STOP TRASHING THE CLIMATE

EXECUTIVE SUMMARY
June 2008

ILSR Institute for Local Self-Reliance
eco·cycle Working to Build Zero Waste Communities
gaia

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A ZERO WASTE APPROACH IS ONE OF THE FASTEST, CHEAPEST, AND MOST EFFECTIVE STRATEGIES TO PROTECT THE CLIMATE.

Significantly decreasing waste disposed in landfills and incinerators will reduce greenhouse gas emissions the equivalent to closing 21% of U.S. coal-fired power plants. This is comparable to leading climate protection proposals such as improving national vehicle fuel efficiency. Indeed, preventing waste and expanding reuse, recycling, and composting are essential to put us on the path to climate stability.

KEY FINDINGS:

1. A zero waste approach is one of the fastest, cheapest, and most effective strategies we can use to protect the climate and the environment. Significantly decreasing waste disposed in landfills and incinerators will reduce greenhouse gases the equivalent to closing one-fifth of U.S. coal-fired power plants. This is comparable to leading climate protection proposals such as improving vehicle fuel efficiency. Indeed, implementing waste reduction and materials recovery strategies nationally are essential to put us on the path to stabilizing the climate by 2050.

2. Wasting directly impacts climate change because it is directly linked to global resource extraction, transportation, processing, and manufacturing. When we minimize waste, we can reduce greenhouse gas emissions in sectors that together represent 36.7% of all U.S. greenhouse gas emissions.

3. A zero waste approach is essential. Through the Urban Environmental Accords, 103 city mayors worldwide have committed to sending zero waste to landfills and incinerators by the year 2040 or earlier.

4. Existing waste incinerators should be retired, and no new incinerators or landfills should be constructed.

5. Landfills are the largest source of anthropogenic methane emissions in the U.S., and the impact of landfill emissions in the short term is grossly underestimated — methane is 72 times more potent than CO_2 over a 20-year time frame.

6. The practice of landfilling and incinerating biodegradable materials such as food scraps, paper products, and yard trimmings should be phased out immediately. Composting these materials is critical to protecting our climate and restoring our soils.

7. Incinerators emit more CO_2 per megawatt-hour than coal-fired, natural-gas-fired, or oil-fired power plants. Incinerating materials such as wood, paper, yard debris, and food discards is far from "climate neutral"; rather, incinerating these and other materials is detrimental to the climate.

8. Incinerators, landfill gas capture systems, and landfill "bioreactors" should not be subsidized under state and federal renewable energy and green power incentive programs or carbon trading schemes. In addition, subsidies to extractive industries such as mining, logging, and drilling should be eliminated.

9. New policies are needed to fund and expand climate change mitigation strategies such as waste reduction, reuse, recycling, composting, and extended producer responsibility. Policy incentives are also needed to create locally-based materials recovery jobs and industries.

10. Improved tools are needed for assessing the true climate implications of the wasting sector.

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***Stop Trashing the Climate* provides compelling evidence that preventing waste and expanding reuse, recycling, and composting programs — that is, aiming for zero waste — is one of the fastest, cheapest, and most effective strategies available for combating climate change.** This report documents the link between climate change and unsustainable patterns of consumption and wasting, dispels myths about the climate benefits of landfill gas recovery and waste incineration, outlines policies needed to effect change, and offers a roadmap for how to significantly reduce greenhouse gas (GHG) emissions within a short period.

Immediate and comprehensive action by the United States to dramatically reduce greenhouse gas emissions is desperately needed. Though the U.S. represents less than 5% of the world's population, we generate 22% of the world's carbon dioxide emissions, use 30% of the world's resources, and create 30% of the world's waste.[1] If unchecked, annual greenhouse gas emissions in the U.S. will increase to 9.7 gigatons* carbon-dioxide equivalents (CO_2 eq.) by 2030, up from 6.2 gigatons CO_2 eq. in 1990.[2] Those who are most impacted by climate change, both globally and within the U.S., are people of color and low-income and indigenous communities — the same people who are least responsible for rapidly increasing greenhouse gas emissions.[3] To effectively address global climate change, the U.S. must dramatically shift its relationship to natural resources. A zero waste approach is a crucial solution to the climate change problem.

