DRIP Committee

From:	Tamara A. Paltin
Sent:	Friday, March 1, 2024 12:12 PM
To:	DRIP Committee
Subject:	FW: Greetings from Seattle - Short and long term solutions, approach to Ash Management, Circular Economy, Waste Management, Renewable Energy - IeRM
Attachments:	Presentation to the Disaster, Resilience International Affairs, and Planning Committee (2023-2025) 2-21-2024.docx; Zero Waste Utopia - Peter Quicker 5-2020.pdf; Copy of Side by Side WTE technology comparsion - KC 2017 Report - Revised Table add Pyrolysis PSP 4-2019[1].xlsx; It's time to stop wasting our waste.pdf

For upload to the alternative debris solutions

From: Philipp Schmidt-Pathmann <psp@ie-rm.org>
Sent: Friday, March 1, 2024 10:26 AM
To: Tamara A. Paltin <Tamara.Paltin@mauicounty.us>
Subject: Greetings from Seattle - Short and long term solutions, approach to Ash Management, Circular Economy, Waste Management, Renewable Energy - IeRM

Dear Honorable Councilmember Paltin,

My name is Philipp Schmidt-Pathmann, President and CEO of the Institute for Energy and Resource Management (IeRM) in Seattle. IeRM is a non-profit, 501c3 organization that works to promote a more responsible waste management policy throughout the United States. Our goal is an Integrated Waste Management System, making maximum use of scarce resources, minimizing methane and CO_2 emissions, and preventing other harmful environmental effects, as well as saving municipal governments and taxpayers from ever-increasing disposal fees.

IeRM was contacted in December of 2023 by a group of concerned individuals who were trying to determine the most efficacious way of disposing of the ash from the devastating fires in Lahaina. While this is an important issue, it became apparent that the problem was larger than just the short-term question. Once the sites are cleared and rebuilding starts, the management of waste in the long term, for the entire island, will be a much larger challenge.

At the suggestion of this group, we are reaching out to you to offer our services in developing a solid waste management plan that provides for a cleaner, cheaper, and more sustainable future. As a non-profit organization, we have no vested interest in any technologies or methods, but we do have, collectively, hundreds of years of experience in developing and managing more efficient solid waste systems. Over the next several months you will be called upon to make decisions about waste management policies and technologies, decisions which will have a profound impact on the environment and the economy of the island. Because of our extensive experience in this field, we can work with you to help reach your goals.

Attached are my presentation to the DRIP Committee from February 21, as well as some other background materials. You can also learn more about us on our website, www.ie-rm.org. We look forward to connecting with you soon.

Sincerely,

Philipp Schmidt-Pathmann
+1-206-313-9774

Per Microsoft Teams via Telephone 2-21-2023
From Philipp Schmidt-Pathmann,
CEO and President of The Institute for Energy and Resource Management - IeRM
-Updated-

Good afternoon honorable DRIP Committee Members, Aloha from Seattle.

Loosing family, friends and homes is devastating, and you have my deepest sympathy and condolences for your losses.
And now you are left with the challenge "What is Next" is especially difficult and I am sure there are more questions than answers.

My name is Philipp Schmidt-Pathmann. I came to the US from Hamburg, Germany over 30 years ago to attend University. I have a BA in Economics and an MBA and an MIS.
I maintain a very close relationship to Germany for family and for work. For the past 26 years, I have been in the field of resource management with a specific emphasize on how best to manage the waste we produce.
I have seen a lot of injustice and decisions that were made based on short term gains of special interests and not for long term economic AND environmental reasons taking into consideration the ones who are affected most – the public.

To make a stand, create awareness and to offer alternative solutions that are proven to work economically AS WELL AS environmentally I cofounded the Institute for Energy and Resource Management (IeRM) in October 2021. Half of our board members are in Europe the other half is in the US. IeRM is a 501c3 non-profit organization to educate and provide scientific research and expertise, which includes navigating challenging processes specifically how to manage waste.

We are a team of leading experts and specialists from universities, institutes, authorities, and similar institutions. We bring our expertise and proven track record to educate, to correct false information, and to counter special interests, so that corrective actions protecting people, the environment, and the economy can be taken. We work independent from technology providers.

Based on our extensive experience (worldwide) and our overall scientific and economic expertise, we have concluded that as long as we continue to rely on landfilling, as we have been in the US, we will never reach a circular economy nor will we be able to achieve meaningful quality recycling and composting, waste reduction or avoidance objectives.

"Because of the serious and immediate threat that landfills pose to the climate and the environment, and because little is being done in the public sector to counter this threat, IeRM has made the elimination of landfilling municipal and similar reactive wastes by 2030 our top priority.” The goal is to replace landfilling with an integrated waste management system prioritizing the international waste management hierarchy.

IeRM’s mission is to provide reliable research for the purpose of finding and implementing sustainable solutions to society's energy and resource management challenges. At IeRM we seek the continuous development and use of technologies and practices that will enable us to significantly reduce the human impacts on the natural environment.
IeRM connects scientific research with business and policy solutions in order to serve the best interests of the public in moving toward a sustainable economic future.

You can find all about us on our website at www.ie-rm.org

How can we at IeRM help this process and find the best way forward?

Out of principle, we are technology independent and do not provide a technology. We are not affiliated with any of the technologies you are hearing about today.

1) We have been involved in the discussion about “what to do with the Ash” for about 2 months now. As we understand there are two issue - the most important one moving forward and rebuilding. In order to do so, we offer our expertise in evaluating on how best to move forward with the ash as there are a number of options on the table.
   For consideration, a beneficial approach would be to prepare (crushing) the ash via shredder with air extraction (operation in negative pressure) and filtering of the exhaust air, a protective hall with appropriate suction and filtering of the exhaust air would be recommended to minimize environmental impact. The materials then could be sorted and appropriately processed. IeRM could help you navigate and implement this process.

2) For the second part in the rebuilding process, we offer our expertise in helping the people of Maui navigate towards a sustainable future (I hope I am saying this correctly) in the direction of AHU PUA’A – to assist in moving Maui towards a sustainability and a circular economy. To big question is how to deal with the huge amount of waste that is already in the landfills as well as finding alternatives to the current landfill approach. And as part of AHU PUA’A investigate options to replacing the energy dependance on fossil fuels with renewables. One of our German colleagues, Mr. Guenter Moegele, Vice Mayor from the Energy Town of Wildpoldsried in Southern Germany, has been consulting Siemens in similar undertakings currently taking place in Oahu.

   Please also see the PPT that was forwarded to you by Spencer Headley yesterday titled **It’s time to stop wasting our waste**, which I presented April last year at the Academy for Lifelong Learning. It was submitted together with the Editorial **The Zero Waste Utopia**. Please reach out to me if you have any questions about wither one. In this PPT you will find many topics discussed pertaining waste management and comparing the Country of Germany, 3rd, largest economy in the world and the US 2nd largest focus waste.

a. For the past 26 years my EU colleagues and I have analyzed and studied the US waste management system. The problem with landfilling is that they are artificially cheap – they are subsidized by not incorporating the true cost such as true environmental impact, long term maintenance, lost resources etc.
b. The only way to start moving towards a circular economy is first and foremost to stop landfilling untreated still reactive waste. A cost-effective proven method is the implementation of an **Integrated Solid Waste Management System** – such a system has been adopted by a number of countries in Europe with a successful track record dating back 20 years.

   If desired, we can make arrangements for you, the Councilmembers, public representatives, environmental leaders and other relevant and interested parties to see these programs in action and/or speak with the officials. In the past 20 years I have taken 10 delegations from the US to Europe.

   The Europeans have passed laws that require all EU countries to phase out landfilling of untreated still reactive (like MSW) waste. 16 Countries have nearly achieved that including Germany, Sweden, Denmark, Austria etc. landfilling less than 5%. Germany, currently the 3rd. largest economy in the world landfills less than 1% and all pretreated waste with a Total Organic Carbon (TOC) of less than 3%. The recycling-composting rate is tangible at over 64% - that is quality recycling working with manufactures to be able to reuse the materials making new products and working with farmers to be able to use quality (free of contamination - no glass, plastic, batteries etc.) compost in for example agriculture. About 30% are send to thermal treatment with energy and material recovery being able to send less than 1% to landfill effectively destroying the toxic organics. Note: The EU decided to require its member countries to phase out landfilling due to the environmental impacts of landfills, not due to space limitations.
c. Landfills are the worst solution when dealing with waste and leave a legacy of pollution at an exponential cost. – There is nothing sustainable about landfilling. Sanitary landfills are an oxymoron – meaning no landfill is sanitary – just an acronym used by the landfill industry trying to justify landfilling.
d. Mining landfilling is also an option that should be explored.

One of our board members (Dr. Weltzin) is the current scientific advisor for Germany moving toward a circular economy. Another (Dr. Schnurer) is the former head of the federal ministry of the environment overseeing the move away from landfilling towards an IWMS. Another (Mr. Rosendahl) is the vice chair for landfilling at ISWA, the international solid waste association (from Denmark).

One of our partners, HiiCCE, is the Consulting arm of the Sanitation Department of the City State of Hamburg, Germany. Hamburg has been a zero waste to landfill City/State

since 1999 and has over 100 years of waste management experience. Hamburg has nearly 2 million people inhabitants.
And many others like the Oeko-institute, IFEU-Institute and many others not listed on our website.

We have close ties to Wildpoldsried, which for the past 15 years has taken a spotlight in being energy independent, producing 800% more energy than they use. The vice major who is credited with making this happen, is frequently invited across the world to work with communities to share his knowledge and insights to help identify ways to become energy independent – specifically Island communities such as Maui.

We would like to work with you and the people of Maui if you chose to do so.
We are here to listen, incorporate our extensive network of experts (many in Europe) and work with you to building a sustainable way forward navigating challenges, systems, technologies, facts vs fiction, that is grounded on decades of hands-on experience, working in the best interest of the people.

You can find more information on our website www@ie.rm.org
Thank you and Mahalo.

Editorial

WM&R

Waste Management & Research
2020, Vol. 38(5) 481–484

DOI: 10.1177/0734242X20918453
journals.sagepub.com/home/wmr
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.

References

Bertram (2013) Ist eine Null-Abfall-Gesellschaft erstrebenswert? In: Thomé-Kozmiensky K and Verstyl A (eds) *Strategie Planung Umweltrecht, Band 7*. Neuruppin: TK Verlag Karl Thomé-Kozmiensky, pp. 171–206. Available at: https://www.vivis.de/wp-content/uploads/SPU7/2013_SPU_171_206_Bertram (accessed 8 April 2020).

Consonni S and Viganò F (2012) Waste gasification vs. conventional waste-to-energy: A comparative evaluation of two commercial technologies. *Waste Management* 32: 653–666.

Consultic (2016) Produktion, Verarbeitung und Verwertung von Kunststoffen in Deutschland 2015 – Kurzfassung. Available at: http://www.bkv-gmbh.de/fileadmin/documents/Studien/Consultic_2015__23.09.2016__Kurzfassung.pdf (accessed 8 April 2020).

ERPC (2016) European Recovered Paper Council: Paper recycling – European Declaration on Paper Recycling 2011-2015. Available at:

http://www.cepi.org/system/files/public/documents/publications/recycling/2016/FinalMonitoringReport2015.pdf (accessed 8 April 2020).

Lonati G, Cambiaghi A and Cernuschi S (2019) The actual impact of waste-to-energy plant emissions on air quality: A case study from northern Italy. *Detritus* 6: 77–84.

Plastics Europe (2016) Plastics – the facts 2016. An analysis of European plastics production, demand and waste data. Available at: https://www.plasticseurope.org/application/files/4315/1310/4805/plastic-the-fact-2016.pdf (accessed 8 April 2020).

Quicker P, Neuerburg F, Noël Y, et al. (2015) Status of alternative techniques for thermal waste treatment, expert report for the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, project no. Z6–30345/18. Report no. 29217. English translation: B r, H. Rheinisch-Westfälische Technische Hochschule Aachen Unit of Technology of Fuels (TEER) Wüllnerstraße 2 52062 Aachen.

Rigamonti L, Niero M, Haupt M, et al. (2018) Recycling processes and quality of secondary materials: Food for thought for waste-management-oriented life cycle assessment studies. *Waste Management* 76: 261–265.

