ITEM 4

Proposed Amendment between California Energy Commission and The Regents of the University of California, - CIEE

Title: Life-cycle Energy Assessment of Alternative Water Supply Systems in California
Amount: $160,000.00
Term: 3 months
Performing Inst: The Regents of the University of California, - CIEE
Contact: Joe O`Hagan
Committee Meeting: 6/1/2010

Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
04	Electric	EA	Master Research Agreement (MRA)	$4,320,832	$160,000	$136,395	3%

Recommendation

Approve this amendment to a work authorization under the Master Research agreement with The Regents of the University of California, - CIEE for $160,000.00. Staff recommends placing this item on the discussion agenda of the Commission Business Meeting.

Issue

In California, a significant amount of energy is required for each step of the water supply process, from extracting or diverting the water at its source, conveying the water to where it will be used, treating the water to appropriate levels, actually using the water and, finally disposing of it. Each step of the wastewater treatment process, including collection, treatment, disposal and reuse is also energy intensive. Furthermore, creating and operating the infrastructure necessary for these water and wastewater systems to function require significant amounts of materials and energy.

Given the significant energy demand associated with this infrastructure, it is important that water supply and wastewater managers understand the energy intensity of their systems and be able to assess the energy and environmental consequences of system changes, such as using desalinated water or initiating wastewater recycling. The best approach to achieving this is by using a lifecycle approach that accounts for energy and materials resource use and other environmental effects caused by extracting raw materials, manufacturing, constructing, operating, maintaining, and decommissioning the water supply and wastewater treatment infrastructure. A decision support tool based upon such an approach, the Water Energy Sustainability Tool (WEST) was created to allow users to calculate the energy and environmental implications of infrastructure associated with California's water supply and wastewater treatment systems.

The proposed amendment to this agreement would further enhance the model's capabilities and allow the model to be web based, greatly facilitating use of this model.

Background

WEST allows the user to evaluate the construction, operation, and maintenance of water and wastewater systems, compare the direct and indirect (supply chain) energy and environmental effects of alternative water sources in terms of material production (e.g., concrete, pipe, and chemicals), material delivery, construction and maintenance equipment use, energy production (electricity and fuel), and sludge disposal. Life Cycle Assessment (LCA) is a systematic methodology that allows the user to comprehensively and quantitatively evaluate the inputs and outputs, both direct and indirect, of a process, product, or service.

The WEST Model was initially funded in 2003-04 for one year and $70,000 by the Energy Commission through the environmental research grant program as a decision support methodology to assist in analyzing the energy and environmental effects associated with a district's water supply infrastructure. This model was intended to provide a screening-level analysis of water supply infrastructure and focused on three water sources: imported, reclaimed, and desalination. For these water sources, it could analyze the energy and material use in the material production and delivery, construction and operation equipment use, and energy production in all stages of the water supply system. The Microsoft Excel based model relies on user inputs, but also contains a database of information to provide default values. WEST reports life-cycle effects in terms of Gigajoules of energy use and million grams of air emissions, including global warming potential (reported in units of carbon dioxide equivalents, sulfur oxides, particulate matter, nitrogen oxides, volatile organic compounds and carbon monoxide. Two California case study systems were evaluated using WEST as a part of the study, the Marin Municipal Water District and the Oceanside Water District and energy use and environmental emissions were reported for the water supply alternatives, life-cycle phases (construction, operation, and maintenance), and water supply functions (supply, treatment, and distribution). Results of this effort are reported in CEC Publication #500-2005-10.

In 2006, additional work on the WEST was funded by the Energy Commission. This effort, funded for $534,788 for 32 months is intended to enhance and expand the model to make it a more robust and comprehensive lifecycle analysis tool. One enhancement being funded is expanding the model's ability to address different water treatment equipment and chemicals that are currently available. This would allow the user to assess certain common components of water systems, and identify emission factors which can be used to inform decision making. For example, the environmental consequences of selecting metal or plastic pipe, steel or concrete storage tanks could be assessed. Another enhancement is to include the supply chain-inclusive life-cycle effects of electricity generation. The effects of electricity generation will be included using emission factors. All methods of estimating the effects of electricity generation will be available to users for comparison or based on user's preference. Uncertainty and sensitivity analyses will be conducted on the results. Another enhancement to the model includes the ability to assess the effects of water conservation programs. Analysis of residential water-efficient fixtures and appliances, common irrigation systems, and commercial and industrial conservation technologies can be assessed and will allow the user to compare results to previous water use levels.

Other efforts under this interagency agreement are to expand the databases used in the model, provide greater user flexibility in selecting values; expand the number of pollutants addressed in the model; and include alternative sludge handling processes in the model. In addition, there is a significant technology transfer component in this contract. A user's manual and additional workshops will be held to disseminate the model to the greatest extent possible. Two workshops, one each in Northern and Southern California were held earlier this year to inform stakeholders of the model's capabilities and to solicit their comments on the model.

Proposed Work

This proposed amendment would facilitate greater accessibility of users to the model by making it a web based tool. This effort would develop internet versions of the WEST, which would be maintained on a web site managed by the UC Berkeley. Not only would this enhance the usability of and access to the tools, but would also allow the researchers to gather feedback from users in the field by being able to monitor how they use the tool (e.g., which parts they spend the most and least time on, and where there may be bottlenecks in use) and allowing the users to send feedback.

The proposed amendment would also update the model to include an assessment of the impacts of consumptive water use. Standard lifecycle analyses normally only address, in terms of water supply, the relative volume of water being used, regardless of the stresses this use causes. This addition would develop a water stress index that focuses on freshwater water availability relative to demand within a specified hydrologic basin. The model would allow users to calculate this index for water sources in California.

The proposed amendment also will quantify the water footprint of various energy sources in California, including electricity, natural gas, petroleum based fuels and biofuels. The goal is to determine the carbon footprint of these energy carriers as a result of water consumption. While the carbon footprint from the extraction, refining, and combustion of these energy carriers has been studied, the water footprint has not been, and since water consumption is associated with greenhouse gas emissions, the carbon footprint of energy carriers will grow once water consumption has been accounted for.

Justification and Goals

This project "[will] advance energy science or technologies of value to California citizens..." (Public Resources Code 25620.(c)), and is part of a "full range of research, development, and demonstration activities that . . . are not adequately provided for by competitive and regulated markets (Public Resources Code 25620.1.(a)); and supports California's goal to evaluate and conduct research to better understand the interaction of water and energy within the state and identify new and innovative technologies and measures for achieving energy and water efficiency savings per the Integrated Energy Policy Report 2005.