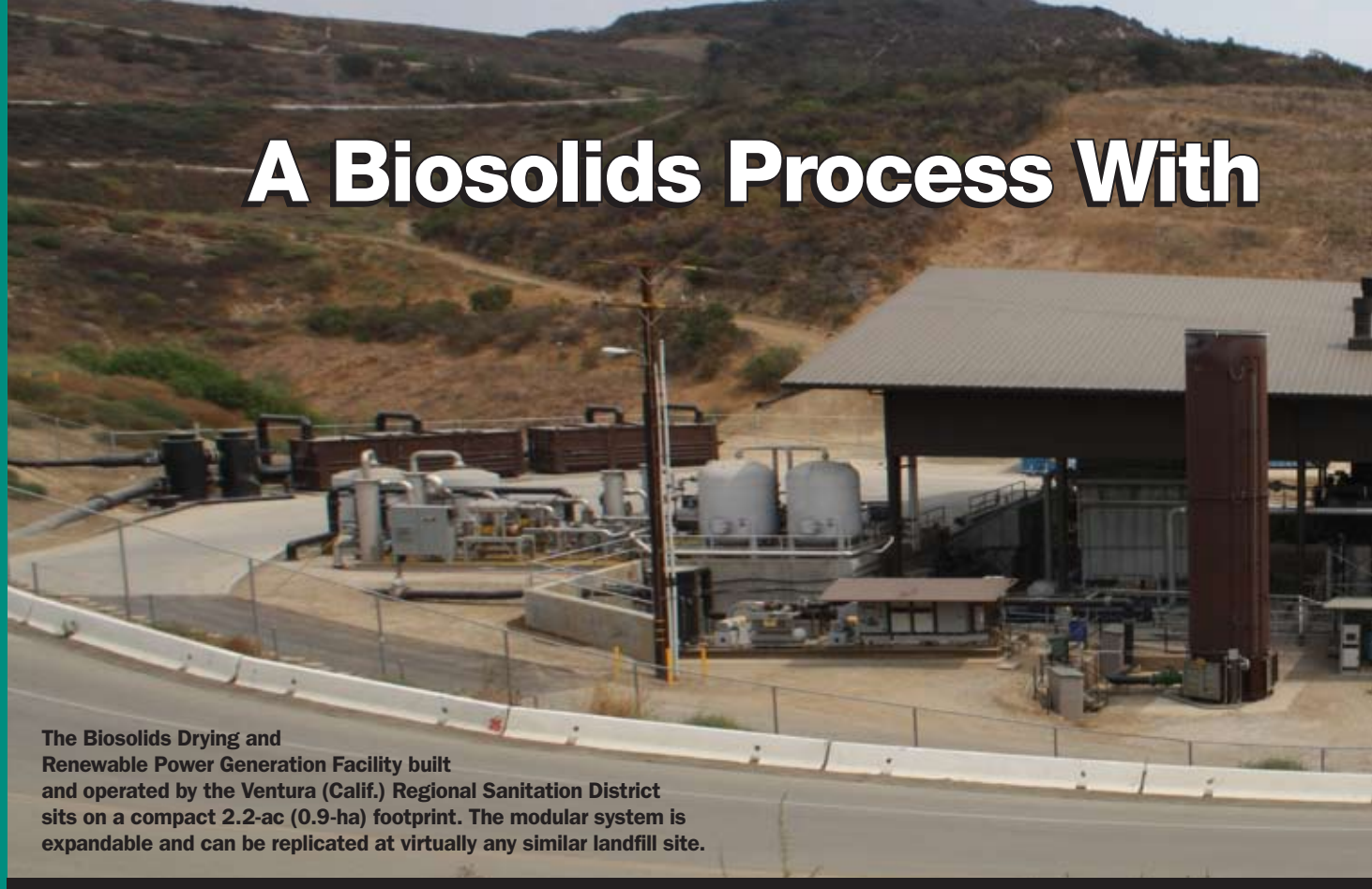
A Biosolids Process With



The Biosolids Drying and Renewable Power Generation Facility built and operated by the Ventura (Calif.) Regional Sanitation District sits on a compact 2.2-ac (0.9-ha) footprint. The modular system is expandable and can be replicated at virtually any similar landfill site.

