



**COP 14 Poznan**

**GBEP Side Event, 11 December 2008**

**From First to Second Generation  
Biofuels: An IEA Report**

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International Energy Agency, Paris



# IEA Recent Work on Bioenergy

**1. *From 1<sup>st</sup> to 2<sup>nd</sup> Generation Biofuels: An Overview of Current Industry and RD&D activities***

Report in collaboration with IA Bioenergy. Just released, 12/2008

Available as a free download at [www.iea.org](http://www.iea.org)

**2. *Review of Life Cycle Assessment Studies on Biofuels***

Produced With UNEP and EEA; contained in the OECD report *Biofuels Support Policies: An Economic Assessment*

Available from [www.oecd.org](http://www.oecd.org)

**3. *Good practice guidelines for Bioenergy Project Development and Biomass Supply***

June 2007

Available from [www.iea.org](http://www.iea.org)



## *From 1<sup>st</sup> to 2<sup>nd</sup> Generation Biofuels*

- An Overview of current industry and RD&D activities
- In collaboration with IA Bioenergy
- With the financial support of the Italian Ministry for the Environment, Land and Sea
- IEA contribution to GBEP
- In collaboration with other international organisations
  - ◆ OECD, UNCTAD, UNEP, FAO and others
- Duration: October 2007 – August 2008

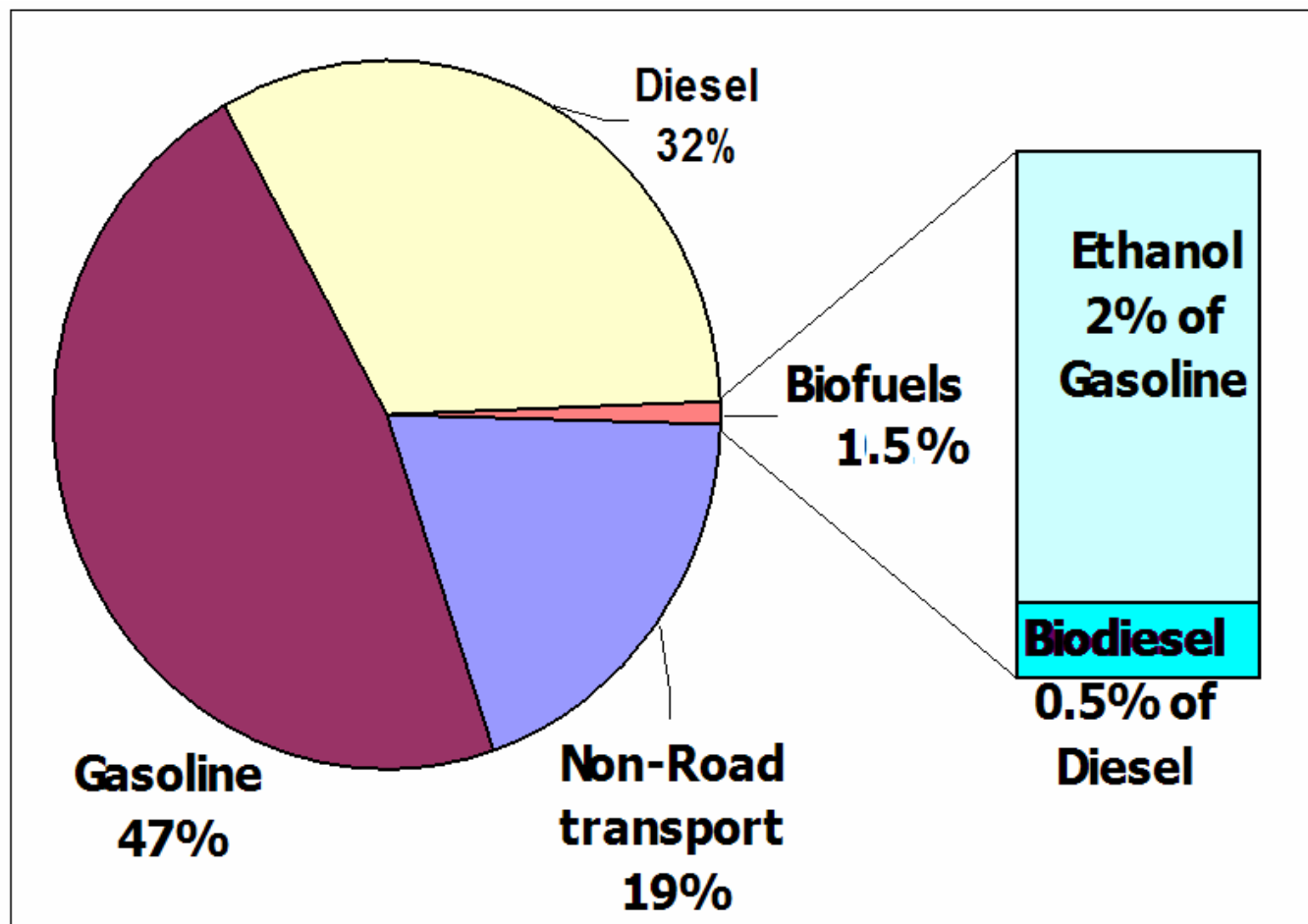


## *From 1<sup>st</sup> to 2<sup>nd</sup> Generation Biofuels*

- Report focuses on two 2<sup>nd</sup> generation pathways:
  - ◆ BIOCHEMICAL: Ligno-cellulosic ethanol from enzymatic hydrolysis of waste biomass, switchgrass, short rotation trees, etc.
  - ◆ THERMOCHEMICAL: Biomass-to-liquids via gasification and Fischer-Tropsch synthesis to build hydrocarbon chains
- There are other approaches, some are touched on in the report (e.g. biofuels from algae) but not covered in detail
- Report primarily reviews recent literature and surveys recent activities
  - ◆ Updates technology and cost estimates



