Geologic CO_2 Sequestration in Kansas

Presented to:

House Environment Committee

March 9, 2004

Presented by:

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Outline

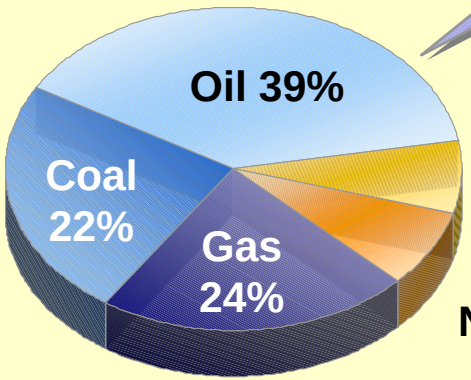
- Overview of Green House Gas (GHG) Sequestration
  - Terrestrial, **Geologic**, Ocean, Other
- Kansas CO_2 Emissions,
  - Challenges and Opportunities
  - Value-Added Approach
- State of the Technology
  - Current Projects
    - Russell Kansas
    - CO_2 Partnerships
  - Planned Projects
    - Cement Flue Gas
    - Landfill Gas
  - Potential Projects
    - FutureGen

Fossil Energy Foundation for Energy in the 21st Century

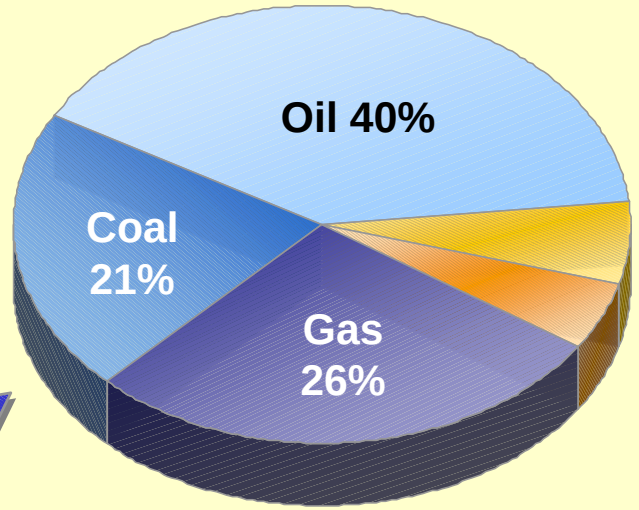
2000

99.3 Quads

Fossil fuels provide 85% of energy (67% of electricity)



+32%



2020

130.9 Quads

By 2020, reliance on fossil fuels could grow to 90%

Source: AEO 2002, Table A1

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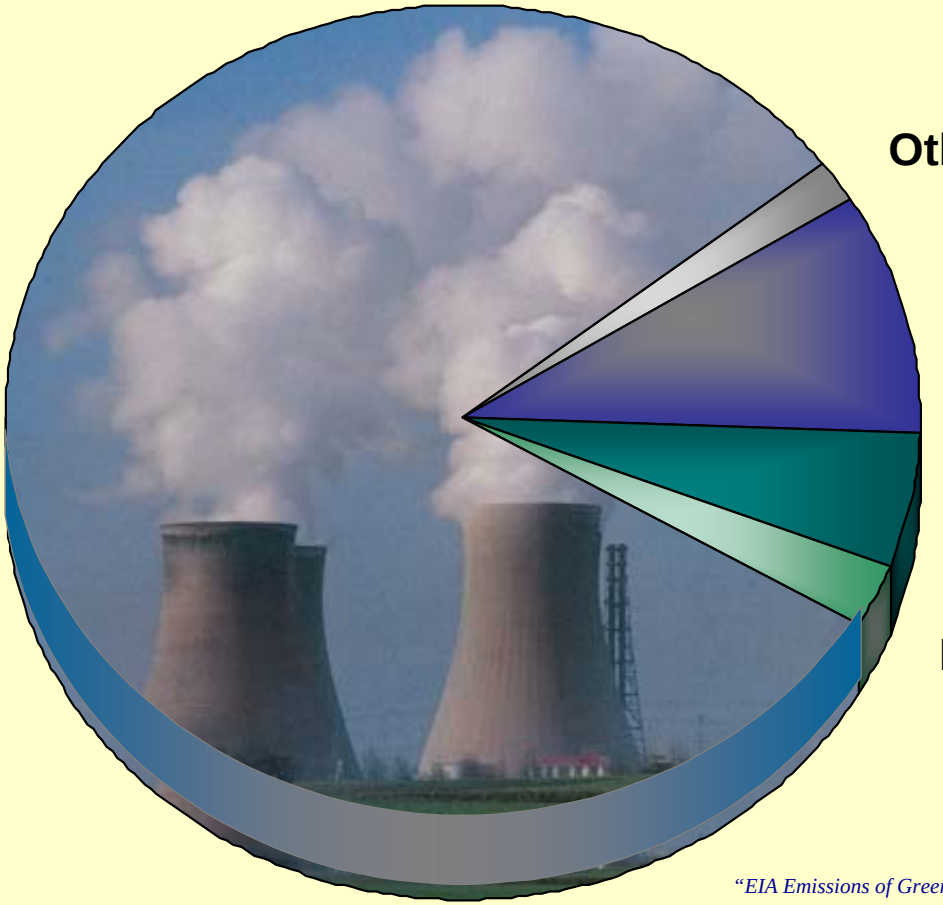
CO_2 & CH_4 Primary GHG Contributors

United States Greenhouse Gas Emissions

(Equivalent Global Warming Basis)



"EIA Emissions of Greenhouse Gases in the U.S.: 2000"

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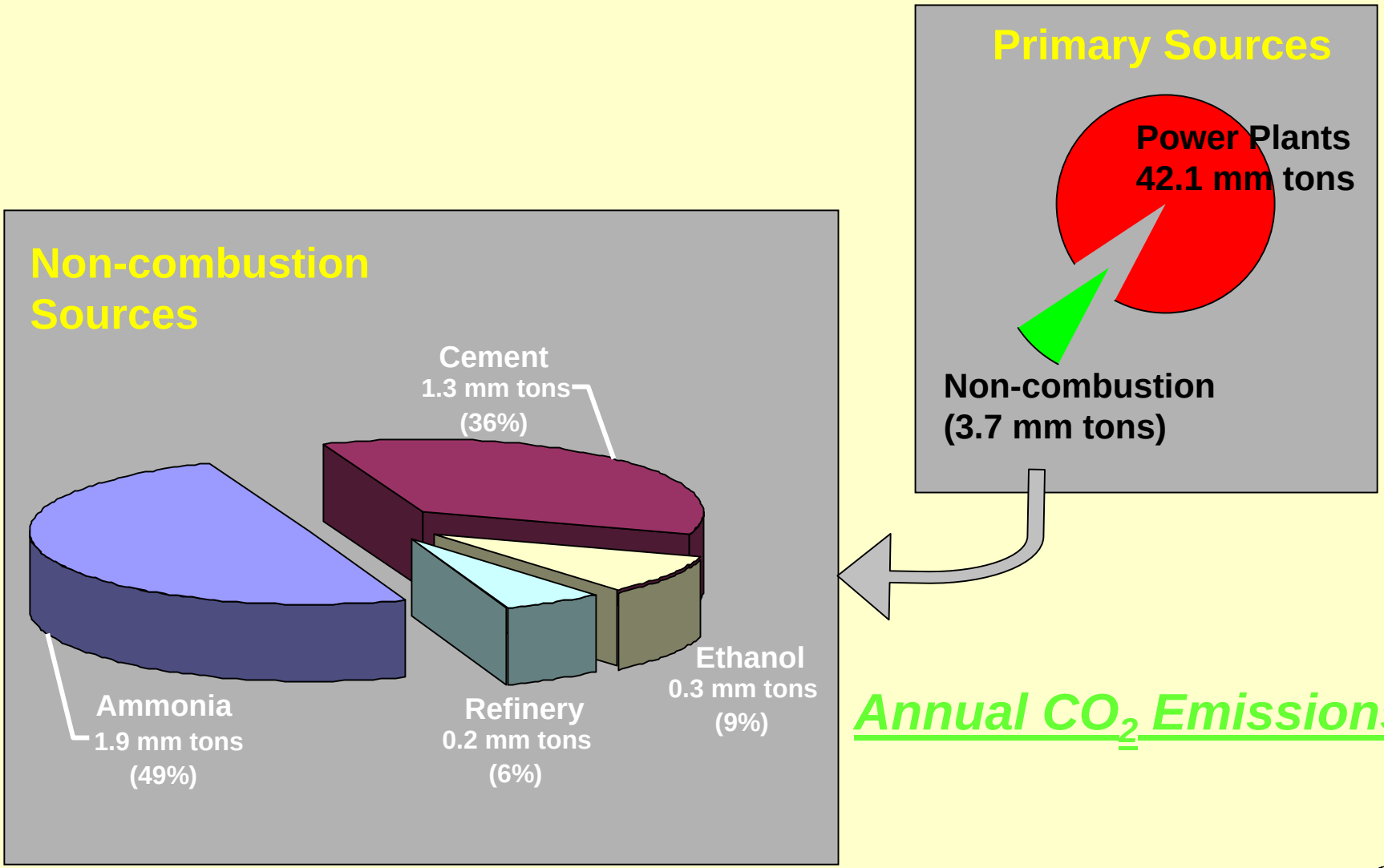
Kansas Sources for CO_2 Capture