Peter Quicker
Unit of Technology of Fuels
RWTH Aachen University
Email: quicker@teer.rwth-aachen.de

Stefano Consonni
MatER (Material and Energy from Refuse) Research Center
Politecnico di Milano
Email: stefano.consonni@polimi.it

Mario Grosso
MatER (Material and Energy from Refuse) Research Center
AWARE (Assessment on WAste and REsources) Research Group
Politecnico di Milano
Email: mario.grosso@polimi.it

Table 3-1 Waste-To-Energy Evaluation Matrix - King County Waste-to-Energy Study

Criteria Number	Criteria Description (Major / Minor)	Score (points)	WTE	Refuse Derived Fuel (RDF) WTE	Advanced Thermal Recycling (ATR)	Thermal Gasification WTE	Pyrolysis	Plasma Arc Gasification WTE	Biochemical Waste-to-Biofuels	Thermochemical Waste-to-Biofuels	Kiln	Comments
1.0	State of Technology Score	15	15	15	15	5	5	3	5	3	12	
	Degree to which entire system has been proven on a commercial scale		Commercially proven over past 50 years	Commercially proven over past 25 years at numerous plants	Commercially proven in Europe since 1999 at MVR facility in Hamburg Germany	Limited commercial experience with MSW in Asia over past 10 years	Only one facility ever operaterd at a very high cost and was shut down (in Burgau Germany)	Pilot scale experience with RDF only	Pilot scale with select waste feedstocks only, Ineos Facility in Florida shutdown end of 2016	Pilot scale with select waste feedstocks only, Enerkem facility in Canada in startup phase for 2 yrs.	One cement plant using RDF (SpecFUEL) in the US since 2015 and several in Europe	Identify status of technology: Bench Scale, Pilot Scale , Demonstration Scale (0-3 years), or Commercially Proven (+ 3 years)
	Operating history / availability		Yes, well proven at > 60 plants in US and over 1,000 plants world wide	~ 5 RDF processing and 5 RDF processing / WTE plants in US	Two EU facilites. ATR is in essence the same as WTE	No commercial experience with MSW in the US	Only one facility every operated. Closed due to economical reasons and high carbon content	No commercial experience with MSW in the US	No commercial experience with MSW in the US	No commercial experience with MSW in the US	One cement plant using RDF (SpecFuel) as a fuel in the US since 2015 and several in Europe	How many operational plants and years of successful operation have been recorded?
	Freedom from high risk failure modes		Yes, mature industry has fully addressed high risks via design codes and operational procedures	High potential for shredder explosions has been observed	Yes. Same as WTE, with additional processes to improve energy recovery and residual efficiencies.	Potential for release of carbon monoxide syngas is dependent upon successful operation of bypass flares	Uncertain, and requires extensive, expensive and energy consuming fluegas cleaning technologies. Energy effciency gets less over time.	Uncertain, molten materials inside reactor present some degree of risk	Uncertain, liquid fuels must be safely stored	Uncertain, liquid fuels must be safely stored	Fully dependent on the financial viability of the cement plant	Are there identified problem areas with mitigation measures implemented to prevent high risk failure modes?
	Demonstrated reliability of entire system		Yes, > 90% typical plant availability, many facilities 20-25 years old available 92-95%	Yes, high reliability (87.5%) has been demonstrated	Yes, high reliability in the EU with 18 years of operations, 92 - 95 percent annual availability	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	No commercial experience with MSW in the US	No commercial experience with MSW in the US	No commercial experience with MSW in the US	One cement plant using RDF (SpecFUEL) in the US since 2015 and several in Europe	What is the capacity and throughput (small, medium, large), and historical system and component annual availability (0-100%)?
2.0	Technical Performance Score	10	9	7	9	4	4	4	4	5	7	
	Compatibility with full spectrum of King County waste tonnage (volume and composition)		Yes, with limited percentage of tires and WWTP biosolids (although not currently considered by King County), except, e-waste, HHW, treated lumber, mercury containing devices	Yes, except numerous non-processible materials removed prior to combustion and disposed of in landfill and/or send to WTE facility	Yes, with limited percentage of tires and WWTP biosolids (although not currently considered by King County), except, e-waste, HHW, treated lumber, mercury containing devices	No - Process requires substantial amount of pretreatment. Process does not work with Heteregeneous waste - needs to be homogenized / presorted	No - Process requires substantial amount of pretreatment. Process does not work with Heteregeneous waste - needs to be homogenized / presorted	No - Process requires substantial amount of pretreatment. Process does not work with Heteregeneous waste - needs to be homogenized / presorted	No - Process is limited to cellulosic wastes (paper, cardboard, vegetative, and wood wastes)	No - Process prefers dry wastes, primarily limited to cellulosic wastes (paper, cardboard, vegetative, and wood wastes) and plastics	No - RDF processing prefers dry wastes, primarily limited to cellulosic wastes (paper, cardboard, vegetative, and wood wastes) and plastics	Is the process compatible with the full spectrum of potential needs (residential, commercial, and industrial MSW; household hazardous waste, construction and demolition waste, medical wastes, electronic wastes, WWTP biosolids, special wastes (asbestos, carpet, shingles, tires, used oils, etc.)?
	Ability to produce marketable byproducts		Yes, gross electricity (+600 kWh/ton), steam, hot water, ferrous and non-ferrous metals, aggregates which can be used as daily LF cover (although not currently permitted in WA)	Yes, electricity, steam, hot water, ferrous and non-ferrous metal, and aggregates which can be used as daily LF cover (although not currently permitted in WA)	Yes, electricity, steam, hot water, ferrous and non-ferrous metal, chemicals, minerals, gypsum, hydrochloric acid, bottom ash (separate from fly and boiler ash) proven uses as an aggregate, permiting expected in WA State	Very limited information available	Very limited information available	Very limited information available	Limited, electricity, liquid fuels, and chemicals	Yes, electricity, liquid fuels, and chemicals	The RDF produced becomes part of the fuel for a cement kiln (reduces coal use)	Does the process produce a viable commodity that can be sold to a large local or regional market? What type of other marketable by-products are produced?
	Need for pre-processing		No, other than removal of a small percentage of bulky, and non-processible items (typically < 1% of waste delivered, but could be as high as 4.9 percent in King County)	Yes, the RDF process has to extract metals, glass, PVC and inert materials then creates a RDF for combustion, with typical 30% sent to landfill	No, other than removal of bulky and non-processible items	Yes, gasification typically requires pre-sorting for removal of metals, glass, and inerts, although Thermoselect process can process MSW less than 2' dimension	Yes, pyrolysis requires extenive preprocessing - single stream homogenous preshreddered materials only	Yes, gasification process is not well suited for high moisture materials, and generally prefers removal of metals, glass, and inerts	Yes, process will require select wastes which are reduced in size and screened of inerts	Yes, process will require select wastes which are reduced in size and screened of inerts	Yes, process will require select wastes which are reduced in size and screened of inerts	Does the process require source separation, sorting, or sizing, and what % of waste is bypassed to landfill?
3.0	Technical Resources	5	5	4	5	1	1	1	1	1	3	
	Proven contractor experience in waste processing		Yes, 3 major, 3 minor, domestic private firms, 9 public in US (B&W, Covanta and Wheelabrator)	Yes, 3 major domestic, 3 minor firms, 1 public in US (Covanta, B&W, Xcel Energy, Great River)	Yes - Contractor has proven experience with underlying technology though not one contractor and vendor in the US with proven experience in the advanced efficiency technologies	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	One cement plant using RDF (SpecFUEL) in the US since 2015 and several in Europe	Does the proposer have direct and applicable experience in the receipt, storage, handling, and processing of MSW?
	Proximity of technical support		US based vendors, often located regionally at WTE facilities with industry crossover	US based vendors, often located regionally at WTE facilities with industry crossover	Uncertain, pilot scale (advanced metals recovery) only.	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Fair technical support for RDF processing and fair support for using RDF in a cement kiln	Does the proposer have local resources to provide on-going technical support of the process, or will the support be located in the US or Offshore?
	Availability to provide support on continuing basis		US based vendors, often located regionally at WTE facilities with industry crossover	US based vendors, often located regionally at WTE facilities with industry crossover	Uncertain, no one primary vendor with experience in managing ATR	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Fair technical support for RDF processing and fair support for using RDF in a cement kiln	Is there one "key project leader" without whom the project may fail, or does a broader team exist that can sustain the project if one or more project leaders leave?
4.0	Facility Siting and Public Acceptance Score	5	4	4	4	4	4	4	3	3	5	
	Acceptable site		Yes, typically located in urban settings, at landfills, adjacent to WWTP facilities, or within industrial areas	Yes, typically located at landfills, adjacent to WWTP facilities, or within industrial areas	Yes, location as any other WTE facility: located in industrial areas, urban settings, at landfills, adjacent to WWTP facilities, near district heating systems	Yes, typically located at landfills, adjacent to WWTP facilities, or within industrial areas	Yes, typically located at landfills, adjacent to WWTP facilities, or within industrial areas	Yes, typically located at landfills, adjacent to WWTP facilities, or within industrial areas	May require special zoning for refinery process	May require special zoning for refinery process	May require special zoning but may not be required if the RDF plant is located at the cement plant	Is there adequate acreage, adequate buffer, acceptable zoning, ability to be rezoned, or is the proposed process better suited for an alternate location?
	Synergy with adjacent activities		Yes, use of reclaimed water, and sale of steam and electricity is common, internal use of electricity may be possible	Yes, use of reclaimed water, and sale of steam is common, internal use of electricity may be possible	Yes, use of reclaimed water, and sale of steam and electricity is common, internal use of electricity may be possible	Yes, use of reclaimed water, and sale of steam, internal use of electricity may be possible	Yes, internal use of electricity may be possible	Yes, use of reclaimed water, and sale of steam, internal use of electricity may be possible	Yes, use of reclaimed water, and sale of steam, internal use of electricity and biofuels may be possible	Yes, use of reclaimed water, and sale of steam, internal use of electricity and biofuels may be possible	Excellent integration of the RDF plant with the cement plant	Is the process able to take advantage of adjacent activities in a synergistic way, such as sale of electric hot water, or steam?
	Adequate utilities		Site specific, typically requires potable, process, sanitary / wastewater, and natural gas (if available)	Site specific, typically requires potable, process, sanitary / wastewater, and natural gas (if available)	Site specific, typically requires potable, process, sanitary / wastewater, and natural gas (if available)	Site specific, typically requires potable, process, sanitary / wastewater, and natural gas (if available)	Site specific, typically requires potable, process, sanitary / wastewater, and natural gas (if available)	Site specific, typically requires potable, process, sanitary / wastewater, and natural gas (if available)	Site specific, typically requires potable, process, sanitary / wastewater, and natural gas (if available)	Site specific, typically requires potable, process, sanitary / wastewater, and natural gas (if available)	Site specific, typically requires potable, process, sanitary / wastewater, and natural gas (if available)	Are adequate water, wastewater, reclaimed water, and natural gas utilities available to the existing site, or will new or increased capacity be required?
	Adequate / affordable electric interconnection		Site specific, facility generally within 3 miles of utility substation	Site specific, facility generally within 3 miles of utility substation	Site specific, facility generally within 3 miles of utility substation	Site specific, facility generally within 3 miles of utility substation	Site specific, facility generally within 3 miles of utility substation	Site specific, facility generally within 3 miles of utility substation	Site specific, facility generally within 3 miles of utility substation, if electricity is to be sold	Site specific, facility generally within 3 miles of utility substation, if electricity is to be sold	Site specific, facility generally within 3 miles of utility substation but may not be an issue if the RDF plant is located at the cement plant	Does the proposed site allow acceptable electric interconnection to a nearby utility substation, or will new transmission lines and switchgear be required?
	Synergy with local infrastructure		Yes, requires accessible via major highways, occasionally served by rail service	Yes, requires accessible via major highways, occasionally with rail service	Yes, requires accessible via major highways, occasionally with rail service	Yes, requires accessible via major highways, occasionally with rail service	Yes, requires accessible via major highways, occasionally with rail service	Yes, requires accessible via major highways, occasionally with rail service	Yes, requires accessible via major highways, occasionally with rail service	Yes, requires accessible via major highways, occasionally with rail service	Yes, requires accessible via major highways, occasionally with rail service	Will the local roads be adequate for the project, or will new transfer stations, transfer trucks, or other infrastructure improvements be required?
	Public acceptance (note that public acceptance is difficult to assess and strongly dependet upon the project site and neighboring development)		Yes, many modern WTE with advanced combustion and flue gas controls are located in urban areas close to population centers. Some were originally rural areas, and neighboring development came later.	Yes, requires greater buffer area due to odors, unless odor treatment system is employed	Uncertain. While the underlying technological premise is similar to mass-burn. There has been no US experience in ATR.	Uncertain, requires greater buffer area due to odors from RDF process, and perceived issues with carbon monoxide gas and explosions	Uncertain, requires greater buffer area due to odors from preprocessing, and perceived issues with carbon monoxide gas and explosions	Uncertain, requires greater buffer area due to odors from RDF process, and perceived issues with carbon monoxide gas and explosions	Uncertain, odors and storage of ethanol may present public opposition	Uncertain, odors and storage of ethanol may present public opposition	Yes, requires greater buffer area due to odors, unless odor treatment system is employed	Will the process be acceptable to local residential, business, environmental and civic groups?
	Local economic impacts		Positive, well paying construction, O&M jobs, positive economic ripple effect over long-term operation	Positive, well paying construction, O&M jobs, positive economic ripple effect over long-term operation	Uncertain. While the underlying technological premise is similar to mass-burn. There has been no US experience in ATR.	Positive, well paying construction, O&M jobs, questionable positive economic ripple effect over long-term due to lack of operational reliance	Positive, well paying construction, O&M jobs, questionable positive economic ripple effect over long-term due to lack of operational reliance	Positive, well paying construction, O&M jobs, questionable positive economic ripple effect over long-term due to lack of operational reliance	Positive, well paying construction, O&M jobs, positive economic ripple effect over long-term operation	Positive, well paying construction, O&M jobs, positive economic ripple effect over long-term operation	Positive, well paying construction, O&M jobs, positive economic ripple effect over long-term operation (may make the cement plant more economically viable)	Will the process / project create well paying construction jobs, operation and maintenance jobs, and have a significant annual economic ripple effect on the local / regional economy?
5.0	Environmental Criteria	15	15	12	15	5	5	5	4	4	12	
	Data to support ability of control technology for air emissions		Credible database, permits grow more restrictive over time	Credible database, permits grow more restrictive over time	Credible database, though it's the European experience	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Credible database, permits grow more restrictive over time	Is there qualified data to allow permitting agencies to regulate major and minor air pollutants?
	Data to support ability of control technology for residues		Credible database, ash residue generally land filled	Credible database, ash residue generally land filled	Potential to significantly reduce solid	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Credible database, no ash residue (becomes part of the cement)	Is there qualified data to allow permitting agencies to regulate residues and non-processible wastes bypassed to the landfill?
	Data to support ability of control technology for liquid discharge		Credible database, some facilities are zero water discharges	Credible database, some facilities can be zero water discharges	Liquid discharges should be similar to massburn and RDF	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Credible database, some facilities can be zero water discharges	Is there qualified data to allow permitting agencies to regulate wastewater quantities and quality?
	Data to support ability of control technology for odor emissions		Credible database, massburn WTE has almost no odors escaping buildings	Credible database, possible odor control needed in the MSW processing building.	Credible database, the underlying massburn WTE has almost no odors escaping buildings	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Uncertain, no commercial experience with data in US	Credible database, possible odor control needed in the MSW processing building.	Is there qualified data to allow permitting agencies to regulate odorous compounds and ability to escape project boundary/ buffer zone?
	Reduction in greenhouse gasses		Credible database, on-going debate over biogenic versus anthropogenic emissions	Credible database, on-going debate over biogenic versus anthropogenic emissions	Credible data base, on-going debate over biogenic versus anthropogenic emissions	Uncertain, on-going debate over biogenic versus anthropogenic emissions	Uncertain, on-going debate over biogenic versus anthropogenic emissions; produces large amounts of hydrogen cholride	Uncertain, on-going debate over biogenic versus anthropogenic emissions	Uncertain, on-going debate over biogenic versus anthropogenic emissions	Uncertain, on-going debate over biogenic versus anthropogenic emissions	Will be a significant reduction in GHGs due to the cement plant using RDF and reducing their dependence on coal	Will there be a net reduction in GHG compared to local sources of electric power or comparable energy generation; compared to current landfill disposal option; compared to future landfill option with landfill gas collection and destruction?
6.0	Environmental Criteria - Sustainability Score	10	8	8	9	7	7	7	9	7	8	

