A Review of Today's Anaerobic Digestion Technology of Organic Municipal Solid Waste and Its Implementation in California

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Introduction

Anaerobic digestion (AD) of organic municipal solid is defined as the metabolization of carbon-based substances by microorganisms in environments lacking oxygen. AD already occurs naturally in landfills that contain organic waste such as food scraps, paper products, and yard trimmings. One of the main by-products of this process is methane. As a result, landfills have become the third largest source anthropogenic methane emissions in the U.S.[1] Methane that is not captured or burned off ends up contributing significantly to the warming of the climate.

Anaerobic digestion technology is attractive on multiple fronts: organic waste management, climate change mitigation, and biomethane production; the potential for expansion and commercialization of this technology in the state of California can be fully realized by addressing and maximizing these benefits.

Technology: Benefits and Impacts

Key Advantages

1. Organic Municipal Solid Waste Management
   - **19.74 million tons of organic waste** such as food and paper were generated in California in 2008[2]
2. Climate Change Mitigation
   - Methane is the 2nd most prevalent greenhouse gas emitted in the US, and is 21 times more potent than CO_2[3]
   - **12,868 Gg** of methane is released in CA when organic materials are left to decompose naturally in MSW landfills[3]
   - By diverting this organic MSW into AD facilities, we can prevent the release of methane into the atmosphere
3. Energy Production
   - **65,412 million ft³ of methane or 4,935 kWh** can be produced from organic municipal solid waste per year (based on the estimated methane and electricity production rates of EBMUD, respectively[4])

Case Study

SMARTFERM Technology: semi-mobile dry anaerobic fermentation plant

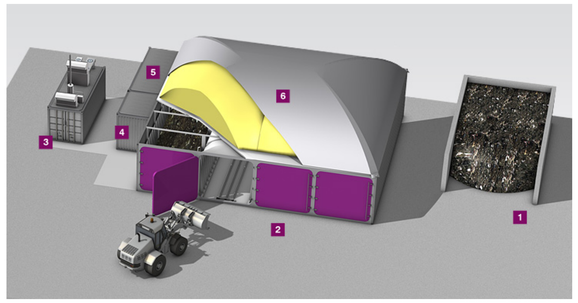
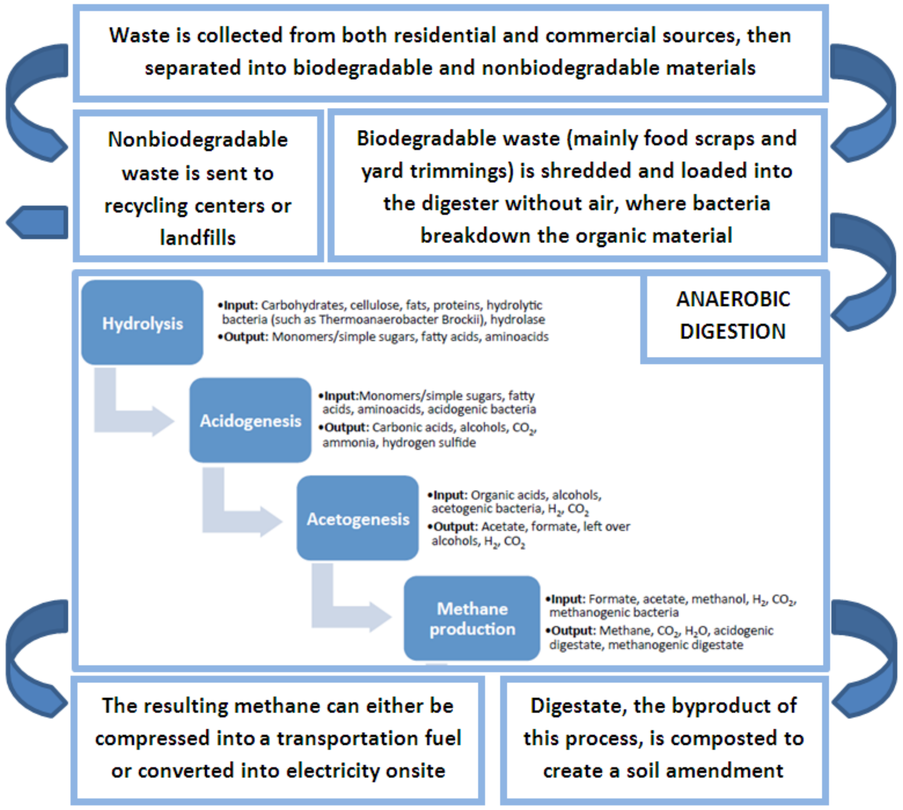


