DRIP Committee

From: Regenerative Education Centers Non-Profit <info@recenters.org>
Sent: Tuesday, February 20, 2024 12:21 PM
To: DRIP Committee; Ellen B. McKinley; Angela R. Lucero; Shelly K. Espeleta; Tamara A. Paltin; Christi A. Keliikoa
Subject: Remainders of Presentations for DRIP meeting 2/21/24
Attachments: Maui Council letter edit feb 19.docx; Zero Waste Utopia - Peter Quicker 5-2020 (1).pdf; DRIP Letter.pdf; It's time to stop wasting our waste.pdf

Hi All,

Here are the remainder of the presentations for tomorrow. If Brando submits, my understanding is that will be directly to you.

I just spoke with Paige to confirm a few things. I think everything is set up on our end. Please reach out if it is not.

Thanks again for hearing them out. I think it will be a benefit to the community.

It’s Time to Stop Wasting our Waste

The Significant Role of Waste regarding Climate, Environment, and Economy

Philipp Schmidt-Pathmann,
President,
Institute for Energy and Resource Management

A L L
–
Academy for Lifelong Learning

April 4th, 2023

Overview:

Part I:

- Introduction IeRM
- State of Garbage – USA

Part II:

- Time to Stop Wasting our Waste – Alternatives to Landfilling: Integrates Waste Management /Sustainable Materials Managment
  - The International Waste Hierarchy
  - Avoidance
  - Reuse
  - Recycling
  - Composting

Q & A (5 min)

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Overview:

Part II continued:

- Time to Stop Wasting our Waste – Alternatives to Landfilling: Integrates Waste Management /Sustainable Materials Managment
  - Thermal Technologies
  - Landfilling

Q & A (5 min)

Overview:

Part III:

- Circular Economy
- Zero Waste

Part IV:

- What Next?
  - What do we need to do? – Action Steps
  - What can we do?
  - Politics?
  - Business?
- Conclusion

Q & A

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Introduction:

- Philipp Schmidt-Pathmann, MBA, MIS
  - 1998-2020 WRSI Consulting Group
    - 2005-2012 10 Integrated Waste Management Systems Study Missions/Delegations to Europe
  - 2007-2010 Green Conversion Systems (GCS)
    - Idea was as part of an Integrated Waste Management System to build and operate WTE facilities in North America: LA (99.5% diversion from landfill guaranteed), Florida, Baltimore, York-Canada, …
    - $3 Billion Budget from Morgan Stanley
  - 2008-2016 on the King County Solid Waste Advisory Board
  - 2012 Zero Landfill Initiative www.zerola.org
  - 2013 Neomer
  - 2016 Neomer Resources
- October 2020 Institute for Energy and Resource Management – IeRM a 501c3 Non-Profit Corporation

IeRM

- # Institute for Energy and Resource Management – IeRM
  - ## Who is IeRM?
    - Team of leading experts and specialists from Universities, Institutes, topic relevant Organizations, leading Authorities etc. to use their experience and proven track record to educate and counter and correct false and misinformation, lack of know-how and experience, special interests, uneducated opinions etc. so that corrective actions protecting people, the environment, and the economy can be taken.
    - Team members have advised Governments (example Germany, EU) on Waste Management Systems for over 40 Years
    - Team members have and continue to design, build and operate State of the art facilities: Recycling , Anaerobic Digestion, Advanced Thermal Processing, Composting, Collection Systems, → every aspect of an Integrated Solid Waste Management System
    - Team Members are working with and advising legislators

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Institute for Energy and Resource Management – IeRM

- What we do? Examples:
  - Design campaigns for public and private entities on better approaches to reuse and recycling
  - Aid public officials in the preparation of legislation regarding waste management
  - Design, develop, implement and manage an integrated waste management system
  - Testify and provide expert opinions on pending legislation and proposed programs

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17th NATIONWIDE SURVEY OF MSW MANAGEMENT IN THE U.S.

THE STATE OF GARBAGE IN AMERICA

Latest national data on municipal solid waste management find estimated generation is 389.5 million tons in 2008 — 69 percent landfilled, 24 percent recycled and composted, and 7 percent combusted via waste-to-energy.

Rob van Haaren, Nickolas Themelis and Nora Goldstein

Table 7. Comparison of US EPA and BioCycle/EEC MSW generation and management data (calendar year 2008)

MSW Data	EPA/Franklin (million tons)	BioCycle/EEC (million tons)
Total generated	249.6	389.5
Total recovery (recycling, composting, mulch)	82.9	93.8
Combustion with energy recovery	31.6	25.9
Discards to landfill	135.1	269.8

The State of Waste Management in the US

Nickolas J. Themelis & Dolly Shin

Nov. 5, 2015

amount. An estimated 247 million tons of solid wastes were landfilled in MSW landfills, i.e., 113 million higher than EPA estimate. This difference is believed to be due to several wastestreams that are deposited in MSW landfills but are not included in the EPA definition of MSW, such as packaging of imported goods, automobile shredder residue, ash residues, paper residues from wastewater treatment plants, and some construction and demolition debris. The Columbia Survey considers that all recyclable, compostable, or combustible materials that are discarded in MSW landfills represent a loss of valuable resources and an unnecessary use of land; therefore, they should be included in the national account of waste management. **Introduction** All states and municipalities provide waste collection and

An interesting finding was that, in comparison to 2008, landfilling decreased by about 20 million tons, while recycling increased by nearly the same amount. An estimated 247 million tons of solid wastes were landfilled in MSW landfills, i.e., 113 million higher than EPA estimate. This difference is believed to be due to several wastestreams that are deposited in

Data discrepancies based on accounting principles, including exports to China

Accountability as there are considerable variances regarding what is and what isn't recycled from Municipality to Municipality

Example in WA State: Most of what is collected in the single blue recycling bin are stated as recycled but are they really recycled? 52% or less than 20%?

WA State Ecology stated that the numbers they publicize are given to them by the Haulers/MRF/landfill operators, but WA Ecology doesn't know if they are recycled and the same applies to US EPA

Key: Terminology MRF marketed as: Recycling Facility

Terminology MRF actual: Material Recovery Facility - no recycling takes place - they try to sort what is collected in the single blue bin – Quality issues – most of the materials 'sold' to 'broker' – often untraceable

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Current US System

- Landfill based system
- Single bin recycling – US trash exports termed ‘recyclables’ to China used to reduce trade deficit
- Myth “China stopped taking Recyclables” Fact: <25% was recyclable >75% just trash – China stopped taking our trash!
- Focus on Zero Waste (30+ years)
- Estimated 70% of landfilled waste could be recycled – Why isn’t it?

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- While the world is moving away from landfilling most of the Waste produced in the US is still landfilled!

Facts are all around us:

WASTEDIVE Deep Dive Library Events

Corporate Collections Recycling Organics Zero Waste Landfill WTE

DEEP DIVE

ISWA Insights: What the US industry can learn from its global counterparts

Photo by Cody Boteler

By Cole Rosengren

Published Oct. 4, 2017

ISWA –International Solid Waste Association

Antonis Mavropoulos, president of ISWA,

"Speaking for the waste management sector, I have to say that we can be proud...because they actually contribute with their work to daily reductions of the CO_2 footprint," he said. "As an example, in Europe, 20% of the CO_2 reduction between 2000 and 2020 is mainly attributed to the waste management sector. This is a role model for the whole world."

EU Law that all member Countries must move to Zero Waste to landfills

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Time to stop wasting our waste–
What alternative(s) do we have?

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What must happen 1:

- Education on how to deal with resources from mining to bringing the materials back into circulation must take priority – it starts with the cycle of how products are made so that recycling gets easier and as in many cases even possible – true cost accounting (landfills)
- Media plays a critical role and so does good journalism (don't cut corners)
- Consistent at source sorting
- Adaptations to climate change must now be integrated, which includes moving away from landfill

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What must happen 2:

- ”My choice on how I deal with waste” is no longer acceptable
- Education vs status quo & money
- Terminology of “might, could, would, should” is no longer acceptable especially if science is near 100% but just because it isn’t, such words are used because it isn’t 100%!
- Pretending and carrying on with business as usual is not only not ok it is ‘ecocide’ and is putting the existence of future generations into jeopardy
- We cannot afford not to act!

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Definition:

An **Integrated Waste Management System (IWMS)** combines (integrates)

Best Available Technology (BAT)

to reduce, reuse, recycle, and process

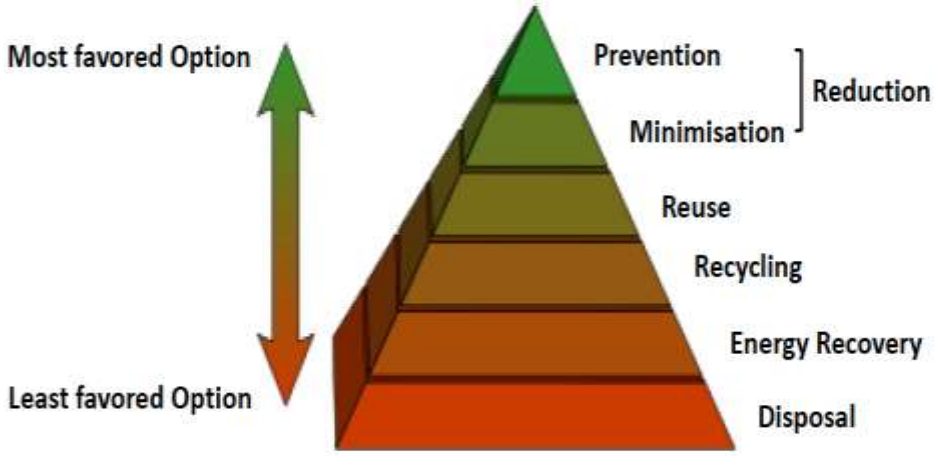
residual wastes to minimize waste disposal

for the protection

of human health, the environment, and resources.

Current US Zero Waste Landfill based System

Waste Management Hierarchy



Waste hierarchy is a tool used in the evaluation of processes that protect the environment alongside resource and energy consumption to **most favorable** to **least favorable** actions. The hierarchy establishes preferred program priorities based on sustainability. To be sustainable, waste management cannot be solved only with technical end-of-pipe solutions and *(therefore)* an **integrated approach** is necessary.

Source: Wekipedia (slightly modified)

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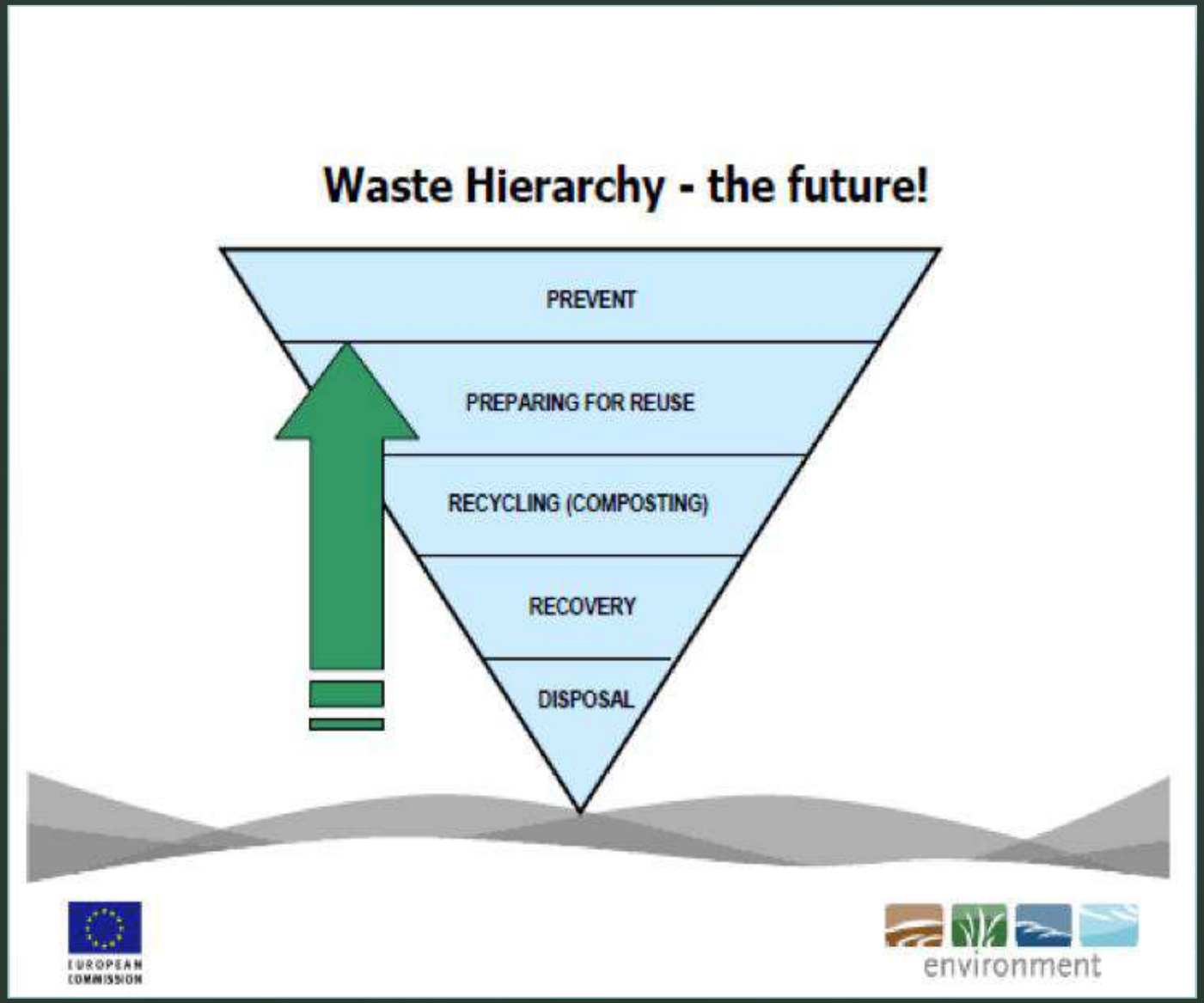
US Non-Landfill based System

By managing **Municipal Solid Waste (MSW)** by means of an **Integrated Waste Management System** applying known and proven measures for collecting and treating different fractions of waste the **Waste Hierarchy** can be turned up-side down, indicating that the amount of waste produced can be reduced by measures of **Reduction/Prevention, Re-Use, Recycling,** and **Thermal Treatment** to almost nothing left for **Disposal**.



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Integrated Waste Management Systems – 1 - Overview

- Well-performing waste management systems rest upon three main technical pillars:
  - Recycling, including composting;
  - Energy recovery;
  - Landfilling (as a last resort of only inert materials).

