

I 8. Unconventional Natural Gas

II. Issues

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Issues associated with unconventional gas development

- Water consumption
- Wastewater disposal
- Potential groundwater pollution
- Habitat fragmentation
- Potential surface water pollution
- Air pollution
- Health issues

Water consumption

- Each well requires 4-6 million gallons of water
- Generally taken from regional waterbodies
- In eastern PA, regulated by SRBC
 - Give permits for all withdrawals
 - Deny during drought conditions
- No similar agency for western PA
- Proposal to use abandoned mine drainage

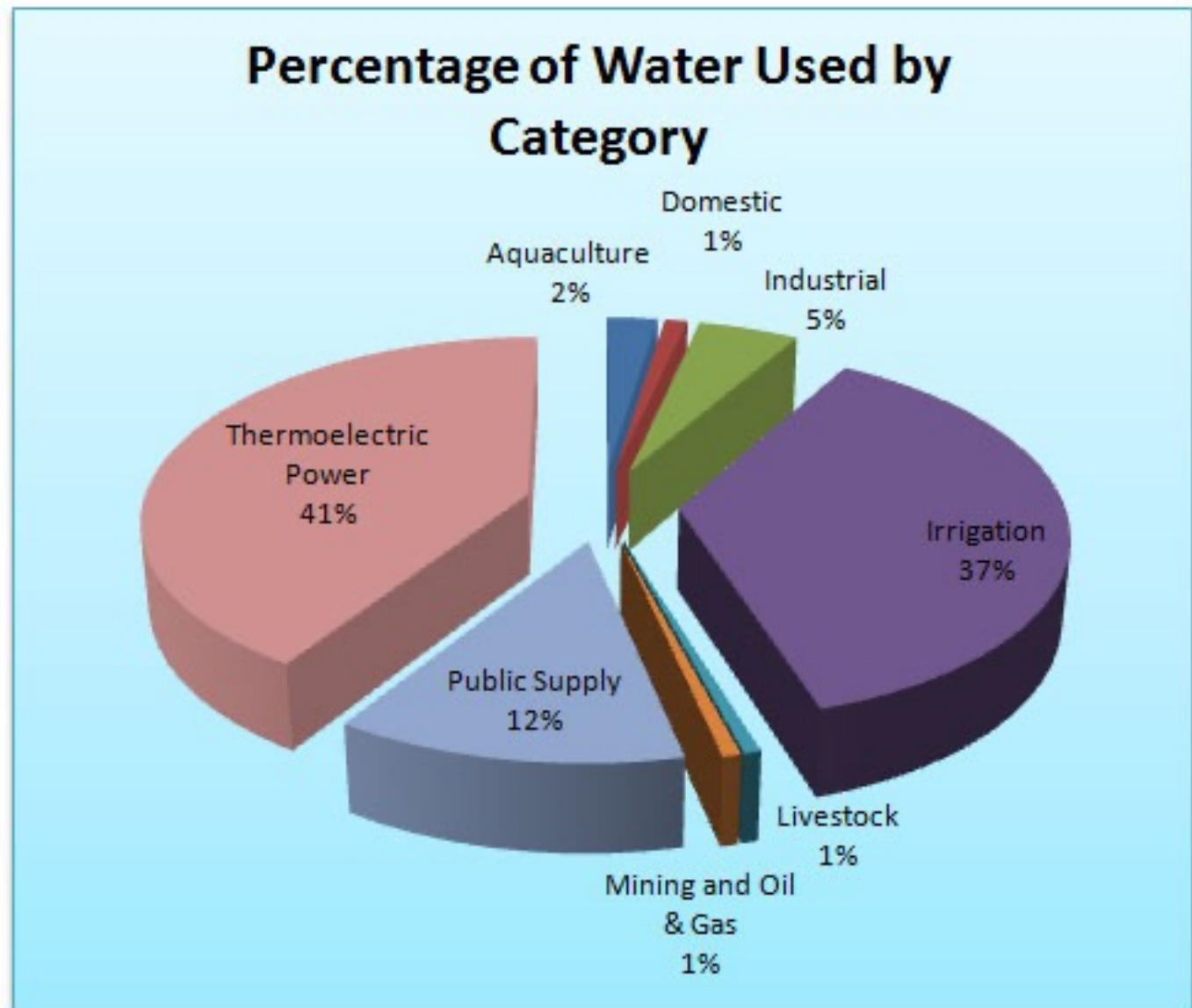


<http://alleghenydefenseproject.files.wordpress.com>



<http://ecowatch.com>

Water use in relation to other activities



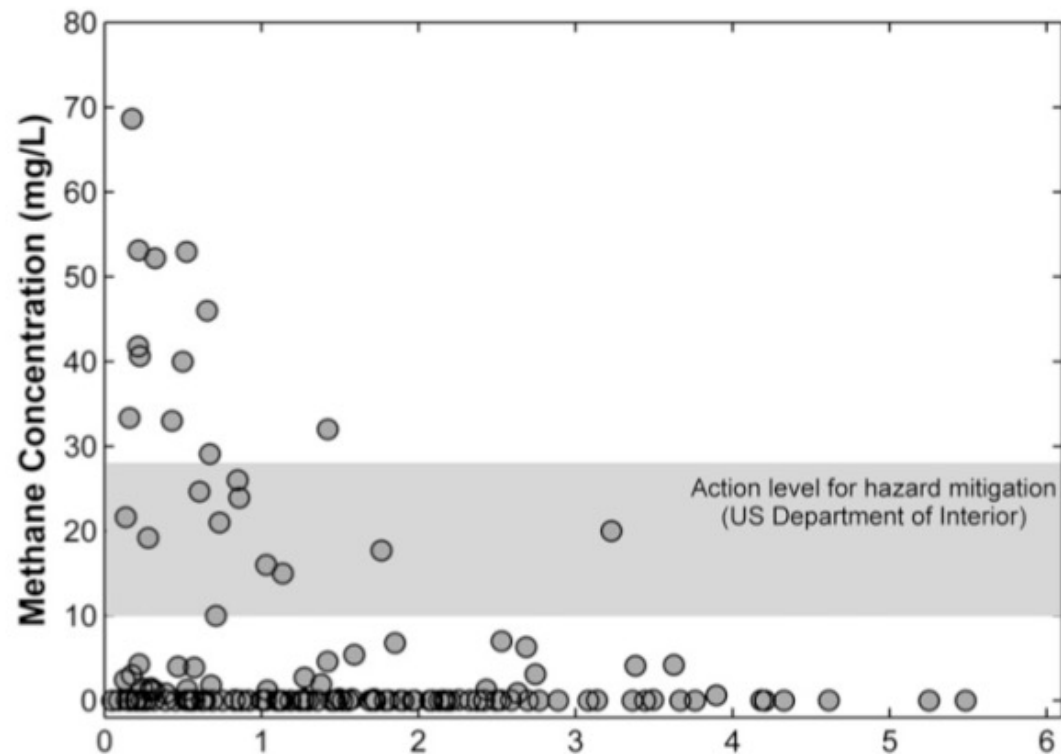
Wastewater disposal

- Approx. 20-80% of water injected returns as flowback and produced water
- High levels of salinity, radioactivity
- Stored in onsite holding tanks
- Once treated in municipal treatment facilities
- Now specialized treatment
 - Clean water returned to drillers
 - Brine trucked to disposal site



Groundwater pollution

- Drilling fluid contains toxic substances
- Flowback and produced water contains salts, radioactivity and methane.
- Studies indicate methane leakage
- Affects well water



Osborne et al (2011)

Habitat fragmentation



Potential surface water pollution

- Spills from flowback
- Holding pond accidents
- Release of wastewater
- Waste water shipping accidents
- Poor E&S control measures



<http://cen.acs.org/>



<http://www.gcbl.org>

Air pollution

- Fugitive methane
- Ozone
- Particulate matter
- Diesel exhaust
 - Carbon monoxide
 - Nitrous oxide
 - Sulfur dioxide
- BTEX



Health issues

- Some HF chemicals carcinogenic
- Anecdotal reports suggested links to autism, respiratory, cardiovascular, neurologic problems, loss of taste and smell
- Recent studies show increased rates of lymphoma, asthma, low birth weights



