Biofuels – BP's experience and approach

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All roads lead to biofuels

Increasing demand for transport fuel

Increasing concern over environment

Biofuels

Increasing concern over security of supply

A growing market for the agriculture sector

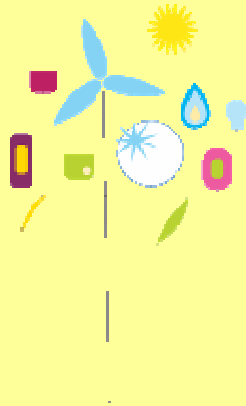
Climate change – BP's journey

1998-2001:
Operational GHG emissions reduced by 10%+

Continuing $450m efficiency challenge to limit GHG emissions across BP

CMI
Carbon Mitigation Initiative

1999 onwards:
Support for academic and industry research projects on climate change

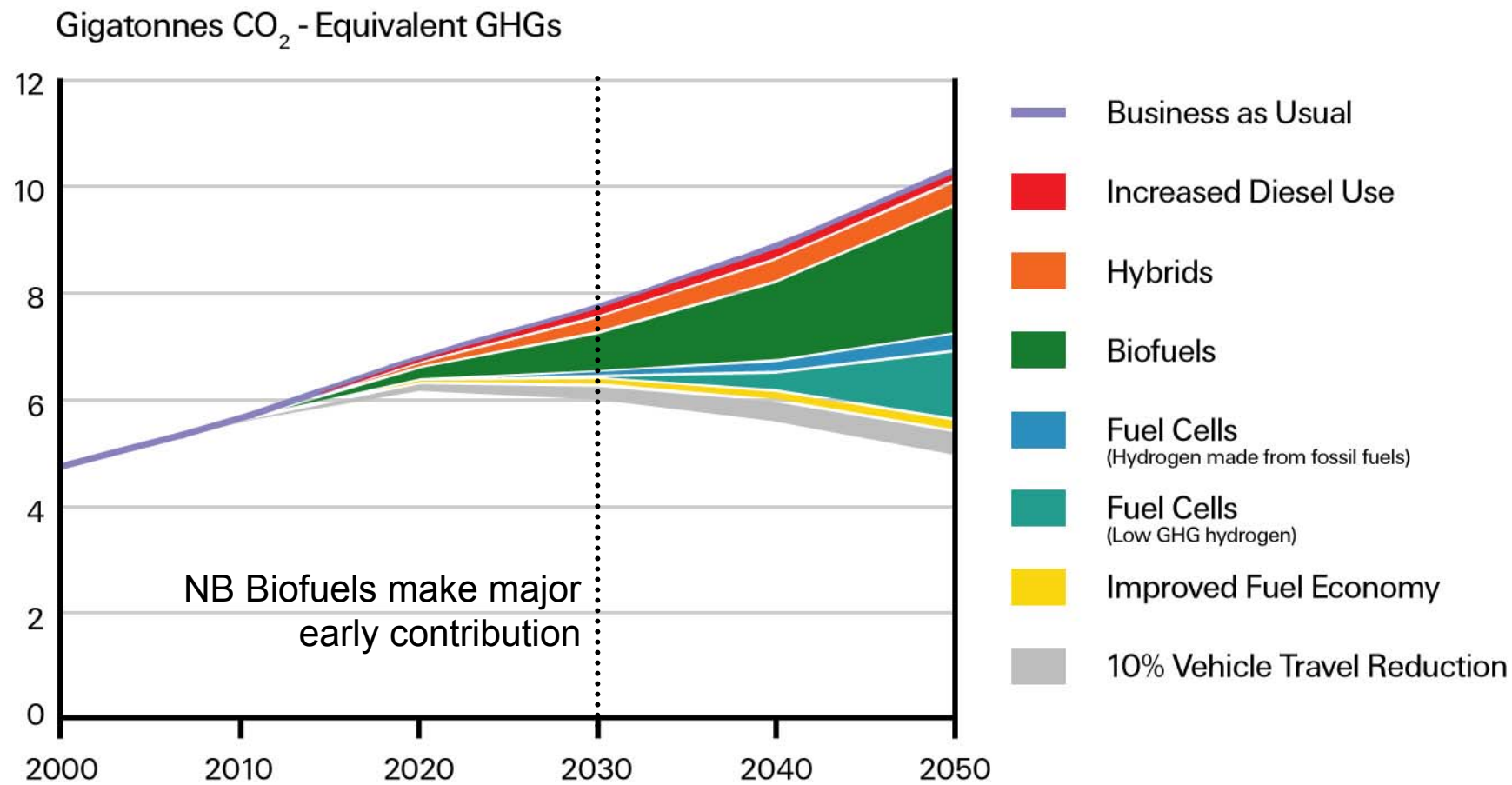


2005:
BP Alternative Energy launched - investing $8bn over 10 years in wind, solar, gas and hydrogen power

