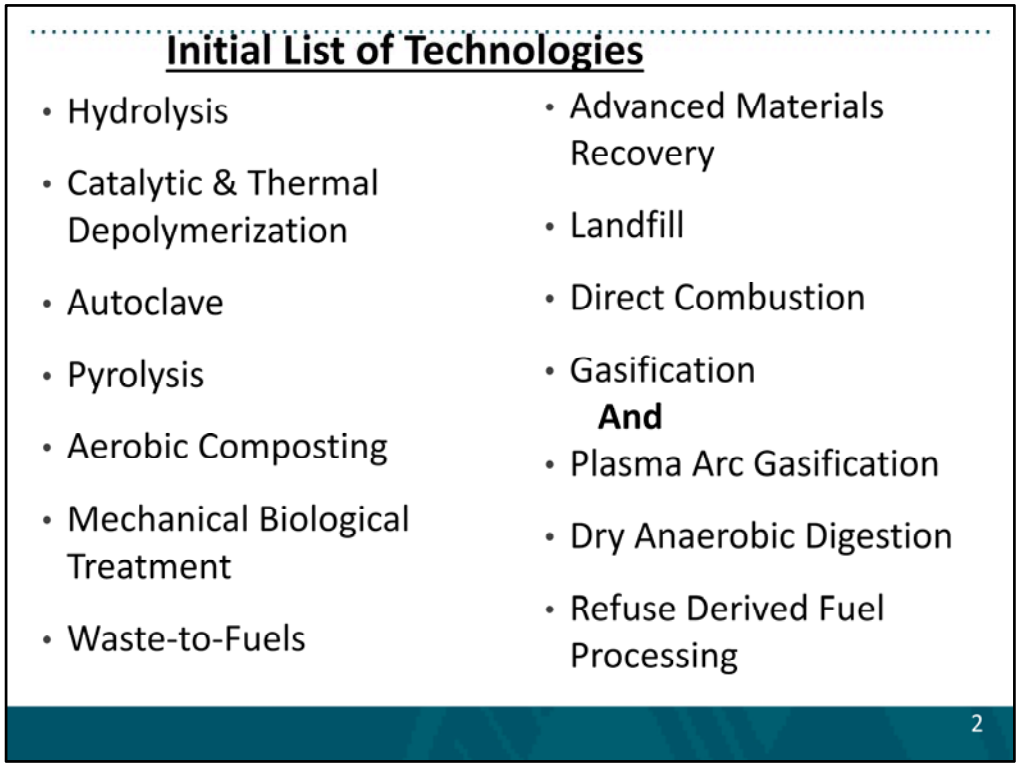
Thank you for being here today

Presenter: Rob Smoot, a senior engineer for the Solid Waste division of Parks and Environmental Services here at Metro, a licensed Chemical Engineer with over 27 years working in the Solid Waste field.

Purpose: To inform you of Metro's long term management of garbage project and ask for your feedback.

Duration: about 30 minutes,

Outline: Describe the Technologies and the evaluation process then explain how scenarios were selected, what has been learned and what information is still being researched. Field questions during the presentation and finish with an exercise to elicit feedback.



Initially 14 technologies were indentified to evaluate as options for managing garbage.

These are listed on this slide and were described. See the supplemental handout for these definitions .

Initial screening was primarily based on whether the technology has been proven to process at least 100 tons per day of garbage or that pilot studies are showing promise, in other words might be Commercially Viable.

The 7 technologies on the left of the slide are those that failed the first screening.

•**Hydrolysis and Depolymerization** would be fun for a Chemical Engineer, but have not shown any success with garbage; and are not likely to.

•**Autoclave** is primarily used to sterilize waste, but could aid in separating paper. Our region does a relatively good job of recycling paper, so it would not be economical to employ this technology for such a small return.

