Integrating Socio-economics Issues with Fusion Power Plant Studies

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Socio-economic (Public Acceptance) Issues

- Cost of product
  - price deregulation trends
  - retail marketing of electricity (source attribution)
- Public/Worker safety
  - ongoing regulatory concern
- Environmental accounting[◇]
  - external $\rightarrow$ internalized costs
    - - clean air, water, $etc.$
    - - climate change
    - - waste disposal/recycling
    - - intergenerational equity/sustainability
- Plant siting
- Are energy decisions rational (and subject to modelling)?
  - probably yes[†]
  - difficult to say[‡]
- How should power-plant studies be conducted?

[◇] National Research Council, *Nature's Numbers-Expanding the National Economic Accounts to Include the Environment*, (National Academy Press, 1999).

[†] IEA, "Mapping the Energy Future–Energy Modelling and Climate Change Policy," (1998).

[‡] P. Ormerod, *Butterfly Economics*, (Pantheon Books, 1998).

Fission Scenario*

- Generation 1
  - late 1950s: reactors that first demonstrated the possibilities of commercial production of electricity
- Generation 2
  - 1990s: reactors that are now succcessfully generation electricity around the world
- Generation 3
  - 1990s: new advanced and evolutionary LWRs, target bypassed (in USA), but still attractive (in Asia, for example)
- Generation 4
  - soon(?): reactors that address the issues of economics, proliferation, safety, and waste

* *cf.* Bill Magwood (USDOE), "Nuclear Power in the 21st Century," [report of ANS Winter Meeting (11/99)], *Nuclear News*, 43, 1 (Jan. 2000).

Fusion Design Enhancement*

Improving fusion power-plant performance results from a combination of factors:

- Exploit better/improving plasma physics
- Exploit better/improving non-nuclear technologies, including high-temperature superconducting coils, efficient IFE drivers, high-heat-flux components, and efficient power conversion cycles.
- Improvement by design choice, use of economy of scale with larger plants (up to some point); minimization of recirculating power; reliability, availability, and maintenance (RAM) improvements; and manufacturing/installation savings.
- Exploit high-performance materials with low unit cost, low radiation damage, high heat flux & power density, and low activation & after-heat.

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Summary*

- Future fusion will face vigorous competition
  - cost
  - environment and safety
  - public acceptance
- New trends and constraints
  - deregulated markets
  - new technologies
  - regional/national circumstances
- Broadened perspectives
  - industrial ecology
  - climate-change mitigation
  - sustainability
  - intergenerational equity
- The community of international fusion-power-plant designers can contribute to making fusion agile and competitive on a timely and sustainable basis.

* *cf.* R. L. Miller, ISFNT5, (Sep., 1999).