



The Opportunity in Wastewater

June 2013



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While scalable and profitable opportunities in the field of water and wastewater are elusive, Equilibrium Capital has determined that the distributed wastewater treatment sector could be one of the most underserved and promising markets for investments. Agricultural, food and municipal waste producers in the sector currently face high costs of waste disposal as well as capital constraints. These inefficiencies can be harnessed to extract the renewable energy and nutrients embedded in the waste streams for profit, using mature bioprocessing technologies. Commercially-proven bioprocessing technologies have a long history of profitability in Europe, achieving industry growth of 370% in Germany over a 10-year period. Capital constraints and financial expertise are the primary barriers to unlocking the \$30.4 billion market in agricultural, food and municipal waste in the U.S.

INTRODUCTION

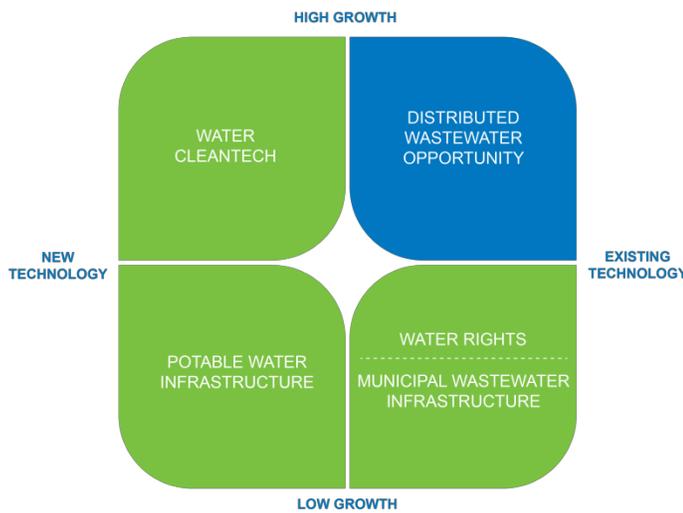
The wastewater sector has substantial unmet investment needs. According to the American Society of Civil Engineers, in 2011 approximately \$58.3 billion of wastewater investment was required to maintain existing operations and maintenance levels in the U.S. Of this amount, only \$16.1 billion was actually funded, leaving a \$42.2 billion funding gap. This funding gap is expected to widen to at least \$60 billion of unfunded wastewater projects by 2020 and \$99.5 billion by 2040.¹

Equilibrium Capital's investment thesis targets underserved, overlooked, scalable and capital inefficient markets, which is detailed in our November 2010 paper, "[Water & Wastewater: Profiting from the Next Big Wave](#)." After a four-year analysis of the water and wastewater markets, Equilibrium Capital determined that the distributed wastewater treatment sector could be one of the most promising markets for investment. The distributed wastewater sector is underdeveloped in the U.S. and ripe with inefficiencies, with previously unseen opportunities to maximize value. Biogas projects in this sector solve critical waste management problems by extracting revenue from the energy and nutrients embedded in wastewater while providing significant social and environmental benefits. In addition to the production of renewable energy, the water embedded in these waste streams can be recycled, which will become increasingly important as more water reuse opportunities emerge in

¹ American Society of Civil Engineers; Failure to Act: The Economic Impact of Current Investment Trends in Water and Wastewater Treatment Infrastructure. 2011.

agricultural, industrial, residential and commercial areas. Currently, there are fewer than 200 agricultural biogas systems operating in the U.S., compared to over 7,500 in Germany.²

In our search to find scalable and valuable opportunities, Equilibrium Capital evaluated both lower growth and higher risk sectors, such as municipal wastewater infrastructure, potable water, cleantech and water rights. Traditional, non-distributed wastewater and water supply are mature sectors with slower growth that largely focus on sewage treatment and potable water delivery. Water cleantech strategies invest in sectors with potentially higher growth but have significant technology risks and less compelling exit strategies. Water rights strategies focus solely on freshwater as a commodity. Ultimately we found the most attractive opportunities were within water treatment, new water and markets with adjacencies to water, but with a solid balance between high growth and existing technologies. Projects in the distributed wastewater sector feature lower technology risk since they utilize commercially proven production processes and common operating models that have a long history of reliability, largely in Europe, and have high growth potential in the nascent U.S. market.



