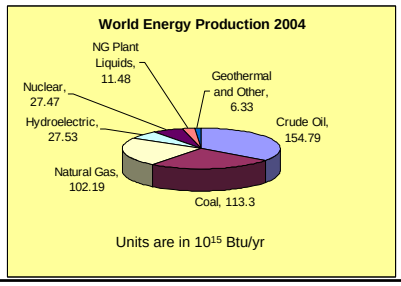
Energy Balances on Complex Fuels

- Why worry about complex fuels?
  - Crude oil, coal, wood, biomass, etc.



Hypothetical Coal Molecule

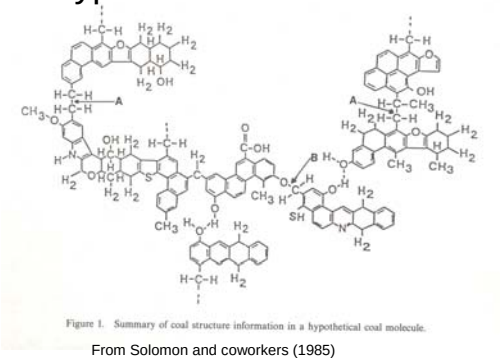


Figure 1. Summary of coal structure information in a hypothetical coal molecule.

From Solomon and coworkers (1985)

Reacting Coal Molecule

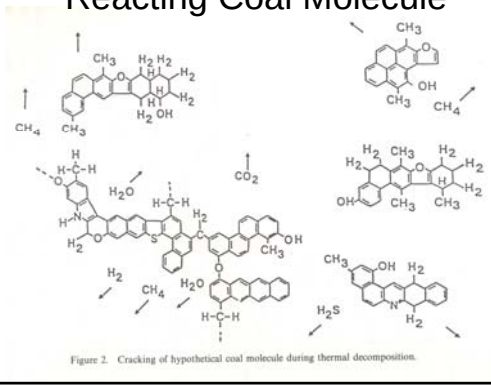
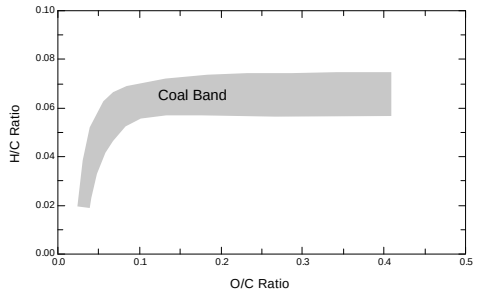


Figure 2. Cracking of hypothetical coal molecule during thermal decomposition.

Fuel Characterization

Where are….graphite…..oil…..peat…..biomass?



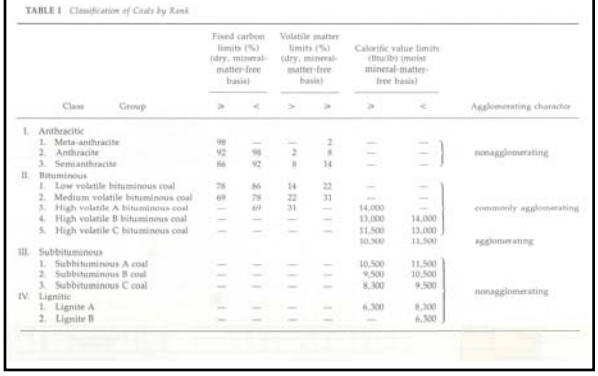


TABLE I Classification of Coals by Rank

Class	Group	Fixed carbon limits (%) (dry, mineral-matter-free basis) ≥	Fixed carbon limits (%) (dry, mineral-matter-free basis) <	Volatile matter limits (%) (dry, mineral-matter-free basis) >	Volatile matter limits (%) (dry, mineral-matter-free basis) ≥	Calorific value limits (Btu/lb) (moist mineral-matter-free basis) ≥	Calorific value limits (Btu/lb) (moist mineral-matter-free basis) <	Agglomerating character
I. Anthracitic								
	1. Meta-anthracite	98	—	—	2	—	—	nonagglomerating
	2. Anthracite	92	98	2	8	—	—	
	3. Semianthracite	86	92	8	14	—	—	
II. Bituminous								
	1. Low volatile bituminous coal	78	86	14	22	—	—	commonly agglomerating
	2. Medium volatile bituminous coal	69	78	22	31	—	—	
	3. High volatile A bituminous coal	—	69	31	—	14,000	—	
	4. High volatile B bituminous coal	—	—	—	—	13,000	14,000	agglomerating
	5. High volatile C bituminous coal	—	—	—	—	11,500	13,000	
						10,500	11,500	
III. Subbituminous								
	1. Subbituminous A coal	—	—	—	—	10,500	11,500	nonagglomerating
	2. Subbituminous B coal	—	—	—	—	9,500	10,500	
	3. Subbituminous C coal	—	—	—	—	8,300	9,500	
IV. Lignitic								
	1. Lignite A	—	—	—	—	6,300	8,300	
	2. Lignite B	—	—	—	—	—	6,300	

Terminology

- High heating value
  - Calculated using H_2O (liq) as product
- Low heating value
  - Calculated using H_2O (gas) as product
- Heating value = $-\Delta H_c$
  - i.e., heating value is positive, but heat of reaction is negative