Source: US EPA

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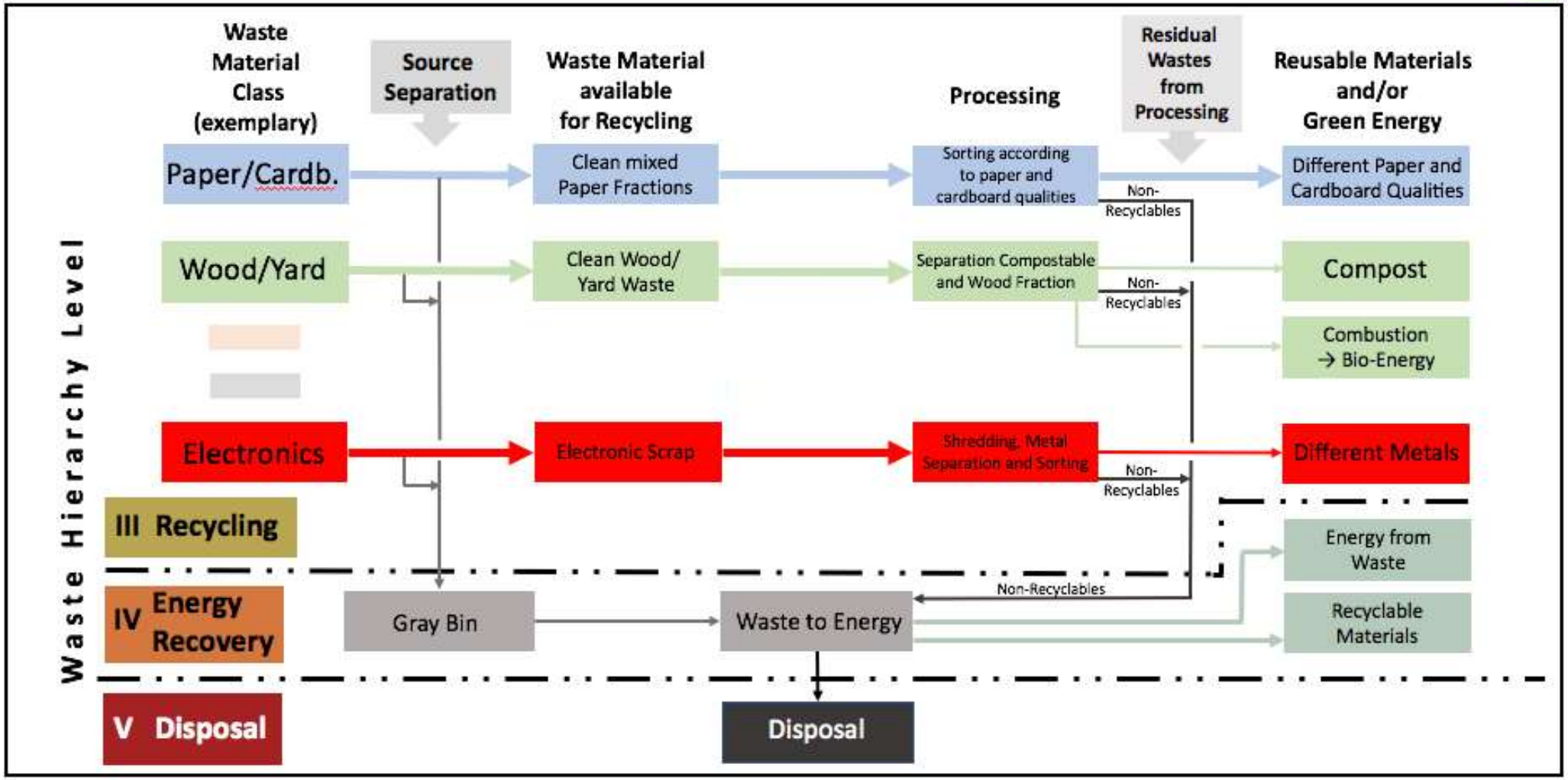
Integrated Waste Management System

3.3 Level III of Waste Hierarchy: Waste Recycling (7)

General Structure of an Integrated Waste Management System



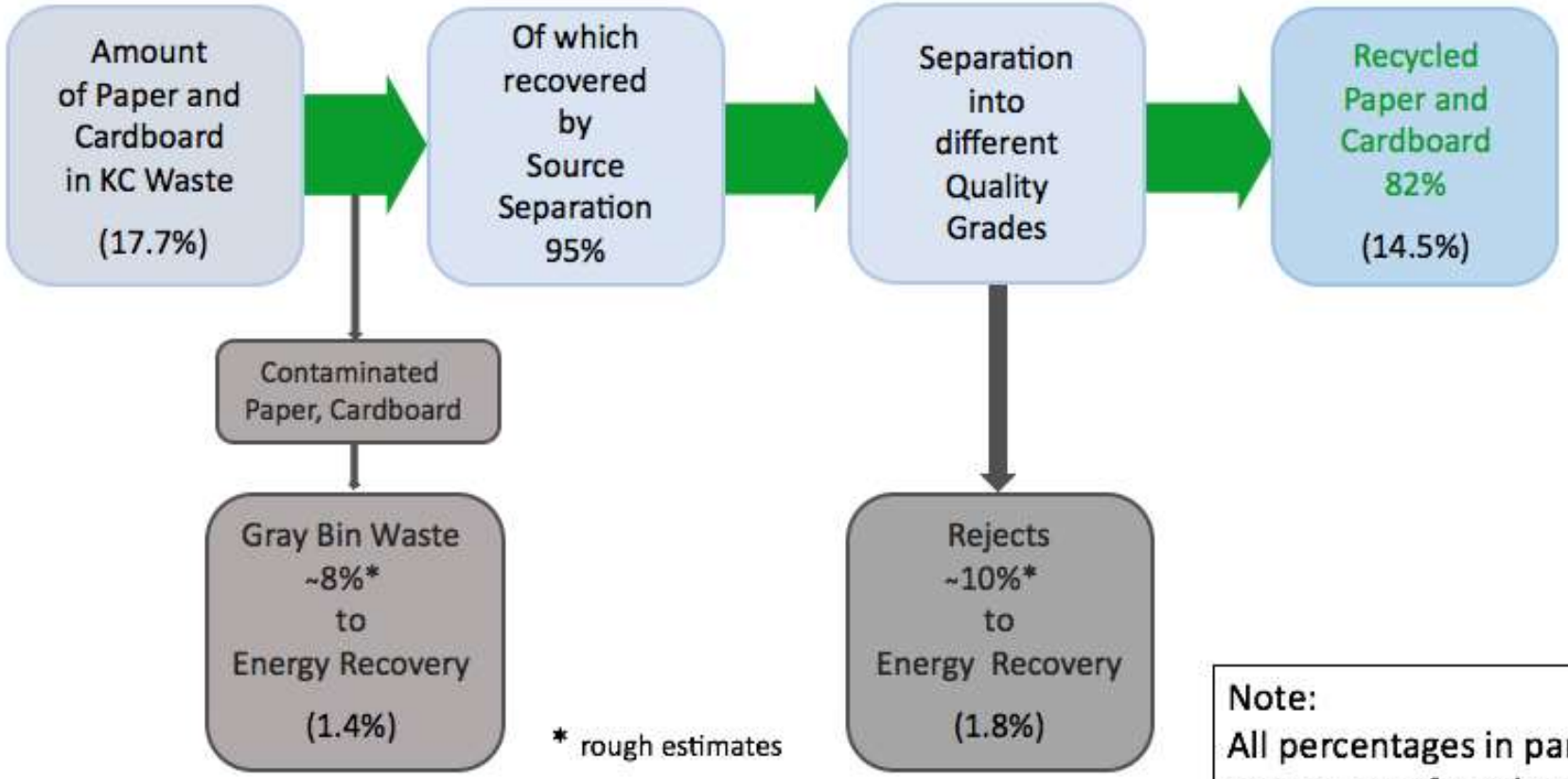
HZ 2022-09-09

Example:

Integrated Waste Management System

3.3 Level III of Waste Hierarchy: Waste Recycling (8)

Assessment of Recyclability of Material Class *Paper and Cardboard*



* rough estimates

Note:
All percentages in parentheses as percent of total waste stream

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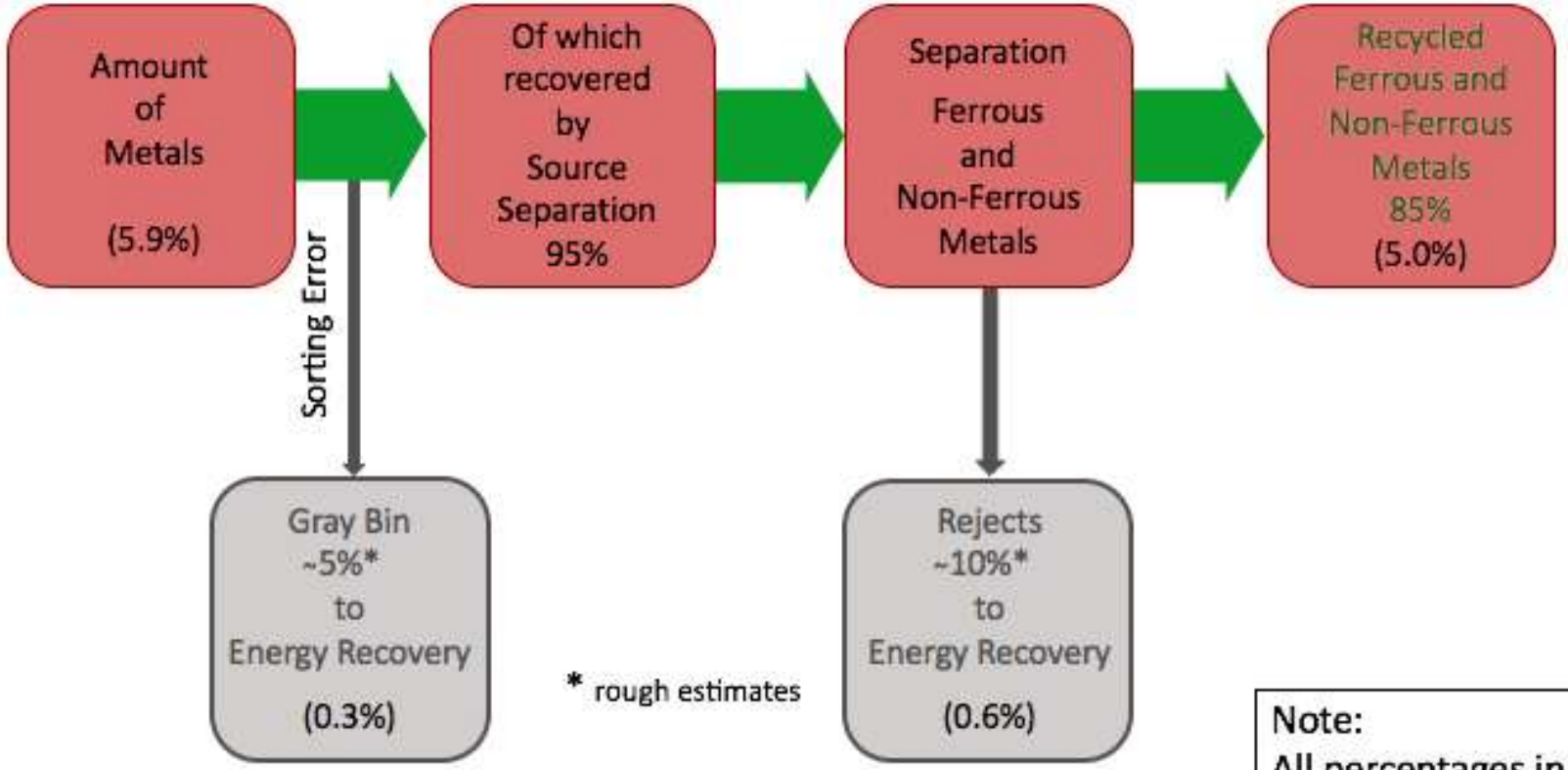
Example:

Integrated Waste Management System

3.3 Level III of Waste Hierarchy: Waste Recycling (12)

Assessment of Recyclability of Material Class *Metals*



Note:
All percentages in parentheses as percent of total waste stream

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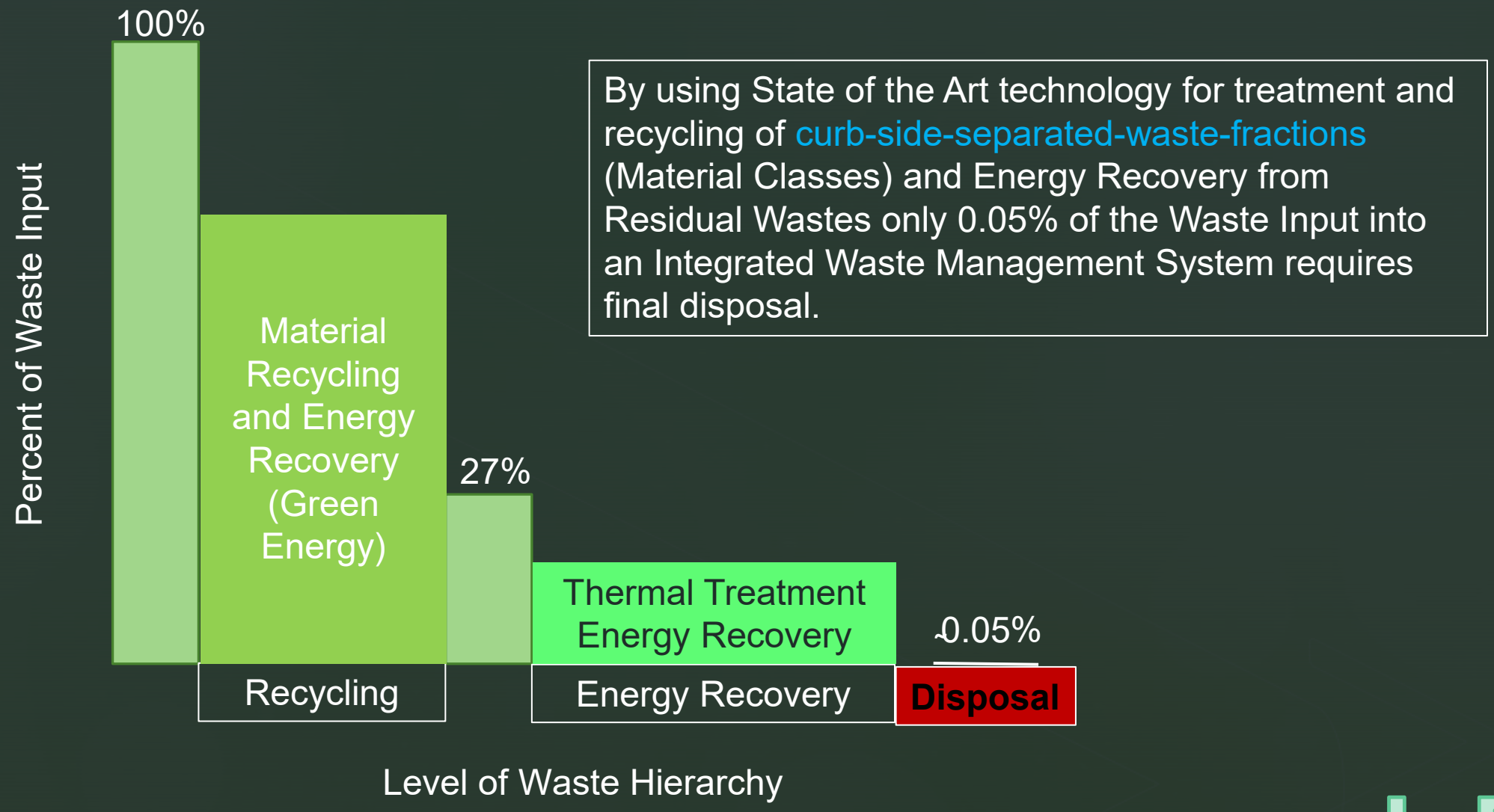
Integrated Waste Management System

Waste Hierarchy: Disposal



By using State of the Art technology for treatment and recycling of curb-side-separated-waste-fractions (Material Classes) and Energy Recovery from Residual Wastes only 0.05% of the Waste Input into an Integrated Waste Management System requires final disposal.