Table 3-1 Waste-To-Energy Evaluation Matrix - King County Waste-to-Energy Study

Criteria Number	Criteria Description (Major / Minor)	Score (points)	WTE	Refuse Derived Fuel (RDF) WTE	Advanced Thermal Recycling (ATR)	Thermal Gasification WTE	Pyrolysis	Plasma Arc Gasification WTE	Biochemical Waste-to-Biofuels	Thermochemical Waste-to-Biofuels	Kiln	Comments
	Impacts on local resources		Requires potable and clean process water, can use reclaimed water and/or other alternate sources for cooling	Requires potable and clean process water, can use reclaimed water for cooling	Requires potable and clean process water, can use reclaimed water for cooling,	Requires potable and clean process water, can use reclaimed water for cooling,	Requires potable and clean process water, can use reclaimed water for cooling,	Requires potable and clean process water, can use reclaimed water for cooling,	Requires potable and clean process water, can use reclaimed water for cooling, if power is co-produced	Requires minor potable and clean process water, can use reclaimed water for cooling, if power is co-produced	Requires potable and clean process water, can use reclaimed water for cooling	Does the process minimize use of local water resources (potable, wastewater, and reclaimed water); minimize fossil fuel (natural gas, coal, oil) and fossil powered electricity, and maximize local recycling / energy recovery?
	Impacts on neighboring communities		With adequate buffer and aesthetic treatment, WTE facilities are compatible with industrial and institutional locations, many have been located near population centers	With adequate buffer and aesthetic treatment, WTE facilities are compatible with industrial and institutional locations	With adequate buffer and aesthetic treatment, ATR facilities are compatible with industrial and institutional locations, many have been located near population centers	With adequate buffer and aesthetic treatment, WTE gasification may be compatible with industrial locations	With adequate buffer and aesthetic treatment, WTE pyrolysis may be compatible with industrial locations	With adequate buffer and aesthetic treatment, WTE gasification may be compatible with industrial locations	With adequate buffer and aesthetic treatment, waste Biofuel facilities may be compatible with industrial locations	With adequate buffer and aesthetic treatment, waste Biofuel facilities may be compatible with both industrial locations	With adequate buffer and aesthetic treatment, RDF facilities are compatible with industrial and institutional locations, especially if the RDF facility is located at the cement plant	Are there any significant or potential issues (positive or negative) on the neighboring communities (visual, traffic, litter, property values)?
	Impacts on natural habitats		Minor, typically much smaller sites than landfills with well developed mitigation strategies	Minor, typically much smaller sites than landfills with well developed mitigation strategies	Minor, typically much smaller sites than landfills with well developed mitigation strategies	Minor, typically much smaller sites than landfills where mitigation strategies can be employed	Minor, typically much smaller sites than landfills where mitigation strategies can be employed	Minor, typically much smaller sites than landfills where mitigation strategies can be employed	Minor, typically much smaller sites than landfills where mitigation strategies can be employed	Minor, typically much smaller sites than landfills where mitigation strategies can be employed	Minor, typically much smaller sites than landfills where mitigation strategies can be employed	Are there any significant or potential issues (positive or negative) on the local, sub-regional, or regional habitat (litter, emissions, noise, lighting)?
	Compatibility with local environmental goals		Complies with the EPA waste management hierarchy of energy recovery over landfill disposal.	Complies with the EPA waste management hierarchy of energy recovery over landfill disposal.	Complies with the EPA waste management hierarchy of energy recovery over landfill disposal.	Complies with the EPA waste management hierarchy of energy recovery over landfill disposal.	Complies with the EPA waste management hierarchy of energy recovery over landfill disposal.	Complies with the EPA waste management hierarchy of energy recovery over landfill disposal.	Uncertain GHG emissions due to limited commercial applications,	Uncertain GHG emissions due to limited commercial applications	Complies with the EPA waste management hierarchy of energy recovery over landfill disposal.	Does the process fully meet all of the local community's environmental goals, such as reduction in pollutants, and greenhouse gasses on a lifecycle basis?
	Compatibility with local waste reduction goals		Recovered and recycled metals help meet local recycling goals, WTE may qualify for recycling goals in some states	Recycled metals help meet local recycling goals, WTE may qualify for recycling goals in some states	Recycled metals, residues, and minerals maximizes the waste reduction goals. Over 99% landfill diversion possible	Recycled metals help meet local recycling goals, gasification may qualify for recycling goals in some states vitrification can minimize residues	Recycled metals help meet local recycling goals, gasification may qualify for recycling goals in some states vitrification can minimize residues	Recycled metals help meet local recycling goals, gasification may qualify for recycling goals in some states vitrification can minimize residues	Waste conversion to biofuels may count toward recycling	Waste conversion to biofuels may count toward recycling	RDF facility can include enhanced recycling	Does the process fully meet all of the local community's waste reduction and recycling goals?
	Synergistic with municipal utilities and recycling processes		Yes, electricity from WTE can be used for other public works and municipal utilities if co-located	Yes, electricity from WTE can be used for other public works and municipal utilities if co-located	ATR maximizes the recovery of energy and material resources and process efficiencies	Yes, electricity from WTE can be used for other public works and municipal utilities if co-located	Yes, electricity from WTE can be used for other public works and municipal utilities if co-located	Yes, electricity from WTE can be used for other public works and municipal utilities if co-located	Less impact than WTE renewable electricity, but biofuels could be internally used for fueling fleets	Less impact than WTE renewable electricity, but biofuels could be internally used for fueling fleets	Yes, there will be no ash stream produced	Does the process afford the opportunity to provides additional benefits to community's public works programs and processes?
7.0	Financial Resources	10	10	10	10	3	3	3	3	3	8	
	Ability of vendor to finance project without public money		Yes, however, most WTE is typically publically owned, unless tax laws are favorable for private ownership	Yes, however, most WTE is typically publically owned, unless tax laws are favorable for private ownership	The underlying technology is typically publically funded. No US demonstrated facility	Lack of commercial development may not allow projects to be suitable for public finance	Lack of commercial development may not allow projects to be suitable for public finance	Lack of commercial development may not allow projects to be suitable for public finance	Lack of commercial development may not allow projects to be suitable for public finance	Lack of commercial development may not allow projects to be suitable for public finance	Lack of commercial development may require a guarantee from the public	What % of public money is at risk?
	Ability to endure and achieve performance goals during prolonged startup and testing phases		Startup easily achieved based upon historical performance	Startup easily achieved based upon historical performance	Uncertain, no commercial experience for the enhanced efficiency processes in the US.	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Startup easily achieved based upon historical performance	Does the developer have the financial resources and access to additional funds and resources to make the system fully functional during prolonged startup?
	Ability to make municipality whole from their investments and costs if technology fails		Historically demonstrated via long-term operation and maintenance service agreements with performance guarantees	Historically demonstrated via long-term operation and maintenance service agreements with performance guarantees	Uncertain, no commercial experience for the enhanced efficiency processes in the US.	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Historically demonstrated via long-term operation and maintenance service agreements with performance guarantees	Does the developer have the financial resources and willingness to accept liquidated damages causes to cover costs and impacts to the public?
	Financial reserves in escrow to dismantle and remove in event of failure		Yes, performance guarantees typically included in O&M service agreement	Yes, performance guarantees typically included in O&M service agreement	Uncertain, no commercial experience for the enhanced efficiency processes in the US.	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Uncertain, no commercial experience in US	Yes, performance guarantees typically included in O&M service agreement	Does the developer have the financial resources and willingness to place adequate funds, insurance, or financial backup to dismantle system in event of failure?
8.0	Project Economics Score	20	20	18	20	10	10	7	7	7	10	
	Requirement for Public capital investment		Typically 100% publically financed with	Typically 100% publically financed with	Uncertain. No commercial experience	Lack of commercial development may	Lack of commercial development may	Lack of commercial development may	Lack of commercial development may	Lack of commercial development may	Typically 100% publically financed with	What % of commitment is required from local municipality to participate
	Commitment for delivery of wastes		Typically require commitment for minimum delivery of wastes on a daily, weekly and annual basis	Typically require commitment for minimum delivery of wastes on a daily and annual basis	Typically require commitment for minimum delivery of wastes on a daily and annual basis	Likely to require commitment for minimum delivery of wastes on a daily and annual basis	Likely to require commitment for minimum delivery of wastes on a daily and annual basis	Typically will require commitment for minimum delivery of wastes on a daily and annual basis	Typically will require commitment for minimum delivery of wastes on a daily and annual basis	Typically will require commitment for minimum delivery of wastes on a daily and annual basis	Typically require commitment for minimum delivery of wastes on a daily and annual basis	What is the commitment of required waste delivery (tons per day, contract years)?
	Acceptable contract terms and conditions		Yes, historically demonstrated as normal practice	Yes, historically demonstrated as normal practice	Uncertain. The underlying technology will have historically demonstrated as normal practice, except for the enhanced efficiency processes.	Uncertain, but likely to adopt as normal practice	Uncertain, but likely to adopt as normal practice	Uncertain, but likely to adopt as normal practice	Uncertain, but likely to adopt as normal practice	Uncertain, but likely to adopt as normal practice	Yes, historically demonstrated as normal practice	Does the project allow acceptable put or pay contract terms; base service fee plus excess waste processing fee; method of determining annual escalation; revenue sharing of energy production, recyclables, and other co-products?
	Economic costs and benefits to the community		Yes, stabilizes solid waste rates over long-term, especially after facility debt is retired, lowest cost of WTE technologies	Yes, stabilizes solid waste rates over long-term, especially after facility debt is retired, costs higher than massburn	Uncertain. The cost effectiveness of the enhanced efficiency processes is unknown	Uncertain, but likely to adopt as normal practice	Uncertain, but likely to adopt as normal practice	Uncertain, but likely to adopt as normal practice	Uncertain, but likely to adopt as normal practice	Uncertain, but likely to adopt as normal practice	Yes, stabilizes solid waste rates over long-term, especially after facility debt is retired, costs higher than massburn	Does the process provide any long-term revenue potential for the host municipality, or other benefits such as renewable energy to the local service area?
	Realistic estimate of project revenues / incomes		Yes, long-term electric power purchase agreements cover bulk of revenues, market fluctuations for recycled metals	Yes, long-term electric power purchase agreements cover bulk of revenues, market fluctuations for recycled metals	Uncertain. The long-term electric power purchase agreement cover bulk of revenues. The cost effectiveness of the enhanced efficiency processes is unknown	Yes, long-term electric power purchase agreements cover bulk of revenues, market fluctuations for recycled metals	Yes, long-term electric power purchase agreements cover bulk of revenues, market fluctuations for recycled metals	Yes, long-term electric power purchase agreements cover bulk of revenues, market fluctuations for recycled metals	Uncertain, market risk for biofuels, long-term PPA if electricity is sold	Uncertain, market risk for biofuels, long-term PPA if electricity is sold	Yes, long-term RDF purchase agreement covers bulk of revenues; market fluctuations for recycled metals	Are the assumptions reasonable for estimating income from sale of power, by-products, or processing of special wastes in comparison with other similar industries and processes?
	Realistic assumptions for estimation of operation and maintenance expenses		Yes, long history of successful operations and data base	Yes, long history of successful operations and data base	Uncertain. The cost effectiveness of the enhanced efficiency processes is unknown	Uncertain, no commercial experience and data in US	Uncertain, no commercial experience and data in US	Uncertain, no commercial experience and data in US	Uncertain, no commercial experience and data in US	Uncertain, no commercial experience and data in US	Limited history of successful operations and data base	Are the assumptions reasonable for estimating expenses (labor, wage rates, power use, cost of chemicals, fuels, and equipment) in comparison with other similar industries and processes?
	Costs to commercial, industrial, or institutions?		No additional cost, system users pay set fees per ton	No additional cost, system users pay uniform fees per ton	Uncertain. The cost effectiveness of the enhanced efficiency processes is unknown	Uncertain	Uncertain	Uncertain	No additional cost anticipated	No additional cost anticipated	Cost of RDF to the cement plant is limited to the energy value content of the coal displaced	Is the impact of implementation of the process acceptable to the commercial, industrial, and institutional community?
9.0	Overall Project Risks Score	10	9	7	8	3	3	3	3	5	7	
	Economic realities		Cost effective approach when evaluated over 45 - 50 life cycle, stabilizes disposal rates	Less competitive than WTE, stabilizes disposal rates	Uncertain. No commercial experience in the US, but should be similar to massburn WTE	Uncertain, no commercial experience and data in US, more costly than WTE	Uncertain, no commercial experience and data in US, more costly than WTE	Uncertain, no commercial experience and data in US, more costly than WTE	Uncertain, no commercial experience and data in US, Biofuel revenues may be significant, but cost of production is uncertain	Uncertain, no commercial experience and data in US, Biofuel revenues may be significant, but cost of production is uncertain	Much lower capital cost compared to WTE, but dependent on the economic viability of the cement plant	What is the process cost differential compared to landfill disposal and other competing technologies? Will the process help stabilize solid waste rates over long-term?
	Technical risk		Low risk, proven technology, experienced contractors	Moderate risk, proven technology, high O&M, potential shredder explosions, few experienced contractors	Low risk, proven technology, experienced contractors	Uncertain, no commercial experience and data in US, technically riskier than WTE and RDF	Uncertain, no commercial experience and data in US, technically riskier than WTE and RDF	Uncertain, no commercial experience and data in US, may be technically riskier than WTE and RDF	Uncertain, long learning curve anticipated, feedstock pre-treatment, process (wastewater, effluents, odors) concerns anticipated	Uncertain, long learning curve anticipated, feedstock pre-treatment, process (wastewater, effluents, odors) concerns anticipated	RDF - Moderate risk, proven technology, high O&M, potential shredder explosions; RDF feed to cement plant - limited experience	Is there a limited history of technology and/or limited history of the service provider?
	Siting risks		Siting a WTE facility is complex and will require an acceptable site with adequate buffers and mitigation strategies	Siting a RDF facility is complex and will require an acceptable site with adequate buffers and mitigation strategies	Siting an ATR facility is complex and will require an acceptable site with adequate buffers and mitigation strategies	Siting a thermal gasification facility is complex and will require an acceptable site with adequate buffers and mitigation strategies	Siting a pyrolysis facility is complex and will require an acceptable site with adequate buffers and mitigation strategies	Siting a plasma gasification facility is complex and will require an acceptable site with adequate buffers and mitigation strategies	Siting a waste-to-biofuels facility is complex and lengthy multi-dimensional process, and the outcome is not always certain.	Siting a waste-to-biofuels facility is complex and lengthy multi-dimensional process, and the outcome is not always certain.	An existing cement kiln will not require a new siting process, only a permit modification. A successful outcome is more likely.	Siting a WTE facility is complex and lengthy multi-dimensional process, and the outcome is not always certain.
	Procurement issues		Several qualified contractors in the US	Few experienced contractors in US	Proven experience in Europe, not in US	Few experienced contractors in US	Few experienced contractors in US	Few experienced contractors in US	Few experienced contractors in US	Few experienced contractors in US	Few experienced contractors in US	Is there a lack of qualified competition due to the uniqueness or state of technology development?
	Fatal flaws		No fatal flaws	Minor potential flaws due to equipment performance and potential explosions	No fatal flaws but no demonstration facility with ATR in the US	Uncertain, no commercial experience and data in US, carbon monoxide in syngas	Uncertain, no commercial experience and data in US, large quantities of hydrogen choride	Uncertain, no commercial experience and data in US, carbon monoxide in syngas	Uncertain, no commercial experience and data in US	Uncertain, no commercial experience and data in US	Dependent on the economic viability of the cement plant	Is the project dependent on uncertain factors / conditions, such as the acceptance of a byproduct by an industry that could leave the local community, or income from a byproduct whose price or market is not reliable?
	Contractual risk		Minimal contractual risk	Minimal contractual risk	Minimal contractual risk	Uncertain, no experienced contractors in US	Uncertain, no experienced contractors in US	Known vendor filed for bankruptcy protection within the past 5 years	Uncertain, few experienced contractors in US	Uncertain, few experienced contractors in US	Minimal contractual risk	Can the definition of "failure" be clearly described or expressed in a contract?
	Contract terms		Yes, demonstrated ability to meet performance guarantees	Yes, demonstrated ability to meet performance guarantees	Yes, demonstrated ability to meet performance guarantees	Uncertain, few experienced contractors in US	Uncertain, few experienced contractors in US	Uncertain, few experienced contractors in US	Uncertain, few experienced contractors in US	Uncertain, few experienced contractors in US	Limited demonstrated ability to meet performance guarantees	Is the developer willing to include an "escape clause" if the technology fails to achieve benchmark performance goals / guarantees?
	Total Score	100	95	85	95	42	42	37	39	38	72	