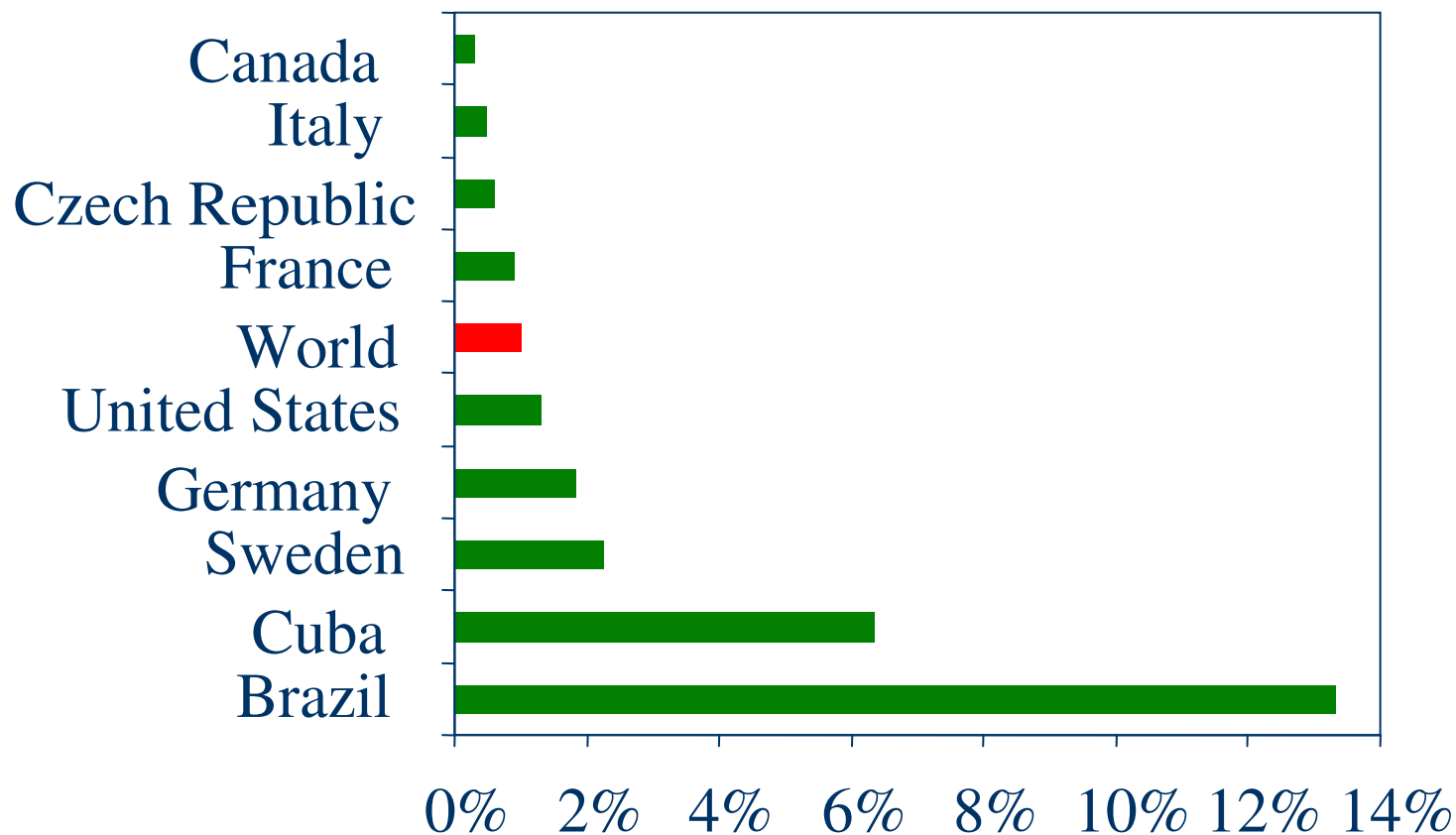
# Global transport fuel shares, 2007



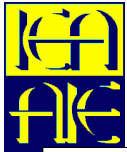
IEA/OECD 2008



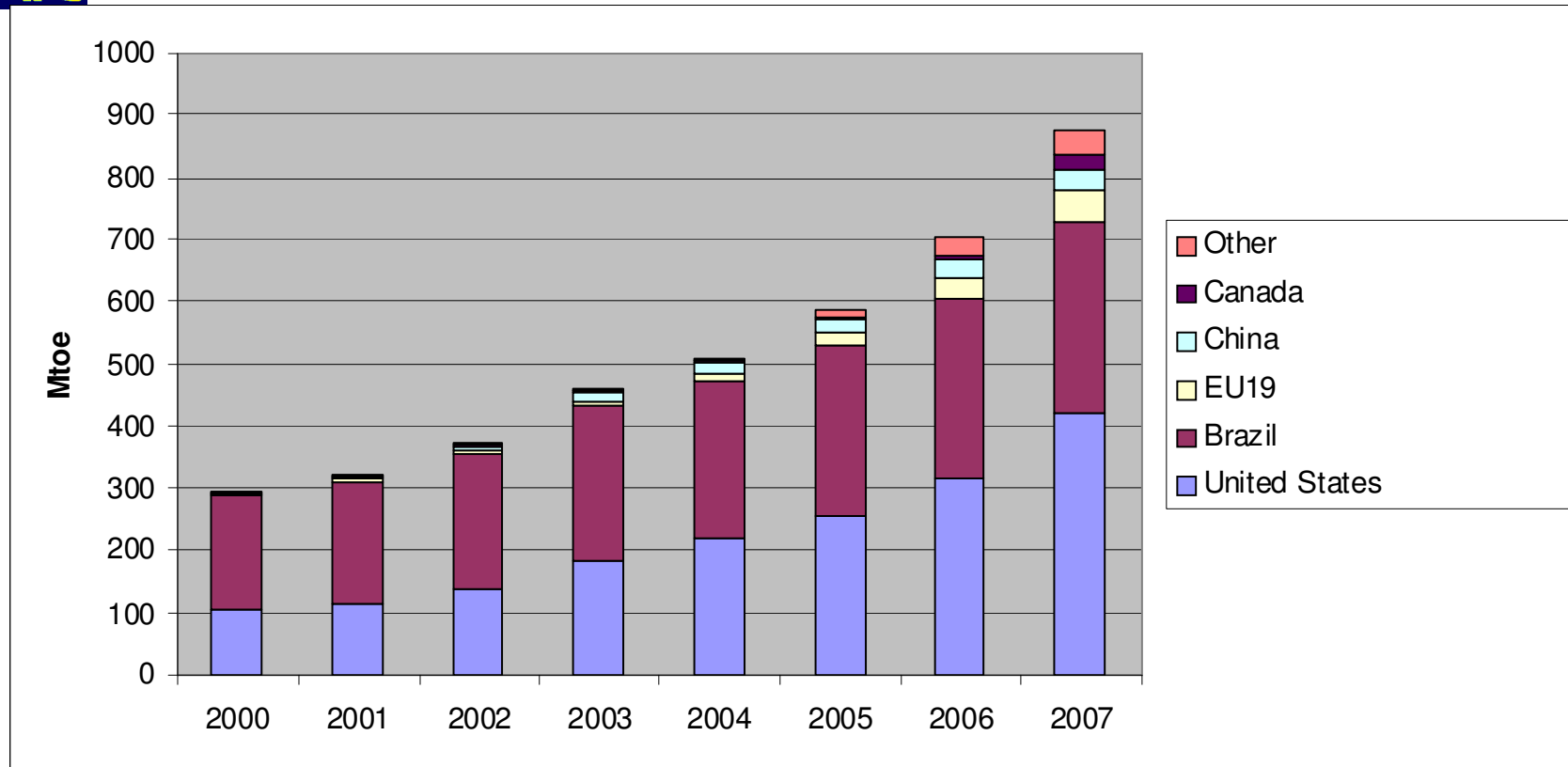
# National shares of biofuels in total road-transport fuel consumption