Integrated Waste Management Systems - 2a

- Recycling
  - key prerequisite for a high-quality recycling system is the source separation of materials that have market values
  - Recycling Centers (not transfer stations) offer several further separate collection systems – for example, for wood, WEEE, batteries, hazardous wastes, building materials, etc.
  - In well-developed at source (curbside) waste management systems, the separate collection and recovery rates are high, and the quality of each material stream tends to be good

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Integrated Waste Management Systems - 2b

- Recycling continued:
  - Glass (common): close to becoming unlimited (Excluded specialty glass i.e.: lead), if separated by color (green, white, brown) and plastics and metals are kept out (not like in Material Recovery Facilities or MRFs that try but can not effectively separate single bin)
  - All other materials can only be recycled to a certain extent or up to a limited number of cycles, due to several physical and other constraints
  - Ex: Paper on average about 3.5 in Europe and only 2.4 worldwide due to degraded short fibers and can no longer be incorporated into new paper
  - 100% recycling has not been possible

Differences in collection and processing:

US 3 Bin System - EU 6+ bin system

- @ Source/Curbside separation
- Ability to process
- Local/regional processing vs export

- US Zero waste is understood as sending less waste to landfill (good faith effort)
- Europe is regulated by no longer allowing untreated waste to landfill

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USA

The 3 Bin System

European/German 6+ Bin System (6th bin for organics)

Coloured recycling bins in Aurich, Germany. The simple task of throwing things away in the country is not for the faint-hearted. Photograph: Sean Gallup/Getty Images

Note: Oregon Bottle bill in 1971 (deposit for every beverage container) one of 1st in the US

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Paper & Cardboard, Plastic; Underground collection Glass - Switzerland

At many European Train stations:

Typical household (single and multifamily) in several EU countries

- Suburb of Hamburg next to Gymnasium (5 -13 Grade) High School
- Collection of Glass (Green, White, Brown); Cardboard & Paper

Over 800 locations in the Free and Hanseatic City/State of Hamburg, Germany –
EU Green Capital 2011

Glass (Green, White, Brown); Cardboard & Paper

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One of 12 Recycling Centers serving the City of Hamburg (2M people):

- Bulky waste
- Green waste
- Recyclables
- Problematic materials
- More than 50 different materials
- Many companies drop own container

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Lightbulbs

Printer Toner, others

Car Batteries, others

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Contaminated Wood

Construction Waste

Charges Apply

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Multiple categories

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This photo shows how bulky waste is collected in Hamburg: A compactor for the scrap…

…and a truck for well-preserved items which go directly to Stilbruch. This service is also included in the waste fees.

Stilbruch – Hamburg: Reuse vs Trash

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State of the Planet

EARTH INSTITUTE | COLUMBIA UNIVERSITY

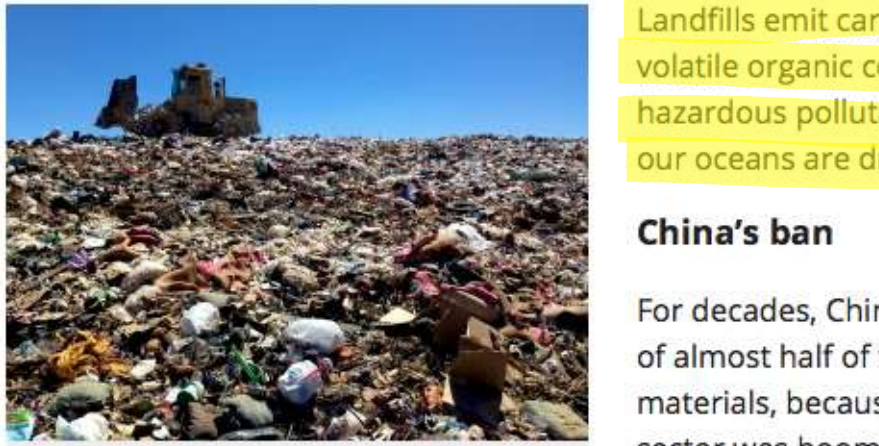
"The way the system is configured right now, recycling is a service that competes — and unsurprisingly often loses — for local funding that is also needed for schools, policing, et cetera," said Stephanie Kersten-Johnston, an adjunct professor in Columbia University's Sustainability Management Master's Program and director of circular ventures at The Recycling Partnership. "Without dedicated investment, recycling infrastructure won't be sufficient. In addition, we need to resolve the simple math equation that currently exists — when it's cheap to landfill, recycling will not be 'worthwhile' so we need to start to recognize what landfill really is: a waste of waste!"

Recycling in Baltimore. Photo: KristianBjornard

SUSTAINABILITY

Recycling in the U.S. Is Broken. How Do We Fix It?

BY RENEE CHO | MARCH 13, 2020 227 Comments



Buckhorn Mesa landfill in AZ. Photo: Alan Levine

Landfills emit carbon dioxide, methane, volatile organic compounds and other hazardous pollutants into the air. And our oceans are drowning in plastic waste.

China's ban

For decades, China handled the recycling of almost half of the world's discarded materials, because its manufacturing sector was booming and needed these materials to feed it. In 2016, the U.S. exported 16 million tons of plastic, paper and metals to China. In actuality, 30 percent of these mixed recyclables were ultimately contaminated by non-recyclable material, were never recycled, and ended up polluting China's countryside and oceans. An estimated 1.3 to 1.5 million metric tons of plastic found its way into the ocean off China's coast each year.

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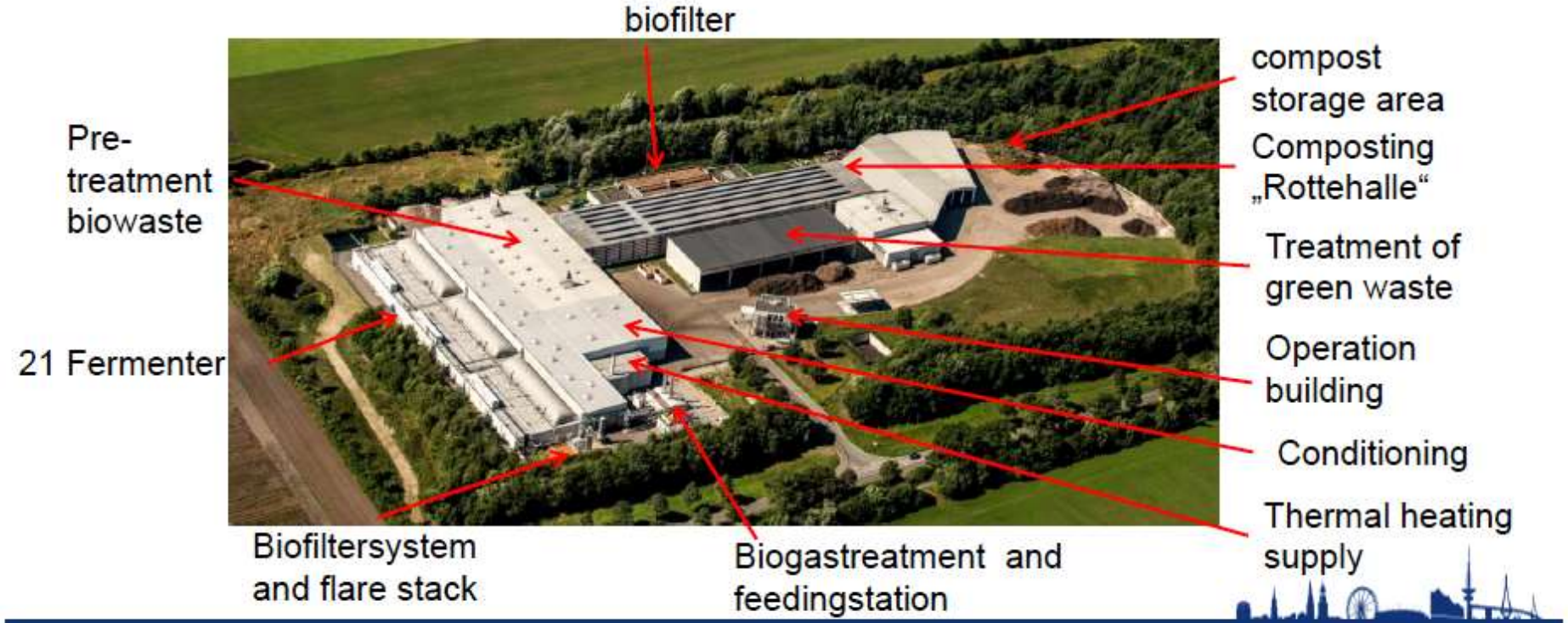
Integrated Waste Management Systems - 2c

- Compost
  - Humus build-up to resist drought and extreme weather only possible with good compost not bad contaminated compost in which Microbes cannot survive
  - Very stringent collection @ curb site to limit contamination
  - In the US compost is often contaminated due to funding constraints as a result of landfilling
- Anaerobic Digestion (AD)
  - Anaerobic digestion is a process, where biowaste is converted into biogas as well as a liquid and/or solid digestion residue by means of microorganisms under anaerobic conditions (exclusion of oxygen)

Biogas- and Composting Plant Bützberg

STADTREINIGUNG.HAMBURG



50,000 t/y in process of expanding to 90,000 t/y

Energy, Heat & Compost from Organic Waste

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Biogas and Composting Facility Buetzberg

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Biogas and Composting Facility Buetzberg

Sifting by 80 mm perforation

Extracting Metal, Plastic Bags or other Contaminants

Breaking organic Material > 80 mm

Quality of Biowaste-Collecting

STADTREINIGUNG.HAMBURG

NO PLASTICS IN THE ORGANIC WASTE BIN.

Why neither plastic or "organic plastic" may be placed in the organic waste bin

Put simply, plastic bags primarily consist of crude oil and take around 20 years to break down. But broken down does not mean biologically degraded. What remains of the plastic bag is **microplastics which then reach the food chain, ground water and oceans** where they damage the ecosystem. Even "**compostable plastic bags**" are allowed to contain a proportion of crude oil, which does break down but does not fully biologically degrade within the production processes in our plants. The time it takes these bags to disintegrate far exceeds the production times. These bags also „melt" in the digestion stages of our plants and are almost impossible to separate from the compost. We want clean compost soil and functional plants for more bioenergy.

Get involved and make a switch from plastic bags and compostable plastic bags – for clean organic compost and more bioenergy.

Biogas and Composting Facility Buetzberg

logistics area

Loading the Fermenter

Fermenter with bio-waste

Anaerobic Digestion
15-17 Days

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Biogas and Composting Facility Buetzberg

Compost –
10 turn cycles 35 Days

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High-quality compost!

Biogas and Composting Facility Buetzberg

Integrated Waste Management Systems – 2d

- Biochar
  - Not well enough understood/studied
  - Real biology has shown that there are significant issues:
    - Biochar blocks water and nutrients from penetrating the soil
    - At this point not a reliable solution for carbon sequestration
    - The more hands-on studies, the less favorable

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Integrated Waste Management Systems – 2e

Sewage Sludge

- The cost of landfilling has a direct impact on Sewage Disposal: Cost
- Sewage sludge contains many heavy metals, flame retardants, dioxins and furans and many other toxics that common sewage “treatment” facilities are incapable of dealing with
- Best ‘treatment’ is the thermal treatment in dedicated facilities
- Recovery of phosphates, others
- Co-treatment possible, mono better

One of the plant’s three windmills in the background, with the incinerator on the left.

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Integrated Waste Management Systems – 2e

State of the Art Sewage Processing Facility, Hamburg, Germany (VERA)

- Safe destruction of toxics
- Net Energy positive
- CO2 reductions
- Phosphorus recovery

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Q & A

5 Minutes

Integrated Waste Management Systems - 3

- Thermal Treatment Processes / Energy Recovery
  - Non recyclables used to create energy in proven state of the art facilities
  - Energy and material recovery from waste is an essential and compatible partner of recycling and not a competitor as some claim
  - Ecological friendly and affordable treatment for residues from recycling processes and non-recyclable/residual waste
  - Ability to destroy toxic organic substances and to mineralize all organic components in waste
  - Sanitizing of medical waste to make it harmless to humans and animals

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Integrated Waste Management Systems -3a

- If there were no sink for these harmful substances, our society would poison itself by the concentration of toxic components in all anthropogenic (human made) mass flows and, as a result, in water, air and soil. This fundamental kidney function can only be fulfilled by proven thermal treatment
- Note: mechanical and/or biological waste treatment options (MBT) are not able to guarantee this fundamental requirement, let alone the fact that they are just an intermediate processing stage

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Integrated Waste Management Systems - 3b

- WtE is the incineration in dedicated plants with energy recovery, highly sophisticated flue gas cleaning and maximum recovery of the process residues
- Alternative thermal processes, like gasification, pyrolysis, liquefaction or plasma technologies, are often considered a better option for this purpose, because they allegedly offer higher efficiencies and, in some cases, also the possibility to produce chemicals or fuels. This is, however, not the case. It has been clearly proven that alternative thermal waste treatment processes are entirely unsuitable to treat residual waste:
  - Non homogenous character of waste/too complex
  - Technical issues not resolved
  - Lower performance and unfavorable economics

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1St Incinerator on the European Continent
1895 Hamburg, Germany

1982 Commodore 64

2023 Apple iMac Pro

WTE: bridge technology

Highly complex structures - not just incinerators:

Build according to specs

Highly flexible systems that can serve many objectives:

- Ultra low NOX <5PPM

- Landfill Diversion >99%

- CHP-Heating-Cooling-Energy

- Desalination

- Base Load Power

- Material Recovery

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24-year proven track record: MVR Hamburg, Germany

Recognized as one of the most sustainable State of the Art Resource Recovery /Advanced Thermal Treatment Facilities Worldwide >95% diversion from landfill

