Integrating the Bio-Petroleum Sector



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Transition to a Bio-Economy –
Risk, Infrastructure and Industry Evolution

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The Dimensions of Energy

Corn:

- Global corn crop – **680 MMT/year** (2007)
- Corn ethanol – 420 gallons per year

  (typical for one acre of land – US Midwest)

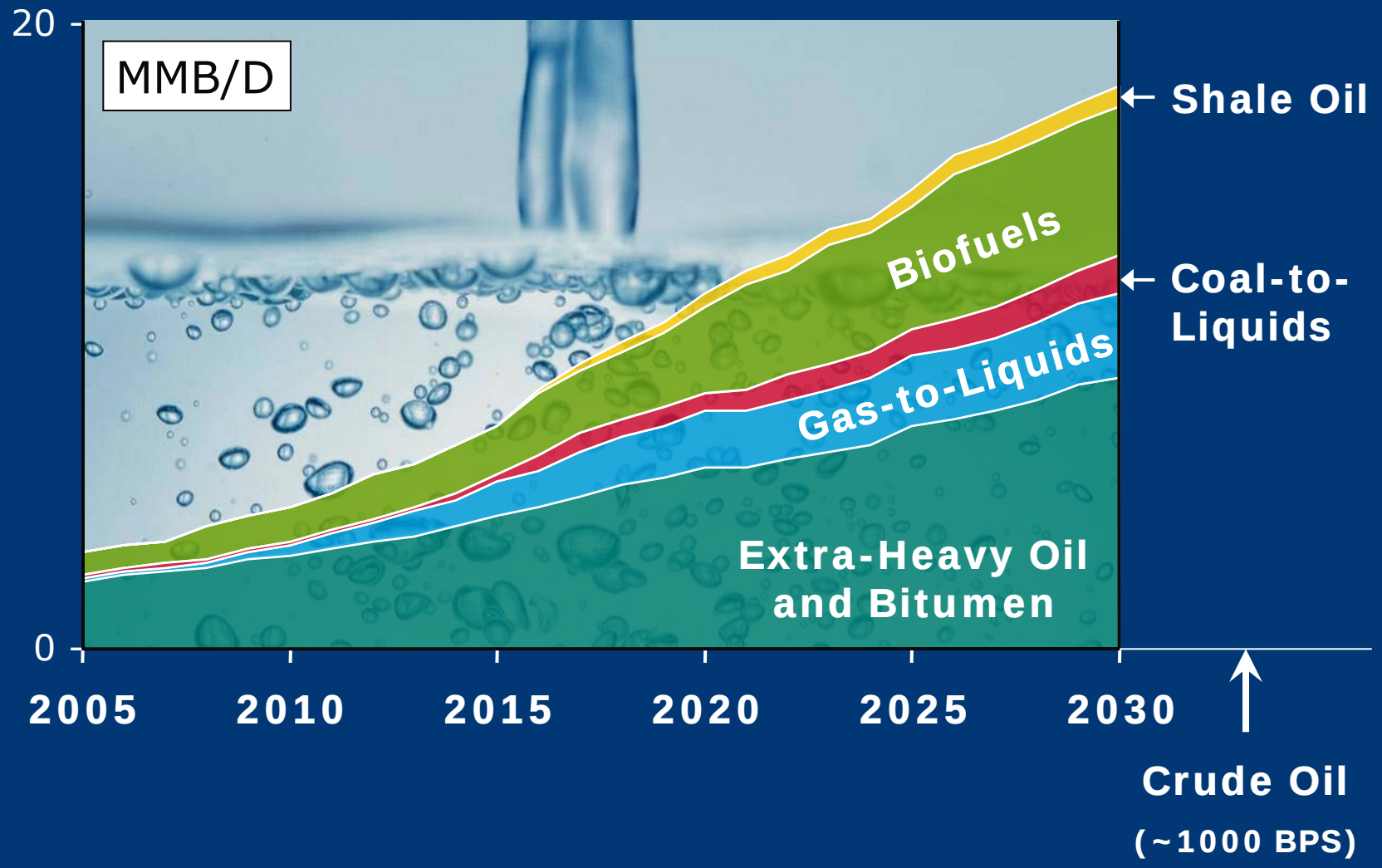
Crude Oil:

- Global petroleum – **5,000 MMT**/year (2007)

  (1,000 barrels per second or 1/3 x Colorado River)
- Oil well – 1,500,000 gallons per year

  (typical for 1.5" pipe – "average" oilfield)

Growth in Renewables – Conventional Crude Oil will not meet consumer demand for motor fuel



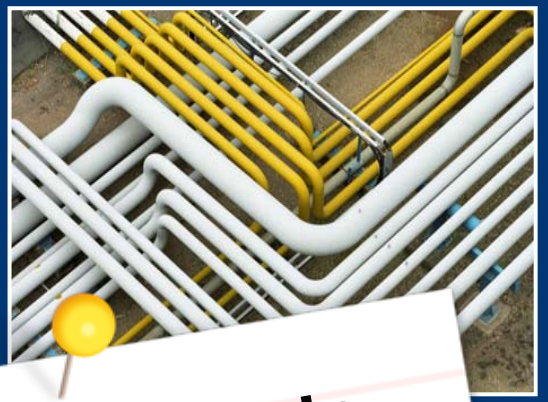
Source: U.S. DOE/EIA Energy Annual 2006

Advanced Biofuels Development

Large, concentrated supplies of feedstock

2nd-Gen conversion technology

Industrial-scale infrastructure



***Plus* sustainable business models**

Key Components

Feedstock Challenges

The three most important things in commercial biofuels:

