The Importance of Zero Waste in Climate Action Plans

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ABSTRACT

Zero Waste Systems, as a diverse group of practices, programs and legislation which seeks to avoid waste disposal by maximizing prevention, reuse, recycling and composting, is on the cutting edge of waste management in communities and businesses. This paper describes zero waste systems, how some communities are setting goals of achieving zero waste and moving towards this goal, and the similarity of zero waste to several other hierarchies of preferred practices in the context of sustainability.

At the same time that waste management departments are developing and implementing plans to prevent and manage their municipal solid waste, increasingly, other municipal or state departments are planning and implementing measures to improve municipal sustainability more broadly defined, and looking for ways to lower the carbon footprint. Though some communities recognize the potential contribution of zero waste systems to reducing carbon footprint, many have not yet seen the connection. The importance of including zero waste in governmental climate action plans is supported by information from EPA that shows the emissions resulting from the production of goods to be the largest single component of total greenhouse gas emissions, when evaluated nationally or globally, and that zero waste methods reduce greenhouse gas emissions while disposal methods either add to or slightly reduce these emissions. The presentation describes these connections, presents the data from EPA and others, and shows how zero waste can be and is being integrated into some climate action plans.

INTRODUCTION

Since 1988 governments in the U.S. have been managing municipal solid waste under the rubric of the Integrated Solid Waste Management paradigm, where a combination of methods are employed, with waste being managed according to a hierarchy with waste prevention (source reduction plus reuse) the most preferred, recycling / composting, waste-to-energy, and landfilling as a last resort. Many jurisdictions passed legislation establishing goals or mandates for increasing recycling and/or diversion from disposal methods. Long-range plans have been prepared along these lines since then, programs have developed, and to a widely varying extent across the country, recycling rates have increased and landfilling rates decreased as a percentage of the whole. However, waste generation rates have risen over the last decades. [1]

Zero Waste – A Paradigm Shift

In the 1990s a new paradigm began to be discussed in the west coast states and a few other locations: zero waste. The goal of zero waste is to maximize source reduction + reuse + recycling + composting in that order, to the exclusion of thermal treatment and landfilling.

The Planning Group of the Zero Waste International Alliance adopted the following definition of Zero Waste on November 29, 2004. This is intended to assist businesses and communities in defining their own goals for Zero Waste

- "Zero Waste is a goal that is ethical, economical, efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use.

- Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them

- Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health."[2]

Zero Waste began to be adopted by some states and municipalities as a long range goal in the last decade. In fact, zero waste has been adopted by countries as well as corporations around the world.[3] It was increasingly seen that as long as expensive disposal facilities, such as waste-to-energy and landfills continued to be sited, these would limit the growth of zero waste systems since they compete for the same resources (both material and financial), and once an expensive disposal facility is sited, it requires waste (tip fees) to repay the debt incurred by its construction.

However, there seems to be an aversion to the term, zero waste, perhaps because it conjures up the image of no discards. But every society will have discards including everything from packaging, to used/broken products, to food scraps, but it doesn't mean that all of that has to go into an incinerator or landfill. In fact, the organic fraction has always been compostable, and increasingly, there are technologies to recycle much of the rest. Reuse (including repair, repurposing, and many other ways of maintaining a product for its initial intended purpose) preserves all the materials, energy, water, and labor input in the creation of the product, and therefore is a more environmentally sound method than either recycling or composting.

Fig. 1 Zero Waste defined [4]

Source reduction, via better product and packaging design, environmental procurement, and other "designs for environment", avoids extraction and refinement of new virgin materials, and is superior environmentally. Figure 1 shows how zero waste seeks to prevent disposal and promote changes in materials extraction, product design and manufacturing stages in the early part of the production lifecycle.

Sustainability and Climate Change Plans

Along parallel tracks, prompted by work by United Nations, in meetings from Kyoto to Rio to Copenhagen, and its publications and policies, [5] as well as environmental groups, governments at all levels and businesses, have started becoming aware of the importance of sustainability and climate change, and have begun to create plans to address these issues. For sustainability, plans explore ways to reduce impacts in transportation, energy, buildings, water, as well as materials/waste sectors.

