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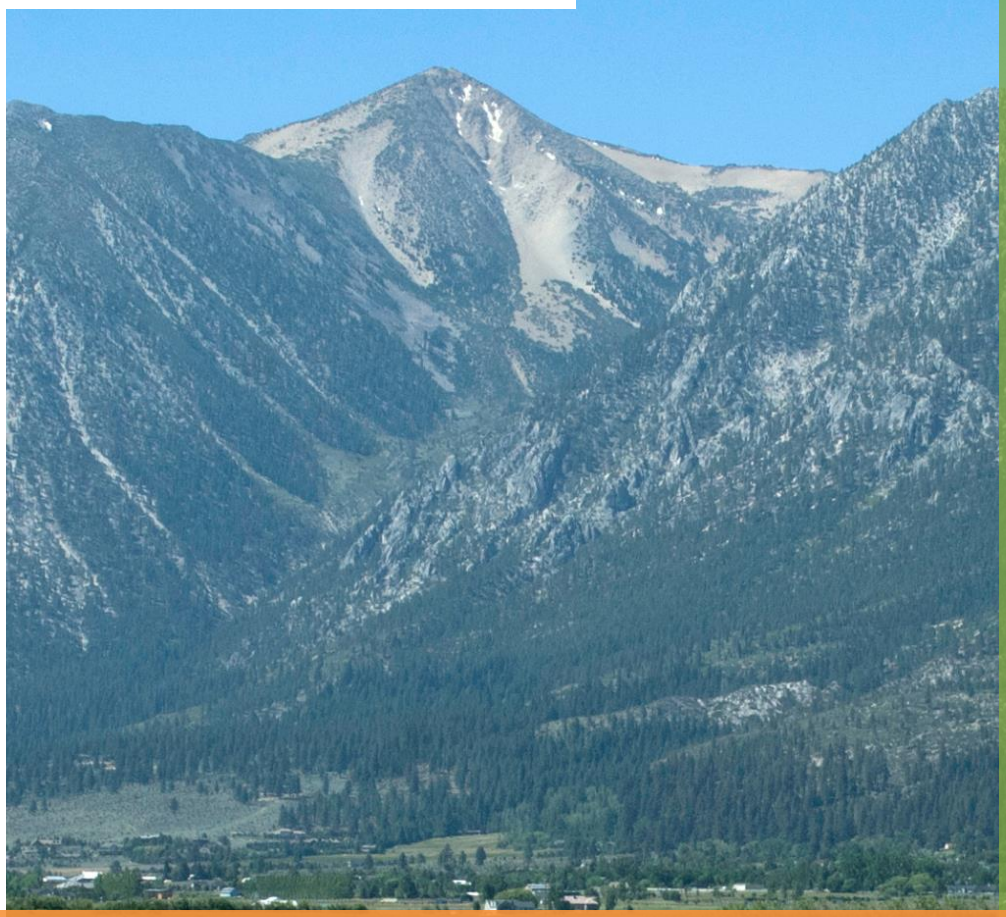

Implementing Large-Scale Composting Programs in Nevada: A Guide for Decision Makers

"A ROADMAP TO INCREASE ORGANIC MATERIAL DIVERSION IN NEVADA" SERIES

Sustainable Organics Materials Management is a broad term and can be used to describe a portion of a circular economy where all viable organic materials within waste streams are used to the extent possible and then returned for natural environmental regeneration.

Executive summary

Nevada is progressing to a more sustainable future by creating new infrastructure and programs to better manage its resources in a more circular manner and to reduce greenhouse gas emissions. A key component of macro-sustainability improvements is tackling waste diversion and landfill management. Landfilling not only entails the loss of valuable resources but it also produces methane gas, a powerful greenhouse gas linked to climate change. Because organic wastes (e.g., yard waste and food waste) contribute to 39.89%[1] of landfill capacity, reducing organic waste and/or diverting these organic materials to more useful processes can fulfill circular economic goals and greenhouse gas reduction goals.

The creation of large-scale organic materials diversion programs involves the collaborative support of communities, municipalities, public, and private organizations. To help guide the development and implementation of new programs, the Partners for a Sustainable Nevada (PSN) has started the development of an "organics diversion roadmap" to assist decision makers by highlighting previous and current roadblocks and success factors. This document, *Implementing Large-Scale Composting Programs in Nevada: A Guide for Decision Makers*, is the first in a planned series of guides called *A Roadmap to Increase Organic Material Diversion in Nevada*. These guides can assist decision makers who want to implement organics diversion strategies in their communities. The scope of this guide focuses on implementing large-scale composting programs as a key strategy for diverting organic material away from the landfill and facilitating commercially viable operations to move Nevada to a more circular economy.

There are several reasons to focus on composting as it has the potential to generate economic opportunities as well as environmental benefits. PSN foresees a future where a large amount of Nevada's organic wastes are being reused and recycled through organics diversion programs like composting rather than landfilling.

At a high level, the environmental benefits of producing and using compost include:

- Reductions in methane emissions associated with landfill management of waste at a rate of 0.88 tons of CO2e for each ton of materials composted[2]
- Improved soil health[3]
- Conservation of water[4]

[1] https://www.epa.gov/sites/default/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf
[2] http://www.stopwaste.co/calculator/
[3] https://www.compostingcouncil.org/page/SoilHealthBenefits
[4] https://www.compostingcouncil.org/page/WaterConservationBenefits

- Assistance in stormwater management[5] and erosion control[6]
- Bioremediation of soil by restoring contaminated soils and degrading and binding contaminants[7]
- Inactivation or destruction of weed seed and pathogens[8]

Additionally, many states across the US are adopting new regulations and implementing organic waste diversion programs to limit organic wastes flowing into landfills. Nevada's neighboring states, California and also Washington State, have in-depth composting programs and industries. This paper discusses some of these other states' programs as well as the many hurdles and opportunities ahead of Nevada for efficient implementation of new waste diversion programs. Currently, the regulatory and economic environment for composting solutions for waste diversion is impeding the growth of the composting industry across Nevada. Landfill rates, materials hauling, and lacking regulations are all decreasing the incentives for new compost companies to enter or existing composting companies to expand in Nevada. These barriers need to be reviewed and understood in order to implement and maintain effective and efficient compost programs in Nevada.

Goals

The Partners for a Sustainable Nevada developed this document with the following long-term goals in mind:

- To inform the development of policies and practices that will create the most favorable conditions for effective organic materials management programs - with a focus on creating and expanding existing commercially viable composting operations in Nevada.
- To maximize the benefits of composting and maximize the amount of organic materials put through the landfill diversion strategies, such as composting.

[5] https://www.compostingcouncil.org/page/StormwaterBenefits
[6] https://www.compostingcouncil.org/page/ErosionBenefits
[7] https://calrecycle.ca.gov/organics/compostmulch/toolbox/bioremediation/
[8] https://www.compostingcouncil.org/page/CompostCharacteristics

Definitions & Acronyms

Term	Definition
Agricultural Waste	Waste produced from normal agricultural operations including plant based sources and manures.
Construction Land Clearing and Soil	Construction projects for residential homes, commercial buildings, along with road/highway projects can produce waste soils mixed with organic materials such as roots, trees, grasses, and many other organic materials. Compost equipment can remove soil from organic materials to be composted. Industry definitions vary from “duff” to “over-burden”.
Contamination	The inclusion of unwanted materials in input source materials for composting, both visible (e.g., produce stickers) and invisible (e.g., herbicide residue). Contamination can also come from mixing of input sources (such as Green Waste and Food Waste) which makes the resulting composting process more complex.
Wasted Food and Food Waste	Wasted food “is an overarching term to describe food that was not used for its intended purpose and is managed in a variety of ways.” This can include unsold food products at grocery stores originally intended for customer purchase. Food waste is defined as “food that was not ultimately consumed by humans that is discarded or recycled, such as plate waste (i.e., food that has been served but not eaten), spoiled food, or peels and rinds considered inedible that is sent to feed animals, to be composted or anaerobically digested, or to be landfilled or combusted with energy recovery.” Food waste can sometimes include food service items that are designated compostable by the composting industry, including compostable food service ware like plates, cups, and napkins. Lacking designations between food waste and compostable food service items can cause issues in defining waste streams. Other items such as paper waste can be composted depending on the processing by local composting facilities. https://www.epa.gov/sustainable-management-food/sustainable-management-food-basics
Forestry	Wood products harvested from forestry operations
Green Waste	Green waste means any vegetative matter resulting from normal yard and landscaping maintenance. Green Waste includes plant debris, such as grass clippings, leaves, pruning, weeds, branches, brush, holiday trees (without stands, flocking or ornamentation), and other forms of vegetative waste. Green waste can come from residential, institutional and commercial sources. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/yard-trimmings-material-specific-data
MBF	Thousand board feet of lumber

MSW	"Municipal solid waste (MSW) (also called trash) consists of everyday items such as product packaging, yard trimmings, furniture, clothing, bottles and cans, food, newspapers, appliances, electronics and batteries." MSW is a single stream of all materials commingled. Source separation allows for materials within the MSW waste stream to be "pulled out" and sent to processors that can recycle the viable materials into new products and commodities. https://www.epa.gov/report-environment
Sewage/Sludge/Biosolids	Sludge is a product of the wastewater treatment process. During wastewater treatment the liquids are separated from the solids. Those solids are then treated physically and chemically to produce a semisolid, nutrient-rich product known as biosolids. The terms 'biosolids' and 'sewage sludge' are often used interchangeably. Normally the term biosolids is used for end products able to be used in the consumer market that have gone through extra processing to meet specification requirements for use. Pet waste can also be considered a sludge-type material, due to differences in compost processing needed to effectively treat pet waste through composting https://www.epa.gov/biosolids/basic-information-about-biosolids
STA Certification	Seal of Testing Assurance (STA) Certification Program: A set of definitions and rules for documenting contents and recommendations for use of compost products from the US Composting Council. It is important to note that there are three varieties of recommendations for end product compost, including Trees & Shrubs, Flowers & Vegetables, and Lawns. STA approved compost products can include other forms as well as compost is an ingredient used to make many products such as potting soils, garden soils, construction soils, mulches, erosion control products and others. Agriculture also uses STA certified compost. https://www.compostingcouncil.org/page/CompostManufacturersSTA https://www.compostingcouncil.org/page/HowUseCompost
Wood Waste	The sources of wood in municipal solid waste (MSW) include furniture, other durable goods (e.g., cabinets for electronic equipment), wood packaging (crates, pallets) and some other miscellaneous products. Only specific types of wood waste are viable for composting. Clean wood waste without glues, chemicals, stains, paints, or other synthetic substances are the only viable wood wastes for composting or creating mulches. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/wood-material-specific-data

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Acknowledgements

This document would not exist without the key input from experts in the organics industry and environmental field. The PSN would like to acknowledge the two lead authors of this document for their hard work, dedication, and willingness to share their expertise and experience – Cody Witt and Philip Moore. Additionally, key PSN partners reviewed this document and provided valuable information and feedback. We would like to acknowledge and thank Clinton Combs, *Managing Member, Combs Brothers, LLC and Las Vegas Livestock*.

CODY WITT

Northern Nevada Manager (Strategic Everything), Full Circle Soils & Compost

Cody Witt owns and operates Full Circle Compost in Carson City. He creates sustainable communities of suppliers and producers through organic materials composting, soil health program implementation, and education. Cody Witt is a fifth generation Nevadan who completed his MBA and undergraduate degrees from UNR. Full Circle helps keep around 50,000,000 lbs of organic materials out of the landfill which is the equivalent of 30,000 cars worth of CO2 off the road through carbon sequestration.