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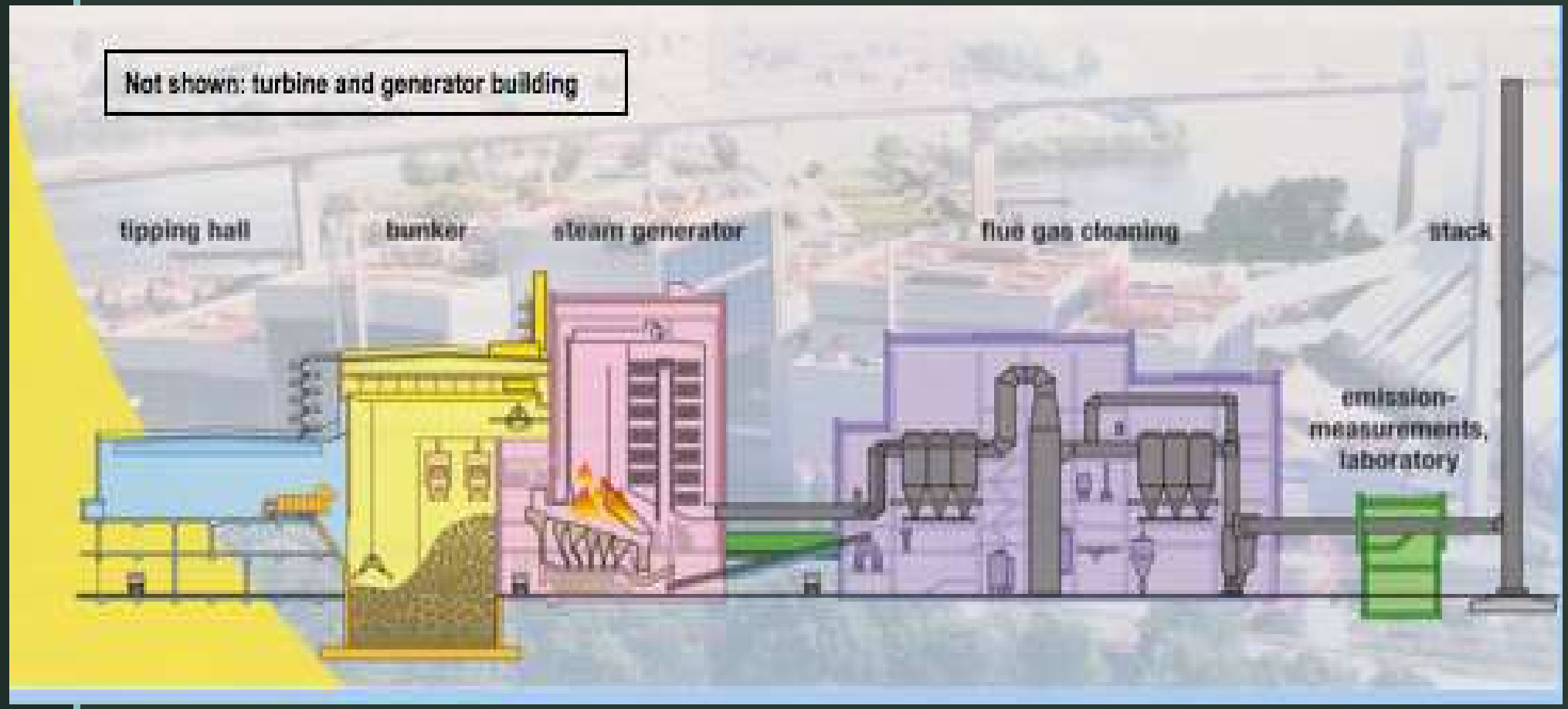
Overview of Thermal Treatment/Recovery Facility:



Source: MVR Annual Report

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WTE Benefits Include Waste Sterilization, along with 90% Volume and 75% Weight Reduction

Input

Output

Waste in, stabilized and inert ash out!

Source: Paul Hauck

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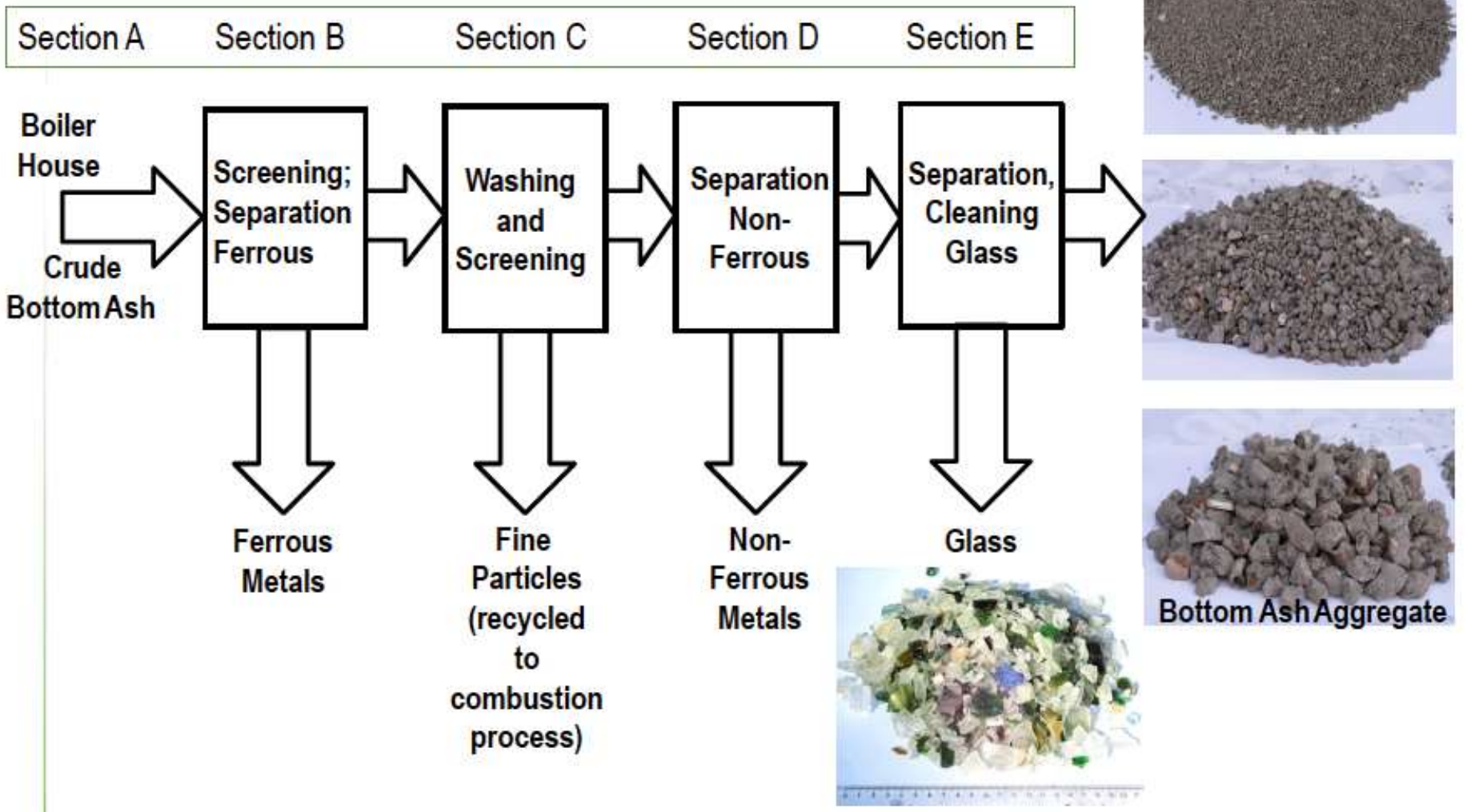
European Advanced Bottom Ash Treatment Main Process-Steps



Source: Paul Hauck

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500,000 tons of Bottom Ash used as carrying layer for most advanced (2006) container terminal in the world in Hamburg, Germany:

neomer
Innovations in Sustainable Business Development

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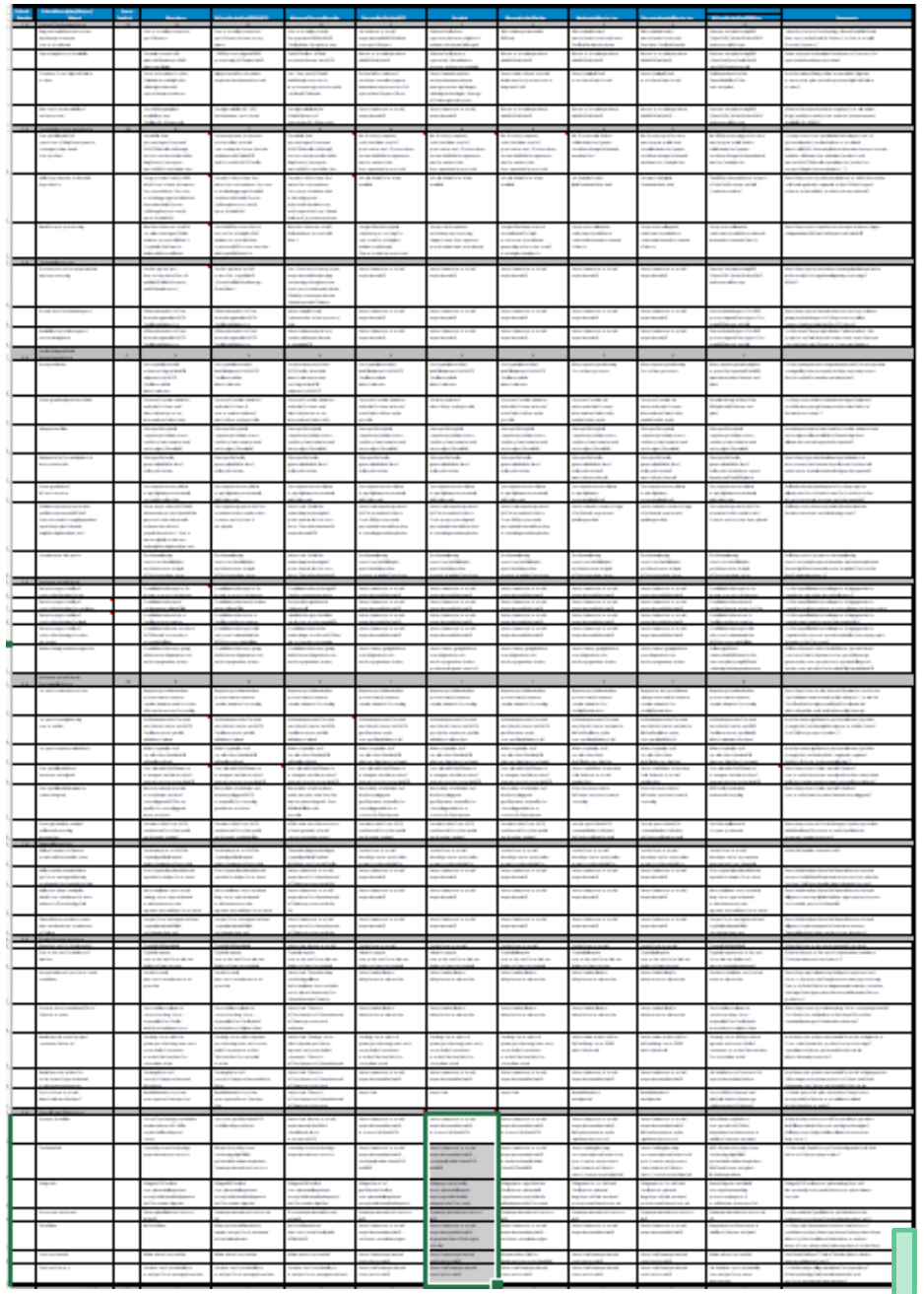
Integrated Waste Management Systems - 3c

- Evaluation of WTE, RDF, ATRT, gasification, Pyrolysis, Plasma Arc, Biochemical Waste to Fuel, Biofuels, Cement Kilns
- 47 criteria points including demonstrated reliability of entire system, operating hours, need for preprocessing, Impacts on neighboring community, finance-ability, Cost to operate, fatal flaws, reference facilities….
- ‘exotics’/non proven scored >50/100 points
- Highest score ATR and WTE at 95/100 points



Integrated Waste Management Systems - 4

- Landfilling
  - Lowest on the international waste hierarchy
  - Most expensive when true cost (including all externalities) accounting
  - Only used for waste fractions that can neither be recycled nor used for energy recovery – only inert materials
  - The landfill ban of untreated waste has resulted in the largest Greenhouse gas reductions of the waste sector (ex: Germany)
  - The higher cost for disposal (pretreatment and disposal) has supported the economics of recycling.

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Reduction potential from landfill elimination via use of an IWMS:

Approximately net GHG Reductions of about 700,000 $MtCO_2e$ per year/1M tons landfilled (Example King County, WA).

It can be assumed that the reductions are larger, because the landfill gas collection efficiency may not be as high as assumed in the calculations.

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Economic Benefits

USA Equivalent:

- “Not to bury $250-375 Billion in economic value in landfills every year (GDP Opportunity Cost)”, Jimmy Jia 2017

Q & A

5 Minutes

“We need to learn to balance our economic desires with the ability for the environment to remain healthy.”

With a population exceeding 7.5 Billion it is all about circular economies, protecting the environment and resources and how efficiently we manage them

Circular Economy

- Waste prevention, re-use, recycling, recovery, disposal: this is what is referred to as waste hierarchy, the foundation of waste management in Germany. In the past, waste management was merely about waste disposal, but it has since been recognized that waste is a valuable resource which can be used effectively to conserve natural resources.
- All wastes are not created equal. Although the aforesaid common terms are also used by waste management experts, waste management necessitates that subtle distinctions be made between the various types of waste.
- All in all, there are 842 different types of waste.

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842 types in 13 Categories

Circular Economy

- Waste Batteries (appliances, vehicles, and industry)
- End-of-life Vehicles (Environmentally sound disposal)
- Waste glass (Glass is an ideal material for recycling)
- Waste Wood (Waste wood to produce energy)
- Waste medicines (Disposing of waste medicines)
- Waste oil (Strict regulations on disposal of waste oil)
- Waste paper (Waste paper is a valuable resource)
- Construction waste (Information for builders and architects)
- Organic waste (Recovering biowaste as an essential part of recycling)
- Waste electrical and electronic equipment (A divers and challenging product group)
- Sewage Sludge (Municipal sewage treatment plants)
- Municipal waste (Process and monitoring)
- Packaging waste (Part of our daily life and used for many purposes)

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NEW EU ‘RIGHT TO REPAIR’ LAWS
REQUIRE TECHNOLOGY TO LAST FOR A
DECADE

The circular economy model:
less raw material, less waste, fewer emissions

Source: European Parliament

The Zero Waste Utopia – taking a closer look at some claims

- The proposition of Zero Waste tends to mislead public into thinking waste can disappear if only we had the will to make it happen
- Countless governmental and non-government organizations initiatives worldwide
- Zero Waste only acceptable aim of today's politicians (commitment countries and municipalities)
- Today – no one has managed it and given the many scientific roadblocks, no one ever will
- Zero Waste concept resulted in the idea of 'consuming with a good conscience'!