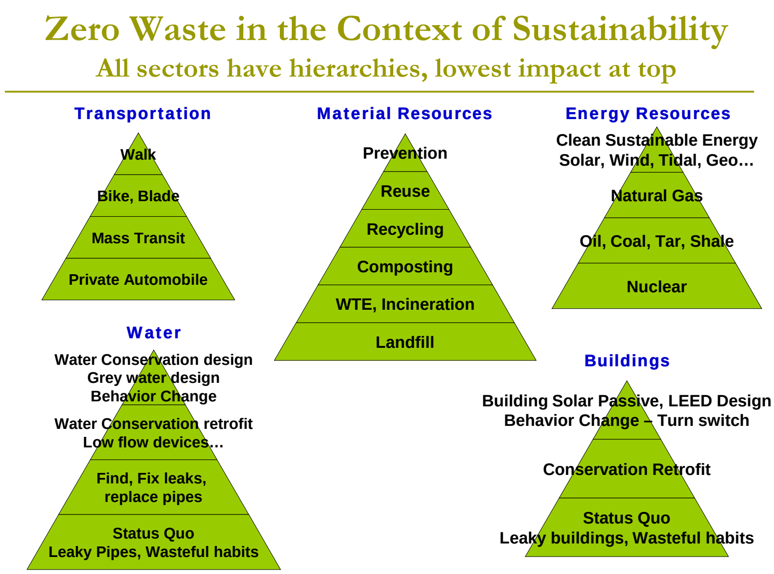

Fig. 2. Sustainability Hierarchies [6]

At the same time, the UN has been encouraging measures to reduce human impact on climate change, hosting conventions, most recently in Durban, South Africa in December 2011,[7] and publishing documents and recommendations to reduce carbon-based emissions, including Cities and Climate Change: Global Report on Human Settlements, 2011, [8] which reviews policy responses, strategies and practices that are emerging in urban areas to mitigate and adapt to climate change, as well as their potential achievements and constraints. Jurisdictions have responded and some are writing Climate Action Plans (CAPs) [9] and/or calculating their community's carbon footprint using ICLEI or other methods. [10]

Unfortunately, for years, the ICLEI community carbon footprint calculation excluded the greenhouse gas (GHG) impacts on climate caused by extraction, manufacturing, transportation (production) of products and packaging that it imported from other locations, thereby underreporting the impact and therefore, potential, of zero waste systems. [11] Figure 3 shows how New York City calculated its carbon footprint in its 2007 report, counting only emissions associated with one landfill in 1995, contributing 3% of the total carbon footprint, and nothing at all in subsequent years, because all waste materials were being exported outside the city then. Carbon emissions generated due to the demand for products and packaging by New York City residents and businesses were ignored in the calculations as was impact from exporting waste.

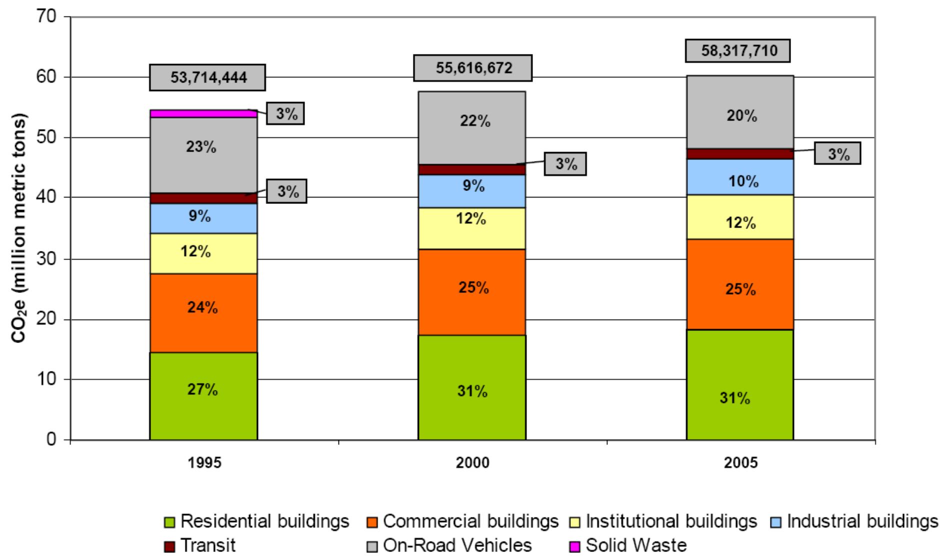

Figure 7. Time Series of New York City's citywide CO_2e emissions by sector, 1995, 2000, 2005.

Fig. 3. Time Series of New York City's citywide CO_2e emissions by sector, 1995, 2000, 2005.