PHILIP MOORE

Sustainability Consultant

Philip Moore has worked in renewable energy, local food, and transportation systems in Northern Nevada for the last twenty years. He is currently working on consulting engagements related to the local food system in Northern Nevada. He is an avid composter and was happy to rely on Cody's depth of experience with composting to provide the necessary details for this document.

Introduction

Organic “wastes” should be seen and understood as valuable resources, and depending on the type of organic material, they can be used in a variety of processes such as feeding livestock, the production of biogas, and composting.

Keeping Organic Materials Out of Landfills

Organic wastes are biodegradable materials that originate from living organisms, such as plants and animals. Examples of organic wastes include food waste, green waste (e.g., plant debris and other vegetative materials), wood waste, sewage sludges, and agricultural waste. However, instead of being viewed strictly as "wastes," these organic materials should be seen and understood as valuable resources, and depending on the type of organic material, they can be used in a variety of processes such as feeding livestock, the production of biogas, and composting. Additionally, because placing organic waste in landfills generates methane, a powerful greenhouse gas[9], implementing an organics diversion program can be an important strategy for decision makers looking to reduce methane emissions.

When determining which organics diversion approach to implement, think about the "reduce, reuse, recycle" framework. Take food waste, for example. First, when possible, we want to prevent food from being "wasted" in the first place (i.e., source reduction). By "wasted food" we mean "a food that was not used for its intended purpose"[10] - such as unsold food products at a grocery store meant for customers. Wasted food is a valuable resource that can be sustainably managed in a variety of ways, including donating the excess food to feed people, using food scraps to produce livestock feed, and producing biogas or compost. Figure 1 depicts the priority of these strategies and is based on the U.S. Environmental Protection Agency's (EPA) Food Recovery Hierarchy. This diagram prioritizes actions organizations and governments can take to prevent or divert wasted food.[11] Other organic wastes can also be managed in a similar manner.

The selection of diversion strategy for a municipality or region will depend on a variety of factors, including, but not limited to, the resources and infrastructure available in an area, economic factors, and government's sustainability priorities and goals.

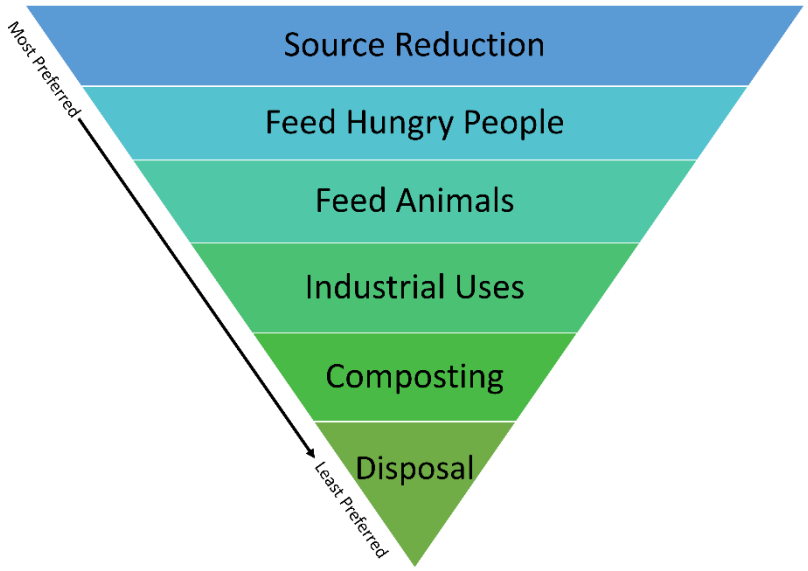


Figure 1: Actions organizations can take to prevent or reduce wasted food. Diagram based on U.S. EPA's Food Recovery Hierarchy

[9] https://www.epa.gov/sustainable-management-food/reducing-impact-wasted-food-feeding-soil-and-composting
[10] https://www.epa.gov/sustainable-management-food/sustainable-management-food-basics
[11] https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy

Composting & Scope of this Document

This document, *Implementing Large-Scale Composting Programs in Nevada: A Guide for Decision Makers*, is the first in a planned series of guides called *A Roadmap to Increase Organic Material Diversion in Nevada*. These guides will assist decision makers who want to implement organics diversion strategies in their communities. The scope of this document focuses specifically on implementing large-scale composting programs as a key strategy for diverting organic material away from the landfill and facilitating commercially viable operations to move Nevada to a more circular economy.

Goals

The Partners for a Sustainable Nevada (PSN) developed this document with the following long-term goals in mind:

- To inform the development of policies and practices that will create the most favorable conditions for effective organic materials management programs - with a focus on creating and expanding existing commercially viable composting operations in Nevada.
- To maximize the benefits of composting and maximize the amount of organic materials put through the composting process.

Sources of Organic Wastes

This section analyzes sources of organic materials that increase the likelihood of commercially viable compositing operations.

Municipal Solid Waste Generation

According to the U.S. EPA, the United States generated 292.4 million tons of MSW in 2018.[12] Of that, 39.89%, or 116.6 million tons, was organic materials including wood, food, and yard trimmings (Figure 2). This number does not include non-treated paper products and the new market of compostable products, which can add even more to the organic materials total.

In 2021, Nevada generated approximately 3.56 million tons of Municipal Solid Waste (MWS).[13] As of the writing of this document, Nevada does not have a statewide waste characterization study to show the composition of its MSW stream. For the purposes of this document, we will assume that Nevada MSW follows the same breakdown as the national MSW stream as presented in Figure 2. Therefore, we assumed 39.89% of Nevada's MSW consisted of organic materials and estimated that 1.42 million tons of organic waste was disposed of in 2021.

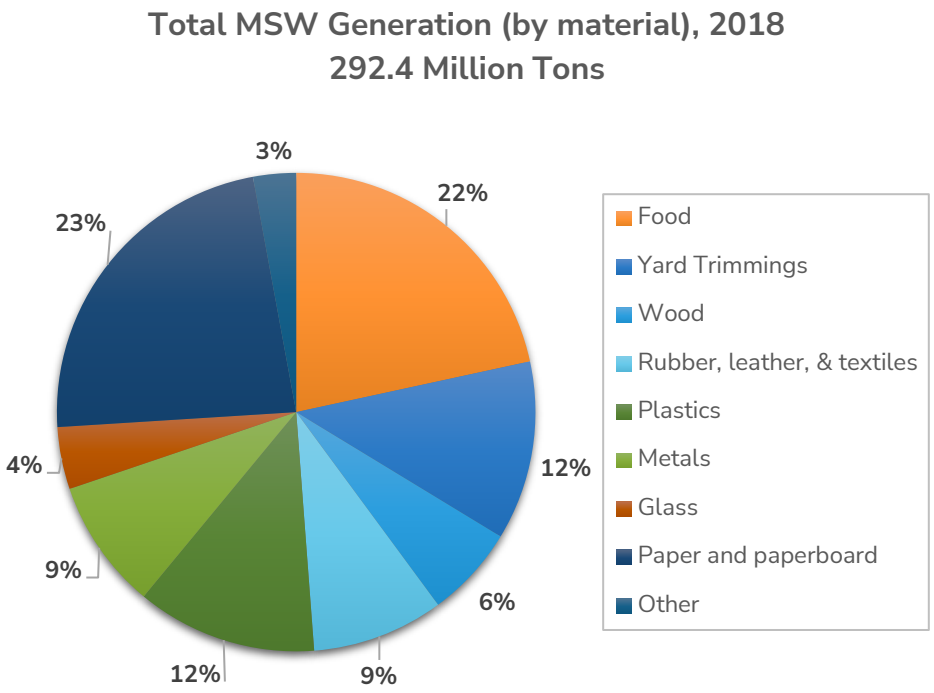


Figure 2: Using data from across the country, the US EPA analyzed the nation's MSW stream. The chart depicts a breakdown of MSW generation by material type. Over 39% of the waste stream is composed of organic material. Data taken from the EPA's "Advancing Sustainable Materials Management: 2018 Fact sheet."

The EPA and State of Nevada figures do not include wood coming from forestry treatment given that those materials do not pass through municipal waste operations. The ability to divert biomass from the Tahoe Basin can highly increase waste diversion to composting figures. A recent study entitled "Increasing Pace & Scale of Wood Utilization from the Eastern Central Sierra and Western Nevada" demonstrated that there is up to 423,148 mbf (thousand board feet) of sawlogs, or 635,000 tons of estimated dry weight, available in the eastern slope of the Sierras and western Nevada as part of

[12]https://www.epa.gov/sites/default/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf
[13]https://ndep.nv.gov/uploads/land-waste-solid-swmp-docs/2022_Nevada_Sustainable_Materials_Management_Plan_12-14-2022.pdf

enhanced forestry management.[14] The actual amount available would be based on accessibility to the land where those materials reside and economic feasibility of transportation to processing facilities. This figure does not include forestry slash such as the branches and other biomass collected for fire prevention measures.

Residential

Residences produce food waste, green waste, and wood waste. The challenges with managing residential organic waste for composting include the high variability in compliance with waste segregation rules and the possibility of contaminants, such as household trash being mixed into organic wastes and potential chemical residuals in green waste. Composters using diversified feedstock materials can limit the issues with potential chemical residuals by limiting residential green waste in compost recipes. Only composting residential green waste as the primary feedstock can increase the potential for chemical residuals based on the concentration of only one feedstock in a recipe.

There is a cost associated with education for residential organic materials diversion programs. Even though more emphasis on sorting education must be done in the residential sector, this sector is one of the most attractive to composters as new regulations and new diversion program implementation normally starts with residences.

From an analysis of current organic materials diversion programs generated from the residential sector in Nevada, green waste is the most readily available and is the lowest barrier to entry material to divert to composting. Contamination rates in green waste from the application of fertilizers, herbicides, and pesticides need to be controlled through education; however, new green waste diversion programs are already beginning in Nevada and current program success and failure issues can be analyzed for the betterment of new programs. Additionally, contamination of the green waste stream by household trash is a significant issue for Nevada residential green waste diversion programs. This contamination is caused by a lack of program outreach and education and incorrect sorting by residents. Current programs are discussed in the Full Circle Case Study, located in Appendix B of this document.

In Nevada, the main area for program planning for the diversion of residential materials is a firm understanding of waste-hauling franchise agreements and costs to customers.

Residential customers are unlikely as a group to support increased fees for compost mandates due to their immediate interest in moderating their household expenses. Analysis of the costs of new program implementation and program economic viability needs to be understood.

Residential food waste is also viable material for composting, but it will require the highest level of education for sorting due to contamination issues from mixing with other waste streams (e.g., MSW) as well as food packaging and produce stickers. Residential green waste should be considered before residential food waste. Also, after speaking with composters in other states about problematic contamination levels in some residential green waste and food waste programs, it is highly suggested to not "commingle" residential organic materials into one waste diversion stream. There is also a higher level of needed material containment systems such as bins and totes with locking abilities due to wildlife vector issues in certain parts of Nevada. Bears and other large animals are attracted to food waste and can cause large problems with collection programs if the correct bin system is not implemented for food waste materials. Implementing extensive "bear proof" containers may be cost prohibitive in areas for potential residential food waste collection.