2006:
Dedicated biofuels business launched; partnership with DuPont; announcement of plans for $500m Energy Biosciences Institute

Biofuels – a major potential contribution to limiting GHG emissions

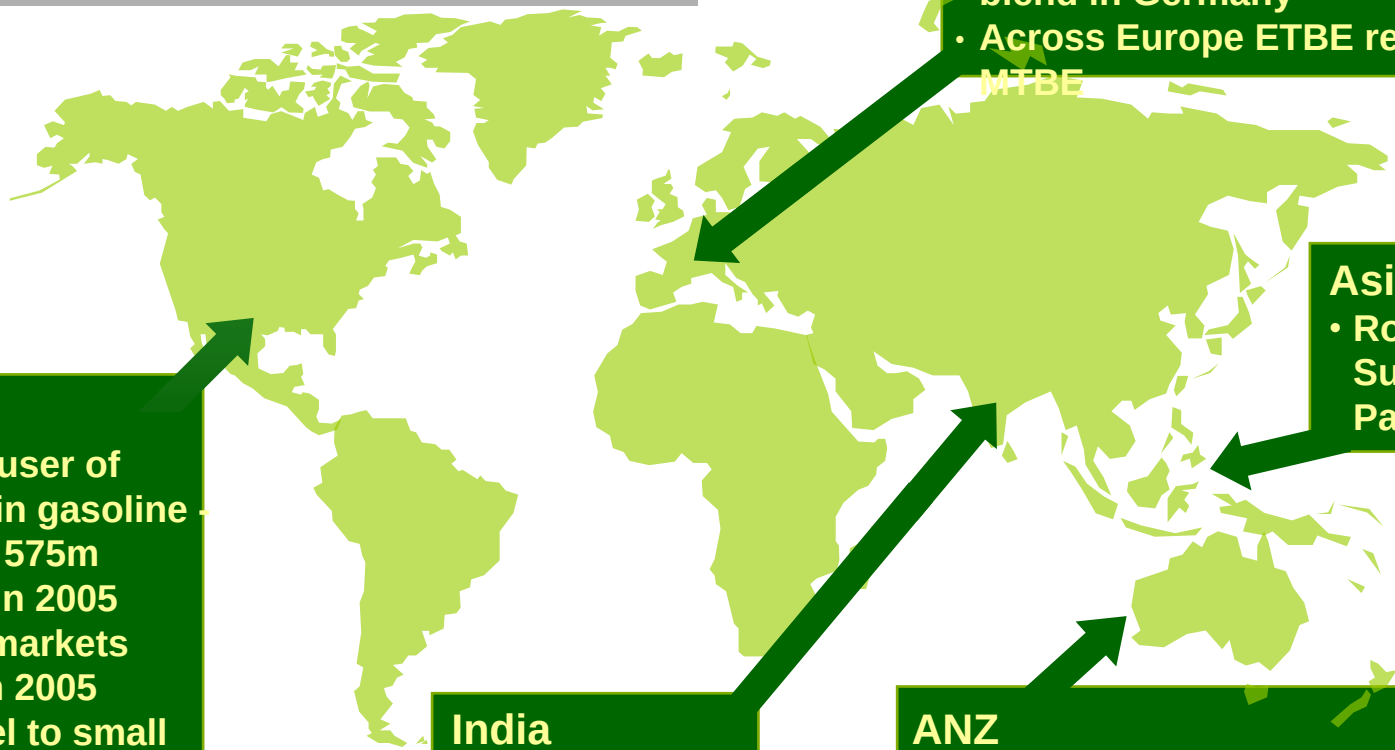
Potential reductions in CO_2 emissions from new vehicles, new fuels and changing customer behaviour



Source: World Business Council for Sustainable Development. *Mobility 2030* report. 2004

BP's biofuels activity

BP uses around 10% of all biocomponents produced globally



Europe
- First major to introduce 5% FAME blend in Germany
- Across Europe ETBE replaces MTBE