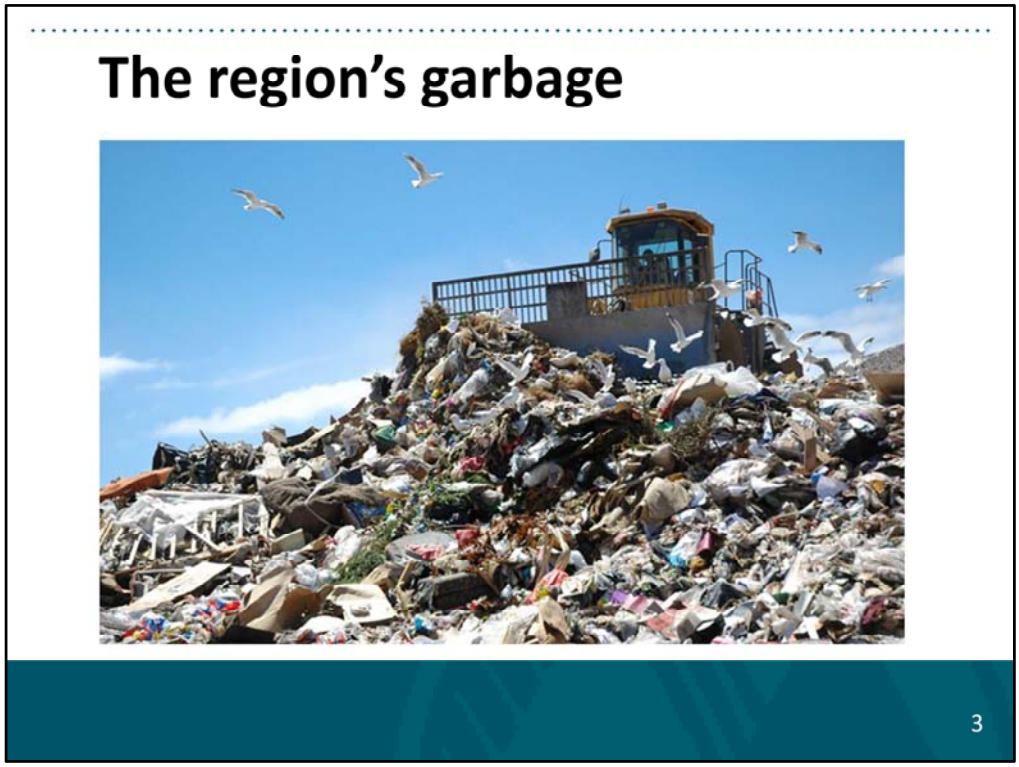
•**Pyrolysis** works with specific feedstock (such as plastic), but has not been shown to work with garbage. Pyrolysis may do well with clean plastic from our garbage after it has been separated and processed.

•**Aerobic composting** of garbage has been shown to not work in our region; remember the Riedel Compost facility of the 1990's.

•**Mechanical Biological** Treatment is being considered in our scenarios four and five using advanced materials recovery and anaerobic digestion. We prefer to consider and discuss the two processes separately.

•**Waste to fuels** is a post process or add-on to a primary process and might be considered later, but is not being evaluated now.

The 7 technologies on the right of the slide are those that are being analyzed further, because they have been working at a commercial scale some where in the world. These will be presented on the next several slides.



Just to reiterate that we are considering the garbage of the entire region for our analysis and comparison of technologies and scenarios. We are looking to the future, 2019 and beyond.

However, we are not including recyclable and source separated materials. In fact we anticipate and have forecasted increases for recycling and source separation for future garbage volume and composition.

We are talking about materials recovery on the wet waste delivered to transfer stations in the region. This process is similar to what we use now to separate materials from the comingled recyclables collected from residences and businesses. Metro attempted this at MCS in the early 90's and was unsuccessful; however, there is new machinery today that might improve success.

{This could be similar to the Enhanced Dry Waste Recovery Program or could become the front end of a new technology}

We estimate that an additional 10 points on the regions recovery rate could be achieved from the Metro area garbage through use of advanced sorting and processing.

This is the Newby Island facility in San Jose (I toured this last spring break).

This photo was taken at the Greenwaste Materials Recover Facility during my trip to San Jose CA. Materials recovery can be both labor intensive, as seen here, and machine intensive, as depicted in the previous slide.

Some details of the facilities visited in San Jose.

Greenwaste MRF – Processes San Jose's multi-family mixed waste.

Sunnyvale MRF (SMaRT) – processes post recycling waste.

Newby Island Resource Recovery Park – is processing San Jose's wet and dry commercial wastes and residential commingled. They can process about 1,400 tons per day with 65 sorters per shift and two shifts per day.

When we are considering landfills; it is not the landfills of the past. We must be sure to inform our constituents and the public that there have been significant changes in methods of landfilling.

Modern landfills are lined and managed to prevent the escape of undesirable materials, such as wind-blown debris, liquid leachate and landfill gas.