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)

IeRM

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)

IeRM

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

IeRM

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

IeRM

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

IeRM

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

IeRM

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

IeRM

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?

IeRM

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

IeRM

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

IeRM

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

IeRM

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

IeRM

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!

IeRM

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

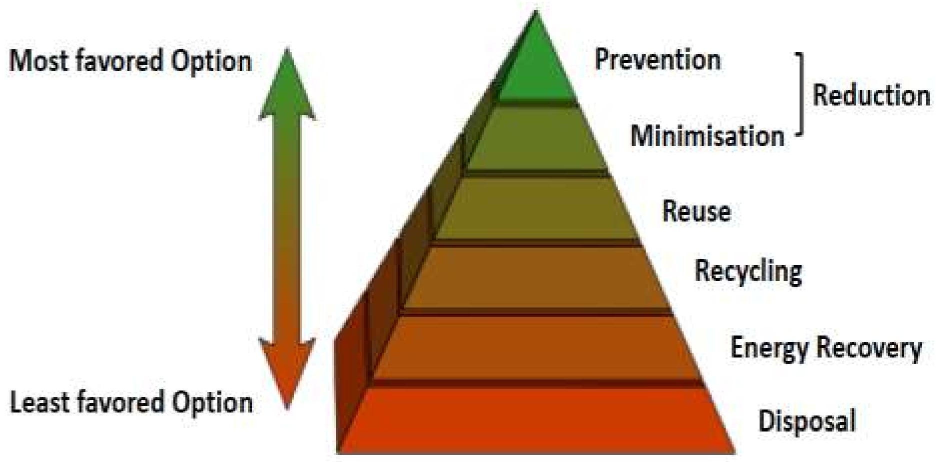
for the protection

of human health, the environment, and resources.

IeRM

Current US Zero Waste Landfill based System

Waste Management Hierarchy



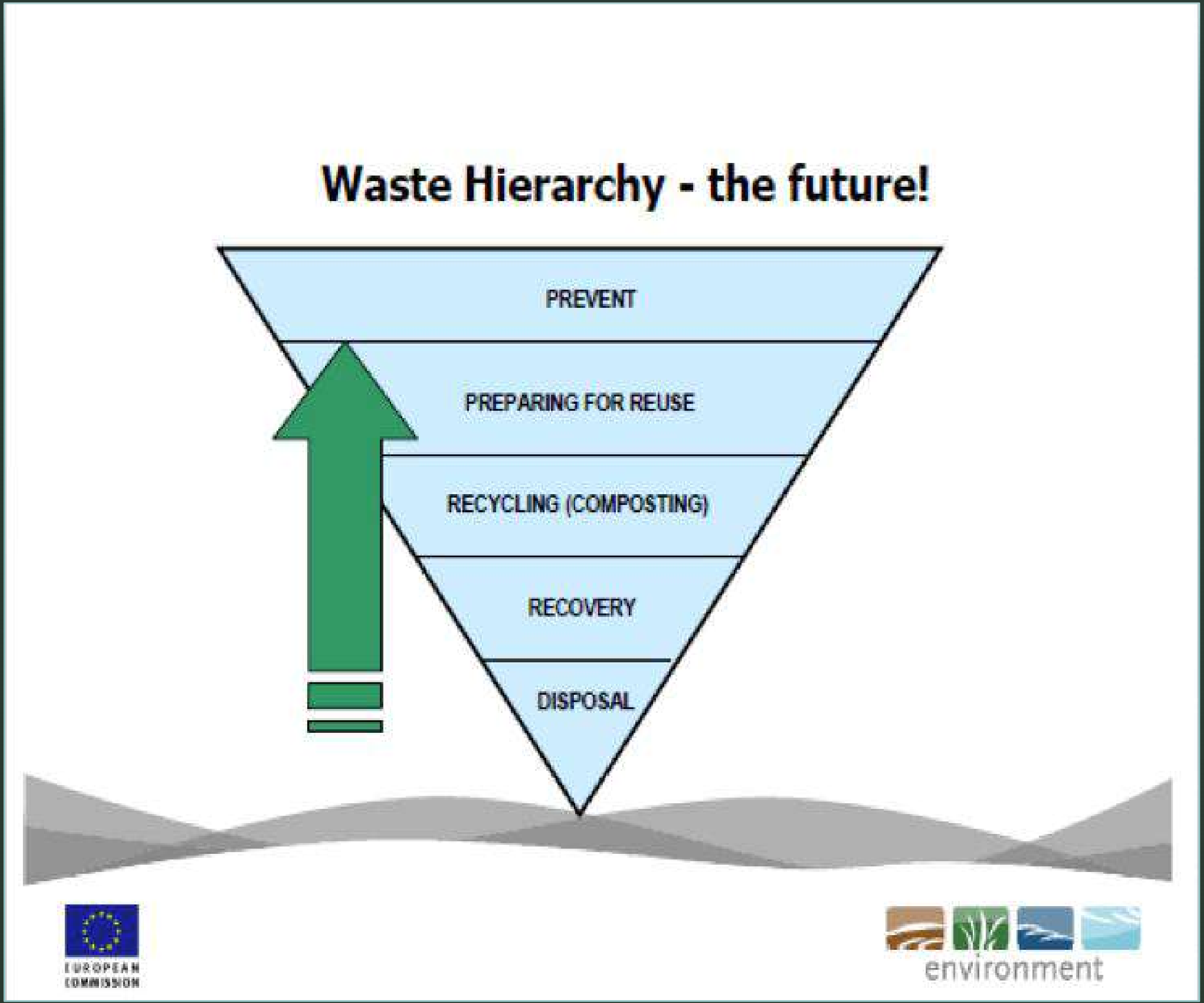
Waste hierarchy is a tool used in the evaluation of processes that protect the environment alongside resource and energy consumption to **most favorable** to **least favorable** actions. The hierarchy establishes preferred program priorities based on sustainability. To be sustainable, waste management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

Source: Wekipedia (slightly modified)

IeRM

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**.



IeRM

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).