Meanwhile, according to its current website, USEPA is in the process of gathering and reviewing new life-cycle inventory (LCI) data for several material types to develop updated and new emission factors for WARM, its model for estimating and comparing net greenhouse gas emissions vs. a baseline and across alternative management pathways.[12] WARM first appeared in EPA's 1994 U.S. Climate Change Action Plan. In 1990 an international group of experts, of which I was part, under the auspices of SETAC (Society of Toxicology and Chemistry) wrote the first document on what LCA (Life cycle assessment) should look like.[13] The first of three analyses would be LCI or life cycle inventory, where all emissions/environmental impacts would be categorized and emissions listed for each stage of production/use/discard cradle-to-grave. This was supposed to be the easy part. The next stage would convert the apples and oranges of the list of emissions to a single factor so that all could be aggregated to a single sum and compared with an alternative scenario (e.g. paper vs. plastic bags). The single factor could be something like risk of cancer (which could be applied well if all emissions were carcinogenic) or CO_2 equivalents (which applies well if all emissions include CO_2 eq.) Most, if not all, categories of waste do involve generation of CO_2 eq in one or more stages of their lifecycle. Third stage of analysis would be to determine how to retool the various lifecycle stages in the process to prevent or reduce pollution. In light of the 1990 SETAC report providing the blueprint for lifecycle assessment, and the genesis of WARM in 1994, the statement that EPA is still in the process of gathering and reviewing life-cycle inventory data 20 years later is disappointing.

In addition to carbon and other pollutant emissions being less as you go up the hierarchy, studies have lately found that job creation also increases when using greener practices. Figures 4 and 5, below, show the number of jobs created with reuse and recycling are considerably more than for waste disposal.

Type of Operation	Jobs per 10,000 TPY
Product Reuse	
Computer Reuse	233
Textile Reclamation	93
Misc. Durables Reuse	69
Wooden Pallet Repair	31
Recycling-based Manufacturers	
Paper Mills	19
Glass Product Manufacturers	29
Plastic Product Manufacturers	102
Conventional Materials Recovery Facilities	**11**
Composting	**4**
Landfill and Incineration	**1**

TPY = tonnes per year
Note: Figures are based on interviews with selected facilities around the U.S.
Source: Brenda Platt and Neil Seldman, *Wasting and Recycling in the United States 2000* (GrassRoots Recycling Network, Athens, Georgia, U.S.: 2000), p. 27.

Figure 4. Job Creation in the U.S. – Reuse and Recycling vs. Disposal

	Incineration	Recycling/Composting Approach
Metric tonnes per day generated	3,500	3,500
Metric tonnes per day diverted from landfill disposal	1,750	3,150
Diversion level	50%	90%
Capital cost (US$)	$119 million	$4.6 million
Workers employed	320	5,600
Impact	waste encouraged dirty environment with much litter citizens oppose system increased truck traffic and pollution citizens continue throw-away habit reliance on foreign technology and know-how	waste reduced clean environment and neighborhoods citizens support and are involved in system decreased truck traffic (reliance on pedal power) citizens take responsibility for waste reliance on local resources and know-how

Note: Incineration costs are based on a 600 tonne-per-day incinerator planned for Perungudi in Chennai (plant cost is Rs 200 crore or US$41 million). (One crore is 10 million Rs.) Three incinerators would be needed to handle the 1,750 tonnes per day. Jobs for the incinerator are based on employment figures for U.S. incinerators. The costs and employment for the recycling/composting approach are extrapolated from Exnora International's recycling/composting program model, which is working in many communities across India. Tonnage data for Chennai was reported in The Hindu, June 18th, 2002, and attributed to Exnora International.

Source: Institute for Local Self-Reliance, Washington, D.C., U.S., April 2004.

Figure 5. Comparison of incineration vs. a recycling/composting approach, Chennai, India

Linking Zero Waste Systems and Climate Change Plans

But in 2006, EPA's third edition of Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks, was published, showing, in great detail, with tables of data including carbon emissions, sinks, and contributing factors for these calculations, for many materials in the waste stream and for source reduction, recycling, composting, waste-to-energy, and landfilling scenarios.[14] Figure 6 shows clearly how for most of the material categories, source reduction and recycling produce a net negative GHG emission, whereas combustion and landfilling have net positive GHG emission or just slightly negative.