Annual CO_2 Emissions

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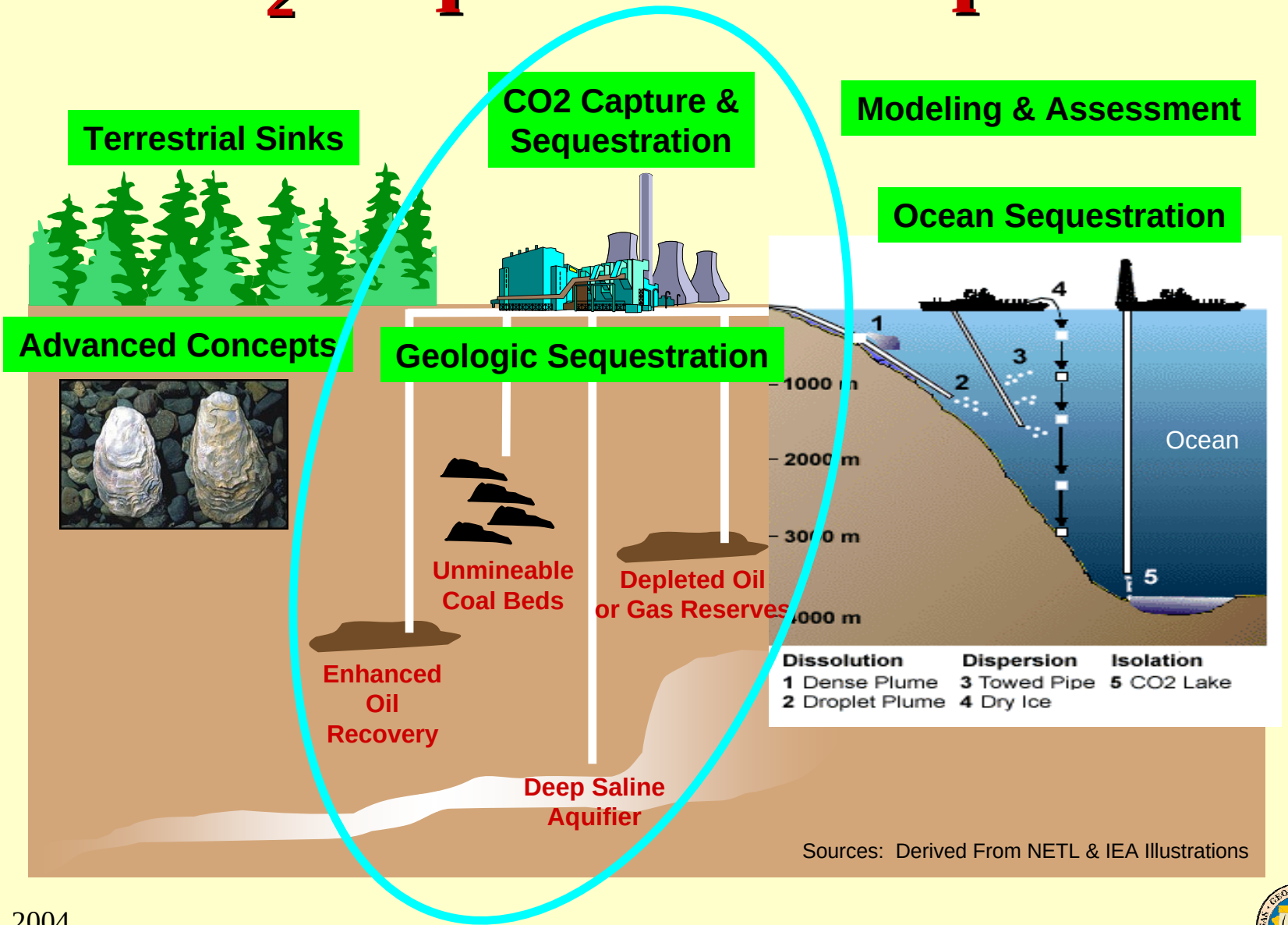
CO_2 Sequestration Options



Sources: Derived From NETL & IEA Illustrations

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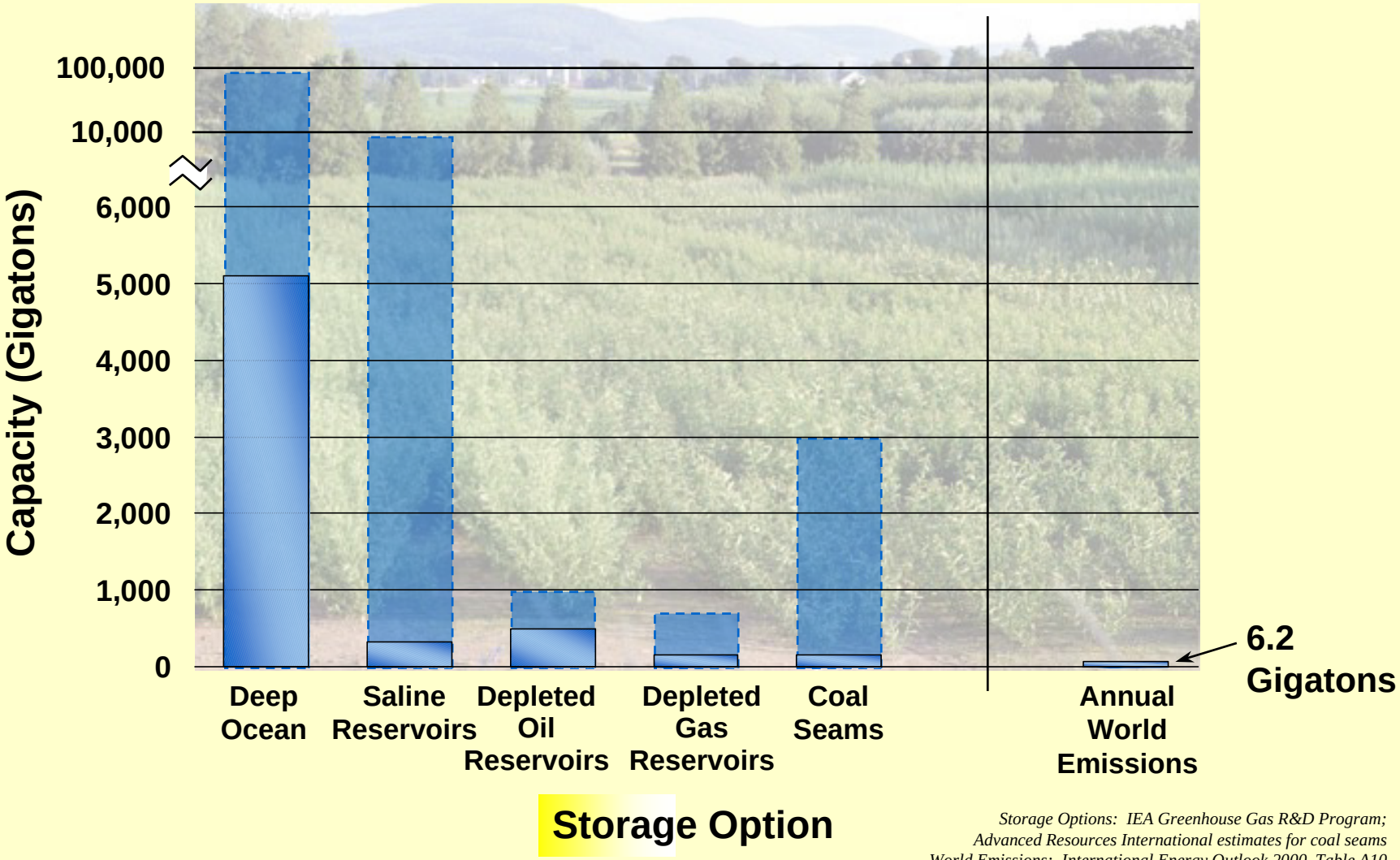
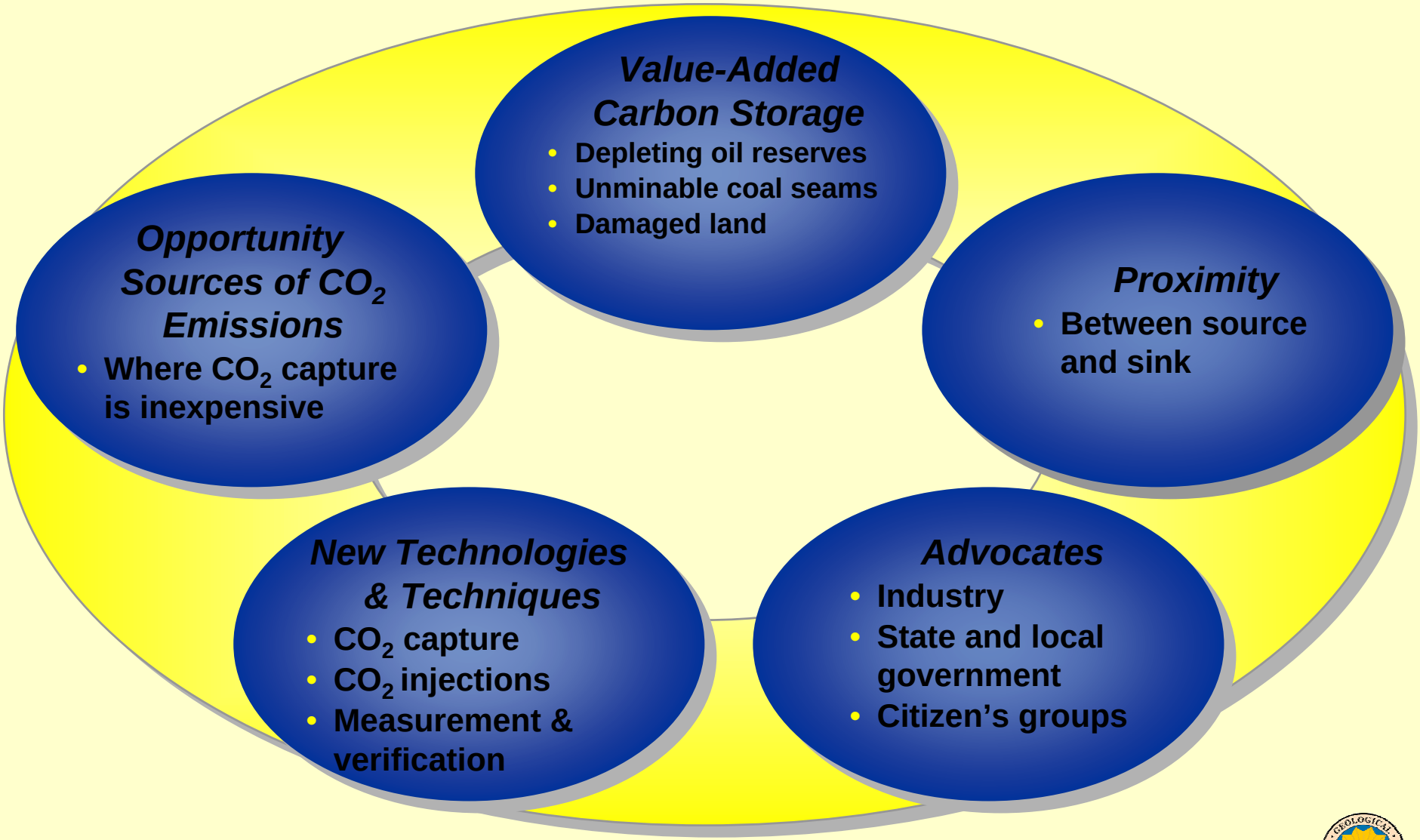
Large Potential Worldwide Storage Capacity