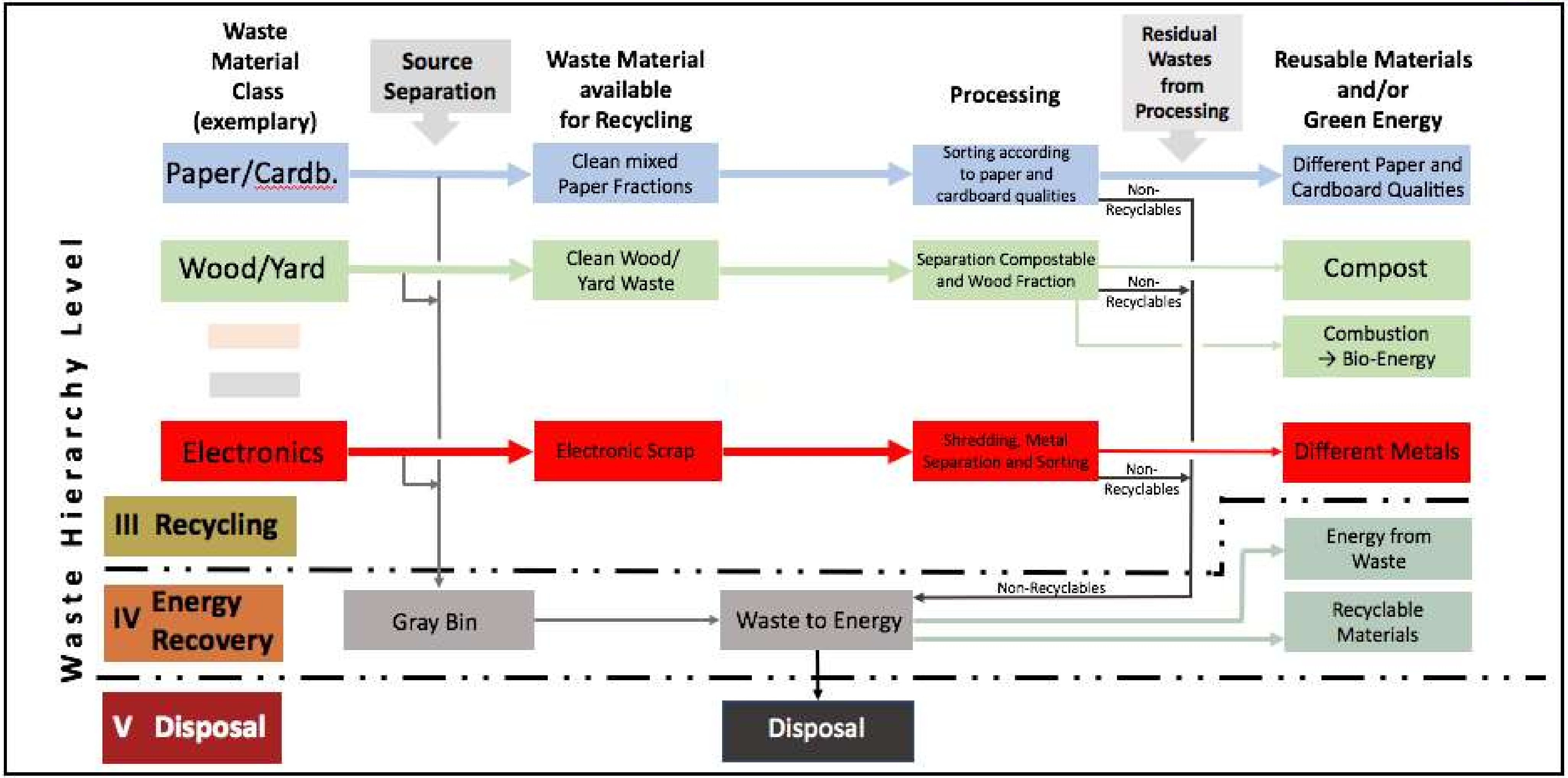
Source: US EPA

IeRM

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

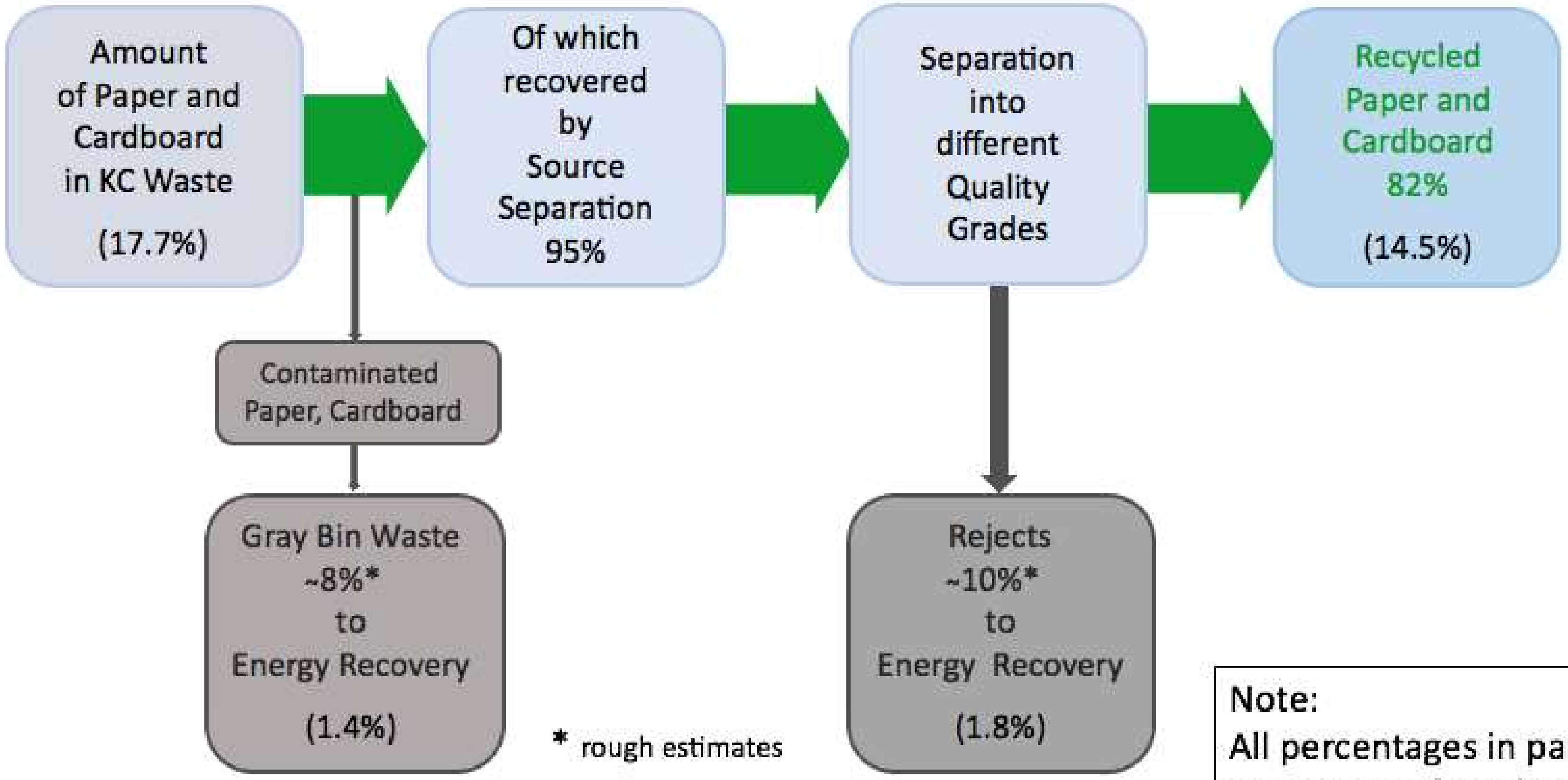
IeRM

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

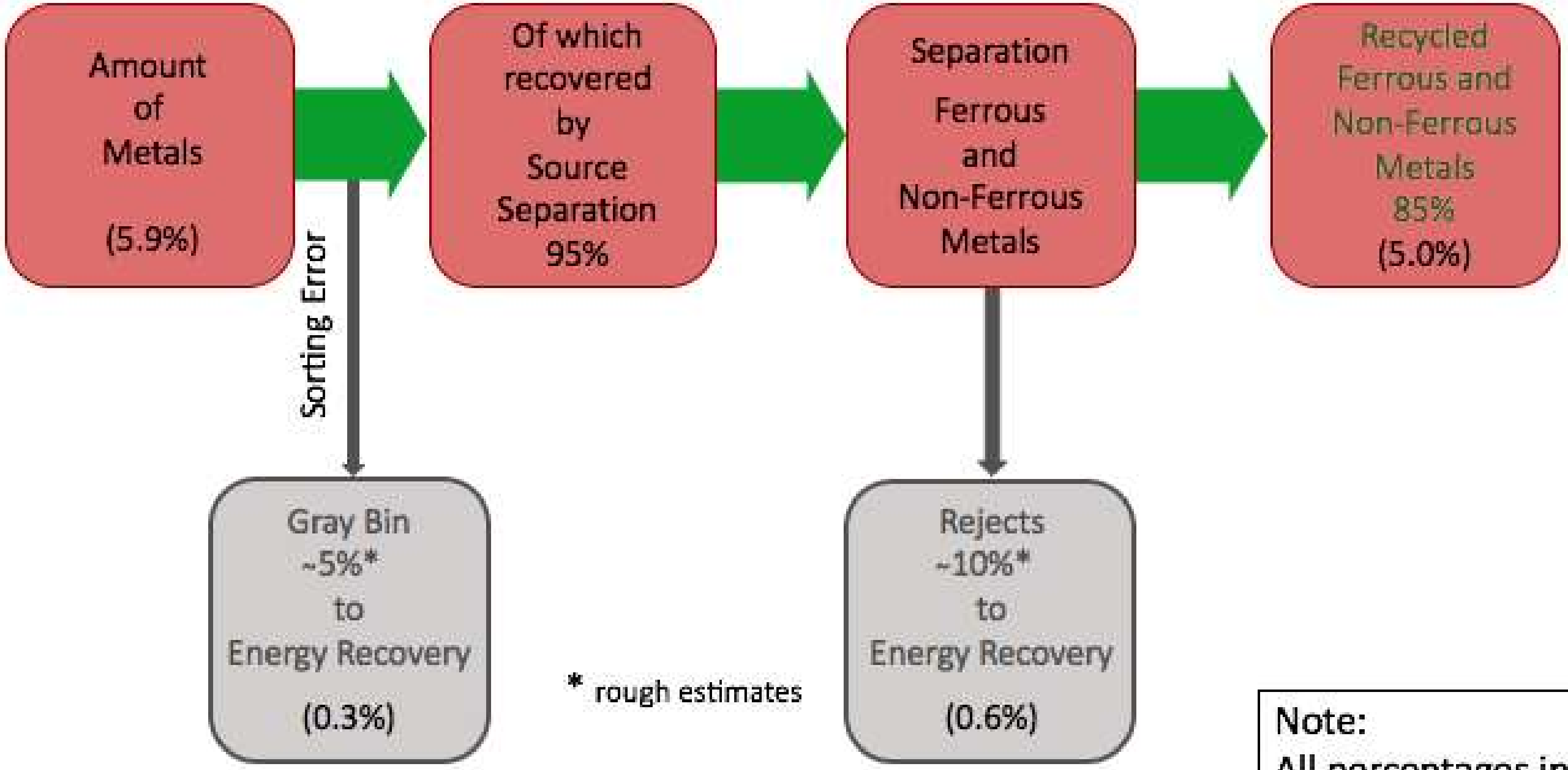
Note:
All percentages in parentheses as percent of total waste stream

Example:

Integrated Waste Management System

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

Assessment of Recyclability of Material Class *Metals*

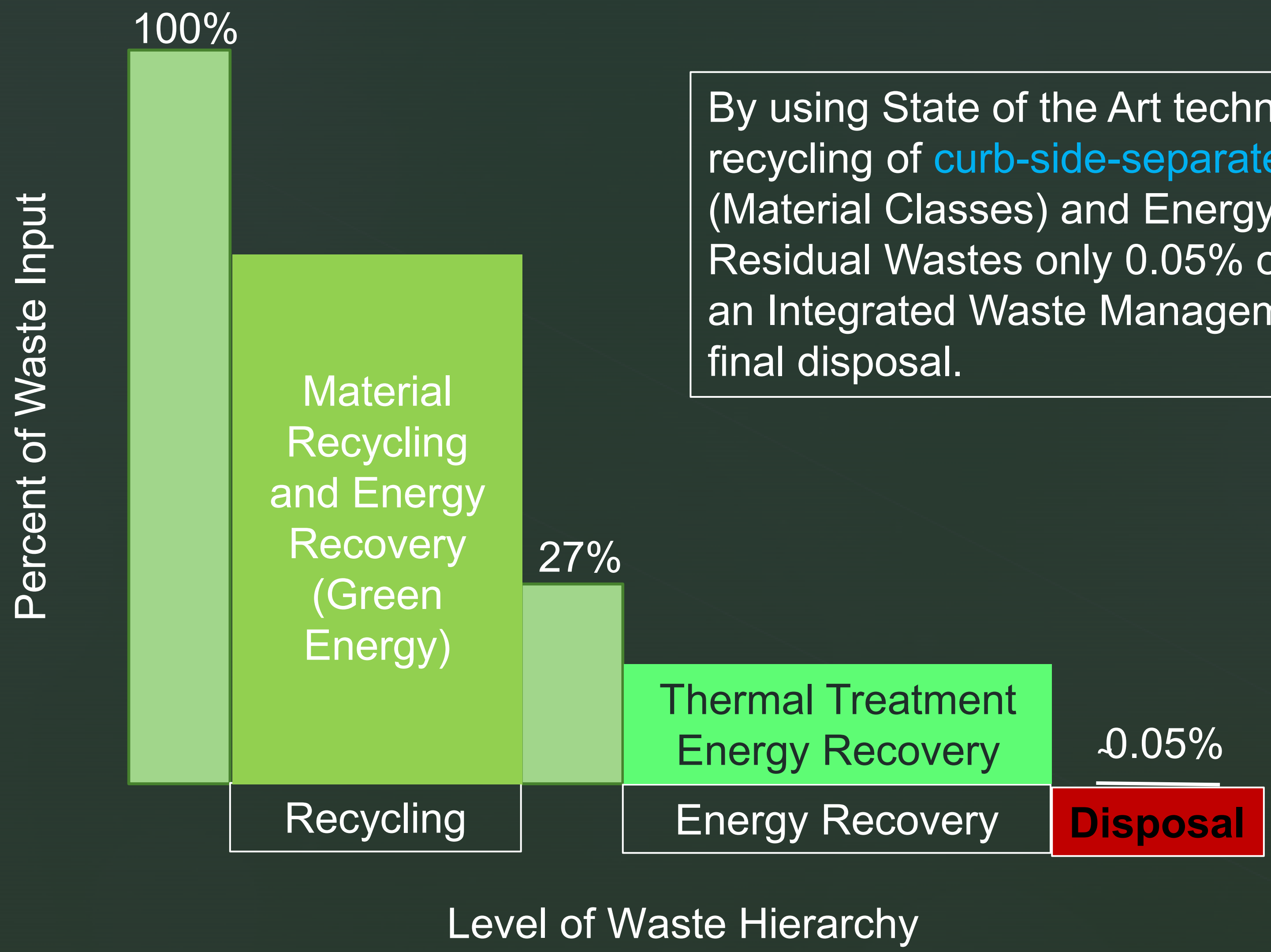


Note:
All percentages in parentheses as percent of total waste stream

HZ 2022-09-09

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.

IeRM

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

IeRM

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

IeRM

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

IeRM

USA


The 3 Bin System
SOILED PAPER / FOOD
RECYCLABLES
LANDFILL
COMPOST
堆肥 Abono
RECYCLE
回收 Reciclaje
LANDFILL
垃圾填埋場 Basurero

IeRM

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

IeRM

Paper & Cardboard, Plastic; Underground collection Glass - Switzerland

At many European Train stations:

Typical household (single and multifamily) in several EU countries

IeRM

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

IeRM

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

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

IeRM

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

IeRM

Lightbulbs

Printer Toner, others

Car Batteries, others

IeRM

Contaminated Wood

Construction Waste

Charges Apply

IeRM


Multiple categories


21
19
20
Cooling and air conditioning units
Specific PC and TV screens
Small electrical appliances

IeRM

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.

