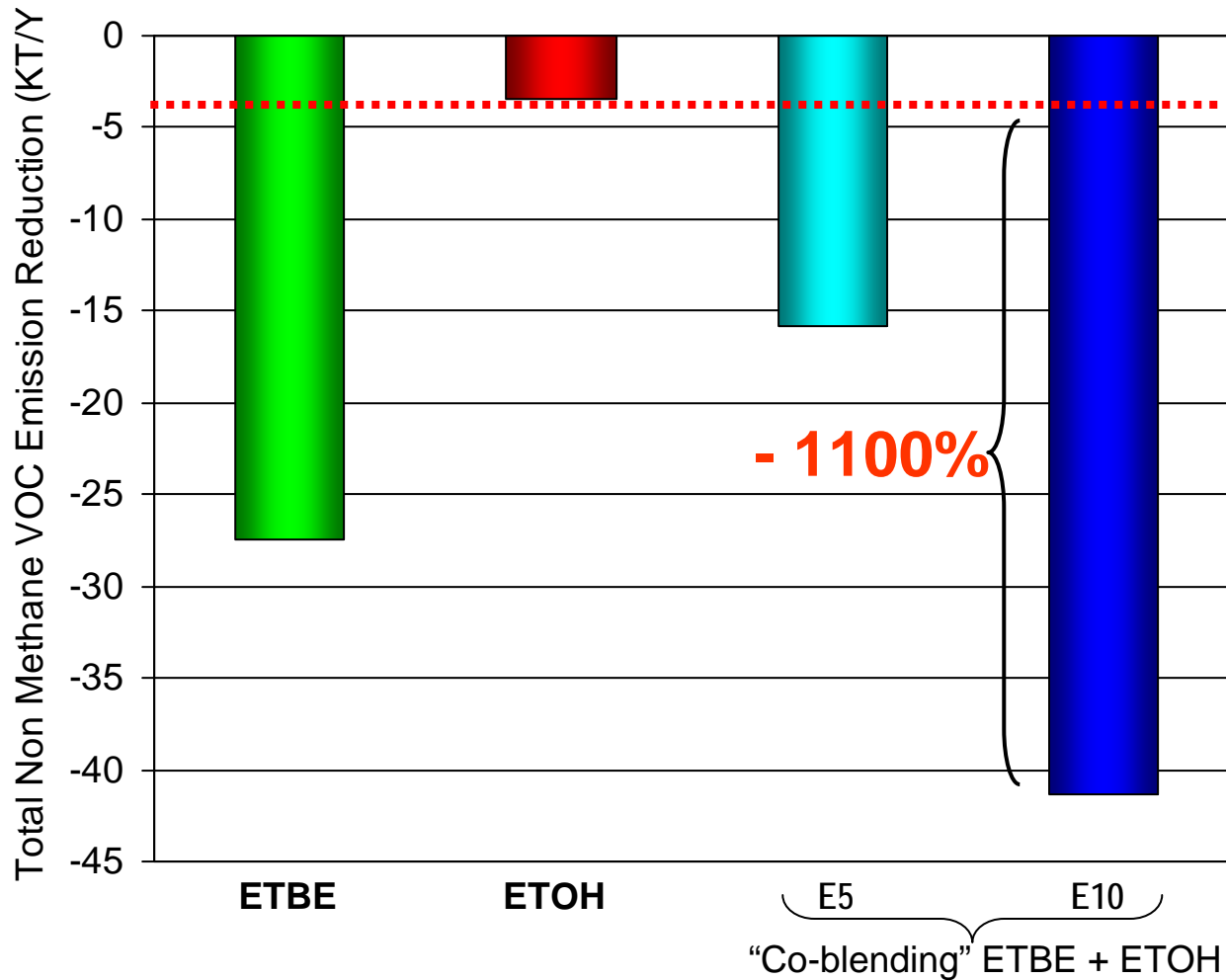


The impact of ethanol and ETBE blending on refinery operations and GHG-emissions  
ELSEVIER - Energy Policy  
*2009*

[http://www.ce.nl/art/uploads/file/Artikelen%20\(medewerkers\)/EnergyPolicy\\_TheImpactofEthanolandETBEblending\\_HCBKa.pdf?PHPSESSID=4d91cd6d759b670b5c0f4d0c98735687](http://www.ce.nl/art/uploads/file/Artikelen%20(medewerkers)/EnergyPolicy_TheImpactofEthanolandETBEblending_HCBKa.pdf?PHPSESSID=4d91cd6d759b670b5c0f4d0c98735687)