Ventura County, a multihued California quilt of laid-back beach towns, fertile farmland, and sparkling suburbs just north of Los Angeles had a problem — what to do with the 8000 ton (7260 Mg) of biosolids produced by local wastewater treatment plants every month. For years, the answer had been to load the treated solids onto trucks and haul them more than 150 mi (240 km) to Kern County, Calif., where it was given additional treatment and then land-applied as soil conditioner and fertilizer.

But in 2006, a Kern County voter initiative threatened to halt the hauling for good. Faced with the need for a more reliable solution, the management and engineers at Ventura Regional Sanitation District (VRSD) proposed a creative idea: Use methane gas produced from decaying refuse in a local landfill to fuel a regional biosolids-drying system and simultaneously drive a network of microturbines to generate power for the facility and the local grid.

The individual operational components of this potential long-term solution were already proven and accepted. Using landfill gas to generate electricity is a fairly common practice among solid waste disposal agencies — California alone has more than 50 such facilities. Running biosolids through thermal dryers also is relatively common practice. However, VRSD's idea of fueling the dryers with treated landfill gas at a regional facility is an innovative approach (see figure, p. 58).

In 2005, even before the voter initiative known as Measure E made its way onto Kern County ballots, VRSD launched its ambitious project to put these technologies together.

Four years later, in summer 2009, the dryers began heating, the microturbines started generating, and cities in Ventura County assumed local control of their biosolids management. The region also began enjoying a host of environmental benefits, including

- a reduction in biosolids-related truck traffic estimated at 1 million mi (1.6 million km) per year at the VRSD's facility's full production capacity (and an associated decrease in greenhouse gas emissions of roughly 1800 ton [1600 Mg] annually);
- lower demand on existing conventional power-generation facilities (offsetting up to 15,000 ton [13,600 Mg] of fossil-fuel-based carbon dioxide each year); and
- a self-sustaining facility that recycles virtually all of the resources it uses while efficiently processing biosolids at competitive and stable costs.