Many states that implement new residential diversion programs allow the mixing of residential green waste and food waste into one bin at a home for ease of transportation. This is beneficial for hauling efficiency; however, this "commingling" can highly increase contamination as multiple sources of feedstocks are coming in one bin versus source separation. Also, residential green waste decomposes at a different rate than residential food waste. Food waste putrefies increasing stench and pathogens very quickly. Mixing food waste with green waste increases the difficulty in sorting due to different types of materials with different decomposing rates in one bin. For example, clean dry leaves will be mixed with putrefying food that may have plastic stickers on them. This increases the volume of material to be sorted.

The separation of residential green waste and food waste allows for educational emphasis on each stream and allows the composters to process each material differently at the compost site, therefore increasing the efficiency of processing and product quality. Green waste can be hand sorted and mechanically sorted through specific equipment. Food waste requires a different set of equipment for proper sorting.

Commercial

A variety of commercial and private businesses are significant generators and sources of organic wastes. These include restaurants, grocery stores, casinos, resorts, landscaping, and construction businesses.

Restaurants

Restaurants produce mostly food waste. There is a better chance for compliance with waste segregation given that professional staff normally handle all food products. Restaurants, either because of their own mission or demands from their customers, may be more inclined to support higher fees for composting mandates.

There is also the ability to distinguish between sources of food waste coming from "pre-consumer" (i.e., the preparation of food) and "post-consumer" (i.e., the final food waste after consumption in a restaurant). Pre-consumer food waste diversion is more easily trainable within the restaurant sector as employees handle the pre-consumer food waste. Waste audits and training can be implemented to restaurant staff to control contamination from food packaging and labeling. Post-consumer food waste is more difficult to control

contamination, as the customer must also be educated on proper sorting principles to eliminate contamination from non-compostable serveware and other non-compostable items. Many new commercial restaurant food waste diversion programs can begin with pre-consumer food waste only and then adopt post-consumer diversion once program viability is proven.

A Note on Compostable Serveware

There are many manufacturers of compostable serveware with varying rates of "compostability". There are regulatory groups testing compostable serveware such as the Biodegradable Products Institute; however, each composting facility may or may not be able to degrade the compostable plastics in the same way based on processing and temperature of the composting systems.

Also, there is debate within the composting industry of the compostable serveware ingredients affecting product quality. The compostable serveware, depending on composition, may be adding to microplastic and chemical residual contamination, such as Per- and polyfluoroalkyl substances (PFAS), in end compost products. The Biodegradable Product Institute monitors such items; however, branding and marketing of compostable products is varied. Just because an item says "compostable", that item may have not gone through as much testing and compliance as other products. Also, there are many companies creating slightly more environmentally friendly packaging, but their packaging may not be compostable. There are differences between the packaging labels of "biodegradable," "recyclable," and "compostable," and distinguishing between such labeling can be difficult and confusing. Furthermore, many products are often subject to "greenwashing" when marketed. Greenwashing includes misleading or untrue claims about a product's impact, or lack of impact, to the environment. Such products can negatively impact the end compost product.

The most difficult material to process in the restaurant food waste stream is compostable serveware and "to-go ware". The decision to allow compostable serveware to the food waste diversion program needs to be evaluated with care before implementation.

Once compostable serveware is introduced, the level of education to differentiate between acceptable and non-acceptable compostable serveware along with differentiation between "compostable", "plant-based plastics", and biodegradable must be heavily understood.

Due to difficulty in all product labeling, the introduction of compostable packaging into an organics diversion program has seen increased rates of contamination due to difficulty in differentiating between compostable and non-compostable packaging. Also, many restaurants do not move to using all compostable products. For example, a restaurant may be purchasing a compostable cup, but the lid or straw is not compostable. In such cases, these items are often disposed of together in the compostable waste stream. Tapes, stickers, condiment packets, and many other non-compostable materials can easily end up in compostable waste streams.

At most compost sites in Nevada, commercial food waste programs are “food only,” meaning compostable serveware is not allowed. This allows for the simplest education programs for restaurant staff and customers as the diversion of “food only” is easily understood.

With the proper funding and diversion tip-fee economic models, composters can purchase de-packaging equipment that will allow composters to take more contaminated food waste removing packaging from the waste to create a clean compost feedstock. Specific to compostable serveware, if this material is run through a de-packaging system, it will most likely end up at a landfill as the contamination level of de-packaged materials will be very difficult to sort between compostable and non-compostable materials.

Grocery Stores

Grocery Stores produce mostly food waste. Given the higher volume of food and associated packaging of food in the stores, there is a higher chance of contamination of the food waste stream. However, given the high volume of waste per source, education focused on grocery stores and those with missions that support sustainable systems would be likely to generate high volumes of quality food waste for composting operations. Grocery stores can be the first line of de-packaging of the food waste materials going to composters. However, grocery stores have typically low profit margins and unless they have missional support for composting, they would be unlikely to support any increased costs associated with compost mandates. Food waste generated from grocery stores with effective education programs are some of the most sought-after food waste streams for composters in Nevada.

PRODUCE STICKERS

In Nevada, one of the largest contamination sources in food waste is produce stickers as many restaurants and stores do not remove stickers from the produce. Once the food is composted, the stickers remain in the compost.

This is a good example of how specific and small contamination needs to be controlled.

Removing produce stickers can be a very laborious for food waste generators like restaurants and grocery stores. However, it is necessary for an effective diversion and composting program.

However, with the proper funding and diversion economic models, composting facilities can purchase de-packaging equipment that will allow composters to take more contaminated food waste removing packaging for the waste to create a clean compost feedstock.

Landscaping and Construction

Landscaping and construction businesses generate mostly green waste and land clearing/soil. There is likely a low level of contamination from this waste source as many construction locations are new land. However, landscaping can have much higher levels of contamination due to trash and chemical residues in commercial and residential landscapes.

The priority in this area is education with specific landscape and construction companies using composting to divert organic materials to control contamination. Landscape companies will need to pre-sort contamination from green waste. Construction companies will need to pre-process trash, rock, or other non-compostables from overburden. Due to low landfill tip fees in Nevada, these businesses would be also unlikely to support increased costs associated with compost mandates.

Construction companies seeking LEED certification for their projects can receive credit for implementing organic collections on site.

Communities/Municipalities

There are a variety of organic wastes generated by municipalities. Cities and counties generate food waste, yard trimmings, and wood waste. Yard trimmings and landscape waste are generated from parks and public spaces managed by cities and counties. Food waste can be generated from governmental institutions and places of work. Additionally, cities and counties manage the sewer system, which can produce sewage to process human waste into biosolids. t should be noted that many states and the federal government are considering tighter controls on the use of biosolids due to the presence of PFAS.[15]

When implementing organics diversion programs, cities and counties should develop and document standard processes that result in low levels of contamination of their waste. Such processes could include regulations to limit chemical fertilizers, pesticides, and herbicides in sustainable parks and opens space as well as training staff on sorting trash from wood waste and green waste. Depending on their commitment to sustainability, the city or county may be supportive of increased cost associated with compost mandates due to leading the example of circular economic program

[15]https://www.ecos.org/wp-content/uploads/2023/01/PFAS-in-Biosolids-A-Review-of-State-Efforts-and-Opportunities-for-Action.pdf

implementation. City and county employees can also be educated in a controlled environment to sort materials properly for segregation and contamination control.

Agriculture

Agricultural sites, depending on the type of agriculture performed, can produce large amounts of manure and agricultural feedstocks. For example, hay and alfalfa may not be viable if not consumed by animals in a specific period and can be diverted to composting operations. Manures can be used as a nitrogen source in compost. Two challenges face collection of these organic wastes for the purpose of composting. The first is that many agriculture sites reuse their own organic wastes, and the second is the potential for large physical distances between collection sites.

Another challenge is the use of fertilizers, pesticides, and herbicides that could contaminate the organic waste stream. For example, heavy use of herbicides can contaminate the resulting compost regardless of processes used to compost the organic waste. Priority for collection should be given to those agricultural sites that do not use fertilizer and pesticides, those that are closer to composting operations, and those that have a surplus of organic materials. Given their inherent ability to use their own organic waste, it is unlikely that agricultural sites would be interested in increased costs associated with compost mandates.

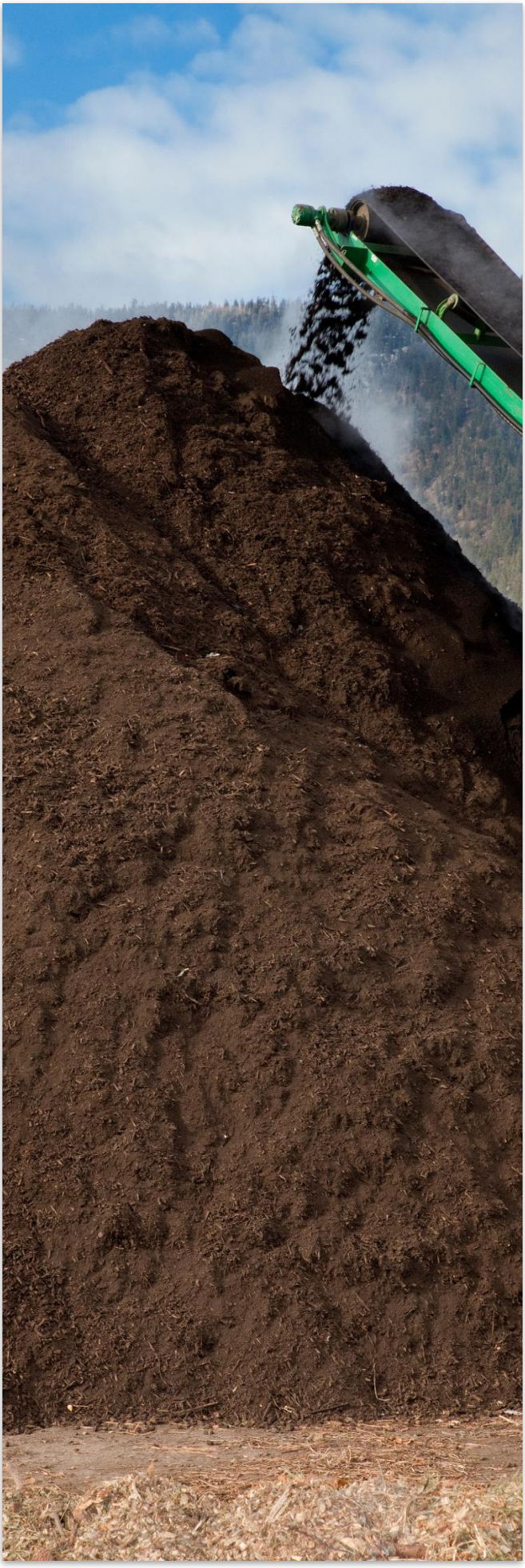
Forestry

A recent study by Living Forests examined our fire suppression practices over the last 100 years and determined that these practices have resulted in more intense fires, a loss of biodiversity, and unused timber resources. The report, entitled “Increasing Pace & Scale of Wood Utilization From the Eastern Central Sierra and Western Nevada ” documented how better forest management practices could result in a one-time harvest of up to 423,148 mbf of Forestry Waste that could be used to support composting operations.

Currently, the largest barrier to diversion of forestry materials is funding to harvest, transport, and pay for the composting of these materials. The volume of forestry materials available are immense; however, a system of collaborative and well-funded organizations must come together to remove the materials from the forest and get them to composters who desperately want these materials. Many times these materials are viewed as “valuable” with the desire to sell the materials for a profit. With the pressure of forest fires, the perception of “value” may need to change in this industry to create

more efficient movement of materials to processors who can convert the materials from fire-prone carbon into materials that can be reused back in the forest to grow more vegetation.

