Public Policy Statement 2009-2012

Framework for a 21st Century United States Energy Strategy

Objective Decision-Making in a Complex Energy Landscape

Ensuring a secure, clean, sustainable, and affordable supply of energy is the central global challenge for the 21st century. Energy demands in developed and developing nations continue to grow as traditional supplies become increasingly expensive and scarce. Over-dependence on fossil fuels continues to threaten the global climate and impede the transition to more sustainable energy sources. It is imperative that policymakers make difficult decisions to foster the development of renewable, sustainable, and/or clean energy solutions, and to spur greater efficiency in the use of traditional fossil and nuclear fuels.

To attain a reliable, affordable, predictable, and sustainable supply of energy for the mid- to long-term future, policymakers must identify and implement a comprehensive energy strategy that includes targeted investments in technologies for energy solutions and encourages conservation. The strategy must consider current and projected energy capabilities. It must also be responsive to projected US energy needs in the context of global demand. All these factors may evolve significantly over time. A complex and challenging analysis of the costs and benefits of different energy solutions will be required to formulate this strategy; however, without credible analyses, policymakers cannot ensure their investments will enable the US to meet its future energy requirements at acceptable environmental, economic, and social costs.

Policymakers must move immediately to support the development of a transparent, comprehensive analysis framework for proposed energy solutions. This framework will facilitate comparison of diverse energy systems and guide technology development and public policy. Currently, the lack of a framework compromises policy decisions and will likely result in misplaced investments. The framework must allow consideration of diverse issues, including but not limited to

- the entire energy production/distribution/use cycle, “cradle-to-grave,” including sustainability and direct and indirect costs and benefits;
- the global nature of the energy production/distribution/use cycle (i.e., US energy decisions may impact other nations, and vice versa);
- the probability that a mixture of different energy solutions (e.g., traditional fuels, biofuels, synthetic fuels, and low-emission technologies) will be required, and that this mixture will change over time;
- the role of conservation and greater energy efficiency, including issues associated with energy storage and transport; and
- the balance between improving traditional and integrating emerging energy technologies.

Developing a framework to evaluate energy strategies will be difficult. However, the end result will allow policymakers and stakeholders to understand the costs, benefits, and performance of different combinations of energy solutions, and to make informed decisions on investing in our energy future.

Importance of a Transparent Analysis Framework to Inform Energy Policy

Currently, there is no widely accepted framework for analyzing energy solutions. Different credible groups have proposed radically different energy solutions, in part because each uses different assumptions, baselines, input data, and system (problem) boundaries. *The following case study is presented for purposes of illustration; the ACS and the AIChE do not endorse any particular fuel options or analyses.*

Two peer-reviewed analyses compared the greenhouse gas emissions from corn-derived ethanol as a transportation fuel to a baseline case of gasoline over the lifecycle of the fuels[1]. One study concluded there is a 20 percent reduction in greenhouse gas emissions from corn-derived ethanol compared to gasoline, while the other concluded a 96 percent increase in greenhouse gas emissions from a corn-to-ethanol system. Such conflicting results, at best, confuse decision-makers. An assessment of the analyses illustrates that discrepancies arise from one study using a model to factor in greenhouse gas emissions associated with converting land for agricultural purposes; the other study does not. It is interesting that the studies agreed on some impacts, (e.g. the magnitude of the uptake of emissions by crops); however, since they assumed different system boundaries, they came to different conclusions.

The analysis that is needed to ensure we can meet our future energy requirements will require systematic consideration of many issues. A number of analysis frameworks may be applied. In general, these frameworks involve

- Definition of the problem to be analyzed;
- Selection of criteria or metrics for evaluating potential solutions to the problem;
- Identification of a full suite of known potential solutions, critical knowledge gaps, and required research agendas; and
- Comparative evaluation of the performance of potential solutions against the criteria or metrics.

Many commercial software programs facilitate these types of analyses; alternatively, existing models that have been developed by federal agencies may be adapted to this purpose.

Necessary Components of a Transparent Analysis Framework

Policymakers must encourage adoption of an analysis framework and the development of a rigorous process for vetting and updating it. Since the evaluation of energy solutions is a complex problem with many variables, the initial framework must be carefully formulated, or, as in the example above, confusion will persist.

It is not reasonable to expect the framework to include every criterion. Policymakers must commission an up-front analysis to identify the key criteria relevant to the major impacts. The most important criteria must be selected based on their predicted impact and their sensitivity on overall outcomes. Criteria must also be concisely defined, so they can be easily referenced, and transparent enough to show the effects of assumptions and values.