**Biofuels currently meet around 1.5% of road-fuel demand worldwide, with Brazil leading.**



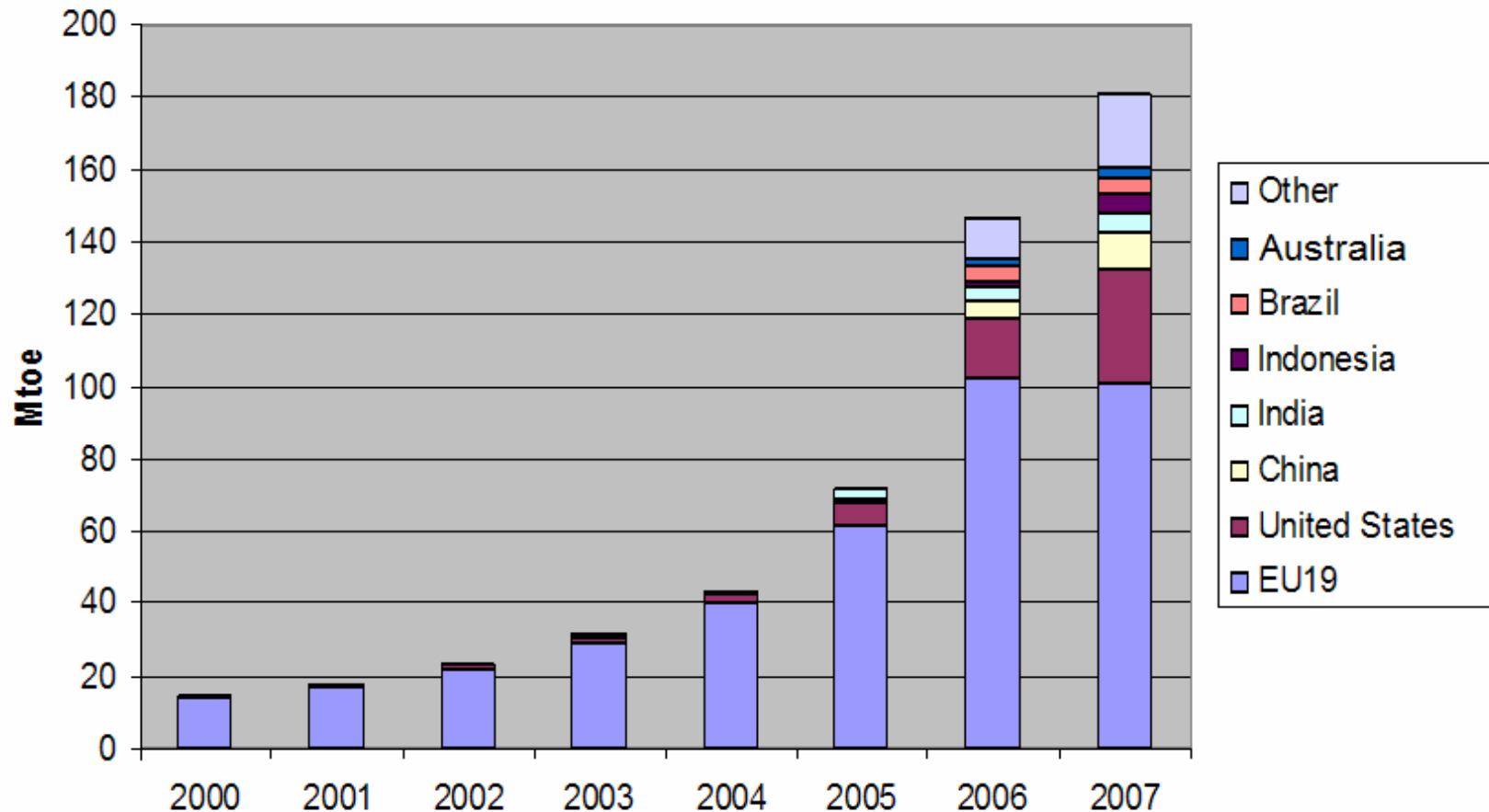
# Trends in ethanol production



**Ethanol production tripled in 7 years, with the bulk of the increase coming from Brazil and the United States  
US now the lead producer.**