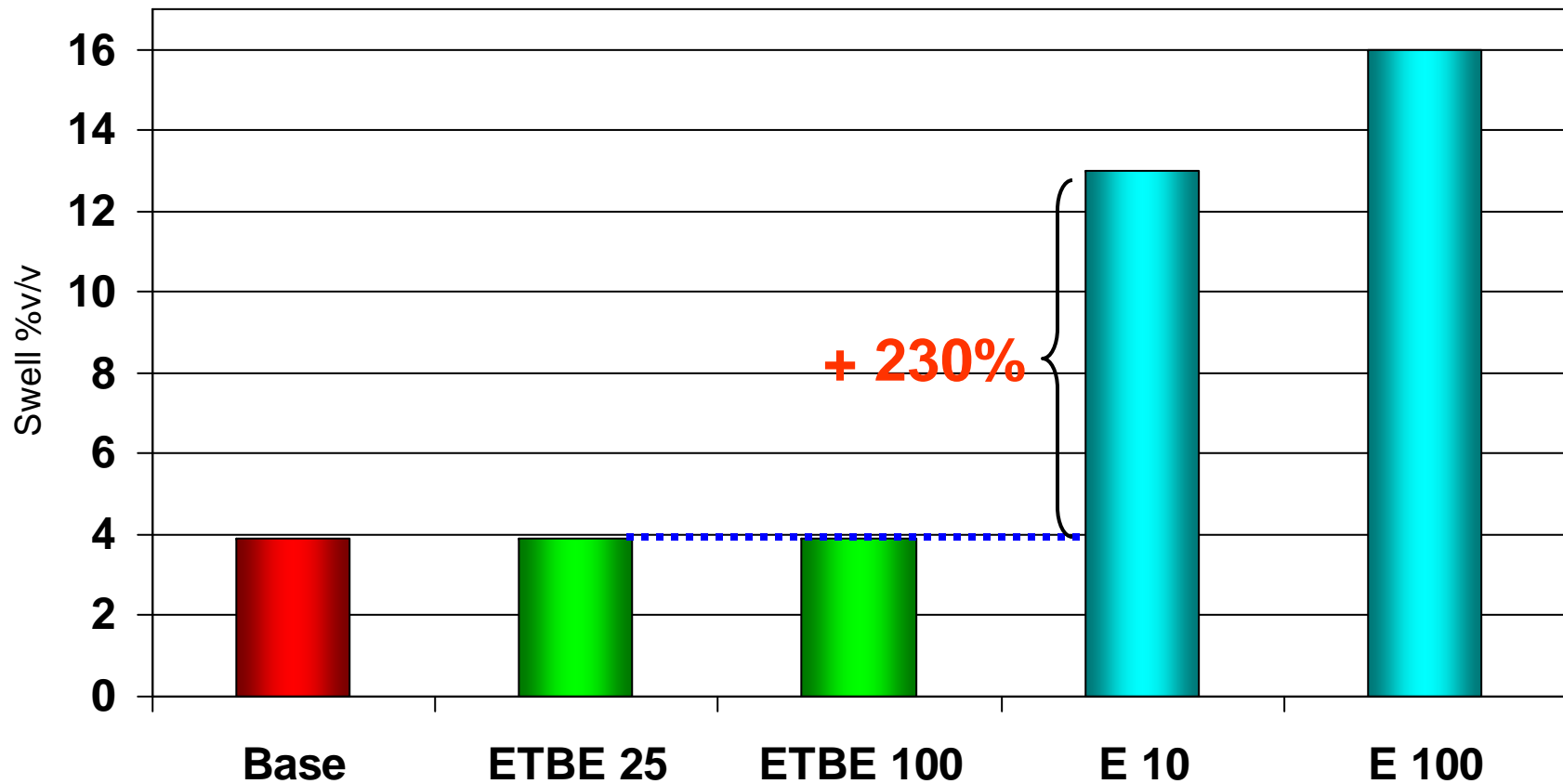


# Significantly **lower NMVOC Emissions** by Co-Blending ETBE with Ethanol



Source: Elaboration from EU Commission's (JRC) COPERT simulation ETOH 5% equivalent Europe 2010