<http://news.nationalgeographic.com>

Quality of life

- Industrialization of rural landscape
- Displacement of families



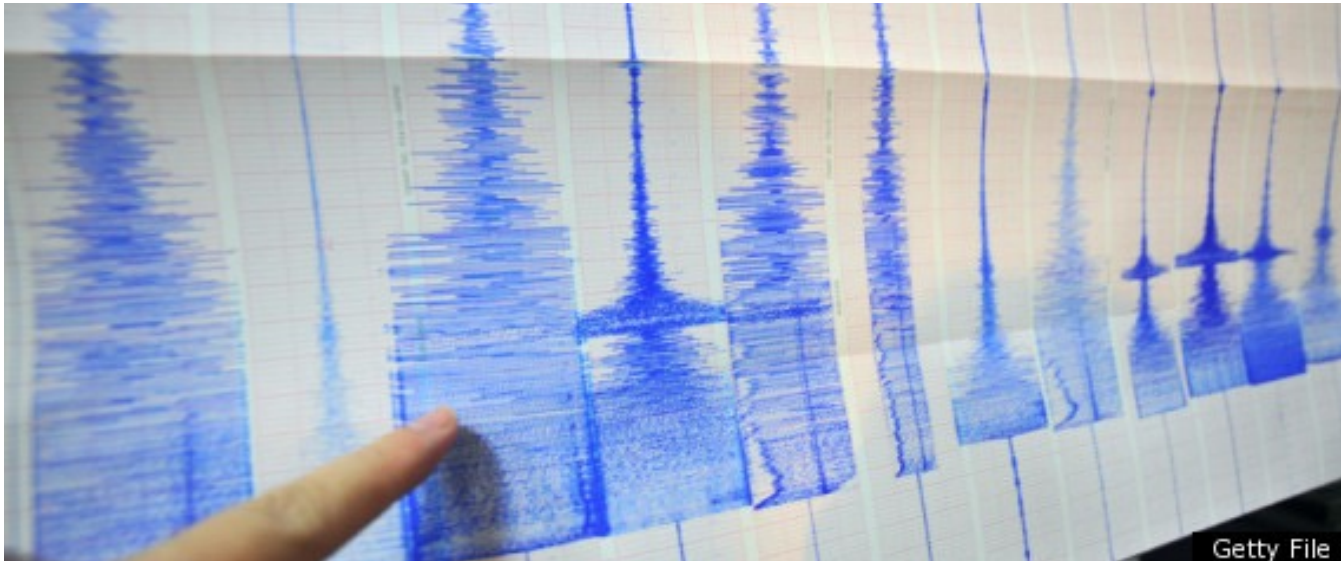
<http://money.cnn.com/>



<http://www.lowerusquehannariverkeeper.org/>

Earthquakes

- Injection of wastewater into boreholes may trigger earthquakes
- Some concern that HD and HF may cumulatively cause seismic activity