Figure 1. The structure of a SMARTFERM plant. (1) input storage, (2) four dry fermenters, (3) Combined heat and power plant (CHP), (4) machine technology, (5) electrical technology, (6) gas storage. [6]

Highlights of the SMARTFERM technology:

- The biogas from AD generates electricity and heat (75 – 150 kW electrical power per plant, 115 – 200 kW thermal power per plant)
- A four fermenter SMARTFERM plant can be installed in just 20 working days on a 18.5m x 15 m surface
- The plant costs $1.6 million, with low operating and maintenance cost: scalable
- Suited for the treatment of organic substances in amounts from approx. 3,000 to 3,600 metric tons per year (for the 3000 sq. ft plant)[7]

Our Process



Steps Towards Commercialization and Expansion:

To understand the role of AD in California's future energy portfolio, we first need to examine current scale of AD implementation; next we looked into policy and law for further commercialization and expansion.

Case Study: Technology Companies

- Zero Waste Energy (ZWE)[6]
  - **Joint ventures** with Bulk Handling Systems and Green Waste Recovery
  - **Strategic partnerships** with Environmental Solutions Group and Marathon Equipment co.

Case Study: Utility Companies

- Monterey Water District
  - Important Government Policies
    - Section 1603 of the American Reinvestment and Recovery Act
    - Rural Energy for America Program

ZeroWaste™ ENERGY, LLC. *Recovery and Energy with Zero Waste*

Business and Public Policy incentives for promotion of AD technology:

Group 1 (indirect):

- Landfill bans or taxes
- Stricter environmental regulations of other biofuel processes, such as hazardous byproduct disposal
- Location restrictions, environmental/agricultural regulations of feedstock production.

Group 2 (direct):

- Promotion of separate collection of waste (tax breaks, federal/state regulations)
- Promotion of biogas/byproduct usage (tax breaks, educational programs for businesses, institutions and individuals, federal/private grants for R&D)
- Decrease of capital intensity of AD facilities (subsidies, on-site waste management protocols, cost-effective transportation solutions, grants for R&D to increase yield and efficiency of the process)
- Development od mandatory certification in health and environmental safety for energy production

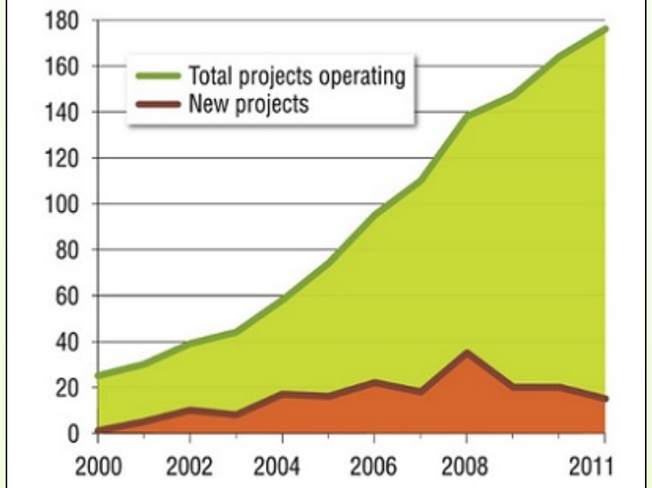


Figure 2. Trends in Anaerobic Digesters in the US[5]

Conclusion

- Anaerobic Digestion of all California's organic MSW can prevent the release of 12,868 Gg of methane into the atmosphere[3]
- California has the potential to generate 65,412 million ft³ of methane or 4,935 kWh per year through anaerobic digestion[4]
- Further action needed to be taken for expansion
  - Creation of more economic and policy incentives for expansion and commercialization
  - Further research on health and environmental hazards

References:

[1]Environmental Protection Agency. (2013). Retrieved from http://epa.gov/climatechange/ghgemissions/gases/ch4.html
[2] California Integrated Waste Management Board. (Aug 2009). *California Waste Characterization Study and Report*.
[3] U.S. Environmental Protection Agency. (Apri, 2013). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011* (Publication No. EPA-430-R-13-001). Washington, DC.
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[6] Zero Waste Energy. (2013). *SMARTFERM*. Retrieved from: http://www.zerowasteenergy.com/content/smartferm
[7] Zero Waste Energy. (2013). *Projects of the Future*. Retrieved from: http://www.zerowasteenergy.com/content/projects

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