There is extremely low levels of contamination in this organic waste stream. However, the biggest issue is the ability to transport these organic materials in a way that is economically viable. It is likely that - given the need for better forest management in the face of the increasing risk of forest fires - the agencies who manage these forests would be willing to cover the increased costs of composting.



The Compost Industry

This section provides an overview of the composting industry and highlights opportunities and challenges for commercially viable composting operations in Nevada.

The Composting Process

> *The process of composting is simple and practiced by individuals in their homes, farmers on their land, and industrially by cities and compost sites.*[16]

Compost is composed of organic materials derived from plant and animal matter that has been decomposed largely through aerobic decomposition. Many people partake in this process by piling up organic materials in their garden and waiting for it to decompose to use as a fertilizer on their gardens. Industrial composting pushes the aerobic decomposition process of these organic materials into overdrive, cutting the timeline for full decomposition from years down to a few months. For example, Full Circle Compost in Northern Nevada can fully compost tons of organic materials in an average 3–6-month process. The product is a highly nutrient rich material that is used in many different residential, commercial, and industrial applications.

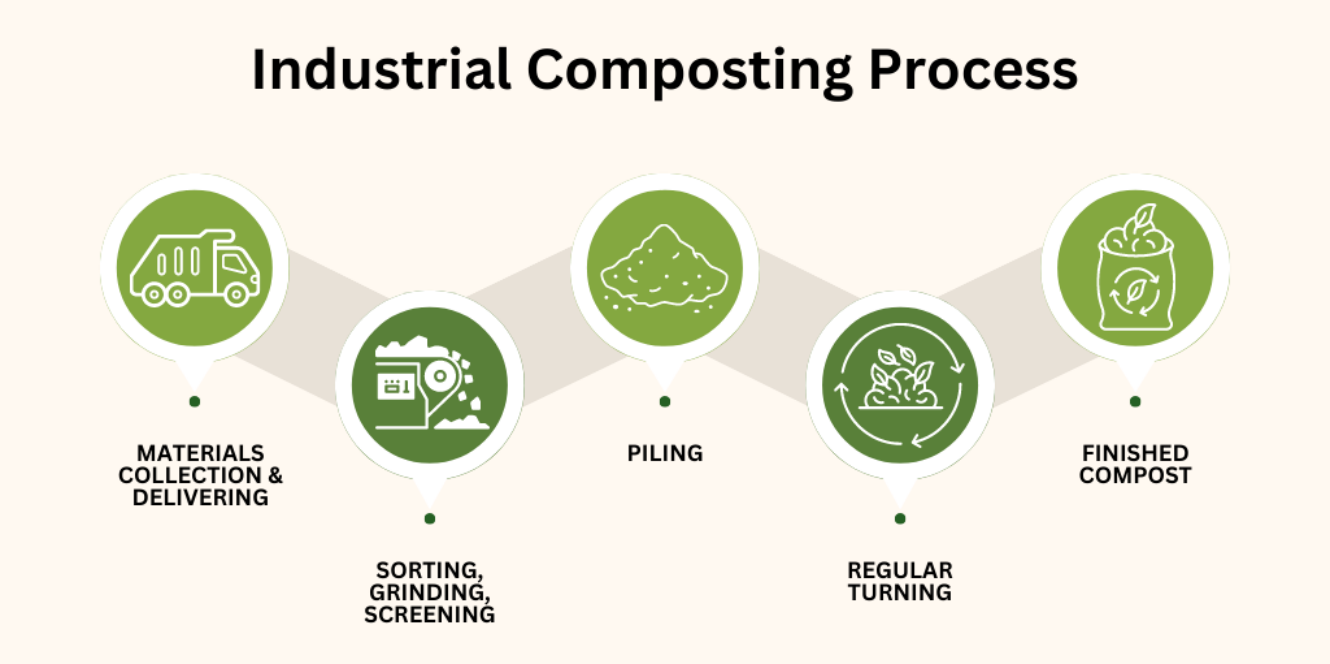


Figure 3: A variety of composting processes are employed by different industrial and commercial composting facilities. Most widely used is an aerobic process through constant turning of the materials.

Compost facilities throughout the nation can use different types of processes to break down these organic materials. Most widely used is an aerobic process, called windrow composting, which involves the constant turning of the materials. This process is shown in the photo on the next page and is of a windrow turning at Full Circle Compost in Carson City, Nevada. A compost turner runs over the organic materials that are in

[16] https://www.compostingcouncil.org/page/CompostManufacturing

Windrow turning at Full Circle Compost facility in Carson City, Nevada.

long windrow piles. The compost turner turns the materials to allow oxygen to enter and to release built up CO2 that is created from the breakdown of the materials. Some compost turners also turn in water depending on moisture levels and temperature. Composters manage the CO2 and temperature levels throughout the process. Many other factors are also evaluated through the recipe creation process and cooking process. When specific indicators have dropped to a certain level, the process has finished.

Another composting method is called static pile composting. This process involves making large static piles of organic materials. To help aerate the piles, layers of loosely piled bulk agents, such as wood chips, are incorporated so that air can move from the bottom to the top of the piles.[17] Also, large tractors can take the place of compost turners to aerate the piles using a similar turning method. A network of pipes can also be placed under the static piles to deliver air in or out of the piles.

The application of compost as a soil amendment is the main usage of the material created through these processes. The creation of methane used as natural gas is a new field and is growing rapidly in anaerobic digestion. Compost can be used in a plethora of situations including but not limited to gardening, lawn applications, golf course fertilization, forest rehabilitation, erosion control, park management, nature habitat rehabilitation, etc. Compost is also used as a primary ingredient to create other soil products such as landscape soils, potting mixes, garden soils, and mulches. All these applications and the benefits for organic

Overhead view of the Cedar Grove Organics Composting Site. (https://kingcounty.gov/~/media/depts/dnrp/solid-waste/greenschools/documents/2009-Green-Schools-workshop-Cedar-Grove.ashx?la=en)

[17] https://www.epa.gov/sustainable-management-food/types-composting-and-understanding-process

materials recycling have caused a large growth in the composting industry.

Tipping Fees

Composting is a two-part system of receiving materials and then converting these materials into a sellable product. This could be considered a dual revenue driver as there is normally a "tipping fee" associated with taking in the materials that need to be composted, and then the compost is sold at a specific price. The balance between the tipping fee and the compost price is based on factors influenced by landfills, regulations, and product quality. Community, governmental, and market factors can also affect these rates.

Composting requires a tipping fee, because this revenue stream covers the cost of cleaning, sorting, and feedstock processing before it is put into active composting. Tipping fees are a primary funding source for composters to invest in the needed and costly equipment to process inbound feedstocks. Compost companies run millions of dollars in specified equipment for processing organics. The ability for compost companies to scale up equipment to fund more diversion primarily is generated through the collection of tipping fees. The sale of finished compost covers the price of product creation through thermophilic composting. Creating fair tipping fees and maintaining high quality end compost products at fair market prices are the main goals of any large-scale composting operation for long-term business success.

As per Appendix A, low-cost landfill tipping fees in Nevada put downward pressure on compost tipping fees through competition. This requires Nevada composters to primarily fund composting operations through end compost product sales. This puts pressure on product market development and increases the ability for low-cost product competition from other states. In California, organics diversion mandates have created a huge supply of organic materials without a corresponding control over compost quality to ensure a sufficient demand. In some cases, jurisdictions that are required to purchase the resulting compost are resorting to giving it away free to farmers and home gardeners.[18] It is important to balance mandates and regulations on both the supply and demand side of organics management.

Many communities outside of Nevada are mandating organic materials recycling as an effort to reduce greenhouse gases or find sustainable organic materials recycling processes. This can be very beneficial to the compost industry as more materials will begin to flow to composters due to regulations. If tipping fees are at adequate prices, such as shown for Washington State in Appendix A, the increased flow of materials can be extremely beneficial due to increased revenue from inbound materials tipping fees. Increased inbound materials and revenue can improve operational management and expand organic materials diversion overall. However, this is where the compost product market must also be supported by the community. When implementing large-scale composting programs, the community must also use the end compost. If only half of the "composting life cycle" (Figure 4) is completed (i.e., inflow of materials but no end demand), an imbalance of materials will come into a composting site. With an imbalance in tipping fees and large volumes of feedstocks flowing to compost sites, the composter is mainly driven by the inbound

[18] https://civileats.com/2022/03/02/california-compost-law-food-waste-produce-farmers-brown-gold-soil-health-climate-agriculture/

tipping fee revenue. This can cause the composter to drop product quality and price, essentially flooding the market to remove compost products from the site so more materials can be brought in to drive revenue. The end compost marketplace suffers from increased supply with no demand, thus starting a disintegrating price spiral. This can be seen in California. Increased regulation forcing composting at beneficial inbound rates is flooding the market with compost product supply dropping the entire marketplace with low quality, low priced products.[19]

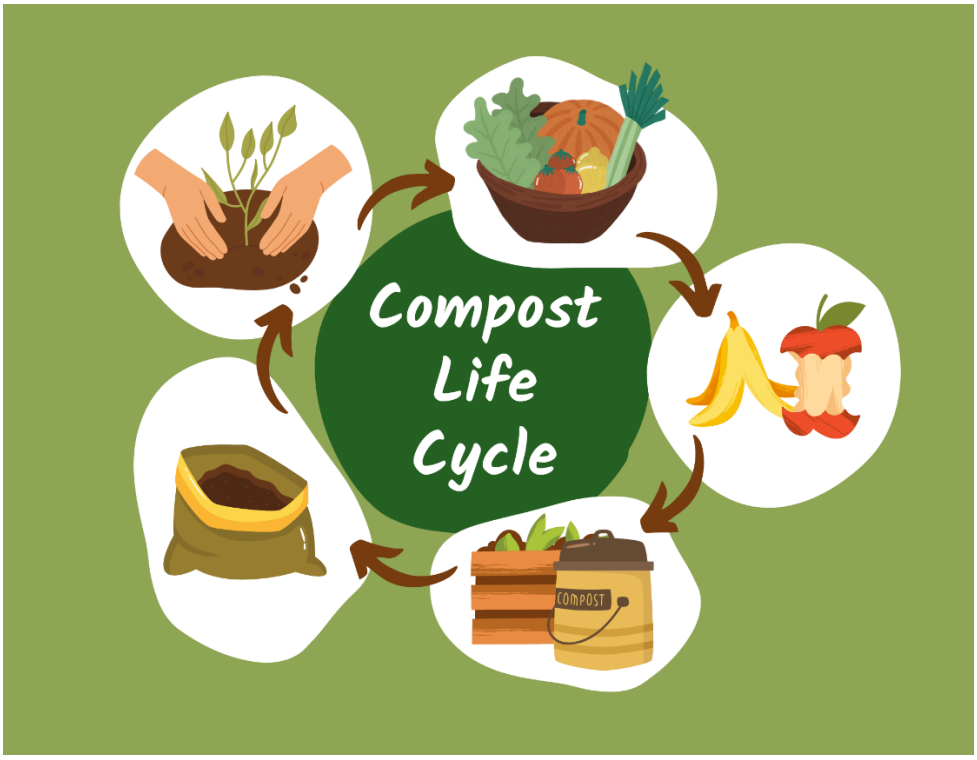


Figure 4: The composting lifecycle must be balanced between the amount of end product compost produced and the demand for the end compost product. Without enough demand, the lifecycle cannot be fully closed.

