PUBLIC POLICY PLANNING FOR BROAD DEPLOYMENT OF COLD FUSION FOR ENERGY PRODUCTION IN THE U.S.

Task Report 2. Technology Assessment

Revision 5

February 15, 2013

"It is difficult to say what is impossible, for the dream of yesterday is the hope of today and the reality of tomorrow" – Robert H. Goddard

Prepared by:

Megan Leseberg, Graduate Research Assistant
John Maxwell, Graduate Research Assistant
Thomas W. Grimshaw, Ph.D., Principal Investigator and Research Fellow
Center for International Energy and Environmental Policy
The University of Texas at Austin
Austin, TX 78712

Executive Summary

The introduction of technology can be viewed as throwing a rock into a body of water and the ripples which radiate outwards are the impacts to society with the strongest ripples being the structures of society which have a disturbance of the highest magnitude. Technology Assessment is one way that policymakers can predict where and how far those “ripples” will travel with the “splash” of a new technology.

Table of Contents

1 Introduction and Background

The process of Technology Assessment (TA) is a tool which can be used to anticipate and mitigate negative impacts from the introduction of new technologies. The process of a Technology Assessment is more of an art than a science, but the overall goal of discovering the higher-order effects of technology is why Technology Assessment was created. One way of describing TA is to bring together researchers and policymakers.[1] By linking these two groups of people together, there is the possibility to breach the divide which exists a wedge between progress and development in new areas of science and technology. Examining the process of conducting a TA will show the path for a way to examine the development of the technology in the LENR/CF field.

Many have described TA as a type of systems analysis which would examine the impacts of a technology on society and various other metrics. But it also more than that, as Lee & Bereano state: "…the authors do not believe that a singular approach is possible…TA is neither merely forecasting nor futures research, neither social impact analysis nor purely system analysis. It goes beyond simply identifying the impacts and their causation."[2] The field of TA has shown that is possible for the government and scientists to find a place for a dialogue to exist which can showcase the higher order impacts of the introduction of new developments in science and technology. Since there is some variability as to what should even be included in a TA, different people have opined on what should be included. Sampling different TAs can give a taste of how different committees of people have answered the question of "What will this technology do to the society it is to be introduced to?". Coates[3] gives answer for how the Committee on Science and Public Policy answered what should the TA emphasize: "…the focal points of from which the assessment should begin…[are] the technology, the environment or the individual. Beginning

[1] Rich, Robert F. "Systems of Analysis, Technology Assessment, and Bureaucratic Power." *American Behavioral Scientist*. 22. no. 3 (1979): 393-416, http://dx.doi.org/10.1177/000276427902200305.

[2] Lee, Alfred M., and Philip L. Bereano. "Developing Technology Assessment Methodology: Some Insights and Experiences." *Technological Forecasting and Social Change*. 19. no. 1 (1981): 15-31, http://dx.doi.org/10.1016/0040-1625(81)90047-0.

[3] Coates, Vary T. *Technology and Public Policy: The Process of Technology Assessment in the Federal Government Vol. I.* George Washington University. Prepared for the National Science Foundation and National Aeronautics and Space Administration. Distributed by the U.S. Department of Commerce: National Technical Information Service. July 1972.

with the focal point an assessment must consider both economic, social and legal arrangements which facilitate and use of a technology."

No matter the composition or areas of focus that the TA will cover, there are two things that all TAs should strive to achieve. The first is bounding the assessment. By setting the boundaries of what the assessment will cover, it allows for the project team to make progress toward the answers which they seek. Without bounding, the "…problem can be extended infinitely without method to limit the scope of the study."2 The second attribute that the TA should attempt is to lay out policy alternatives. The effects of technology are most uncertain when the time horizon for introduction of the technology is a long way off. But policymakers do not want the researchers to make the decisions for them. It is necessary that society is informed of the policy alternatives are selected. Society will undergo changes with or without a TA completed on a given topic, but with the TA, society is illuminated to alternatives that can point it in an optimal direction.[4]

[4] Black, Guy. *Technology Assessment – What Should it Be?* Washington, D.C.: George Washington University, 1971.

2 Technology Assessment

2.1 Purpose and Scope

The TA should be organized in a way to focus the study on the impacts from the deployment of this type of technology. Maybe the way to structure alternatives would be to lay out the different types of technology and the materials in the reactions- i.e. the nickel vs. palladium or the type of scale that each type of company is proposing. The TA must find a way to focus the issues and list alternatives or put up the alternatives just to shoot them down.

TA will require experts in many fields to be able to identify the numerous impacts that may occur, broad deployment will hit some areas of economy quicker and harder than others. Experts can outline what the likely areas will be.

2.2 History

The Office of Technology Assessment (OTA) was created in 1972 as a passion project of Congressman Emilio Q. Daddario. The Congressman wanted a way to provide policymakers with a mechanism for policy research that would be able to respond to a world in which technology continues to be developed at a rapid pace. There was a need to categorize the potential positive effects of technology and give a methodology for integrating this technology into society. It was also necessary for predicting and offer mitigation strategies for the negative impacts.[5] Since there was a lack of information about technology that was reaching policymakers, the final construction of the oversight board, Technology Assessment Board was made up of members of the House and Senate. The new agency, Office of Technology Assessment began its work and produced its first final TA in July of 1974.

OTA completed many reports during its time in existence. For this project, there were five TAs that were related to energy and were evaluated for their applicability to the LENR/CF field.

[5] Porter, Alan L., Frederick A. Rossinni, Stanley R. Carpenter, and S.T. Roper, et al. A Guidebook for Technology Assessment and Impact Analysis. Vol. 4. New York: Elsevier North Holland, Inc., 1980.

1. White, Irvin L., et al. *Energy from the West: Summary Report*. U.S. Environmental Protection Agency. Prepared by Science and Public Policy Program, University of Oklahoma. Prepared for Office of Research and Development. August 1979. EPA (600/9-79-027).

2. A Technology Assessment of Coal Slurry Pipelines. *Office of Technology Assessment*. March 1978. Accessed on 02/13/13, http://www.fas.org/ota/reports/7817.pdf.

3. Coastal Offshore Energy Systems: An Assessment of Oil and Gas Systems, Deepwater Ports, and Nuclear Powerplants Off the Coasts of New Jersey and Delaware. *Office of Technology Assessment.* November 1976. Accessed on 02/13/13, http://www.fas.org/ota/reports/7615.pdf.

4. Renewing Our Energy Future. *Office of Technology Assessment.* September 1995. Accessed on 02/13/13, http://www.fas.org/ota/reports/9552.pdf.

5. Energy Technology Choices: Shaping Our Future. *Office of Technology Assessment.* July 1991. Accessed on 02/13/13, http://www.fas.org/ota/reports/9119.pdf.

More in-depth summaries of the TA reports are presented in Appendix B.

The first three reports all have the distinction of evaluating a specific technology or project in a certain spatial context. There are bound by geography and for number 2 and 3, they are bounded by specific technologies. The latter TAs are geared toward overall trends in energy and the energy mix choices for the country. The TA report for the LENR/CF case should be mainly broad like numbers 4 and 5 to bring about the most robust analysis. But since, LENR/TA is a specific technology choice, it is bounded similar to the reports which cover technologies. The project team should seek to follow the model which does not limit the spatial scope, but the technical one to cover LENR/CF in a proper way.

2.3 Current Development and Participatory TA

Though the OTA was defunded in 1995, the process of Technology Assessment did not completely disappear. In fact, it has thrived in Europe and also brought in laypeople to help with the analysis and policy for analyzing science and technology trends. In fact, there are about 12 TA bodies in Europe including one in the European parliament. Scholars have pushed to reestablish Technology Assessment in the United States and to bring the public to the table when it comes to creating technology policy. Experts have recognized the valuable input that citizens can provide to science and technology policy. Within Europe, the best example of citizen engagement is the Danish style “consensus conference” which provides policy makers with a

window into ordinary citizens' opinions on technological developments by facilitating discussion about a particular topic and getting these stakeholders to participate in the policy making process.

Since Participatory Technology Assessment (pTA) is focused on bringing citizens into the discussion, it would alleviate one of the biggest criticisms that were leveled at the OTA: no citizen perspective. While the OTA solicited outsider opinions on a regular basis, by far these people were concentrated in academia, industry and public-interest groups. The lay people were not brought into the process in a formalized way. Without the citizen, layperson involved in the TA process, the results will lack social values and specification of concerns of the public. With the knowledge base that a large sample of the general population can provide, the TA can assimilate broad understandings and other ideas that experts may overlook or underweight.[6] Policy development is enhanced when real-world citizens are included in the process rather than scientific decisions being made from the Ivory Tower. The legitimacy is improved with outreach and greater consensus on impacts from technology.

The pTA can utilize 21st-century technology to reach many more people than a traditional expert-only TA would. Social networks and transparent reporting can make for a robust process with many opinions of the average person taken into account.

2.4 Importance of Evaluating Alternatives

Since policy assessment is the main focus for TA, emphasizing the alternatives should be major focus of the report. An analysis which focuses on scenarios provides the greatest insight to where the technology could be headed and gives policymakers a firm grasp on the uncertainty which may exist in the choice of technology. Without a range of possibilities it is hard for people to understand where developments could be headed. The upper and lower bounds which the TA project team provides is a way for the TA to be valid and understandable by a wide range of people. A good model for scenario analysis is contained in Chapter 4 of the Energy Technology Choices TA. In that TA, there is a wide dispersion of possible outcomes and different weights associated with different impacts of the technology. A TA which can say that it covered the

[6] Reinventing Technology Assessment

range of outcomes offers an unbiased diagnosis of the technology and can be a quality reference document for the policymakers in the United States.

Without a focus on scenarios and their possible outcomes, the project team has only one opportunity to deliver its assessment to the policymakers. The incorporation of pTA within the scenario analysis offers a sensitivity analysis to conclusions that the project team will offer.

2.5 Relevance of TA to/for? LENR/CF case

Since there is a potential for a paradigm shift, LENR/CF is a great candidate for a TA. With a potential for a huge impact at the intersection of technology and society, there exists a need for an evaluation of the higher-order impacts from what the introduction of LENR/CF could mean for American society. Though the OTA is no longer funded and TA is no longer an integral part of Congress' information gathering apparatus, TA is tool which has been used in Europe even after it fell out of favor in the United States. By integrating more laypeople into the actual project and gaining insight into underweighted or overlooked impacts, the study allows for much more practicality for policymakers to make informed policy choices. Since LENR/CF could upend the current structure of the American economy, there would need to be a study of the downstream effects from the introduction of a cheap and clean energy source. The web of society and its different factors would need a broad and deep investigation of what LENR/CF could mean. Correlation and causation of different impacts would need to be detailed in a formal project which could offer effective policy for the government, business, academia and non-profit organizations. Providing a proper guidebook for the potential progress of a technology this powerful would be valuable to show policymakers a way for plans to be formed when and if LENR/CF reaches commercial scale. Preparing in advance of a gathering wave could mitigate negative effects and enhance the positive effects.