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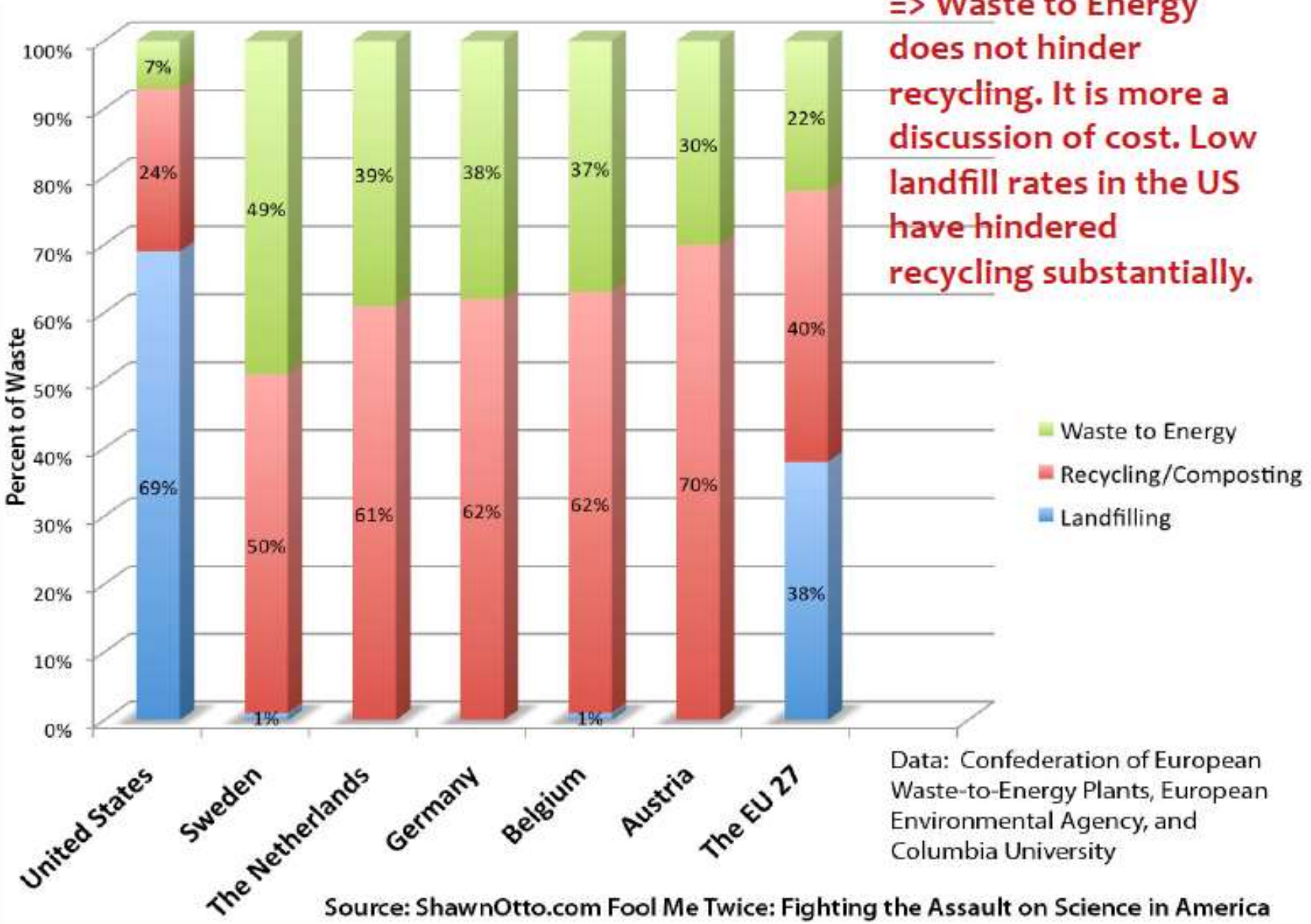
Zero Waste Utopia - Exposed

- Facts vs Fiction:
  - Claim: WTE/TT competes with recycling as it takes recyclable materials to feed the fuel needs of existing WTE facilities
  - False! The opposite is true. 1) Non recyclables need a 'sink' as described on previous slides. The recycling system can function properly only if ecologically friendly options for the treatment of these fractions exist; 2) Landfills are artificially cheap not including true cost (externalities such as impact on environment, lost resources, forever care…). If landfilling is the only alternative to recycling, like it is the case in much of the US, the economic incentive to divert resources, which would otherwise be recycled, to cheap landfills is high. The relationship between landfilling, WtE and recycling is well known among practitioners. It shows that those countries with a highly developed waste management system (see chart), characterized by high recycling rates, have the highest share of WtE and the lowest percentage of landfilling.
  - Note: WTE/TT can not handle excessive amounts of plastic – can't exceed BTUs to avoid damaging the plants

United States is Far Behind Europe on Recycling and Waste to Energy



Source: ShawnOtto.com Fool Me Twice: Fighting the Assault on Science in America

Zero Waste Utopia - Exposed

- Facts vs Fiction:
  - Claim: WTE/TT emits CO_2 and escalates climate change
  - Misleading, Context/Clarification: Compared to what?
    - Landfilling of still reactive materials (non inert) produces methane (among other toxic gases) – based on the science of landfills and despite what landfill companies claim, international experts agree that less than 50% of the methane from landfills is captured.
    - Key is when the calculation starts and when it ends
      - Day of delivery?
      - Day of cell closure?
      - In 30 Years? In 100 Years? In 10,000 years?
    - US EPA states that landfills underreport by a factor of 2

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Landfill Issues:

From an Environmental and Occupational Health Aspect there are several issues within our landfill based/focused waste management system:

- Landfilling is subsidized as the true costs are ignored!
- Environmental Impact – Air, Water
  - Climate Problem
  - Landfilling contributes in a fundamental way
  - Advanced Thermal Treatment (Advanced Waste-to-Energy) based on Mass-Burn plays a very important role in mitigating the problems (not just GHGs but toxics)
  - 'Forever' Toxics in our groundwater – irreparable/lost water supply
- Single Bin Recycling = Counterproductive - Why? Cross contamination that technology can't fix
- Misperception of Cost – Landfill incl. externalities highest cost!

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Methane from landfills

- Biden Administration acknowledges landfill methane a serious issue. Whitehouse statement just before COP 26 in Glasgow (2021): “three largest methane sources in the US: Oil & Gas, Landfills and Dairy Industry”
- Nov ’22 AP News - “The administration also is taking aim at methane emissions from landfills, with emphasis on food loss and waste that serves as a major contributor. EPA has set a voluntary goal of capturing 70% of methane emissions from U.S. landfills.”
- Problem – ‘Voluntary” - vs not phasing out landfilling of untreated still reactive waste altogether!!!
- What happened?

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2008

BÜNDNIS 90 DIE GRÜNEN

Sustainable Waste Policy

Dr. Michael Weltzin
Scientific Assistant
in the Parliamentary Group

Future concept for 2020: zero waste

- **Greens are campaigning to end the disposal of waste from human settlements on landfill sites by 2020 completely. That means:**

1.) much more waste avoidance (e.g. by taxes on raw materials)

2.) more production of reusable and recyclable products (e.g. by producer responsibility, integrated product design, ...)

3.) automatically sorting of the residual waste

4.) recover all valuable substances

5.) residues that are left over should be used to generate energy

2008

BÜNDNIS 90
DIE GRÜNEN

Sustainable Waste Policy

Dr. Michael Weitzin
Scientific Assistant
in the Parliamentary
Group

Lessons learned

- **Waste avoidance and recycling quotas are not the solution, they are just a part of it,**
- **Recycling has limits, e.g. plastics!**
- **Even recycling products become waste after use,**
- **Using best available technology for the incineration of residual waste means less impact to environment and to climate than landfilling.**
  - *although many members of the green party started their "career" in action groups against incineration plants, incineration with low emission levels, energy and material recovery is accepted today.*

BÜNDNIS 90
DIE GRÜNEN

Position of Alliance 90/The Greens belonging to disposal of waste

Dear Ms. Lambert,

Thank you for your request and your interest in our position belonging to the disposal of waste in landfill sites. As parliamentary group of Alliance90/The Greens in the German Bundestag our policy is evidently focussed on sustainability. And due to the disposal of waste in landfill sites we have an absolute clear position:

Disposing of waste in landfills is not a solution. It is the most unsustainable way of waste treatment and it is also not the cheapest way to get rid of waste. Landfill site deposition is just shifting problems and costs to next generations. Landfill sites are more or less black boxes with unpredictable processes and a burden for the future. Keywords are greenhouse gases, many other toxic emissions, danger of leaks, heavy metals etc… Therefore the minimum requirement is to treat waste before disposing of it. This is not only an effective protection of groundwater and soil, it is last but not least also an inexpensive reduction of greenhouse gas emissions e.g. methane. And of course: Treatment of waste before disposition is much cheaper than a remediation of a contaminated landfill site.

Therefore in Germany and Europe a lot of efforts are made to decrease the amount of waste being disposed in landfill sites. We from Alliance 90/The Greens are going even further. We want to close the loop for raw materials. Therefore we are campaigning to end the disposal of waste from human settlements on landfill sites until 2020 completely. This ambitious target presupposes the complete sorting and recovery of waste. This 2020 target is not an utopian goal, it is a realistic objective:

- waste can already be sorted fully automatically and the valuable substances can almost completely be recovered
- Sorting residues that are left over can be used to generate energy in waste incineration plants operated by very high standards. The different by-products of waste incineration can also be reused (for example the waste incineration facility in Hamburg at Rugenberger Damm)

For us it is not comprehensible, that waste disposal in landfill sites should bring a reduction of greenhouse gas emissions by low costs. It is the opposite of the wide accepted knowledge in Europe and Germany, that recovery and treatment are essential elements of a sustainable waste and environmental policy.

Best regards

Alliance90/The Greens

cc: Philipp Schmidt-Pathmann, WRSI

Disposing of waste in landfills is not a solution. It is the most unsustainable way of waste treatment and it is also not the cheapest way to get rid of waste. Landfill site deposition is just shifting problems and costs to next generations. Landfill sites are more or less black boxes with unpredictable processes and a burden for the future. Keywords are greenhouse gases, many other toxic emissions, danger of leaks, heavy metals etc… Therefore the minimum requirement is to treat waste before disposing of it. This is not only an effective protection of groundwater and soil, it is last but not least also an inexpensive reduction of greenhouse gas emissions e.g. methane. And of course: Treatment of waste before disposition is much cheaper than a remediation of a contaminated landfill site.

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Four Critical reasons to stop landfilling

European Union Directive: 27 **countries** agreed!!!

1. Landfilling of municipal waste leads inevitably to dangers to **human health** (leachate into groundwater, emissions into the air);
2. The release of **climate damaging** gases (Methane - CH4, Carbon Dioxide - CO2, Nitrous Oxide - N2O, etc.) – scientifically less than 50% capture possible
3. The **destruction of resources** that otherwise could replace primary raw materials or fossil fuels (energy, raw materials).
4. Long-Term Care as the forever toxics in the waste in the landfills need to be managed for 1000s of years and landfills are engineered structures that will fail!

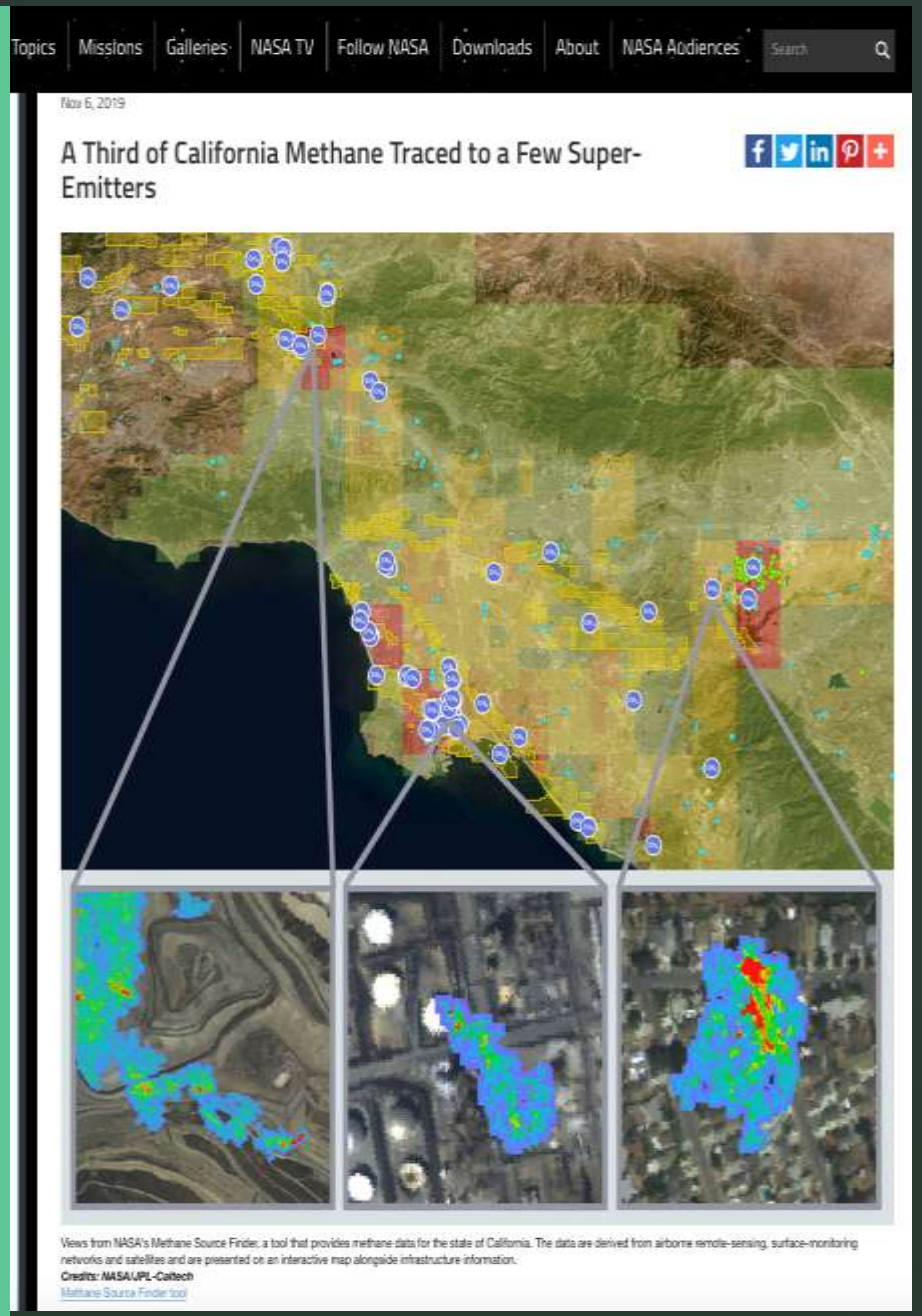
IeRM

- While Carbon Dioxide is emitted from Power plants and cars, <u>primary emitters for methane are waste management, dairy farming, and oil and gas operations</u>. In the 5th Assessment Report of the IPCC (Intergovernmental Report on Climate Change) Methane, over a 100-year cycle has a GWP (Global Warming Potential) of 34 times that of CO_2 or 86 times GWP over CO_2 based on a 20-year cycle.