# ETBE Offers Fuel System **Compatibility**



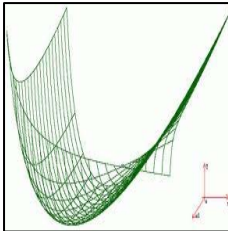
VITON™ A Fluoroelastomer in Gasoline Blends and Neat Oxygenates Volume Swell after 168 Hours @ 23 C

Source: [www.dupontelastomers.com/TechInfo/chemical.asp](http://www.dupontelastomers.com/TechInfo/chemical.asp)

..and **“Co-blending”**  
Offers even **Additional Benefits!**



Full **Exploitation** of Bio-related Existing  
Fuel **Specification Limits**

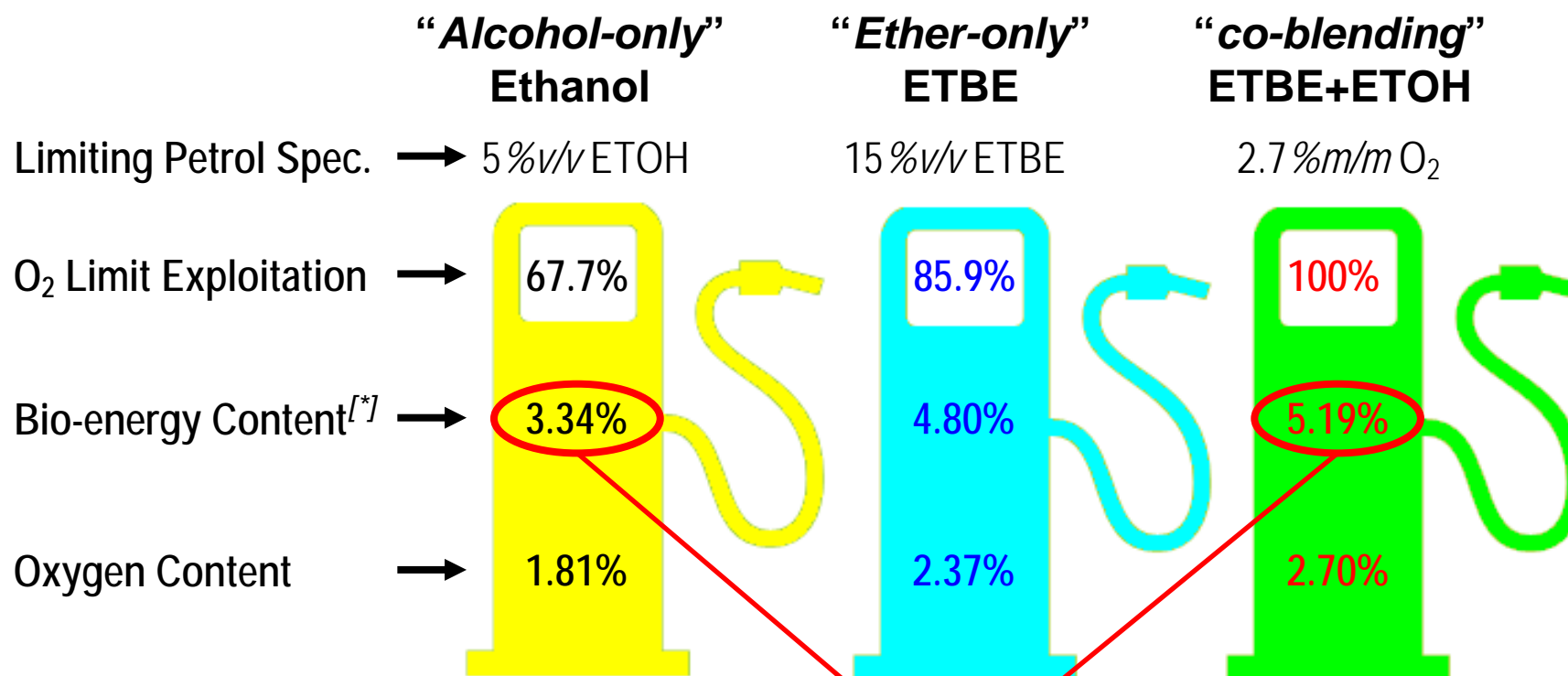


Harvesting **Synergetic "Non-linear"**  
**Effects** of Bio-components



Enabling **common “BOB”** allowing  
**optimised logistic**

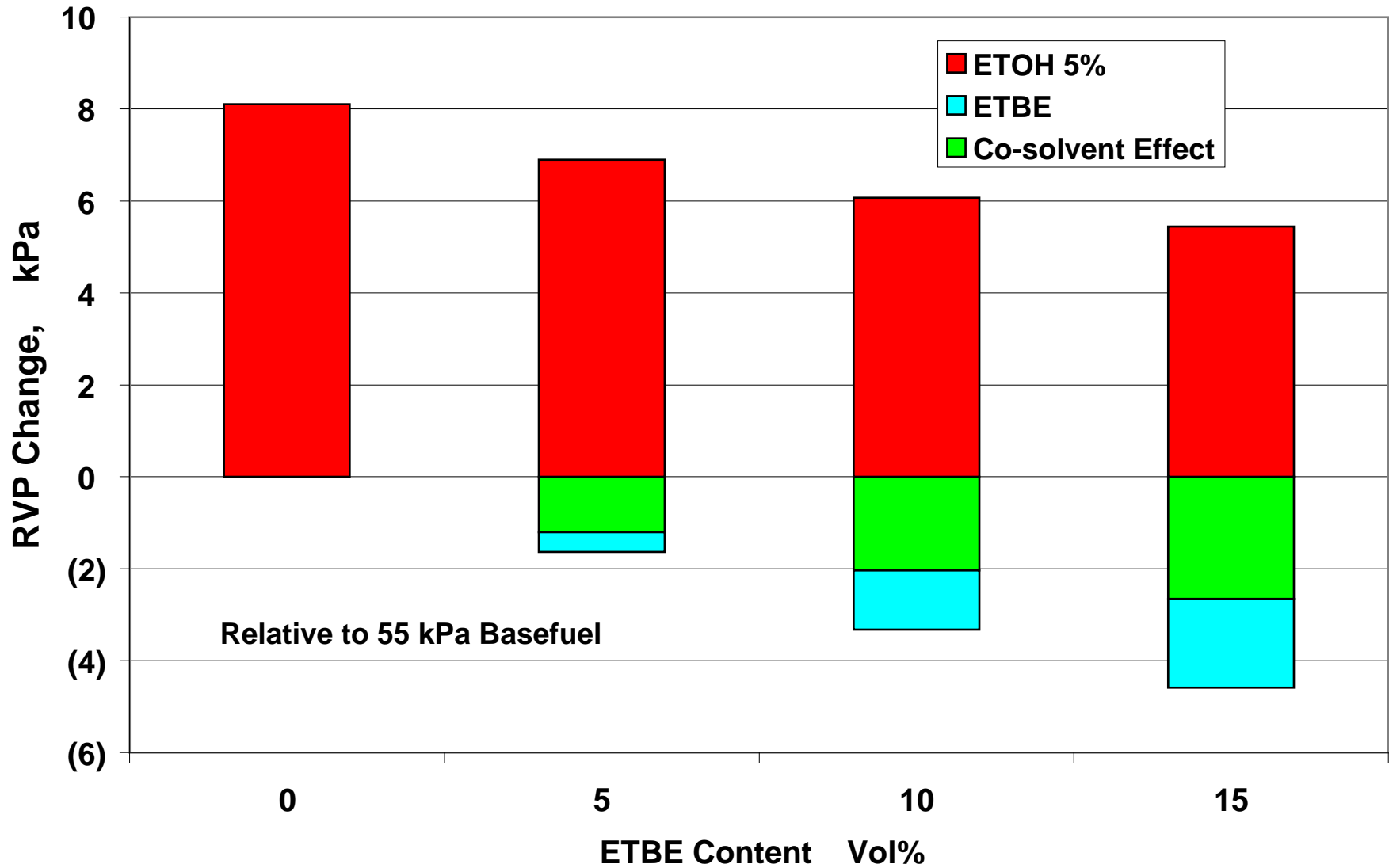
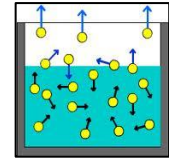
# “Co-blending”: Maximizing E5 Bio-energy Content