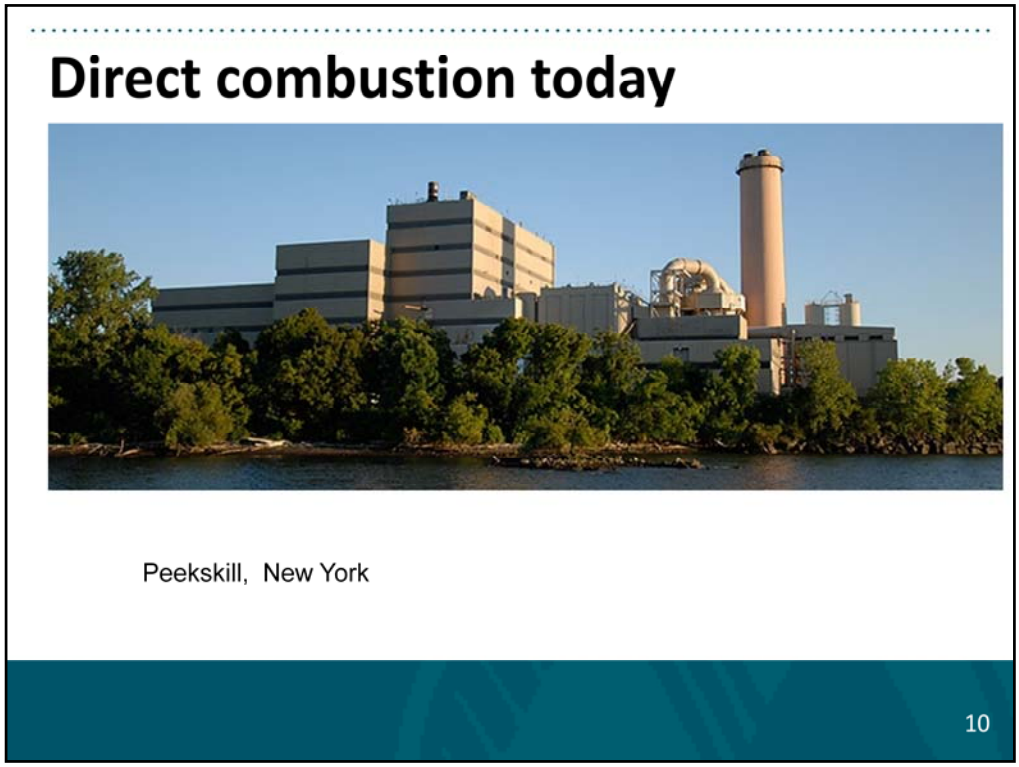
Today's landfills also include landfill gas to energy, as here at the Columbia Ridge landfill. This also shows a pilot plasma arc gasification facility in the background.

There is lots of landfill capacity within 200 miles of our region.

This is our current method for managing garbage and it may be the lowest cost option for managing garbage and the most adaptable to changes, but disposal in a landfill is the bottom of waste hierarchy.

Portland mid 1900's Direct Combustion. These are the furnaces at the Chimney Park facility located across the street from the St. John's landfill.

Portland has had waste incinerators before, but new technologies have come a long way since we had incinerators here and even since Metro's last look at selecting this technology in the late 1980's process of reviewing proposals that resulted in the siting of MCS (there was at least one proposal for a waste-to-energy facility).



New facilities are thousands of times cleaner then they were several decades ago, meeting and exceeding all environmental regulations.

There are over 800 installations world wide, with over 88 in North America.
The Covanta facility in Marion Co. has been successfully operating for over 25 years and is only 30 minutes south of Portland.

We could get electric energy and heat from this type of facility, which would move our use of the garbage up the hierarchy, but they come with high capital costs.

This facility in Peekskill, New York manages about 2,250 tons per day and produces enough electricity to power about 88,000 homes.

Direct combustion

Barcelona, Spain waste to energy plant

11

The industry has learned how to blend their facilities into the surroundings, as seen here in Barcelona, Spain.

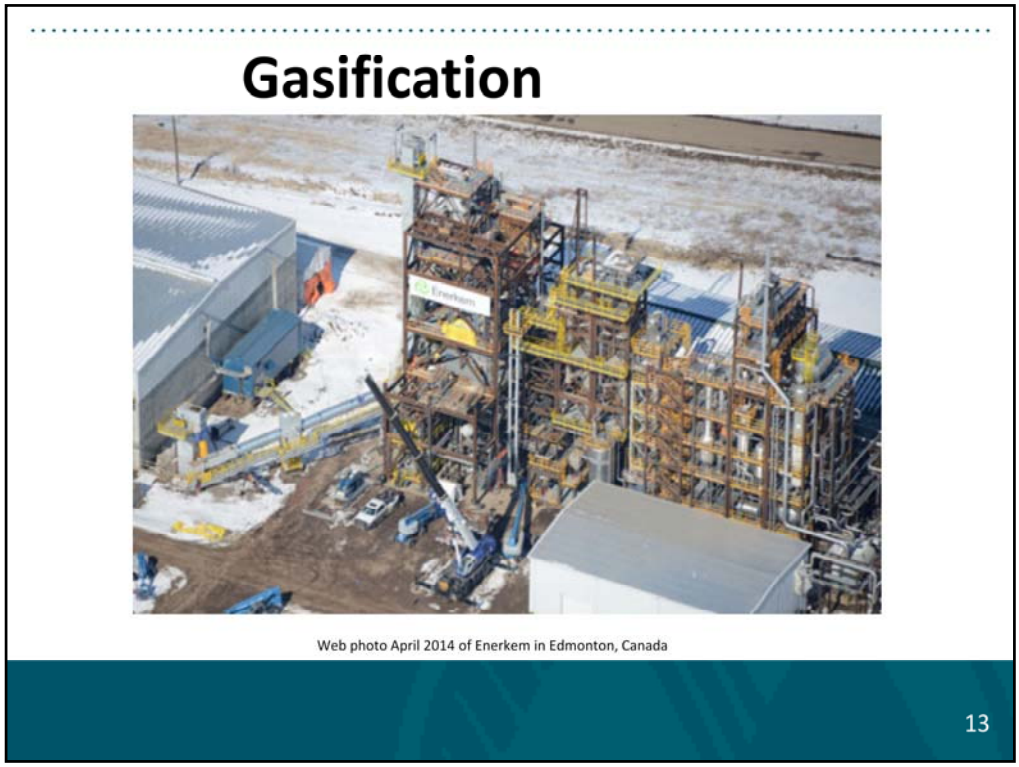
This facility was also able to take advantage of selling steam to a local user. Being able to make use of the heat from the steam, along with generating electricity with the steam, can double the efficiency of using the energy from the garbage.