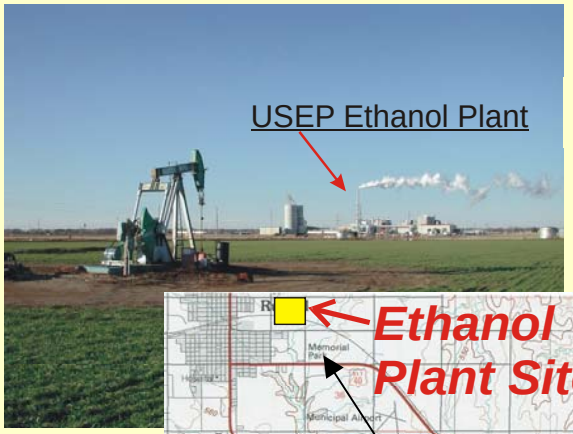


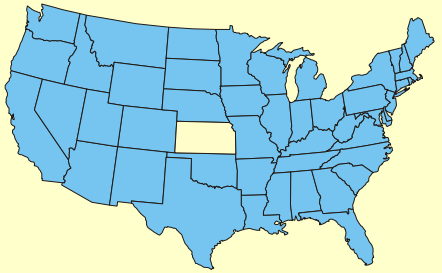
Storage Options: IEA Greenhouse Gas R&D Program; Advanced Resources International estimates for coal seams
World Emissions: International Energy Outlook 2000, Table A10

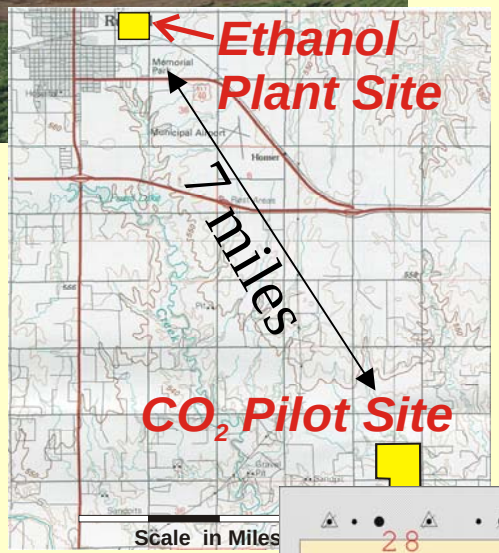
Sequestration Opportunities

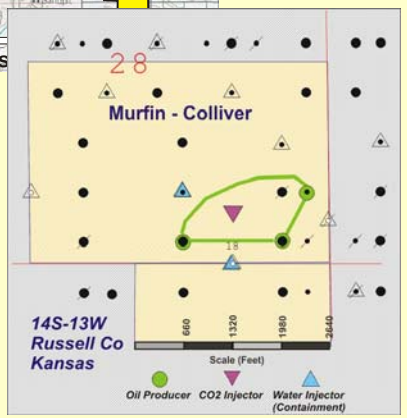


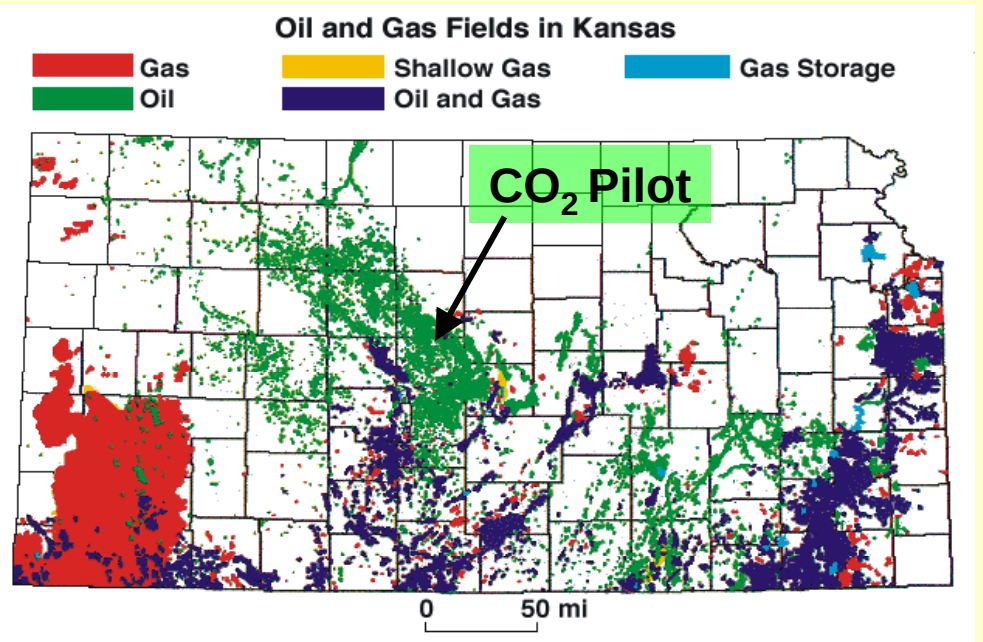
Russell, Kansas Project











Russell is centered in oil, grain and cattle region

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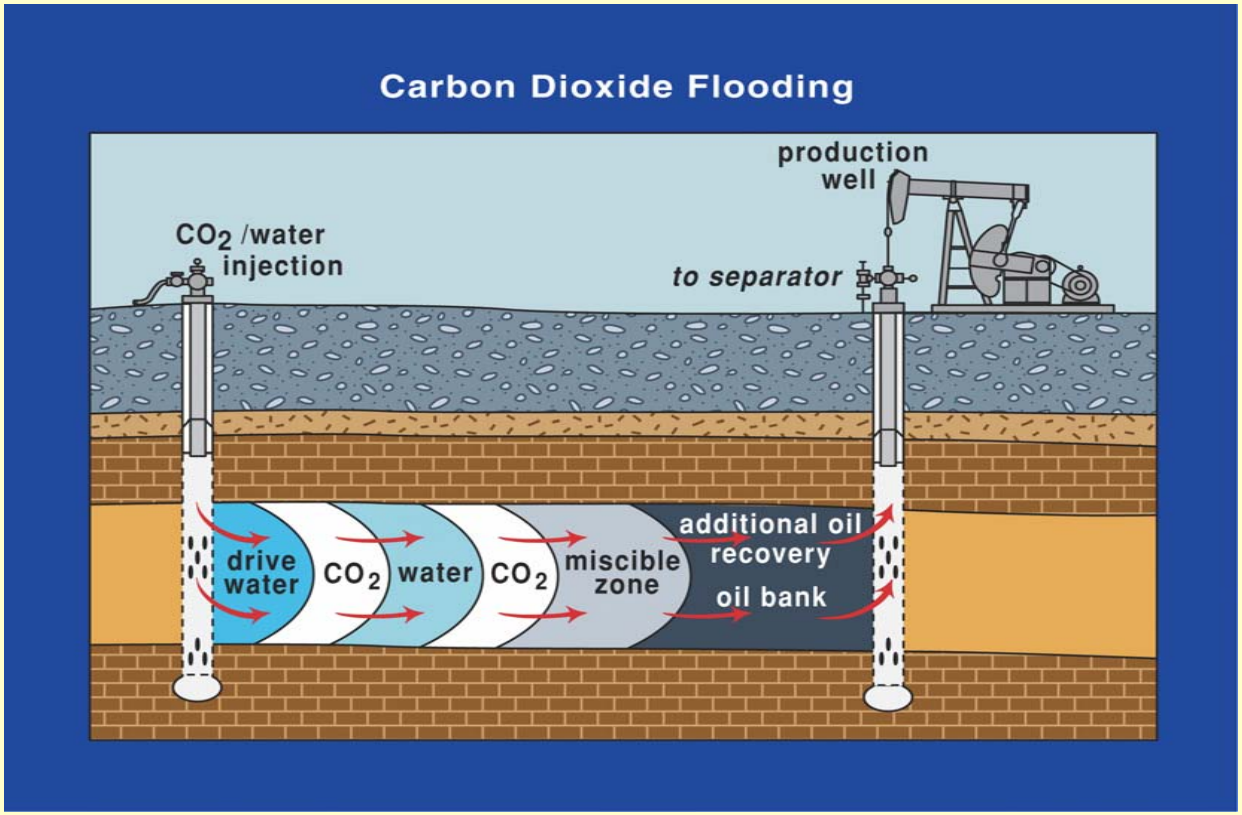
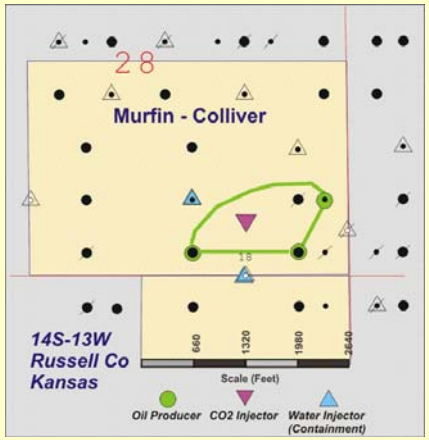
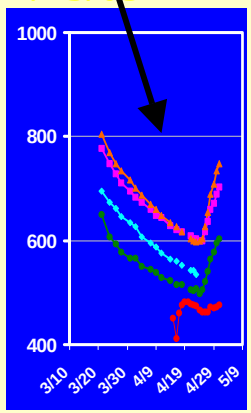
The CO_2 EOR Oil Resource