**55%** more bio-energy can be blended into E5 (Protection Grade)  
Trough the adoption of **ETBE/ETOH “Co-blending”**

<sup>[\*]</sup>Based on very conservative ETBE bio-energy content of 37% of LHV of ETOH

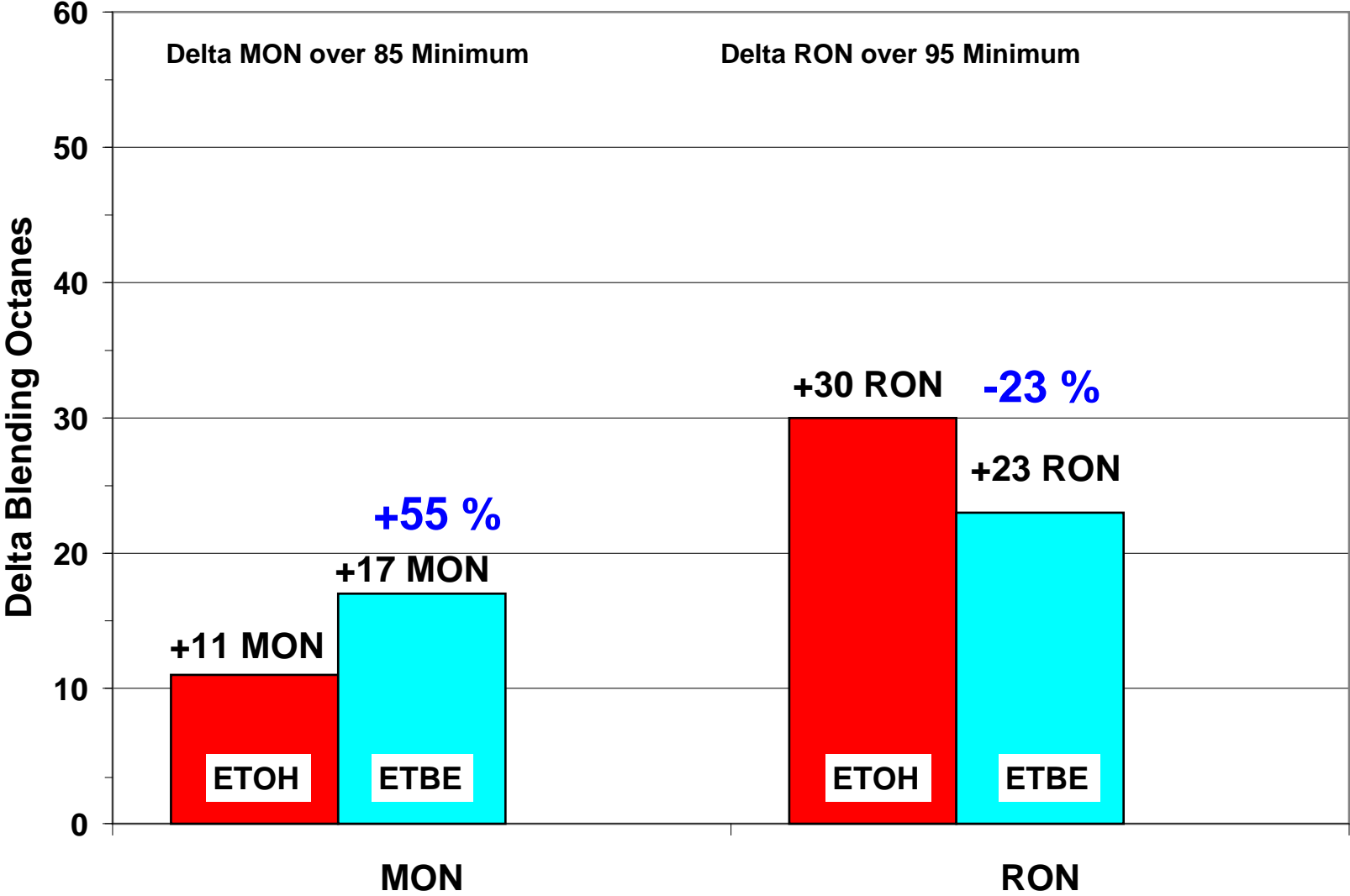
# ETBE/ETOH "co-blending": Co-solvency Effect on RVP



