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fair-energy



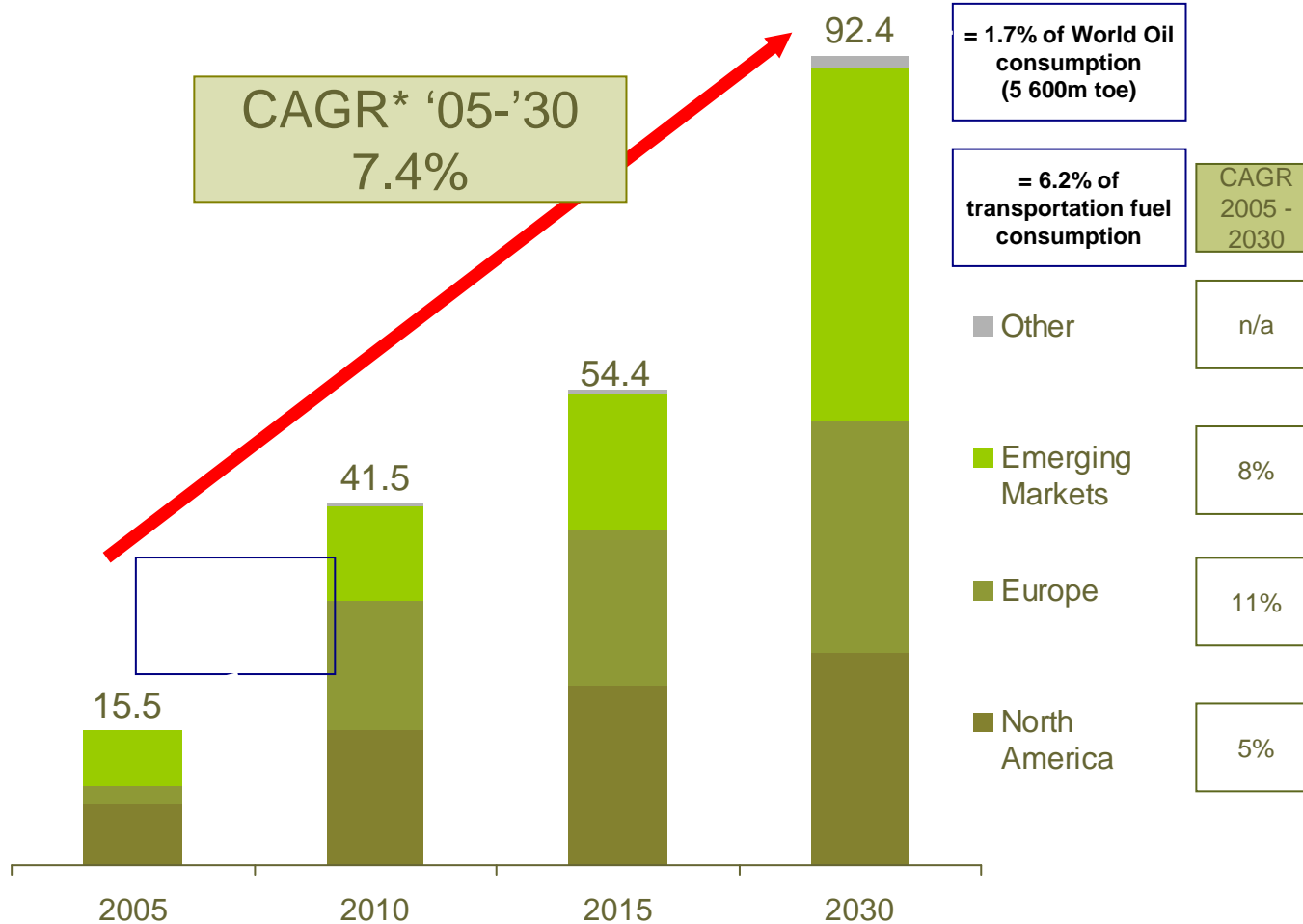
Gilbert Brunner

Biofuels & sustainability

March 2009

Biofuels are set to grow

World Biofuels consumption (Mtoe)