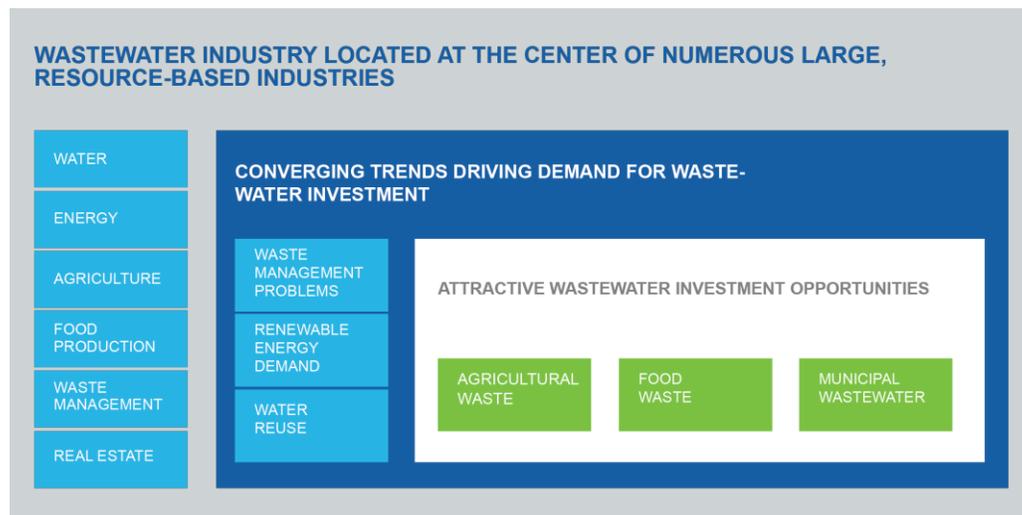
THE WASTEWATER INVESTMENT OPPORTUNITY

The distributed wastewater market lies at the nexus of numerous large, resource-based industries, including water, energy, waste management, agriculture, food production and real estate. Distributed wastewater solutions that use biogas technologies within agricultural, food processing and municipal wastewater treatment facilities benefit from the linkages between industries to offer a balanced risk/reward profile. Stable, long-term revenues in the distributed wastewater market are generated from a combination of:

² German Biogas Association.

- Renewable electricity or fuel
- Nutrients: fertilizer and soil amendments
- Waste disposal tipping fees
- Renewable Energy Certificates (“REC”)
- Renewable Identification Numbers (“RIN”)
- Carbon credits
- Tax credits
- Other byproducts

Capital constraints and financial expertise are the primary barriers to unlocking the \$30.4 billion market in agricultural, food and municipal waste in the U.S.



The development of the distributed wastewater market is being driven by three broad trends:

- Growing demand for renewable energy
- Problematic waste management issues
- Increasing wastewater reuse

According to the U.S. Energy Information Administration (USEIA), demand for both biofuel and electricity generated from renewable sources will increase significantly during the next three decades. The USEIA expects consumption of domestically produced biofuel to rise from 1.3 quadrillion Btu in 2011 to 2.1 quadrillion Btu in 2040. This will result in an increase of biofuel’s share of total U.S. liquid fuels consumption of at least 66%. Similarly, the share of U.S. electricity generation coming from renewable fuels is expected to grow by at least 23%.³

³ USEIA Report, “Annual Energy Outlook 2013 Early Release Overview.” December 2012.

Furthermore, dairy and livestock farms, food and beverage production facilities and wastewater treatment facilities have costly and ineffective systems to treat and/or dispose of their organic waste, which can have serious economic and environmental repercussions if not managed effectively. Distributed wastewater solutions using biogas offer not only the opportunity to enhance revenues and reduce costs but also provide improved odor control, less potential for groundwater contamination and reduced methane emissions.

