# Sustainability and offshore oil and gas exploration and production

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# Key topics

- Importance of sustainability to the oil and gas industry
- Importance of sustainability to environmental regulators
- Sustainability challenges facing the exploration and production industry
- Key responses to these challenges
- Future exploration and production sustainability challenges – methane hydrates

# Sustainability

- How to produce energy so as to sustain *over many generations* our society, environment and the economy.

- Sustain: “to keep going”
  - Oxford English Dictionary

# Sustainability Drivers

- Increased population
- Increased competition
- Civil strife
- Global climate change
- Stakeholder and shareholder expectations

# Population Projections

**World's Largest Countries in 2003**

| Rank | Country | Population (millions) |
|---|---|---|
| 1 | China | 1,289 |
| 2 | India | 1,069 |
| 3 | United States | 292 |
| 4 | Indonesia | 220 |
| 5 | Brazil | 176 |
| 6 | Pakistan | 149 |
| 7 | Bangladesh | 147 |
| 8 | Russia | 146 |
| 9 | Nigeria | 134 |
| 10 | Japan | 128 |
| 11 | Mexico | 105 |
| 12 | Germany | 83 |
| 13 | Philippines | 82 |
| 14 | Vietnam | 81 |
| 15 | Egypt | 72 |
| 16 | Turkey | 71 |
| 17 | Ethiopia | 71 |

**World's Largest Countries in 2050**

| Rank | Country | Population (millions) |
|---|---|---|
| 1 | India | 1,628 |
| 2 | China | 1,394 |
| 3 | United States | 422 |
| 4 | Pakistan | 349 |
| 5 | Indonesia | 316 |
| 6 | Nigeria | 307 |
| 7 | Bangladesh | 255 |
| 8 | Brazil | 221 |
| 9 | Congo, Dem. Rep. of | 181 |
| 10 | Ethiopia | 173 |
| 11 | Mexico | 153 |
| 12 | Philippines | 133 |
| 13 | Egypt | 127 |
| 14 | Russia | 119 |
| 15 | Vietnam | 117 |
| 16 | Japan | 101 |

# Importance of sustainability to the oil and gas E& P industry

- A way to live one's values
- An approach to maximize environmental social and financial performance
- An approach to have multi-generational impact
- An approach to secure the "license to operate"

# The importance of sustainability to environmental regulators

- Environmental performance has improved because responsibility and accountability is dispersed throughout the company
- The CEO, CFO, senior VP for corporate affairs, senior VP for environment health safety and sustainability all have a stake sustainability
- Everyone in a corporation has a stake in sustainability
- Sustainability is the link between environmental and social impact: environmental justice

# Challenges: exploration and production

Historic and present challenges:

- Flaring and venting
- Decommissioning of oil and gas installations
  - Brent spar oil storage tank disposal
- Management of drill cuttings
- Produced waters
- Drilling muds and fluids
- System for estimating and validating greenhouse gas emissions
- subsidence
- Spills
- Safety
- enhanced profitability

# Sustainability E&P responses

- Venting and flaring: piping of gas to coastal facilities; use of gas as as an on platform source of energy
- Use of solar and wind power generation on offshore production facilities
- Spill prevention
- Less harmful drilling muds and fluids
- Safety improvements
- New techniques to estimate and manage GHG emissions

# Responses: the role of technology

- Identify and development discovered reserves less intrusively
- Faster elimination of non-prospective areas do more efficient basin modeling
- Better subsurface imaging and interpretation using gravity and 4-D seismic data thereby decreasing the number unsuccessful wells
- More efficient off take from smarter wells, requiring fewer wells per unit of production
- Less environmentally intrusive handling of drill cuttings
- Decreased venting and flaring

- --Dr. John H. Barwis, Shell UK exploration and production

# Sustainability reporting

- Global reporting initiative
- United Nations environment programs oil sector report
- International Petroleum Industry Environmental Conservation Association and American Petroleum Institute joint corporate reporting project

# performance measures

Present Measures

- Emissions to air
- Discharged water
- Waste
- Health and safety
- Social
- Resource management
- Economic
- regulatory sanctions
- Contractor performance
- Management systems – ISO 14001

# performance measures

- Future measures
- Environmental impact of products
- Health impact of processes in products
- Access to sensitive areas
- Land-use and habitat restoration
- Climate change – GHG. trading
- Stakeholder consultation
- Strategic EHS risk management

# Impact

- Marine Mammals
- Human Health Impact
- Climate Change

# Future challenges-- methane gas hydrates

# What are Gas Hydrates?

www.gashydate.de/images/hand.jpg

The heat from the flame melts the hydrate thus releasing more methane to fuel the flame.