Net GHG Emissions from Source Reduction and MSW Management Options (MTCE/Ton)

Material	Source Reduction[a]	Recycling	Composting	Combustion[b]	Landfilling[c]
Aluminum Cans	-2.24	-3.70	NA	0.02	0.01
Steel Cans	-0.87	-0.49	NA	-0.42	0.01
Copper Wire	-2.00	-1.34	NA	0.01	0.01
Glass	-0.16	-0.08	NA	0.01	0.01
HDPE	-0.49	-0.38	NA	0.25	0.01
LDPE	-0.62	-0.46	NA	0.25	0.01
PET	-0.57	-0.42	NA	0.30	0.01
Corrugated Cardboard	-1.52	-0.85	NA	-0.18	0.11
Magazines/Third-class Mail	-2.36	-0.84	NA	-0.13	-0.08
Newspaper	-1.33	-0.76	NA	-0.20	-0.24
Office Paper	-2.18	-0.78	NA	-0.17	0.53
Phonebooks	-1.72	-0.72	NA	-0.20	-0.24
Textbooks	-2.50	-0.85	NA	-0.17	0.53
Dimensional Lumber	-0.55	-0.67	NA	-0.21	-0.13
Medium-density Fiberboard	-0.60	-0.67	NA	-0.21	-0.13
Food Discards	NA	NA	-0.05	-0.05	0.20
Yard Trimmings	NA	NA	-0.05	-0.06	-0.06
Mixed Paper					
Broad Definition	NA	-0.96	NA	-0.18	0.09
Residential Definition	NA	-0.96	NA	-0.18	0.07
Office Paper Definition	NA	-0.93	NA	-0.16	0.13
Mixed Metals	NA	-1.43	NA	-0.29	0.01
Mixed Plastics	NA	-0.41	NA	0.27	0.01
Mixed Recyclables	NA	-0.79	NA	-0.17	0.04
Mixed Organics	NA	NA	-0.05	-0.05	0.06
Mixed MSW (as disposed)	NA	NA	NA	-0.03	0.12
Carpet	-1.09	-1.96	NA	0.11	0.01
Personal Computers	-15.13	-0.62	NA	-0.05	0.01
Clay Bricks	-0.08	NA	NA	NA	0.01
Concrete	NA	0.00	NA	NA	0.01
Fly Ash	NA	-0.24	NA	NA	0.01
Tires	-1.09	-0.50[d]	NA	0.05	0.01

Note that totals may not add due to rounding, and more digits may be displayed than are significant.
NA: Not applicable, or in the case of composting of paper, not analyzed.
[a] Source reduction assumes displacement of current mix of virgin and recycled inputs.
[b] Values are for mass burn facilities with a national average rate of ferrous recovery.
[c] Values reflect national average CH_4 recovery in year 2004.
[d] Recycling of tires, as modeled in this analysis, consists only of retreading the tires.

Fig. 6. Net Greenhouse Gas Emissions for Source Reduction and Management Methods [15]

In 2009 another important development, critical to demonstrating the impact of production of products and packaging on greenhouse gas emissions, came with the USEPA publication, “Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices”. [16]

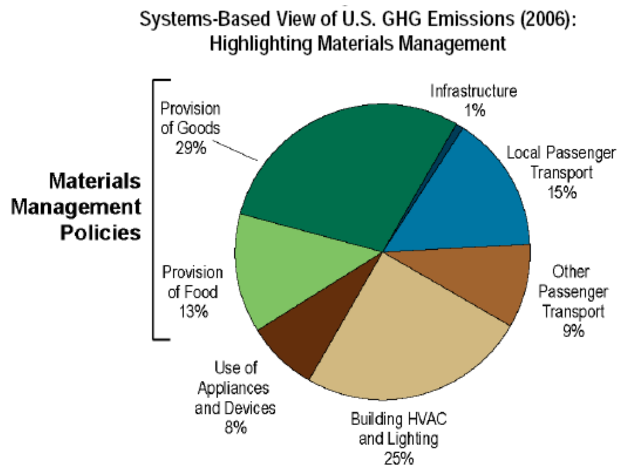

Fig. 7. Provision of Goods and Materials contribute 42% to U.S. Greenhouse Gas Emissions [17]

Figure 7 shows that when upstream (in the product lifecycle) carbon emissions due to production of goods and food are included in the analysis, these make a significant (42%) contribution to greenhouse gas emissions, and therefore, materials management policies (e.g. zero waste systems) become a major means of reducing greenhouse gas emissions. It also shows how earlier carbon footprint calculations, based only on the carbon emissions from waste disposal facilities within a community’s borders and ignoring upstream lifecycle impacts and those occurring outside the community’s borders, were erroneous.