Methane, which is the second most abundant manmade greenhouse gas after carbon dioxide, is 23 times more potent than carbon dioxide and is a major driver of human-related climate change due to its ability to trap heat in the atmosphere.⁴ In the U.S., the agricultural sector accounts for approximately 6.3% of greenhouse gas emissions.⁵ Methane capture via biogas technologies offers an opportunity to solve a waste management problem by mitigating climate change and simultaneously creating renewable electricity or fuel. Additionally, these projects have the opportunity to monetize carbon credits under California's established current cap and trade legislation. As of February 2013, carbon credits were trading at around \$10 per ton of carbon dioxide equivalent.

The Waste Problem in the Dairy Industry

The average dairy cow produces an estimated 49,000 pounds of manure per year. At a 2,000-animal dairy farm, this equates to 48,000 metric tons of manure annually. By installing a biogas plant to process the manure, the dairy could not only produce up to 3,500 megawatt hours of electricity annually (enough to power 300 homes); it could also reduce the farm's methane emissions by 7,000 tons per year.⁶

Finally, the importance of water reuse is gaining momentum across the U.S. as wastewater reuse projects have played an important role in states with water scarcity and water quality issues. Florida currently reuses more than 660 million gallons per day, equivalent to 10% of statewide daily water withdrawals.⁷ California reuses 450,000 to 580,000 acre-feet of wastewater annually,⁸ and water reuse in the state is expected to grow 300% to 400% by 2030.⁹ California's Title 22 establishes the most rigorous standard for water reuse in the nation. However, despite strides in Florida and California, 29 states are inadequately prepared to deal with the threats from climate change related to water.¹⁰ Over one-third of all U.S. counties are facing higher risks of water shortages by mid-century as the result of global warming, and more

⁴ Intergovernmental Panel on Climate Change, Fourth Assessment Report: Climate Change, 2007 and as updated.

⁵ U.S. EPA, Inventory Of U.S. Greenhouse Gas Emissions And Sinks: 1990-2011. April 2013.

⁶ Innovation Center for U.S. Dairy, Sustainability Report. 2012.

⁷ Florida Department of Environmental Protection

⁸ Association of California Wastewater Agencies, Water Recycling. 2010. www.acwa.com

⁹ Association of California Water Agencies

¹⁰ NRDC Press Release, "NRDC Report Reveals 29 States Unprepared for Growing Water Threats to Economy, Health." April 5, 2012.

than 400 of these counties are at extremely high risk for water shortages based on July 2010 estimates from the Natural Resources Defense Council (NRDC).¹¹ These are all indicators that water reuse will expand in importance in the years to come.

MARKET SIZE AND PENETRATION

The use of biogas technologies in the distributed wastewater sector represents a promising, untapped investment opportunity. Globally, this market (currently dominated by incineration and anaerobic digestion technologies) is expected to grow at a compound annual growth rate of 11.2% from \$8.5 billion in 2011 to \$27.2 billion through 2021.¹² The three most underserved markets within this sector with the most growth potential are agricultural waste, food waste and the municipal wastewater segments.

- **Agricultural waste** projects are typically located on dairy, swine or livestock farms and include manure management, anaerobic digestion, nutrient capture and renewable electricity or fuel generation.
- **Food waste** projects include pre-consumer organic waste from food processing operations (e.g., cheese and yogurt producers, fruit, vegetable and meat processors, breweries) or post-consumer food waste from municipalities that are fed into anaerobic digesters and other systems that generate soil compost, fertilizer, renewable electricity or fuel. Some projects combine feedstocks from multiple sources in co-digestion processes.¹³
- **Municipal wastewater** projects are typically additions to existing wastewater treatment facilities that generate renewable electricity or fuel from captured methane.