Asia
- Roundtable on Sustainable Palm Oil

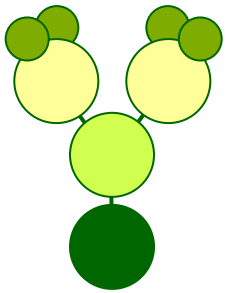
US
- Largest user of ethanol in gasoline blended 575m gallons in 2005
- 20 new markets added in 2005
- Biodiesel to small number of B2B, evaluating more widespread customer offer

India
$9.4M project on Jatropha "oil bearing crops" for diesel fuel

ANZ
- Supplying Ethanol to retail sites in Queensland
- Producing renewable diesel via tallow

The biofuels value chain

Feedstock Production | Conversion | Primary Transport | Storage & Blending | Secondary Transport | Retail | End Use




- Develop Sustainable Production
- Diversify Supply
- Maximize Yields
- Minimize Diversion of Food Crops

- Minimize Carbon Footprint
- Maximize use of Existing Infrastructure
- Provide room for industry to find cost efficiencies

- Minimize Local Air Quality Impacts
- Minimize CO_2 Emissions
- Focus on Existing Fleet
- Meet Consumer Needs
  - Reliability
  - Performance
  - Cost

Conventional biofuels

Ethanol for gasoline

sugar & starch crops

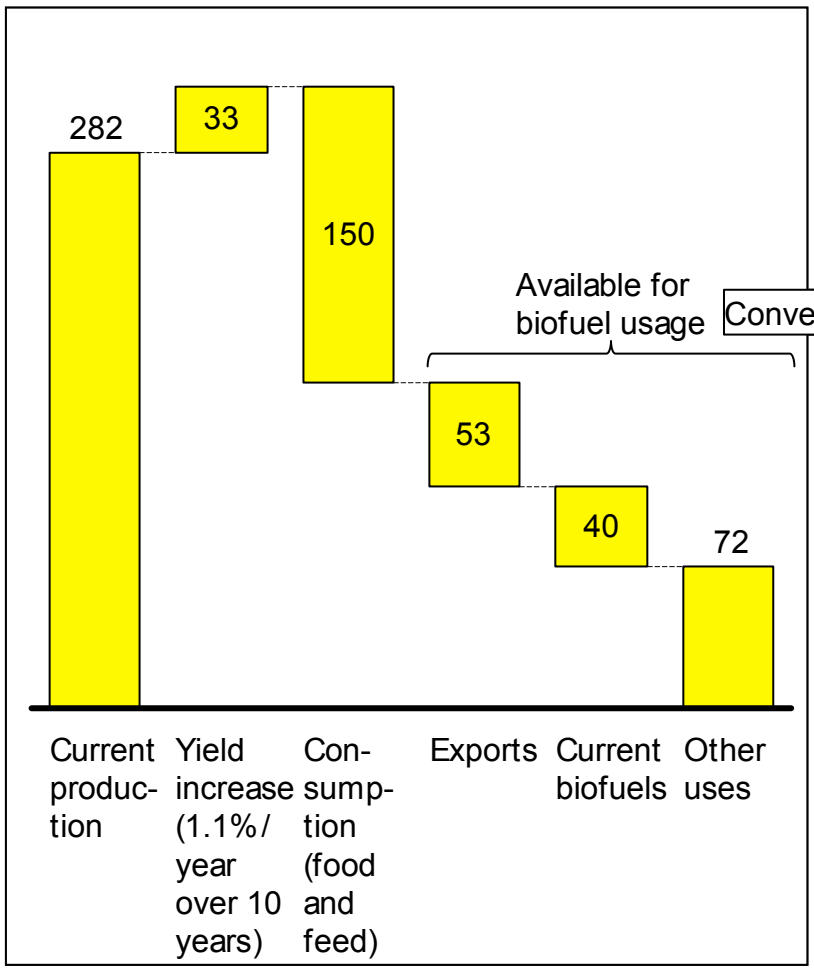
Esters for Diesel (FAME)

oil crops

- Conventional biofuels are a positive first step in use of biomass
- Limitations :
  - Competition from food uses
  - Challenges to availability at scale
  - Modest GHG reductions
  - Environmental issues – eg with palm oil and soy
- Ethanol issues:
  - Low energy density - c 66% that of gasoline
  - Impact on vapour pressure – requires low vapour pressure blendstocks
  - Blends separate in presence of water – requires blending at terminal

Although E10 is a good first step in the US, penetration above a 10% level faces real issues