Longevity of wells a question

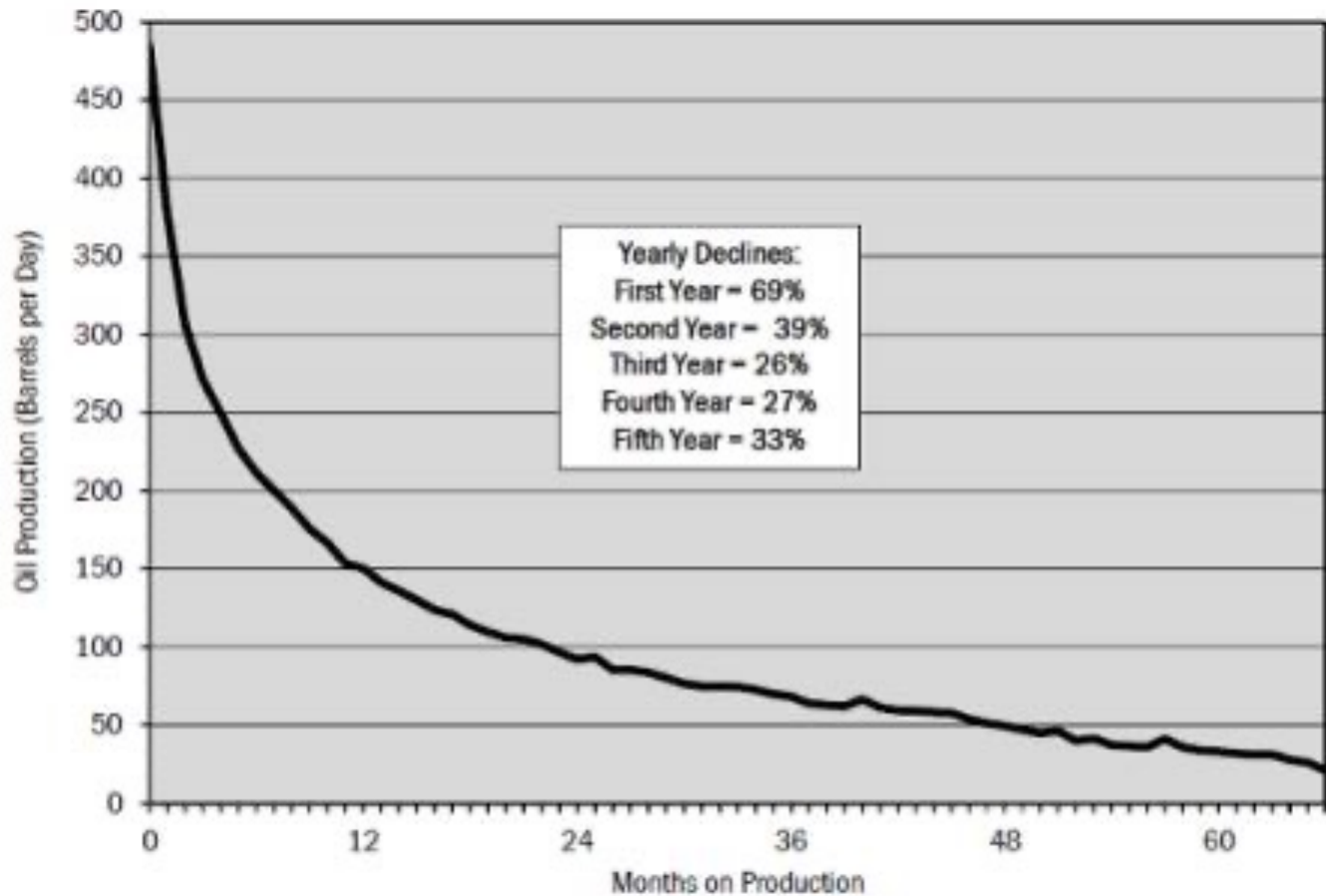


Figure 63. Type decline curve for Bakken tight oil wells¹²⁹.

