LESSONS LEARNED ABOUT SOCIETAL RESPONSES TO EMERGING TECHNOLOGIES PERCEIVED AS RISKY*

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BY WAY OF INTRODUCTION:

- **I Am Reporting on a Project That Seeks:**
  - **to consider the historical experience in the U.S. with developing new technologies associated with public concerns about risks**
  - **to consider how lessons learned might be relevant to societal implications of emerging technologies such as bioengineering for alternative energy production**
  - **all of this in the context of major commitments by DOE to advance science and technologies for bioenergy production, including potentials for genetic engineering**
- **Principal Investigators For The Project Are:**
  - **Susan Cozzens, Georgia Institute of Technology; Brian Davison, Oak Ridge National Laboratory; Eugene Rosa, Washington State University; Paul Stern, National Research Council, and Tom Wilbanks, Oak Ridge National Laboratory**

Generally, We See Around Us:

- **Breakthroughs in science and technology (S&T) that are driving societal change, seemingly at an accelerating rate**
- **Institutions that are better at producing such breakthroughs than anticipating and coping with their effects**
- **A significant challenge of establishing adaptive management practices that avoid undesirable effects, unnecessary social controversy, and a waste of R&D investments in new S&T that run into obstacles due to societal concerns**
- **One contribution to such adaptive management is to improve our foresight about possible societal concerns, so that:**
  - **R&D programs can take such concerns into account in agenda-setting**
  - **programs can incorporate public involvement in technology development discussions as soon as possible**
  - **institutions that would implement the results can begin developing socially acceptable risk management strategies in time to earn public credibility and trust**

There are At Least Two Possible Sources of Insight About Societal Concerns and Responses:

- **Induction from past experience with societal reactions to risks associated with emerging technologies**

- **Deduction from knowledge bases about relevant behavioral and social processes affecting societal decision-making in such cases**

Induction from Past Experience (I):

- **Experience with technology utilization**
  - **Nuclear energy use**
    - **While scientists tend to focus on probabilities, the public tends to focus on consequences**
    - **Consequences associated with unknown risks are viewed differently than consequences associated with evidence-based knowledge**
  - **Radioactive waste management**
    - **Dread is associated with consequences that are potentially unbounded in their effects**
    - **Public participation is often an effective way to promote public confidence in both institutions and technologies**
  - **DNA manipulation**
    - **It is easier to discuss risk issues before they become chronic and positions become hardened**
  - **Risk assessment and management more generally**
    - **Risk amplification is shaped by risk communication**

Induction from Past Experience (II):

- **Experience with emerging technologies**
  - **Nanotechnology**
  - **Biotechnology**
  - **Information science and technology**

Deduction From Knowledge of Basic Social Processes:

- **Perception, assessment, and management of societal risks**
  - **It is at least as important to get the right science as to get the science right**
- **Common-pool resource management**
  - **Adaptive risk management is more likely to be successful if it employs a mixture of institutional types and decision rules**
- **International institutions and networks**
  - **The effectiveness of policy networks depends heavily on a shared sense of need for collective thinking**
- **Science communication and utilization**
  - **Effective use of information often depends on efforts of intermediaries or "boundary organizations"**

General Insights From These Two Sources Include:

- Technology acceptance is fundamentally a social process, not a scientific process
- Societal concerns tend to focus on non-zero vs. zero risks of large-scale catastrophic unintended consequences, while S&T programs tend to focus on most likely outcomes under best practices – these very different perspectives need to be bridged
- Social impediments are less likely to arise if risk communication occurs earlier rather than later, building trust in institutions by promoting public participation

We Are Now Looking At The Case of Bioengineering for Alternative Energy Technologies, Generally Grounded in Societal Concerns about Genetic Engineering (I):

- **Most of the relevant existing literature is concerned with (a) agricultural applications of genetic science, (b) threats to human security, or (c) risks associated with the interconnectedness of all life**
- **Applications of bioengineering to alternative energy production include two alternatives:**
  - **Accelerating demonstrated technologies: e.g., uses of genetically modified organisms in biorefining**
  - **Radically transforming organisms: e.g., increasing the hydrocarbon of plants through genetic engineering**

We Are Now Looking At The Case of Bioengineering for Alternative Energy Technologies, Generally Grounded in Societal Concerns about Genetic Engineering (II):

- **Concerns about unintended consequences may include:**
  - **Possible auto-replication that could spin out of control**
  - **Possible mutation of new organisms into unintended forms**
  - **Possible unintended transfer of genes to a third species (e.g., from growing genetically-engineered crops)**
  - **Possible releases from biorefineries as their numbers increase**

If These and Other Concerns Can Be Addressed Early in the Bioengineering R&D Process:

- **It is more likely that the resulting technologies will have features sensitive to societal concerns, increasing their likelihood of acceptability**
- **It is more likely that impact-sensitive constituencies will be supportive of technology deployment and use**