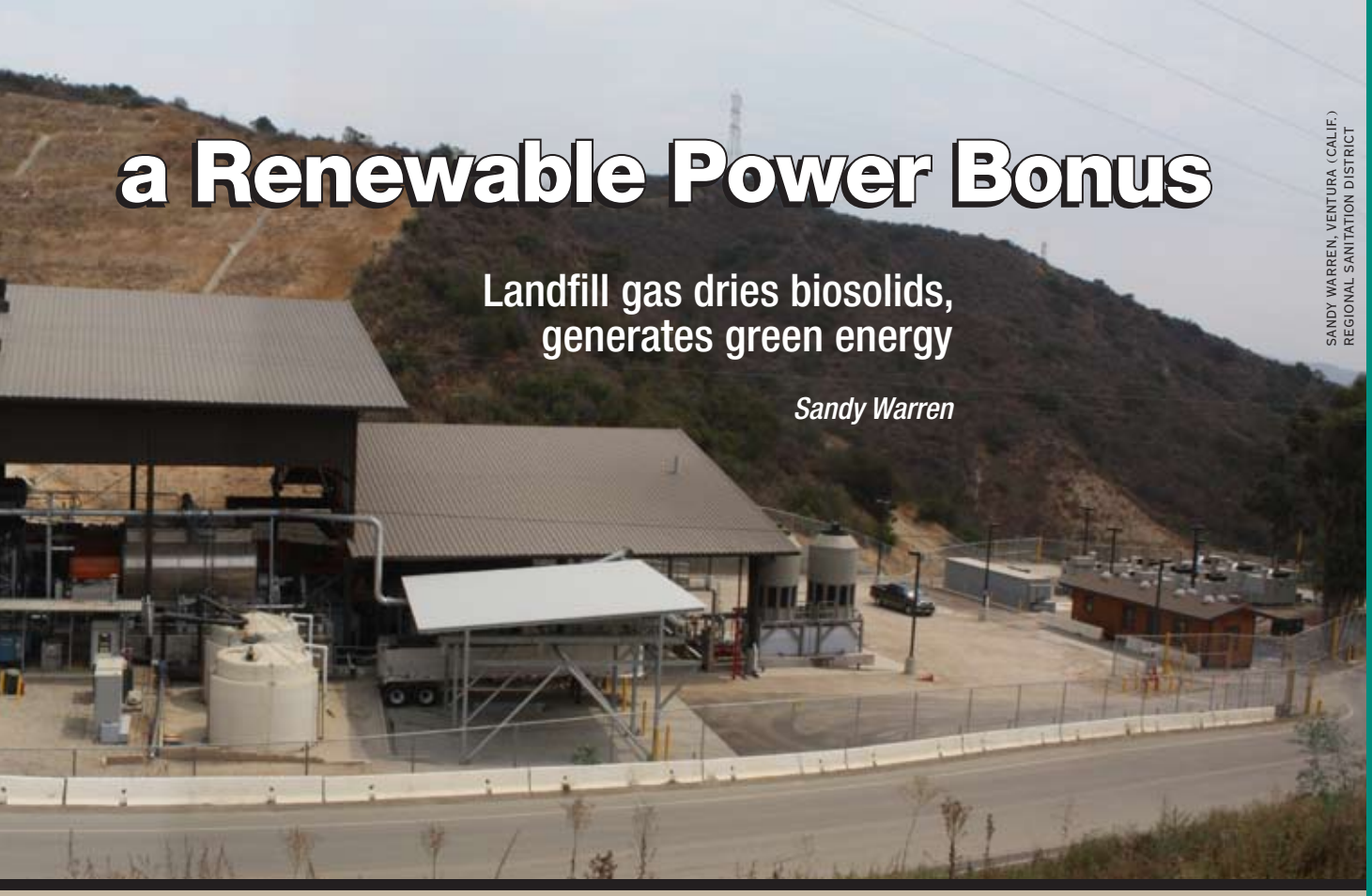
Gas Capture

VRSD worked for 2 years to navigate California's environmental regulations, among the most stringent in the world. A demonstration project, initiated at the landfill in September 2005, provided

a Renewable Power Bonus

Landfill gas dries biosolids, generates green energy

Sandy Warren



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the means to evaluate process technology and address potential environmental issues. In November 2007, the Ventura County Board of Supervisors issued a conditional-use permit for the facility. Final design and initial construction work began shortly thereafter.

VRSD selected its Toland Road Landfill as the project site. Located in Santa Paula, 15 mi (24 km) east of Ventura and 60 mi (97 km) north of Los Angeles, the landfill encompasses nearly 350 ac (140 ha) and is permitted to handle 1500 ton (1360 Mg) of municipal solid waste per day until 2027. Thus, a reliable supply of landfill gas is assured for years to come.

In landfills, decaying refuse produces gas with a methane content of 40% to 60%. Prior to construction of the new facility at Toland, VRSD extracted the landfill's gas through a network of wells and flared it. Now, VRSD captures that gas and compresses it for use as fuel for the biosolids dryers and the microturbines.

Before it can be used as fuel, however, the gas must be treated. To prevent fouling of equipment and to remove volatile organic compounds, water vapor is extracted through a dew-point suppression system that reduces the temperature of the gas by approximately 20°F (6.6°C). Siloxane, a common additive in cosmetics and processed food, is removed with carbon and media, as it can form harmful deposits in the microturbines. Sulfur in the gas stream is reduced from about 150 ppm to comply with a regulatory limit of 60 ppm.

Once treated, the landfill gas is compressed to 10 lb/in.^{2} (70 kPa) to fuel the drying process and 100 lb/in.^{2} (700 kPa) to run the microturbines.

Mechanical Dryers Prove Most Efficient

Right now, the facility receives solids from four cities within Ventura County; VRSD also is pursuing contracts with other entities within the county. Biosolids arrive at the facility via truck from local wastewater treatment plants — incoming material is usually 15% to 20% solids — and are deposited into a receiving hopper.