Notice the water dripping from the person’s hands.

# What Are Gas Hydrates?

- Crystalline Solids
- Clathrate Structure
  (gas molecules within water cages)

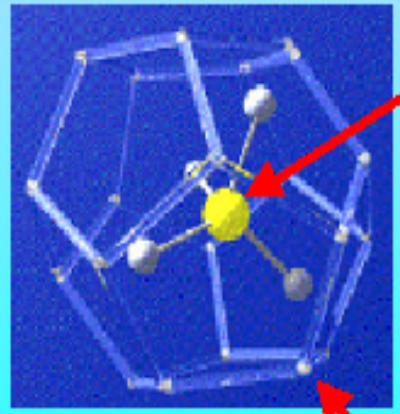
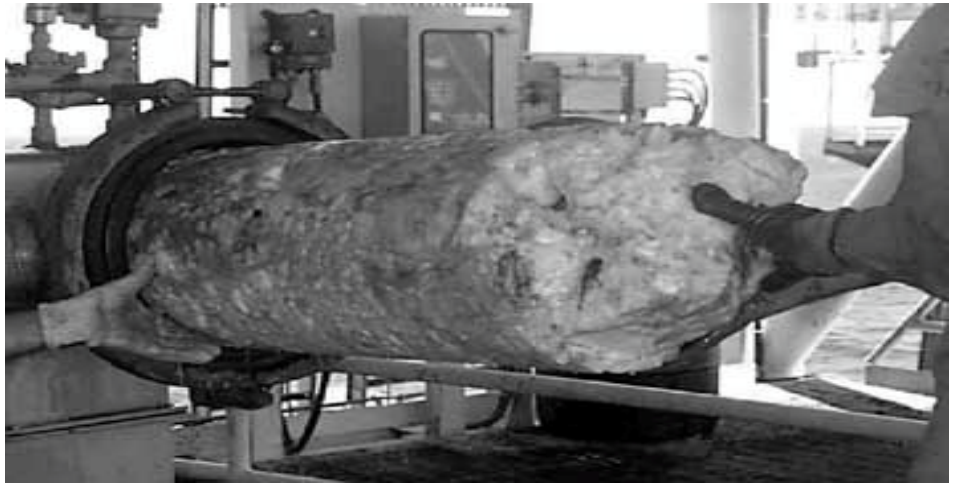



Photo source: http://woodshole.er.usgs.gov/project-pages/hydrates/

# Pipeline Plugging

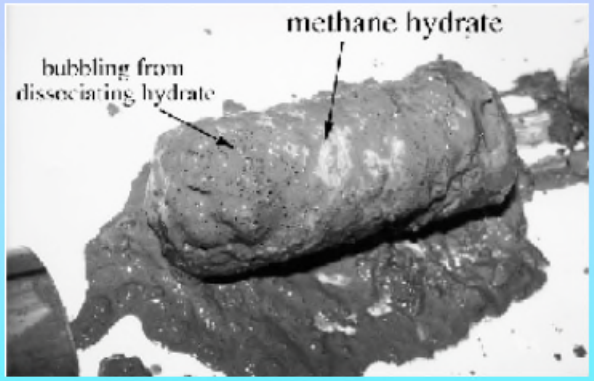
– preventing Gas Hydrate formation accounts for
  - 10-15% of the production costs
  - $1 Million per day for Methanol alone