Repressure 4/23/03



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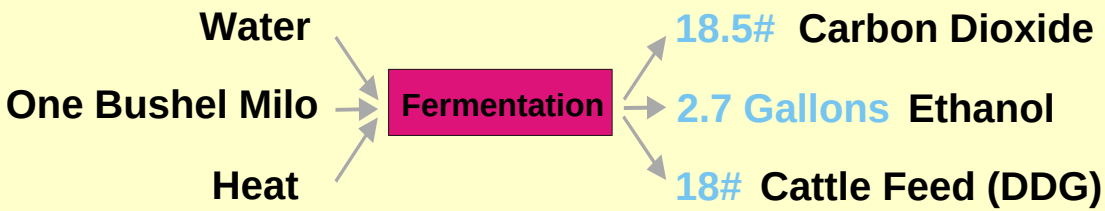
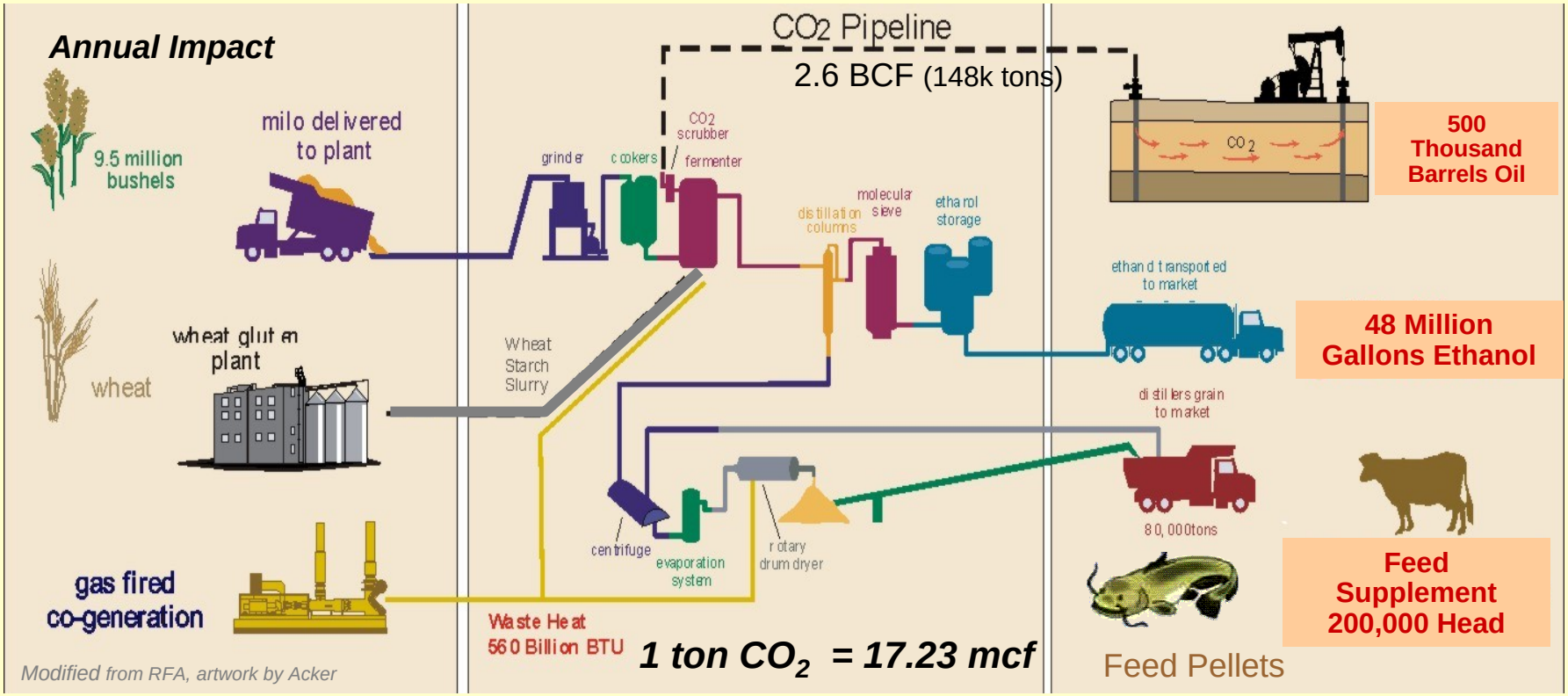
Russell Linked Energy System



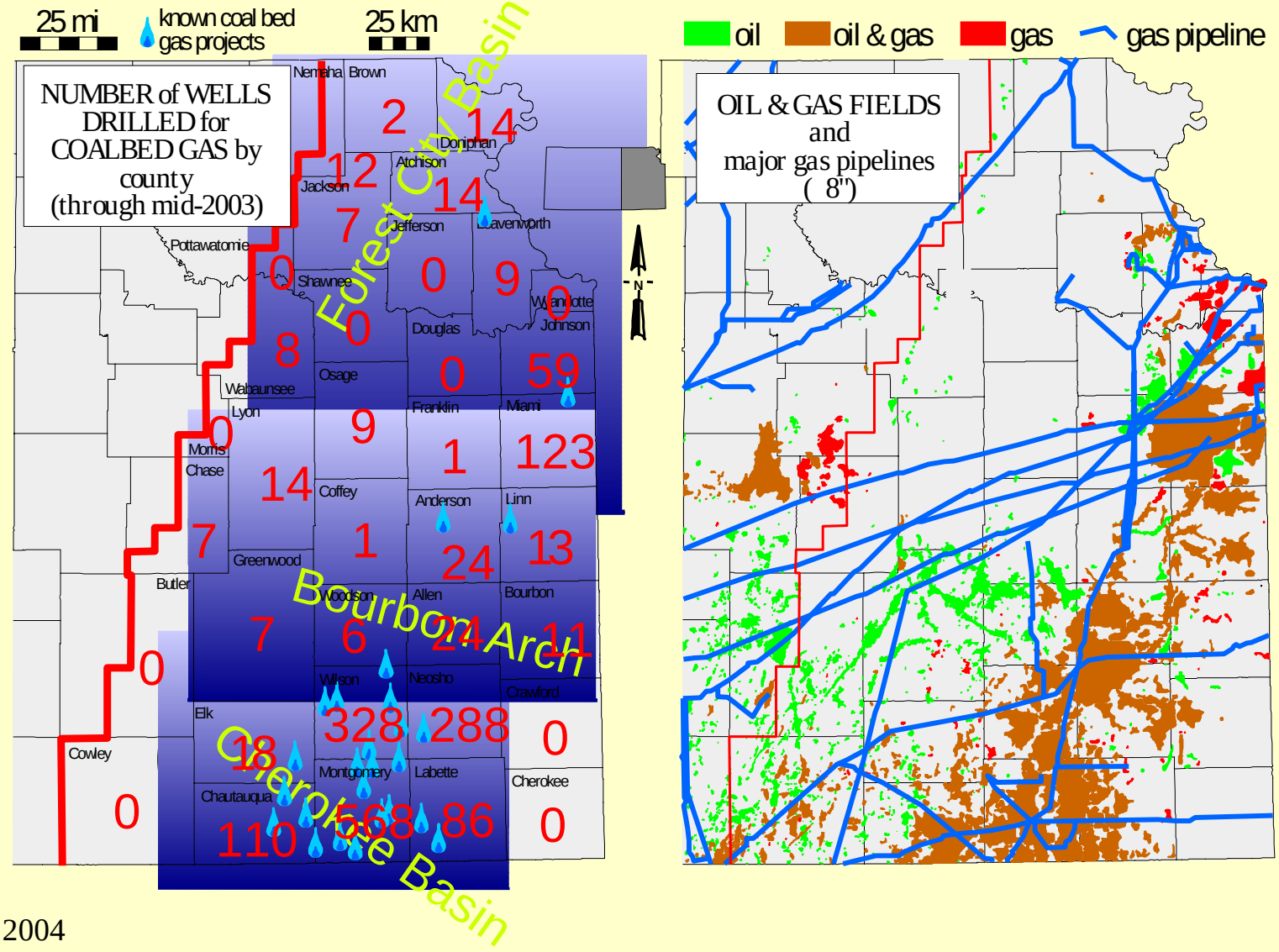
Raw Materials

Ethanol Plant

Products



Kansas Coalbed Methane Activity



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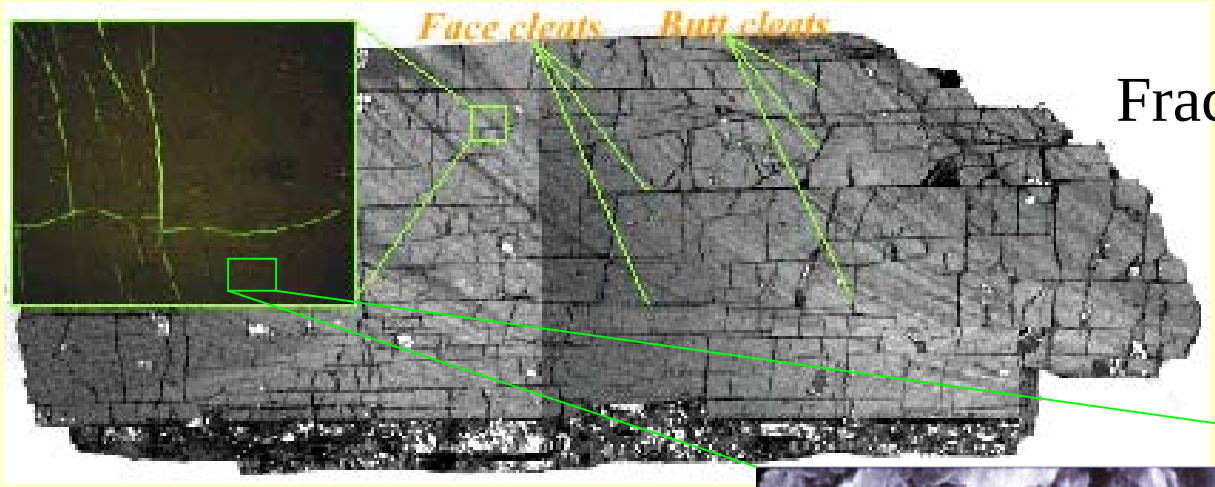
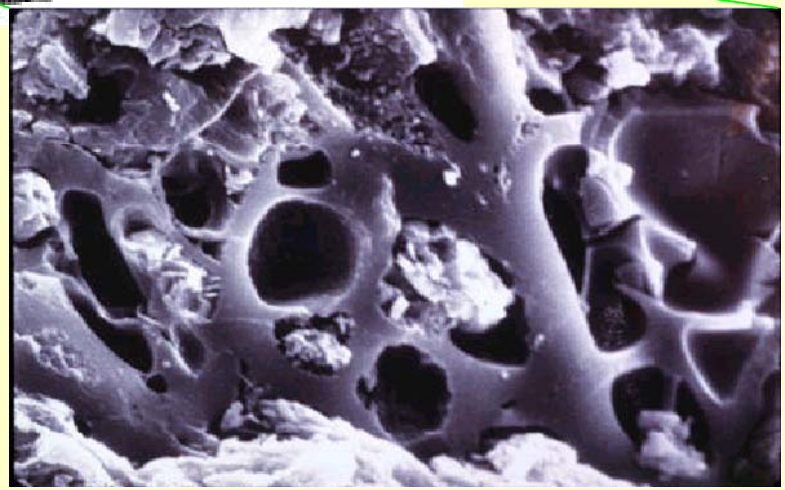
Coal, an Unconventional Reservoir