= 1.7% of World Oil consumption (5 600m toe)

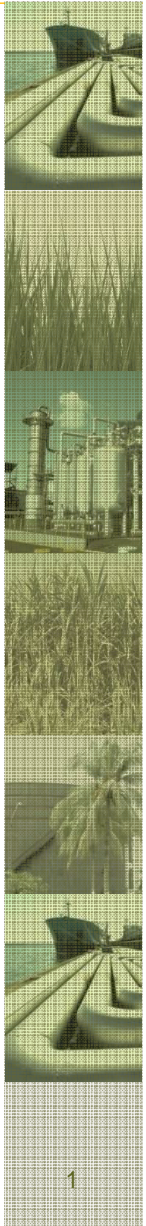
= 6.2% of transportation fuel consumption

CAGR 2005 - 2030

Key drivers

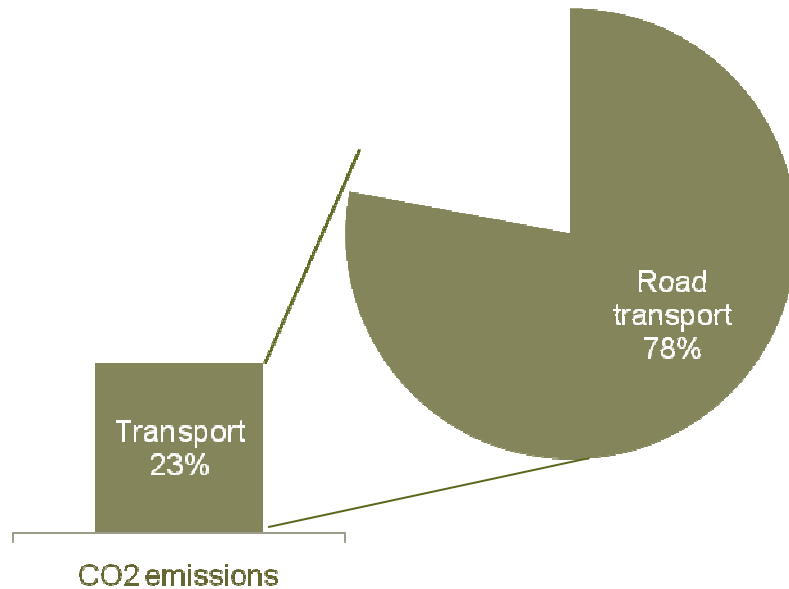
- Emission targets
- Mandatory programs
- Source of domestic growth
- High oil prices
- Energy security
- Competitive product
- MTBE bans

Source: OECD/IEA, World Energy Outlook 2006 based on the reference scenario
 Note: *CAGR = Compound Annual Growth Rate



Are there better alternatives?

CO2 and abatement options for road transport



Electric cars - still problematic

- (i) CO2 reduction depends on clean electricity
- (ii) Production cost still 2-3x internal combustion engine
- (iii) Radius remains limited to 400km
- (iv) Battery life too low (5 years) and cost too high (\$10k+)

Hydrogen cars - only viable long term

- (i) Safe and durable technology at least 10 years away
- (ii) Production cost still 8-10x internal combustion engine
- (iii) Entirely new global distribution infrastructure needed
- (iv) Consumer acceptance doubtful

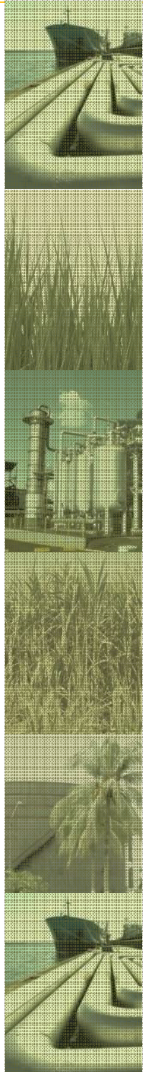
Hybrid cars - compatible with biofuels

Toyota Prius already successful and Chevrolet Volt on its way for 2010. Typically 2-3 liter per 100km of fuel needed