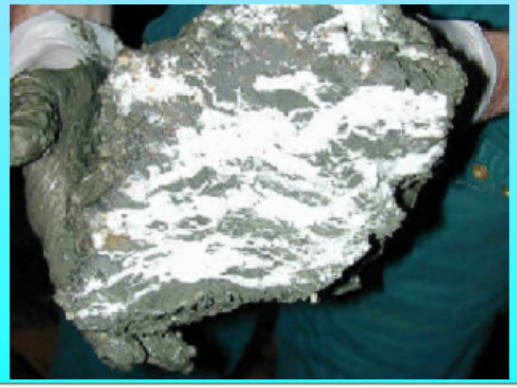
www.spe.org/cda/images/ hydrate.jpg

# Examples of Natural Gas Hydrates

Blake Ridge

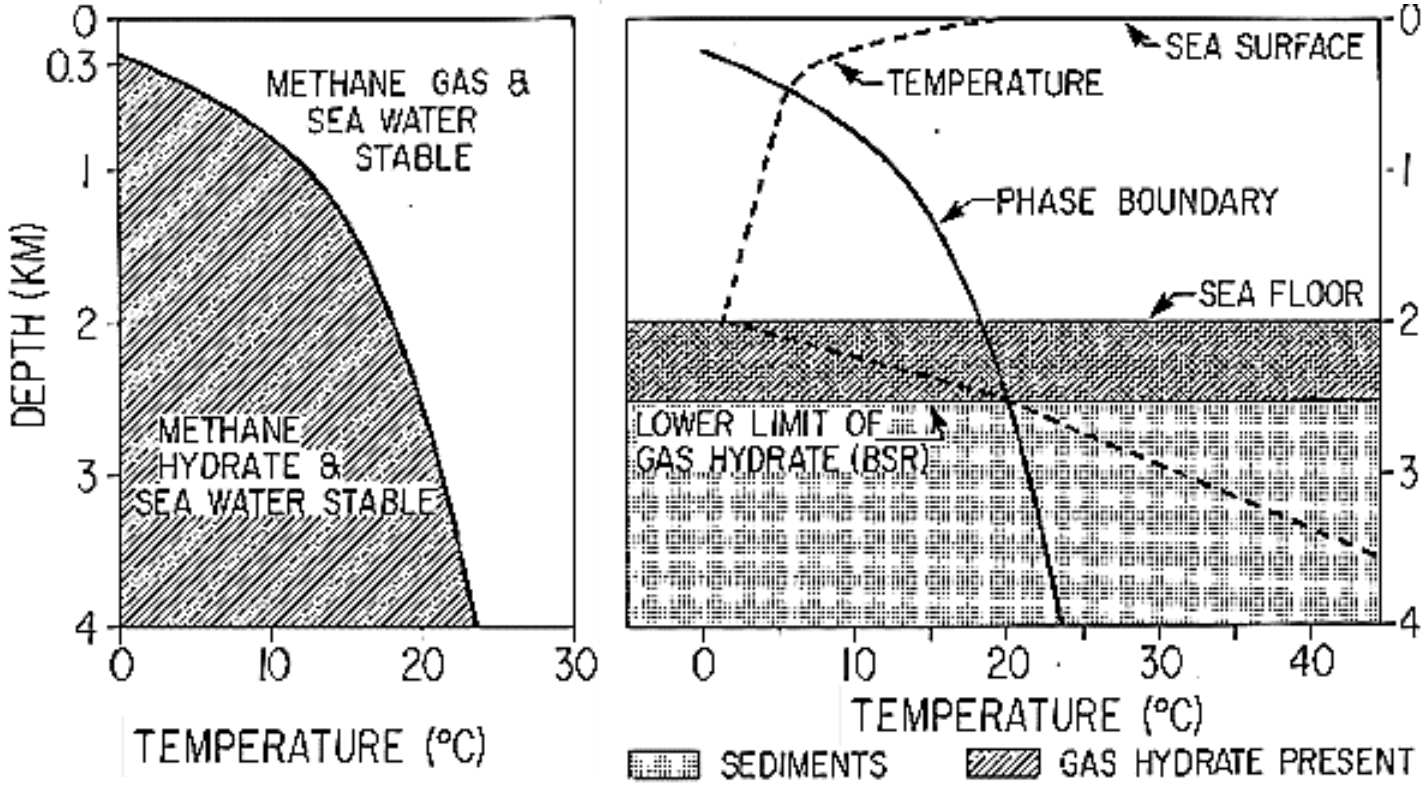



Hydrate Ridge



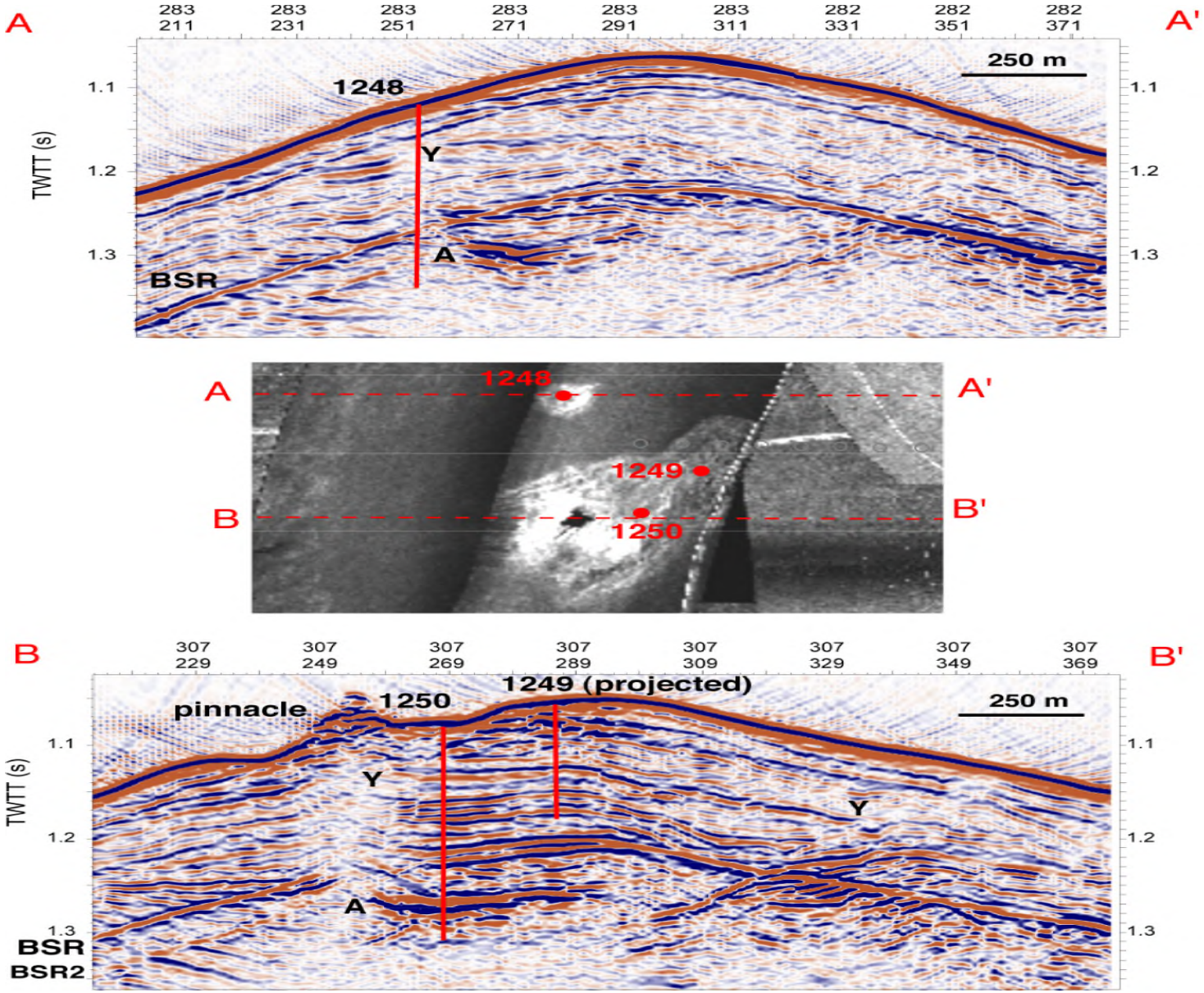
# Where Do Hydrates Form?