From there, they are diverted into two storage hoppers with a total capacity of 300 yd^3 (229 m^3), or about nine truckloads. For every four loads of biosolids delivered, the process yields one load of dried material. To control odors from the storage hoppers, VRSD uses a carbon filtration system under vacuum pressure.

The VRSD project team chose mechanical dryers as the ideal biosolids processing technology to minimize the facility's footprint, provide reliable pathogen elimination, and create a marketable, multiuse end product. In the drying process, augers move the biosolids from the storage hoppers into two identical batch dryers. Compressed landfill

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Biosolids from local wastewater treatment plants arrive at the facility by truck. For every four truckloads of wet biosolids, the drying process yields one truckload of dried material.

gas heats oil in two ultra-low-emission thermal fluid heaters to approximately 450°F (232°C). The heated oil circulates through rotors within the dryers, as well as the dryer shell, to remove liquids from the biosolids.

The rotors move the biosolids through the dryers, turning them to maximize heat exposure. Depending on moisture content, biosolids remain in the dryers for 3 to 4 hours. The material reaches boiling point, ensuring pathogen destruction through pasteurization. At the completion of each batch process, the dried biosolids are conveyed into trailers in a three-bay receiving station.

The end product — 70% to 85% solids — complies fully with California's Integrated Waste Management Act of 1989, which includes a plethora of recycling mandates and other provisions designed to improve the environmental impact of the state's solid waste management activities. VRSD is using the dried biosolids as alternative daily cover for the landfill and investigating opportunities to market the nutrient-rich material as a fertilizer. A cement manufacturer also has expressed interest in using the product as fuel for its processing kilns.

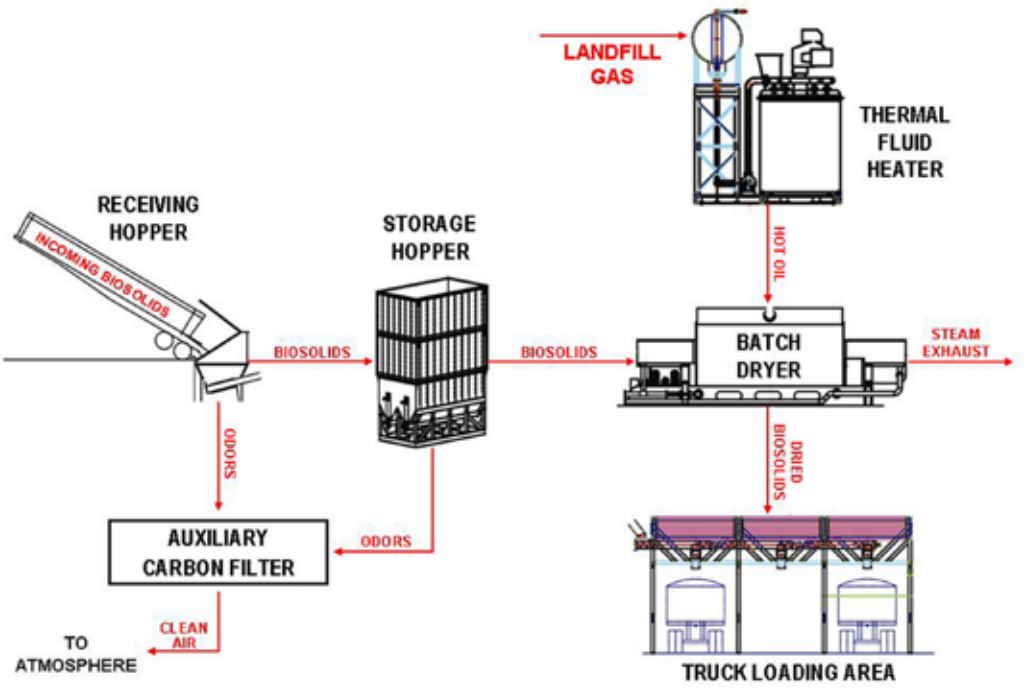
Process Includes Water and Air Treatment

Steam from the two batch dryers is piped to a condensation unit, where it is condensed using cold water from two evaporative cooling towers. This is the only portion of the entire project that does not make use of a recycled resource. As part of the environmental permitting process, VRSD agreed to use potable water for the evaporative coolers, as opposed to using the water reclaimed from the biosolids.