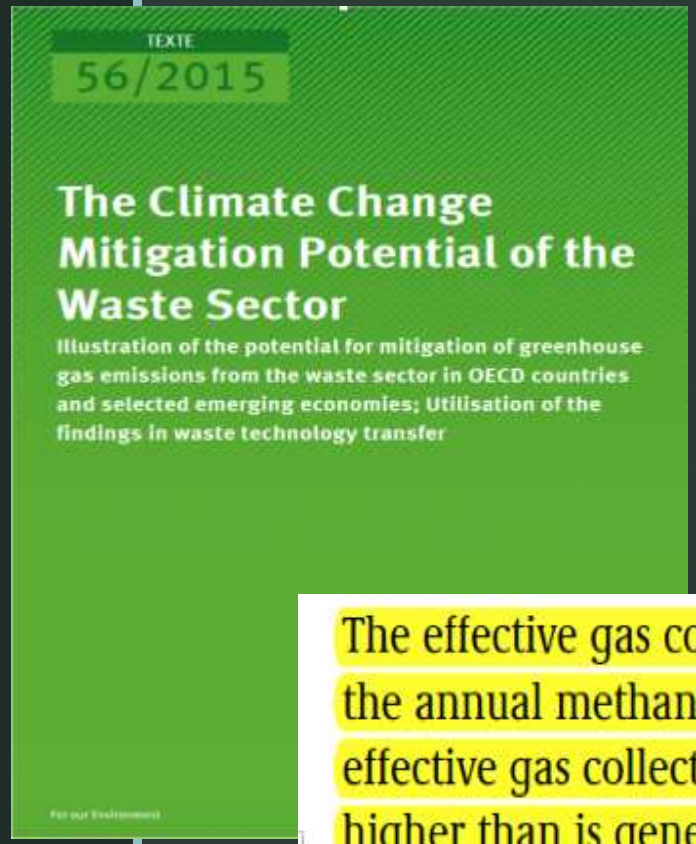
- NASA's Scientific Evaluation of Methane from Landfills used airplanes with special detection technology.

<u>Methane from the three largest sources in California:</u>

>40% from Landfill Gas (=> most landfills are underreporting)
26% Dairy Industry
26% Oil and Gas Operations



Secondly, another special feature of landfilling in the USA is the gas collection efficiencies quoted, which are relatively high. The majority of landfills in the USA are operated by two large companies, one of which is Waste Management Inc. An expert (Thorneloe 2012) states that the efficiency of the gas collection systems used in landfills varies. Operators postulate the "CO_2-neutral landfill" with 95% gas collection efficiency. According to measurements performed by USEPA (ORD), these gas collection efficiencies are unrealistic. Measurement programmes at three landfills yielded the gas collection efficiencies shown in Figure 21.[32] However, these apply only to the landfilling period that was considered or investigated. There are no data on effective gas collection efficiencies over the entire storage period, which should be considered to last 100 years.



The effective gas collection efficiency over the 100-year time span is not given; it depends on the annual methane formation rate that is applied. However, it can be assumed that the effective gas collection efficiency, if calculated, would be over 80% and hence significantly higher than is generally postulated under the current state of scientific knowledge. It is for this reason that (EEA 2011), for example, does not adopt the high gas collection efficiencies reported by some EU countries; instead, a maximum technically feasible effective national gas collection efficiency of 45% is assumed, even if all landfills have gas collection systems.

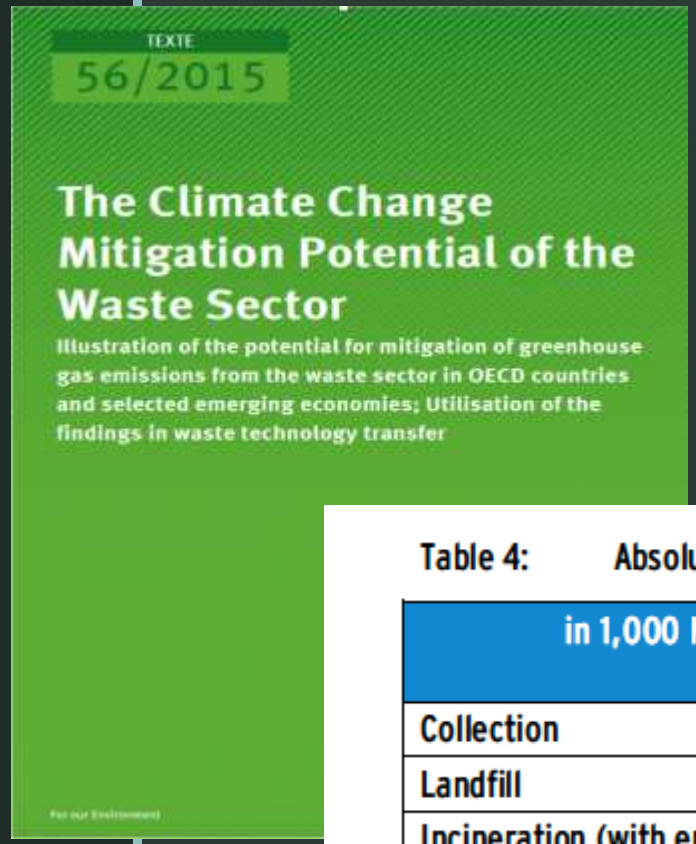


Table 4: Absolute net results – global warming potential, status quo and future scenarios to 2030 in the USA

in 1,000 Mg CO_2-eq	status quo	2030 medium	2030 ideal
Collection	2,151	2,151	2,151
Landfill	64,689	39,591	0
Incineration (with energy)	-3,454	-28,840	-50,840
Recycling	-44,688	-65,906	-89,850
Composting/anaerobic digestion	-595	-712	-2,863
Total	**18,104**	**-53,717**	**-141,402**

The SOG survey results in considerably larger waste amounts than the USEPA data; in particular, it shows larger amounts landfilled. According to the survey, the MSW generated in 2011 was about 389 million short tons, of which 64% was landfilled. On the basis of the volumes in the SOG survey the net debit in the GHG balance for the USA is 3.6 times higher at 64.5 million Mg CO_2-eq. The GHG emissions from landfilling are nearly twice as high.

For the USA a medium and an ideal future scenario were analysed with the following conditions:

2030 medium:	45% recycling, 25% incineration, 30% landfill
2030 ideal:	60% recycling, 40% incineration, 0% landfill

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

As of: 03. June 2005

Waste Management

As of: 03. June 2005

A milestone for environmental protection: landfilling of untreated wastes consigned to the past

Waste Storage Ordinance enters into force on 1 June 2005

A new era of domestic waste management has begun: from 1 June 2005 wastes can no longer be landfilled in Germany without pretreatment. This protects our health and the climate - and creates jobs. Federal Environment Minister Jürgen Trittin: "Today marks an end to the practice which created innumerable contaminated sites for future generations - that of burying waste in landfills and forgetting it. This fundamental change is a milestone for environmental protection, comparable with the introduction of the legally regulated catalytic converter for cars."

Just 15 years ago a great deal of domestic and commercial wastes ended up untreated on the rubbish tip. First residents complained about the stench, then pollutants such as dioxins were found in the groundwater and drinking water. The digester gas methane emitted from landfills causes 21 times more damage to the climate than carbon dioxide (CO_2). Domestic waste landfills became contaminated sites which result in costs for rehabilitation and after-care amounting to billions.




Pictures provided by Richard Honour, PhD, Book Sludge Tracker

Landfill Leachate

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Landfill Leachate R.H.

Landfill Leachate
Wholly Unknown Chemistry

The Most Toxic Leachate goes to the Resulting Sewage Sludge

- King County Solid Waste Division operates Cedar Hills Regional Landfill in eastern King County, WA (2015 Report)
- Leachate from the landfill flows to a Leachate Effluent Pump Station to mix with other wastewaters (e.g., contaminated stormwater, gray water and BEW process water (Bio Energy Washington, LLC)
- Following aeration, the combined wastewaters discharge to the King County sewerage system (i.e., to South Plant [WWTP])
- The volume of landfill leachate wastewater is about 180 million gallons/Year, or about 15 million gallons/Month
- The resulting highly toxic sewage sludge goes to forest, farm and food

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Why landfilling of Waste is not a good solution:

- Mixed waste contains organic as well as hazardous substances:
  - Production of landfill gas (best case scenario only 50% can be collected and treated; the remaining 50% are a hazard to climate)
  - Production of leachate (long term collection and treatment is necessary – which is expensive)
  - Engineered barriers will not work for ever but fail in ???
- Landfilling shifts problems only to the future – opposite to sustainability
- Remediation of old landfills may be necessary (problem for future generations) – but how?
- On the long term, landfill is the most expensive „solution“ and the contrary of sustainability
- Landfill of waste, therefore, has already the lowest priority in many countries
- Exemptions for inert (no longer reactive) wastes, if not recyclable

Zero Waste Utopia - Exposed

- Facts vs Fiction:
  - Claim: WTE/TT emits CO_2 and escalates climate change
  - Continued:
    - Thermal treatment of biogenic fractions in the waste WTE is carbon neutral
    - Combustion of plastic does release CO_2, but the saved emissions from the displaced fossil fuels are offsetting, and this is especially relevant for high-efficient WtE facilities
    - Carbon Capture and storage would make WTE/TT carbon negative
    - EPA states that for each ton treated in WTE/TT vs landfilling one ton of CO_2 is avoided

Zero Waste Utopia - Exposed

- Facts vs Fiction:
  - Claim: Mechanical Biological Treatment (MBT) is better than WTE/TT
  - Misleading claim:
    - MBT: Mechanical Sorting, Biological Processing: Not able to destroy toxic organic substances, Can't concentrate harmful inorganic substances – no sink for pollutants; High Capital Costs; Material too contaminated to be able to be used in Composting or recycling - still needs WTE/TT.

2015 Definition by the German EPA: There are two different mechanical-biological waste treatment methods. In the classic method, metallic waste and high heat value waste are separated for energy recovery purposes, leaving behind so called landfill waste, which after undergoing biological treatment (rotting or fermentation), is deposited at landfill sites – by which point the waste exhibits extremely low levels of residual biological activity.

The second method, known as stabilization, involves the production of refuse-derived fuel (RDF) (also known as Stabilat), which results in the disposal of little or no mineral landfill waste. RDF residues are readied for recycling by drying them biologically using RDF reaction heat. These dry residues are more readily recyclable to produce RDF, iron, non-ferrous metal and so on.

Zero Waste Utopia - Conclusion

- Facts vs Fiction:
  - Claim: Mechanical Biological Treatment (MBT) is better than WTE/TT continued
  - Misleading
    - At source separation key – MBT too contaminated for quality recovery of materials (metals ok)
    - Much of the end 'product' of MBT must still be thermally treated to properly deal with toxics
    - Thermal treatment of biogenic fractions in the waste making WTE/TT carbon neutral
    - Combustion of plastic does release CO_2, but the saved emissions from the displaced fossil fuels (if used as an energy source) do offset, this is especially relevant for high-efficient WtE facilities
    - Carbon Capture and storage would make WTE/TT carbon negative
    - EPA states that for each ton treated in WTE/TT vs landfilling one ton of CO_2 is avoided

Zero Waste Utopia - Exposed

- Facts vs Fiction:
  - Claim: WTE/TT affects the environment and human health by harmful pollutants
  - Misleading claim - Context/Clarification: Compared to what?
  - WTE has lowest emission limits among all industry -> and normally preforms much better by orders of magnitude, sometimes below detection threshold of the instruments
  - WTE best monitored combustion plants, with atmospheric emissions continuously controlled and publicly reported (at least in Europe = high acceptance)
  - Residual; emissions on air quality is negligible compared to for example traffic
  - Compared to landfills: Landfills gaseous and liquid emissions are much harder if not impossible to capture at the level that WTE does.

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Zero Waste Utopia - Exposed

- Facts vs Fiction:
  - Claim: Most plastics can be recycled
  - False:
    - Only plastics 1 can be recycled
    - Plastics 2, 5 possibly
    - Most plastics cannot be recycled
    - Germany recycles less than 10% (produces more than 15 Mio Metric tons/annually) - 2021
    - US recycles less than 5% (produces more than 80 Million Metric tons/annually) – 2022. The United States in 2021 had a dismal recycling rate of about 5 percent for post-consumer plastic waste, down from a high of 9.5 percent in 2014, when the U.S. exported millions of tons of plastic waste to China and counted it as recycled—even though much of it wasn't. https://ie-rm.org/plastic-recycling-doesnt-work-and-will-never-work/

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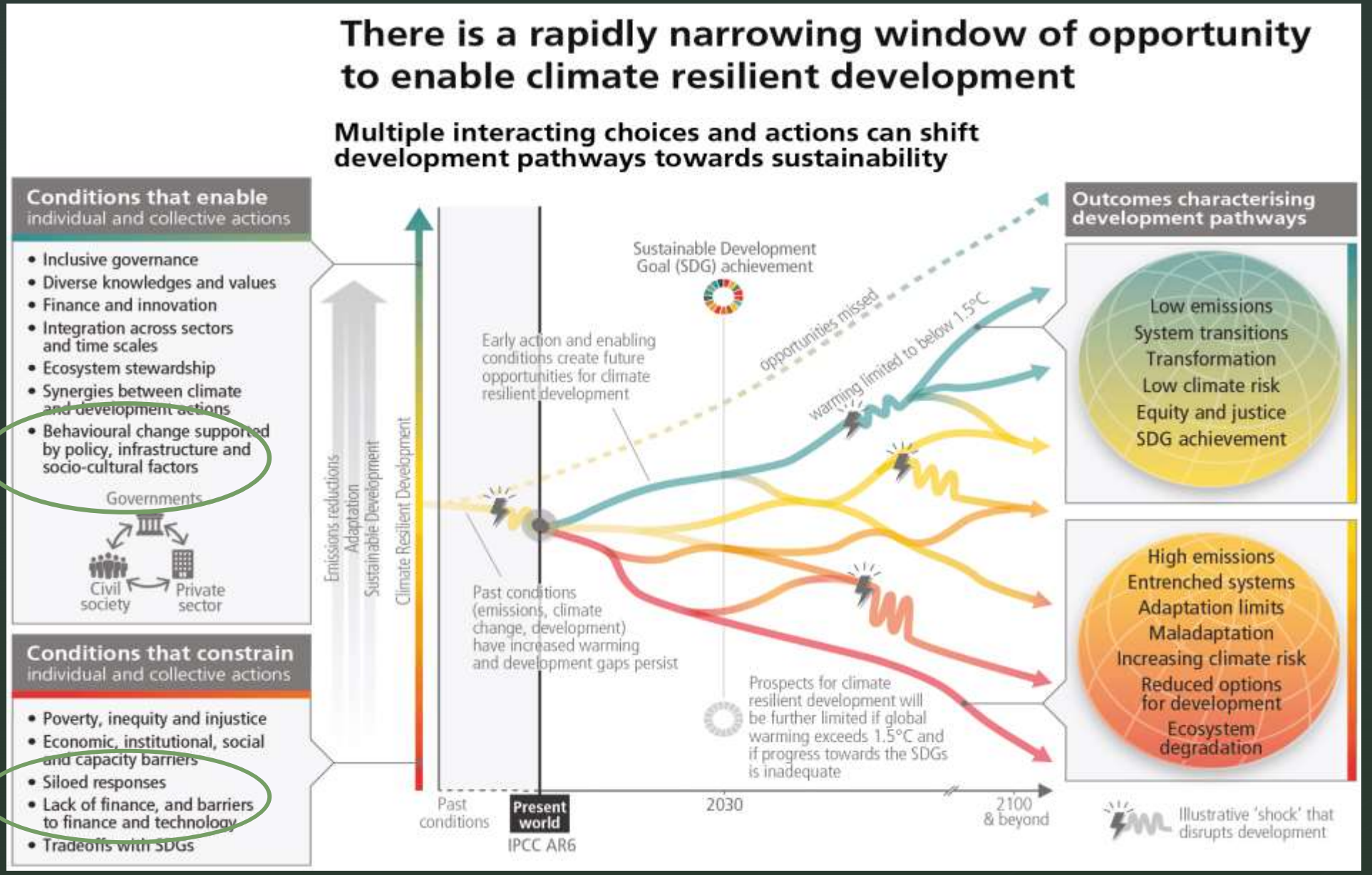
Zero Waste Utopia - Exposed

- For society it would be ideal if somehow, we could operate an economy without waste. However, Zero Waste is clearly an unattainable chimera/dream/fantasy; it is, thus, irresponsible for government to structure programs to achieve a technological and economically infeasible objective, especially if by doing so it undermines the operations of well-established and functioning existing waste management systems. Proponents of Zero Waste are challenged to offer better achievable and certainly realistic alternatives.