Finishing the "composting life cycle" is not only done by regulation and support of "recycling through composting" but through the support of the use of compost by the community in all possible avenues. The same communities pushing the diversion of organic materials to composting also need to support compost purchasing to keep material flowing in the market with standards for quality. For example, if a community makes "green waste recycling" through composting mandatory but that same community does not buy or use compost for community parks, landscapes, or agricultural projects, then all the burden is put on the composter to create the market. Furthermore, if the inbound materials are contaminated and the inbound price is low, the whole system collapses. A balance between inbound tipping fees and end compost product markets are crucial. This is where composters need to differentiate and maintain compost product quality and prove viability of the marketplace.

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[19] https://civileats.com/2022/03/02/california-compost-law-food-waste-produce-farmers-brown-gold-soil-health-climate-agriculture/

Mandates

There is currently a patchwork of mandates to keep organic waste out of landfills throughout the nation. According to the US Composting Council[20], as of 2021, there were 22 states that have bans or aggressive legislative rules for keeping green waste out of landfills. There are also eight states that mandate the collection of food waste and food scraps. At the local level, five cities have general organic bans and three have mandates for the collection of food waste and food scraps. Any of these legislative remedies need to be balanced with community engagement to ensure that the bulk of the materials being collected are not contaminated to the point of needing to go to the landfill.

On the demand side of the market, Washington State mandates that 80% of funds used for soil amendment by the Department of Transportation be spent on compost[21]. California has extensive mandates and regulations on the diversion of organic materials and the procurement of compost to create beneficial waste diversion systems. The California model could be used as a basis for new program review in Nevada; however, learning from current California supply and demand issues and compost quality must be kept in balance.

There is the ability to limit mandates through economic changes in Nevada specific to waste and composting. In some states such as California and Washington, the price to landfill materials is much higher than the inbound tipping fee charged by composters. This creates natural flows of material to the lower cost disposal option.

According to NDEP's recycling database, 325,000 tons of organic material was recycled in Nevada in 2021. Assuming a Nevadan MSW stream that matches the national MSW composition (Figure 1), 1.42 million tons of organic waste are landfilled. This would mean that an estimated 18.6% of organic material was diverted from the landfill. Thus, there is room for growth.

In Nevada, because landfill tipping fees are very low, composting is not as favorable due to the same or higher fees. By increasing landfill tipping fees, composting options can become a more competitive disposal option for organic materials without mandates.

Other municipalities are discussing pilot and future organic waste diversion programs. Based on Full Circle's experience in organic waste diversion programs in Nevada from municipalities and commercial sources, the following concepts should be considered:

- Municipalities need to be involved in the management, demand assessment, education, and training of their community for residential waste diversion programs to be successful. The full burden of oversight should not only be on the private companies managing the programs. An understanding of the demand for waste diversion at fair rates should be assessed before implementing mandates.
- Residential programs should start with green waste diversion programs first before moving to any other potential diversion materials. Green waste is easier to manage and educate for contamination control. Residential food waste must be managed with extreme oversight to control contamination.
- Commingling of materials should be avoided. Many municipalities are moving to commingling of green waste and food waste for increased hauling efficiency; however, this increases the complexity of processing the material by the composter and increases contamination. Separated materials allow for more control. Commingling is only possible if inbound tipping fees at compost sites provide for adequate funding for processing and euipment investment.
- Currently tipping fees by composters in Nevada are 50-70% cheaper than tipping fees in other states with broad composting regulations. This deflated tipping fee environment due to competition with low cost landfill rates in Nevada does not provide adequate cost coverage for composters to invest in the needed equipment to efficiently control contamination. The tipping fee structure for landfills and composters should be addressed. Composters in Nevada currently only average $30 per ton for inbound materials where other states range from $60-220 per ton for inbound green waste materials. Without the proper inbound tipping fees, composters will not be able to adequately scale operations for residential programs. Municipalities interested in residential programs need to understand fair inbound tipping fee pricing and that there are added costs for sustainable waste diversion to reduce greenhouse gases and divert wastes headed to the landfill.
- Commercial organic materials diversion programs are based on needs assessments of private businesses. Those Nevadan businesses wanting to divert organic materials can develop synergistic working relationships with other companies to create demand for route creation by waste haulers or self hauling to compost sites. Food waste programs are designated by waste franchise agreements. The ability to create routes is possible with enough interested businesses. Pricing of the service will be the main hurdle if there is enough participation demand. Food-only programs should be followed. If enough food waste is generated, composters can invest in depackaging equipment. This would allow more materials to be included in the collected organic waste stream.
- Green waste is primarily generated by the construction and landscape industries and can be currently hauled to composters as long as contamination levels are under control by the generator. Education and culture change within the landscape and construction industries are needed to improve these industries's understanding of the importance of reducing contamination in the organic waste stream and the significance of waste diversion for sustainability.

- Accountability and control mechanisms on organic waste diversion programs, waste haulers, and compost companies all need to be evaluated. Just because an organic waste diversion program is created does not mean that the materials end up at a compost site or that the composter is accountable for repurposing the organic materials. Material going into a “green waste can” or a “food waste can” provided by a waste hauler does not simply guarantee the material will be delivered to a compost site. Without accountability controls, it is possible for organic materials to “pass through” waste haulers or compost sites and still end up at the landfill. For example, with too much trash contamination, materials can be deemed “unsuitable” for composting, be dropped directly at a landfill or dropped at a compost facility just to be reloaded into another bin to be hauled to a landfill. Properly managed compost sites will have some materials that are unsellable and must go to the landfill; however, accountability measure need to be implemented to make sure “green washing” does not take place where excessive materials are landfilled. For example, a compost site that inbounds thousands of tons of material but does not have balanced movement of end compost products back into the community could be green washing sending a majority of the material to the landfill.

Source Quality Control

The level of contamination in the inbound stream needs to be evaluated. With more contamination, the inbound material stream will be harder to process, requiring increased investment by composters for sorting. The cleaner the inbound materials, the lower the tipping fee. The more contaminated the inbound materials, the more the expenses increase for sorting. The inbound materials may then also directly affect product quality. More contamination can negatively impact a composter's ability to produce quality compost and may result in sending otherwise compostable material to the landfill. In Nevada, with less revenue coming from the compost facility tipping fees, more revenue must be made on the outbound product side to cover costs. Equipment costs alone can be from 20-40% of total revenue. Extra costs due to cleaning inbound materials may invert the revenue stream, causing composters to go out of business.

To combat contamination, an emphasis on the education and training of organic waste generators must be the main area of concentration. In addition to education, another possible remedy to higher levels of contamination is higher inbound tipping fees. With higher fees, composters can take dirtier materials as long as they have the revenue to invest in sorting equipment.

Another important aspect of source quality management is monitoring compost companies for accountability. The term “compost landfill” is used for composters who greenwash by bringing in materials but are not actually composting them or are instead sending most of their inbound materials back to the landfill. Ensuring composters are doing their best work to create the highest quality products and limiting the landfilling of organic materials should be high priorities. A lack of oversight can allow for some composters to take advantage of the situation and send viable materials to the landfill while not actually composting the materials at all.

Landfilling unsellable end compost products is often a result when contamination levels are too high after composting. Therefore, composters need to ethically complete their job, and the generators need to send viable materials to the composters.

Segregation of Waste Streams

Due to compost recipe requirements and processing for highest quality products, green waste and food waste should stay separated for large scale diversion programs and no commingled. This does create more logistical hurdles for hauling but will maintain clear definitions between waste streams and help curb contamination in multiple streams. Food waste streams are much more contaminated with other MSW materials than compared to green waste streams.

Separate streams also allow for differing diversion price structures. Green wastes are easier to process with less vector controls. Food waste is much more difficult to process due to pathogen and contamination control. Currently, at Full Circle Compost in Carson City, Nevada, tipping fees for clean green waste averages $30 per ton and food waste averages $65 per ton. Contamination/sort fees do apply. Estimated prices per ton to cover contamination and sort fees would be around $55 per ton for green waste and $80 per ton for food waste.

Demand for Compost

This section provides an overview of the market demands for the finalized compost products. It is essential that we have sufficient demand for finalized compost products to support commercially viable composting operations.

Current & Potential Demand Opportunities

Due to current economic and waste diversion factors, Nevada has only two primary retail composting operations selling large quantities of compost products on the market. Full Circle Compost in Northern Nevada and Terra Firma Organics in Southern Nevada. Both sites currently sell all compost products that they produce annually with minimal surplus outside of their current customer base. This is primarily driven by a lack of organic materials being diverted to composters, therefore limiting the amount of end product being able to be produced. With more organic materials flowing to compost sites, there is the ability to produce larger volumes of end compost products to new compost marketplaces.

Full Circle Compost has driven a large distributor network of end compost product wholesalers. Also, both companies have created their own end product marketplaces, which has allowed for the sale of all end product inventory. With increased diversion, there is the opportunity to create more compost products for the market.

In Nevada, there are several potential opportunities to develop a strong demand for large quantities of end compost products primarily involving municipalities, agriculture, and highway sectors. For example, following application rates of compost as a topdressing for soil at ¼", it requires 32 cubic yards of compost per acre. At 1" applications of compost per acre, it requires 130 cubic yards of compost per acre. Full Circle Compost and Terra Firma Organics can produce approximately 25,000-50,000 cubic yards of finished compost each year. For example purposes to show demand, we will use a total of 50,000 cubic yards of compost between the two sites:

- 50,000 cubic yards at ¼" coverage = 1,562 acres of compost application
- 50,000 cubic yards at 1" coverage = 384 acres of compost application

When comparing these coverable acreages to farmland and parks, the potential demand for compost can be seen. The Farmland Information Center indicates that in 2016 there were 824,100 acres of crop and pasture land in Nevada[22]:

- Retail compost currently produced in Nevada at a ¼" coverage could only amend .1% of crop and pasture land in Nevada.
- Retail compost currently produced in Nevada at a 1" coverage could only amend .04% of crop and pasture land in Nevada.

In Northern Nevada, Washoe County manages over 12,000 acres including over 10,000 acres of open space, 49 parks, an Arboretum, developed trails, trailheads, athletic fields, golf courses, a campground, a

[22] https://farmlandinfo.org/statistics/nevada-statistics/

shooting facility, an archery facility, a museum, and so much more![23] Assuming all 12,000 acres could benefit from compost usage:

- Retail compost currently produced in Nevada at a ¼" coverage could only amend 13% of the acres managed by Washoe County.
- Retail compost currently produced in Nevada at a 1" coverage could only amend 3% of the acres managed by Washoe County.

The Nevada Division of Transportation (NDOT) is responsible for the planning, construction, operation and maintenance of the 5,400 miles of highway[24]. Assuming the use of compost for erosion control to grow native vegetation on the side of highways at a 20ft swath on each side of the highway:

- Retail compost currently produced in Nevada at a ¼" coverage could only amend 641 miles of highway or 12% of the highways managed by NDOT
- Retail compost currently produced in Nevada at a 1" coverage could only amend 153 miles of highway or 3% of the highways managed by NDOT.

The potential demand for end compost products by agriculture, municipalities and roadways is enormous in Nevada. Current end compost production does not even scratch the surface of possible compost demand if specific sectors begin to see the value in compost product use. The demand would highly outweigh the available production. When looking at the large amounts of organics still being landfilled, there is the opportunity to divert these materials to composting to create more products to fulfill future demand.

The above analysis also does not account for the use of compost as an ingredient item in the creation of other soil products. Full Circle Compost creates 30 different products derived from compost. The use of compost in garden soils, potting soils, landscape soils, mulches, and site-specific custom soil amendments increases the need for compost even more.