3 Prospective Plan for Technology Assessment of LENR/CF Case

3.1 Form Initial TA Project Team to Bring in for the Project

3.2 Perform TA Micro-assessment

Microassessment can guide the team to the best areas of research and what to make sure to include in the TA for the LENR/CF cased. After microassessment has been performed, the basics of the larger TA will be in place. The microassessment which is a "quick and dirty" can give the assessment team the initial context and provide a roadmap where the research should begin (Porter et al. p. 156)

Formulate Plan Boundaries and Scope

What type of TA should be undertaken? (From Coates & Porter et al.)

For the LENR/CF case, a technology-oriented TA is best methodology to follow for this type of technology

3.3 Problem/System/Technology Definition

Decide which methodology or combination of methodologies would work the best for LENR/CF case. (Lee and Bereano, Coates, 1977 hearings, TA Theory, Black)

3.4 Technology Description

A good tool for this part of the study is a MITRE technology description checklist. Performing this analysis would provide most of the information for the Technology description step as well as the Technology forecast step

3.5 Technology Forecast

Though the MITRE checklist will capture most of the information for the technology forecast, using the techniques such as monitoring, trend extrapolation and expert opinion methods can help the project team with forecasting the LENR/CF field

3.6 Social Description

Answer questions about the technology. Will it affect the society at large? Will there be impacts to the national conditions of the country?

3.7 Social Forecast

Using social indicators, there are scenarios that can be used to facilitate the predicted outcome for the technology on society. Unlike technology forecasting, there is much more uncertainty in the prediction of state of society. Insight and intuition are the assessor's best guides

Steps 3.8-3.11 should be conducted iteratively rather than sequentially to determine the complete and thorough analysis for the technology.

3.8 Impact Identification

Use the EPISTLE technique to go through the impacts to the following categories:

- Environmental
- Psychological
- Institutional/political
- Social
- Technological
- Legal
- Economic

Techniques such as scanning, tracing and policy considerations are tools within the EPISTLE framework

3.9 Impact Analysis

Employment of models which can simulate reality are the best tool to use to gain insight into the impact from the technology. A systems dynamic model which outlines feedback loops is one of the best models to use for LENR/CF case.

3.10 Impact Evaluation

From the Impact identification EPISTLE tool and the models developed from Impact analysis, evaluating impacts allow for assigning value to the impacts.

Three techniques could be used, but decision analysis is the best technique for LENR/CF to divide the decision making up.

3.11 Policy Analysis

Policy analysis is a most important part of any assessment. It requires sufficient time and resources to be done well. Using the models and making explicit recommendations is option of the assessors and is usually desirable if the assessment team can convince its audience that is unbiased

3.12 Communication of Results

The project team should be open at all times of the TA. From before the study begins to after the final report is released, providing open information to the public community allows for all the stakeholders to voice their concerns as well as advantages to the project team.

Appendix A: Technology Assessment Theory

The following sources are analyzed and explained within this Appendix A to explain in greater depth the Technology Assessment Theory:

1. Rich, Robert F. "Systems of Analysis, Technology Assessment, and Bureaucratic Power." *American Behavioral Scientist*. 22. no. 3 (1979): 393-416, http://dx.doi.org/10.1177/000276427902200305.
2. Office of Technology Assessment, "Technology Assessment in Business and Government." January 1977. Accessed 02/13/13, http://www.princeton.edu/~ota/disk3/1977/7711/7711.PDF.
3. Coates, Vary T. *Technology and Public Policy: The Process of Technology Assessment in the Federal Government Vol. I.* George Washington University. Prepared for the National Science Foundation and National Aeronautics and Space Administration. Distributed by the U.S. Department of Commerce: National Technical Information Service. July 1972.
4. Lee, Alfred M., and Philip L. Bereano. "Developing Technology Assessment Methodology: Some Insights and Experiences." *Technological Forecasting and Social Change*. 19. no. 1 (1981): 15-31, http://dx.doi.org/10.1016/0040-1625(81)90047-0.
5. Kiefer, David. "Technology Assessment." *Chemical and Engineering News*, October 05, 1970. Accessed 02/13/13, http://pubs.acs.org/doi/pdf/10.1021/cen-v048n042.p042.
6. Black, Guy. *Technology Assessment – What Should it Be?* Washington, D.C.: George Washington University, 1971.
7. Porter, Alan L., Frederick A. Rossinni, Stanley R. Carpenter, and S.T. Roper, et al. *A Guidebook for Technology Assessment and Impact Analysis*. Vol. 4. New York: Elsevier North Holland, Inc., 1980.

A.1 Systems of Analysis, Technology Assessment, and Bureaucratic Power, by Robert F. Rich[7]

Technology Assessment (TA) can assist the federal government with "…evaluative information on potential positive and negative environmental, economic, sociological, technological, and other impacts before budgetary appropriations are recommended and approved by the appropriate branches of government."

TA seeks to connect researchers and policymakers. Performing a TA is akin to a system analysis which brings a "rational, systematic" method to public policy. TA is a way to view impacts on the world from the introduction, extension or modification of technology.

A System of Analysis: TA

"Systems of analysis can be thought of as both formal and informal. The critical distinction between systems of analysis and more routine knowledge or information is that a system of analysis is associated with a set of general rules, procedures and processes which guide the production of the end product. "

The commitment to performing a TA or any systems of analysis is a cultural change for an organization. It will modify the way that information is collected, no longer is a specific information goal; with TA it is a generic information gathering process. Once an organization makes a formal commitment to TA, the capacity of the organization will likely change to a methodology of developing systematic and rational decisions.

There is a friction in TA between the researcher and the public official. Both are likely to pursue an outcome that minimizes uncertainty, risk, and cost; but, these two types of people will likely pursue different outcomes when it comes to solving a problem. The researcher is on a search for "truth" while the public official is on a search for "power". TA is a powerful way to view problems because it can help make predictions about the future. TA can help lessen the risk that public officials will guess wrong about a particular type of technology.[2]

TA represents a tool that seeks to "span boundaries" and bring in people from many different disciplines. It represents an advantage to policymakers in that it is "more rational in a scientific

[7] Rich, Robert F. "Systems of Analysis, Technology Assessment, and Bureaucratic Power." *American Behavioral Scientist*. 22. no. 3 (1979): 393-416, http://dx.doi.org/10.1177/000276427902200305.

sense", utilizes scientific research, and depend s less on intuition than officials are normally asked to do.

A.2 Technology Assessment in Business and Government, by the Office of Technology Assessment

From 1977 hearing s in Congress which covered TA in government and private industry, there are six major facets to TA, detailed below:[8]

I. Evolution
   a. The potential primary impacts and side-effects of technology need to be identified when developing approached for achieving an organization's goals. The TA concept can be utilized either as a strategy for anticipating problems associated with emerging technologies or as an organizing concept for clarifying policy options associated with long-range and complex social-technological issues
   b. TA should be tailor-made to fit each study. A flexible approach is mandatory, but there are a number of preliminary mandatory steps that have proven useful. The two critical steps that fell out of the discussion was defining the task and the technology
   c. A complete TA is a comprehensive attempt to identify and describe a technology's entire range of side-effects as well as its policy options and alternatives

II. Adaptability
   a. TA will be more credible and have more impact if a wide spectrum of alternatives is communicated to affected parties before they become committed to specific courses of action
   b. The characteristics of adaptability and flexibility have also proven of interest to planners who claim that TA maps a problem much better than other types of techniques

III. Alerting
   a. In addition to elucidating options and alternatives, TA can provide early warning of consequences normally unanticipated in traditional planning. This is a distinctive advantage for policy makers.

IV. Planning
   a. "…TA program is used to anticipate and plan for the impacts of technology changes on our products and operations…In short, our TA program is an essential ingredient in our long-range business planning, investment policy, product planning and market development." – George E. Mueller, President and Chairmen of the Board, System Development Corporation
   b. "…TA studies do not promise to accurately predict the future. Their purpose is to make us aware of future possibilities." – Jack B. Moore, VP California Edison Company

[8] Office of Technology Assessment, "Technology Assessment in Business and Government." January 1977. Accessed 02/13/13, http://www.princeton.edu/~ota/disk3/1977/7711/7711.PDF.

c. Factors Corporate Planning of a TA
    i. Technology, Present and Future
    ii. U.S. Governmental and Public Policies
    iii. Economy
    iv. Social Trends
    v. Product Supply and Demand
    vi. Competition
    vii. Feedstocks
    viii. Demographics
    ix. Environment
    x. International Factors

V. Utilization
    a. Pressures for TA involvement
        i. Defensive reactions
        ii. Positive pressures
        iii. Corporate Social Responsibility
    b. TA is important because it provides the decision makers with a spectrum of options and alternatives
    c. TA is useful to help address externalities that may not be considered in the routine supply chain impacts

VI. Communication
    a. TA can bring in potential users, sponsors, decision makers, affected parties and other stakeholders to provide a comprehensive view of the impacts of a specific type of technology
    b. Could provide for more effective regulation as the business side as the public is involved along with industry to bring together all potential impacts from the implementation of a technology

From these hearings, here is a selection of the main findings that the committee found:

- The use of a team of assessors, cutting across man disciplines, is essential for carrying out large and complex TAs.
- TA is a process that is likely to be repeated at more sophisticated levels as new knowledge develops and technology evolves.
- TA possesses certain structural elements:
    - Describes the technology
    - Defines the issue and its current status
    - Sets forth the issue's ostensible future course
    - Identifies policy actions
    - Suggests alternative policy scenarios
    - Assesses the complete spectrum of potential impacts
- TA can reveal surprises because its results are not necessarily predictable.
- TA is more of an art than a formalized scientific discipline.

A.3 Technology and Public Policy: The Process of Technology Assessment in the Federal Government Vol. I, by Vary T. Coates[9]

This reference material is from 1972 and takes a high-level view of Technology Assessment up until that point in time. Working with the National Science Foundation, this report is a comprehensive view of the field of technology assessment and how it has been deployed across the federal government. The report works through the initial phases of TA, gets to the different aspects of what makes up and TA, and where TA was heading to at this point in time. The study walks through findings from the Congressional Committees as well as two scientific committees, the Committee on Science and Public Policy (COSPUP) and the Committee on Public Engineering Policy (COPEP). The following list and ideas outline some of the major findings from these committees and what the most important ideas to take away from the reports.