# ETBE/ETOH Co-blending: Additional Octane Contributions (1/3)



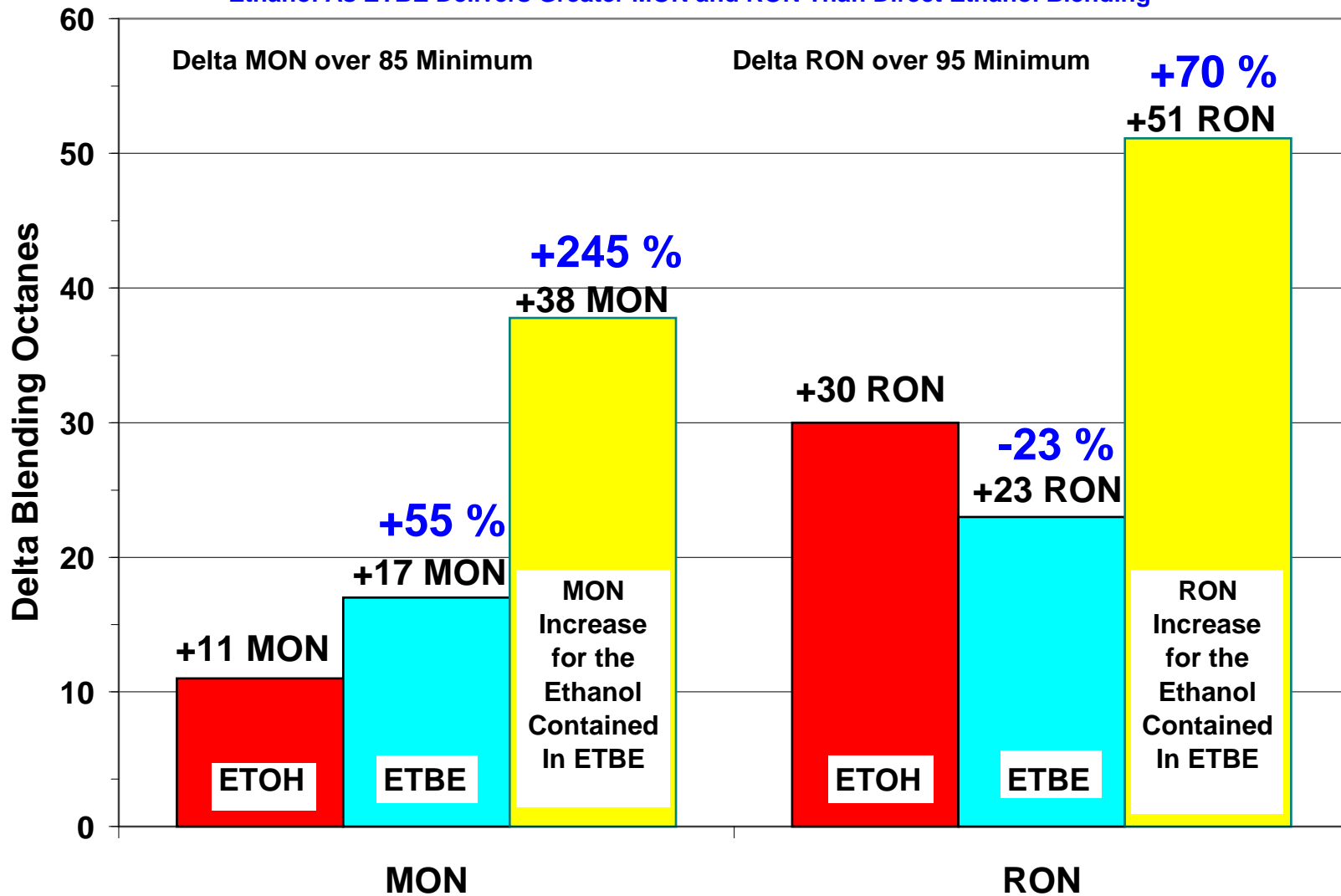
Both Ethanol and ETBE are Petrol Octane Boosters