Zero Waste Utopia – Exposed – IPCC Conclusion



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The Problems with landfilling in the US:

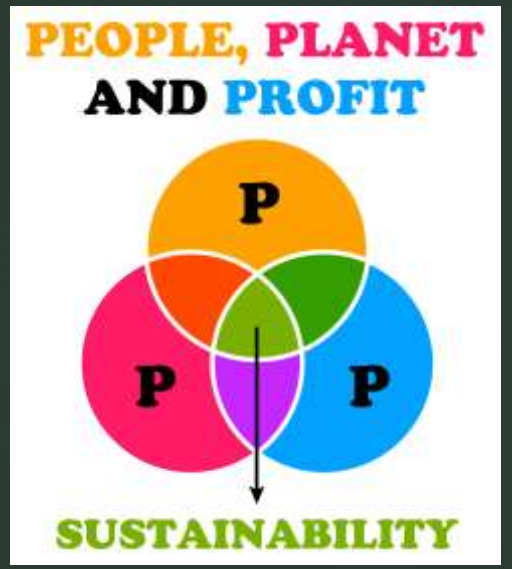
- Landfilling is too cheap!
- Externalities such as lost resources and environmental impact are not included
  - Result: Alternatives to landfilling cannot develop to offer viable solutions
  - Large amounts of recyclables were exported to countries like China -> According to Wall Street Journal and New York Times in 2014 “Waste was the largest Export commodity of the US to China” and now end up in US landfills
  - What happened once the ‘recyclables’ reached China or India or any other place that cannot even mange their own waste? There is strong evidence that a large percentage didn’t get recycled but was either burned or dumped
  - That is not Recycling… and can and should not be counted…but it was… because it made an industry look good.

Zero Waste Utopia – Real life Example

	US	Germany
1990 Recycling incl Compost %	15	15
1990 WTE %	15	15
1990 Landfill %	70	70
	Focus Zero Waste	Focus Zero Landfill
2020 Recycling incl Compost %	<20	>60
2020 WTE/ATT %	7	30
2020 Landfill %	>70	0.2
2020 GHG Reductions	-	>50M T/Y w/o Externalities
2020 Jobs Created	-	250,000
2020 Revenues Retained Annually	-	$75B
King County, WA Disposal in Landfill 2023	1M Tons for 2M people	200,000 Tons for >80M people
Average $ per Single Family H-H	400$/Y (>$50!)	350$/Y

How we do things at IeRM

- We educate and inform based on facts
- We analyze the situation and draw on our extensive network of experts to work with municipalities, government, industry and the public to plan, develop and implement solutions that we know work
- With our window to act closing fast, we try to help prepare and build necessary resource (starting with waste) infrastructures in order to best navigate the challenges of a warming planet



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The challenges that we are facing:

Where the problems start:

- Education, (flow of) Information, Media:
- Lobby & Special Interests, Data provided and controlled
- Politics – election cycles, misinformation, lack of much needed subject matter expertise, business as usual,
  - Example: King County, WA (owns a 1,000-acre landfill in operation since 1950s, Approximately 50 Mio tons of waste)
    - County Executive, Council, Staff
    - 25 years direct working experience
    - SWAC (8 years)
    - 2017 KC study (remove data from study, falsification of cost)
    - 2018 study

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2017 KC, WA study - Study Objective: Evaluate Landfilling (incl. Export) and WTE):

How Cost of an Alternative (WTE) Changed:

- Actual Cost 1Mio t/y: Approx. $900 Million
- Designed requirements in Plan adds $300 Million
- 'Oversight' Error adds $300 Million
- Newspapers added $300 Million

Actual Cost: $900 Mio vs Stated Cost: $1.8 Billion!

And yet capacity need: Approx. $350 Million (@ 70% Recycling)

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Germany:

II. German Waste Management Policies and Strategies

Basic Principles

- Waste Hierarchy Principle: waste prevention, reuse, recycling, (energetic or other) recovery, disposal
- Polluter-Pays Principle: those generating waste also pay for its treatment – this is needed in order to create necessary investments and incentivize environmentally-friendly behavior
- Precautionary Principle: the government has the duty to intervene in order to prevent possible damage to the environment/human health
- Proximity Principle: waste should be treated/disposed of as close as possible to the place of its origin in order to avoid unnecessary transportation as well as associated environmental pollution and risks
- Subsidiarity Principle: who is doing the job, depends on who is doing it best. Cost, benefit and efficiency are often determined by proximity to waste generation and treatment

USA:

Making the situation more complicated—the U.S. does not have a federal recycling program. "Recycling decision-making is currently in the hands of 20,000 communities in the U.S., all of which make their own choices about whether and what to recycle," said Kersten-Johnston. "Many stakeholders with many different interests converge around this topic and we need to find common ground and goals to avoid working against one another. That means companies coming together with communities, recyclers, haulers, manufacturers and consumers to try to make progress together."

20,000+ opportunities for lobby to influence the thought process in their favor

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Confronting overshoot: Climate change, energy and one-planet living

by William E Rees (wrees@mail.ubc.ca)
Vancouver, CANADA, May 2022

- The international community is focused on climate change as an existential threat to human civilization.
- 2. This exclusive focus is misdirected. Climate change is indeed a horrific problem, but is only one symptom of a greater truly existential threat, ecological overshoot. Overshoot means that human beings are depleting even renewable/replenishable resources faster than biophysical systems can regenerate and dumping wastes in excess of nature's assimilation capacity.
- 3. Overshoot is a meta-problem. It is the cause of climate change and numerous co-symptoms including plunging biodiversity, ocean acidification, tropical deforestation, landscape/soil degradation, contamination of food supplies, the pollution of everything, i.e., virtually all other so-called environmental problems.
- 4. Overshoot is the result of too many people consuming and polluting too much on a finite planet. It is an existential threat because continued depletion and contamination of the ecosphere is potentially fatal to human civilization on several fronts simultaneously.

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Overshoot: Cognitive obsolescence and the population conundrum

Bottom line?

- The future holds daunting prospects for humanity even in best-case scenarios. Earth will ultimately survive any human folly; the question is: will humans survive themselves?
- We cannot really see the whole picture and what we do see, we often deny;
- How many policymakers and politicians effectively ‘connect the dots’ among our many ecological and socio-political crises?
- Only serious self-examination, a colossal global exercise of consciousness-raising, clear-headed analysis of biophysical data/trends, a rethink of the economy-as-subsystem of the ecosphere and an unprecedented degree of international agreement and selfless cooperation for the common good (of humanity and nature) can succeed in taming overshoot.

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Carbon Mapper - CM

- Carbon Mapper – no relevant landfill data yet!
  - The Carbon Mapper project will conduct an initial remote-sensing survey of over 1,000 managed landfills across the United States, Canada, and other sites in Latin America, Africa, and Asia in 2023.
  - Following its first year, the Carbon Mapper team will begin a broader survey of around 10,000 landfill sites across the globe using satellites equipped with imaging spectrometer technology developed at JPL. These specially purposed Carbon Mapper spacecraft are set to launch in late 2023.
- IeRM and CM are in teaming arrangement discussions

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Politics regarding Waste

- Who is in control? Which way does the ‘Ask/Tell’ go?
- What policies are in place or needed?
- What are the True Cost – what externalities are missing?
- Best allocation of time, money, resources?
- Re-evaluate priorities
- Identify fact vs. fiction
- Ex: In the Waste Management Hierarchy are landfilling (with LFG) disposal = to WTE (recovery) -> Fiction; Fact is that WTE
- => We are running out of time as the growing number and severity environmental disasters take away much needed money for developing critical infrastructures

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Benefits for our Future

- The landfill ban of untreated waste in European Countries has resulted in the largest reduction of climate damaging gases from the waste management sector in these countries
- The landfill ban was also so first important step toward a circular economy.
- Zero Waste starts with the recognition that landfilling, especially of untreated waste, is a major obstacle for zero waste objectives and needs to be phased out the sooner the better
- An integrated waste management system including WTE is a key step in moving towards a circular economy
- Legal framework needed: No untreated waste allowed in landfill (to protect people and environment of the effects of landfilled waste).
- The strict emission standards for waste ‘incineration’ have contributed to an extraordinary reduction of environmental impacts through waste management
- => Stop landfilling of (untreated, reactive) waste asap. 2030 is tangible for most regions – planning and implementation need to happen NOW

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Thank You for Your Attention and I look forward to our discussion

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"There are some things in the world we can't change- gravity, entropy, the speed of light, and our biological nature that requires clean air, clean water, clean soil, clean energy and biodiversity for our health and well-being. Protecting the biosphere should be our highest priority or else we sicken and die. Other things, like capitalism, free enterprise, the economy, currency, the market, are not forces of nature, we invented them. They are not immutable and we can change them. It makes no sense to elevate economics above the biosphere."

David Suzuki

Editorial

WM&R

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SAGE

The Zero Waste utopia and the role of waste-to-energy

While there is no doubt that the prevention of municipal solid waste (MSW) generation should sit at the top of any public policy, industrial strategy and individual behaviour, just like reducing the consumption of energy, this proposition might mislead the public into thinking that waste can suddenly disappear if only we had the will to make it happen. Despite these unattainable expectations, the 'Zero Waste' concept has become a viral and omnipresent phrase in recent years. A Google search of this term shows around half a million hits, as of March 2020, and countless government and non-governmental organisation initiatives worldwide. Zero Waste seems to be the only acceptable aim for today's politicians who embrace an environmentally friendly platform. As a result, countries and municipalities all over the globe have committed themselves to achieving the goal of Zero Waste. So far, however, nobody has managed it, and given the many scientific and practical roadblocks, no one ever will.

In many respects, the Zero Waste concept in the waste management realm seems akin to those seeking to create a perpetual motion machine, and to sell the idea to uninformed citizens. People are fascinated by the idea because it envisages the inspiration of consuming with a good conscience, leaving no garbage behind. Several hundred years ago, they were similarly captured by the idea of producing energy from nothing, using a perpetual motion machine. While the possibility of the latter has often been debunked, the potential to attain a Zero Waste state is still too broadly accepted by citizens and their government officials.

Against this background, this editorial addresses the idea of Zero Waste and the impossibility of its realisation, as well as the essential necessity of (a certain amount of) waste generation as a consequence of economic activity and consumption, due to its function as a sink for non-recoverable toxic and harmful substances.

First, an introduction to modern waste management is given, to clearly show that even the most sophisticated and well-developed programmes for waste reduction, collection, recycling, and treatment systems for waste cannot prevent the formation of at least a moderate, if not significant, residual waste stream.

Since the Zero Waste philosophy is often grounded in ideological environmental prejudices and opposition to proven and cost-effective elements of waste management – naturally, landfills and waste-to-energy (WtE) facilities – the (mostly unsubstantiated and often willingly wrong) related arguments are reflected on in the second part.

Well-performing waste management systems rest upon three main technical pillars:

- Recycling, including composting;
- Energy recovery;
- Landfilling.

All these elements are inevitable for the effective and efficient function of the entire MSW management system, but their relative ratio can change to a very wide extent. Waste reduction and material recycling are the main targets, aimed at retaining as many resources as possible in the loop. Only those residual waste fractions which are no longer available for material utilisation should be treated in WtE plants, especially if they are harmful or hazardous. For inert and mineral waste and hazardous concentrates from other waste treatment processes, specific landfills are needed as final sinks.

Recycling

According to the European waste hierarchy, recycling is the desired treatment option for waste that cannot be prevented or directly re-used. A key prerequisite for a high-quality recycling system is the source separation of materials that have market values. Typical material streams that are collected separately in households (and, to some extent, also at commercial sites) are glass, metals, paper and cardboard, (mixed) plastics and biowaste. Recycling points offer several further separate collection systems – for example, for wood, WEEE, batteries, hazardous wastes, building materials, etc.

In well-developed waste management systems, the collection and recovery rates are high and the quality of each stream tends to be good. Nevertheless, only the recycling of glass is close to becoming unlimited, if contaminants (typically additives used to deliver a specific colour) can be kept out of the material in the long run. All other materials can only be recycled to a certain extent or up to a limited number of cycles, due to several physical and other constraints, as discussed in Rigamonti et al. (2018).

The number of recirculation cycles for paper, for example, amounts, on average, to 3.5 in Europe and only 2.4 worldwide (ERPC, 2016). After the material is utilised, the degraded short fibres that cannot be incorporated into new paper products are used as fuel, normally by combustion at the site of paper mills to supply the energy for the paper-making process (and often by co-combustion of refuse-derived fuel (RDF)). Plastics show the lowest recycling rates of all separately collected bulk materials. In part, this is due to the wide variety of plastics in commerce, only some of which are recyclable. Depending on the collection system, a high share of non-recyclable material (considered

contaminates to buyers) is collected together with the valuables. In Germany and in Italy, for example, the official input-calculated recycling rate is, therefore, high, but less than 50% of the introduced material is, in fact, recycled. So, despite the good intentions of citizens, a significant portion of the after-use materials they deposit in recycling bins ends up as waste. More than 50% are incinerated as auxiliary fuels in coal power plants as well as in cement kilns and as sorting residues in WtE plants (Consultic, 2016). On a European level, the main share of plastics is used for energy recovery (39.5%) and 30.8% is still sent to landfill (Plastics Europe, 2016).