- "Throughout most of history the impetus for technological innovation was the expectation of direct benefits for the user and for relatively small segments of society, usually the economic dominant class…social costs…need not be considered and could almost said to have been invisible."
- "…political thinkers are again pointing to the seeming inability of democratic societies to provide… "stable metasystems" for the control of self-directed, change-resisting social institutions which are powerfully organized to maintain their internal stability and survival."
- "Technology Assessment has been discussed as a technique for improving societal control over technological development and applications within the constitutional framework and institutional structure of the federal government. By technology assessment is meant the systematic identification, analysis, and evaluation of the potential secondary consequences (whether beneficial or detrimental) of technology in terms of its impacts on social, cultural, political, economic, and environmental systems and processes."
- "Technology assessment is intended to provide a neutral, factual input into the decision-making process. Assessment techniques may be integrated into the planning, designing, and evaluative process used by government agencies in preparing technology-oriented programs and projects, and may also provide a critical review of such programs and projects after their injection into the public policy arena."
- Quote from Congressman Daddario: "…a form of policy research which provides a balanced appraisal to the policymaker. Ideally, it is a system to ask the right questions and obtain correct and timely answers. It identifies policy issues, assesses the impacts of

[9] Coates, Vary T. Technology and Public Policy: The Process of Technology Assessment in the Federal Government Vol. I. George Washington University. Prepared for the National Science Foundation and National Aeronautics and Space Administration. Distributed by the U.S. Department of Commerce: National Technical Information Service. July 1972.

alternative courses of action, and presents findings. It is a method of analysis that systematically appraises the nature, significance, status and merit of a technological program… (and) is designed to uncover three types of consequences – desirable, undesirable and uncertain."

- "Perhaps the greatest difficulty…with scientific information was that '…members of Congress found it impossible to accept the proposition that science is probabilistic.'" (p. 1-18)
- "It must be an iterative process…At the same time, delay in decisionmaking can allow irreversible detrimental impacts to occur…it is important that the process of TA should begin to occur as far upstream as possible." (p. 1-19)
- Committee on Science and Public Policy (COSPUP) Report
- The COSPUP report also included a first attempt at structuring a methodology for technology assessment. (p. 1-21)
    - "Recognizing that there was 'no unique way to break down so vat a subject', the panel conceptualized the tasks in three interrelated subject areas:
        - **The focal points from which assessments should begin**
            - Focal point may be the technology, the environment, or the individual
            - Beginning with the focal point an assessment must consider both economic, social and legal arrangements which facilitate the introduction and use of a technology
                - The Assessment must examine:
                    - The rate of advancement in development of the technology
                    - Possibilities for technology transfer to related areas
                    - Probable growth in the scale of application
                    - Availability of intermediaries or buffers between technology and user
                    - Degree of departure from existing, accepted technologies
                    - Economic concentration of producers
                    - Centralization of decision making with regard to the technology and susceptibility to collective control
                    - The competitive environment
                    - Societal sources of resistance to the use of the technology (legal, social, religious)
                - The assessment might also focus on the individual:
                    - Development and socialization
                    - Work experiences
                    - Access to material goods and social values
                    - Opportunity to participate in decisionmaking
                    - Health and safety

- "The COSPUP panel concluded that a combination of all of the three focal points was required in an adequate assessment…of the possibility of…important second- and third-order consequences

- **Assessment modes and mechanisms**
  - Internalized assessments
    - Assessment built into the incentive structure of the decision-making process
  - Externalized assessments
    - Assessments conducted by an institution deliberately separated from the front-line decisionmaker
  - Negative Assessment vs. Positive Assessment
    - Negative Assessment – performed by agency with regulatory responsibility
    - Positive Assessment – agency responsible for evaluation and promoting new technology
- Patterns of response and action P. 1-24
  - Resource allocation decisions
  - Modifying private initiatives by internalization of costs or enforcement of standards or regulation
  - The altering of incentives through the creation of new legal rights or other social innovations
  - Structured so as appropriate for the ends in view and the needs of the specific decision-making entities

- Cmte on Public Engineering Policy (COPEP) Report Findings P. 1-25
  - Seven-step analytical approach for TAs
    1. Identify and refine the subject to be assessed
    2. Delineate the scope of the assessment and develop a database
    3. Identify alternatives strategies to solve the selected problems with the technology under assessment
    4. Identify the parties affected by the selected problems and technology
    5. Identify the impacts on the affected parties
    6. Valuate or measure the impacts
    7. Compare the pros and cons of alternatives strategies
  - Both problem-initiated assessments and technology-initiated assessments P. 1-26
    - Problem-initiated assessments
      - Process begins at the large-end of a funnel, and the optimum solution to a given problem is at the small end
    - Technology-initiated assessments
      - Process begins with the new technology at the small end and emerges as a complex pattern of consequences

- In carrying out steps 5 and 6, (identification, evaluation, and measuring of impacts on affected parties), COPEP worked out a simple scheme for comparisons of the judgements of the assessors. Each assessor rated each potential impact, for each affected party.
    - P. 1-27
    - Impacts were rated as to their nature:
        - Favorable
        - Unfavorable
        - Unknown
    - Their probability of occurrence
        - Likely
        - Unlikely
    - Susceptibility to federal action
        - Controllable
        - Uncontrollable
        - Unknown
- COPEP lamented the fact that there is a: "…lack of an acceptable and accepted system of social indicators for the measurement and comparisons of potential impacts which have been identified by the TA
- COPEP came away with 14 conclusions based on the experiments that it performed in analyzing the features of TA P. 1-27-29:
    1. TA are feasible and useful to Congress "when prepared by properly constituted, independent, ad hoc task forces with adequate staff support and time
    2. They should be free from political influence or bias…the assessment group should limit itself to outlining alternative strategies for action
    3. Assessors should be chosen for their expertise and not as representatives of affected parties or interests
    4. Assessors must be chosen from public and private organizations with knowledge about the subject, organizational biases of the experts will tend to cancel out and be neutralized
    5. There should be participation by behavioral and political scientists; experience shows that engineers, economists, and social scientists can work together harmoniously
    6. To be of most use, the assessment should take about 1 year and be the sole activity of the research group
    7. Congress would be best served by a small management group which would arrange for the TAs by diverse organizations. No one entity can provide adequate in-house expertise for all assessments
    8. Cause-effect analysis should be supplemented by "the intuitive judgments of knowledgeable individuals"

9. Assessments can begin through consideration of either technology or a social problem. The procedures for these two kinds of assessments will differ somewhat
10. Technology-initiated assessment requires a choice between "diffuse searches seeking some early-warning signal" and "conversion to a problem-oriented study" that choses the most significant (potentially detrimental) impacts for analysis. The latter choice involves the danger of overlooking hitherto unrecognized impacts
11. Long-term forecasts (more than five years) are valuable for planning and "setting the stage" for consideration of unforeseen events, but are likely to be unreliable
12. Criteria for establishing the priority of topics for assessment include the breadth and depth of expected social impact, the visibility of the problems to legislators and to the public, and the current and expected rates of development of the technologies
13. Appraisal of impacts must include the derivation and use of social values pertinent to the quality of life, in addition to conventional economic and technical risk-benefit criteria
14. TA can provide the public support necessary for national programs designed to secure the benefits and avoid the problem of technological advances.

- COPEP tended to downplay exploratory, anticipatory assessment at an early stage of technological innovation when problems have not become obvious and potential consequences have not yet been recognized. It becomes problematic when the TAs are focused on the drawbacks rather than the benefits from TAs
- "…there is an effort to extend this kind of analysis to include the estimates of the probability and weight of other potential consequences of a proposed program, the process may be called risk-benefit analysis; however the emphasis is still on the significance and probability of tangible advantages and disadvantages – that is an attempt is made to assign a monetary value to intangible secondary social benefits or external costs. However decisions are likely to be bases firmly on the primary benefits and the direct costs." P. 1-59
- "Since WWII executive decisionmaking has benefitted from the development of…: systems analysis and operations research.
    1. Systems analysis is a technique for analyzing the performance or effectiveness of a system in terms of a desired result (system goal or mission)
        - Effectiveness is measured in terms of quantified relationships between performance, cost, efficiency, maintenance, reliability, and compatibility with the external environment

        - Therefore, effectiveness results from the aggregate of design decisions making optimum trade-offs at each decision point.
    2. Operations Research is sometimes called a subset of systems analysis. It is defined as "an experimental and applied science devoted to observing , understanding, and predicting the behavior of purposeful man-machine systems." P. 1-60
- Both Systems Analysis and Operations Research are closely related to TA
    1. Both focus sharply on the performance characteristics of a system in terms of its intended or planned ends or goals.
- TA on the OTHER HAND, is an attempt to evaluate ALL potential impacts or effects, particularly secondary, tertiary and higher order consequences which are unplanned byproducts of the primary intent of a technological innovation, application or intrusion into society. P. 1-61
- "Agency-initiated TA of power technology like that of water resources technology, is apt to be constrained or biased by the agencies' own interests and defensive postures and by anticipated pressures reflecting the political needs and vulnerabilities on Congressman from the affected regions." P. 3-39
    1. Make parallels about the search for energy that can meet many different stakeholders interests
        - Nuclear Post-Fukushima
        - New coal regulations
        - The long search for the Higgs-Boson which came out of a theory
- TAs where divided into six categories P. 4-1
    1. Wide-scope TAs
        - Studies which represented a relatively high level of effort
        - Analyzed the potential impacts of a technology over a wide range of possibilities (social, institutional or political, economic, environmental, and ethical impacts or some combination)
        - Also to be considered wide-scope, they had to meet two additional criteria:
            - Must have been addressed to a public policy issue or potential decision
            - Must have utilized a multi-disciplinary team
    2. Narrow or partial assessments
        - In generally, these studies considered some pre-selected kinds of impacts, most often economic or environmental, which did however go beyond the

primary, planned consequences of the technology or project
    - The studies were not concerned solely with performance characteristics or technical feasibility
    - The distinction between wide-scope assessments and narrow or partial assessments was admittedly arbitrary
    - For the most part they did not address a specific policy decision or action, were not funded to the same level as the wide-scope and they utilized only few disciplines on their research teams
3. Problem-Oriented Assessments
    - Focus on a problem such as environmental pollution and identify the technologies which contribute to the problem or may be used to alleviate the problem
    - Problem definition and conceptualization is central task of the study
4. Environmental Impact Statements
    - Required by the NEPA of 1969.
5. Future Studies
    - These are not necessarily TAs but TAs need to take the future into account to be useful for the future social context effects to be taken into account
    - They include supply and demand studies, long-range planning studies, technological forecasts, or formulations of alternative social environments which deal with technology and its impacts on the future
6. Methodological Studies and Surveys
    - These reports just survey the techniques of TAs

A.4 Developing Technology Assessment Methodology: Some Insights and Experiences, by Lee and Bereano[10]

"…the authors do not believe that a singular approach [for TA] is possible."

- TA is neither merely forecasting, nor futures research, neither social impact analysis, nor purely systems analysis.
- It goes beyond simply identifying the impacts and their causation.
- It ascertains whether the impacts have been planned or intended in real world situations.

[10] Lee, Alfred M., and Philip L. Bereano. "Developing Technology Assessment Methodology: Some Insights and Experiences." *Technological Forecasting and Social Change*. 19. no. 1 (1981): 15-31, http://dx.doi.org/10.1016/0040-1625(81)90047-0.

