2003-2004 IREE Seed Grant Program

Project Title: Full Cost Accounting of Renewable Energy Systems

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Project Description/Specific Goals and Objectives of the project

The State of Minnesota, along with the rest of the United States and the world, faces a serious problem of finding enough energy to power the economy while not causing irreparable harm to the environment. Fossil fuels (coal, oil and natural gas) are limited in supply and their burning leads to numerous environmental problems. A transition from burning fossil fuels to other sources of energy during the next several decades seems inevitable. Renewable energy sources are a promising alternative to burning fossil-fuels, but numerous technical, economic and environmental challenges must be met before renewable sources become a significant fraction of overall energy supply.

While many alternative sources of energy are technologically possible, whether or not they are economically and environmentally desirable requires consideration of the full cost of energy use. Two types of costs can be distinguished, private costs and external environmental costs. Private costs are paid directly by firms to produce, transport and store energy, and by firms and individuals who consume energy. Market prices of energy typically reflect these private costs. If private costs were the sum total of the costs of energy use, market prices would provide a true signal of full costs and market forces would guide society toward the most efficient energy alternatives. However, external costs of energy use, those that are not paid for directly by energy users, are pervasive. These costs include human health and welfare impacts caused by residual air, water, and solid waste emissions, impacts of climate change tied to emissions of greenhouse gases and ecological changes from land use and nutrient cycles. Such costs are not captured by market prices for energy. As a result there is often no clear signal of the full costs of energy use and therefore no clear test of which alternative energy sources are economically and environmentally desirable.

Several methods have been proposed to calculate the full cost of energy use, variously called full cost accounting, life-cycle cost analysis, cost-benefit analysis, and other names. The basic principle of these approaches is clear: to account for the complete present value of cost of an energy technology over its entire life-cycle (Lowe 1996). Life Cycle Analyses (LCAs) for energy systems emphasize the need to assess all initial, operating, maintenance, repair, disposal and transaction costs. Cost-benefit analysis emphasizes the need to include both direct and external costs in the analysis. A focus of work in this area has been to estimate non-market environmental benefits (Freeman 1993, Smith 1996). Applications of this approach to energy production include Burtraw et al. (2001), European Commission (1995), Krupnick and Burtraw (1997), Lee et al. (1995), Rowe et al. (1996). Here we use the term full cost accounting to include both direct and external costs over the complete life-cycle of an energy technology.

While the principle of full cost accounting is clear, the practice of full cost accounting is far from straightforward ("the devil is in the details"). How to estimate the full costs of environmental damages for which there is no readily available signal of cost and for which understanding of biophysical cause and effect relations may be imperfectly understood, and how far in the production chain to include, are important issues. For full cost accounting to be a practical approach that will help decision-makers evaluate alternative energy technologies, these issues must be addressed in a clear and compelling manner.

The purpose of the proposed research is to help define a set of rules to apply in the conduct of full cost accounting of energy technologies and to begin to apply these rules to account for the complete life-cycle direct and external cost associated with renewable energy methodologies proposed by other clusters within IREE. The University of Minnesota has not been active in this area in the past. DOE national laboratories have done most of the cost accounting studies for energy systems to date. However, the University of Minnesota has prominent faculty in applied economics, policy, and ecosystem research. The project leaders believe that there is an important void in current

understanding that prevents the systematic application of full cost accounting to analysis of energy systems. It is currently difficult to assess the economic and environmental consequences of alternative energy, yet there is great national and international interest in doing so.

In this light, this IREE research team proposes the following initial first year research plan to develop a capacity to develop full cost accounting methods for energy systems.

1) A Ph.D. graduate student conversant with aspects of energy, ecology and economics will work with a MS science policy student to compile and summarize full cost accounting studies in three areas: the use of biomass as a source of energy and products, the use of fossil fuels, and the use of wind, solar and other renewable energy systems. Hydrogen production and use scenarios will not be covered in this first year, as such studies are being conducted by another PEEC research team (M. Amin and R. Nordstrom).
2) The team of PIs and the students will meet to discuss the review and begin to develop recommendations for more specific research directions for the team (i.e. a needs assessment).
3) The team of PIs and the students will work on developing approaches that can be applied to evaluate biomass as a source of energy and products, the use of fossil fuels, and the use of wind, solar and other renewable energy systems. The approaches will be as inclusive as possible of the full costs and benefits. The existence of data will not yet be a concern.
4) The team will meet with a larger group of external experts (e.g. state and industry experts in the area) to vet the models.
5) The team will revise the models and begin to identify data sources. At this time, external funding may be sought.

Justification of proposal in light of current issues, opportunities, and in the context of IREE mission and investment principles

This project will help develop the U of MN's capacity to conduct full cost accounting of energy systems. It is important for such analyses to be independent and comprehensive. A team approach within the University seems ideal for this. The University has world – renowned researchers in ecosystem science (Tilman, Reich, etc.) who will advise the work of the students and comment on the models and methods at various stages in the research project. This project will support future IREE decisions with regard to supporting energy systems that make sense from financial, social, and ecosystem perspectives.

Project timelines and budget detail (Intent is to complete projects and expenditure of funds within a calendar year of approval unless specifically identified in proposal)

The work will begin in March 2004 and conclude March 2005. A report based on the effort will be published and posted on the IREE website (and submitted to appropriate journals).

Budget:

Graduate Student Research Assistant 50% Time, 12 months + Fringe	$31,506
Humphrey Science Policy MS student 12.5% Time, First 9 months+ Fringe	$5,000
Travel and meetings Visits by outside experts and trips to DOE national labratories	$2,000
TOTAL	$38,506

Description and documentation of external partnerships

Several PEEC members from outside the university will be asked to comment on the various stages of the project. These experts include those from state government, NGOs and industry (e.g. Cargill-Dow, ME3, PLA assessors). Their input will greatly benefit the project.

Probability for seed grant project leading to significant external funding or commercialization

The first year of the research will lay the necessary groundwork for applying the full cost accounting approach to analysis of particular energy systems. As particular proposals from other IREE clusters, or elsewhere, emerge as prospective energy sources, our intention is to carry out full cost accounting of such systems. It is probable that out-side funding will be sought to carry out full cost accounting of actual energy alternatives.

References

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