Choosing between Composting and Anaerobic Digestion: soil, fuel or both?

Many communities, businesses and institutions are considering whether they should focus on composting of discarded organic materials or anaerobically digesting (A.D.) those materials. There has been a lot of interest in pursuing A.D. (otherwise known as "Biodigestion") in recent years, as it has the attraction of both recovering energy from discarded materials operating at biological temperatures, and also recovering materials that may be used as a soil improver. This position paper provides guidance for a more informed decision-making process.

There are a number of key factors that should be considered when evaluating whether to compost or digest, such as:

1. In general, composting should be considered as a priority option over A.D., to return discarded organic materials back to soils to improve their capability of sustaining or improving plant and animal life. This is due to its intrinsic robustness and scalability. Composting is particularly more suitable for small-scale, low-tech, or temporary approaches in communities, businesses and institutions.
2. The Zero Waste Hierarchy of Highest and Best Use recommends the following for pursuing options, in this order:
    a. Support and expand composting as close to the generator as possible (prioritizing home or on site or local composting wherever possible)
    b. Whenever home/decentralized composting is not possible, consider large-scale composting, or if local conditions require/allow, anaerobic digestion.
    c. If conditions allow, recover energy using only systems that operate at Biological Temperature and Pressure (The ambient temperature and pressure that occurs naturally without the use of added energy or in any case not above 100C to change it such as anaerobic digestion).
3. The focus must be on returning organic matter to improving the soil. If A.D. is giving back to the soil, it's acceptable, and it's just another way to initially process organics prior to composting. If clean organics derived from source separated collection are not mixed with other municipal solid wastes, Biodigestion or A.D. may be used to produce both a soil amendment and renewable energy.
4. Biodigestion or A.D. may be appropriate when planning, siting and operating aerobic composting is not feasible due to the location and land use constraints. A.D. can be considered whenever home or large-scale centralized composting is not possible. For example, many larger cities may generate larger amounts of food scraps than yard trimmings, which may make the mixture not as conducive to good management of composting. Also, A.D. (followed by a shorter

aerobic maturation) generally shows a smaller footprint than composting, which might be beneficial in case of land shortages

5. To avoid end-product pollutants, there is a need to check quality not only of the end-product, but also of input material, so that any "dilution" of pollutants is avoided (as might happen with some low-quality biosolids/sludges). This applies to both co-digestion and co-composting
6. A.D. should be required to meet all regulations adopted for composting programs as they should be just another way to initially process clean source separated organics in a composting system.
7. A.D. should not be pursued solely to produce energy with the residue ("digestate") being landfilled. In Europe, the EU Commission stipulates that A.D. only counts toward meeting recycling targets if it produces a material fit for use on soils and farmlands. For the moment, "fitness for purpose" depends on legislation in each of the nations for defining what's fit for use. The EU, though, is working to develop a common EU standard for what's "fit". Separate collection of organics should be one of the prerequisites, so that only clean source separated organic feedstocks not contaminated or mixed with other materials (plastic bottles, plastic films, textiles, hazardous waste) from separate collection of municipal solid waste may be anaerobically digested or "biodigested" into a high-quality product that then may be mixed with existing soil and be capable of sustaining or improving plant and animal life.
8. In some locations multiple A.D. systems in one geographic area are being implemented to obtain incentives for energy production. Without subsidies, A.D. typically can't compete with composting, due to larger capital costs of the A.D. processing equipment and facilities. Typically, investments related to A.D. systems cost 1.5x – 5x as much as composting systems. In Europe, there are very high subsidies for A.D. (up to 300 Euros per megawatt hour). If these subsidies are used to develop A.D. for crops raised for energy, that promotes land grabbing by agri-business and heightens the problems of raising crops for fuel instead of food, which is a social justice problem.
9. A problem with subsidies going to A.D. is that there is a limited amount of dollars available to spend on things for a community. If communities invest in composting instead of A.D., they generally would have to invest less money. Conserving resources also includes conserving cash. Even though with all the subsidies the larger costs for A.D. are competitive with composting, they are still larger capital expenditures that are balanced by the subsidies.
10. ZWIA supports investing in and subsidies for A.D. only if the facilities are planned primarily to treat organics that are source separated and discarded from residents or businesses (and not to process agricultural energy crops).
11. A.D. produces biogas, which includes methane and other compounds; biogas may be burned to produce heat and power at a CHP unit, or turned into biomethane once other compounds are removed. Use of biomethane which has been treated to remove hydrogen sulfide, nitrogen and ammonia, water and other byproducts and trace contaminants to replace gasoline fuel (automotive) or natural gas is preferable to the use of combined heat and power (CHP) units at centralized process site to produce electricity and heat for district heating or reheating the biomass for digestion. Biomethane produced fuels that don't keep the impacts on site and avoid concentrated burning in a single place, provides replacement fuels for cars or trucks, and/or add to the natural gas pipeline.
12. A.D. and composting may also be appropriate for alternative treatment for residual waste in Materials Recovery and Biological Treatment (MRBT) systems. The B in MRBT could be aerobic