- It seeks to describe the beneficial or adverse nature of consequences.
- It establishes the trend of technological change and the resulting implications for all relevant sectors of society.
- TA is a form of policy analysis and is in essence a societal impact study that deals with value-oriented, institutional, and other nonquantitative issues, it cannot be performed adequately by relying solely on formal statistical, survey or operations research methods

This paper is very good at describing some of the needs for a quality TA. It lays out several lists of quality methodologies for one to pursue when completing a TA.

Need for Methodology

"A good TA should be successful in better organizing…uncertainty, even if it does not reduce the amount or obviously simplify the task of decision making."

A methodological framework for TA is both possible and necessary to rationally order the complexity of the task being undertaken

Project personnel need a sense of timetables and procedures to avoid getting bogged down in a mass of detail and becoming diverted onto minor pathways

Methodological Framework

There are several lists contained in this paper which provide a good summary of the way that TAs should be structured to include the most critical elements of the subject to be studied.

A set of 10 prescriptions should be followed by assessors for a TA methodology:

1. Statement of problem to be considered
2. Definition of system
3. Identification of potential impacts
4. Evaluation of impacts
5. Definition of the relevant decision-making apparatus
6. Laying out options for the decision maker
7. Identification of parties of interest; potential "winners" and "losers"
8. Definition of macroalternatives
9. Identification of exogenous variables
10. Conclusion and possibly recommendations

This is just one way of following a methodology for a TA. The authors of this paper make very clear that there is "no validated, universally accepted methodology for TA."

One rule of thumb for a TA would be focusing the project in the following ways. 20% on defining and exploring the technologies being assessed, 30% on establishing the non-technological setting in which the technology would be imbedded and almost 50% on identifying and analyzing the societal impacts generated by the technology.

Another section of the paper gives a more general summary of what TAs will contain in the report:

1. An overall framework
2. A management plan for allocation of time or effort to different project tasks
3. Carefully considered use of specialized techniques for portions of the overall analysis
4. Methods for structuring the interaction among assessment participants
5. Attention to considerations for "knowledge" to foster new insights

This provides a good framework to designing the TA for LENR/CF. It gets to the crux of what exactly a TA needs to include and how to start a TA from scratch.

The L&B paper makes a number of observations which should be key to any scientific research, but will be very important for a TA on LENR/CF:

"…bias should be suppressed, the overall technology assessment process contains elements that are normative, judgmental, creative, and subjective."

"…the quantification of social benefits and disbenefits often obscures the difficult task of separating fact from opinion."

"…assessors cannot make a neutral, objective and value-free analysis of all topics of concern, the need for representation of all viewpoints must be satisfied."

Another key insight that is critical for any TA is the practice of bounding. In theory, a problem can be extended infinitely without method to limit the scope of the study in order to keep primary focus on what the TA seeks to explore. The L&B paper give nine factors to bound the TA.

1. Time horizon
2. Geographical scope

3. Institutional considerations
4. Technology
5. The application of the technology
6. Impact sectors
7. Range of policy options to be considered
8. Input considerations
9. Output considerations

A.5 Technology Assessment, by David Kiefer[11]

- Science and technology have vastly benefitted man and contributed to his well-being. At the same time, however, they all too often have done him and his environment harm
- Now, an overriding need is to devise a way of protecting man from his own technology creativity
- Technology Assessment is an attempt…to establish an early-warning system to control, direct, and if necessary, restrain technological development so to maximize the public good while minimizing the public risks
- Little or no concern has been shown for indirect or by-product effects of new developments. Yet second-order and third-order or even more remote consequences, in a society as complex and interlocking as ours, are no less significant than first-order effects. In the long run second-order consequences may have even greater impact.
- A change in one system will be reflected through all and thereby affect the quality of life in the entire community- even though the decision to make the initial change may be reached in one small part of the community remote from the usual centers of political power or control
- The costs or hazards stemming from indirect effects, moreover, frequently fall not upon those who benefit from new technology but upon uninvolved or even unidentifiable, bystanders, or upon the public at large, or even upon generations unborn. The benefits may be local whereas the costs are far-reaching or even global.
- …a new development that is acclaimed as a technological and economic success in the short run and on a microscale may lead unwittingly to a long-run sociological macrofailure.
- Policy does not anticipate future problems; rather merely deals with those of the past and present
- TA is a mechanism for focusing on second and higher-order consequences and balancing these consequences against first-order benefits.

[11] Kiefer, David. "Technology Assessment." *Chemical and Engineering News*, October 05, 1970. Accessed 02/13/13, http://pubs.acs.org/doi/pdf/10.1021/cen-v048n042.p042.

- The aim moreover, may not be to eliminate all untoward side effects of technology. In many cases, this would not be feasible, just as it would not be possible to cure all maladies with medicines that are completely devoid of risky side effects.
- TA, however, goes beyond all this by focusing on the interactions, side-effects, spillovers, and trade-offs among several technologies or between technology and other aspects of living. A full-fledged TA would not just look at transportation as a means for moving people and things about. Rather, it would examine the effects of transportation developments on housing and urban development, for example, or at the ways new methods of communication might affect the need for transportation
- Without public demand or support any major assessment efforts would be little more than an academic exercise
- It would be responsible for providing "an early warning system of the probable impacts, positive and negative, of the applications of technology"…
- Function as an "institution without any innate orientation rather toward technological advancement or environmental protection" but able to consider "human, philosophical, social and economic as well as scientific values"
- A full-scale TA must not only ask but also in some way answer many difficult questions: How will a new development or innovation be used? What consequences, direct or indirect, for good or ill will these applications have on any or all sectors of society or the environment? What responses can be expected in other areas of technology? How do the desirable results balance against those that are undesirable or uncertain? Are the effects reversible in the short term or the long term? What alternative technologies might achieve the same results?
- These questions should be answered as quickly as possible
- …the NAE recommends that most assessments "be concentrated on the near future and supported at a relatively modest funding level." The reliability of forecasts, it points out, "declines rapidly with extension into the future and with the number of sequential events predicted."
- Technological discoveries have sometimes been heralded by precursor events to be sure. When scientists have inklings of the future course (or consequences) of new technology, however, their voice has usually gone unheeded.

A.6 Technology Assessment – What Should It Be? By Guy Black[12]

- "Means are being sought to predict, evaluate and direct the path of technological change in such a way as to preserve the public interest." P. 2
- "TA should be concerned with evaluating the full range of techniques that are relevant to a particular decision or change." P. 4

[12] Black, Guy. *Technology Assessment – What Should it Be?* Washington, D.C.: George Washington University, 1971.

- "It is change itself rather than the cause of change which creates problems for society. What should concern society is not broadened awareness of alternatives, but the process by which alternatives are selected…Society undergoes changes even in the absence of new techniques." P. 6
- "…relationships that have never been thought important have never been studied at all- and even relationships which have been studied intensively are often imperfectly understood." P. 10
- "…TA is a future-oriented analysis, any analytical method with the capability of relating past and future to the present conditions may be useful." P.14
- "Unfortunately, as models are expanded to deal explicitly with more and more second-order consequences, they become larger, more complex, and unless deliberately limited, they would ultimately encompass every element of society." P.15
- "The existence of a useful expertise in a technology assessment group may result in participation in agency policy formation in ways that may bias the technology assessment function" P.17
- "The long-run strategy for TA must be to identify important unknown functional relationships and persuade government to fund, scholars to perform studies that will define and then refine knowledge of them." P.19
- "Preliminary screening is merely the initiation of the technology assessment function; there is no real accomplishment until the ideas which pass the screening have been considered in depth. Depth analysis would be analogous to the systems approach and would indicate problem identification, creation of a general model of the relevant situation…" P.26
- "It is clear that TA…means balancing the desirable against the undesirable." P.33
- "Some part of the notorious difficulty of successful interdisciplinary research results from the incompatibility of data outputs from various disciplines, as they are normally produced." More bridges need to be built" P.35
- TA can be efficient when the following prescriptions are followed P.36
    - TA will have more impact when the analysis is competent
    - It will have more impact when it conforms to the values and philosophies of decision makers
    - It will have more impact if its results are communicated to decision makers before they become committed to specific programs
    - It will be more acceptable when it is relevant to the high-priority decisions which are the immediate responsibility of the decision makers
    - It will have more impact if it does not threaten the power and prestige of the decision makers
    - It will have more impact if it presents alternatives rather than calling for or demanding one rigid course of action

- "..no single TA is likely to be satisfactory to the entire structure of decision makers." P.38
- "TA must not attempt impossible precision. The structure of the future…is…stochastic…[with] array of possible outcomes, appended by probability estimates…"

A.7 A Guidebook for Technology Assessment and Impact Analysis, by Alan L. Porter, et al.[13]

Chapter 1 -p.4

TA usually deals with a technology that could be geographically situated almost anywhere

In terms of policy, TA is likely to explore a wide range of possible subsidies, incentives, regulations, and so forth

Chapter 2

The technological component and its ties to human society [are] intensifying with the passage of time

The technological society is not without its problems. In many cases technological developments have been seen as causing social problems. Cases of "social shock" are caused by technological developments that went wrong

The notion of assessing technology has originated from the convergence of two observations: p.11

(1) that technology is a crucial force in modern society

(2) and that technological developments can go awry

Technology Causes Social Change – p.16

1. Technological advance creates a new opportunity to achieve some desired goal
2. This requires (except in trivial cases) alterations in social organization if advantages is to be taken of this new opportunity
3. Which means that the functions of existing social structures will be altered
4. With the result that other goals that were served by the older structures are now inadequately achieved

[13] Porter, Alan L., Frederick A. Rossinni, Stanley R. Carpenter, and S.T. Roper, et al. A Guidebook for Technology Assessment and Impact Analysis. Vol. 4. New York: Elsevier North Holland, Inc., 1980.