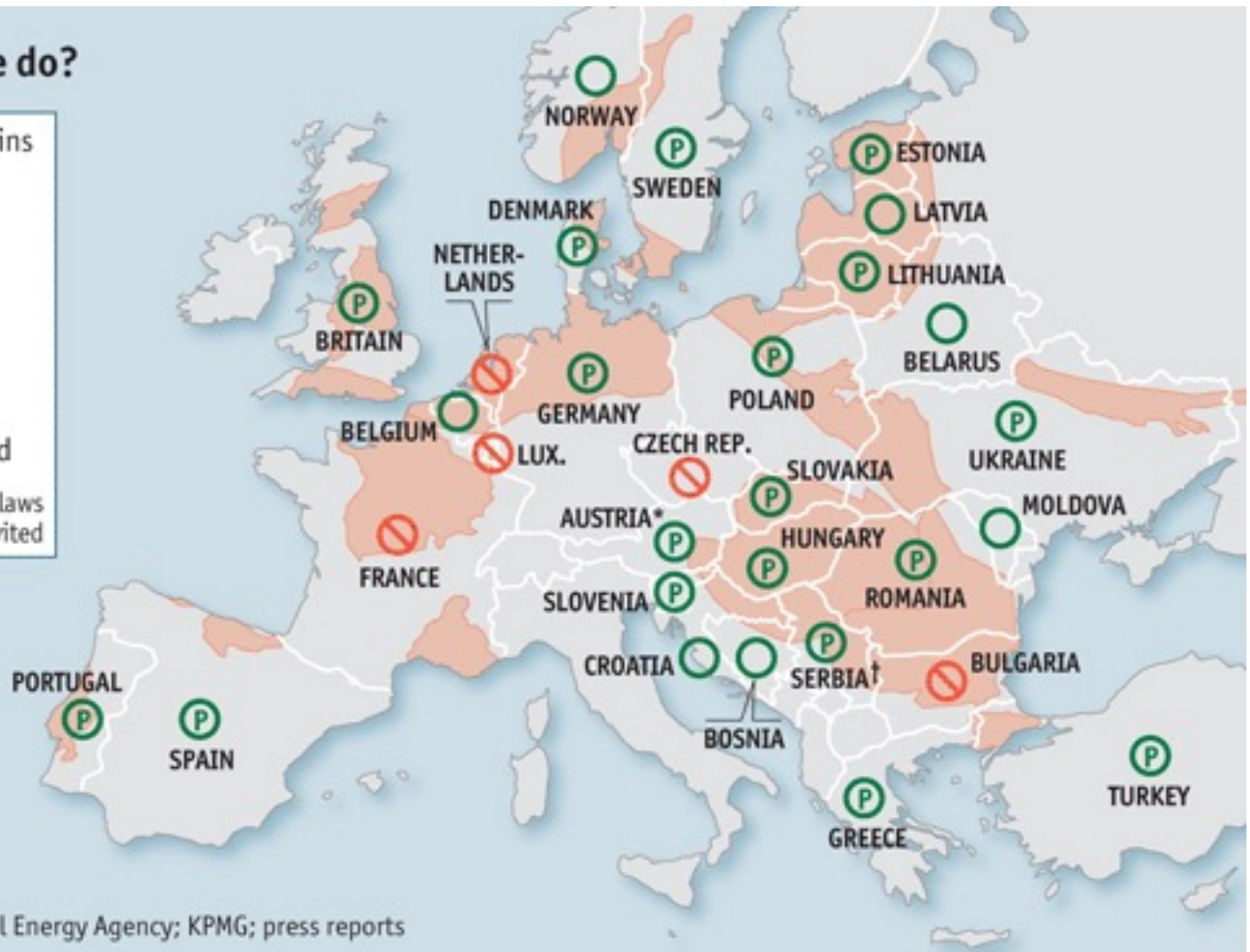
Based on data from the most recent 66 months of this play's oil production.

Shale gas moratoria - US

- In place
 - New York State
 - New Jersey
 - Delaware basin
 - Mora County, NM
- Proposed
 - Pennsylvania
 - Colorado