These facts clearly show that 100% recycling has not been possible to achieve even after decades of evolution in the waste management industry, aimed at maximising diversion of wastes from WtE plants and landfills. Harmful contaminants are always collected alongside the valuables and must be segregated to protect man and the environment. Apart from glass and metals, the valuables themselves may lose their original properties and need to be excluded from the cycle. For these residuals, a safe final treatment or disposal method must be available in order to protect public health. The only options are WtE for organic substances and landfilling for minerals and hazardous residues.

WtE

The necessity of a sink for non-recyclable and harmful substances has been explained above. Therefore, WtE is a necessary and compatible partner of recycling, and not a competitor that some might claim. A modern recycling economy is reliant on ecologically friendly and affordable treatment options for the residues arising from the recycling processes.

WtE is also indispensable for the treatment of another large and problematic fraction: the residual waste. These remainders of our civilisation have to be treated in an environmentally sound manner. Modern WtE plants are the method of choice and the only reasonable option for this purpose in locations with sufficiently dense populations and with the resources and technical talent to build and operate such plants.

WtE plants are able to destroy toxic organic substances and to mineralise all organic components in the waste. This can be regarded as a 'kidney function,' which is necessary for all organisms to keep themselves healthy and functioning (Bertram, 2013). If there were no sink for these harmful substances, our society would poison itself by the concentration of toxic components in all anthropogenic mass flows and, as a result, in water, air and soil. This fundamental kidney function can be fulfilled by WtE only – mechanical or biological waste treatment options (like mechanical and/or biological treatment (MBT)) are not able to guarantee this fundamental requirement, let alone the fact that they are just an intermediate processing stage.

State of the art for WtE is the incineration in dedicated plants with energy recovery, highly sophisticated flue gas cleaning and maximum recovery of the process residues. Nevertheless, alternative thermal processes, like gasification, pyrolysis, liquefaction or plasma technologies, are often considered a better option for this purpose, because they allegedly offer higher efficiencies and, in some cases, also the possibility to produce chemicals or fuels. This is, however, not the case. It has been clearly proven that alternative thermal waste treatment processes are entirely unsuitable to treat residual waste (Quicker, 2015). Its non-homogeneous character is not appropriate for such complex approaches, however sensible they might be for industrial operations – and even assuming that the technological issues related to such non-homogeneous characteristics could be solved, one would still be confronted with lower performances and unfavourable economics (Consonni and Viganò, 2012). Only homogenous fractions with constant composition and very low impurities may be suitable input materials for these processes.

Landfilling

Landfilling sits at the lowest level of the European waste hierarchy. This means that waste fractions shall only be landfilled if they can be neither recycled nor used for energy recovery – that is, inert or mineral fractions. Even though landfilling is the least favourable option for waste treatment, it is nonetheless an indispensable element of a modern MSW management program. We need a sink for all mineral fractions that cannot be used in the cycle anymore, like polluted construction materials, contaminated soils, flue gas cleaning residues, asbestos, etc.

The preceding paragraphs make it evident that aiming for the establishment of a Zero Waste society is as impossible as the construction of a perpetual motion machine. But, in contrast to the thermodynamically impossible device, a lot of people, institutions and politicians are unwilling to accept the fact that Zero Waste is an unattainable utopia and cannot be realised in a world that operates according to the longstanding laws of physics. Nevertheless, in order to support their position and to show that Zero Waste is without alternative, its protagonists sometimes try to discredit other treatment options, especially WtE. Some of the most frequently spread myths and lies about WtE are briefly listed and refuted below.

Thesis: WtE prevents recycling

Zero Waste activists tend to claim that WtE is a competitor to recycling and subtracts recyclable materials from the cycle in order to feed the fuel needs of existing WtE installations.

In fact, the opposite is true. WtE supports recycling by two framework conditions. The first point is that recycling needs a sink for the non-recyclable residues (as previously described). The recycling system can function properly only if ecologically friendly options for the treatment of these fractions exist. The second point is an economic one. The costs for WtE are much higher than for landfilling and on a comparable level to recycling. As a result, there is no economic driver to switch valuable materials from recycling to WtE. If landfilling is the only alternative to recycling, like it is the case in many southern and south-eastern European countries, the economic incentive to divert resources,

which would otherwise be recycled, to cheap landfills is high. The relationship between landfilling, WtE and recycling in the European Union countries is well known among practitioners. It shows that those countries with a highly developed waste management system, characterised by high recycling rates, have the highest share of WtE and the lowest percentage of landfilling.

There is actually a third point worth considering. The recycling programs are far from being well established worldwide, being affected by market fluctuations as well as by specific policies such as China's 'National Sword'. This might, and already has, stress a system that can work properly only if the full value chain is operational and healthy. Being able to rely on the WtE option guarantees to deal with such situations, without the need to store huge amounts of waste materials, with a consequent risk of uncontrolled fires.

Thesis: WtE emits CO_2 and intensifies climate change

WtE is carbon neutral when it comes to the combustion of the biogenic fractions such as paper, wood, and food waste. If landfilled, the degradation of such fractions would release methane, a more significant greenhouse gas than CO_2, in situations where full capture of the landfill gas is not achievable. Obviously, the combustion of waste plastics will release fossil CO_2, but the saved emissions from the displaced fossil fuels are offsetting, and this is especially relevant for high-efficient WtE facilities. Moreover, the recycling of low-quality mixed plastics streams, whenever that it is feasible, will hardly deliver a favourable greenhouse gas balance. Finally, in case a carbon capture and storage system is put in place at WtE facilities, they would become carbon negative!

Thesis: MBT is the better alternative

It is difficult, if not impossible, to establish a fair comparison between MBT and WtE, since the former is just a pre-treatment process that generates a number of outputs (as high as 80–90% in mass of the input), which require subsequent processing such as energy recovery, whether in a WtE plant or in co-combustion. Co-combustion in cement kilns is a fascinating option, but it can hardly be a structural one because, among others, of the reliance on a private sector that might be subject to market fluctuations and different dynamics. Moreover, MBT is not able to destroy toxic organic substances or to concentrate harmful inorganic ones – that is, it cannot act as a sink for pollutants.

Thesis: WtE affects the environment and human health by harmful pollutants

There is a general consensus that WtE has the lowest emission limits among all industrial facilities and WtE plants normally perform much better by orders of magnitude, sometimes even below the detection threshold of the instruments. WtE plants are the best monitored combustion plants, with atmospheric emissions continuously controlled and publicly reported. The effect of the residual emissions on the air quality is negligible, when compared, for instance, with the traffic emissions in surrounding areas (Lonati et al., 2019). Also, in comparison with landfills, the gaseous and liquid emissions from the latter are much more difficult to capture and contain.

Thesis: WtE is an extremely inefficient way of producing energy

Significant improvements have been achieved in recent years on the energy recovery efficiency of WtE plants. Large plants that produce only electricity can attain net efficiencies not too far from 30% – an impressive performance for a process where the waste-as-fuel input is very inhomogeneous and typically has a low heating value (lower than, say, coal) – a performance definitely higher than that achieved by small-scale biomass-fired plants. In addition, the combined heat and power operation is becoming mainstream, whether taking place at the service of district heating networks or of industrial facilities, yielding first-law efficiencies (sum of electric and thermal efficiency) of 80% and more.

The authors fully agree that society would be ideal if somehow we could operate an economy without waste. However, Zero Waste is clearly an unattainable chimera; it is, thus, irresponsible for government to structure programs to achieve a technological and economically infeasible objective, especially if by doing so it undermines the operations of well-established and functioning existing waste management systems. Proponents of Zero Waste are challenged to offer better achievable and certainly realistic alternatives.

The vital need of effective systems for dealing with residual waste streams, which include sinks for residuals, is demonstrated by the recent outbreak of Coronavirus, which is peaking as we compose this Editorial. For example, huge amounts of single-use, potentially contaminated items used to test for and treat COVID-19 patients are currently flooding the waste management system in many countries, and will do so whenever similar emergencies emerge in the future. The waste management sector must be structurally well prepared to effectively deal with such materials via combustion and secure landfilling when waste reduction and recycling alone cannot ensure the protection of public health and the environment.

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Dear Maui Ohana,

Thank you for inviting us to speak today. My name is Jim Holm.
I go by Homer.
I speak with love for Lahaina, having learned my craft as a commercial boat captain there in the 70s and 80s.
I have friends living there, and we also lost friends in the fire.

I represent Clean Oceans International (COI), an environmental non-profit in Santa Cruz, California, working to reduce ocean plastic.
We offer our sympathy for what you are enduring and respect your need to rebuild your lives as soon as possible.

I can't offer a miracle technology to treat the toxic ash and render it safe. However, we offer what we do have in the hope it helps Maui.

COI promotes "Portable Plastic Waste Conversion" (PPWC) to manage most plastic rubbish. Unlike mechanical plastic recycling, at the conclusion of PPWC, the plastic is actually gone, and in its place is a valuable diesel fuel additive to supplement existing supplies.

PPWC converts 10 lbs of plastic into one gallon of diesel fuel for pennies of energy and creates 14% less carbon in the process. Our partners at Oregon State University School of Chemical, Biological and Environmental Engineering, and PDO Technologies, of Brooks, Oregon, can provide technical details on this process. In the long cleanup and rebuilding process the ability to convert a waste management challenge into fuel that supports your efforts while reducing your costs can be a valuable contribution for years to come.

As a gesture of solidarity, COI's partner, PDO Technologies, is offering to donate PPWC systems to MAUI. These could be set up and running within a few months of a decision. If invited to participate, COI is offering to work hand in hand with the Maui County administration to secure funding, and provide design, installation, and operational assistance during the time required for Central Maui Landfill Staff to take over operations in situ.

This letter is light on technical and cost analysis, so here are links to our COI webpage and PPWC Frequently Asked Questions. We are available to provide further details and answer questions. We invite the Maui County Council to send representatives to our partner facilities in Oregon to further understand the scale, simplicity, and efficacy of Portable Plastic Waste Conversion operations.

While doing homework to understand the current situation on Maui, we gained a better understanding of the principal challenges and concerns of displaced residents and their neighbors. This leads to a suggestion regarding cleanup logistics.

Lahaina residents need to return to their property at the earliest safe opportunity. There are profound benefits to adopting some changes to the ash removal process that increase the speed of removing, transferring, and storing debris while reducing some economic and environmental impacts. These do not impede ongoing efforts during setup and will dramatically expedite cleanup when operational.

We also understand the importance of honoring the culture and spirit of Hawaii, and the desire for disposition of ash on Maui soil, to respect the remains of lost relatives. Our proposal provides time for everyone to agree on the best way to process ash efficiently and respectfully.

From an environmental view, temporarily containing toxic debris in a landfill is a concern. This is dramatically different impact than a few cars a day over so many years. This is an enormous quantity of toxic stew deposited as quickly as possible in a bowl. Rainwater absorbs toxins from debris during the inevitable filling of the impermeable membrane. If the membrane is not collecting water then it is already draining into the earth and downhill into the island's premier coral reef destination. Maui’s visitor economy depends on a pristine environment and the highest standards are essential to protect marine life, the heartbeat of Maui tourism.

Our suggestion responds to Maui Council's stated concerns. Speedy cleanup, daytime traffic impacts and environmental concerns by

cleaning numerous sites at once during the day, moving prefilled containers at night and avoid handling and transporting debris twice, which costs more and increases the opportunity for leakage.

From an economic perspective, human interaction is always the largest economic component of any job and efficiency is valuable. Currently, trucks are loaded one at a time at each job site in Lahaina during daylight hours, then join the traffic stream to and from Olowalu.

We suggest using small, skid steer machines to simultaneously load multiple shipping containers at numerous locations during each work day. Containers are staged, then moved to CML, at night, and stored until a suitable technology is decided upon for the respectful handling of the ash. Full containers are exchanged for empty ones to replenish stockpiles at the staging area to be distributed to jobsites the next day. This way 25 sites could be cleared at a time with no pause for truck exchange. Debris at Olowalu could also be moved much sooner.

Central Maui Landfill (CML) can house a large number of containers that can withstand decades outdoors protecting their contents. The estimate of 400,000 cu yards of debris will cover 17 acres if stored two containers high. This is less than 1% of CML acreage.

When agreement on final disposition of ash is made containers can be processed inside a purpose-built structure to protect the environment. CML is also the most convenient location for refueling transport vehicles or tankers serving the skid steer army working in Lahaina.

If the Council wishes to investigate this option we are available for further conversation.

Thank you for your time.

Jim Holm

These are relevant #s to consider.

These calculations are based on a number we took from an information video, for conversation's sake: The size of the cleanup in question is 400,000 cu yards.

Volume of ash to be removed, contained, transported and stored.= 400,000 cu yds
40 x 8 x 8 container = 87 cu yds = # of containers needed for Lahaina - 4,600
Est cost of new container $4000 ea, 5000 containers @ $4000 ea = $20MM.

Transport from Lah to CML, no idle time for offloading, 17 mi ea way, 40 min RT X time.

Time used for:
Cover tarping each day to avoid excessive plastic or loss in the wind or rain.
Cost of design and build of collected water evacuation and filtration system for contaminated water handling. Cost of repair filtration system in storm conditions.
If storm conditions prevail transport can delay for safety w/o risking cargo spoilage.

Containers can stage at Pioneer Mill area, tractors preload for 6 min stage release to facilitate orderly discharge @CML

6 min per truck = 10 trucks per hour potential, x 12am to 6am, (6Hr) = 60 trucks/nite
5000 containers @ 60/night = 83 nites, /30 = less than three months. To remove and store the ash from Lahaina.

90 nights to remove the debris, 2200 structures = 24 lots per day
30 working vehicle per day needs 25% cushion = 7.5 extra = 10 extra = 40 Skid Steer

40 @ $50k = $2,000,000 + operations $500000 = $2.5MM
$50/HR X 50 PX/DY = $25k dy + $10k/dy Admin = $35k/dy x 90 dy = $2,160,000

5000 containers, $20MM resell for $7MM	$13MM
40 Bobcats @ $50k/ea = $2MM + parts $500k =	$2.5MM (sell for $1,0MM)
$60 people @ $50/hr x 8hr dy x 120 dy	$3,600,000

Extra Fuel 35 mi @ 5mpg = 7 gal/RT, x 60 LPN = 420 gal fuel/dy RT to CML
420 gal @ $6 gal = $2520/day x 90day = $226,800 Extra fuel

After cleanup there will be an army of equipment operators and 40 skid steers avail for rebuilding work and personal professional landscaping maint companies afterward.