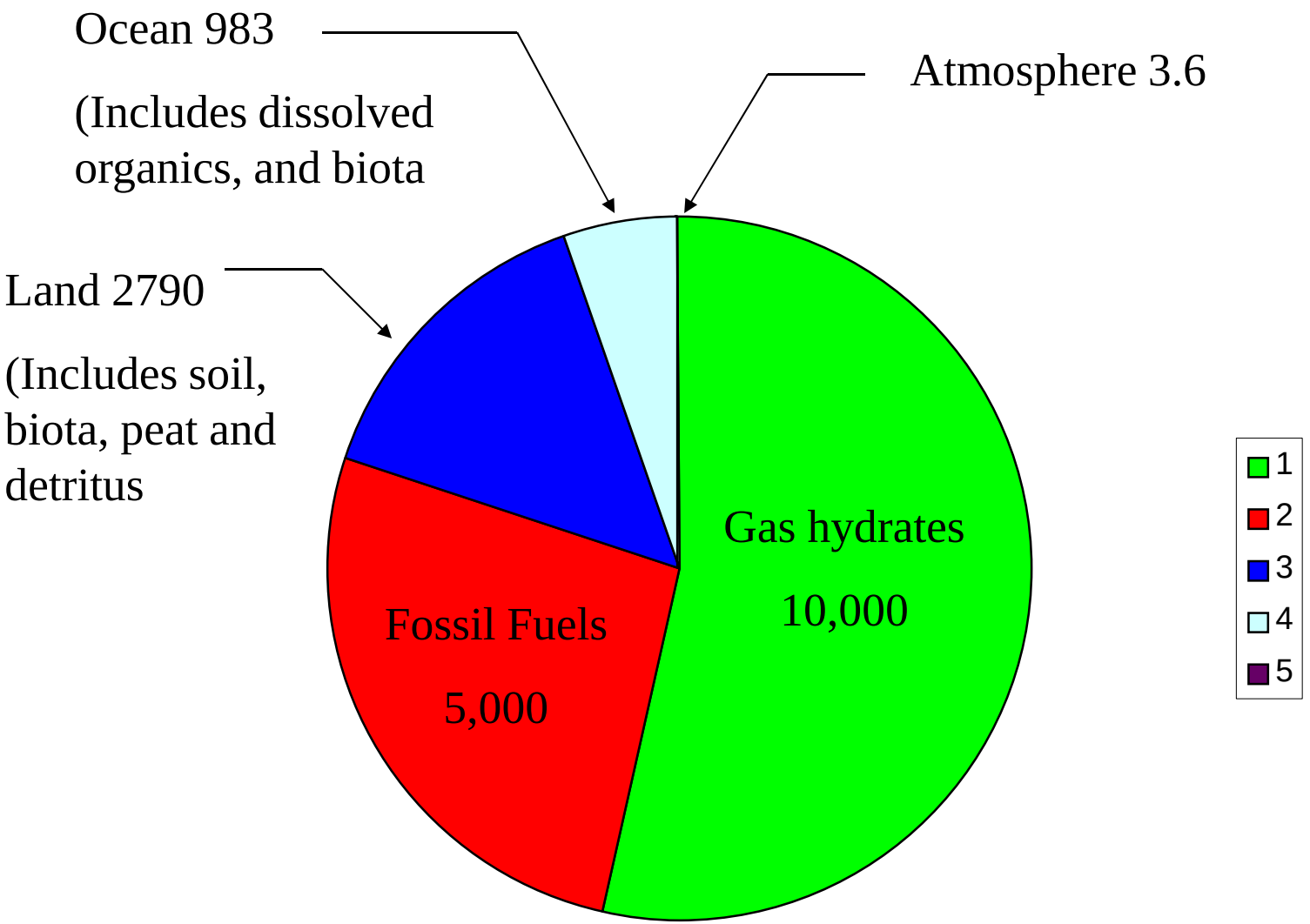
- In sediments below the ocean floor




http://marine.usgs.gov/fact-sheets/gas-hydrates/title.html

# Geologic Settings

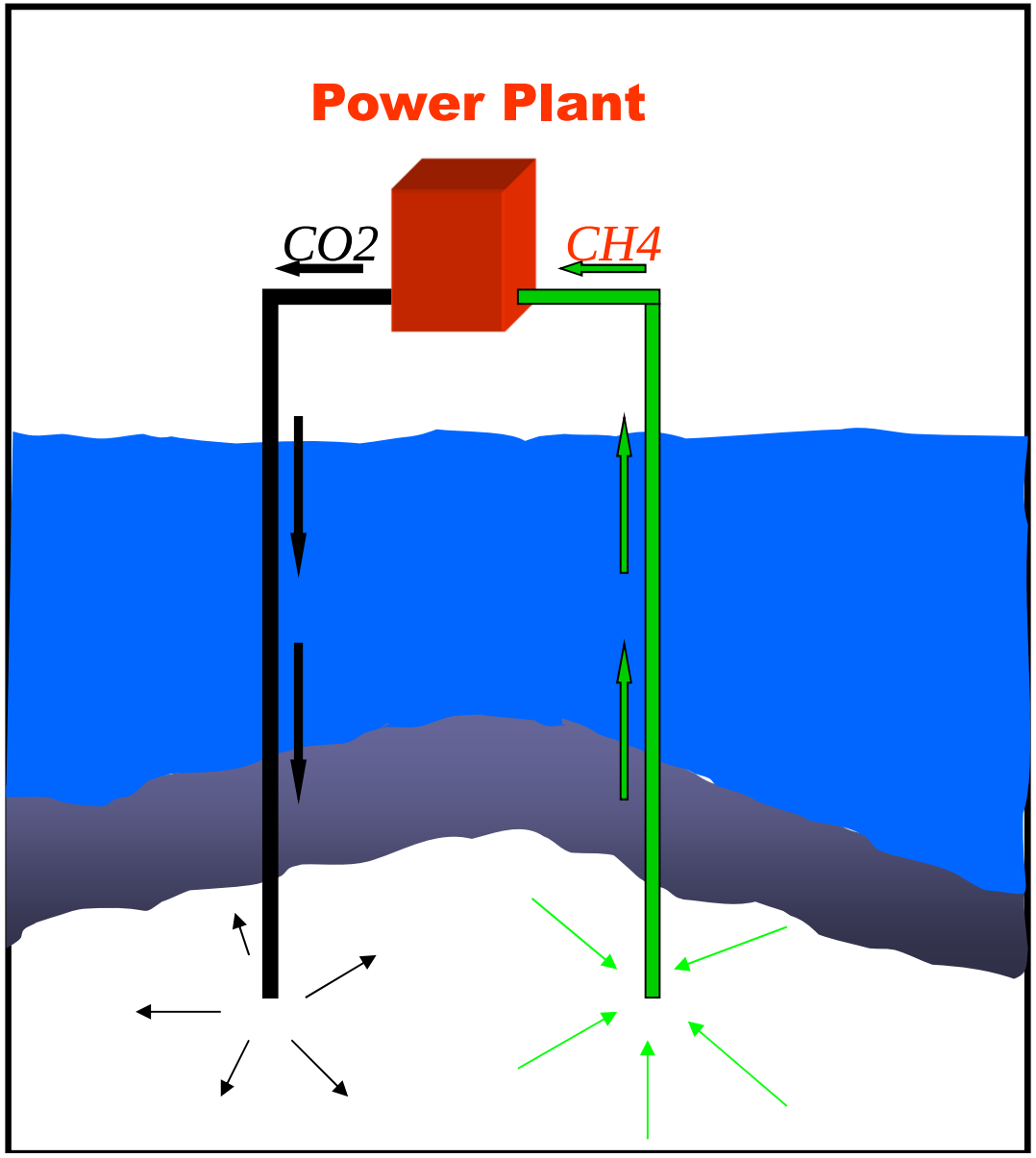





Distribution of organic carbon in Earth reservoirs (excluding dispersed carbon in rocks and sediments). Numbers in gigatons ($10^{15}$ tons) of carbon

Data from USGS

# *CO2 Displaces Methane*




Sketch of a Proposed Method to Sequester CO2 while Producing Methane and Possibly Electricity.

# Backup Slides

# An integrated approach

- Offshore oil and gas exploration production is part of an overall system:
  - E& P
  - Transportation
  - Storage
  - Refining

# Challenges and responses: transportation, storage and refining

**Transportation**

- Double hulled tankers
- Movement to zinc based paints

**Storage**

- Segregation of water and ballasts of
- No discharge of ballast waters
- Minimize use of water tank cleaning

**Refining**

- Reduction of sulfur content in oil
- Use of heat exchangers to preheat feedstock in reformulation process
- floating roof tanks to control benzene