IeRM

Stilbruch – Hamburg: Reuse vs Trash

State of the Planet

EARTH INSTITUTE | COLUMBIA UNIVERSITY

SUSTAINABILITY

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

BY RENEE CHO | MARCH 13, 2020

227 Comments

"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

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.

IeRM

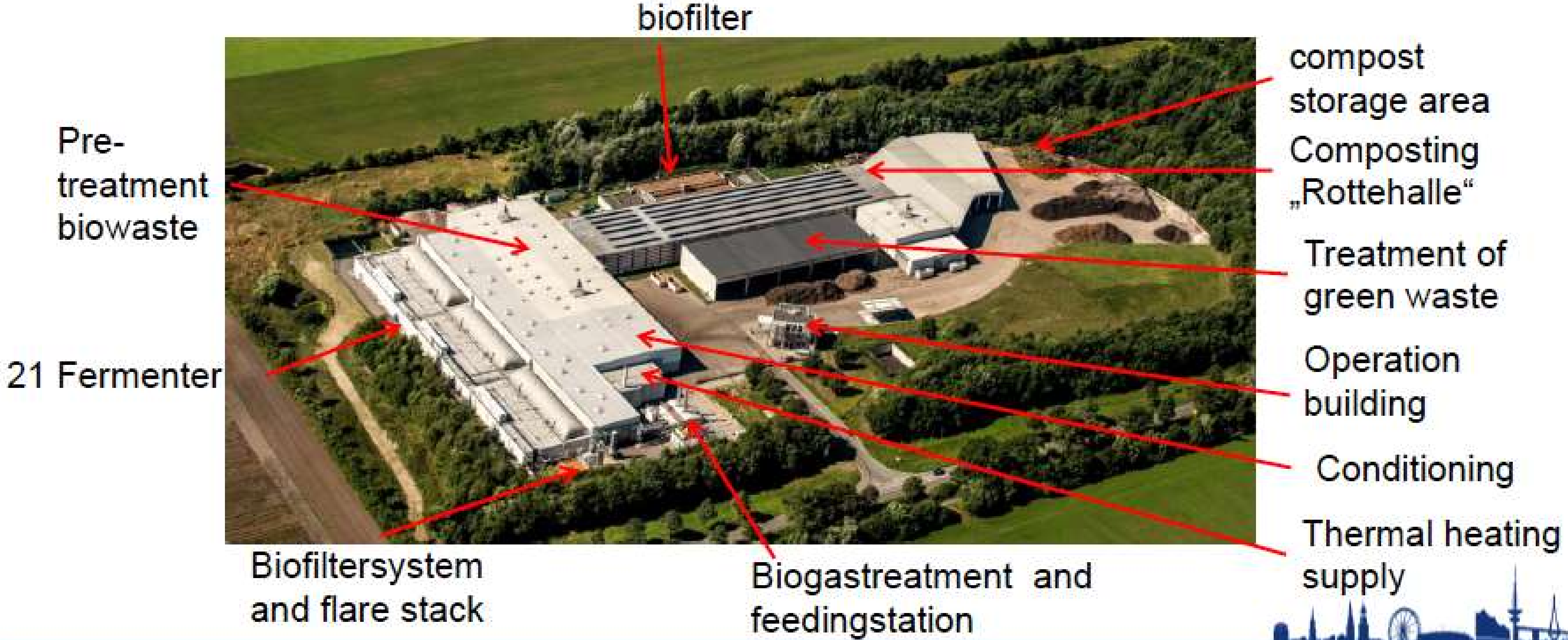
Integrated Waste Management Systems - 2c

- 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)

IeRM

Biogas- and Composting Plant Bützberg

STADTREINIGUNG.HAMBURG



2019 Stadtreinigung Hamburg - Biogas- und Kompostwerk Bützberg 9

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

Energy, Heat & Compost from Organic Waste

IeRM

Biogas and Composting Facility Buetzberg

IeRM

Biogas and Composting Facility Buetzberg

Sifting by 80 mm perforation

Extracting Metal, Plastic Bags or other Contaminants

Breaking organic Material > 80 mm

IeRM

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.

IeRM

Biogas and Composting Facility Buetzberg

logistics area

Loading the Fermenter

Fermenter with bio-waste

Anaerobic Digestion
15-17 Days

IeRM

Biogas and Composting Facility Buetzberg

Compost –
10 turn cycles 35 Days

IeRM

High-quality compost!

Biogas and Composting Facility Buetzberg

IeRM

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

IeRM

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.

IeRM

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

IeRM

Q & A

5 Minutes

IeRM

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

IeRM

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

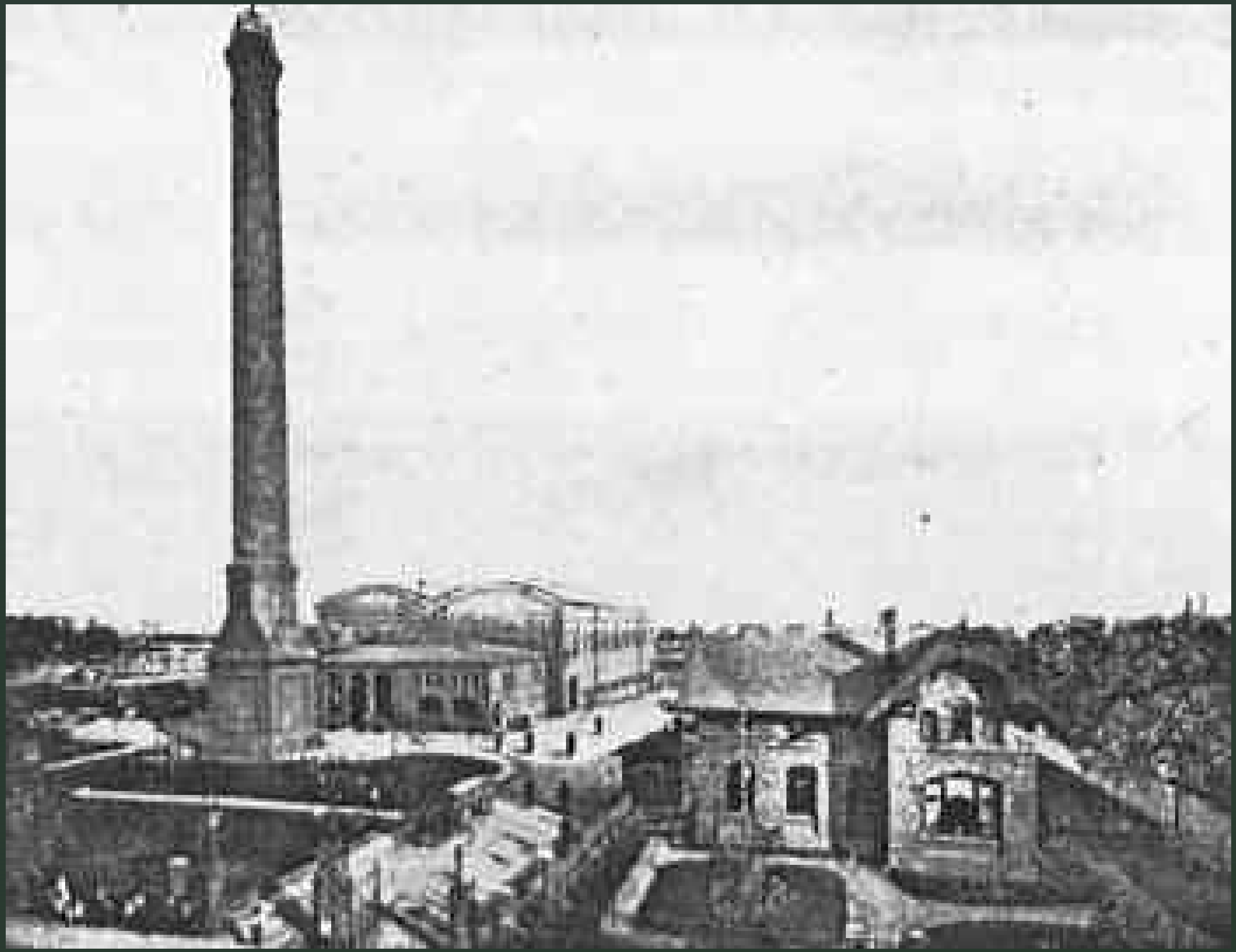
IeRM

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

IeRM

1st Incinerator on the European Continent 1895 Hamburg, Germany



IeRM

1982 Commodore 64

2023 Apple iMac Pro

IeRM

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

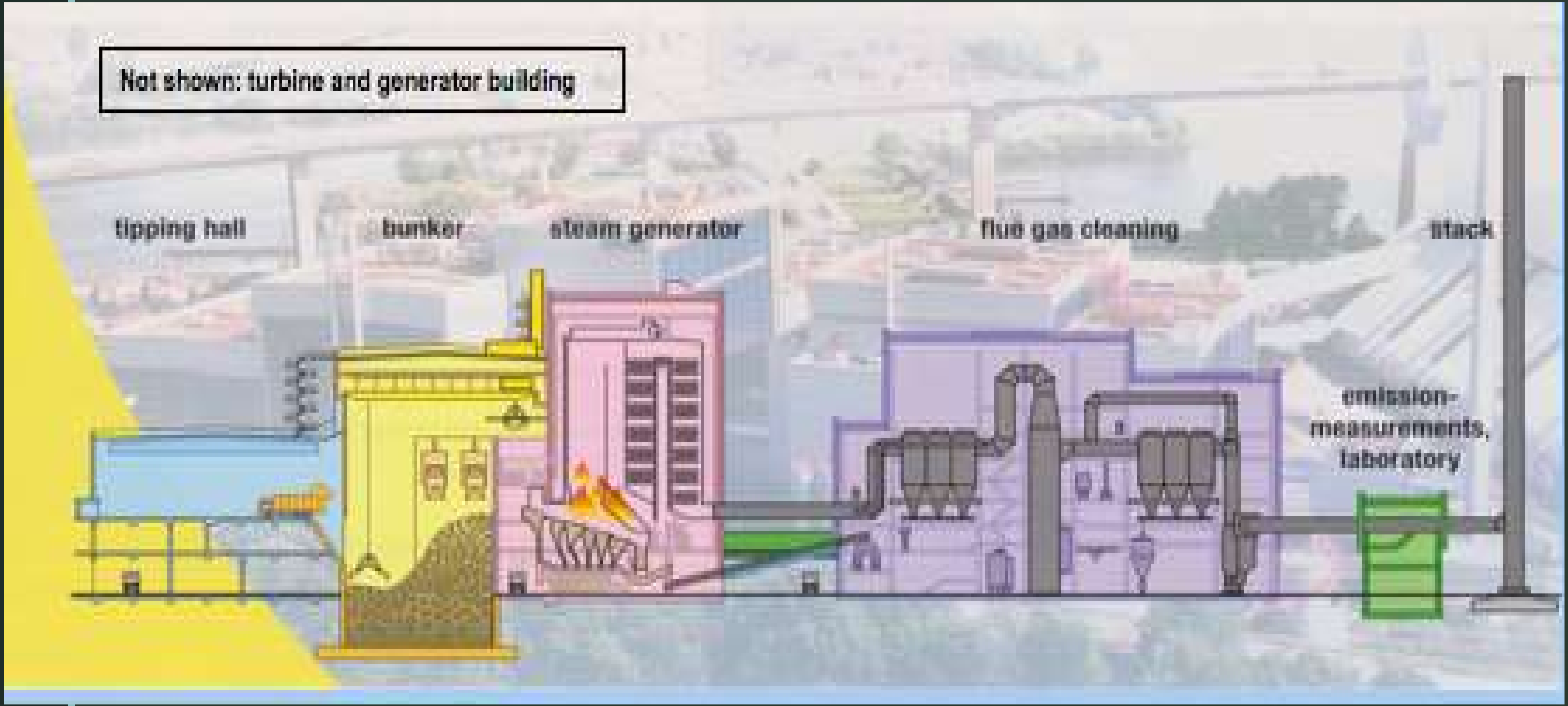
IeRM

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

IeRM

Overview of Thermal Treatment/Recovery Facility:



Source: MVR Annual Report

IeRM

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

Input

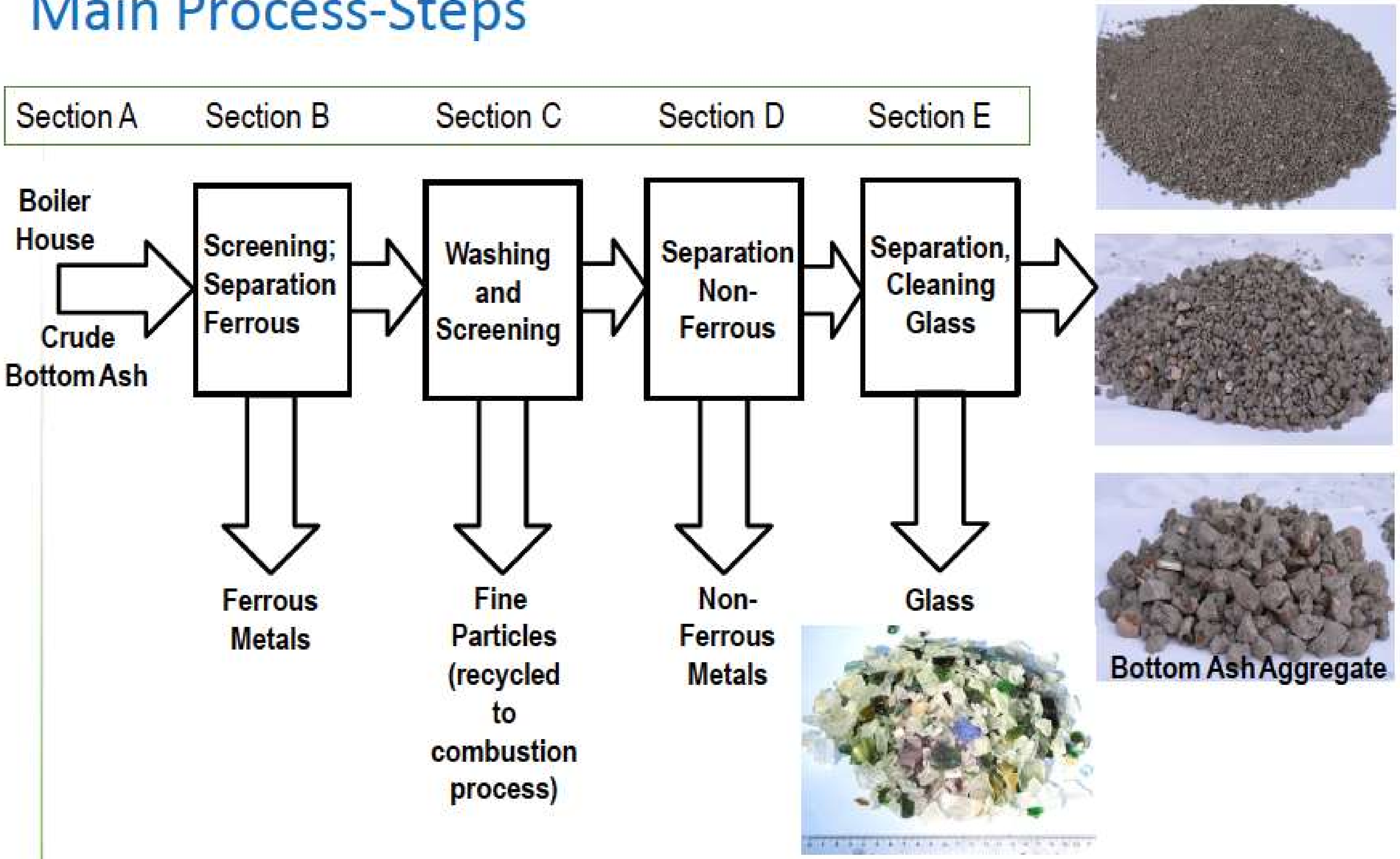
Output

Waste in, stabilized and inert ash out!

Source: Paul Hauck

IeRM

European Advanced Bottom Ash Treatment
Main Process-Steps



Source: Paul Hauck

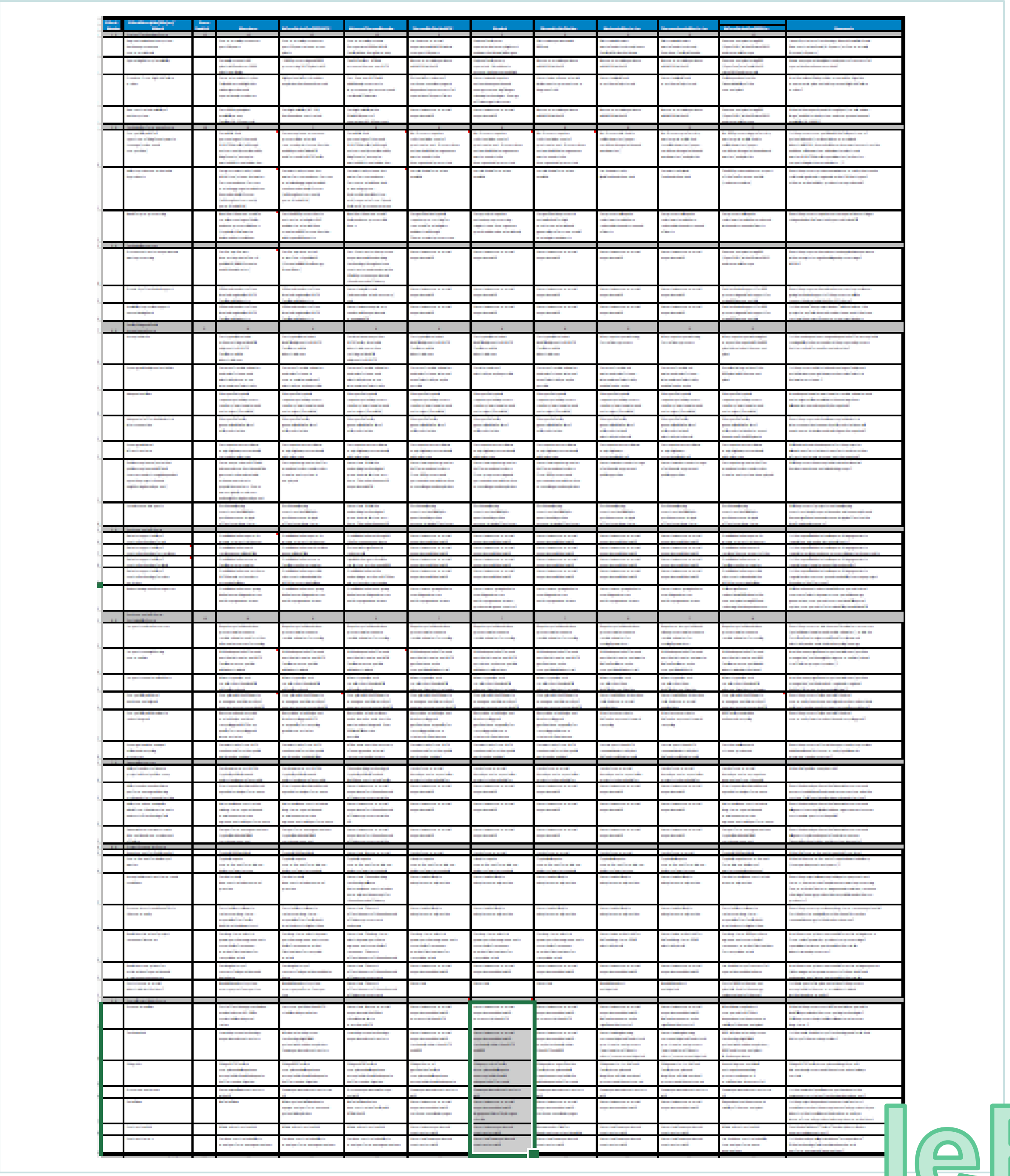
500,000 tons of Bottom Ash used as carrying layer for most advanced (2006) container terminal in the world in Hamburg, Germany:

neomer
Innovations in Sustainable Business Development

IeRM

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



IeRM

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.

IeRM

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.

IeRM

Economic Benefits

USA Equivalent:

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

IeRM

Q & A

5 Minutes

IeRM

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

IeRM

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

IeRM

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.

IeRM

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)

IeRM


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

IeRM

Source: European Parliament

IeRM

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'!

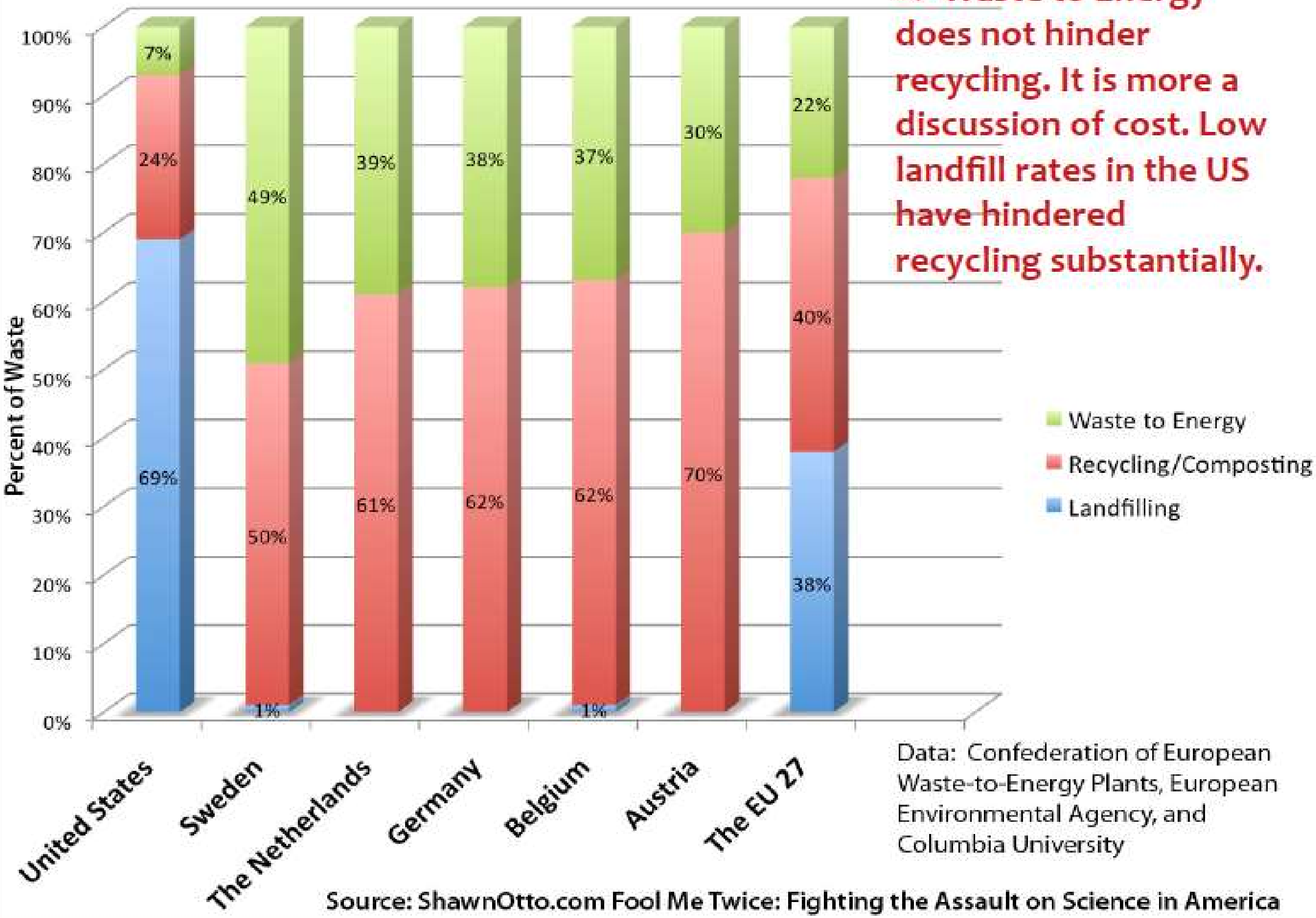
IeRM

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

IeRM

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



=> Waste to Energy does not hinder recycling. It is more a discussion of cost. Low landfill rates in the US have hindered recycling substantially.

Data: Confederation of European Waste-to-Energy Plants, European Environmental Agency, and Columbia University

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

IeRM

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!

IeRM

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?

IeRM

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 Weltzin
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.

IeRM

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.

IeRM

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 - CH_4, Carbon Dioxide - CO_2, Nitrous Oxide - N_2O, 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!

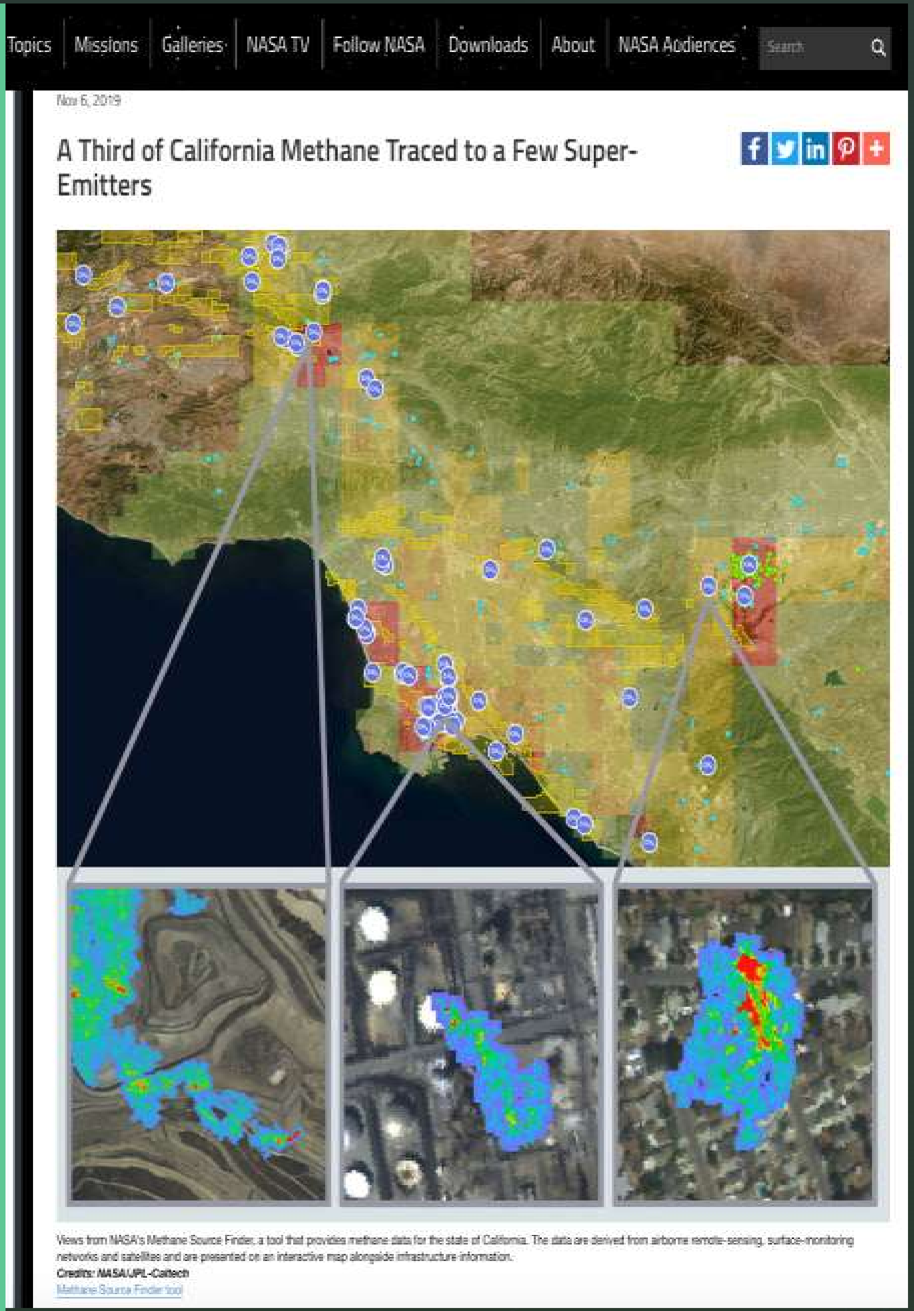
IeRM

- 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 CO2 or 86 times GWP over CO2 based on a 20-year cycle.