Direct combustion

Maishima, Japan

12

Even in an industrial setting, facility architects have found ways to be creative and make this facility attractive; this is in Maishima Japan.



This is a very recent photo of a facility being constructed in Edmonton, Canada.

Gasification is being used in Japan and Germany with reported success. However, information from those facilities is often lacking, which makes it challenging to estimate how these systems could be successful here in our region. To date there are no successful plants of this type in the U.S.

Thermal conversion without combustion produces synthetic gas (mostly carbon monoxide and hydrogen) and char.

The gases can be utilized to produce electricity or further processed to create liquid fuels. The char could be sold for other uses; however, when created from garbage it is usually landfilled. This process moves garbage management up the hierarchy, but again has high capital costs and uncertain operating costs.

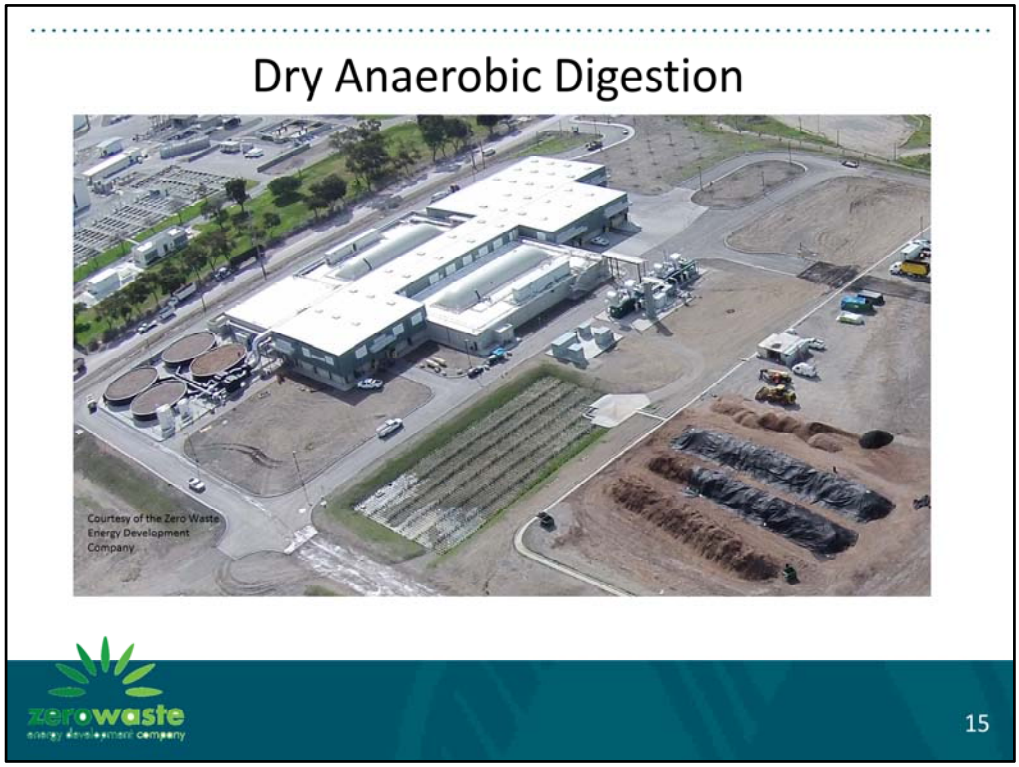
Gasification

Plasco Trail Road project in Ottawa Canada.

14

Gasification can be used alone, but is often combined with plasma arc gasification as in this facility in Ottawa, Canada.