With these two recent reports, states and communities were able to start calculating the carbon footprints and reduced emissions more accurately.

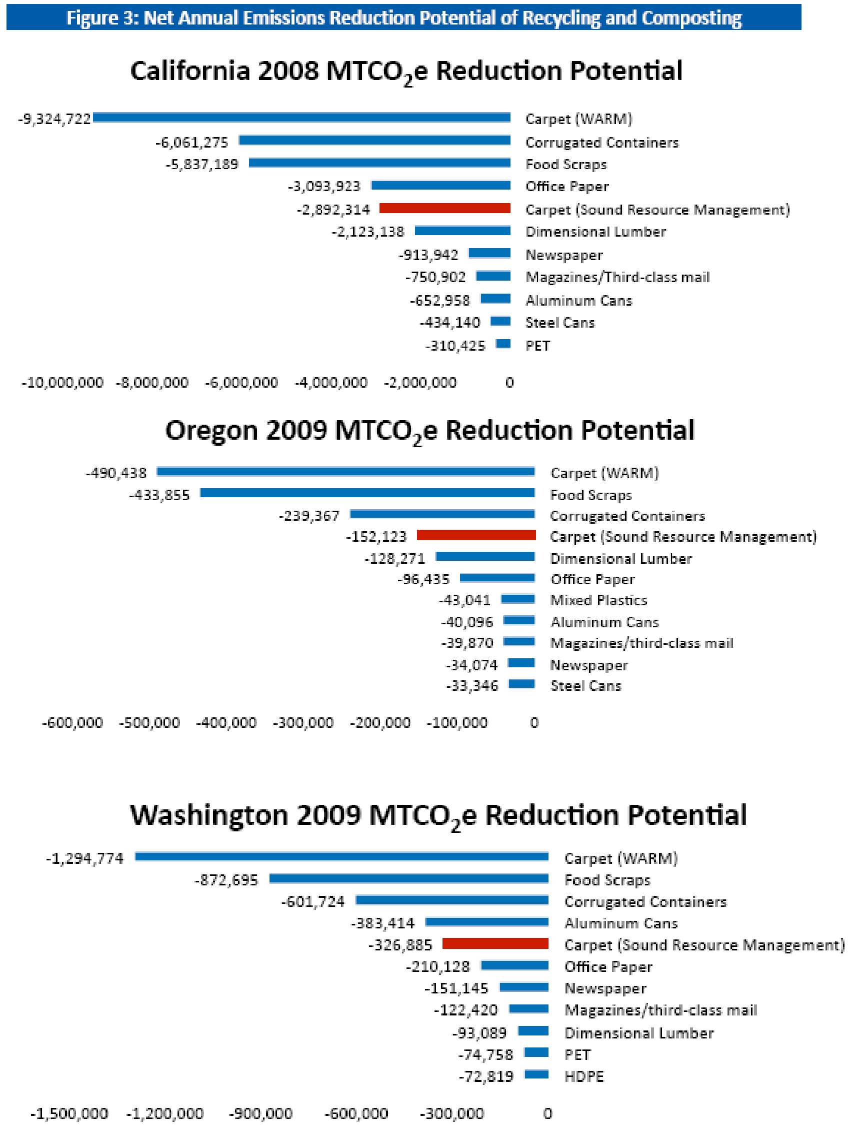

Fig. 8. EPA CO_2 eq. Reduction Potential for California, Oregon and Washington using the WARM model [18]