Uses of Compost Products by Sector/Industry

The following sections discuss how different industries and sectors can use compost. These sections also reference categories of certified compost products as defined by the U.S. Composting Council's Seal of Testing (STA) Certification Program. This program provides a set of definitions and rules for documenting contents and recommendations for use of compost products. It is important to note that there are three varieties of recommendations for end product compost, including Trees & Shrubs, Flowers & Vegetables, and Lawns.

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[23] https://www.washoecounty.gov/parks/

[24] https://www.dot.nv.gov/doing-business/about-ndot#:~:text=The%20department%20is%20responsible%20for,and%20assistant%20engineers%20in%20each.

Construction & Landscape Companies

Construction companies could be large users of compost to support the landscaping placed around new construction and for retrofit projects. Typically, construction projects would be interested in **Lawn and Trees & Shrubs** certified products and would be interested in conserving water and establishing healthy soil to reduce ongoing maintenance expenses for the building owner. The U.S. Green Building Council's LEED certification program for buildings includes additional points towards LEED certification for the development of landscaping and roof-top projects that would benefit from compost[25]. As there are no specific requirements for the types of compost used on construction projects, it is anticipated a medium level of quality would be required and that construction firms would have a high level of price sensitivity and would use their purchasing power to find the least expensive product.

Roadwork

Departments of Transportation over the US use compost on road construction and maintenance projects to help with stormwater management and erosion control. It is anticipated that most of the compost would be **Lawn and Trees & Shrubs**. Many Departments of Transportation have published specifications for the compost they use on their projects. These detailed specifications indicate an expectation of consistency of compost content but would only require a low to medium level of quality. Also, given the very large volumes used, the Departments of Transportation can get the lowest prices for the compost they purchase.

The demand for compost for road work could be increased through state or local mandates for increasing the amount of recycled materials used in their operations such as the one mentioned for Washington State earlier in this document. Compost manufactures can work with landscape architects to create specified local compost to meet roadwork erosion control specifications.

Agriculture

Agriculture has large potential use for compost if they are not creating their own compost products. Many agriculturalists primarily use conventional synthetic fertilizers for crop fertility. Many organic farms are increasing compost use. If an agricultural operation required composting, the compost product would most likely need to adhere to specific requirements regarding PH levels, nutrients, and other requirements based on the current soil and crop needs. The number of farms that may be interested in compost to improve soil health, manage soil erosion and offset costs of artificial additives such as fertilizer and pesticides could be increased by education efforts through organizations such as the Desert Farming Initiative. While most agricultural sites would be interested in **Flowers & Vegetables and Tree & Shrubs** compost, sod farms would be also interested in **Lawn** compost. These agricultural sites would be price sensitive and would need to understand true economic benefits of delivered compost over what they can produce themselves. Also, agriculture normally has a smaller budget per acre for soil fertility over other industries due to overheads in farming.

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[25] https://mcgillcompost.com/wp-content/uploads/2022/01/Using-Compost-BMPs-for-LEED-Green-Building-Credits.pdf

Residential

As noted in Grand View Research's compost market analysis report, the residential market for compost is expected to continue to increase significantly[26]. This is due both to increasing awareness of the risks of pesticides and fertilizers, but also the increase in home gardening in part due to the COVID-19 pandemic and continuing today. Residential users would be interested in all three compost types (**Flowers & Vegetables, Tree & Shrubs, Lawn**) and would expect a high level of quality of the compost products. And while the online market for compost is increasing, most compost will continue to be purchased at brick-and-mortar establishments. Accordingly, it is likely there is a medium level of price sensitivity as the consumers would not necessarily seek out the best price above the convenience of their local garden or retail store. Additional education about the benefits to compost for soil health and water conservation, and the benefits of avoiding fertilizers and pesticides could serve to further increase demand. The advantage to local bulk compost-based products allows residential customers to save money by buying by the truckload rather than in packaged products.

Garden Nurseries

Garden Nurseries would be interested in **Trees & Shrubs and Vegetable & Flowers** compost products to support their own operations. They would also be a pass-through for all products to go to Residential Users and to some smaller Construction and Landscaping businesses. As such, Garden Nurseries are an important outlet for training about the benefits of compost for soil health, water conservation and to avoid the use of commercial fertilizers and pesticides. Partnerships with these organizations could increase the demand for compost both for their own operations as well as for their customer base. Like Residential users, it is anticipated that Garden Nurseries would expect high levels of quality in the compost products.

Municipalities

Municipalities would mostly be interested in **Lawn and Trees & Shrubs** compost products to maintain their own grounds and public spaces. In addition to improving soil health and conserving water to reduce operational costs, their responsibilities may also dictate using compost for bioremediation of contaminated soils as well as erosion control and stormwater management. Their level of demand would be based on cost considerations as well as the use of recycled materials as part of a sustainability effort. The amount of compost demanded could be increased by having more municipalities with sustainability goals or by increasing the level of recycled products to be used within an existing sustainability effort. Given the potentially large volume of compost to be used, municipalities would be able to use their buying power to drive down costs of the compost. It is expected the level of quality would be medium given the use of the products in landscaping projects.

[26] https://www.grandviewresearch.com/industry-analysis/us-residential-organic-compost-market-report

Barriers to Meeting Goals in Nevada

This section provides an overview of the barriers and constraints affecting Nevada's composting industry, while also highlighting the opportunities that exist to expand commercially viable composting operations.

What Barriers Exist?

Nevada has only a handful of commercial composting operations. This section attempts to explain why more compositing operations are not in place and why the existing operations struggle with remaining commercially viable. These barriers must be addressed if we are going to successfully divert more organic materials from our landfills to make beneficial compost.

Contamination of Source Materials

There is a significant risk of contamination of the organic materials for composting based on the source of the materials. There are several types of contamination. First, there is mixing of food related-items in the food waste stream, such as glass beverage containers, stickers, and packaging. This type of contamination affects the cost to process the food waste, the likelihood that the food waste will have to be landfilled, and the likelihood that residual contamination will appear in the compost product affecting its quality. There is also the contamination of MSW in all organic materials. Homeowners may put garbage into their green waste cans or landscapers may not clean out trash from commercial landscapes. Trash not being removed from green waste and food waste by the generator is a significant contamination factor.

There is also a risk of amendments such as fertilizers, herbicides, and pesticides in green waste and agricultural waste. These chemicals can contaminate the compost and cause it to not meet specifications for finished products.

Another risk is mixing of waste streams. The mixing can require additional equipment, and expense, to separate the streams and will increase the likelihood of the materials having to be landfilled due to high levels of contamination. The best strategy to avoid these risks of contamination is to source materials that have a minimum of risk for contamination. However, most any strategy must include community involvement and education so that the individuals and organizations providing organic materials for composting understand their role in making the compost system sustainable.

Failure to address contamination at the source will only increase the imbalance of tipping and landfill fees as composters will be forced to charge more to cover additional labor or to invest in equipment to remove contamination in their pre- or post-compost processes.

Imbalance of Tipping and Landfill Fees

At this time in Nevada, we see the tipping fees for compositing operations to be $30 per ton for green waste, whereas landfill tipping fees are only $12-$52 per ton[27]. This type of imbalance causes suppliers

[27] As noted in Appendix A, Lockwood Landfill has a posted rate of $63 per ton for Green Waste. This figure does not represent the lower negotiated fee for large-volume waste haulers.

to rely more on landfilling rather than composting. There are a number of options for addressing this imbalance, such as raising landfill tipping fees or subsidizing tipping fees for composting. Another option would be for the composting operations to reduce their tipping fees to be competitive with landfill fees and raise their product pricing to make up for the difference. However, that price increase could cause them to be non-competitive with other sources such as compost coming from California.

No Mandates for Composting

There are no mandates for organic materials diversion in Nevada and limited requirements for government agencies or businesses to use the compost products. Some do suggest compost as the benefit of the products have been proven in projects. As noted above, many states and municipalities are imposing these types of mandates to both avoid landfilling of organic materials and to take advantage of the environmental benefits of composting. Lack of mandates can result in a lack of inbound organic materials for composting or a lack in demand for the end product, or both. If we were to consider these types of mandates in Nevada, they must be coupled with community involvement and education as well as a rebalancing of tipping fees so that suppliers are willing to participate rather than finding ways around the mandates for social or economic reasons.

Distances for Hauling

Nevada is a large state with relatively low population density. We also have only a few composting operations. This means that there are significant distances between suppliers and composting operations as well as between composting operations and compost customers. These distances necessarily raise the cost of hauling both source materials and finished products. The best option for addressing this barrier would be to increase the number of composting operations through creating economic incentives and/or reducing regulatory burdens for composting as is the goal of this paper.

Market Flooding

The compost market must remain in balance between supply and demand or else risk compost suppliers flooding the market to remove finished product from their facilities. We are seeing this risk play out with California. With the California enforcing composting mandates, compost operators are overwhelmed with supply without a corresponding increase in demand. They are also forced in some cases to process contaminated source materials to keep up with the supply chain. They are currently dropping their prices to push out lower quality compost products to rebalance the supply and demand. Our best hope for this situation is that California begin to look again at how their mandates are causing this situation and perform their own rebalancing.

Composting Regulations

Nevada Administrative Code (NAC) 444.670 requires that any compost site must be 1000 feet from a main road and 500 feet from a property boundary. This requirement makes finding any compositing site in an urban setting difficult if not impossible and forces composters to find land outside our urban areas. This increases the likelihood that the physical distance to the composting site may present a logistical and financial barrier to sending materials to a composting site.

Recommendations for Decision Makers

When discussing, designing, or implementing an organics diversion program for the community, PSN suggests that decision makers consider a few key recommendations – including accessing the community's demand capacity, developing stakeholder maps, considering mandates, and reviewing regulations and permitting processes. Involvement of the community is key for any successful organics diversion as it will determine supply, demand, and viability of composting.

Recommendations for Designing and Implementing Successful Large-Scale Compost Programs

Often, organic waste diversion programs begin at the municipal/city-level. However, the state government can also play a role in ensuring that these local programs are successful. For example, some state agencies are ideal end users of compost, while others affect the siting and permitting process of compost facilities.

When discussing, designing, or implementing an organics diversion program for the community, PSN suggests that decision makers consider the following recommendations, which are discussed in more detail in this section:

- Assess community demand for an organic materials diversion program, such as composting
- Develop stakeholder maps to connect composters, generators of organic waste, and end users of compost – thus helping to close the compost life cycle loop
- Consider mandating an organic waste diversion program and educate the community
- Create end compost specification standards and source locally
- Find and communicate funding opportunities for new programs to help offset infrastructure and project implementation costs
- Review and update regulations and permitting processes to ensure accountability and to encourage an industry standard end product that is made in a safe and environmentally protective manner but is also not economically restrictive to the industry

New Organic Materials Diversion Community Demand Assessment

Involving the community is important for the long-term success of an organic waste diversion program. Decision makers should create opportunities for community members to be involved in the decision-making process, and the community should help identify materials that should be diverted from the landfill (e.g., yard waste, food waste, other items). Municipalities can send surveys to the community to assess and identify:

- Community desire and willingness for an organics diversion program
- Potential for rate increases for hauling
- Sorting requirements

- Community educational needs
- Demand and benefits of compost products
- Opportuntites to change tipping fees

When reviewing surveys and assessments, make sure the community has efficient demand capacity to be involved. It is possible that the assessment will result in the identification of individual and community-level composting initiatives. Developing a pilot project can be a good way to test the feasibility of a community-wide composting program and identify any potential hurdles that need to be addressed before launching on a larger-scale.