European moratoria

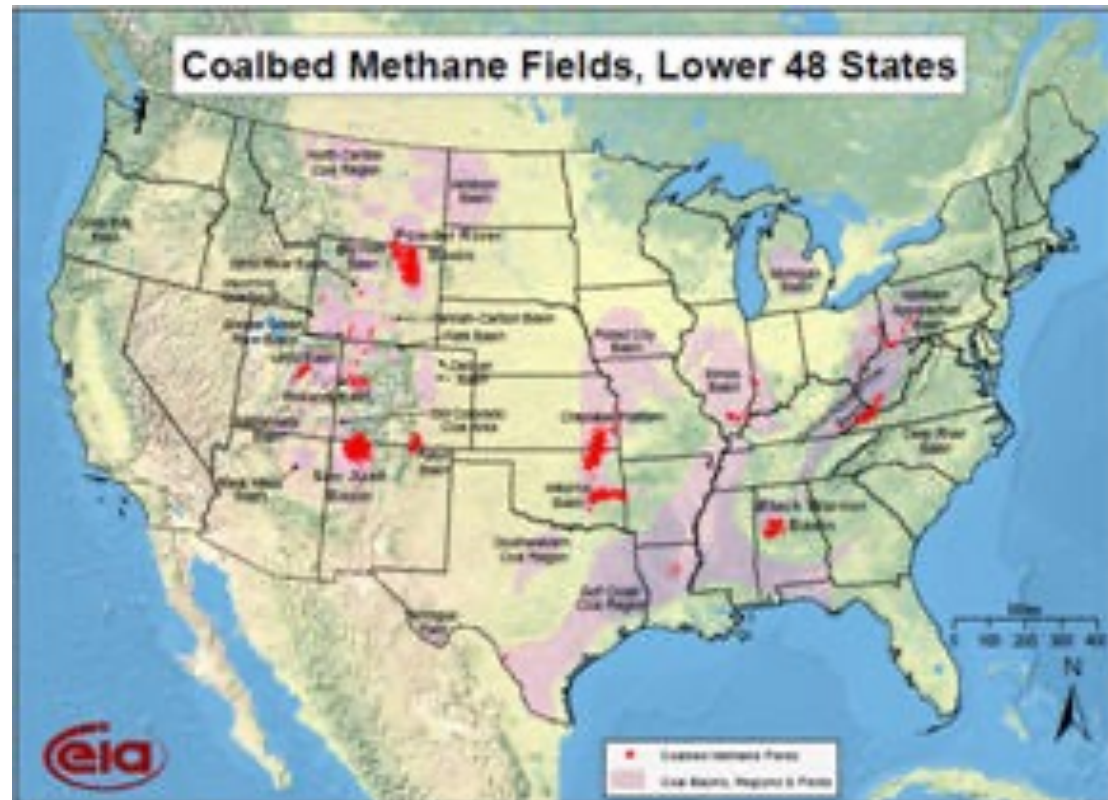
What shale we do?



Sources: International Energy Agency; KPMG; press reports

Coalbed methane

- Associated with coal seams
- Once a nuisance and vented
- Now efforts to collect
- May represent 8% of NG supplies

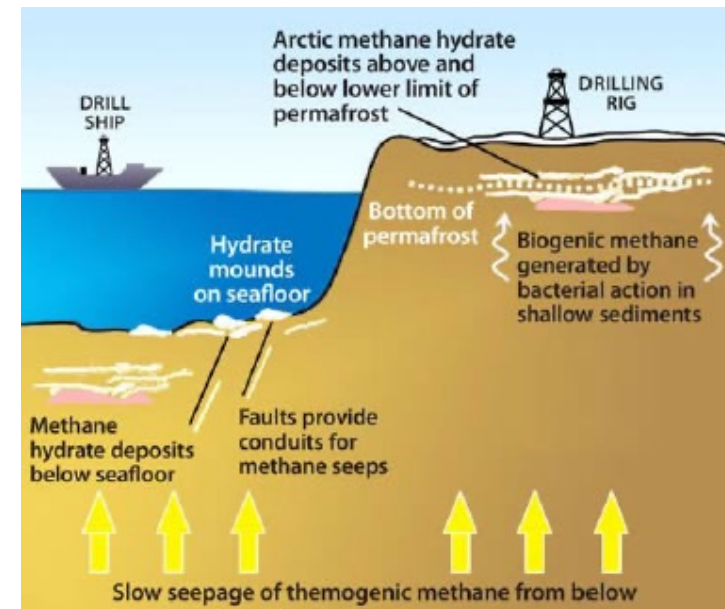
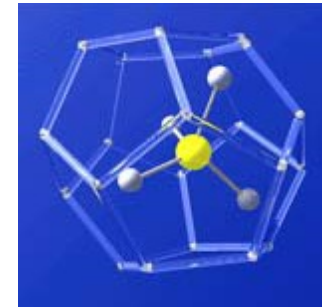