CALIFORNIA			OREGON			WASHINGTON		
Material Type	Est. Tons	$MTCO_2e$ Reduction Potential	Material Type	Est. Tons	$MTCO_2e$ Reduction Potential	Material Type	Est. Tons	$MTCO_2e$ Reduction Potential
Carpet (WARM)[13]	1,285,473	9,324,721	Carpet (WARM)	67,610	490,438	Carpet (WARM)	145,282	1,053,864
Carpet (Sound Resource Management)[14]	1,285,473	2,892,314	Carpet (Sound Resource Management)	67,610	152,123	Carpet (Sound Resource Management)	145,282	326,885
Core Recyclables	**3,904,101**	**12,217,563**	**Core Recyclables**	**180,860**	**526,229**	**Core Recyclables**	**495,334**	**1,616,408**
Aluminum Cans	*47,829*	*652,958*	*Aluminum Cans*	*2,937*	*40,096*	*Aluminum Cans*	*28,085*	*383,414*
Corrugated Containers	*1,905,897*	*6,061,274*	*Corrugated Containers*	*75,266*	*239,367*	*Corrugated Containers*	*189,205*	*601,724*
Magazines	*283,069*	*750,902*	*Magazines*	*15,030*	*39,870*	*Magazines*	*46,149*	*122,420*
Newspaper	*499,960*	*913,943*	*Newspaper*	*18,640*	*34,074*	*Newspaper*	*82,682*	*151,145*
Office Paper	*731,298*	*3,093,923*	*Mixed Plastics*	*28,035*	*43,041*	*Office Paper*	*49,667*	*210,128*
PET	*199,643*	*310,425*	*Office Paper*	*22,794*	*96,435*	*PET*	*48,079*	*74,758*
Steel Cans	*236,405*	*434,140*	*Steel Cans*	*18,158*	*33,346*	*HDPE*	*51,467*	*72,819*
Dimensional Lumber	1,184,375	2,123,138	Dimensional Lumber	71,555	128,271	Dimensional Lumber	51,929	93,089
Food Scraps	6,158,120	5,837,189	Food Scraps	457,709	433,855	Food Scraps	920,676	872,695

Fig. 9 Materials with Highest Potential for GHG Emissions Reduction by State [19]

The Institute for Local Self Reliance, Eco-Cycle and Gaia published a report, "Stop Trashing the Climate" in June 2008 making the connection between zero waste and carbon emissions reduction. This table shows the great potential of zero waste to help stabilize climate change vis a vis commonly considered options such as transportation and building conservation strategies.

Table ES-1: Greenhouse Gas Abatement Strategies: Zero Waste Path Compared to Commonly Considered Options (annual reductions in greenhouse gas emissions by 2030, megatons CO_2 eq.)

Greenhouse Gas Abatement Strategy	Annual Abatement Potential by 2030	% of Total Abatement Needed in 2030 to Stabilize Climate by 2050[1]
ZERO WASTE PATH		
Reducing waste through prevention, reuse, recycling and composting	**406**	**7.0%**
ABATEMENT STRATEGIES CONSIDERED BY McKINSEY REPORT		
Increasing fuel efficiency in cars and reducing fuel carbon intensity	**340**	**5.9%**
Improved fuel efficiency and dieselization in various vehicle classes	195	3.4%
Lower carbon fuels (cellulosic biofuels)	100	1.7%
Hybridization of cars and light trucks	70	1.2%
Expanding & enhancing carbon sinks	**440**	**7.6%**
Afforestation of pastureland and cropland	210	3.6%
Forest management	110	1.9%
Conservation tillage	80	1.4%
Targeting energy-intensive portions of the industrial sector	**620**	**10.7%**
Recovery and destruction of non-CO_2 GHGs	255	4.4%
Carbon capture and storage	95	1.6%
Landfill abatement (focused on methane capture)	65	1.1%
New processes and product innovation (includes recycling)	70	1.2%
Improving energy efficiency in buildings and appliances	**710**	**12.2%**
Lighting retrofits	240	4.1%
Residential lighting retrofits	130	2.2%
Commercial lighting retrofits	110	1.9%
Electronic equipment improvements	120	2.1%
Reducing the carbon intensity of electric power production	**800**	**13.8%**
Carbon capture and storage	290	5.0%
Wind	120	2.1%
Nuclear	70	1.2%

Fig 10. Comparison of zero waste to other methods of stabilizing climate change [20]

Zero Waste as used in various climate action plans

EPA advises state and local jurisdictions on writing Climate Action Plans and has a listing of plans on its website:

> "A climate change action plan lays out a strategy, including specific policy recommendations, that a local government will use to address climate change and reduce its greenhouse gas (GHG) emissions" [21]

Many jurisdictions now have climate action plans, but not all have recognized the importance of including zero waste measures in reaching their goals as yet. Following are a few of the cities and one large business that have climate action plans with significant zero waste goals and provisions.

Portland, OR

Portland's 2009 climate action plan is an aggressive one, aiming to reduce carbon levels to 40% below 1990 levels by 2030 and to 80% below by 2050 (and the state of Oregon is aiming for 75% below by 2050). Its zero waste achievements are already high, with a recycling rate of 64%, almost twice the national average. Its goals are:

- To reduce solid waste generated by 25% by 2030, which, with expected population increases will require residents and businesses to generate about half the waste they do today.
- Recover 90% of all waste generated by 2030, 75% by 2015.
- Reduce the greenhouse gas impacts of the waste collection system by 40% by 2030. This includes weekly food and recycling collections, shifting standing waste collections to every other week, using cleaner transportation fuels and emission control technologies. By 2012 there are many actions specified for completion.