Mesthene sees society as basically reacting to technology rather than leading it. New technology alters the range of available choice

Chapter 4 – Basic Features of an Assessment

Assessment Objectives:

The Large Picture

Assessments:

1. Provide pertinent information to policy makers
2. Alert concerned people who, in turn, influence the policy making process
3. May even contribute to serious thought about societal values

Each assessment has its own context, sponsor, particular interests, and unique problem definition. There are main general objectives that apply across all assessments: p.44

1. Validity
    a. Validity carries a host of precise connotations
    b. Generally refers to being well-grounded in fact and verifiable
    c. In the case of research dealing with the future, we take validity to refer to the congruence between predicted and actual results
    d. Since the results of an assessment apply to the future, and since their correspondence with actual happenings may vary as a function of time, the validity of an assessment will remain uncertain
        i. Cause and Effect Understanding
            1. A technological intervention as a cause produces impacts as it effects. These impacts, in turn acting as causes, may produce other impacts as (higher-order) effects. The central task of an assessment is to understand the full set of interactions involved in the coupling between technology and society.
        ii. Balance
            1. An assessment should provide a balanced appraisal to the policy maker. “Balance” refers to an even-handed treatment of the major assessment issues, both in terms of coverage all important aspects and in relation of salient points of view
                a. A value-explicit approach in which the assessors attempt to lay out as clearly as possible the divergent value perspectives involved in the issue
                b. More importantly, the assessors should try to spell out their assumptions and make clear their personal allegiances, so that the users of their study can judge the positions taken.
        iii. Methodological Soundness
            1. TAs should use the available, relevant data and follow established scientific principles and procedures

2. When reasonable, the reproducibility of results should be ascertained

2. Utility –p.46
    a. The utility of a TA is determined by how much useful information the study provides to its sponsor, to parties impacted by its subject, and to makers of decisions involving the assessment subject
    b. Utility depends on such factors as the time a study becomes available relative to when a decision must be made, the study content, and the presentation
    c. Utility can be gauged as the difference, in terms of information gained, the study makes to its potential users

        i. Relevance
            1. An assessment is irrelevant and hence useless if it does not ask the questions that the sponsors and parties at interest need answered
        ii. Timeliness
            1. In a policy context, it is imperative that an assessment be available when the time is ripe. Time pressure can also be a major constraint on the depth of analysis possible
        iii. Credibility
            1. Whatever the validity of a report, it is valueless unless the audience believes the report to be worthy of consideration
        iv. Communicability
            1. Unless the findings are presented in a usable format, the study may receive scant attention
            2. This threat is particularly acute in the case of more quantitative approaches that use elaborate techniques.
3. Improving assessment methodology
    a. Given the social importance of TA, continued methodological advance through development and refinement of study strategies and techniques that lead to valid and useful results should be carefully considered in every significant study

Types of Assessment – p.47

TA is differentiated in terms of its

1. Comprehensive view of complex issues
2. Requirement of many disciplines, working in an interdisciplinary mode
3. Component tasks (beginning with a need to structure the problem and continuing through analysis of policy options)

TA stands apart for its breadth, interest in higher order effects, and concern for all parties at interest

Three Types of TA – p.51

1. Project Assessment – a focus on a particular, localized project such as a nuclear power plant

2. Problem Oriented Assessment – a focus on solutions of a specific problem, such as an energy shortage
3. Technology Oriented Assessment – a focus on examining a new technology and trace its impacts on the society – most likely outcome for the LENR/CF case
    a. Technology oriented assessment often deal with innovative technologies. Important considerations in a technology-oriented assessment are the forms of technology, the time frame of the innovation process and the ways in which the implementation of the technology are likely to occur
    b. The time frame covered by such an assessment is typically more open than other assessment types
    c. As a result, the range of societal outcomes is generally wider
    d. The policy content is more diffuse since the options are great and the uncertainties large

A Family of Assessment Studies – p.53

Macroassessment (comprehensive, full-scale):

Full range if implications and policies considered in depth (on the order of magnitude of 5 person-years work for technology-oriented assessment)

Miniassessment:

Narrow in-depth, or broad but shallow focus (about an order of magnitude smaller than the macroassessment in work effort)

Microassessment:

A though experiment, or brainstorming assessment exercise to identify the key issues or establish the broad dimensions of a problem (about an order of magnitude smaller than the miniassessment, say 1-person-month of effort)

Monitoring:

Ongoing gathering of selected information on a topic. May be done formally or informally; as a result of a prior assessment identifying critical uncertainties; and/or as a way to identify critical changes that warrant a new assessment

Evaluation:

Evaluation of ongoing projects and programs can determine whether alterations or new programs are needed. In addition these can provide feedback as to the validity of previous TA predictions

Components of a TA – p.54

1. Problem definition
2. Technology description
3. Technology forecast
4. Social description
5. Social forecast
6. Impact identification
7. Impact analysis
8. Impact evaluation
9. Policy analysis
10. Communication of results

The effects of Technology – p.59 – a breakdown of the orders of effects from the introduction of television

Problem definition – p. 65

The first step in comtemplating an assessment – whether as sponsor or assessor- is to challenge its existence. Taking as broad and open a perspective as possible, one should pose questions such as:

1. Why study this technology or project? What can be gained from this assessment
2. Is there are core problem reflected in the assessment assignment?
3. What conditions cause the problem or pose essential opportunities?
4. What assumptions are being accepted in the TA formulation?
5. Would reasonable changes in assumptions make a core problem disappear?
6. Who are the parties at interest to the technology or project? How do their values differ?
7. Are there other social values meriting consideration?

Bounding an Assessment – p.66

Bounding a TA – that is – setting limits is difficult to accomplish, deeply intertwined with the other assessment tasks, and crucial to the effective conduct and completion of the assessment.

Bounding an assessment should be an ongoing activity. It depends on constraints set by the study sponsor, and also on characteristics of the development under assessment, the critical impact areas and selection of policy option

Areas for Bounding – p.67

Time horizons – extent of future projecting and the intermediate "viewing times" are central to problem bounding. Could chose a 10 to 25 years or more for the scope of the study

Spatial extent – is the primary emphasis of the study local, regional, state or national concern. Defining the spatial boundaries is important for which policy makers and which policy jurisdictions will be included

Institutional Involvements – Institutions considered should those affecting policy, those likely to use the study and those impacted by the technology in question

Technology and Range of Application – Limiting technological options to a feasible range may be important for emerging technologies and for technological solutions to social problems. Innovative and unconventional alternatives should be included whenever time, funds, and sponsors permit

Impact Sectors- criteria for the selection of impact sectors for in-depth treatment should be established to ensure coverage of all areas critical to policy considerations. An initial microassessment is the best means of determining which impact areas to assign highest priority

Policy Options- a wide latitude of policy possibilities exists, especially in emerging and social technologies. Limiting the range must be consistent with the thrust of the assessment. In particular, the sponsor and assessment team must agree upon the range and limits of radical or utopian policy options to be considered

Technology Description and Forecasting – p.98

Comprehensive description of the state of the art of a technology is necessary but not sufficient for accurate prediction of its future impact. The technology must also be projected along feasible paths into the future.

What is the emergence of the technology and what is it impact?

MITRE Technology Description Checklist – p.106-108

This statement includes information such as:

1. Physical and functional description
    a. Type of technology
    b. Scientific disciplines
    c. Industries/businesses involved
    d. Professions and occupations involved
    e. Products involved
    f. Design-dimension data
2. Current State of the art
    a. Current state of the assessed technology
    b. Current state of the supporting sciences
3. Influencing factors
    a. Technical breakthroughs needed
    b. Technological factors affecting development
    c. Technological factors affecting application
    d. Institutional factors affecting development
    e. Institutional factors affecting application
4. Related technologies
    a. Complementary (supporting) technologies
    b. Competitive technologies
5. Future state of the art
    a. Timing
6. Uses and application
    a. Current and prospective
    b. Buyers

Technology forecasting- p .113

Monitoring – assumption that technological change is foreshadowed by changes in the political, technical, economic, ecological, and/or social environments. Therefore it should be possible to monitor signals in these environments, analyze them and forecast the emergence of new technologies.

Trend extrapolation – p.115

A technique which attempts to capture the historical progress of a technology in a mathematical expression or graphical display. Once determined this information can be used to project or extrapolate performance at a future time, provided that no discontinuities occur.

Expert Opinion Methods – p. 122

“Asking a person who knows” – surveys and soliciting predictions from people in the field

Social Description and Forecasting – p.135

Social Description – will this technology affect society at large? P.138

1. No war will result from this technology
2. No internal conflict will undermine or overthrow the present democratic system
3. No major shifts in the balance of power between government and private decision making or between federal, state and local governments
4. Value system may change, the so-called Puritan ethic which prizes work and personal achievement will not change

Will there be changes to the national conditions?

1. Population size
2. Adjusted GDP growth rate
3. Proportion of federal spending in defense and civilian programs
4. Shift in industrial structure from manufacturing to services

Six major categories for the state of society:

1. Values and goals
2. Demography
3. Environment
4. Economics
5. Social factors
6. Institutions

Will the technology change social indicators? See page 141

Social forecasting – p.148

Using social indicators, there are scenarios that can be used to facilitate the predicted outcome for the technology on society. Unlike technology forecasting, there is much more uncertainty in the prediction of state of society. Insight and intuition are the assessor's best guides

Impact Assessment – p.156

Impact identification, impact analysis, impact evaluation and policy impact analysis must be executed iteratively to allow for the process to produce the most effective results.

The assessment team must select the "important" impacts to be analyzed. The determination of which impacts are most important is of course "a judgment call". That judgment call must be

based on sound understanding of the sponsor, the interests of potential users of the TA, as well as the probability, timing, and extent of the impacts themselves.

Impact Identification Strategies

By using a technique which can divide the complex field into smaller, more easily examined sectors. One way to divide the complex field is to use a technique known as EPISTLE:

- Environmental
- Psychological
- Institutional/political
- Social
- Technological
- Legal
- Economic

Impact identification techniques – p.162

Scanning – assembling a checklist

Tracing p.168 – relevance tree which can branch out based on the impact from the introduction of the technology

Policy considerations –p .176

The focus of assessments should be policy. Assessment results will generally be useful to sponsors only insofar as they delineate effective policy alternatives.

There are no set criteria for impact identification, but there are many considerations to include:

Type of perspective – reductionist or holistic

Selection of identification techniques for scanning or tracing the impact field

Choice of resource people to employ in impact identification – only those on the project team, or persons external to the team as well

Successful strategy must blend these decisions with the following study characteristics and constraints:

- Characteristics of technology
- Characteristics of the impacts

- Characteristics of the team members
- Sponsor and potential study user requirements
- Resource constraints
- Study time constraints

Impact Analysis

Impact analysis links the identification of significant impact to their evaluation and formulation of effective policy to deal with them

Models are the best way to determine impacts from the technology

Models are systematic arrangements of elements that are intended to represent real-world systems in structure and/or behavior

Any model is a representation of a simplification of reality, but must consider the following dimensions:

- Complexity (few to many variables)
- Time (static to dynamic)
- Uncertainty (deterministic to probabilistic

Models include p.210:

- Physical models
- Planning models
- Gaming models that allow stakeholders to act out their inclinations and see the implications
- System dynamic models which show counter-intuitive workings of feedback relationships
- Probabilistic systems dynamics models that incorporate influences of uncertain future events
- Monte Carlo methods to sample probability distributions
- Queuing and Markov approaches to stochastic situations
- Bayesian statistics to combine prior knowledge with new information

Impact Evaluation – p.351

Evaluation is the process of assigning value. The value of something is assigned relative to that of something comparable with which evaluator is familiar.

There are several techniques to evaluate the impacts

Dimensionless Scaling – p.362

In this simple approach, impacts are rated on a common "dimensionless" scale and displayed in a matrix format. This technique is simple, takes relatively little time to perform, and produces an output that is clear and easy for users to comprehend. Its disadvantages are that is generally subjective and any quantification is open to criticism.