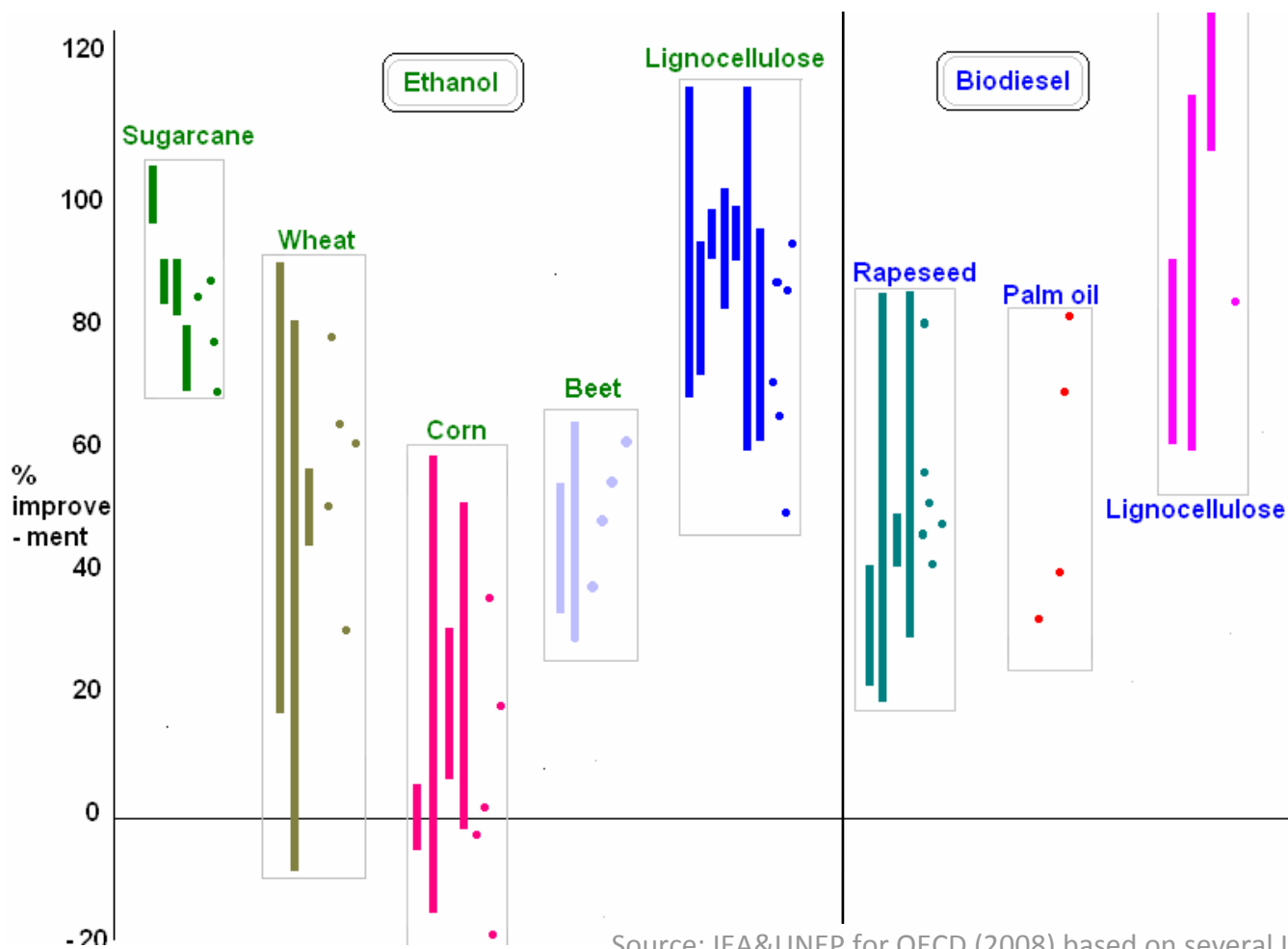
# Trends in biodiesel production



**Biodiesel production increased 10 fold since 2000, with European countries, notably Germany, contributing most of the growth - but now declining after a change of government policy.**



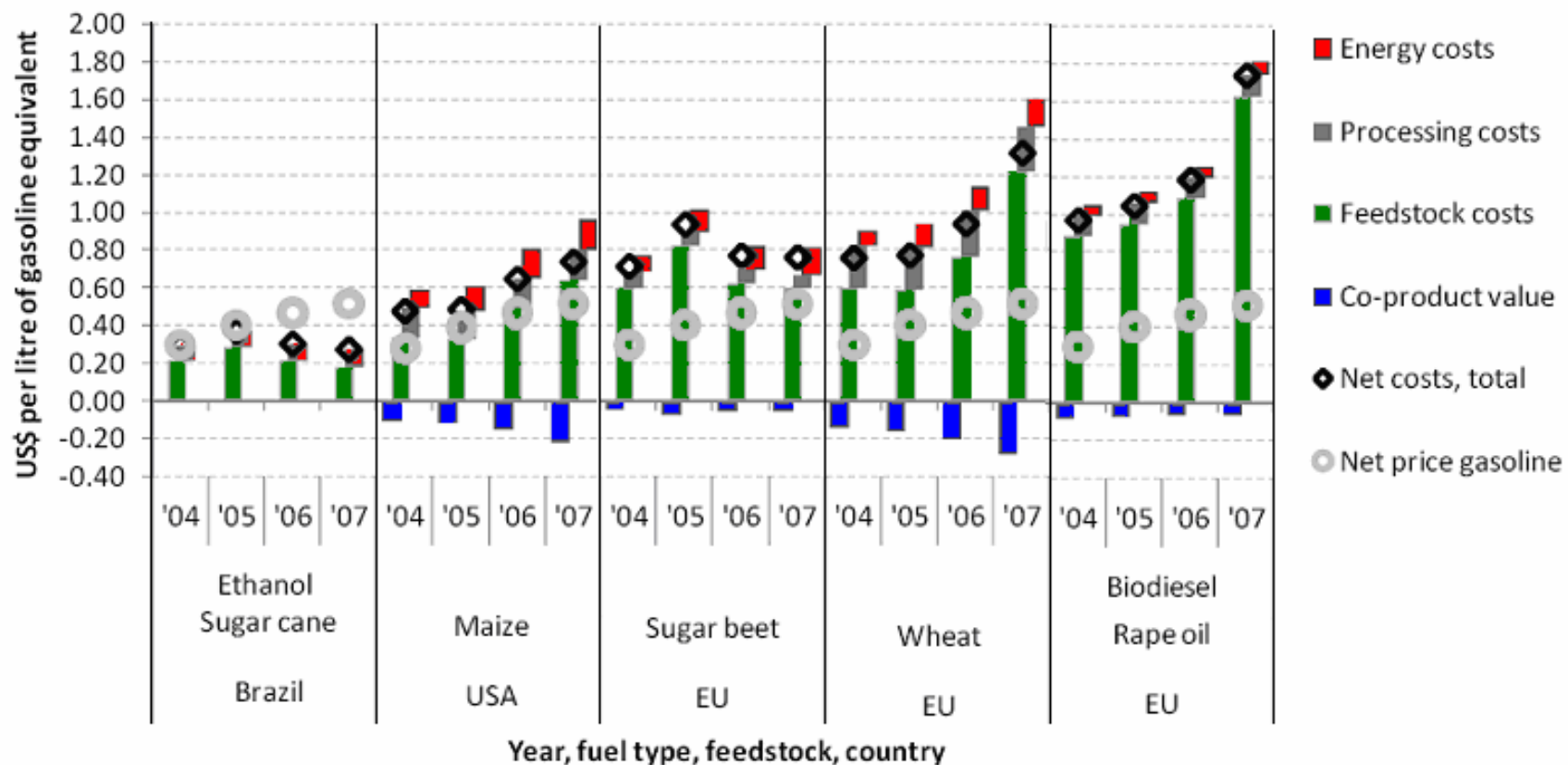
# Biofuels life cycle GHG abatement potential (w/o Land Use Change)