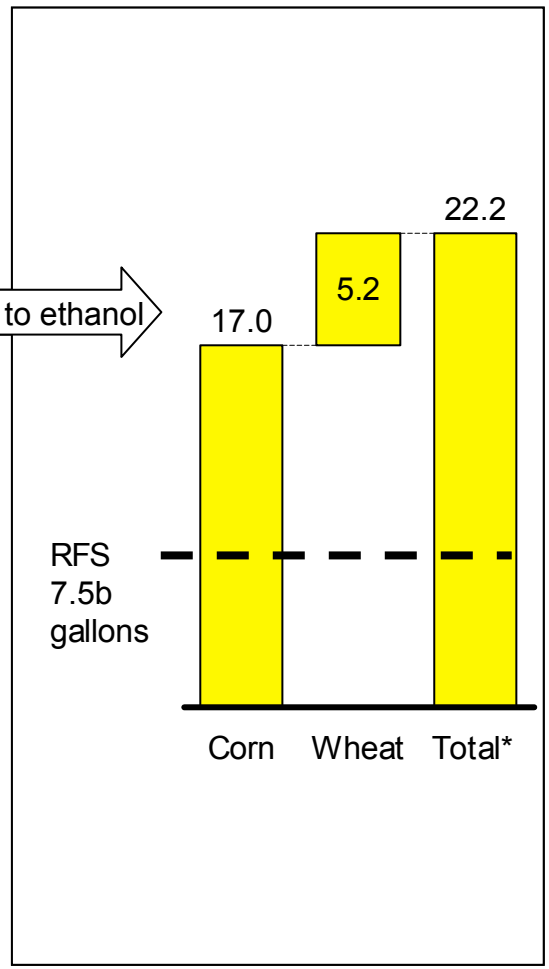
Million tonnes of U.S. corn in 2016



Available for biofuel usage

Conversion to ethanol

Potential 'non-food' ethanol feedstock supply
b gallons/yr ethanol



22.2 bn gallons = ~14% ethanol penetration by volume

Source: FAPRI; USDA; team analysis

Next generation biofuels

woody crops → Ethanol / butanol / ? for gasoline

oil crops → Oily crops eg Jatropha for diesel

- Next-generation bio-components can provide higher energy content and GHG reductions
- Energy content:
  - Corn yields 240 gallons an acre; sugarcane 440 gallons per acre
  - Sunflower yields 75 gallons per acre; jatropha 140-220 gallons per acre; palm oil 450 gallons per acre
  - Opportunities to explore woody crops – straw, residues etc
  - Ligno-cellulosic conversion offers prospect of using entire plant – up to 1200 gal/acre
- GHG benefits:
  - Biofuels can offer GHG emissions reductions of 20% to 90%, depending on feedstock and conversion process
  - Goal should be in upper end of range through high energy feedstock, less intensive cultivation crops, low carbon conversion processes

BP's New Biofuels Business

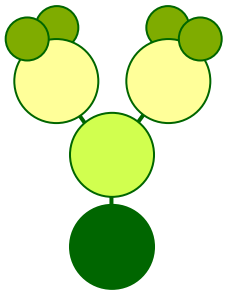
- Formed a new biofuels business in June 2006
- Announced plans to invest $500m in new Energy Biosciences Institute to provide a pipeline of biofuels technology for the business – also to investigate other applications of bioscience to energy
- Will partner with science company DuPont to develop advanced biofuels – with bio-butanol as early target molecule.

Butanol – a next step

- Advanced biofuels respond to all drivers - environment, security of supply & support for agriculture sector
- Biobutanol has a number of attractive properties:
  - Produced from same feedstocks as ethanol with minimal process modifications
  - Easily blended into gasoline
  - Can use existing fuel infrastructure without major modification
  - Potential to be used at higher blend concentrations than ethanol in unmodified vehicles
  - Energy content closer to that of gasoline than ethanol – reducing the impact on fuel economy for the consumer
- Biobutanol is complementary to ethanol and can enhance the performance of ethanol blends in gasoline

Policy opportunities for the whole value chain

Feedstock Production | Conversion | Primary Transport | Storage & Blending | Secondary Transport | Retail | End Use




- Encourage new conversion technologies and advanced molecules – by moving beyond feedstocks and vehicle emissions and avoiding fuel-specific targets and fixed per-gallon mandates
- Create incentives or obligations based on emission reduction or energy content rather than volume basis
- Encourage sustainable and responsible production routes

Introducing BP Biofuels

a growing alternative