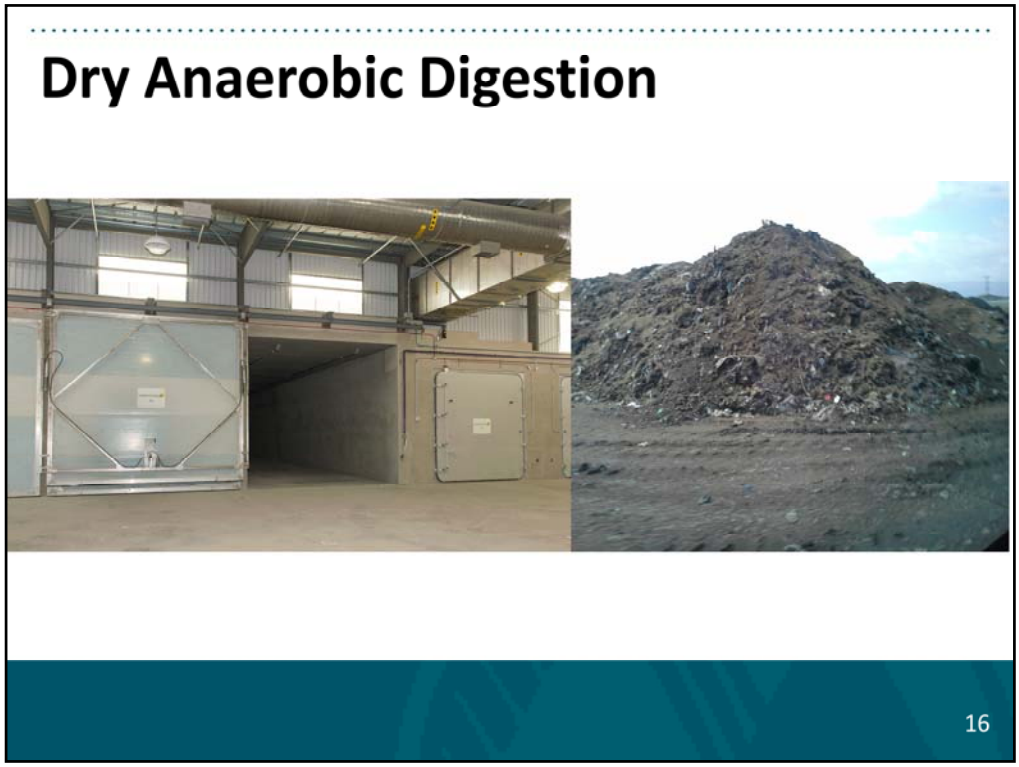
This facility in Canada is now being tested. We will be keeping an eye on this to see if it is successful.



I visited this Dry anaerobic digestion facility in San Jose, California last March.

The facility was still in its shake down process and was not completely operational.

The compost you see outside is not going to be your garden variety, but will be likely be sent to a landfill for use as daily cover. The material might also be used in road construction for ditches and slope stabilization.



This is a close-up of the inside of the building and the outdoor waste pile from the previous slide.

These chambers are filled with the garbage, sealed to control air and sprayed with a bacteria rich liquid to start the digestion process. Methane gas will be produced (about 60% methane and 40% carbon dioxide) during digestion.

The gas at this facility is being used to fuel electric generators. The leftover garbage coming out of this process is likely headed to a landfill; in CA they are using it for daily cover and along side roads. We think that this material would also be good feedstock for a Refuse Derived Fuel process.

Garbage could be sorted and separated for use in Refuse Derived Fuel (RDF).

Back in the mid 90's Metro had a demonstration process set up at Metro Central to create RDF. This turned out to be too expensive at that time.

Refuse derived fuel can take many forms depending on how it is to be used. Here is a photo of pelletized garbage (post sorted) and a photo of baled garbage (post sorted).