# ETBE/ETOH Co-blending: Additional **Octane** Contributions (2/3)



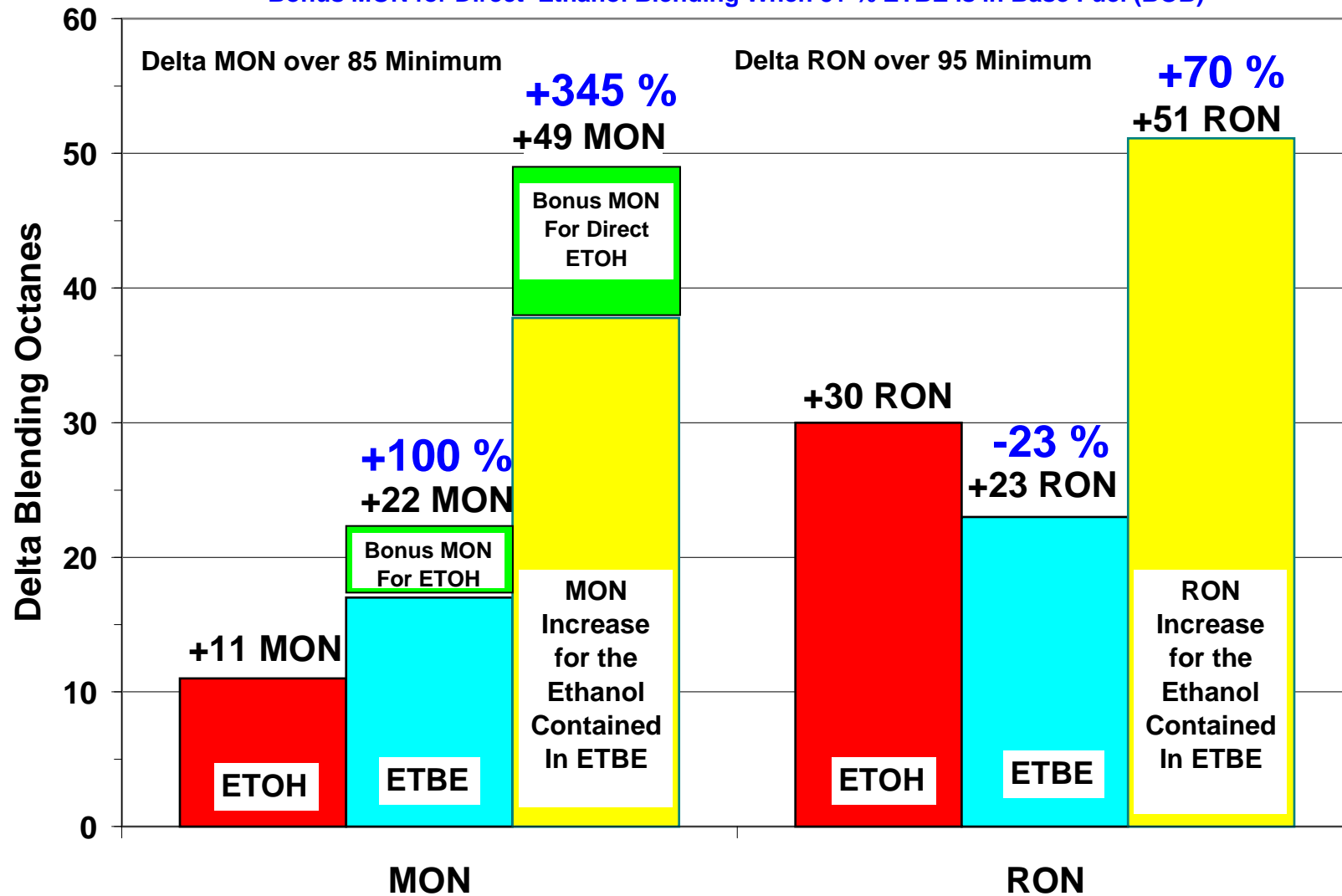
Ethanol As ETBE Delivers Greater MON and RON Than Direct Ethanol Blending



# ETBE/ETOH Co-blending: Additional Octane Contributions (3/3)



Bonus MON for Direct Ethanol Blending When 5+ % ETBE is in Base Fuel (BOB)





