From Waste to Profit:

Modeling program evaluates energy, use alternatives

By Joan Slattery Wall

It's an almost unfathomable figure: 90 percent of the materials consumed by industry end up as waste.

So imagine the potential of turning some of that waste into useable energy and materials, or even finding alternative, environmentally responsible ways of disposing of it.

Engineering researchers at Ohio State's Center for Resilience have developed a computer modeling program, Eco-Flow™, that can evaluate the economic and environmental effects of waste reuse alternatives.

"With Eco-Flow, we try to understand hidden energy flows in the supply chain and the impacts of industrial and consumer activities," says Joseph Fiksel, who co-directs Ohio State's Center for Resilience with Bhavik Bakshi, professor of chemical and biomolecular engineering. "It turns out that one of the best ways we can find to reduce energy consumption is to reuse materials that are typically considered as waste."

Eco-Flow makes it possible to rapidly and repeatedly calculate the optimum pathways for material uses, even in complex networks with hundreds of processing facilities.

The model assumes that the output of any industrial process can become either resources or feedstocks for other industrial processes or unrecoverable wastes sent to disposal sites, and it calculates the most profitable allocation based on revenues, transportation and operating costs as well as other characteristics, such as capacity and environmental constraints. To discover the best overall strategy, Eco-Flow uses a network optimization algorithm based on a mathematical technique called "integer programming" to produce an optimal solution. The methodology was developed under the guidance of Marc Posner, professor of industrial and systems engineering.

In addition, the Collaborative for Enterprise Transformation and Innovation in the Department of Computer Science and Engineering is helping to develop a modern software implementation of Eco-Flow that enables users to build and modify networks graphically and run repeated optimizations.

The initial development of the Eco-Flow model was sponsored by the Solid Waste Authority of Central Ohio, SWACO, which is a member of the Center for Resilience consortium. SWACO handles close to 2 million tons of solid waste annually and is examining ways to commercialize novel landfill gas recovery; convert waste into other materials suitable for uses including composting, energy production, brownfield remediation and building materials; and separate wastes for processing in an anaerobic digester to produce renewable energy.

While the team's goal is a 15 percent reduction in waste disposal to landfills by 2012 along with a 15 percent increase in manufacturing productivity, initial Eco-Flow modeling demonstrates even greater potential.

"We believe up to 50 percent of the industrial waste stream could be recovered for valuable uses," says Fiksel, "and this would lead to benefits such as reducing Ohio's energy dependence, creating new jobs and protecting landfills."

The team also is working to improve solid waste management on the Ohio State campus; to reduce greenhouse gas emissions from City of Columbus wastewater treatment facilities; and to extend the use of Eco-Flow nationally through the U.S. Business Council for Sustainable Development.

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SWACO's Franklin County landfill receives five to six tractor trailer loads of polystyrene (Styrofoam) daily, making up 6 percent of the landfill's annual volume. The polystyrene can be ground up and mixed with cement to form Rastra, a material used to make construction panels that have a high insulation value, are fire-proof and termite-proof, and resist moisture. In partnership with the City of Columbus and SWACO, with financing from a $2 million Ohio Department of Development loan, Rastra Inc. plans to open a plant in Columbus to make the panels using polystyrene waste that otherwise would be dumped in the landfill.

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