1st photo from the web

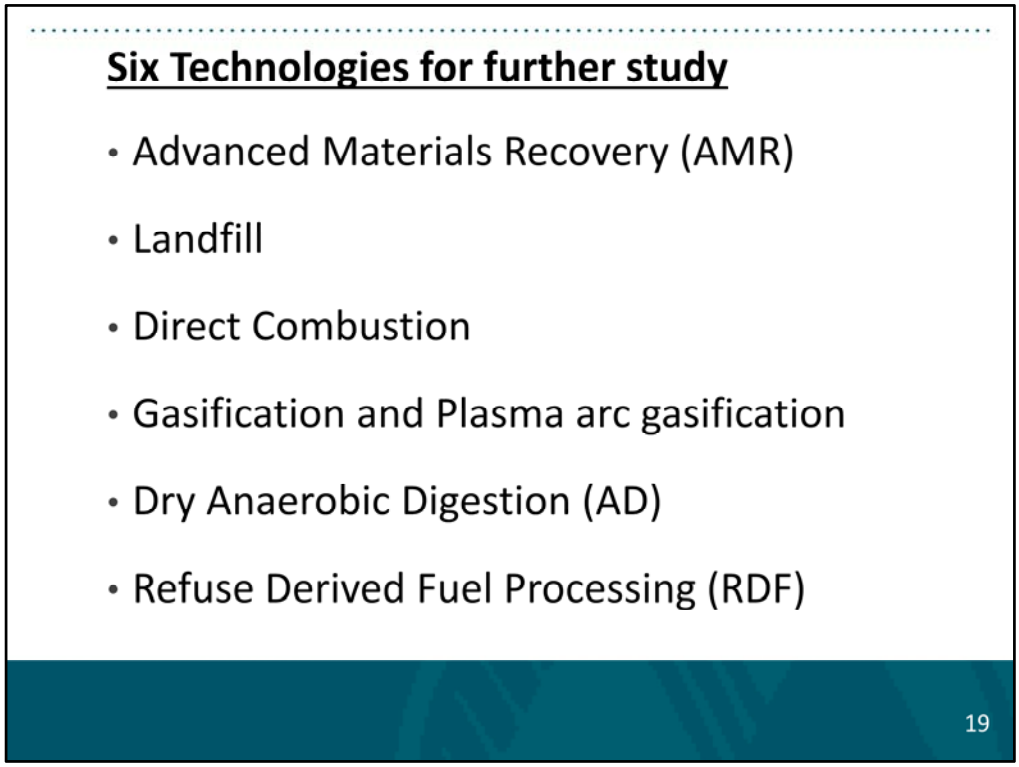
2nd photo from *HDR photo of stockpiled RDF at the Rennerod, Germany Facility.

Refuse-derived fuels

- Hawaii refuse derived fuel facility

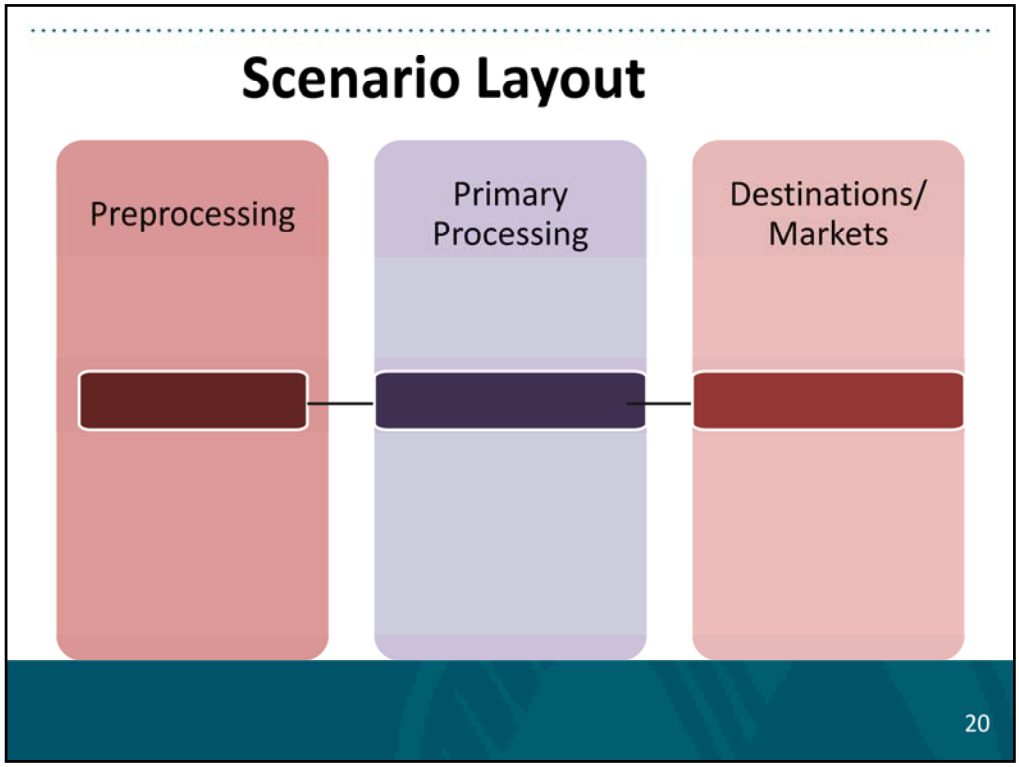
18

Hawaii's refuse derived fuel facility.



Again we are considering gasification and plasma arc gasification together, as we continue to find examples where they are used together.

From these six technologies we developed potential packages, or scenarios, for managing the region's garbage.