Increased efficiency – 2x the same effect

- IPCC conclusions on abatement potential for road transport:
- (i) energy efficiency improvements 700-800 Mt at <\$100/ton
 - (ii) current and advanced biofuels: 600-1,500 Mt at <\$25/ton

Source: IPCC, Others

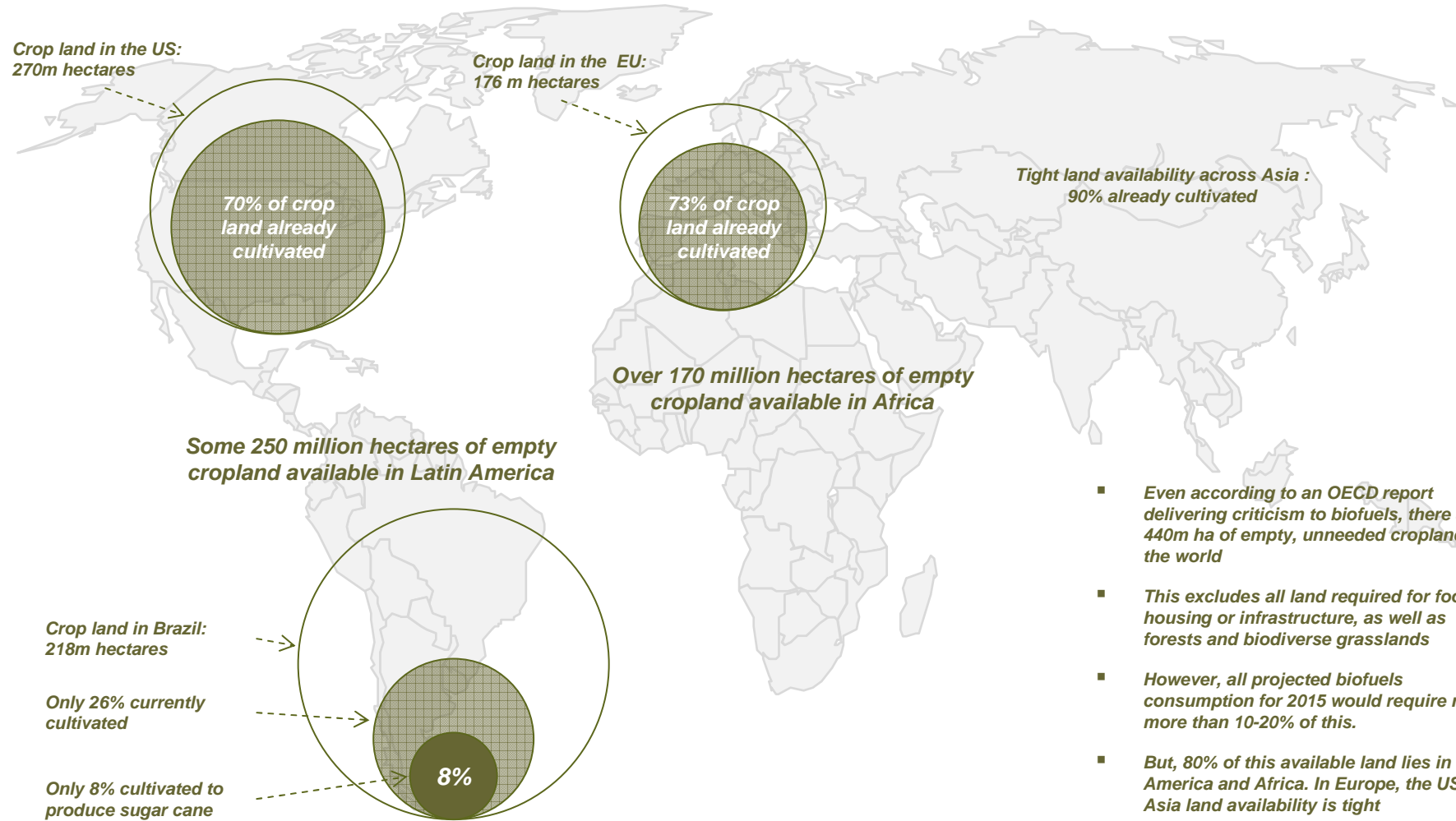


The biofuels industry has suffered from many wrong assumptions

Available land	<p>There is enough available land in the world without any deforestation. (Brazil has 6m ha producing 25m MT of sugar and 16m m³ of ethanol. Available land without going near the rainforest is 90m ha, i.e. 15x more).</p>
CO2 emissions	<p>Correlated to the choice of feedstock. (Between 0% and 92% reduction)</p>
Irrigation	<p>If needed, there are new techniques which have the potential to substantially reduce the use of mechanical irrigation. (Over 90% of Brazilian sugar cane grows on rain-fed land).</p>
Fertilizers	<p>Selection of the right feedstock in order to minimize soil depreciation and consequently less use of fertilizers/pesticides. (Ethanol from sugar cane uses up to 80% less chemical fertilizers than corn).</p>
Food chain	<p>The degree to which feedstock competes with the food chain varies strongly. (Sugar cane, beet, cassava, etc. pose much less of a problem than corn, wheat and oilseeds. Cellulosic ethanol and jatropha will not compete at all)</p>
Biodiversity	<p>Global warming will make more damage to the biodiversity than biofuels, the rule to apply is "The Less Evil Choice".</p>