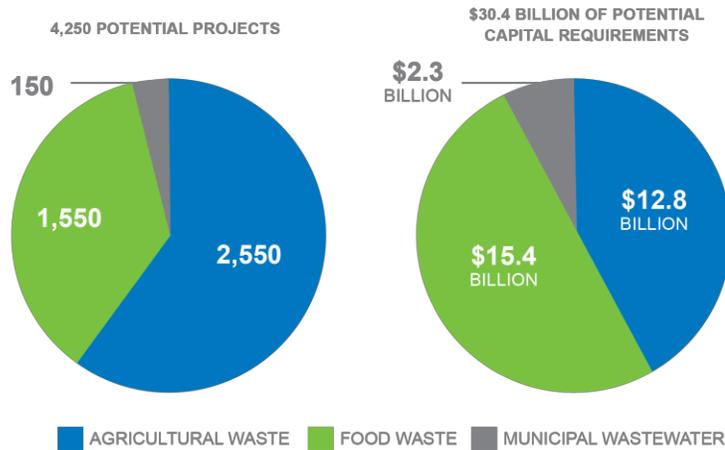
The total investable market size is estimated at \$30.4 billion in capital over the next five years. This includes over 4,250 potential projects across the sectors detailed below.

¹¹ NRDC Press Release, "Report: More than One Out of Three U.S. Counties Face Water Shortages Due to Climate Change." July 20, 2010.

¹² Scharf, Stewart. "Industry Surveys Environmental & Waste Management." S&P, Oct 2012. Note: figures represent the global waste-to-energy market, which includes incineration technology used in landfill waste, which is not a target sector of Equilibrium Capital.

¹³ Co-digestion is a technology used for the simultaneous treatment of several solid and liquid organic waste streams. The main advantages of this technology are higher methane yields because of the supply of additional nutrients from the co-digestates, higher value nutrient outputs (fertilizer) that can be sold or utilized on farm, more efficient use of equipment and cost-sharing by processing multiple waste streams in a single facility. A biogas facility can generate extra revenue by charging waste haulers of liquid or solid waste a tipping fee (usually priced from \$20-\$60/ton for solid) to discharge this waste at their facility.

Total Investable Market Size¹⁴



The Agricultural Waste Sector Opportunity

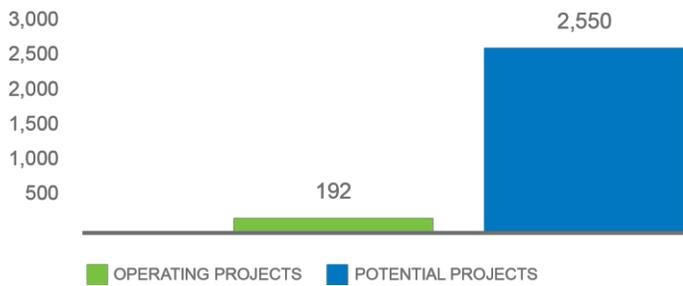
Dairy, swine and livestock farms present an ideal opportunity for deploying biogas technology since manure is a consistent, reliable supply of wastewater. These operations are constrained by the amount of nutrients that can be applied to the land, which limits their profitability and potential growth. By installing biogas plants that incorporate improved manure management and nutrient capture systems, these operations can achieve additional growth and strengthen underlying farm economics while positively impacting environmental sustainability.

The market penetration for agricultural waste projects in the U.S. is low, especially compared to Europe. There are fewer than 200 agricultural anaerobic digester systems operating in the U.S. as of 2012, as compared to over 7,500 in Germany.¹⁵ The sector shows signs of being in an early growth phase. From 2000 to 2011, the energy generated by anaerobic digesters in agriculture grew from under 25 million kWh to 541 million kWh of useable energy, enough to supply over 36,000 average U.S. homes for a year.¹⁶ But this sector is still largely capital constrained and underserved in the U.S.

The Environmental Protection Agency (EPA) estimates the number of potential new agricultural waste anaerobic digesters in the U.S. is over 10,000.¹⁷ Equilibrium’s research identified 2,550 projects that represent attractive investment opportunities based on system size, project cost, production process, feedstock and other considerations. The total investable market size is \$12.8 billion in capital over five years.