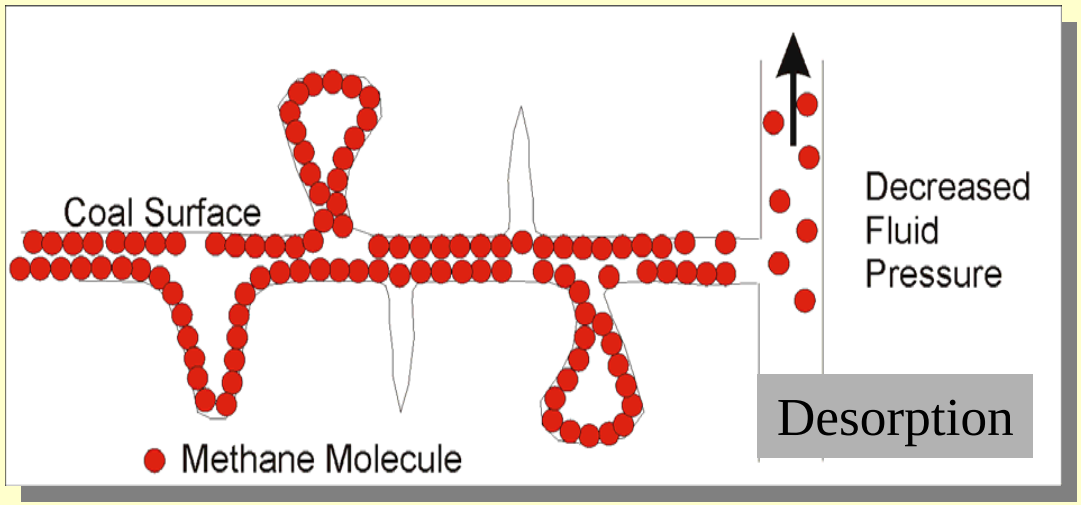


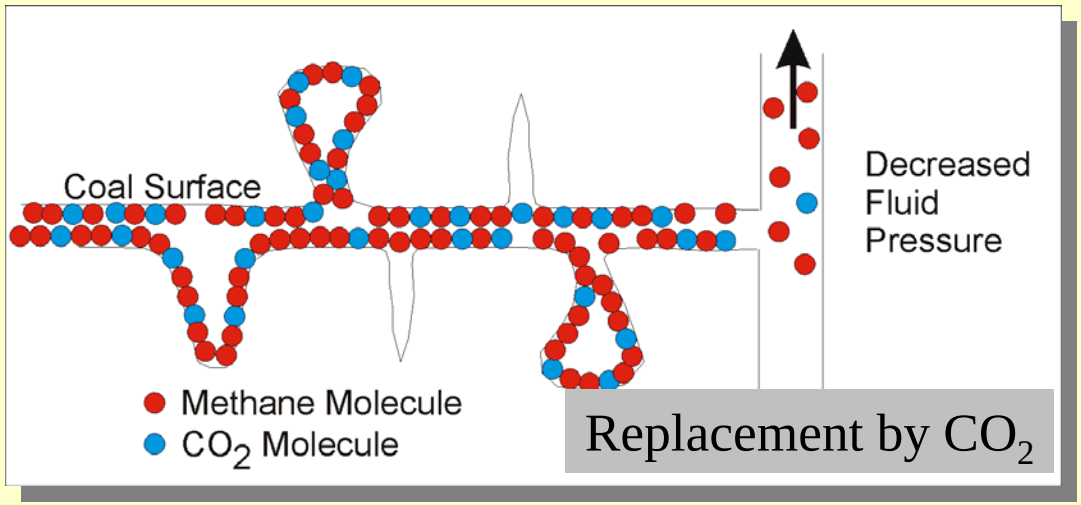
Fractured Reservoir



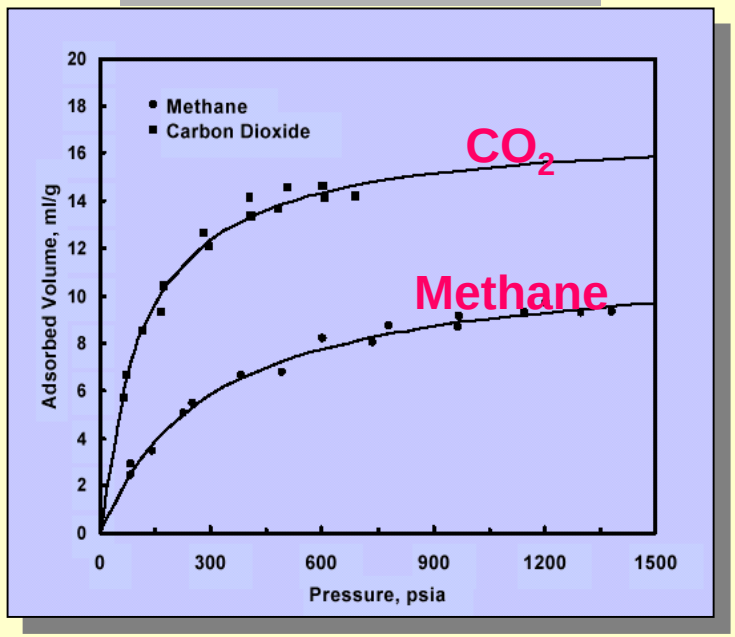
Micropores

Methane Production from Micropores and ECBM Production





Sorption Isotherms



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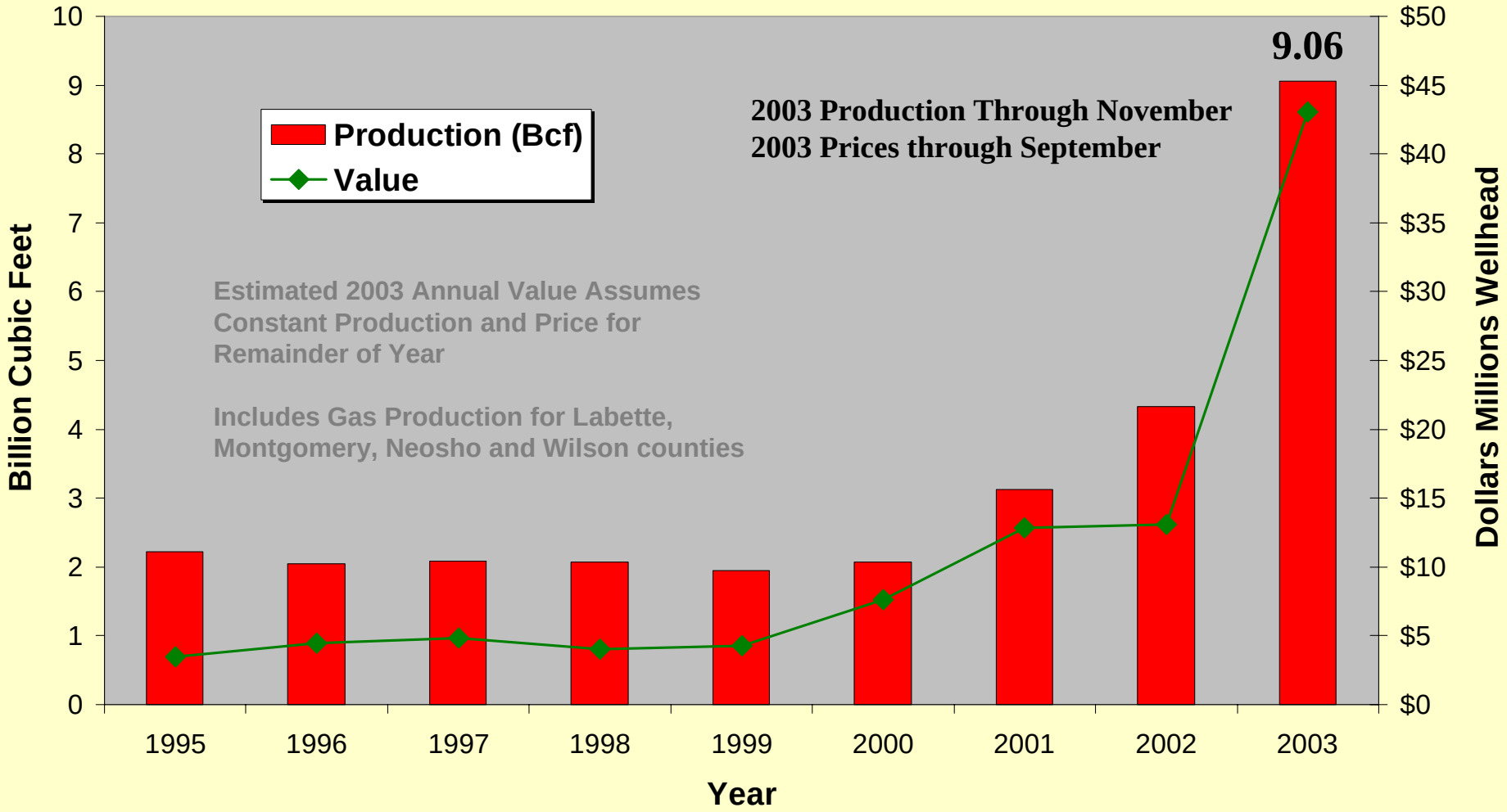
SE Kansas CBM Production



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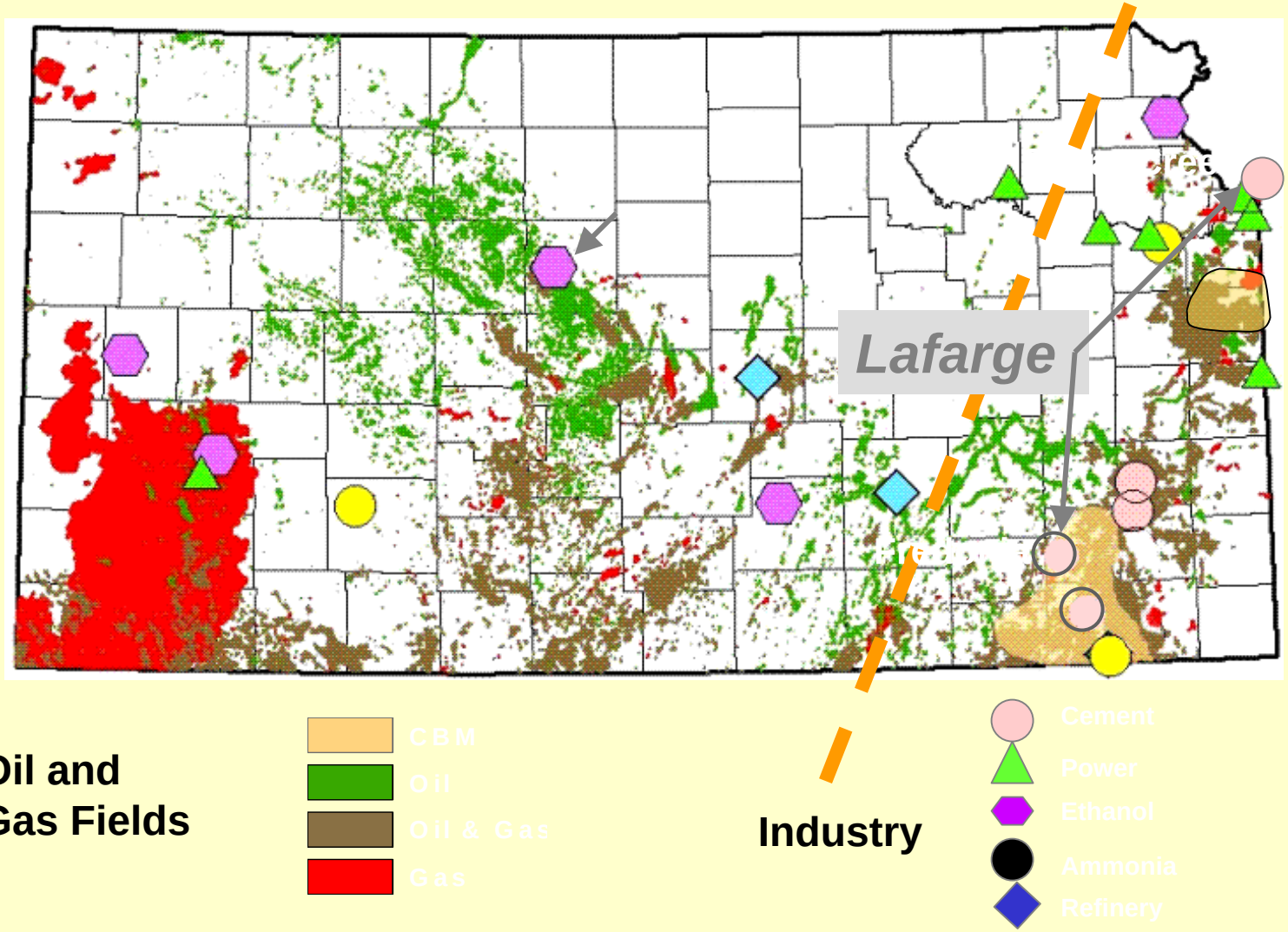
Kansas Industrial CO_2 Sources