The condensate is treated in a clarification process, much like that of a typical wastewater treatment plant. The system separates sediment, as well as fats, oil, and grease, and pumps the reclaimed water into storage tanks for use in landfill dust control.

Treatment of the exhaust air from the condensation process consists of a biofilter system that uses coated-pumice media, supplemented in a prefiltration process by the application of

The Biosolids Drying and Renewable Power Generation Facility



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Each of the two batch dryers holds approximately 12 ton (11 Mg) of biosolids. Hot oil circulates within the dryer shell and through a series of internal rotors to efficiently dry the material and eliminate pathogens.

phosphoric acid to reduce ammonia content. Carbon and HEPA filters provide final polishing before the air is released to the atmosphere.

'Micro' Turbines Generate 'Mega' Wattage

For power generation, VRSD installed nine microturbines manufactured by Ingersoll Rand (Piscataway, N.J.). Each unit is rated at 750 kW; together, they generate about 2.32 MW, enough power to supply about 2200 typical homes. Three of the nine microturbines cycle on and off automatically to meet the needs of the biosolids drying system. The remaining six units are dedicated to supplying power for the local grid and, therefore, run continuously. VRSD's system constitutes the largest such installation of Ingersoll Rand microturbines in the world.

The "green," sustainable, low-emission power system complies with California's Renewables Portfolio Standard, a 2002 regulation that requires increased energy production from renewable sources, such as wind, solar, biomass, and geothermal. Under an executive order signed by Gov. Arnold Schwarzenegger in 2008, California has a mandated Renewables Portfolio Standard of 33% by 2020.

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Nine ultra-low-emission microturbines use compressed landfill gas to generate 2.32 MW of electricity. Roughly one-third of this power is used to operate the biosolids facility, while the remainder is delivered to the local power grid.

VRSD's entire biosolids-drying and power-generation process is computerized, which enables remote monitoring and control. Thus, while the facility can operate 24 hours a day, 7 days a week, it does not require round-the-clock staffing beyond on-call personnel to respond to system alerts, many of which can be handled remotely via computer.

The project team designed the facility with expansion in mind. The current biosolids processing capacity of 160 ton/d (145 Mg/d) can be doubled to 320 ton/d (290 Mg/d) with the addition of two more drying units, and the 2.32-MW power-generation capacity is expandable to 3.82 MW with six additional microturbines.

Project Funded Without Public Money

VRSD used no public funding (government grants or loans) in the design and construction of the facility; instead, it relied on a combination of cash, private debt, and a $1 million self-generation incentive program grant from the Southern California Edison Co. (Rosemead, Calif.).

Of the total $19 million project price tag, the largest expenses included site work ($7 million), the two biosolids dryers ($5.4 million), the nine microturbines ($2.8 million), and the landfill-gas conveyance system ($2 million).

To cover operating expenses and debt service, VRSD relies primarily on service fees from the cities that have signed 10-year contracts with the agency to handle their biosolids. At approximately $52/ton ($57/Mg), including transportation costs, VRSD's fees are extremely competitive with those of other biosolids disposal alternatives. VRSD also has a 10-year contract with Southern California Edison for energy sales at $0.10 per kWh, which also helps fund operations and repay debt.

VRSD estimates that its Biosolids Drying and Renewable Power Generation Facility will pay for itself in approximately 10 years — or perhaps even sooner once a market for the dried biosolids is developed. Ventura County already is reaping the environmental benefits of this first-of-its-kind project, one that may well serve as a model for other cities and counties to follow as they grapple with their own biosolids-related challenges.

Sandy Warren *oversees public affairs at the Ventura Regional Sanitation District, which serves the sanitation needs of more than 600,000 residents of Ventura County, Calif.*