Create Stakeholder Maps

To help close the compost life cycle loop, stakeholders should be able to easily connect with each other and find opportunities to get involved. Decision makers should create stakeholder maps of current organics material diversion options and opportunities as well as create lists of existing and potential organizations that could be key stakeholders in the diversion program.

Connecting stakeholders together and connecting them with opportunities and options must be an area of focus for decision makers. For example, many compost facilities already exist that need or want organic wastes/materials. Other generators of organic materials may not know that there are options outside of landfilling. Therefore, it is crucial to make these options known to organic waste/material generators (e.g., construction, forestry, communities). Additionally, it is important to connect end users to this stakeholder map so that demand for compost remains strong. These stakeholder maps could be added to the local and state government websites.

Mandate Organics Materials Diversion

As decision makers begin to have discussions around organic waste diversion programs, the idea of mandates will come up. Mandating organic waste diversion through a large-scale, municipal-wide composting program will help keep large volumes of organic waste out of the landfill. A case study of Full Circle and Carson City's Residential Green Waste Program can be found in Appendix B, and decision makers may find it useful in their discussions.

Create End Compost Specification Standards

To close the compost life cycle, decision makers should require the use of locally sourced organic materials and compost products. A mandate for locally sourced compost product could be based on miles from project location. Additionally, NDOT, home construction, landscaping, and municipalities can begin specifying the

use of local compost products. Decision makers and end users should consider the use of compost to increase water holding capacity, soil health, and nutrients and then make compost requirements and specifications accordingly. Other states are creating procurement mandates to assist in the continued use of compost. Also, decision makers could consider requiring large generators of organic wastes to use specific amounts of compost products on an annual basis to offset the inbound diversion. For example, if a city is a large generator of organic waste, then it must start using specific amounts of local compost for parks, landscape, roads, and other projects.

These standards must come with accountability to ensure that composting companies meet the documented standards or else risk causing reputational damage to all composting companies.

Educate the Community

Also, as addressed throughout this document, educating the community is a must for any mandate. Education is crucial to reducing contamination and keeping costs down and ensuring that the diversion program is successful in the long-term. For example,

- Residents need to be educated about the importance of segregation of waste streams,
- Grocery stores and restaurants must be educated about the importance of removing food packaging and stickers from pre-consumer food waste and segregation of post-consumer waste, and
- Municipalities must train their staff to segregate their organic wastes.

Municipal/cities are crucial in continuing education programs beyond the composter or waste hauler. If all the emphasis on education is left to the composters and haulers only, continued educational campaigns can become too costly or laborious for effective management.

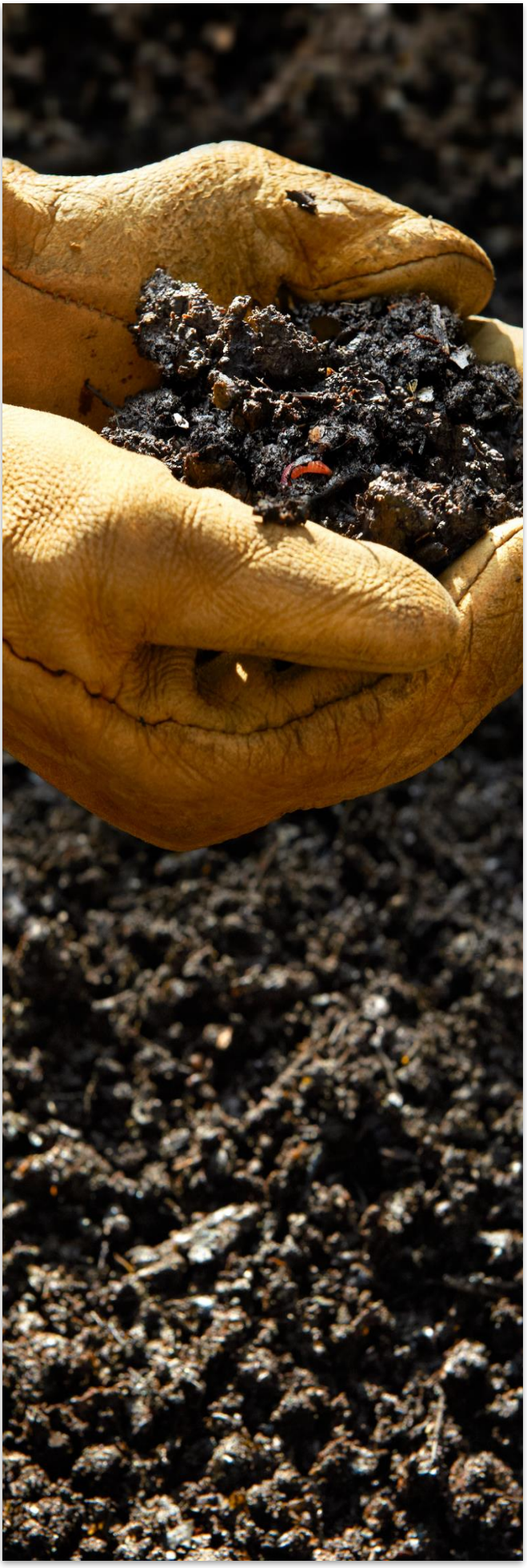
Find and Communicate Funding Opportunities

Connecting funding opportunities to help establish or expand an organics diversion program is often necessary to cover costs related to infrastructure and project implementation. Decision makers and the PSN can help by creating a list of existing grant funding to help offset the costs related to processing, transportation, or tipping fees. Such funding can help improve the ability of these materials to move to secondary markets. Decision makers can also establish new grant or funding opportunities to expand existing or encourage new composting operations.

Regulation and Permit Changes

Compost regulations and permitting processes should be reviewed to identify barriers and opportunities to the development of sustainable, large-scale compost programs. Regulations and permitting processes can

be designed or changed in ways to help ensure accountability of compost facilities across the state - especially if new mandates lead to the development of more compost facilities. Additionally, regulation and permit changes could help standardize reporting and inspections and promote the production of an industry standard compost that is made in a manner that is sustainable and environmentally protective.



Appendices

Appendix A – Tipping Fee Analysis

The following analysis is provided to support the discussions earlier in this document regarding tipping fees. A key takeaway from this analysis is that states that have more mature organics management (such as Washington and California) include the actual cost of processing organics into compost built into their higher tipping fees. Without this type of pricing, we are faced in Nevada with a "battle to the bottom" of competing on lower tipping fees with subsequent impacts to the viability of composting operations.

This analysis compares the tipping fees for uncompacted and unground Green Waste. The pricing shown per ton is commercial pricing in order to remain consistent with the commercial pricing for Full Circle Composting which does not currently take residential waste directly. It is noted that publicly quoted tipping fees do not include separate negotiated agreements for large-volume haulers which can reduce per ton fees well below those shown in this analysis.

As tipping fees are often quoted per yard, a four to one ratio between yard and ton was used to calculate the tipping fees per ton.

Site	Type of Site	State	Tipping Fee per Ton	Green Waste Specification
Full Circle Compost[28]	Composting	Nevada	$28	Branches, Leaves, Grass, Hay, Straw, Etc.
Lockwood Landfill[29]	Landfill	Nevada	$63.40	Trash/MSW (Not Compacted) or Residential Wood (untreated lumber, green waste max dimension 18")
Terra Firma[30]	Composting	Nevada	$30	None provided
Carson City Landfill[31]	Landfill	Nevada	$12	Wood Waste and Green Waste
Douglas County Transfer Station[32]	Transfer Station	Nevada	$51.85	Douglas Disposal Green Waste Recycle Program

[28] http://fullcirclecompost.com/

[29] https://lockwoodlandfill.wm.com/documents/Lockwood-Gate-Rates-2021.pdf

[30] http://nevada.terrafirmaorganics.com/ Note: Terra Firma does not publish their tipping fees.

[31]https://www.carson.org/government/departments-g-z/public-works/divisions/landfill and https://www.nevadaappeal.com/news/2023/feb/02/carson-city-supervisors-ok-first-reading-of-landfill-rate-increases/ Pricing is for in-county fees prior to announced rate change on July 1, 2023

[32] https://www.douglasdisposal.com/transfer-station

Salt Lake County Landfill[33]	Landfill	Utah	$32	Green Waste/Trees (less than 2-foot diameter)
Provo City Composting Yard[34]	Composting	Utah	$20	None provided
Seattle Landfill[35]	Landfill	Washington	$119	Clean Yard Waste
Cedar Grove[36]	Composting	Washington	$124	Yard waste/Land clearing
Eastern Region Landfill[37]	Landfill	California	$60	None provided
San Francisco Transfer Station & Hazardous Waste Facility[38]	Landfill	California	$219.86	Green waste, brush, and compostables
Kiefer Landfill Facility[39]	Landfill	California	$105.85	Green waste/Wood waste

[33] https://slco.org/landfill/pricing/

[34] https://www.provo.org/departments/public-works/sanitation/compost-yard-2563

[35] https://www.seattle.gov/utilities/your-services/collection-and-disposal/transfer-stations/rates

[36] https://cedar-grove.com/organic-waste-recycling

[37] https://www.waste101.com/rates/

[38]https://www.recology.com/recology-san-francisco/sf-transfer-station/#:~:text=Minimum%20disposal%20fee%20of%20%2450.00%20per%20load%20applies%20to%20all

[39] https://wmr.saccounty.gov/Pages/KieferLandfillFees-.aspx

Appendix B: Full Circle Compost Case Study

Full Circle Compost began in the late 1980's by Craig Witt who was searching for an alternative to conventional agricultural field fertilization with chemical fertilizers. Craig wanted to repurpose manures into a better alternative to improve soil health rather than just to produce compost. This led Craig to research and begin composting on a Nevada dairy farm. Over the years, with more research and experience, the knowledge of Nevada soil science allowed Craig to incorporate Full Circle Compost as Nevada's first industrial composting company in 1997. For the last 25 years, Full Circle has become the leaders in Nevada composting and soil health helping keep thousands of tons of organic materials out of the landfill while turning them into nutrient rich compost and soil products for improving soil health infrastructures to complete circular economic goals. On average, Full Circle Compost annually diverts around 25,000 tons of organic materials to composting rather than landfilling.

Full Circle Compost Process

The composting process used by Full Circle Compost under EPA permit SW274REV02 located at 1721 Snyder Ave. in Carson City, Nevada. Full Circle is a member of the US Composting Council (USCC) and participates in the US Composting Council Seal Of Testing Assurance (USCC STA) program to regulate quality compost creation. Full Circle produces all three types of STA composts - Trees & Shrubs, Flowers & Vegetables, and Lawns. Full Circle also produces products that use compost as an additive such as garden soils, landscape soils, potting soils, erosion control products, and mulches. Compost and compost bi-products can be used in many product lines as the main organic matter and biological ingredients. Full

Circle utilizes both aerated windrow composting and aerated static pile composting process following the USDA National Organic Protocol under USDA Organic Regulations for Organic Compost (7 CFR § 205.203(c)) maintaining:

"The producer must manage plant and animal materials to maintain or improve soil organic matter content in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances" 7 CFR § 205.203(c)(2).

Feedstocks vary in composition:

- Plant and animal materials, such as, crop residues, animal manure, Food Waste, yard waste
- Non-synthetic substances not prohibited by 7 CFR 205.602
- Synthetic substances specifically allowed for use as a compost feedstock per 7 CFR 205.601
- Synthetics approved for use as plant or soil amendments

Thermophilic processing follows: An aerated static pile reaching 131 degrees Fahrenheit for three consecutive days, or a turned compost pile reaching 131 F for 15 days not necessarily consecutive, which must be turned at least five times to ensure processing to completion. Full Circle primarily utilizes treated water. If untreated water is used, it is only used during one of the above approved composting processes for full sanitization. If water or compost tea is added to any finished compost or vermicompost product, only treated water is used.