Source: IEA&UNEP for OECD (2008) based on several LCA studies

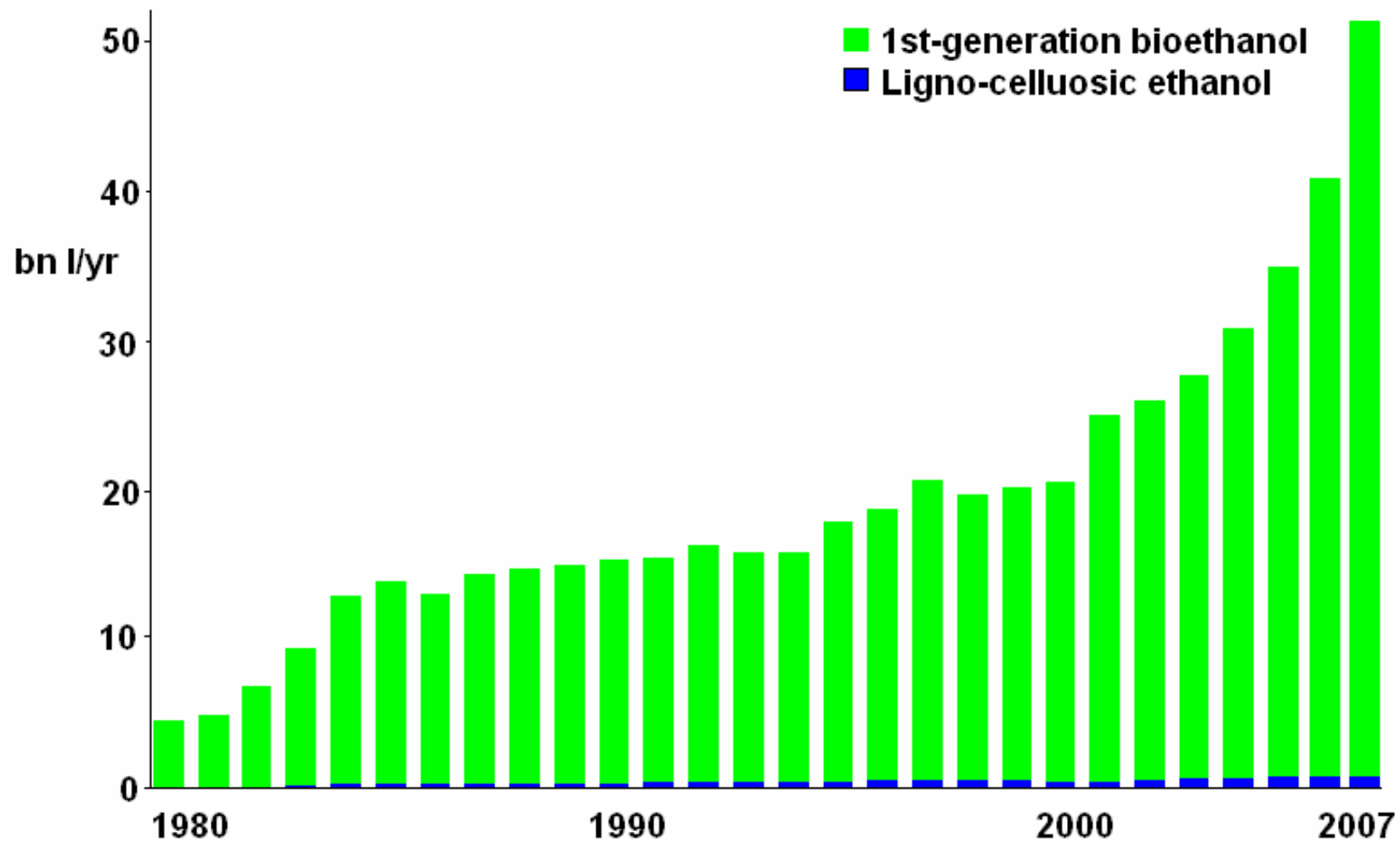


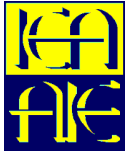
# First Generation Biofuels Costs, 2004-2007





# Present share of 2<sup>nd</sup>-generation biofuels is only 0.1%.





## Potential for 2nd-generation biofuels

- The present share of 2nd-generation biofuels is less than 0.1% of total biofuel production.
- Biomass residues and wastes can be used as feedstocks.
- Where energy crops are grown, similar issues of sustainable production, land use change, and food-versus-fuel competition will exist as for 1st-generation.
- Both biochemical and thermo-chemical conversion routes have reached the demonstration stage - but key technical and economic issues remain.
- Of the US\$ 26.3 trillion cumulative investment needed in the energy sector by 2030 in the IEA WEO Reference Scenario, only US\$ 0.2 trillion is assumed for biofuels.
- The future potential for biofuels remains very uncertain and full commercialisation is unlikely to occur for some years yet.