Geopressurized methane

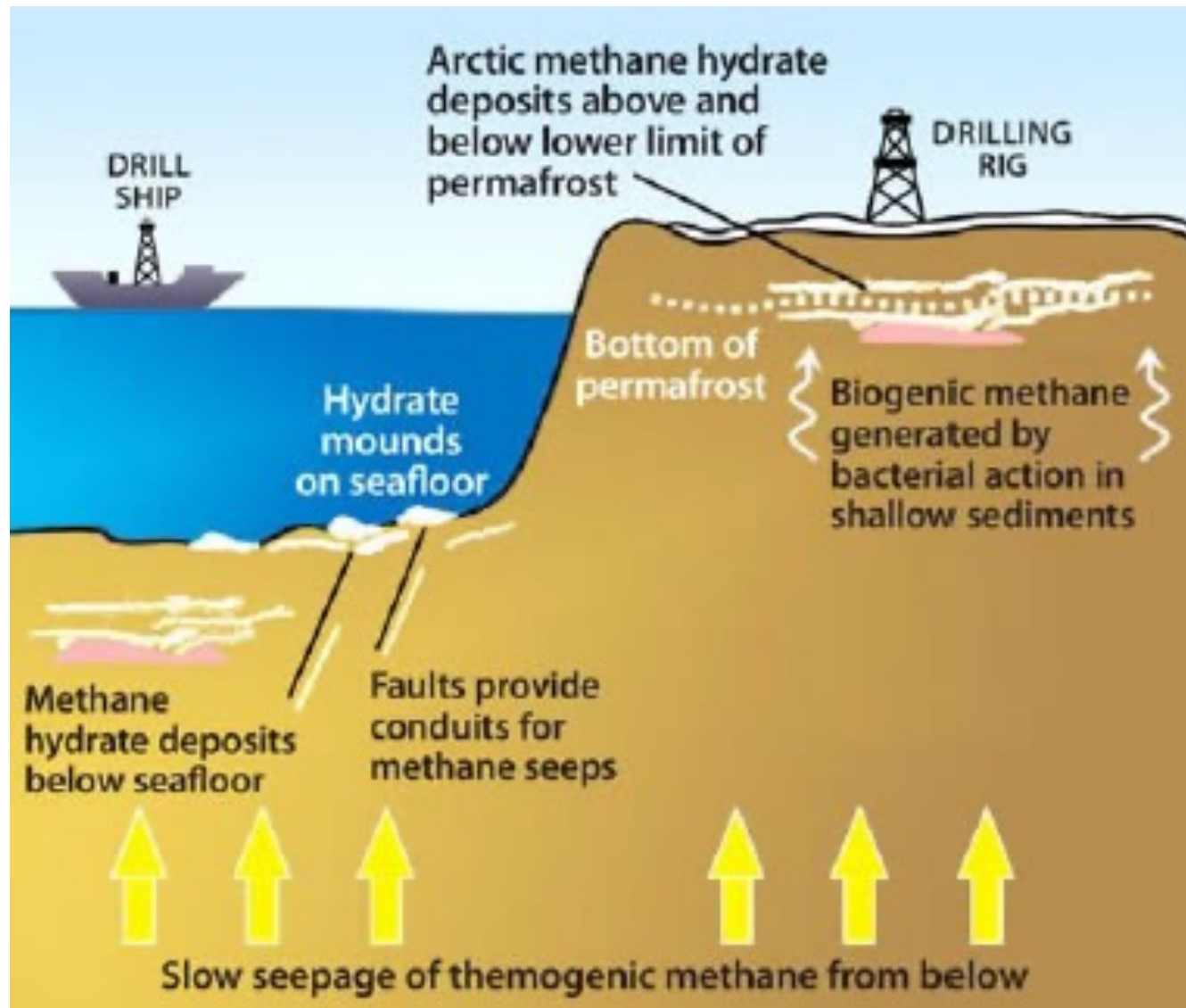
- Methane in porous rock overtopped by clay layer
- At depth of 10,000-25,000'
- Thus under tremendous pressure
- May hold 5,000 – 49,000 TCF of methane
 - Compare with 12,000-20,000 TCF of known reserves
- Not possible to extract with current technology

Methane hydrates

- Molecules of methane surrounded by “cage” of frozen water
- Found in seafloor and Arctic soils
- May contain 7000 – 73,000 Tcf of methane
 - More than all coal, oil and natural gas combined
- Research in its infancy
- Utilization may impact global carbon cycle



Global distribution of methane hydrates



Conclusions

- Unconventional gas has changed the energy picture in the US and worldwide
 - Due to improvements in extraction technology
- Supporters believe that UNG can supply energy needs for decades, if not longer
 - In US, can relieve need to import energy
- Detractors point to many risks
 - More science critically needed
 - What to do in the meantime