The following video is an excellent overview of the process at Full Circle Compost: https://www.google.com/url?q=https://www.youtube.com/watch?v%3Dt_Zi-y-aM_A&sa=D&source=docs&ust=1676042960682256&usg=AOvVaw2ot7RA-H7G-MgPL9480I9a.

Full Circle is the only US Composting Council STA approved composting site in Nevada. Batch analysis profiles for products include minimum testing of the following: pH, soluble salts, nutrient content (total N, P2O5, K2O, Ca, Mg), moisture content, organic matter content, bioassay (maturity)stability (respirometry), particle size (report only), pathogen (Fecal Coliform or Salmonella), trace metals (Part 503 regulated metals).

Historical Organic Materials Diversion Data

Full Circle Compost kept a total of 89,341.56 cubic yards of organic materials out of the landfill in 2021. That's equal to filling the University of Nevada Reno Wolfpack's football field 42-feet high with yard waste. The volume this material weighed was an impressive 25,452.42 tons. The weight is equal to 11,775 Tesla Model S cars. And the greenhouse gasses that were avoided by composting all of that material rather than throwing it into the landfill is equivalent to pulling 39,480 cars off the road (based on the EPA WARM model).

Specific to Food Waste composting, Full Circle is approved for pre-consumer and post-consumer Food Waste. In 2016, Full Circle adopted a strict "food only" policy for received Food Waste given the challenges that have come up in the past with contamination in the Food Waste. One type of contamination is mixed

materials from other waste streams such as recyclables and other non-food items, including food packaging. Another source of contamination is "compostable" products that sometimes break down into undesirable products (such as microplastics) or do not break down as advertised. Full Circle has devoted a significant amount of time to testing various compostable products and has determined that - given the wide variety of contents and variability in compostability of different items, the contamination levels of non-compostables, and the differentiation in time to compost between products - it is best to exclude these products entirely from the Food Waste stream. If a delivery of Food Waste is too contaminated, it is sent to the landfill rather than having to incur the high cost of removing the contamination.

The ability to accept Food Waste with compostable serveware and mixed packaging is possible and an opportunity Full Circle is investigating. The purchase of a de-packaging machine will allow food materials to be slurried while packaging and compostable plastics are removed from the food. The issue with depackaging machines is they are not able to differentiate between compostable and non-compostable packaging. All will be removed as contamination and most likely be landfilled. From Full Circle's perspective, a "food only" program ensures limited contamination, the highest level of Food Waste diversion, and the most viable end Food Waste compost-based products.

Full Circle's green waste recycling program has grown to include many municipalities and organizations around northern Nevada and Lake Tahoe, including:

- Incline Village's fire prevention pine needle composting program
- South Lake Tahoe's fire prevention pine needle composting program
- South Lake Tahoe's commercial Food Waste program
- Truckee, California's commercial Food Waste program
- Carson City's residential organic materials composting program
- University Of Nevada's organic materials composting program
- Many landscape organizations' organic materials composting programs
- Many construction and excavation organizations' organic materials composting programs

Carson City Residential Green Waste Program Review

In 2019, the Carson City Board Of Supervisors approved the adoption of a green waste diversion program to be included in the normal residential waste pick up by the franchised waste hauler. The mandate requires the collection of green waste by the waste hauler for all customers in the franchised waste area who opt to participate. The green waste is to be sent to a composting facility with final decision of receipt of materials determined between the waste hauler and the composter. Full Circle implemented a 5% maximum contamination by volume threshold for inbound materials. The education and marketing of approved and non-approved materials to go into green waste carts is the responsibility of the waste hauler and the

composter. The municipality has had limited involvement in program management and implementation since the adoption of the mandate.

Due to swift implementation of the program with minimal education and training programs to the community, contamination levels of the green waste carts was nearing 20%. The best remedy for controlling contamination by Full Circle was rejecting loads that were over the 5% contamination threshold. This resulted in excess costs to the waste hauler. A strict contamination policy was adopted and implemented on the residents of Carson City, which involved the removal of green waste diversion services for those that contaminate. The contamination policies implemented in the program have decreased contamination rates of inbound materials to the compost site to around 5%, down from 20%; however, in a three-year period, the volume of green waste being diverted to composting rather than landfilling has decreased around 60%. Only specific areas of the City Of Carson meet the contamination threshold and others are landfilled. This decrease in diversion is very large and negatively impacts the goals of the program.

Full Circle has invested in one of the largest green waste sorting machines in the area to be able to process residential green waste and clean contamination. The goal is to be able to increase the contamination threshold. Due to the scale of municipal programs, sorting systems for contamination control are necessary and can cost $2 million or more for purchase and installation, highly increasing composting operational budgets. Full Circle emphasizes the need for municipal oversight and participation in education and marketing of mandated waste diversion programs. The separation of the municipality from the management of new waste diversion programs will lead to program failure. Synergistic relationships between the municipality, waste hauler, and composter are needed for education, training, and cost control for long-term program success.

Full Circle Composting Business Model Information and Hurdles

The composting industry is a perfect solution for completing circular economic programs in communities producing organic wastes. Since most communities and businesses produce organic wastes, composting can recirculate these materials and finished products into the marketplace with many benefits. Efficient composting requires two main revenue streams:

- Inbound tipping fees for receiving organic wastes. The inbound tipping fee covers costs to clean, sort, and process materials before they are able to be composted.
- Outbound product sales. Adequate prices for end compost based products to cover costs of the composting process and return profit to the company for continued efficient operation.

Composting requires both inbound and outbound revenue streams for operation due to high costs of equipment and the continual flow of materials. Composting sites should convert and sell all finished composted products after compost processing due to permit regulations and limit landfilling. These require continual inward and outward flow of materials. The inbound prices should be fair to the community and

reflect the true costs of cleaning, sorting, and processing of inbound materials before going into the composting system. Outbound product pricing is determined by market demand and product quality. The demand for end products can be assisted by circular economic mandates where generators of organic wastes need to use localized products recycled from organic wastes to get them back into the community. End compost demand can be highly increased with the help of municipal and state regulations to include compost product use in construction, parks, community landscape, road, and community space rehabilitation.

Specific to Full Circle Compost in 2022:

- Average tip fees for inbound organic materials at Full Circle averaged around $2-10 per yard which converts to $10-40 per ton depending on material type without contamination sort fees.
- Landfill organic materials tip fees in Northern Nevada vary with yardage rates around $1-20 per yard and tonnage rates from $12-52 per ton.
- Average price retail compost products from Full Circle are $40-175 per yard

The Northern Nevada regulatory and business environment specific to “green businesses” is minimally developed. Tipping fees in Seattle for composters can range from $50-$100 per ton which can be estimated to $20-$50 per yard. Full Circle Compost has suffered from increased pricing competition on the inbound tipping fee due to low-cost landfill disposal rates in Nevada. Since costs are low to throw material in the landfill, composting is not a very attractive alternative unless organizations have adopted sustainable goals and operating procedures.

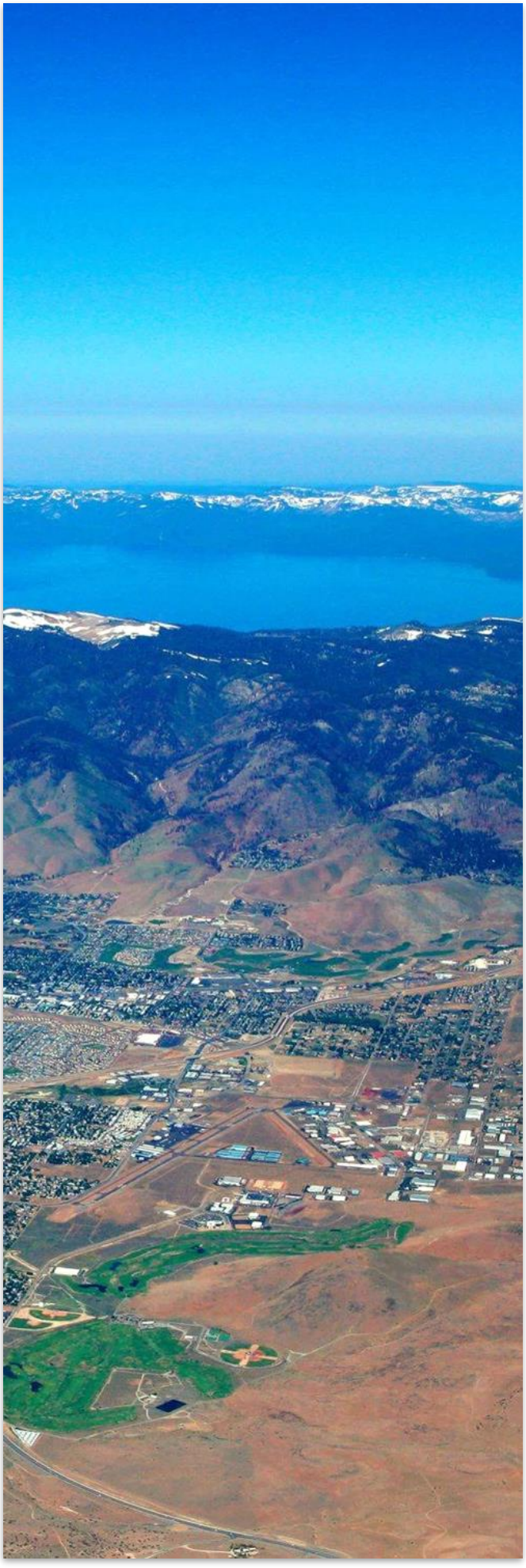
This caused Full Circle to emphasize product quality and differentiation to create a high-end outbound product marketplace to help offset production costs due to low inbound fees. The opposite is happening in California where cheap low-cost products are now flowing into Nevada bringing down prices to a market that is not supported by inbound tip fees. Success is a balance of inbound tipping fees and composting support from the community with an emphasis on high quality compost products that create lasting changes in soil health.

Full Circle creates over 30 compost-based products ranging from multiple size sorts of compost for specific applications, mulches, potting soils, garden soils, landscape soils, erosion control blends, and site-specific custom blends. Full Circle is one of the only compost companies that also performs on-site soil testing to create site specific custom blends using blends of up to 20 different added soil amendments to compost. This allows for customization of products specific to project types.

While Full Circle has shipped final products as far as Las Vegas, the more usual case is that long distance shipping of inputs or final products becomes economically infeasible. Full Circle Compost has provided proposals to several sites in California and across Nevada that have never been realized due to the increased expense associated with the transportation of the materials.

Future Opportunities

Even though the organic materials diversion framework in Nevada has been lacking, Full Circle has managed to operate for 25 years due to dedicated recycling partners and end compost product customers that value sustainable materials management and high-quality compost products. Full Circle has grown over the last 25 years to Northern Nevada's largest retail composting operation. Capital equipment investment has been made prior to mandates in hopes of increased materials flow and the ability for Full Circle to be leaders in Nevada organic waste diversion. The costs are high; however, Full Circle envisions a bright future for the composting industry in Nevada as stakeholders come together to increase organic materials diversion and end compost use.



The mission of the Partners for a Sustainable Nevada is to change the way Nevada thinks about sustainability for our future generations by identifying and promoting opportunities to advance and expand sustainability efforts statewide.

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