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Comments on Future Directions for Power

By

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QUESTIONS

- *General Questions*
  - What are the future opportunities for commercial nuclear power?
  - In what ways can the proliferation resistance of commercial nuclear energy activities be strengthened?
- *Specific Questions*
  - What kind of nuclear power is likely to be deployed in the future and when? LWR, HTGR, nuclear fuel cycle, fast fission, fusion, thermo-electric conversion?
  - What are the prospects for civilian applications of fission energy besides electricity generation?

KEY EXTERNAL FACTORS

- Liberalization of electricity market (especially in Asia)
  - Demand growth(Asia is fastest), fossil fuel prices, investment criteria
- Climate change constraints (and institutional arrangements) on energy choice
  - Timing and scope of regulation (in particular on developing countries)
- Technology innovation of distributed energy sources
  - Fuel cell, Micro Gas Turbine, Gas-Engine Co-generator, etc.
- Public perception of nuclear (technological/political) risk
  - Accident, proliferation and terrorism, , radioactive waste management
- Long term resource concern
  - Depletion of fossil fuel, uranium, environmental impact

PROSPECTS (1)

- Existing LWRs can be competitive for another 20-30 years (up to 2030 or so)
- Diversified demand for new reactor designs (under liberalized market)
  - Small, modular type design preferred for low-growth, small grid market
  - Large reactor still preferred for high-growth or large grid market
  - Higher profitability (higher capacity factor/efficiency, low uncertainty) is required
  - "*Conservative bias* (Familiarity of existing technologies [i.e. human resource, regulatory and social infrastructure])" can be a very significant barrier to introduce innovative technologies for existing users (probably also true for new users with less degree)

PROSPECTS (2)

- Fuel cycle requirements
  - Resource constraints are only important after 2050 (low priority on recycling)
  - Shorter refueling period, higher burn-up, higher conversion ratio
  - Proliferation resistant (less generation, less separation, less transportation of weapons-usable material)
- Public perception requirements
  - Enhanced safety (i.e. less trouble, not necessarily inherent safety)
  - Better waste management (time horizon, controllability of risk)
  - These can and should be considered independently from advanced designs
- Non-Power applications, nuclear fusions etc.
  - Unlikely to be competitive with fossil fuel for a foreseeable future (up to 2050)

KEY STRATEGIES

- Innovative designs need to accommodate different market conditions
  - Important to keep dialogue with potential users and other stakeholders
  - Important to keep various technological options including recycling and breeders
- Demonstration needed to overcome “conservative bias” of utility markets
- Institutional assurance is much more important for proliferation resistance and public perception improvements
  - Even small trouble incidents could erode entire credibility of nuclear power industry and regulatory system
  - Uncertainty in back-end of fuel cycle (waste management and decommissioning) should be minimized
  - It is critically important to provide better transparency and “objective” scientific information on various technological risks (including proliferation risk)