# Second generation biofuels – key messages

- First commercial plants unlikely before 2012-15
- Commercial scale plants within a few years, but probably no large contribution of 2<sup>nd</sup> gen biofuels much before 2030
  - United States and EU policies will be important to watch
- Current estimated costs
  - 0.80 – 1.00 USD/l gasoline equivalent for ethanol
  - >1.00 USD/lge for biodiesel
  - High-risk investments, need for government support
  - Long-term cost reductions down to USD 0.55-0.70 USD/lge possible (easier for bio-chemical route)
- Key requirements
  - Continued government support
  - Part of a comprehensive strategy on bioenergy
  - Improved understanding of feedstock requirements and costs
  - Co-products and process integration



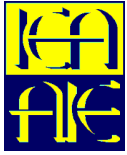
# Key Obstacles and Issues

- A better understanding of feedstocks, their geographic distribution and costs is required
  - ◆ Feedstock optimisation will take many years
- Optimisation of plant scale in conjunction with required crop growing area and distance from plant
- Feedstock pre-treatment technologies are inefficient and costly
- New and/or improved enzymes are still being developed
  - ◆ Conversion of all C5 and C6 sugars into ethanol a key challenge
- Increased process efficiencies and cost reduction

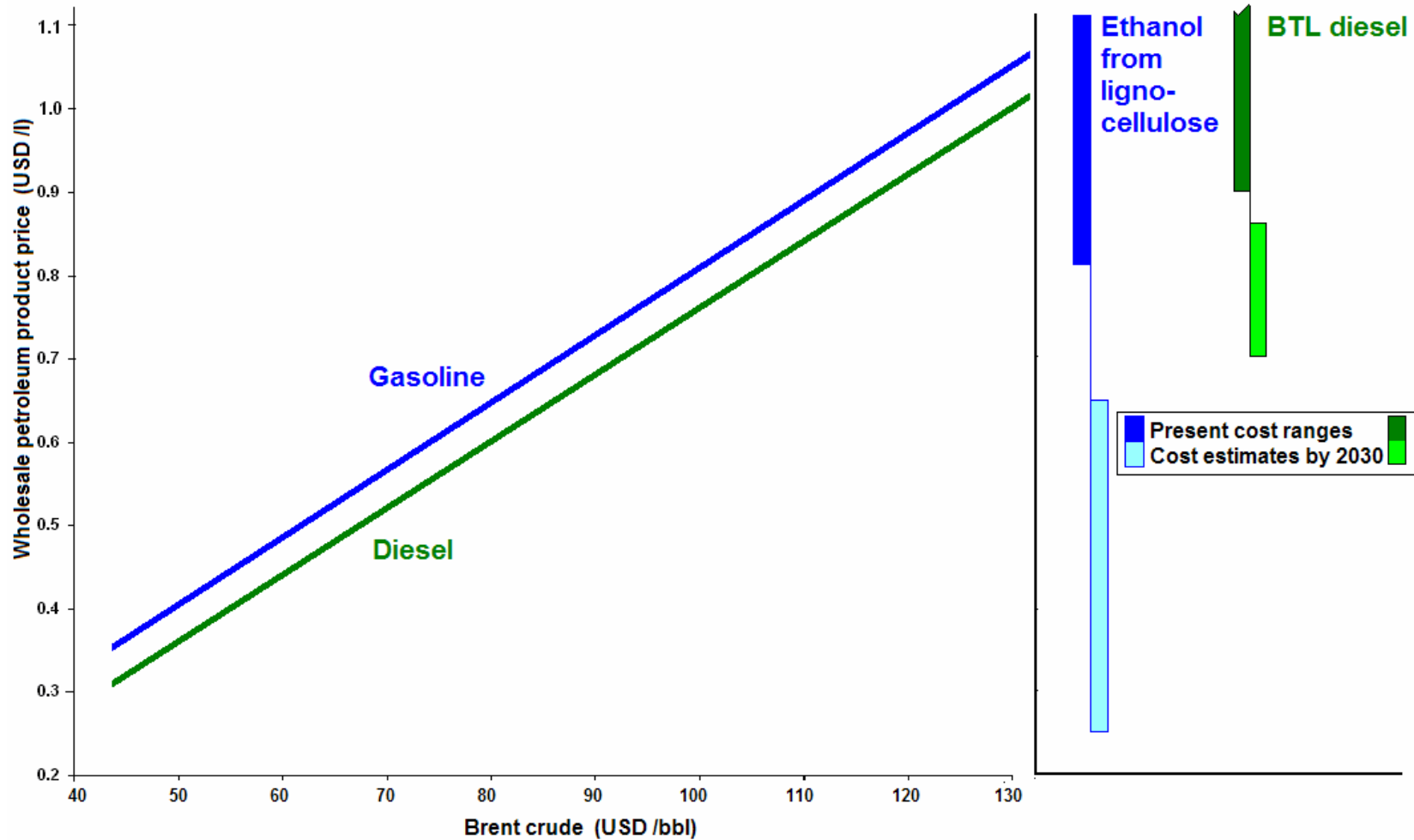


# “From 1st to 2nd Generation Biofuels” – Current Efforts





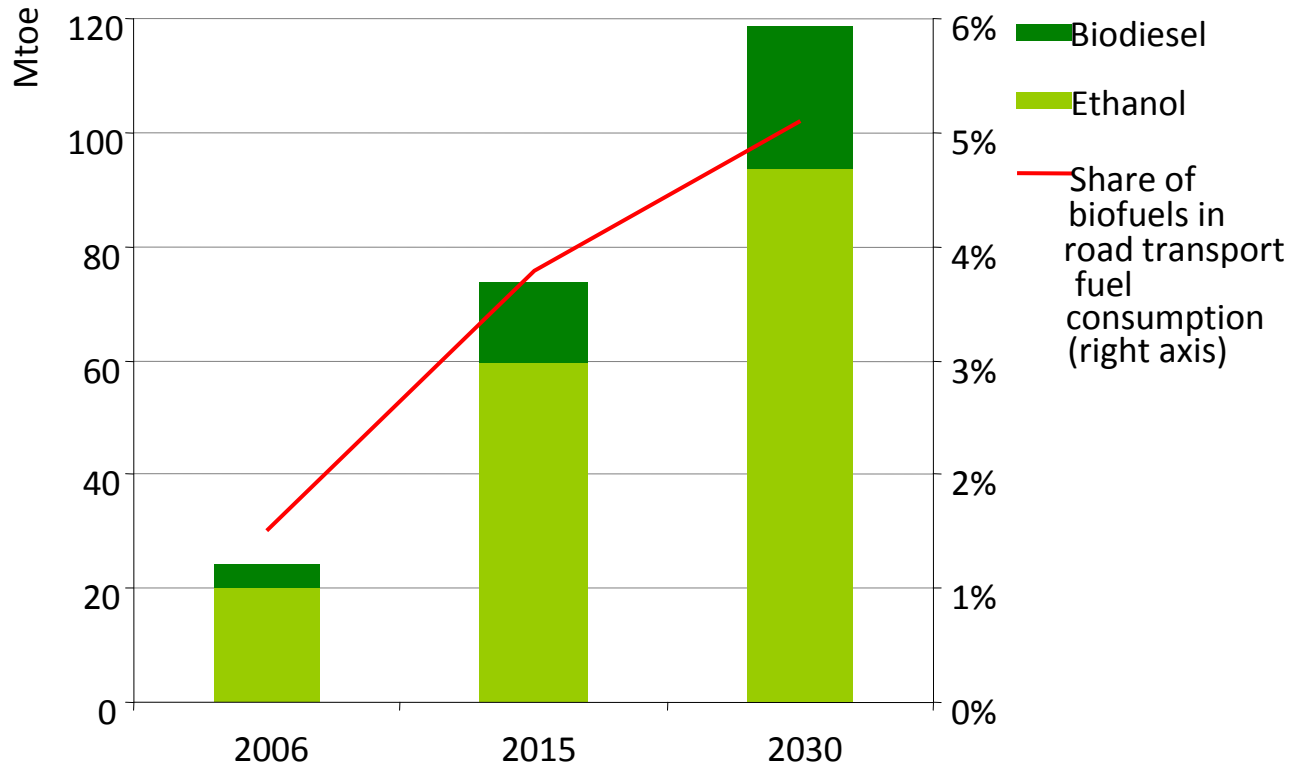
# Current and future 2<sup>nd</sup> gen costs v. gasoline/diesel fuel





# IEA World Energy Outlook 2008

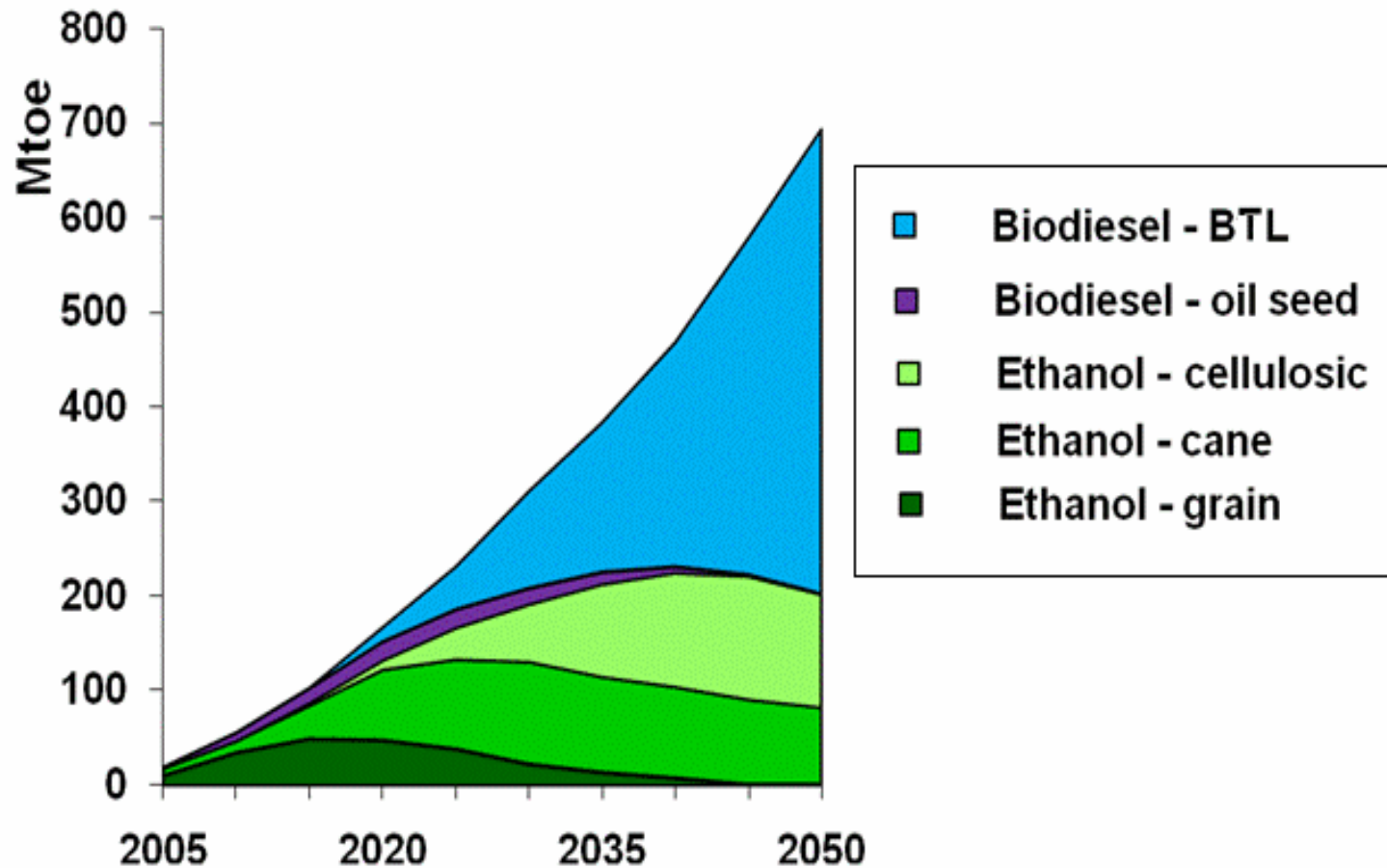
## Reference Scenario: World biofuels consumption