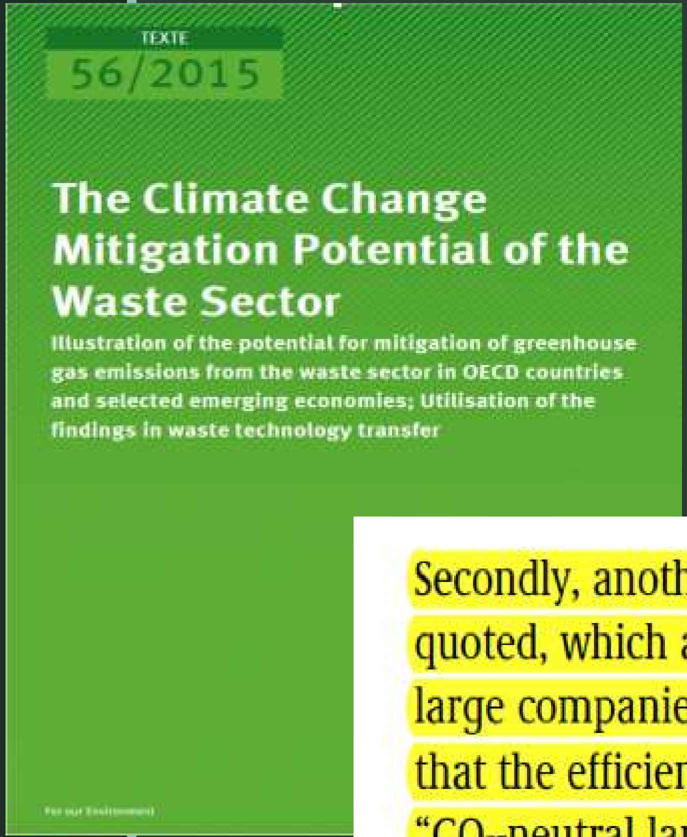
- NASA's Scientific Evaluation of Methane from Landfills used airplanes with special detection technology.

<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



IeRM


TEXTE 56/2015

The Climate Change Mitigation Potential of the Waste Sector

Illustration of the potential for mitigation of greenhouse gas emissions from the waste sector in OECD countries and selected emerging economies; Utilisation of the findings in waste technology transfer

For our Environment

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.

IeRM

TEXTE

56/2015

The Climate Change Mitigation Potential of the Waste Sector

Illustration of the potential for mitigation of greenhouse gas emissions from the waste sector in OECD countries and selected emerging economies; Utilisation of the findings in waste technology transfer

For our Environment

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.


TEXTE 56/2015

The Climate Change Mitigation Potential of the Waste Sector

Illustration of the potential for mitigation of greenhouse gas emissions from the waste sector in OECD countries and selected emerging economies; Utilisation of the findings in waste technology transfer

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**

IeRM

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

IeRM

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

IeRM

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

IeRM

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

IeRM

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

IeRM

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.

IeRM

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

IeRM

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.

IeRM

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/

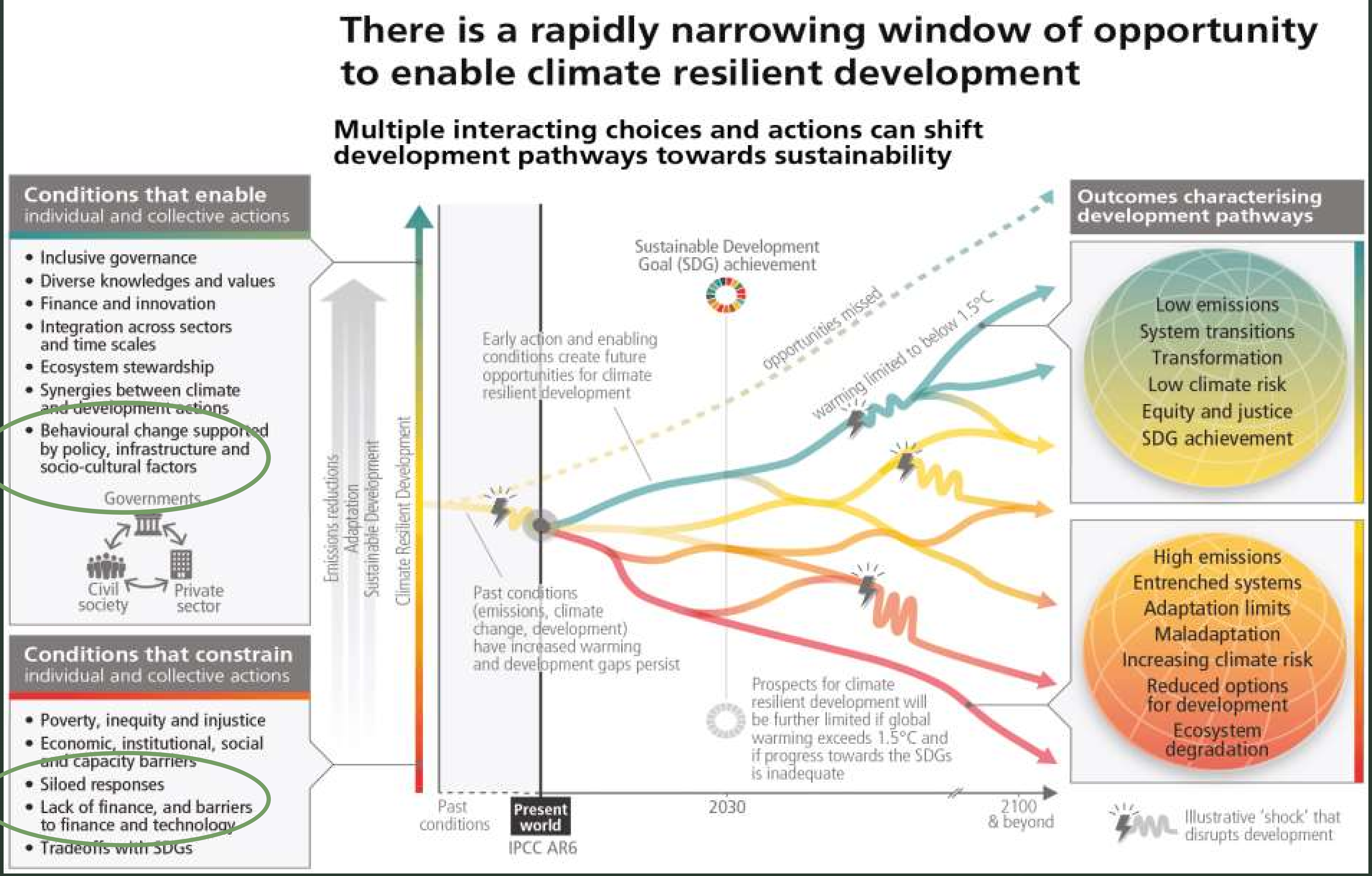
IeRM

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.

IeRM

Zero Waste Utopia – Exposed – IPCC Conclusion



IeRM

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.

IeRM

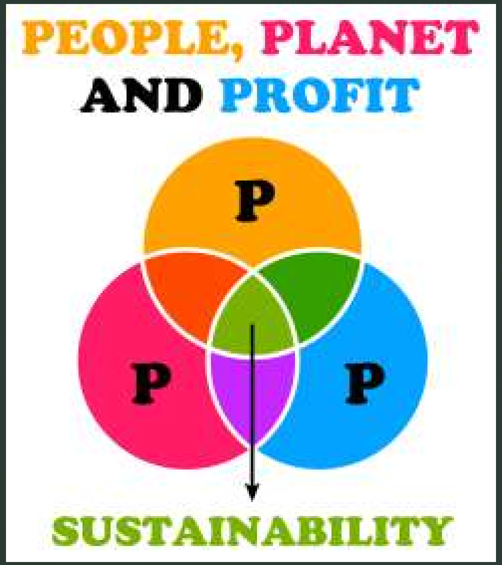
Zero Waste Utopia – Real life Example

	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

IeRM

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



IeRM

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

IeRM

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)

IeRM

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

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.

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.

IeRM

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

IeRM

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

IeRM

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

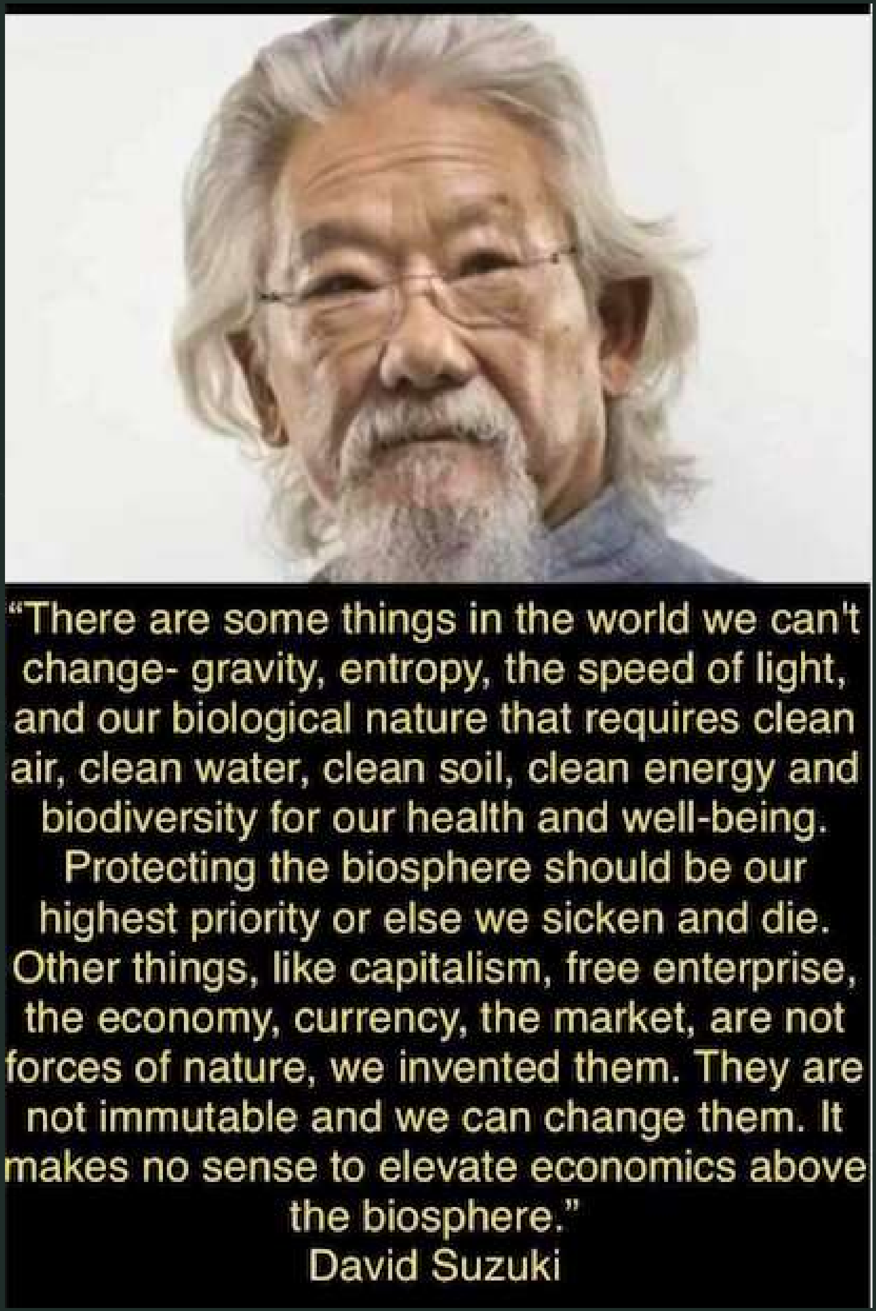
IeRM

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

psp@ie-rm.org

+1-206-313-9774

IeRM


"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