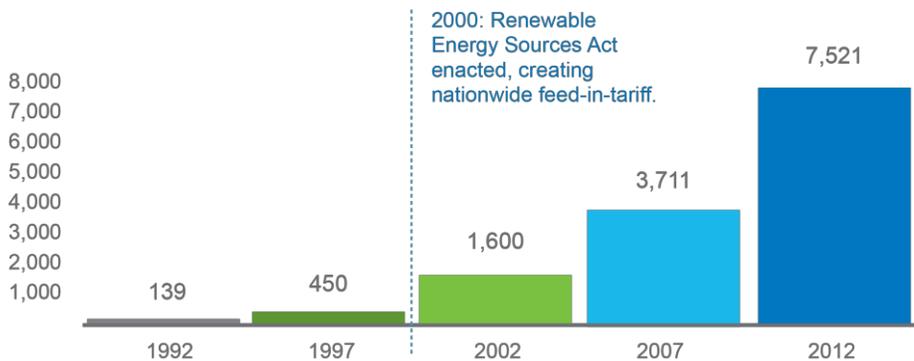
¹⁴ Equilibrium Capital proprietary data.
¹⁵ German Biogas Association.
¹⁶ AgStar, “U.S. Anaerobic Digester Status: A 2011 Snapshot.” 2011.
¹⁷ IEA Bioenergy and U.S. EPA.

U.S. Agricultural Waste Market Penetration



The U.S. has yet to experience the growth in agricultural waste projects that European countries have undergone due to two major differences. First, European countries, led by Germany, established adequate renewable energy standards and pricing. Second, European land constraints and environmental regulations to reduce pollution required action to improve the sustainability of operations that generate wastewater. Similar incentives are being put in place at the state level throughout the U.S., making this a very attractive environment for the wastewater industry and creating the potential for rapid growth in line with German trends over the past two decades. Germany has experienced 370% growth over a 10-year period and Equilibrium believes many U.S. states are poised for similar progress.¹⁸

Growth in German Agricultural Waste Projects¹⁹



Twenty-nine states, including California, are primed for development of this industry. California, which is the largest dairy state in the country, has a strong mandate for expanding renewable energy and offers above-market rates for electricity from renewable sources. California also has strict and expanding environmental regulations governing wastewater, creating a major opportunity for wastewater projects in California and other states with similar enabling environments.

¹⁸ German Biogas Association, Industry Report, November 2012.

¹⁹ German Biogas Association, Industry Report, November 2012.

Industry-wide sustainability goals and the pursuit of higher margins from organic products also drive the agricultural industry to invest in anaerobic digestion and other sustainable solutions. The dairy industry is developing sustainability criteria, carbon pollution reduction targets and an explicit goal to install 1,300 anaerobic digesters by 2020,²⁰ which supports the growth of this market. Additionally, the U.S. Department of Agriculture (USDA) has invested over \$800 million to expand anaerobic digestion, renewable energy, energy efficiency and other projects through Rural Energy for America Program grants and loan guarantees.²¹ The USDA also recently signed a Memorandum of Understanding with the Innovation Center for U.S. Dairy to accelerate the adoption of dairy-based biogas installations with a goal of reducing greenhouse gas emissions from manure 25% by 2020.²²

The Food Waste Sector Opportunity

The U.S. food processing industry is large with over 17,000 facilities that collectively account for 13.5% of all manufacturing shipments in the country.²³ The industry is driven by health, safety and environmental concerns including compliance with the Clean Water Act and ISO 14001 standards. Industry leaders are pursuing “zero emission” systems and processes that provide high levels of wastewater reuse. The industry includes cheese and yogurt producers, fruit and vegetable processors, meat processors and breweries that have historically regarded their waste streams as cost centers. For many manufacturers, the status quo for wastewater management is often a focus on the minimum needed to achieve compliance and avoid fines from environmental regulatory agencies.

Additionally, approximately 40% of food in the U.S. is not eaten, resulting in over 30 million tons of food and organic waste being transported via truck to landfills, which accounts for 15% of landfill volume.²⁴ A few municipalities and states, such as California, Connecticut and Massachusetts have implemented voluntary goals or mandatory waste diversion requirements, which will require food waste to be diverted away from landfills. Organic waste processing facilities are being modified and established to process the organic fraction of municipal solid waste (OFMSW) and capture methane for renewable energy generation that can satisfy on-site electricity requirements or be distributed back into the electric grid. Equilibrium anticipates that waste diversion mandates and high waste transportation and disposal costs will continue to expand this market.