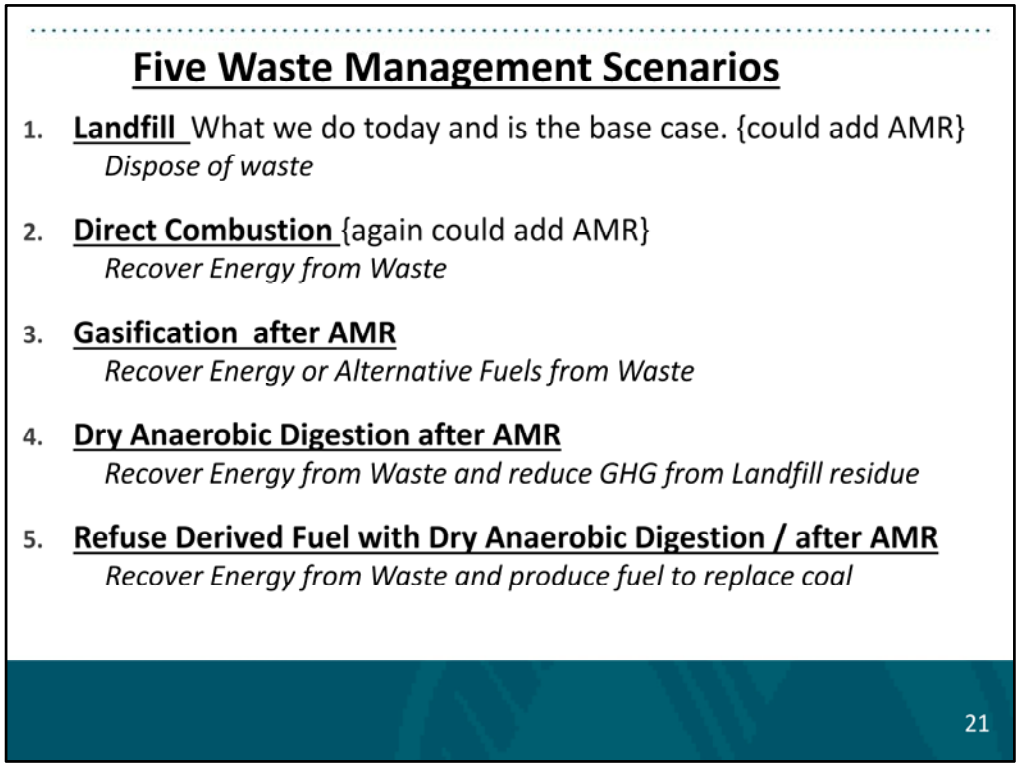


This graphic shows how we are compartmentalizing our thinking of technologies for development of scenarios.

Advanced Materials Recovery is preprocessing

Direct Combustion, Gasification, Anaerobic Digestion and Refuse Derived Fuel are processing

Landfills would fall into final destinations with recovery markets, energy markets, etc..

