

Engineering ways to turn waste into energy

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Landfill disposal and waste-to-energy incineration remain the two principal options for managing municipal solid waste.

(PhysOrg.com) -- In recent years, Nickolas Themelis has devoted his career to the management of household trash -- a fitting occupation for a professor originally from Athens, where the ancient Greeks created the first municipal garbage dump in the Western world near Athens in the sixth century B.C.E.

The engineering professor has overseen a global consortium of experts dedicated to waste management and waste-to-energy research from his desk on the ninth floor of the Seeley W. Mudd building.

Themelis founded the Waste-to-Energy Research and Technology Council (WTERT) in 2003 as part of the Earth Engineering Center,

which he directs, at Columbia's Fu Foundation School of Engineering and Applied Science. WTERT offshoots now exist in Greece, Germany, China, Brazil and Japan, with others planned in France, Britain, India and Mexico. The mission of the consortium is to promote research and innovation in sustainable technologies such as recycling, composting, waste-to-energy and landfill gas capture, as well as to share information among developed and developing countries.

Originally trained as a chemical engineer, Themelis spent the first part of his career working for private industry in extractive metallurgy—the science of processing ores to create metals. He is responsible for what is today known as the Noranda process—named for the company where Themelis worked at the time—which led to the world's first apparatus for continuous smelting and converting of copper that minimized the amount of sulfur emitted into the atmosphere.

It was his first scientific contribution to industrial ecology, a field of study that focuses on environmentally sustainable processes for producing materials.

When Themelis joined Columbia in 1980, he immersed himself in the subject, which changed his thinking about science and its relationship to the environment. In 1995, Themelis began to teach his students about industrial ecology, and a year later, he established the Earth Engineering Center.

It was a critical time in the history of the school, says Themelis, when the academic focus of what had been known as the Henry Krumb School of Mines moved from “the three M's—mining, materials and metallurgy—to the three E's: earth, environment and engineering,” Themelis said. The school changed its name in 1997, and in 1999, he and other engineering faculty founded the school's Earth and environmental engineering department.

In 2007, Themelis retired from teaching to focus on sustainable waste management and, in particular, waste-to-energy research and his administrative role at the center and the global WTER consortium.

Themelis underscores the importance of sharing information among the consortium partners, particularly those in developing countries where technology is lagging. He credits the council for innovations such as beneficial uses for ash and improved metal recovery, as well as for underwriting new research. Under his leadership, WTER and the Earth Engineering Center have helped design advanced waste-management systems that in the future may be implemented in New York City; the Greek cities of Athens and Rhodes; Florence, Italy; Santiago, Chile; and Mumbai, India.

“Right now there are 1.2 billion tons of solid waste annually, and only about one-sixth of this is being turned into [energy](#). The rest goes to landfills,” said Themelis. “This is tantamount to burying one billion barrels of oil by transforming one hundred square kilometers of greenfields to landfills. My hope is that we can show people that the management of wastes can be more sustainable.”

Provided by Columbia University

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