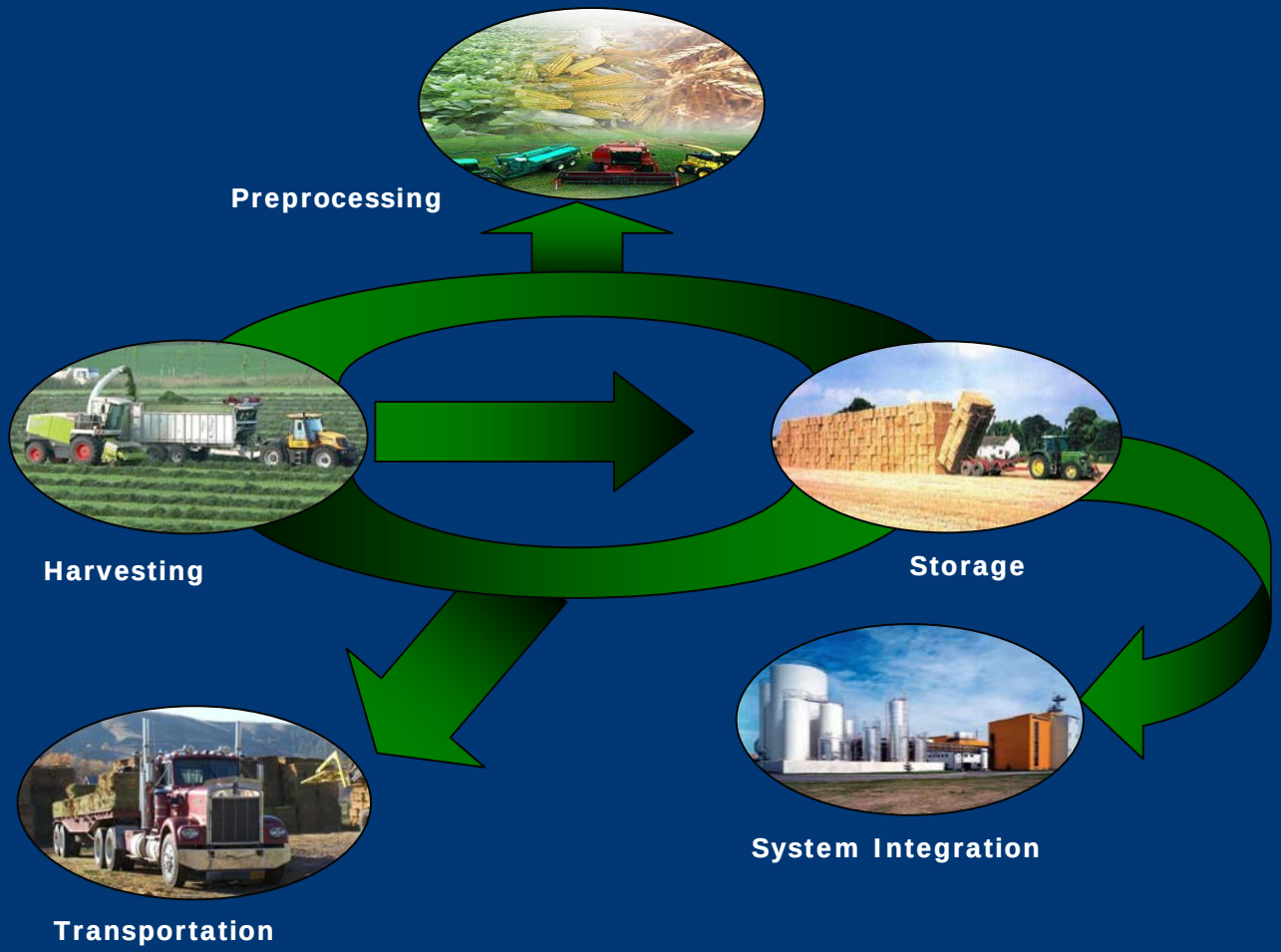
- Feedstock **Scale**
- Feedstock **Cost**
- Feedstock **Sustainability**

- Critical Issues:
  - Food / feed vs. fuel
  - Land availability
  - Subsidies
  - Water supplies
  - Land-use change
  - Regulation

Potential non-food sources:

- Wood, pulp, paper waste
- Agricultural waste
- New oilseed crops
- Fast-growing grasses & trees
- Microalgae

Feedstock Supply Chain



Biofuels Conversion Technology

- Create technologies to bring biofuels to an <u>industrial scale:</u>
  - Hydrolysis & fermentation
  - Pyrolysis
  - Gasification
  - Emerging technology
  - Catalytic conversion to transportation fuels
  - Supporting technology

Biofuels Products

- Fuels & blendstocks:
  - Compatible with storage & distribution infrastructure?
  - Compatible with existing fleet?
  - Compatible in broad blending range with petroleum fuels?
  - Meets consumer expectations for superior performance?

Chevron's Biofuels Business Unit

Catchlight Energy LLC

- 50/50 JV: Chevron + Weyerhaeuser (one of the world's largest forest products companies)
  - WY: Feedstock resources & know-how
  - CVX: Products resources & know-how
  - Both: (some) Conversion resources & know-how
- Initial focus on non-food biomass conversion to economical, low-carbon biofuels

R&D Alliances (focused on non-food biofuels):

- National Renewable Energy Laboratory
- Georgia Tech
- UC Davis
- Texas A&M
- "C2B2" (Colorado Center for Biorefining and Biofuels)