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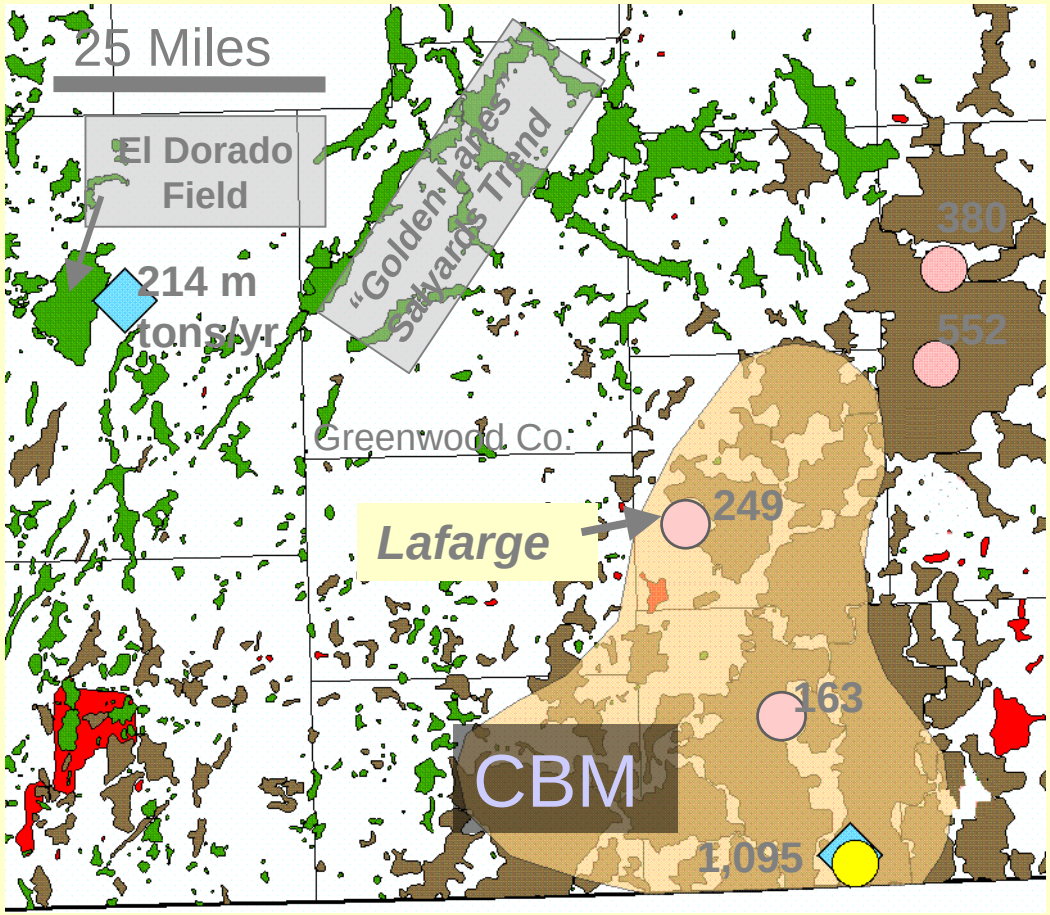
Southeast Kansas

Partially miscible and immiscible CO_2 EOR

- **El Dorado**
- **Salyards Trend**,

Enhanced Coalbed Methane (N_2 and CO_2)

Cement plant gas stream may be best suited for ECBM



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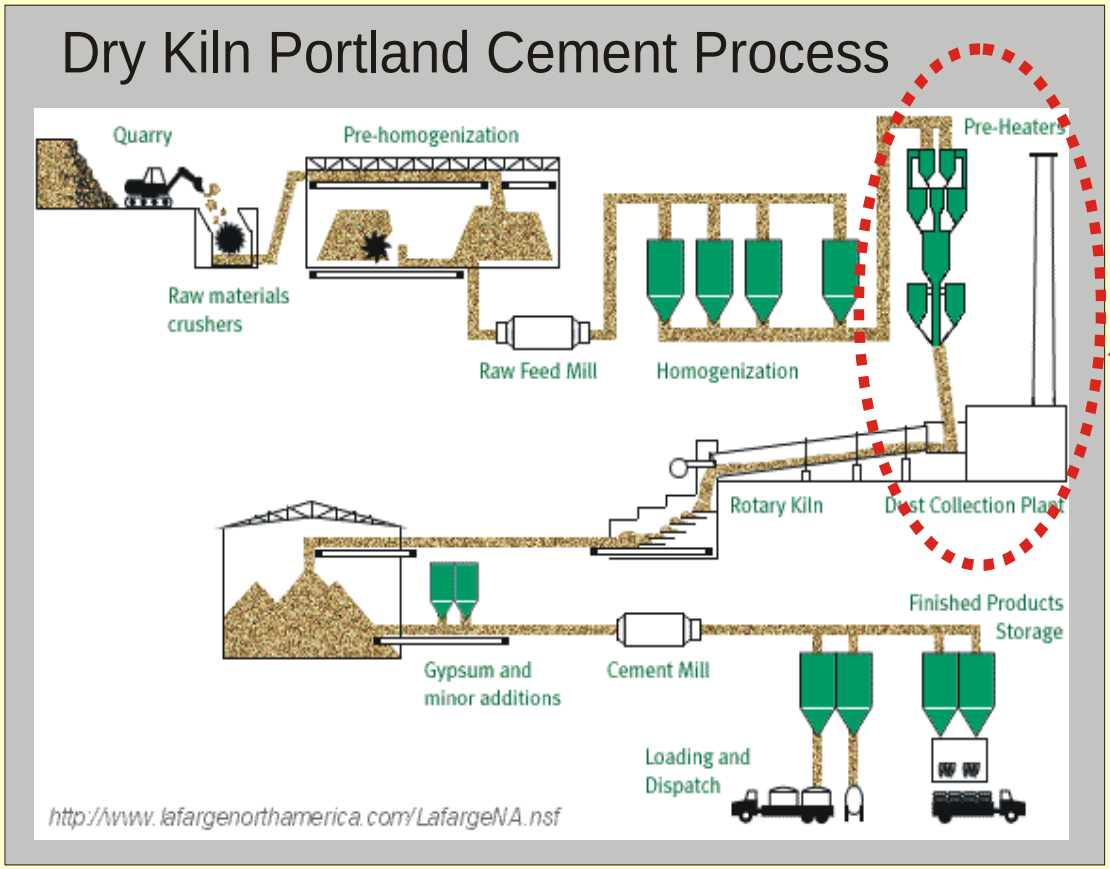
Cement Production