Decision Analysis – p. 363

This technique is a term for a number of techniques intended to quantify and systematize decision making, particularly under conditions of uncertainty or risk. Decision analysis can be subdivided into four basic categories:

1. Certainty – an action results in one and only one outcome
2. Risk – an action can result in more than one outcome depending on external conditions that have known probabilities of occurrence
3. Uncertainty – an action can result in more than one outcome depending on external conditions of unknown probability
4. Conflict – external conditions are replaced by a competitor

Major advantages of decision analysis in the evaluation of complex problems is that it provides an ordered, systematic, and quantified framework that yields reproducible results. One of its disadvantages is that is requires considerable time, effort, and planning. It is also highly specific to the value set of the decision maker for whom it is developed.

Policy capture - p. 367

Alternative values allow for the evaluation to incorporate stakeholders into the process. Policy capture attempts to weigh the factors considered in reaching a decision. Simply put, policy capture constructs a mathematical model to parallel the actual decision process. One or more representatives of each stakeholder group judge the relative acceptability of each scenario. Multiple regression analysis is then used to determine weights implicitly placed by the stakeholder on each factor in reaching a judgment of acceptability. It has two main disadvantages: 1) It is difficult to be sure that all factors pertinent to the decision process have been included; and 2) a good deal of time is required to the participants in the study.

Impact evaluation – p. 371

Impacts, once identified and analyzed must be evaluated in the light of societal values. Evaluation is intended to assess the costs and benefits proceeding from a technology or its alternatives and provide a foundation for policy formulation.

Policy Analysis – p. 397

Policies are guiding principles in both the public and private sectors

Policy studies address policy formulation, implementation, effects, and methodology

Models of the policy process include:

- Rational model
- Institutional model
- Group equilibrium model
- Elite model
- Incremental model
- Systems model

Policy analysis consists of a thoughtful consideration of what is likely to happen under alternatives courses of action

Policy analysis should usually include participation by policy makers and impacted publics – the policy community

Making explicit recommendations is option of the assessors and should depend on study context. Explicit recommendations are usually desirable if the assessment team can convince its audience that is unbiased

Policy analysis is a most important part of any assessment. It requires sufficient time and resources to be done well.

Communication of Results – p. 417

Effective communication of TA findings requires considerations of assessors and study users and ways to facilitate information exchange in both directions between the two communities. Three factors that greatly affect the communication to the prospective users:

1. The level of knowledge about the assessment held by the potential user beforehand

2. The amount of new knowledge the assessment provided
3. Whether the assessment was compatible with the interests if the user's organizations

The TA result should be presented with four characteristics to make policy:

1. Regard the TA subject matter as important
2. Do long-range planning
3. Have made or plan to make decisions relevant to the issues addressed
4. Are receptive to externally produced information

Life-cycle for TA results:

Before the study: intended study should be identified and its information needs understood

During the study: Carefully considered interactions between potential users and study producers can take several forms with different purposes. Study methods, completeness and assumptions should be weighed against user perceptions of what makes for a credible assessment

The report itself: This should match user needs, with attention to length, summary preparation, integration, writing style, and graphics.

After the study: A variety of written, oral and "nontraditional" dissemination means should be selected to best match the users intended users' interests

Appendix B: Applied Examples of Technology Assessment

The following sources are broken down and analyzed within this Appendix B to explain in greater depth the Technology Assessment Theory through examples. The table of contents for the sources was added to demonstrate how the TA was organized and what the priorities of the assessment were.

1. White, Irvin L., et al. *Energy from the West: Summary Report*. U.S. Environmental Protection Agency. Prepared by Science and Public Policy Program, University of Oklahoma. Prepared for Office of Research and Development. August 1979. EPA (600/9-79-027).

2. A Technology Assessment of Coal Slurry Pipelines. *Office of Technology Assessment*. March 1978. Accessed on 02/13/13, http://www.fas.org/ota/reports/7817.pdf.

3. Coastal Offshore Energy Systems: An Assessment of Oil and Gas Systems, Deepwater Ports, and Nuclear Powerplants Off the Coasts of New Jersey and Delaware. *Office of Technology Assessment.* November 1976. Accessed on 02/13/13, http://www.fas.org/ota/reports/7615.pdf.

4. Renewing Our Energy Future. *Office of Technology Assessment.* September 1995. Accessed on 02/13/13, http://www.fas.org/ota/reports/9552.pdf.

5. Energy Technology Choices: Shaping Our Future. *Office of Technology Assessment.* July 1991. Accessed on 02/13/13, http://www.fas.org/ota/reports/9119.pdf.

B.1 Energy from the West[14]

Description

For this appendix, the analysis will focus on the First Year Work Plan of the Western Energy Resources TA and the Work plan for Completing the TA of Western Energy Resources and the Final Report because since this TA was a very large undertaking. Viewing the entire scope of the project makes it more interesting and the way it was completed is more important for the LENR/CF case.

Conceptual Approach & Issues Addressed

The Energy from the West TA was a very large project and viewed the "West" holistically when it came to examining the different energy technologies that were at hand. The following quote is a way to view the TA process from a high level of detail:

"Although the scope of the assessment is limited as described above, its overall purpose will not be achieved if the concerns of the local, state and federal governments, interstate and regional governmental organizations, industry, labor, Indians and other ethnic and minority groups, and other interested groups and individuals are not taken into account. Consequently, the assessment described in this work plan is designed to produce policy-informing results useful to those who have responsibilities for or an interest in the development of western energy resources."

This is the way that the LENR/CF TA should be conducted. Without a concrete policy in mind, the plans and views contained are not all that practical.

Whom was the TA Performed for? /Who Performed the TA?

The TA was performed for the US Environmental Protection Agency Office of Research and Development.

The TA work was performed by the Science and Public Policy Program at the University of Oklahoma and Radian Corporation.

Outcome & Recommendations

The process took three years to complete and examined six energy resources in eight Western states. There is no direct takeaway because the general answer is yes, the west has energy and it should be produced. Here are the items that need to be taken into account from a policy perspective to protect the social, environmental effects for the people in the Western area.

---

[14] White, Irvin L., et al. *Energy from the West: Summary Report*. U.S. Environmental Protection Agency. Prepared by Science and Public Policy Program, University of Oklahoma. Prepared for Office of Research and Development. August 1979. EPA (600/9-79-027).

Applicability to LENR/CF Case

The first year work plan has three phases for its analysis: descriptive, interactive, and integrative. The three phases are an interesting way to view the technology. The descriptive phase, interactive phase and integrative phase are a collection of comprehensive analysis to view a problem. For a LENR/CF TA attempt, this table of contents could provide a good template to design a system of analysis for the projects outcome. LENR/CF will need to be explained in a similar sort of way. An outline of the first year of work would contribute toward a successful project in that discovering the full range of costs and benefits can give decision makers the information that they need to determine the outcome of the funding of LENR/CF research.

One paragraph from the First Year work plan illustrates the need for multidiscipline input into the iterative process of TA. The LENR/ CF case must be viewed through a multi-disciplinary lens for it to have the most comprehensive view.

The work plan to complete the TA is important because it takes all the information that had been gathered up to that point and made decisions on how to complete the study

The final report for the Energy from the West TA is very interesting in the way it is organized and the critical areas that this report chose to focus on. The report limited the scope of the states to Montana, North Dakota, South Dakota, Wyoming, Colorado, Utah, Arizona, and New Mexico. So the study limited the geographic area. Also, within that eight state area, the study focused on six sites within that geography. The LENR/CF case may not focus on specific states, but it may be useful to focus on particular areas where the technology may be more beneficial based on the economic makeup of that area. For instance, if the LENR/CF device can produce enough steam for electricity it may make sense to look for areas which have coal plants that are being retire so these boilers can be placed into existing infrastructure rather than building something from scratch

The study also limited the technologies that it would focus on: crude oil, natural gas, coal, uranium, oil shale and geothermal. This helped to limit the effects from technology development. By limiting the types of technologies the impacts of the technologies were limited as well. LENR/CF TA should be limited as well. From the literature, there is a lot of products and plans that are called LENR/CF. Finding to the most promising technologies and evaluating those is a good way to structure the TA/ .

This holds promise for the final report for the LENR/CF TA there is a template to limit the scope and the impacts of the study to prevent the project from spilling out into too many directions.

The format that the Final Report takes could be a nearly direct template for which the LENR/CF case could follow. It mirrors most of the information that would be needed to make a LENR/CF Ta fully complete.

Table of Contents

I. First Year Work Plan of the Western Energy Resources TA

Using the Table of Contents from the First Year Work Plan of the Western Energy Resources TA, it is possible to lay out a template for beginning a TA.

1. Chapter 1: First Year Work Plan Report
   - 1.1. Introduction
   - 1.2. Purpose and Scope
   - 1.3. Specific Objectives
   - 1.4. Assumptions
   - 1.5. Plan of the Report
2. Chapter 2 Conceptual Framework
   - 2.1. Introduction
   - 2.2. Assessment Phases
   - 2.3. Summary
3. Chapter 3: The Descriptive Phase
   - 3.1. Introduction
   - 3.2. Energy Resource Development Systems
   - 3.3. Overview of the Western Region
   - 3.4. Scenarios
4. Chapter 4: The Interactive Phase
   - 4.1. Introduction
   - 4.2. Physical Impacts
     - 4.2.1. Air Quality
     - 4.2.2. Water Quality
     - 4.2.3. Solid Waste
     - 4.2.4. Noise
   - 4.3. Resource Availability
     - 4.3.1. Water
     - 4.3.2. Land Consumption
     - 4.3.3. Transportation
     - 4.3.4. Materials and Equipment
     - 4.3.5. Personnel
     - 4.3.6. Financial Resource
   - 4.4. Ecological Impacts
   - 4.5. Social, Economic and Political Impacts
   - 4.6. Health Effects
   - 4.7. Energy
   - 4.8. Aesthetic Impacts
   - 4.9. Integrating the Results of the Impact Analyses
5. Chapter 5: The Integrative Phase: Policy Analysis
   - 5.1. Introduction
   - 5.2. General Approach to Policy Analysis
   - 5.3. Procedures, Methods and Techniques
   - 5.4. Anticipated Results
   - 5.5. Data Adequacy
   - 5.6. Research Adequacy

6. Chapter 6: Research Adequacy, Data Availability, and Sensitivity Analysis
   6.1. Introduction
   6.2. Procedures
   6.3. Information and Data Base
   6.4. Assessment of Data Quality and Sensitivity
   6.5. Identification of Research Needs
   6.6. Anticipated Results
7. Chapter 7: Proposed Performance Schedule
   7.1. Introduction
   7.2. The Performance Schedule
8. Chapter 8: Reporting Results of the First Year TA
   8.1. Introduction
   8.2. Baseline Data Compilation
   8.3. Analytical Results
   8.4. Research Adequacy
   8.5. Distribution of Results
9. Chapter 9: Tentative Plans for the Second and Third Years
   9.1. Introduction
   9.2. Overall Scenarios
   9.3. Impact Analysis
   9.4. Policy Analysis

II. Work Plan For Completing A Technology Assessment of Western Energy Resource Development

This work plan is the part of the iterative process of a TA. It reflected on the First Year Plan as well as other publications that had been completed. This interim report is a bit different from the First Year Work Plan in that it provides less technical detail and gives more detail as to how the project is progressing from an overall viewpoint. Its table of contents is shorter and seeks to combine reports from different parts of the TA project.

