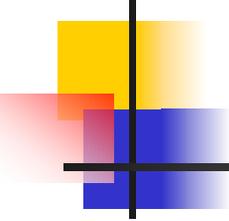


Topics in Fusion Socio-Economics

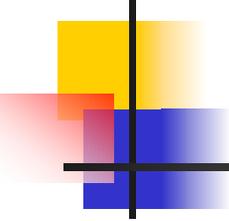
Ronald L. Miller
US/Japan Workshop
April 6-7, 2002





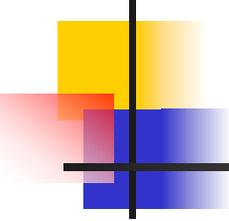
Scientific Context

- Multi-disciplinary Industrial Ecology
- Formal Systems Engineering begins with “requirements specification”



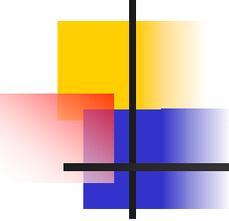
Fission as Precursor

- Ref. S. Levy, *et al.*, "Technology Goals For Generation IV Nuclear Energy Systems," *Trans. ANS*, 85, (Nov. 2001) 58.
- <http://gen-iv.ne.doe.gov/pdf/GENIVGoalsGRNS.pdf>



Long-Term Planning

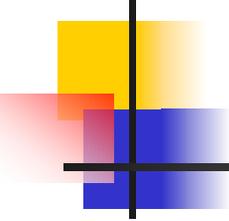
- Naturally a governmental function
- *e.g.*, energy/climate interaction
- Incorporates considerations of
intergenerational equity
sustainability
benefit/cost/risk analysis
- ref. C. Starr, "The Ultimate Uncertainty—
Intergenerational Planning," *Risk Analysis* 20,
6 (2000) 793.



ARIES Systems Code (ASC)

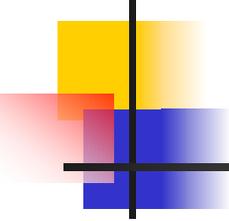
- Contributes to fusion design studies
- Integrates physics/engineering/costing
- Update in progress
- Benchmarking activity is timely

IEA Task 7



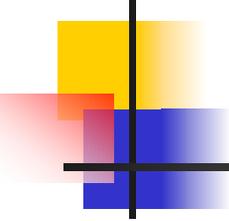
US Sources of Cost Projections

- Nuclear Energy Cost Data Base (NECDB) → J. Delene → ASC
- EPRI Technical Assessment Guide (TAG)
- USDOE Energy Information Administration (EIA)
 - Annual Energy Outlook, AEO20xx (20 year rolling horizon)



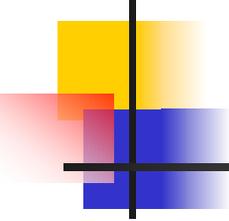
International Cost Comparison

- Inhibited by differences in assumptions
- Ref. NEA/IEA, “Projected Costs of Generating Electricity” (Update 1998).
- Ref. IAEA, “Economic Evaluations of Bids for Nuclear Power Plants 1999 Edition,” Technical Report Series No. 396 (2000).



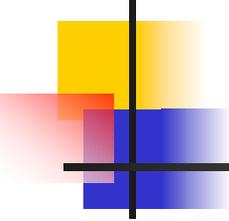
Cost Comparison

- Reconcile different Cost Breakdown Structures
- Compare line by line as needed
- Direct + Indirect --> Internal Cost
- Financial rules yield levelized, life-cycle COE projection
- Consider External Cost/Benefit



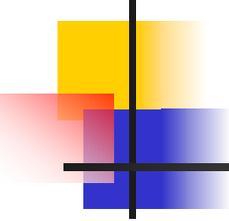
Financial Underpinnings

- Traditional (pre-deregulation) financing
- Government as 'partner'
- Merchant plant
- Government as credit-worthy customer to reduce risk (proposed for fission Gen-IV) of capital-intensive projects



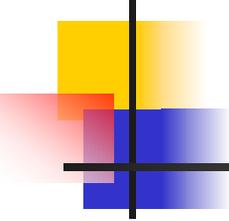
Consistent Cost Projections Enable Energy Modeling

- Energy scenarios ask “What if...?”
- Project future energy-source mix
- Project market penetration of new technologies, *e.g.*, fusion
- Decision-making under uncertainty
- Portfolio analysis



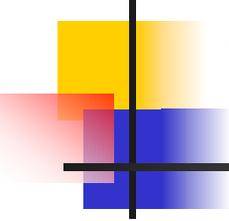
IEA Task 7

- Ref. I. Cook, *et al.*, “Prospects for Economic Fusion Electricity,” ISFNT6
- Discussion of Task 7 later



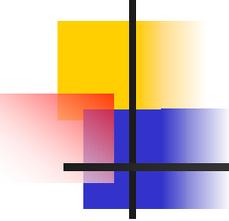
Major Long-Term Energy Planning Uncertainties

- Technological
- Economic
- Environmental health
- Social/public acceptance



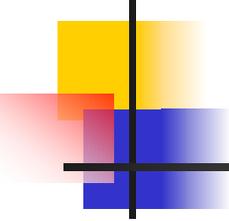
Technological Uncertainties

- Unexpected go-no-go technical issues
- R&D scope greatly underestimated
- Unexpected siting requirements
- Low-level effluent public risk perception
- Unsettled effluent management criteria
- Major earthquake functional survival
- Sabotage/terrorist attack resistance
- National security implications



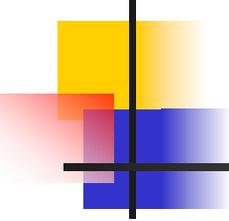
Economic Uncertainties

- Cost of money
- Much delayed financing
- Delay of critical support technology
- Imposition of CO₂ sequestration
- Cooling restrictions: air *vs* water
- Unexpected regulatory requirements
- Unexpected critical resource restrictions
- Unexpected alternative competition



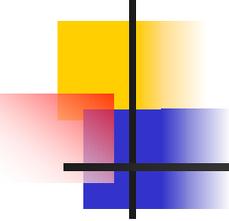
Environmental Health Uncertainties

- Unexpected air/water/land pollution limitations
- Uncertain global climate-related restrictions
- Vague land and sea use restrictions
- Public radiation exposure perceptions
- Unexpected ecological concerns



Social/Public Acceptance Uncertainties

- Unexpected changes in social value priorities
- Unexpected changes in living patterns such as rapid increase in longevity
- Unexpected changes in demographics
- Unexpected public transportation shifts
- Major shifts in city planning
- Public phobias/fear of technology
- Weapons proliferation concerns
- Energy-related national security issues



Summary

- Much interesting work to be done, pending much tedious work in progress.
- This activity contributes to “The Case For Fusion” such that care must be taken to avoid confusion between analysis and advocacy.