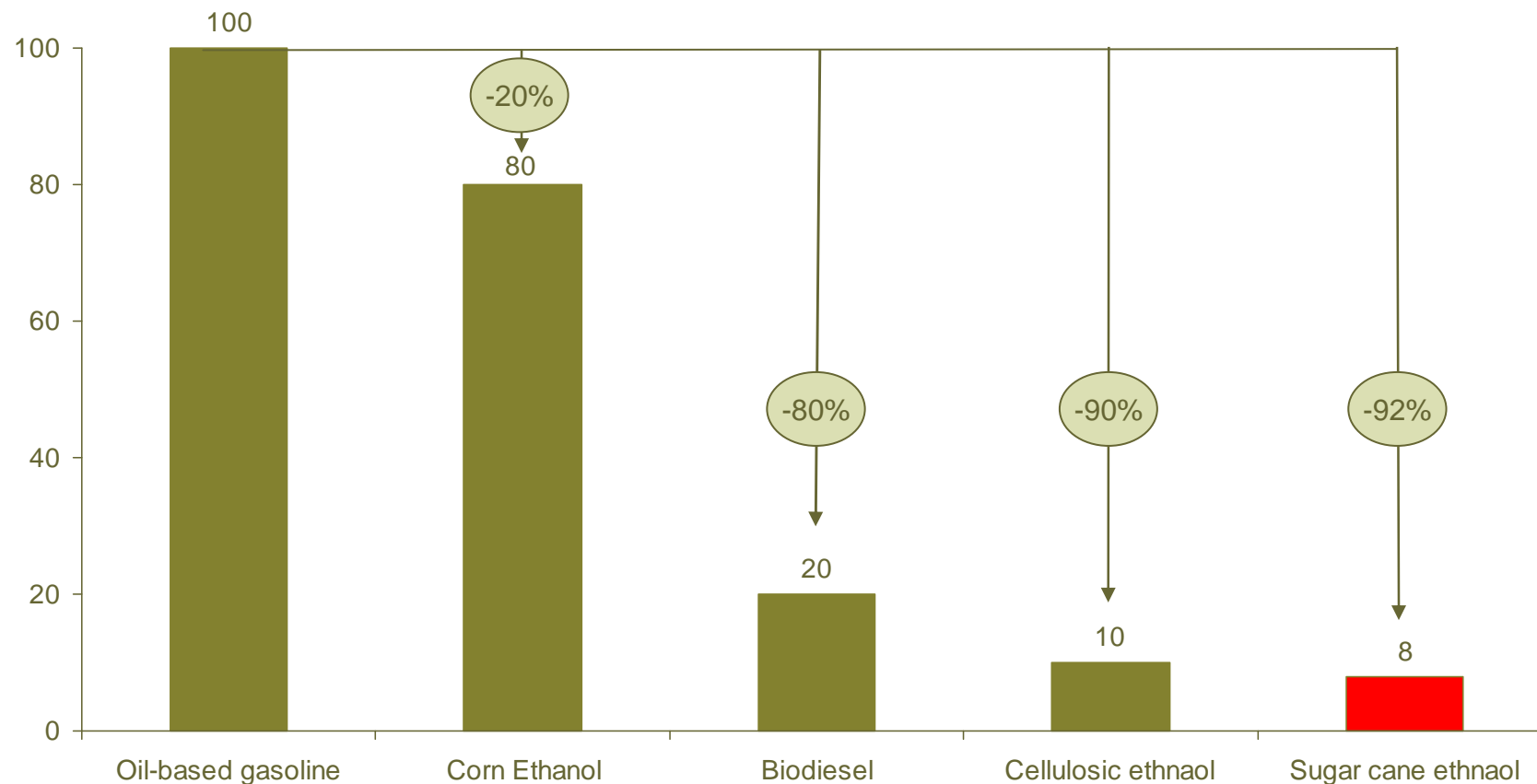


There is enough land for biofuels but 80% lies in the South



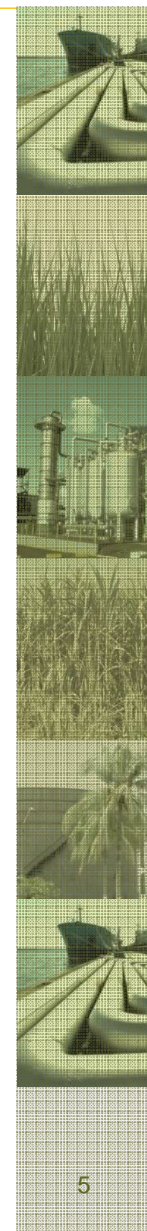
“Biofuels” are mainly here to reduce GHG emissions but they are not born equal

Sugar cane ethanol reduces Green House Gas emission by 92%*



* Well to wheel

Source McKinsey / Macedo et al / Farrell et al. "Ethanol can contribute to energy and environmental goals", Science, January 27, 2006



Cellulosic ethanol is much more efficient than corn ethanol

Cellulosic ethanol environmental benefits

	Corn ethanol	Cellulosic ethanol
Net energy value	1.4 (40% net energy gain)	5.5 (550% net energy gain)
CO2 Emissions	3.5 lbs / gal	0.2 lbs / gal
Water usage	4 gal / gal of ethanol	1.6 gal / gal of ethanol with evaporative cooling eliminated
Nitrogen usage	0.4 lbs / gal of ethanol	0



- 1) "Ethanol's Energy Return on Investment: A Survey of the Literature 1990-Present", Roel Hammerschlag, R., January 2006
- 2) Fossil Energy Use in the Manufacture of Corn Ethanol,. Graboski, Michael S, August 2002
- 3) Source: KL CBE process model heat and material balance, 2008
- 4) Source: KL permit application for 110 MGY corn ethanol plant, Riverwright Energy
- 5) "Water Usage for Current and Future Ethanol Production", Aden, A., Southwest Hydrology, September/October 2007
- 6) "The Energy Balance of Corn Ethanol: An Update", Shapouri, H., James A. Duffield, Michael Wang, July 2002

The market has been quick in punishing unsustainable and uneconomical players

Biofuel stocks performance (prior to financial crisis)

Verasun - US



Verbio - Germany



Sao Martinho - Brazil



Novozymes - Denmark



A sustainable investment in Biofuels should be:

Economical

- Complexity to optimize the cost of feedstock, the cost of production and the cost of distribution
- Complexity of risk management
- Disparities in tax incentives

Ecological

- Deforestation, irrigation, degradation of the ground and use of fertilizers
- Disparities in energy ratios (corn= 1 for 1.2 vs cane= 1 for 8)
- Difficulty to select the appropriate feedstock
- Need of full traceability

Ethical

- Debate between food and non-food feedstock



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