1. Chapter 1: Background and Organization
   1.1. Introduction
   1.2. Progress to Date
   1.3. Purpose and Organization of This Work Plan
2. Chapter 2: Impact Analysis
   2.1. Introduction
   2.2. Levels of Development
      2.2.1. Coal
      2.2.2. Oil Shale
      2.2.3. Oil, Natural Gas, Uranium, and Uranium
   2.3. Extensions and Refinements
      2.3.1. Added development alternatives
      2.3.2. Changes within Impact Analysis Categories
   2.4. Interactive Effects
   2.5. Uncertainty
   2.6. Reporting the Results of Impact Analysis
3. Chapter 3: Policy Impacts
   3.1. Introduction

3.2. Technology Assessment as Applied Policy Analysis
3.2.1. Technical Analysis
3.2.2. Policy Analysis
3.2.3. Overlap and Interaction of Technical and Policy Analyses
3.3. Policy Analysis In The Western Energy Study
3.3.1. Introduction
3.3.2. The Identification and Definition of Problems and Issues in Western Energy Resource Development
3.3.3. The Description and Political Context of Issues Associated with the Development if Western Energy Resources
3.3.4. The Identification, Definition, Evaluation, and Comparison of Alternative Policies and Implementation Strategies
3.3.5. The Policy Analysis Report
4. Chapter 4: Reports
4.1. Introduction
4.2. Background and Supporting Materials Reports
4.2.1. Energy Resource Development Systems
4.2.2. Impact Analysis Report
4.2.3. Policy Analysis Report
4.2.4. Data Research Adequacy Report
4.2.5. Information File Report
4.2.6. Subcontractor Reports
4.3. Final Technology Assessment Report
4.4. Timetable for Completing the Project
5. Chapter 5: Regional Activities and Utilization
5.1. Introduction
5.2. Utilization and Feedback Efforts

III. Final Report

Part I: Introduction
Chapter 1: Context of Western Energy Resources
1. Introduction
2. National Energy Goals
3. Western Energy Resources
4. Selected Factors Affecting Level of Development
5. Purpose and Objectives
6. Scope
7. Overall Assumptions
8. Data Sources

Chapter 2: Conduct of the Study
1. Introduction
2. Conceptual Framework
3. Interdisciplinary Team Approach
4. Summary

Chapter 3: The Impacts of Western Energy Resources Development: Summary and Conclusions
1. Introduction
2. Air Quality

3. Water Availability
4. Social, Economic, and Political
5. Ecological
6. Health Effects
7. Transportation
8. Aesthetics and Noise
9. Summary

Chapter 4: Policy Problems and Issues

1. Introduction
2. Water
3. Air
4. Planning and Growth Management
5. Reclamation
6. Conclusion

Chapter 5: Plans for Completing the Project

1. Introduction
2. Background and Supporting Materials
3. Final TA Report

B.2 A Technology Assessment of Coal Slurry Pipelines[15]

Description

This TA was designed to study the effect of using coal slurry pipelines as a means to move coal from place to place in the United States. This TA is investigating the future and prospects for building coal slurry pipelines within the United States. The study investigates the costs as well as the impacts from deployment of this type of technology. Not just focusing on economic impacts, the study also touches on social and environmental impacts as well.

Conceptual Approach & Issues Addressed

One of the key statements from this TA is that the information contained within it is "based on simplifying assumption and considerable speculation about the future."

Within the study, there are four studies which make up a subset of the TA. The first sub-study focuses on the volumes of coal which may form the baseline for coal shipped until the year 2000 for different regions of the country.

[15] A Technology Assessment of Coal Slurry Pipelines. *Office of Technology Assessment*. March 1978. Accessed on 02/13/13, http://www.fas.org/ota/reports/7817.pdf.

The second sub-study focuses on estimates of cost and market scenarios which would drive the project economics. It also attempts to add up the total social costs of electric power generation, which includes service quality and cost, employment and other economic measures.

The third sub-study covers the social and environmental impacts of the use of water to ship the coal through a slurry pipeline. There is a contrast and comparison between the movement of coal by pipeline and rail and offers the comprehensive view of the alternatives and the plans which the study had in mind.

The fourth study was subjecting the rest of the analysis to a sensitivity analysis which gives the effects of changes in the variables to the rest of the study.

Whom was the TA Performed for? /Who Performed the TA?

This TA was performed for the US Senate Committee on Energy and Natural Resources, US Senate Committee on Commerce, Science, and Transportation, and US House of Representatives Committee on Interstate and Foreign Commerce

The TA was performed by the OTA Coal Slurry Pipeline Project Staff as well as a group of consultants. The study was overseen by the Coal Slurry Pipeline Advisory Panel (which was made up of those in government, private industry and academia) and the OTA Energy Advisory Committee (which was made of people industry and academia)

Outcome & Recommendations

In certain cases, the study recommends the use of coal slurry pipelines and offers the circumstances for which they would make sense.

The study makes a point of arguing the alternatives for transporting coal. The two main alternatives are rail and pipeline. The study concludes that if the regulatory framework was modified with respect to the power of eminent domain, the pipelines would enjoy a considerable advantage over the

Applicability to LENR/CF Case

Both the coal slurry pipeline and the costal energy TAs are mainly focused on evaluating alternatives. For a TA on LENR/CF, the alternatives would probably be less economic and more social because if the promises of LENR/CF became true, the costs would cancel out most of the other forms of energy generation. The economic evaluations would be better suited to measuring

what displacement effects would create opportunities for the government to help manage the transition to LENR/CF.

The way in which the sub-studies make up a larger TA makes sense for the LENR/CF case as different studies could view different parts of the whole if this technology were to take hold. One study could focus on the electric generation parts of LENR/CF and another could focus on the economic issues with the introduction of this technology. The sensitivity analysis could change assumptions and affect the way in which different parts of the field take shape. If the costs are higher for one technology or another, then energy may have to come from other sources. The study must make it clear of the assumptions which are being taken into account, whether it is just a source of excess heat and has limited other benefits or of the LENR/CF technology can be ramped up and applied in creating more meaningful energy such as steam for electricity production or for transportation.

Table of Contents

(3) Economic impacts of water resource allocation

VI) Environmental and Social Impacts
1) Introduction
2) Water Use by Pipelines
   i) Water for the Wyoming Pipeline
   ii) Water for the Montana Pipeline
   iii) Water for the Tennessee Pipeline
   iv) Water for the Utah Pipeline
   v) Alternative Water Supply sources
   vi) Coal-water Interaction and Corrosion
   vii) Slurry Water Reuse and Impacts
3) Community disruption by Railroads
4) Construction Impacts
5) Operational Impacts
   i) Air
   ii) Dust Emissions
   iii) Disruptions of Biological Communities
   iv) Energy/Materials Requirements
   v) Occupational Health and Safety

VII) Legal and Regulatory Analysis
1) Introduction
   i) Legal Provisions which favor pipelines
   ii) Legal provisions which favor railroads
2) Transportation regulation
3) Water Law
4) Environmental Law
5) Eminent Domain

VIII) Appendix – Baseline Rail Revenue and Cost Projections

B.3 Coastal Offshore Energy Systems: An Assessment of Oil and Gas Systems, Deepwater Ports, and Nuclear Powerplants Off the Coasts of New Jersey and Delaware[16]

Description

This TA is concentrated solely on several sources of energy generation in a specific area of the United States, New Jersey and Delaware. The three energy systems that this TA is focusing on are oil and natural gas development, installation of deepwater port to accommodate Supertankers, and construction of at least two floating nuclear powerplants.

Conceptual Approach & Issues Addressed

The TA went about assessing the impacts for three types of energy systems if they were deployed in New Jersey and Delaware.

- Offshore Oil and Gas Development
- Floating Nuclear Plant
- Deepwater Ports which could accept new supertankers

The study analyzed the federal regulations, environmental role, technical designs, risks from accidents, economic impacts as well as many other impacts that could happen depending on the decision that policymakers make on these technologies. The study also outlines several alternatives to the three technologies that are proposed in the study. Most of the alternatives are conventional and this comparison of the alternatives lays out the evidence all at once to help normalize the technologies and make for more informed decision-making between alternatives.

The study looked at the background of each technology, what would be necessary for deployment, what effects would take place on the coast, and what the risks and safety issues are.

There is also an entire section dedicated to the public participation which informed the decisionmakers and led to the important input from those people who could be affected by decisions.

Whom was the TA Performed for? /Who Performed the TA?

This TA was performed for the US Senate National Ocean Policy Study group

The TA was performed by OTA Oceans Program Staff and was overseen by the Oceans Assessment Advisory Panel

Outcome & Recommendations

The study found that there was not likely to be significant damage to the environment or changes in the patterns of life in either New Jersey or Delaware. The study makes it clear that these operations are very complex and require a lot of oversight and strict operational monitoring.

---

[16] Coastal Offshore Energy Systems: An Assessment of Oil and Gas Systems, Deepwater Ports, and Nuclear Powerplants Off the Coasts of New Jersey and Delaware. *Office of Technology Assessment.* November 1976. Accessed on 02/13/13, http://www.fas.org/ota/reports/7615.pdf.

The study makes it clear that the idea of a floating nuclear plant involves unique risks, all of which have not yet been studied in great detail. The study calls for changes within the federal government which would allow for more exploration of the offshore oil and gas resources.

The last point that the study makes is that there is are no alternatives within the group studied which offer a clear social, environmental, or economic advantage over the others.

Applicability to LENR/CF Case

The use of public input to the TA would be important. It would help outline the biggest concerns over the introduction to the technology. Though experts would be necessary for most of the analysis, the use of a public forum would allow the policy to take into account all of the possible outcomes which could take place.

Viewing the LENR/CF case through its anticipated effect, the process of implementing the technology, and the preferences and alternatives to LENR/CF would be a beneficial way to conduct the TA.

Table of Contents

c. Offshore Oil and Gas Issues
    i. Federal Management System
    ii. Regulation Enforcement
    iii. Oil Spill Liability and Compensation
    iv. Oil Spill Containment and Cleanup
    v. Environmental Studies
    vi. State Role
    vii. Pollution Research
    viii. Conflicting Ocean Uses
d. Deepwater Port Issues
    i. Tanker Design and Operations
    ii. Oil Spill Containment and Cleanup at Deepwater Ports
    iii. Standards in State Waters
    iv. Adjacent Coastal State Status
e. Floating Nuclear Plant Issues
    i. Risks from Major Accidents
    ii. Deployment Involute
    iii. Technical Uncertainties
    iv. Siting offloading Powerplants Outside U.S. territorial limits
f. Footnotes

IV. Discussion of the Technologies
a. Introduction
b. Description of the Study Area
c. Development of Offshore Petroleum Technologies in the Mid-Atlantic
    i. Lots of background
d. The Possibility of Deepwater Ports in the Mid-Atlantic
    i. Lots of background
e. The Proposal for a Floating Nuclear Powerplant in the Mid-Atlantic
    i. Lots of background
f. Alternatives to Offshore Technologies

V. Public Participation
a. Public Participation: A Pilot Project
b. Major Findings for All Technologies
c. How Public Participation Affected the OTA Assessment

B.4 Renewing Our Energy Future[17]

Description

This TA analyzes the development of Renewable Energy Technologies (RETs) in the United States from the mid-1970's to 1995.