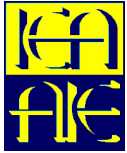
**Biofuels projected to climb from about 0.6 Mb/day in 2006 to 3.2 Mb/day in 2030 – 5% of total road-transport fuel demand**



# Biofuels in IEA “ETP BLUE Map” Scenario

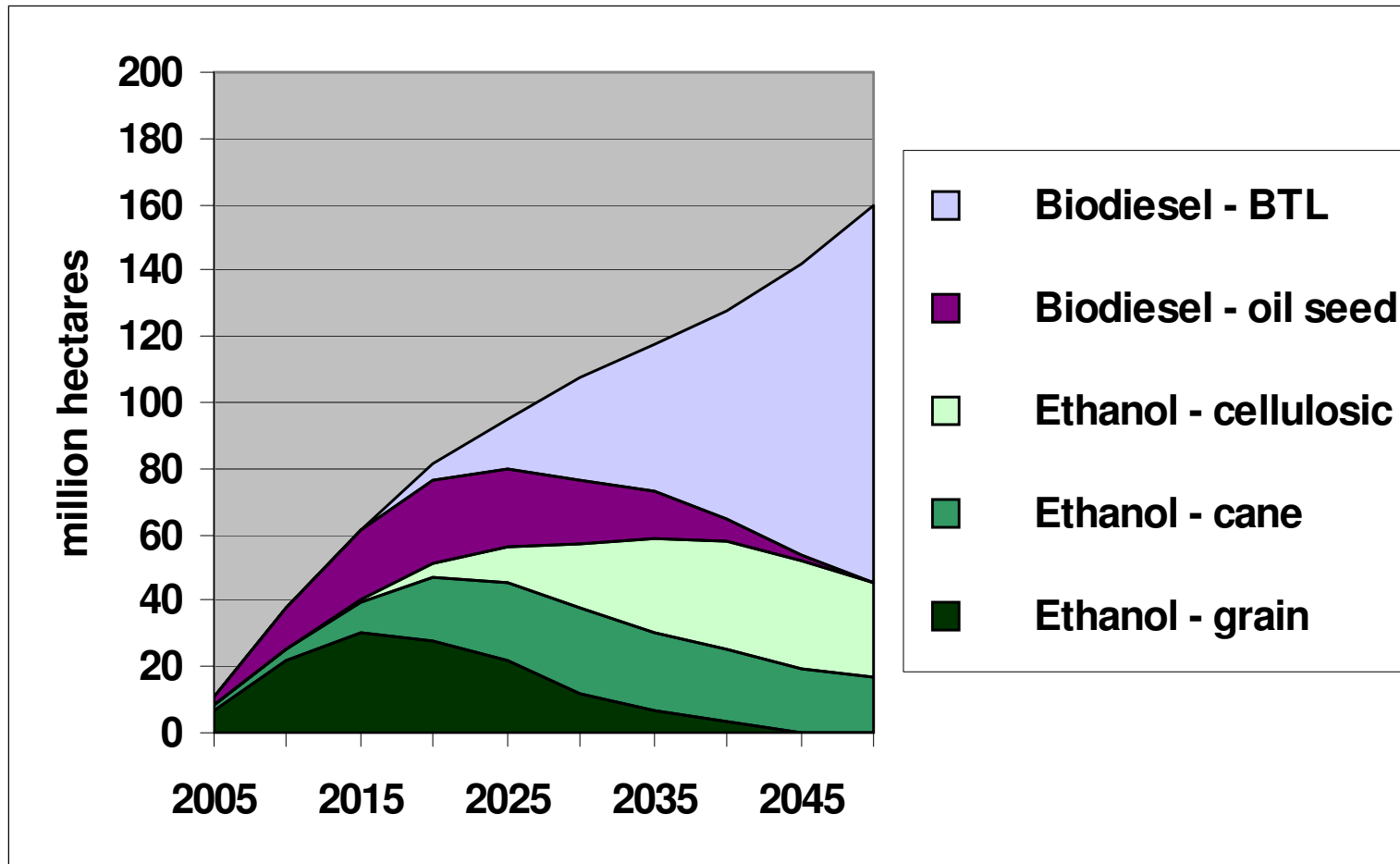


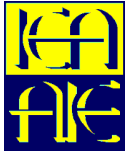
Based on reaching a very low CO<sub>2</sub> target in 2050 (backcasting exercise). Most biofuels growth after 2020 are 2<sup>nd</sup> gen, and after 2030 its mostly BTL for trucks, ships, aircraft



# Biofuels Use in BLUE Map

## Estimated Land Use Requirements





# Summary

- **First Generation Biofuels – not sustainable**
  - ◆ Questions about sustainable production, land use change, greenhouse gas reductions.
  - ◆ With the exception of sugarcane ethanol, 1st generation biofuels are costly- \$/t CO<sub>2</sub> avoided.
- **2nd generation biofuels hold high hopes but have not achieved commercial-ready status**
  - ◆ Technical progress has been made, but they remain costly and unproven at commercial scale. Competing land use remains an issue.
  - ◆ Investment risks in biofuels are high and investors are currently wary.
- **It is unlikely 2nd generation will become fully commercial within a decade.**
- **If they do, and with strong policy support, we estimate that 2<sup>nd</sup> biofuels could reach 5 - 7% share of world transport fuels by 2030 and 25% by 2050.**
  - ◆ Sufficient, sustainable feedstock supplies will be critical



## FROM 1<sup>st</sup>- TO 2<sup>nd</sup>-GENERATION BIOFUEL TECHNOLOGIES

*An overview of current  
industry and RD&D activities*

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AND JACK SADDLER, WARREN MABEE

IEA Bioenergy

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The report provides  
a contribution to  
the Global  
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