Equilibrium estimates that there are at least 1,550 potential projects in the food waste sector representing \$15.4 billion of total project capital requirements in the next five years. This includes 450 OFMSW projects (\$6.8 billion of project capital requirements), 500 cheese and

²⁰ Innovation Center for U.S. Dairy, Dairy Power/Biogas Capture and Transport, Program Goal 2013.

²¹ USDA, “Quick Facts.” Updated January 14, 2013. (www.rurdev.usda.gov/RDSuccessStories.html).

²² USDA, Memorandum of Understanding. April 24, 2013.

²³ Bureau of Census 2010.

²⁴ National Resources Defense Council, Issue Paper. August 2012.

yogurt waste projects (\$3.4 billion), 300 meat processing waste projects (\$3.0 billion), 200 fruit and vegetable processing waste projects (\$1 billion) and 100 brewery waste projects (\$600 million).

These projects could boost profitability for the project host by transforming costs into profit while simultaneously improving waste management practices to meet tightening government requirements and industry standards.

The Municipal Wastewater Sector Opportunity

In the municipal wastewater sector, cities are seeking new ways to enhance existing wastewater treatment facilities but lack the capital needed for investment. According to the American Biogas Council, there are 3,500 wastewater treatment plants in the U.S. that process more than one million gallons per day, which is the minimum amount needed for a biogas plant to be economically feasible. Of these 3,500 plants, 1,500 already use some form of anaerobic digestion to capture biogas. However, only 250 (16%) of these generate energy from the captured biogas. Another 2,000 (57%) wastewater treatment facilities do not use anaerobic digestion to produce biogas at all.²⁵ The EPA estimates that these facilities could generate an additional 200-400 megawatts of power.²⁶ Because about 4% of the nation's electricity consumption is used to move and treat water and wastewater,²⁷ the ability for wastewater treatment facilities to offset their own energy demands would significantly reduce energy consumption. The ability to reduce costs at these facilities is important for influencing decision makers to pursue sustainable solutions that deliver the highest and best economic use of the biogas.

Additionally, many U.S. cities, such as Atlanta, Portland and Seattle, are adopting water reuse technologies that are expected to continue to gain in popularity given rising sewage rates and increasingly constrained water resources. Projects that deal with problematic and costly waste streams and deliver lower operating costs or potential new revenue streams from recycled water are very attractive solutions for improving the sustainability of municipal wastewater treatment facilities. Equilibrium estimates that there are at least 150 municipal wastewater sector projects requiring \$2.3 billion in capital over the next five years.

These three primary market segments represent a large untapped market opportunity with favorable project economics and numerous underlying environmental and social benefits.

²⁵ American Biogas Council (www.americanbiogascouncil.org).

²⁶ U.S. EPA Combined Heat and Power Partnership (2011).

²⁷ Electric Power Research Institute (EPRI), Program on Technology Innovation: An Energy/ Sustainability Research Program (2007).

CONCLUSION

Growing demand for renewable energy, problematic waste management issues and the increasing need for wastewater reuse are the market drivers behind the development of the distributed wastewater sector. Currently underserved and decentralized in the U.S., the sector is poised for rapid expansion similar to the explosive growth Germany has experienced in the last decade.²⁸ The lack of capital and financial expertise have been the primary project-level barriers to the development of the sector. However, with the needed capital and expertise, proven biogas technologies can unlock the \$30.4 billion market in the agricultural, food and municipal waste sectors and capture untapped value from waste.

²⁸ German Biogas Association, Industry Report, November 2012.



Equilibrium Capital is a global asset management platform, focused on investments in sustainability-driven real assets strategies. Equilibrium brings to market institutional-grade investment funds and products in five key real assets sectors: agriculture, water and wastewater management, renewable energy, land and green real estate.

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