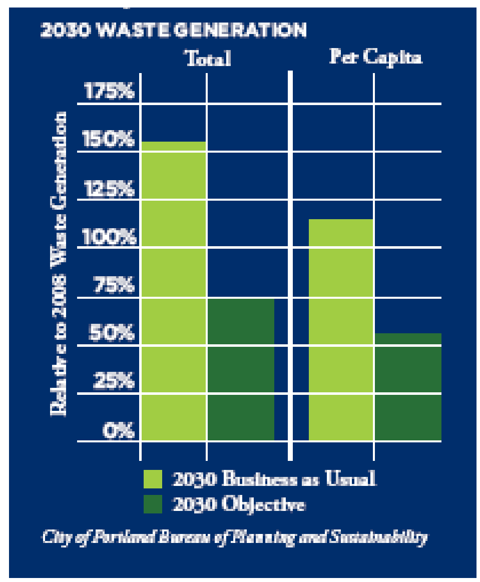

Figure 11. Portland 2030 waste generation objectives

***Oakland**, CA*

The Oakland City Council adopted a Zero Waste Goal in 2006, with a goal of 90% reduction in waste sent to landfill by 2020. These strategies prioritize "systems" solutions to reduce landfilled waste, and expand waste reduction, recycling and composting programs. By pursuing the City's adopted Zero Waste strategies, Oakland can help to create GHG reductions on the same order of magnitude as those related to transportation and building energy use.

"A number of tools are available to the City to reduce GHG emissions associated with material consumption and waste. These include: restructuring Oakland's municipal code, garbage franchise agreement, and residential recycling service contracts; increasing reuse, repair, recycling and composting; advocating for statewide producer responsibility legislation, and promoting local food and material choices. Replacing energy-intensive virgin resources with energy-efficient recycled resources can create significant GHG benefits and help to address global resource depletion. Composting organic wastes can help to replace emissions-intensive, petroleum-based fertilizers with carbon-capturing, water-saving compost, and reduces toxic runoff from California's farms. The Zero Waste hierarchy of reduce, reuse, recycle and compost can be viewed as a global energy efficiency program that significantly reduces the energy and other natural resources used to create consumer goods, from cars to packaging to food" [22]

San Francisco, CA

San Francisco's 2004 Climate Action Plan includes sections detailing zero waste measures accomplished and planned. These represent 302,000 tons of CO_2 reduced from a total of 2,614,000 for all categories of actions (also including transportation, energy efficiency, and renewable energy). [23]

Solid Waste Action Categories	Estimated CO_2 Reduction (tons)
A. Increase Residential Recycling and Composting	70,000
B. Increase Commercial Recycling and Composting	109,000
C. Expand Construction and Demolition Debris Recycling	57,000
D. Support Alternate Collection Methods for Recyclable Materials	66,000
E. Promote Source Reduction, Reuse and Other Waste Reduction[95]	–
F. Expand Municipal Programs[96]	–
Total	**302,000**

Fig. 12. San Francisco Climate Action Plan – Summary of Solid Waste Actions and Estimated CO_2 Reductions [24]

Berkeley, CA

Berkeley, like its fellow Bay area cities, has a long history with zero waste, and has an entire chapter on it in its 2009 Climate Action Plan, detailing achievements and plans. [25] Its overall goal is to increase residential recycling, composting, and source reduction to meet Berkeley's Zero Waste goal by eliminating all materials sent to landfills by the year 2020. [26]

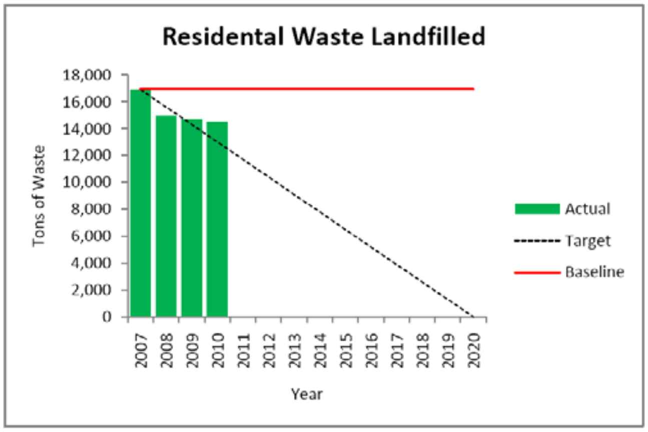

Fig. 13. Berkeley Residential Waste Landfilled – Actual, Target, and Baseline 2007-2020 [27]