composting or A.D. The goal for MRBT is to stabilize before landfilling, not to produce a quality soil amendment. Organics recovered from MRBT should not be used as soil amendments for any food crops. The costs of MRBT should be considered as part of the costs of landfilling, not part of the budget for diversion programs. MRBT should not be pursued alone – it must follow the successful implementation of clean source separated organics collection and processing programs, or at least be planned concurrently. Public investment in MRBT should only be approved after approval and start of implementation of clean source separated organics collection and processing programs, with a plan to maximize capture of organics in time.

13. "Dirty composting" facilities that process mixed solid waste as the only diversion system for a business, sector or geographic area are not MRBT, are not Zero Waste and should not be used. From the beginning, MRBT should be designed, financed and operated to be able to shift the use of the processing equipment over time from stabilization prior to landfilling to processing, clean organics coming from separate collection programs. Only with such preconditions, MRBT may be considered an acceptable option to keep flexibility in residual waste management.
14. ZWIA recommends that the final step for A.D. should be aerobic composting, to ensure the minimization of fermentability of materials. If digestate from A.D. is applied directly back to the soil, it may release fugitive emissions of methane and ammonia, cause phytotoxicity and leakage of nitrogen. Composting of A.D. digestate from clean source separated organics creates a soil amendment that is basically the same quality as coming directly from composting. Hence, A.D. must be seen as a possible alternative initial processing step (when need be) for the early stages of composting, so that carbon is used as a renewable energy source (biogas/biomethane) instead of releasing it as CO2. The final stage should be aerobic, and aimed at the same goals and standards as composting:
    a. Production of well stabilized soil improvers if from clean organics
    b. Proper minimization of odorous or pathogenic materials
15. Similarly, in the case of A.D. systems in MRBT before landfilling, final aerobic stabilization is required, to reduce fermentability of organic matter, and related impacts once landfilled

For more insights, see the ZWIA Zero Waste Hierarchy of Highest and Best Use.

Frequently Asked Questions:

1. **Is burning gas OK?** Sometimes. ZWIA favors biomethane which has been treated to remove hydrogen sulfide, nitrogen and ammonia, water and other byproducts and trace contaminants to replace gasoline (automotive) or natural gas (domestic) to avoid concentrated burning in a combined heat and power (CHP) unit at the process site to produce electricity and heat for district heating or reheating the biomass for digestion. Biomethane doesn't keep impacts on site, provides replacement fuels for cars or trucks, and/or adds to the natural gas pipeline.
2. **Do businesses need to confirm that there are no air emissions from burning gas from digesters?** Yes. Entities need to meet air emissions for burning in whatever application is used. In Europe there are some working groups to come up with common standards among nations.

3. **Do businesses need to test A.D. digestate to make sure no heavy metals/other toxics?** Yes. Just as with composting, both must prove that they are good quality and meet the standards for use in agriculture
4. **Are industrial sludges OK to biodigest?** Yes. When it comes to biosolids and sludge, quality must be checked on inputs and outputs to avoid "dilution" during co-digestion with food scraps and yard trimmings. Typically, agroindustrial sludge tends to be high quality (but there may be exceptions) whereas sewage sludge from WWTPs often includes relatively high concentration of pollutants. This may be different in rural vs. urban areas, and depending on whether any "pollution prevention program" is in place (e.g. setting limits for discharges of wastewater by industry into sewage).

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