# Logistic advantages of a common EU “RBEB”

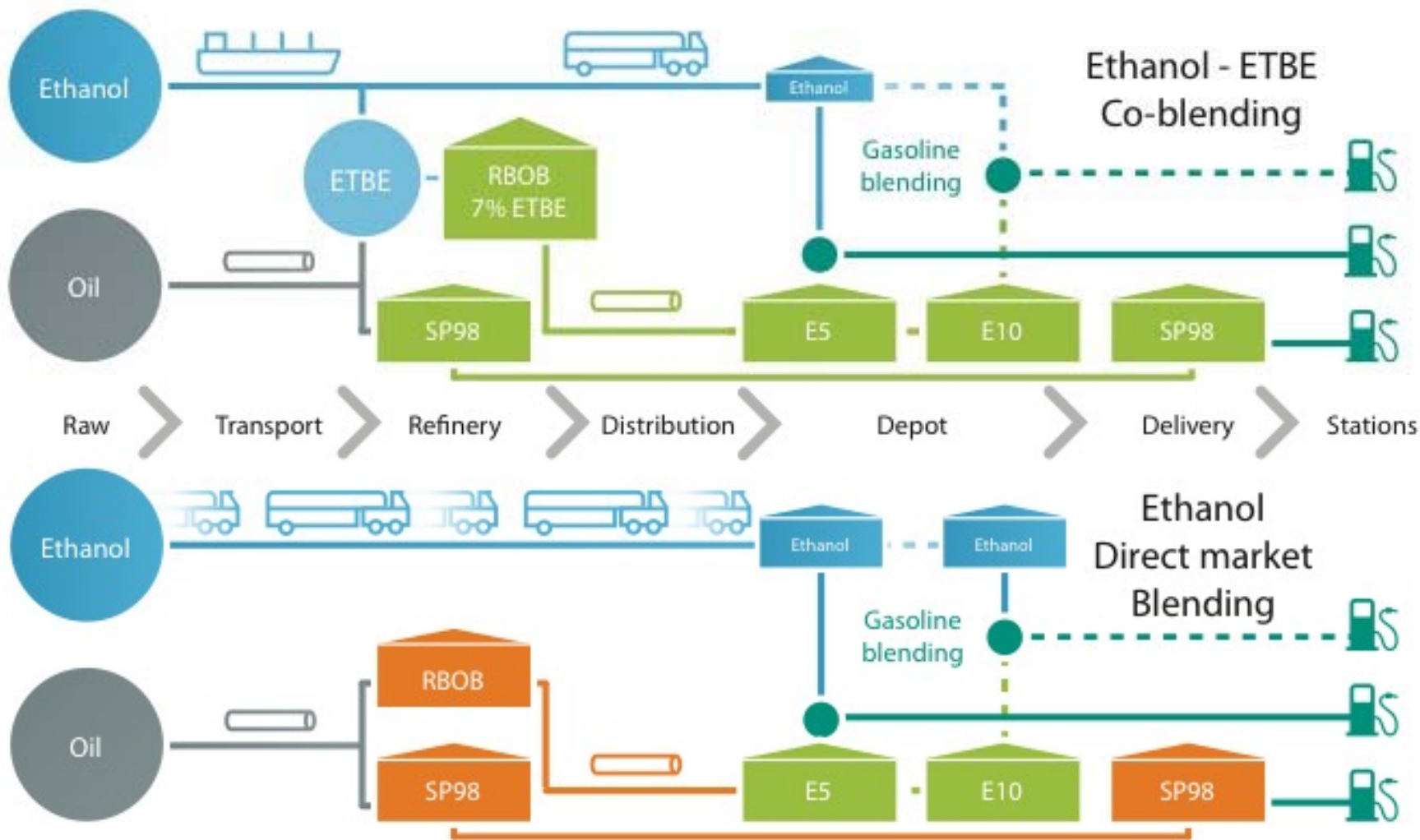
*(Reformulated Blend-stock for Ethanol Blending)*



- ETBE in Blendstock allows suppliers to market multiple grades and achieve higher bio-energy through co-blending
- One co-blended Base fuel (ETBE+ Ethanol) serves E5 as well as E10
- Significant reduction of truck movements to depots and reduced tank storage with clear benefits:
  - Less trucks, less congestion, lower CO<sub>2</sub> emissions,
  - Minimize infrastructure investments, reduce working capital
  - Greater flexibility in planning, ease of handling at depots

# Logistic benefits:

## Ethanol through ETBE is blended at refinery



## Conclusion

Harvesting the synergy of co-blending bio-ETBE and bio-Ethanol, represents an effective, immediate and practical avenue to address both EU and MSs bio-energy ambitious targets, enhancing environmental benefits while increasing operators flexibility