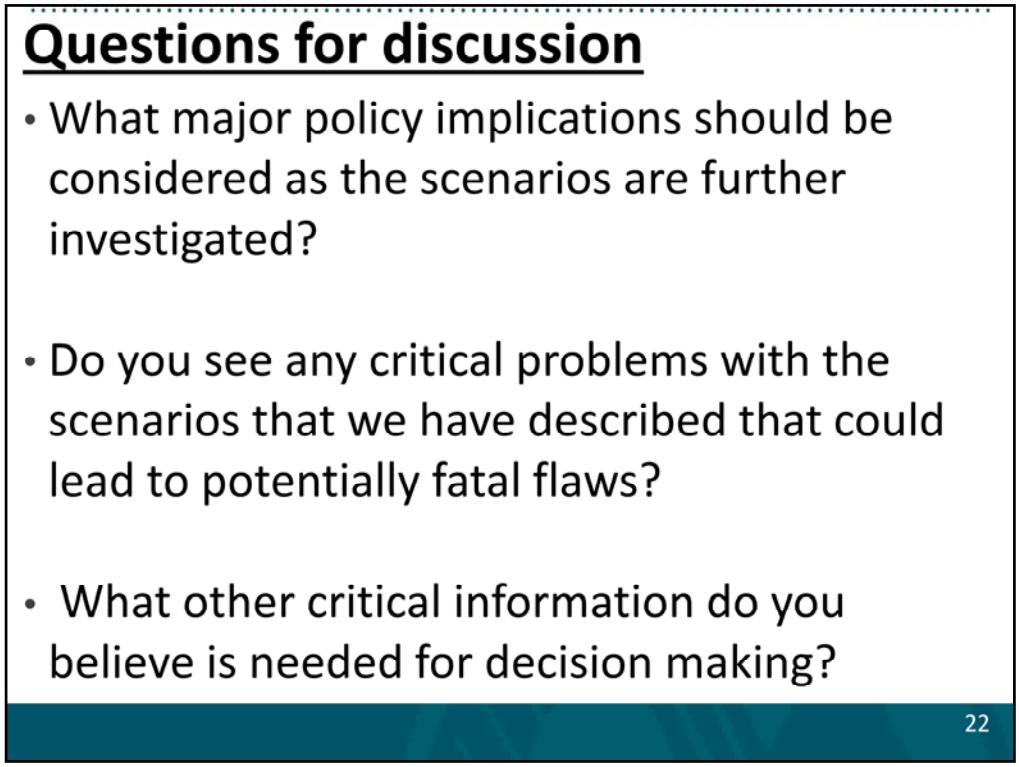


What we do today is our base case, Landfilling.

Advanced Materials Recovery could be considered with the Landfilling and the Direct Combustion scenarios; however, it is required for Gasification, Dry anaerobic digestion and Refuse derived fuel processes or those would not likely be viable options.

Even with advanced recovery the material sent to dry anaerobic digestion will have too many contaminants to make use of the digested material for landscaping amendment or agriculture. In scenario four we assume it would go to a landfill, but in scenario five it could be used for Refuse derived fuel.

These scenarios illustrate potential options that could be integrated into our existing disposal system. We purposefully created single technology scenarios for the first four, so that we could better compare the advantages of the individual technologies. The final scenario illustrates how technologies might logically be combined.



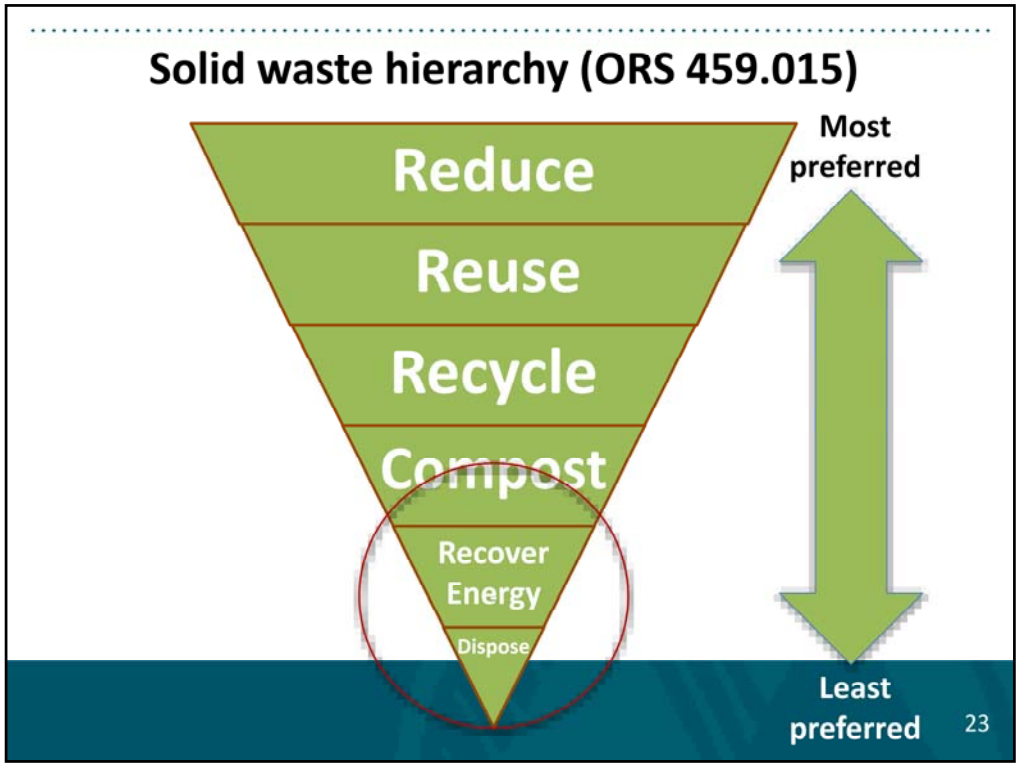
These questions will be displayed during the meeting.

•What major policy implications should be considered as the scenarios are further investigated?

(For example: will recovery or residual standards need to be established to ensure success.)

•Do you see any critical problems with the scenarios that we have described that could lead to potentially fatal flaws?

•What information do you believe is needed for decision making?



This is a slide of one of the posters on display at the meeting.

Metro could gain additional recycling from its waste by using advanced materials recovery technologies.

Expanding programs for source separated food waste and yard debris could improve/increase energy recovery (with anaerobic digestion) and composting.

There will still be a significant amount of garbage discarded in the region that could be managed to do more for us by moving up the hierarchy.

This is also a slide of one of the posters on display at the meeting.

These benefits are used to guide our discussion and evaluation of solid waste management options.