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QUESTIONS FOR ENERGY MODELERS
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I. ENERGY AS A COMMODITY: SPECIAL CHARACTERISTICS

II. THE PRODUCTIVITY OF ENERGY

III. SUPPLY OF ENERGY: EXHAUSTIBILITY, EXPLORATION, AND EXTRACTION

IV. SUPPLY OF ENERGY; FLOW SOURCES

V. SUPPLY OF ENERGY: EXTERNALITIES AND INTERNALIZATION

VI. THE LONG AND UNCERTAIN FUTURE

I. ENERGY AS A COMMODITY: SPECIAL CHARACTERISTICS

- A. Ubiquity of use

- B. Large degree of interconvertibility and substitutability (Conservation of energy: Rumford, Oersted, Mayer, Joule, Clerk Maxwell in theory): water or wind or human or animal power to grinding grain; steam engine (coal to steam), dynamo (coal to steam to electricity), light bulb (electricity to light), etc., electric motor. Therefore, total energy matters

- C. Fossil fuels: Exhaustibility; long time horizon, therefore uncertainty

- D. Fossil fuels (carbon, sulphur, ozone): Externalities
- E. Energy as a free (nonrival) good: The Sun. Agriculture, warmth

II. **THE PRODUCTIVITY OF ENERGY**

- The share of energy = ? output elasticity: say .05
- Implications under Cobb-Douglas: Halving energy intensity reduces output by 2.5%
- Local implications (general production functions: Reducing energy intensity by 5% reduces output by .25%.
- Alternative hypotheses: Low elasticity of substitution

- The solar alternative: Suppose “oil peak” and disuse of coal to avoid climate change. Shift to solar at say 3 times cost. Amounts to reduction of output by 10% (with zero elasticity of substitution). Takes place over considerable period of time, so relatively small effect on rate of growth. Right?

III. SUPPLY OF ENERGY: EXHAUSTIBILITY, EXPLORATION, AND EXTRACTION

- Current major sources of energy exhaustible
- Hotelling model
- Barnett-Chandler: the history of resource prices
- Extraction costs and technological progress
- Exploration: A form of production. Does it change the Hotelling story?

IV. **SUPPLY OF ENERGY; FLOW SOURCES**

- A World of renewable energy: is it feasible? Wind, sun, hydropower
- Electricity: Peak demands (heating and cooling)?
- Transportation (?)

V. SUPPLY OF ENERGY: EXTERNALITIES AND INTERNALIZATION

- A. Local health effects from combustion
- B. Global effects (climate change)
- C. Local effects from mining (oil spills)
- D. Wastes (nuclear)

VI. THE LONG AND UNCERTAIN FUTURE

- Assumption: Criterion is expected sum of (possibly) discounted utilities
- The role of value judgments: Discount rates not governed by market
- The necessity of discounting utilities
- Boundedness of the utility function: the power function is not admissible

- What are the uncertainties? Parameters of climate change relation, costs of climate change, technological progress in the future, the possibilities of R&D, learning by doing, accumulation of additional data based on new kinds of observations (hence Bayesian updating)…