[17] Renewing Our Energy Future. *Office of Technology Assessment.* September 1995. Accessed on 02/13/13, http://www.fas.org/ota/reports/9552.pdf.

Conceptual Approach & Issues Addressed

Viewed the technologies from where they would be deployed. Agricultural crops is not really a "space" where the other chapters have space as an attribute. The TA moves from Buildings, to Transport, to Electricity and then to foreign countries which has a way of organizing itself in a way to frame the different energy technologies for the country.

Whom was the TA Performed for? /Who Performed the TA?

This TA was completed for US Senator Charles Grassley, the US House of Representatives Committee on Science and its Subcommitee on Energy and Environment, two Subcommittees of the US House of Representatives Committee on Agriculture – Department Operations, Nutrition and Foreign Agriculture and Resource Conservation, Research and Forestry; the House Subcommittee on Energy and Environment of the Committee on Appropriations.

The TA work was completed by the OTA project staff and was overseen by an Advisory Panel which was made up of people from academia, private industry, non-profits and industry interest groups. There were also third-party contributors and reviewers which added to the multi-disciplinary aspect of the project.

Outcome & Recommendations

The TA outlines different policy options which could be used to make the technologies more cost effective and lead to outcomes which could strengthen the renewable energy market.

Applicability to LENR/CF Case

The LENR/CF case could be argued to be a renewable energy technology so the way that the TA goes through the different areas where RETs are deployed makes perfect sense for LENR/TA. The way that LENR/CF could change the electricity market, residential and commercial buildings as well as transport and agriculture would all be important areas which the LENR/CF TA could touch on. Going through each area of society in a clear and organized way would be useful for the LENR/CF TA.

Table of Contents

II. Agricultural Energy Crops
    a. Bioenergy Supply
    b. Potential Environmental Impacts
    c. Economic Impacts
    d. RD&D and Commercialization
    e. Policy Options
    f. Crosscutting Issues
    g. Conclusions
III. Residential and Commercial Buildings
    a. Introduction
    b. Renewable Energy Technologies
    c. Policy Options
    d. Crosscutting Issues
    e. Conclusions
IV. Transport
    a. What Has Changed in Transport Fuels?
    b. Renewable Energy Paths for Transport
    c. A Renewable Fuel Menu
    d. Emerging Vehicle Technologies
    e. Policy Issues
    f. Conclusion
V. Electricity: Technology Development
    a. Renewable Energy Technologies and Industries
    b. Renewable Energy Systems
    c. Overcoming Barriers
    d. Policy Options
    e. Crosscutting Issues
    f. Conclusion
VI. Electricity: Market Challenges
    a. Electricity Sector Change
    b. Power Plant Finance
    c. Utility Full Fuel-Cycle Tax Factors
    d. Direct and Indirect Subsidies
    e. Risk and Uncertainty
    f. Environmental Costs and Benefits
    g. Approaches to Commercializing RETS
    h. Conclusion
VII. Government Supports and International Competition
    a. Countries
    b. Comparisons
    c. Policy Options
    d. Conclusions

B.5 Energy Technology Choices: Shaping Our Future[18]

Description

This TA covers the various energy technologies that existed in 1991 that could provide energy sources for the United States.

Conceptual Approach & Issues Addressed

The three uncertainties that the TA addressed were:

1. How to assure a long-term supply of reasonably priced, convenient fuels, especially for transportation
2. How to protect the country against disruptions of petroleum imports
3. How to mitigate emissions of carbon dioxide

Whom was the TA Performed for? /Who Performed the TA?

US Senate Committee on Energy and Natural Resource, US House of Representatives Committee on Government Operations, and US House of Representatives Committee on Energy and Commerce

The TA work was completed by the OTA Project Staff and was overseen by an Advisory Panel which included people from government, academia, private industry and non-profit organizations

Outcome & Recommendations

All options entail some compromises as the study has claimed there is no single energy panacea that can solve all the long-term requirements for the United States.

The TA lays out several scenarios that the nation could follow:

- Emphasizing production of conventional fuels
- Improving efficiency of use to the economic optimum
- Minimizing the use of energy as far as is technologically possible
- Emphasizing renewable energy sources
- Emphasizing nuclear energy

[18] Energy Technology Choices: Shaping Our Future. *Office of Technology Assessment.* July 1991. Accessed on 02/13/13, http://www.fas.org/ota/reports/9119.pdf.

The last two chapters, which compare all the scenarios, offer a picture for what will happen in different cases both in the economic outcomes and policy outcomes.

Applicability to LENR/CF Case

The scenario analysis is a very powerful tool that could be applied to the LENR/CF TA as the different outcomes for the research in the field could guide policymakers to make the correct decisions. Evaluating the different ways which the changes could occur could be paired with the evidence based judgments which can be a signal from the field as to what the results from the experiments are.

The way in which scenario analysis and sensitivity analysis could be combined to make the what-if situations more real and give a lot of help in guiding policymakers to possible outcomes from pursuing the LENR/CF technologies as an energy source.

Table of Contents

b. Baseline Scenario
c. High Growth Scenario
d. Moderate Efficiency Scenario
e. High Efficiency Scenario
f. High Renewables Scenario
g. High Nuclear Scenario
h. Comparing Scenarios

Appendix C: Participatory Technology Assessment

C.1 Participatory Technology Assessment

Community-Based Research and Technoscience Activism

- "…science shops provide knowledge and skills to civil society members as well as students and university researchers; they build equitable partnerships between researchers and civil society organizations; and they inform university leaders and policy-makers of the research and education needs of civil society."
- Likewise, HIV/AIDS activists, opponents of digital surveillance, seed savers, and movements against advanced weapons systems represent but a few of the many grassroots engagements with specific arenas of science and technology that seek democratization and accountability.
- Community-based research has a wellspring of energy and authenticity which is grounded in local issues
- Movements focused on specific technologies are constrained by a different concreteness that requires sustained focus on the industries that deploy these technologies and the policy venues that promote and regulate them.

C.2 Reinventing Technology Assessment

- Over time, taking the public's pulse became integrated into our work on understanding the risks and benefits of new technologies and convinced us that public policy can be improved through sustained and carefully crafted dialogue with laypeople. But it also became obvious that interaction with the public was neither an accepted practice nor a desired outcome in most areas of science and technology (S&T) policy. The idea of "engaging the public" has had high rhetorical value in the S&T community, but little practical impact on decision-making.
- Technology assessment (TA) is a practice intended to enhance societal understanding of the broad implications of science and technology. This creates the possibility of preparing for – or constructively influencing – developments to ensure better outcomes.
- Meanwhile, there are now a dozen parliamentary TA agencies in Europe. They have developed many promising TA practices, including highly effective methods involving participation by everyday citizens.*
- Participatory technology assessment (pTA) enables laypeople, who are otherwise minimally represented in the politics of science and technology, to develop and express informed judgments concerning complex topics. In the process, pTA deepens the social and ethical analysis of technology, complementing the expert-analytic and stakeholder-advised approaches to TA used by the former OTA. European pTA methods have been

adapted, tested and proven in the U.S. at least 16 times by university-based groups and independent non-profit organizations.

- OTA reports were analytically rigorous and supplied extensive, in-depth and useful information. They provided Congress and the nation good value for the money. The OTA also had an oversight and pre-publication review process that ensured that studies were non-partisan
  - Slow delivery
  - Misleading presentation of objectivity
  - Uneven treatment of social consequences
  - Limited insight into synergisms and sociotechnological dynamics
  - No citizen perspective
- Virtues of Participatory Technology Assessment
  - Reasons to include laypeople in the TA methods are:
    - A matter of democratic right
    - Social values
    - Broader knowledge base
    - Cost reduction
    - Expedited conclusions
- Criteria for a New U.S. Technology Assessment Capacity
  - Participation and Expertise
  - 21st-Century Structure
  - Continual Innovation in Concepts and Practices
  - Non=partisan Structure and Governance
  - Commitment to Transparent Process and Public Results
- Practical Options for Establishing a 21st=Century TA Capability
  - One option: Congressional TA capability within GAO or other Congressional organization
  - Second option: Establish Expert & Citizen Assessment of Science & Technology (ECAST) network. This body would independent of government and comprise a complementary set of non-partisan policy research institutions, universities
- Due to the changing pace of innovation in technology today, there is not a mechanism for understanding political costs and opportunities for innovation.
  - Without TA, citizens are often left to their own devices and the less obvious social ramifications of science and technology or practical alternatives are unknown until the technology is already entrenched.
  - With the introduction of the internet and Web 2.0 features, there are now opportunities for organizing TAs which make technology and science more

transparent, publicly accessible, geographically distributed, collaborative and cost-effective.

- European Advances
  - Danish style "consensus conference" – intended to provide policy-makers with a window into ordinary citizens' considered opinions concerning emerging technological developments while also stimulating broad and intelligent social debate on technological issues
  - Additional pTA methods include:
    - Scenario workshops
    - Planning cells
    - Citizen hearings
    - Future search conferences
    - Development spaces
    - Deliberative mapping
- Page 27 – No citizen perspective

C.3 Role of Participatory Technology Assessment in Policymaking

- In its essence, Technology Assessment (TA) has a strong political dimension. When the American Congress developed TA in the 70's, it imagined a political instrument which would give to its members access to independent, objective and competent information on scientific and technological issues.
- The American model was based on a rather scientific approach of the assessment (involving stakeholders only afterwards), European TA always struggled with how exactly to integrate interests and values in the assessment.
- One strand of European TA – mainly originating in Denmark – is trying to solve the problem of how to make values and interests fruitful by organizing participatory procedures.
- With this "participatory turn", the political dimension of TA is even reinforced as it is no more an academic activity whose outcomes are to be communicated to and used by policy-makers, but a political activity itself. Integrating various actors is eminently political, as questions of power, influence and responsibility intervene.
- New developments in science and technology put public authorities under stress as they are faced with uncertainty about the consequences of these developments and with a plurality of values and interests about them. Also our other theoretical lens, inequality, highlights the possible political contribution of pTA, in particular to take into account the plurality of views and values present in society and to give them a voice.
- pTA allows for:
  - Minority proposals are presented as viable solutions and get a chance to be accepted by the majority, too.

- pTA can bring new ideas which will develop in time and generate further new ideas. In this respect, the role of pTA on the policy-making process is of a very special nature.
- when assessing the role of pTA on the policy-making process, we must not forget that the actors intended to take up the results of the pTA do not always agree with its outcomes. PTA is always part of the political game in which power is at stake.