In general, the framework should embrace "big-picture" issues, such as costs (direct and indirect), potential efficiencies, feasibility, overall energy supply and balance, projected national and international demand, and environmental impact and sustainability. Many analyses to date have provided simple projections of existing

[1] Searchinger, T., et. al., *Use of US croplands for Biofuels Increases Greenhouse Gasses Through Emissions from Land-Use Change.* Science, 2008. Wang, M., *Effects of Fuel Ethanol Use on Fuel-Cycle Energy and Greenhouse Gas Emissions*. 1999, Department of Energy: Argonne National Lab.

trends. These may not be correct as technologies, demand, and other factors change significantly over time. The framework should be robust enough to accommodate these changes. It should explicitly consider trade-offs among technology choices and resulting unintended consequences at the national and international level. It should utilize commonly accepted standards of computation so different users can arrive at similar results. It should be verifiable, consistent along a material flow chain and allow evaluation throughout the lifecycle. It must protect proprietary data to encourage industrial participation and be consistent with domestic regulations and international agreements. Furthermore, it must be easily understood, so that policymakers and key stakeholders grasp the framework and can follow it through to the conclusions.

The evaluation criteria will necessarily be both quantitative (e.g., cost, greenhouse gas emissions, energy efficiency) and qualitative (e.g., lifestyle, transfer of wealth, national security impacts). The scientific and engineering community has developed such criteria for other purposes. As an example, the non-profit ABET, formerly the Accreditation Board for Engineering and Technology, standardized criteria for evaluating engineering problems. Their criteria spanned economics, environmental impact, health and safety factors, manufacturability, sustainability, and social, political, and ethical concerns. The latter three categories can encompass impacts on local populations, national goals, or international agreements.

Selected criteria must include both direct and indirect effects. For example, greenhouse gas emissions must be included; also the human health and ecosystem impacts of these emissions must be incorporated. The indirect impact of using food crops (e.g., corn) as ethanol feedstocks on the price of food must be included, as well as changes in cost profiles of other commodities with significant changes in demand. It will be imperative to consider costs from a life cycle perspective; e.g., battery life cycle costs must be evaluated from creation through disposal, including opportunities for reuse or recycle. Indirect impacts on other countries must also be considered, as choices made in the US may be augmented or offset by other nations and vice versa.

The first step in developing the framework will be to sharply focus the scope and define the energy system boundaries. As shown in the earlier example, lack of a common framework among studies may result in strongly differing conclusions. The second step will be to agree upon the evaluation criteria. ACS and AIChE are developing criteria for consideration. Supply-chain steps can then be defined: for bio-ethanol, these might be growth, harvest, and transport, conversion to a fuel, and distribution and use of the fuel. Then, a few key criteria, carefully normalized, can be selected for analysis, such as cost per standardized mile, energy density by mass and volume, water consumption per standardized mile, greenhouse gas emissions per standardized mile, etc. Process boundaries and impacts should be clearly stated to facilitate comparison of systems, and stakeholders should be engaged throughout the process.

Recommendations

- Preliminary efforts to assess energy solutions are currently planned or underway. Multiple federal entities, including the Department of Energy (DOE), the Environmental Protection Agency (EPA), the Department of Commerce's National Institute of Standards and Technology (NIST), and the Department of Agriculture (USDA), must have roles in the formulation of a comprehensive energy strategy. However, policymakers must move promptly to designate a lead federal entity to coordinate these efforts, to fully fund existing federal programs in this area, and to support international collaborations and activities to coordinate energy strategy assessments with other nations.
- ACS and AIChE recommend the Federal BioFuels Metrics Interagency Task Force, encouraged by the Energy Independence and Security Act of 2007 (PL 110), be fully funded. This effort to develop criteria for evaluating biofuel systems must also include an assessment of future energy needs. Indeed, it may provide the starting point for the development of an overall energy analysis framework.

- ACS and AIChE recommend policymakers continue to fund efforts such as those at EPA and DOE to develop life cycle assessment methodologies. These agencies should be encouraged to actively engage other federal agencies, the scientific and technical community, and energy stakeholders in these efforts.
- ACS and AIChE believe it is imperative that the US continue to actively participate in the United Nations' Global Bioenergy Partnership (GBEP). GBEP is working to coordinate and harmonize methodologies for bio-energy lifecycle assessments and sustainability issues, which are integral components of framework development.

Ensuring a safe, secure, clean, reliable, sustainable, and affordable supply of energy will be the central challenge for the foreseeable future. Policymakers must move quickly to identify and implement a comprehensive national energy strategy. Unless this strategy is derived using a transparent, credible, and comprehensive analysis framework, policymakers cannot ensure their policy decisions and investments will enable the US to meet its energy objectives and do "due-diligence" in avoiding unintended consequences. ACS and AIChE are willing and able to provide technical expertise from our broad and experienced memberships to aid the Executive Branch and Congress in these efforts.