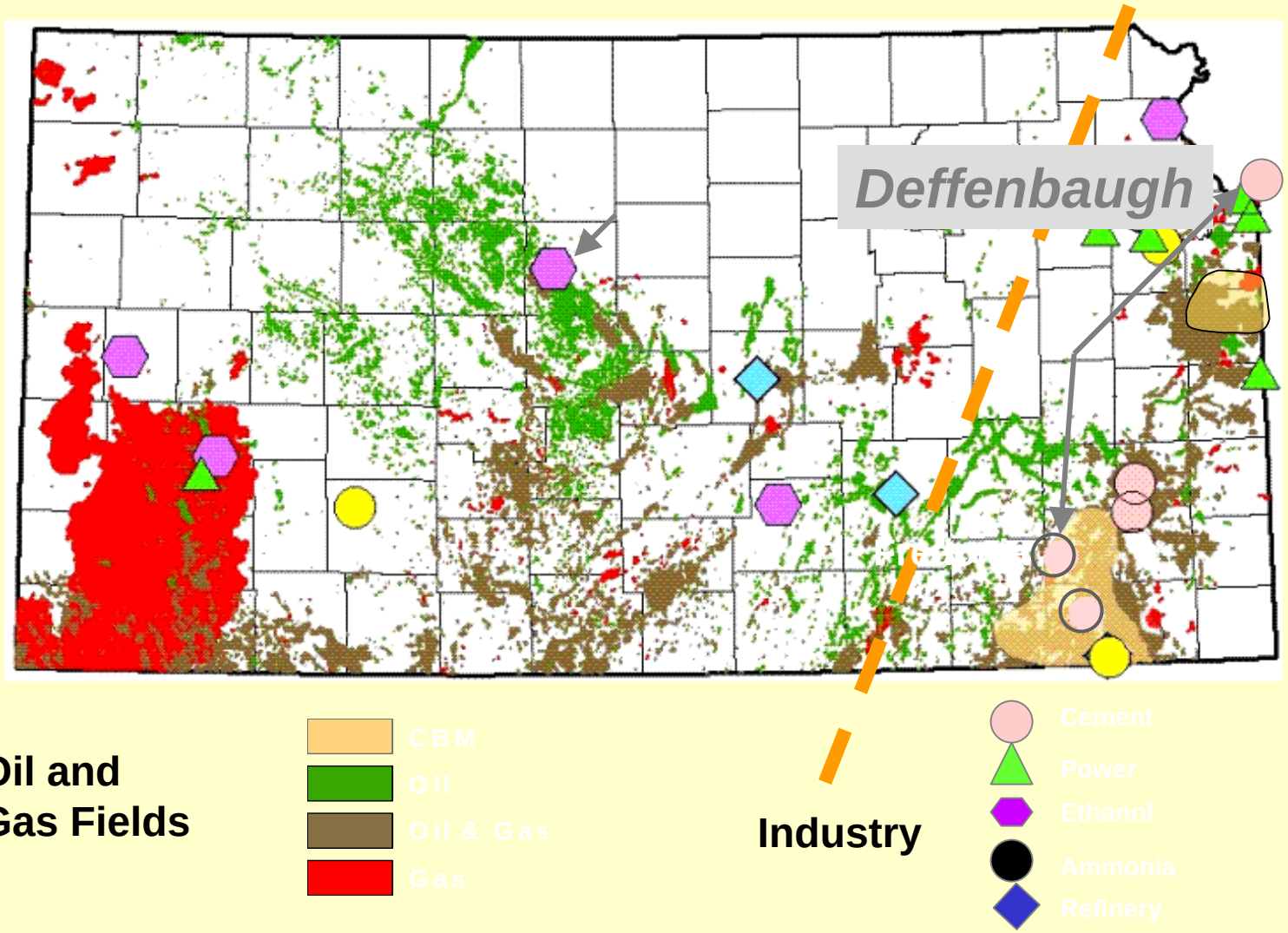
Calcination Process

$CaCO_3 > CaO + CO_2$

0.51 tons CO2 / ton cement

CO_2 and N_2 kiln gas mix may be suitable for ECBM with little processing

Kansas Industrial CO_2 Sources



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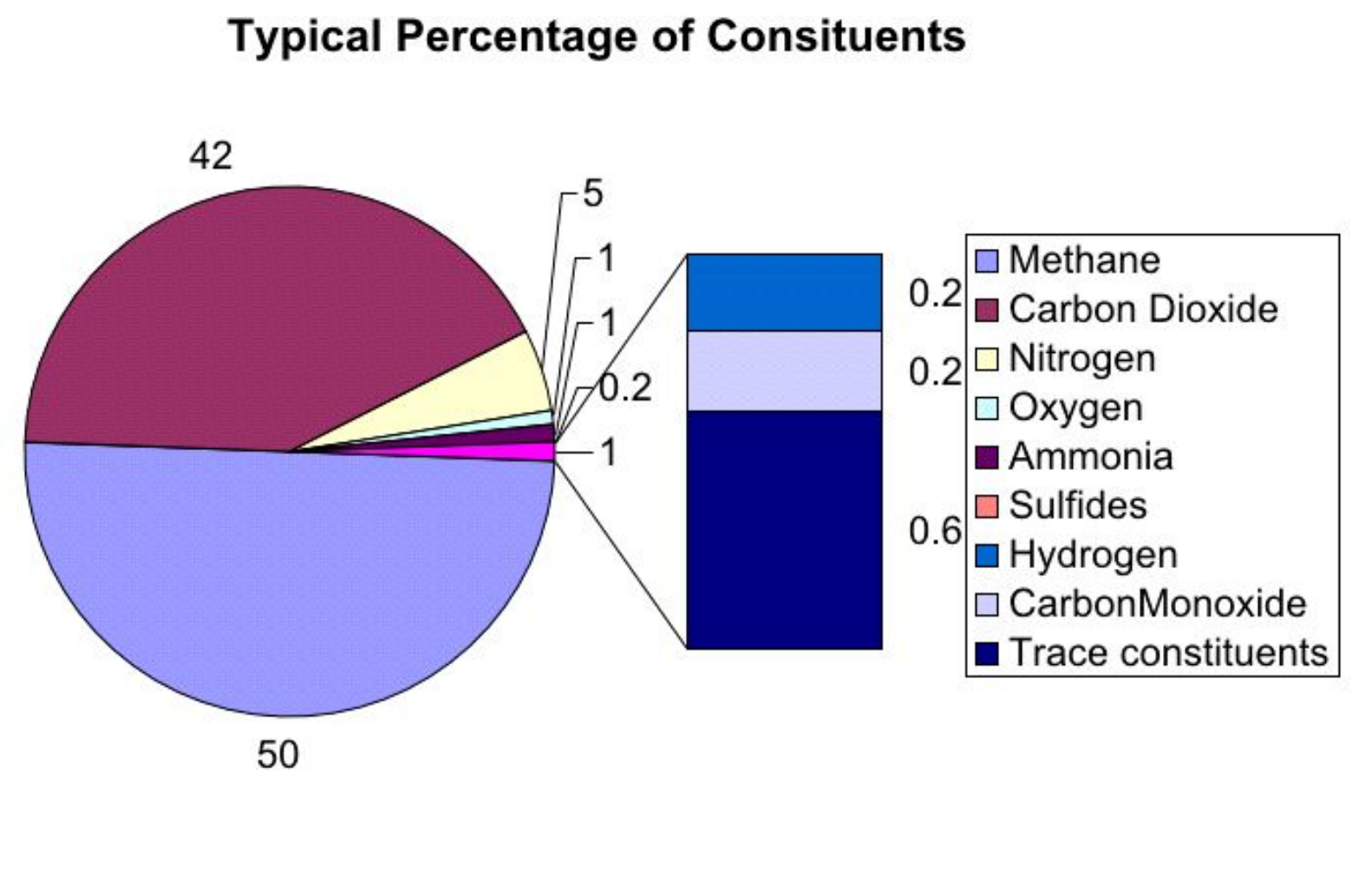
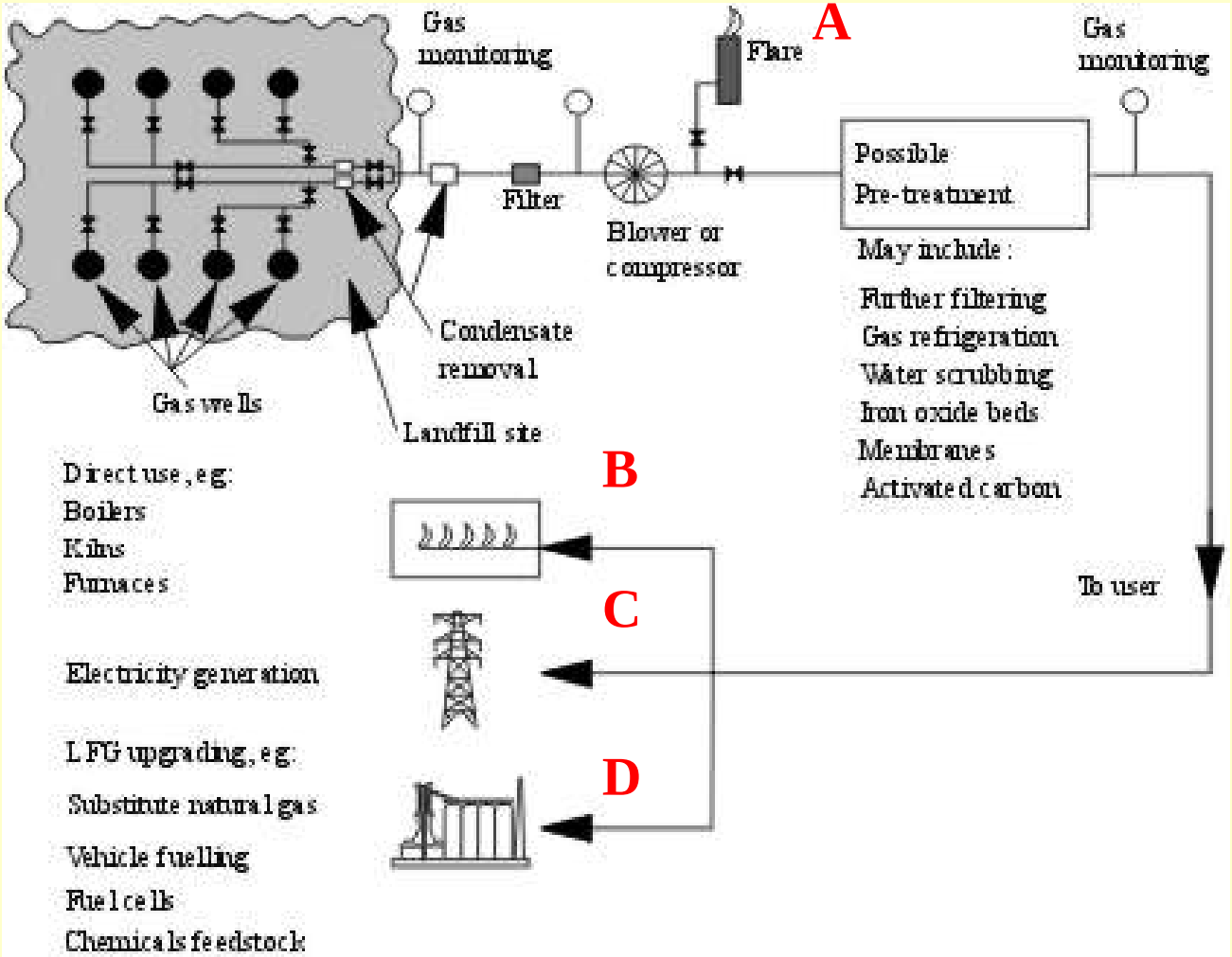
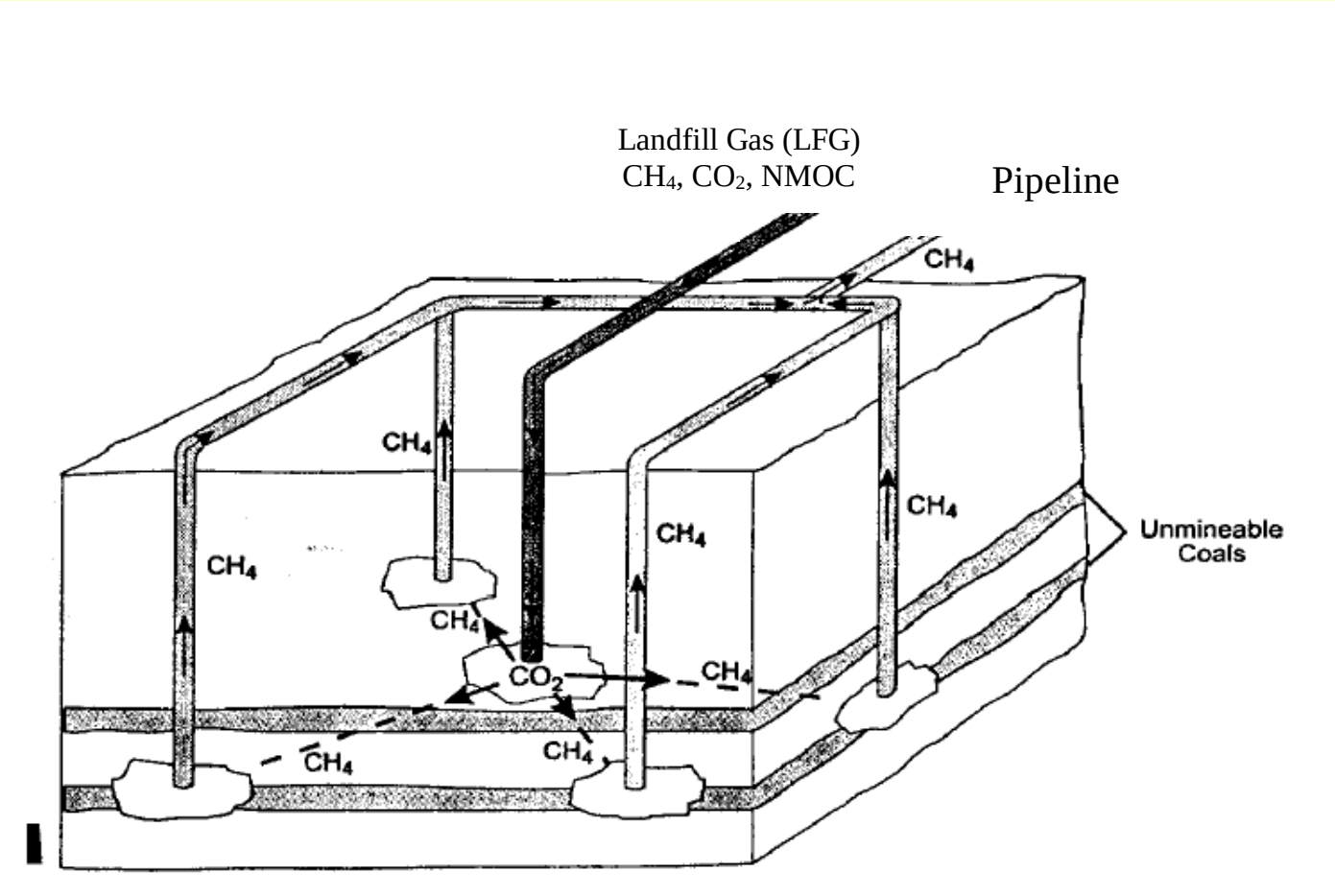
Landfill Gas



