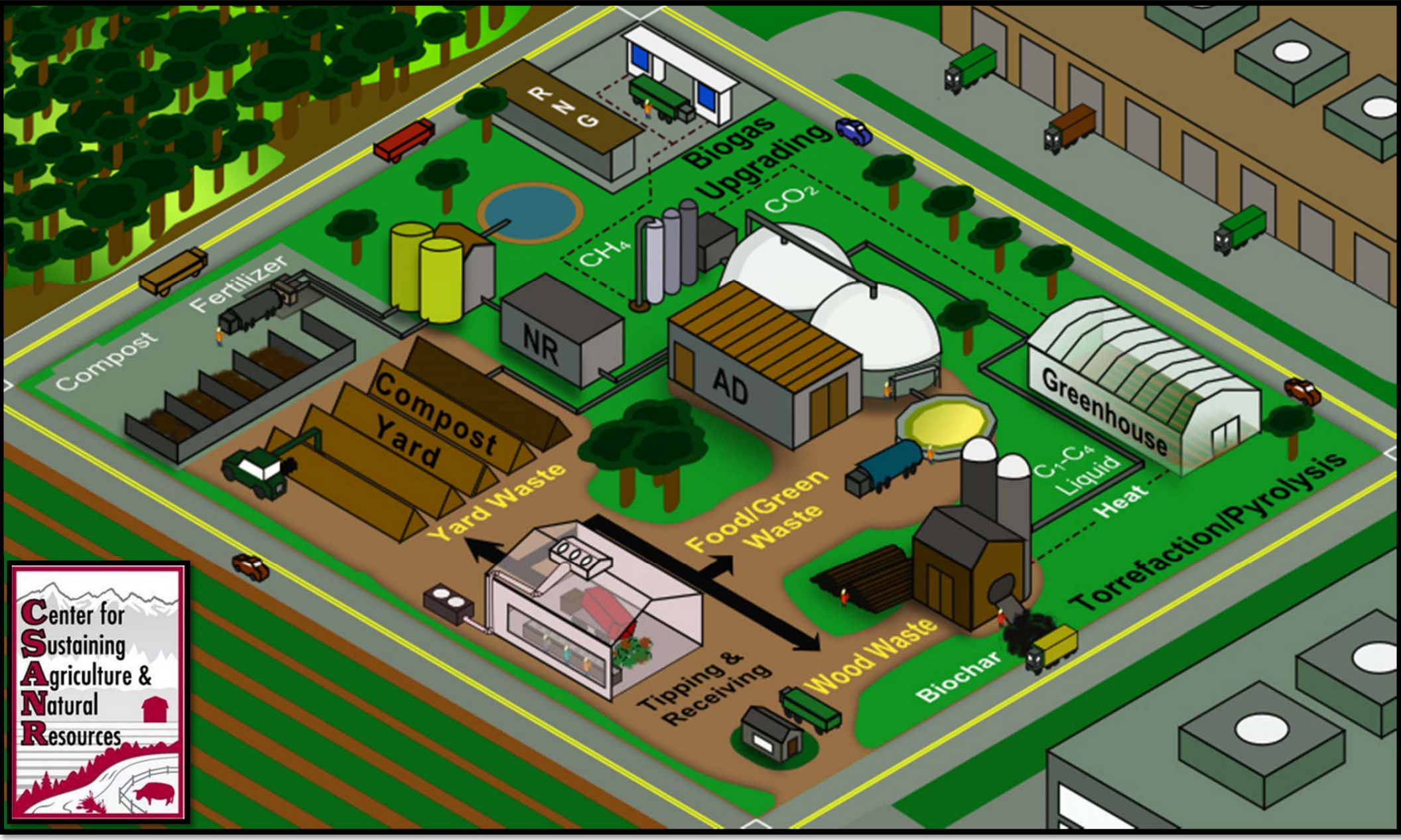


INPUTS OUTPUTS PROCESSING FACILITY

AD = Anaerobic Digestion; NR = Nutrient Recovery; RNG = Renewable Natural Gas

# ORGANIC WASTE BIOREFINERY

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Organics are the largest contributor to landfills in Washington State, accounting for 27.2% of disposed waste in 2009. Food scraps account for about two thirds of organics. Most of the recently established food scrap diversion programs, including successful programs in King County and the City of Seattle, send food scraps to existing compost yards. In some cases this is placing pressure on existing organics processing infrastructure, lowering compost quality and contributing to odor issues. There are multiple ways to address these concerns. Process changes (physical, chemical, operational, infrastructural, and biological) are critical. Meanwhile, integration of advanced technologies (e.g. composting, thermal processing, anaerobic digestion, and nutrient recovery) into an organic waste bio-refinery has the potential to assist in controlling odors, while creating a range of environmental and economic benefits.

## Composting

Yard waste and other typical feedstocks will be processed with traditional composting (e.g. windrows or aerated static piles).

*Benefits include*:

- Reduces greenhouse gas emissions and odor
- Recovers some nutrients

*Outputs include*:

- Production and sale of a soil amendment
- For a higher value soil amendment, biochar can be added as a bulking agent, odor reducer and water retainer
- Recovered excess heat from composting can be utilized elsewhere within the biorefinery

## Anaerobic Digestion

Food scraps, co-mingled food and green waste, and pre-consumer food wastes will be sent to high solids anaerobic digesters where anaerobic microorganisms break the organic matter into biogas and effluent.

*Benefits include*:

- Reduction in odors, pathogens, and greenhouse gas emissions

*Outputs include*:

- Biogas could be upgraded to renewable natural gas for use by waste haulers or other dedicated transportation fleets
- Carbon dioxide could enhance growth of greenhouse crops
- Fiber can be used in greenhouses or by agricultural industry

## Pyrolysis and Torrefaction

Wood waste will be sent to a thermal processing facility where it will be broken down into heat and/or bio-oil and biochar.

*Benefits include*:

- Processing of woody wastes difficult to treat with composting
- Biochar removes impurities from biogas and absorbs nutrients from AD effluent, providing remediation

*Outputs include*:

- Bio-oil will be separated: larger compounds will be converted to transportation fuel at offsite oil refineries while smaller compounds are anaerobically digested on site for energy
- Excess heat could provide energy for other processes
- Biochar can be used offsite as a soil amendment or on site for remediation

## Nutrient Recovery

After anaerobic digestion, the effluent will be sent to a nutrient recovery system that will strip out nitrogen (N) and phosphorus (P) to produce soil amendments.

*Benefits include*:

- Reductions in N and P release to surrounding environment

*Outputs include*:

- Valuable soil amendments can be used in the greenhouse or sold offsite where nutrients are most needed
- Nutrient reduced AD effluent can be used as dilution water for the digester input, or by other biorefinery units

**Synergies and eco-service credits between and from these technologies are key to reducing capital and operation costs and minimizing the use of energy and water – thus providing much needed renewable energy, biologically based products, and greater sustainability**