Town of San Anselmo, CA (Marin County)

The Town of San Anselmo, CA has a Climate Action Plan of almost 50 pages including estimates of GHG emissions avoided from zero waste measures. [28]

Table 12: Section 3.6 Community Mitigation Measures

Mitigation Measures for Community		
Measure		GHG Reductions (Metric Tons)
3.6.C1	Divert All Food Waste from Landfill	395
3.6.C2	Reduce All Other Solid Waste Disposal to Landfills by 25%	443
	TOTAL	838
	% Reduced from 2005 Levels	1.2%

Table 13: Section 3.6 Government Operations Mitigation Measures

Mitigation Measures for Government Operations				
Measure		Cost to Implement	Annual Savings	GHG Reductions (Metric Tons)
3.6.G1	Reduce Solid Waste Disposal to Landfill by 25%	n/a	n/a	10.5
	% Reduced from 2005 Levels			1.7%

Fig. 14. San Anselmo, CA zero waste measures and GHG Reductions [29]

SFO Airport

San Francisco airport released its most recent revision of its Climate Action Plan in February, 2010, including a zero waste plan. [30] Its goals are a recycling rate of 75% by 2010 and 100% by 2020.

An example of calculations using EPA's WARM system (version 10 released Nov. 2009):

Activity Type	Solid Waste Generation (Tons)			GHG Emission[a] (Tonnes)		
	1990[b]	FY 2008[c]	FY 2009	1990	FY 2008	FY 2009
Landfilled Solid Waste:						
General Waste	9,913	6,460	3,249	2,975	1,938	975
Construction/Demolition	50,000	4,636	4,000	1,950	181	156
Subtotal Disposal GHG Emission				4,925	2,119	1,131
Recycled Solid Waste:						
General Recycling	0	3,442	3,125	0	(10,490)	(9,525)
Composting	0	808	3,350		(154)	(638)
Recycled Construction / Demolition Waste	0	112,264	90,000	0	(799)	(644)
Subtotal Recycling GHG Emission				0	(11,443)	(10,807)
Total	59,913	126,618	103,724	4,925	(9,324)	(9,676)

Fig. 15. San Francisco Airport waste generation and GHG emissions over time [31]

Seattle, WA

Seattle is one of the jurisdictions that is currently working on marrying its zero waste planning effort with its sustainability and climate change planning, having recognized the contribution of upstream goods production emissions and emissions outside the city borders as important to its climate action plan. The City Council unanimously passed a resolution adopting zero net carbon emissions by 2050 as a goal for the updated Climate Action Plan, which is being developed in 2012. In 2011 Seattle recalculated its overall and per capita GHG emissions from a consumption perspective, aggregating all the emissions from producing the goods, food and services consumed in Seattle, including the majority, which are produced outside Seattle's border. In this report, it was noted that there is no standard method for doing so. It estimated 25 tonnes of CO_2 eq., considerably more than Seattle's official previous per capita calculation of 11 tonnes per capita, but less than the national average close to 29 tonnes. [32]

Some of the zero waste measures already put in place for Seattle include:

- A 20 cent fee for disposable shopping bags provided at convenience, drug and grocery stores beginning Jan. 2009.
- Beginning food scrap collections at single-family residences starting 2009
- Prohibition on use of polystyrene food containers and requiring businesses to use recyclable and compostable packaging (2010)
- A cap on waste sent to landfills (the amount sent in 2006)[33]

SUMMARY

Thanks to continued data gathering and research by governmental agencies such as EPA, documents and recommendations drafted at the international level by the United Nations, the work of nonprofit organizations like the Grassroots Recycling Network, ILSR, ICLEI, and others have resulted in a number of communities recognizing the importance of preparing climate action plans that include a zero waste component. Though this trend is in an early stage, with the data and methodologies that are already available, early-adopting communities have begun to establish their own zero waste goals and develop detailed methodologies and steps to achieve those goals as part of their climate action plans, to the benefit of both zero waste and climate change prevention achievements.

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KEYWORDS: zero waste; climate action plans; recycling; greenhouse gases; waste prevention.