Landfill Gas



Landfill Gas



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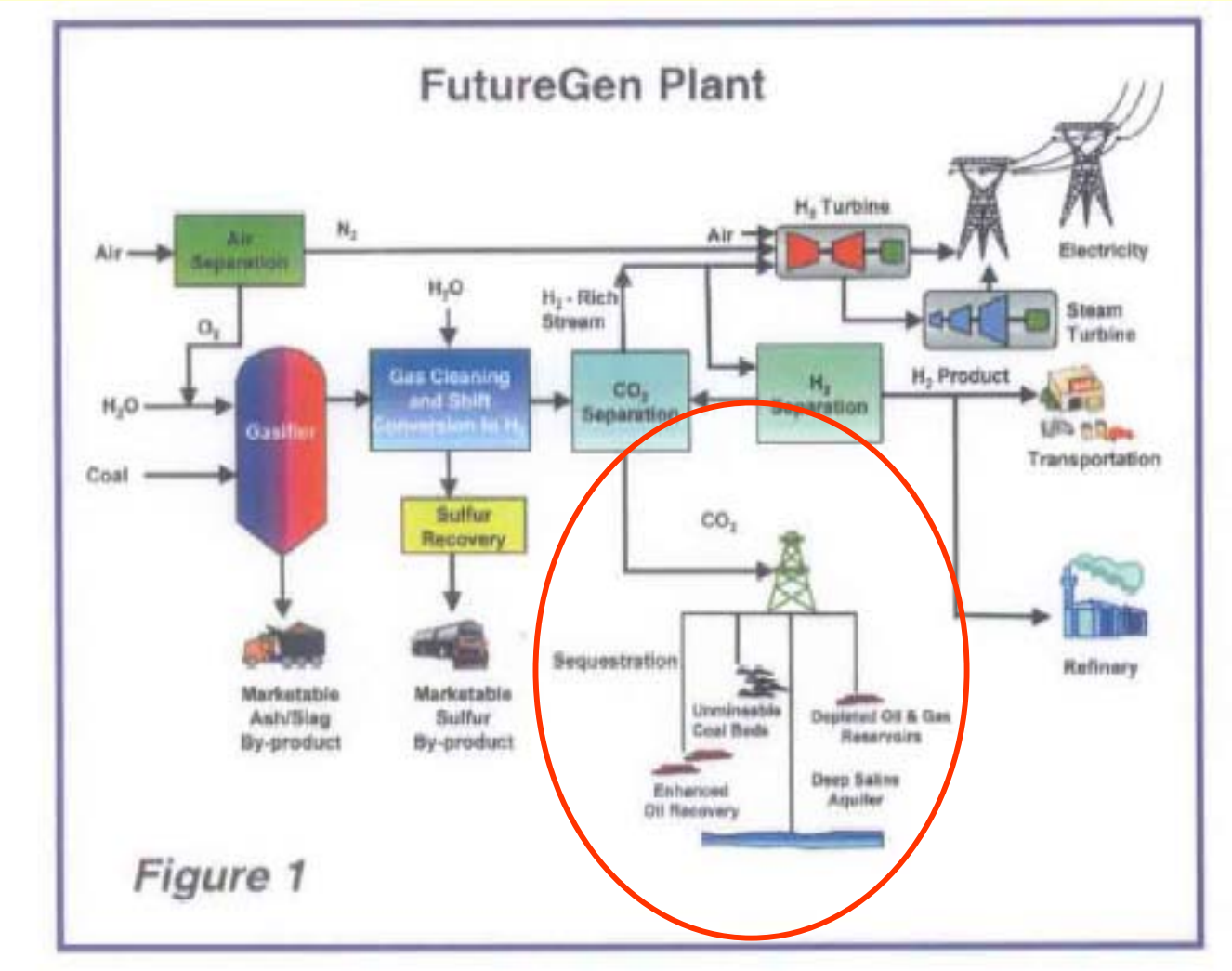
FutureGen



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Expected Program Costs

Project Definition	**$ 20MM**
Engineering & Procurement	**60MM**
Plant Construction	**360MM**
Sequestration Design/Construction	**320MM**
Plant Operation	**220MM**
Total	**$1000MM**

Coffeyville, Kansas, Petroleum Coke Gasification Plant

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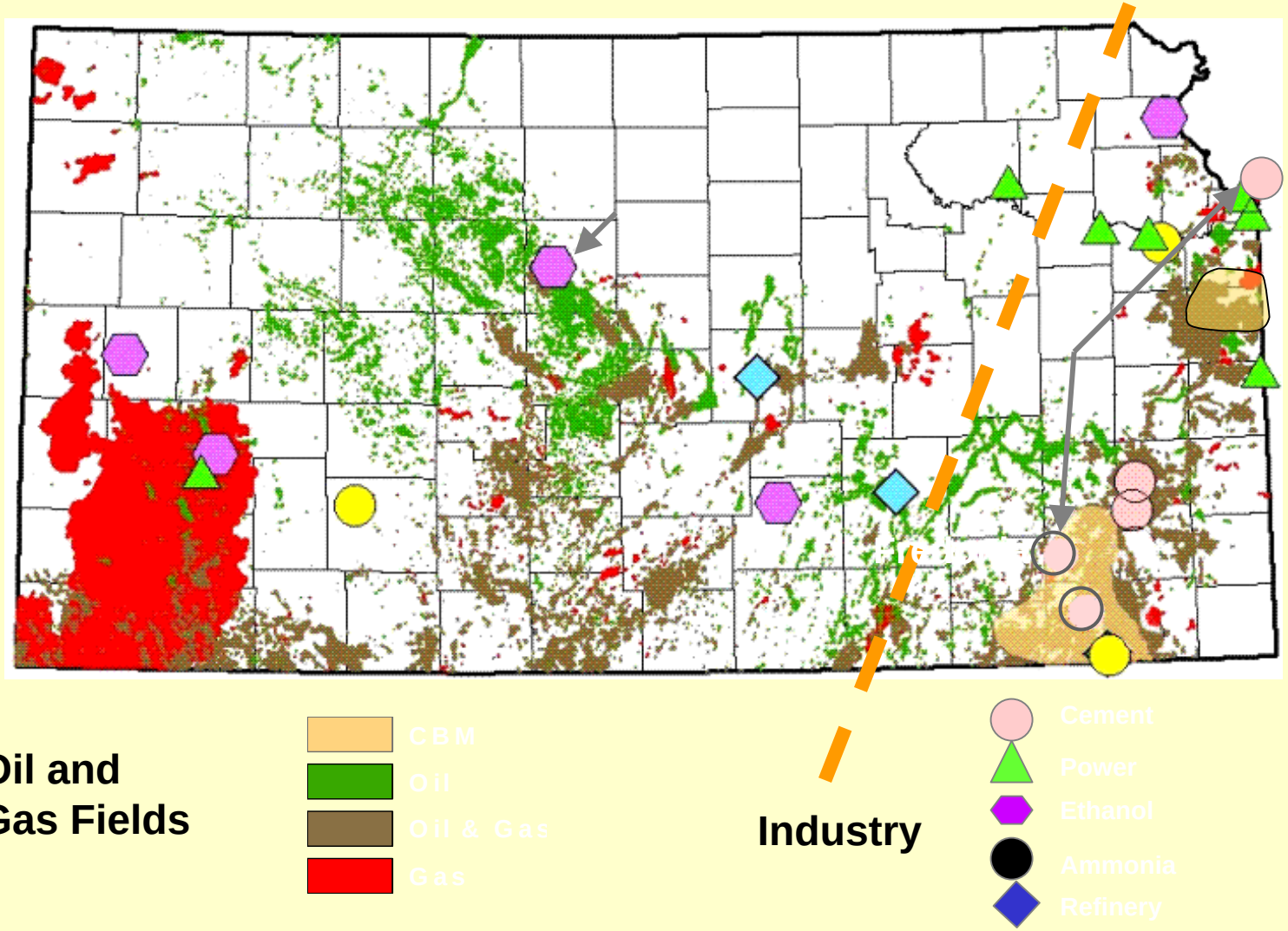
Kansas Industrial CO_2 Sources



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CO_2 Trivia

- 1 ton CO_2 = 17.23 mcf
- 1 tonne CO_2 = 18.95 mcf
- 5 mcf CO_2 / BO (Net utilization: *Sequestered?*)
- Combustion of 1 barrel of oil yields 8 mcf (.46 ton) CO_2
- Perspective:

  US Annual Anthropogenic Emissions 6.3 Billion tons

  KS Annual Anthropogenic Emissions 46 Million tons

  An average human exhales 5.6 mcf (1/3 ton) CO_2/ yr