Why use it,
When to use it,
How to use it.

ETBE
LyondellBasell: Fast facts

• 3rd largest independent chemical company in the world

• **Business segments**
  - Olefins & Polyolefins
  - Intermediates and Derivatives
  - Refining and Oxyfuels
  - Technology

• **2010 EBITDA**
  - $ 4 billion (Refining & Oxyfuels: $ 452 million)

• Refining and Oxyfuels and other segments supply to the automotive and transport market, helping our customers to make lighter, stronger, safer and cleaner products

• As the largest merchant Oxyfuel producer, we supply high quality fuel components, provide reliable service and maintain excellent product stewardship
ETBE: Why use it…

• Significant CO$_2$ savings

• High energy content

• Supply chain benefits

• High Octane, low volatility

• Lower VOC emissions
ETBE Consumption EU 2003 - 2010

Source: EFOA
ETBE in Japan: the all-inclusive approach

• **Japan is world’s 3rd largest oil market.** It fully depends on imports, there is no significant agricultural production for biofuels

• In 2005 government and oil industry started a joint project to determine the best biofuel to meet Kyoto targets, including refinery impact and use in car:
  
  – CO₂ reduction and availability of feedstock
  – Composition of gasoline and fuel economy
  – Car emissions and air quality
  – Product risk assessment and health impact

• **In 2007 Japan choses ETBE (7%v/v) as primary biofuel for the 60 million passenger cars running on gasoline**
ETBE in the EU: the Directives approach

- RED: product driven CO$_2$ savings focusing on feedstock and energy content
- FQD: process driven CO$_2$ savings based on fuel life cycle up to refinery
- ETBE has significant positive effects on GHG emissions due to adjustments in refinery operations
- ETBE has a higher hydrogen / carbon ratio, forming less CO$_2$ for the same energy delivered to the engine and ETBE reduces fugitive VOC emissions from cars, resulting in lower CO2 emissions (1 MT VOC ~ 3 MT CO$_2$)
When to use it…
ETBE achieves higher Bio-Energy content

![Graph showing Bio-Energy % comparison]

Bio-Energy %

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<thead>
<tr>
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<th>SP95 - E5</th>
<th>SP95 - E5 Co-blending</th>
<th>SP98</th>
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<tr>
<td>Delta</td>
<td>+50%</td>
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Δ +50%
When to use it…
Maximum Bio-energy content options

- **Current**
  - SP95-E5: 3.34%
  - SP98: 0%
  - E10: 6.8%
  - Diesel: 6.47%

- **Maximum with ETBE**
  - SP95-E5: 5.15%
  - SP98: 5.15%
  - E10: 6.8%
  - Diesel: 6.47%
How to use it…

• ETBE in Blendstock allows suppliers to market multiple grades and achieve higher bio-energy through co-blending

• One Blendstock / Basefuel in one tank 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 CO₂ emissions,
  ─ Minimize infrastructure investments, reduce working capital
  ─ Greater flexibility in planning, ease of handling at depots
Supply chain benefits: Ethanol through ETBE is blended at refinery
Summary

- Significant CO$_2$ savings
- High energy content
- Supply chain benefits
- High Octane, low volatility
- Lower VOC emissions
Back-up slide
Studies

HART July 2007

Study on Relative CO₂ Savings Comparing Ethanol and ETBE as a Gasoline Component

“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 CO₂ emissions.”

CE-Delft October 2007

ETBE and Ethanol: A Comparison of CO₂ Savings

“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

Bioenergie aus Getreide und Zuckerrübe: Energie- und Treibhausgasbilanzen

“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.”