Stop Trashing the Climate provides an alternative scenario to business-as-usual wasting in the U.S. By reducing waste generation 1% each year and diverting 90% of our discards from landfills and incinerators by the year 2030, we could dramatically reduce greenhouse gas emissions within the U.S. and around the world. This waste reduction scenario would put us solidly on track to achieving the goal of sending zero waste to landfills and incinerators by the year 2040, the target established by the Urban Environmental Accords, which 103 city mayors worldwide have signed.[4]

By reducing waste creation and disposal, the U.S. can conservatively decrease greenhouse gas emissions by 406 megatons‡ CO_2 eq. per year by 2030. This zero waste approach would reduce greenhouse gas emissions the equivalent of closing one-fifth of the existing 417 coal-fired power plants in the U.S.[5] This would achieve 7% of the cuts in U.S. greenhouse gas emissions needed to put us on the path to achieving what many leading scientists say is necessary to stabilize the climate by 2050.[6, 7, 8] Indeed, reducing waste has comparable (and sometimes complementary) benefits to the leading strategies identified for climate protection, such as significantly improving vehicle fuel efficiency and hybridizing vehicles, expanding and enhancing carbon sinks (such as forests), and retrofitting lighting and improving electronic equipment. (See Table ES-1.) Further, a zero waste approach has greater potential for protecting the climate than environmentally harmful strategies proposed to reduce carbon emissions such as the expansion of nuclear energy. Moreover, reuse, recycling, and composting facilities do not have the severe liability or permitting issues associated with building nuclear power plants or carbon capture and storage systems.[9]

The good news is that readily available cost-competitive and effective strategies to reduce, reuse, and recover discarded materials can be implemented on a wide scale within a relatively short time period.

* 1 gigaton = 1 billion metric tons
‡ 1 megaton = 1 million metric tons = 1 Tg (teragram)

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%

The McKinsey Report analyzed more than 250 opportunities to reduce greenhouse gas emissions. While the authors evaluated options for three levels of effort—low-, mid-, and high-range—they only reported greenhouse gas reduction potential for the mid-range case opportunities. The mid-range case involves concerted action across the economy. Values for select mid-range abatement strategies are listed above. The zero waste path abatement potential also represents a mid-range case, due to shortcomings in EPA's WARM model, which underestimates the reduction in greenhouse gases from source reduction and composting as compared to landfilling and incineration. A high-range zero waste path would also provide a more accelerated approach to reducing waste generation and disposal.

The authors of this report, *Stop Trashing the Climate*, do not support all of the abatement strategies evaluated in the McKinsey Report. We do not, for instance, support nuclear energy production.

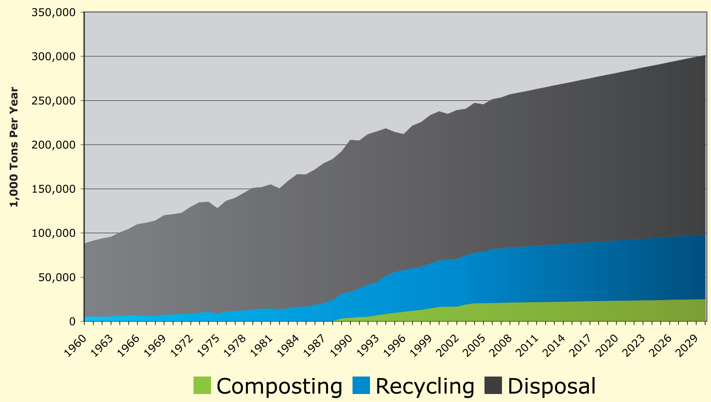
1. In order to stabilize the climate, U.S. greenhouse gas emissions in 2050 need to be at least 80% below 1990 levels. Based on a straight linear calculation, this means 2030 emissions levels should be 37% lower than the 1990 level, or equal to 3.9 gigatons CO_2 eq. Thus, based on increases in U.S. greenhouse gases predicted by experts, 5.8 gigatons CO_2 eq. in annual abatement is needed in 2030 to put the U.S. on the path to help stabilize the climate by 2050.

Source: Jon Creyts et al, *Reducing U.S. Greenhouse Gas Emissions: How Much and at What Cost? U.S. Greenhouse Gas Abatement Mapping Initiative, Executive Report,* McKinsey & Company, December 2007. Available online at: http://www.mckinsey.com/clientservice/ccsi/greenhousegas.asp. Abatement potential for waste reduction is calculated by the Institute for Local Self-Reliance, Washington, DC, June 2008, based on the EPA's WAste Reduction Model (WARM) to estimate GHGs and based on extrapolating U.S. EPA waste generation and characterization data to 2030, assuming 1% per year source reduction, and achieving a 90% waste diversion by 2030.

To achieve the remarkable climate protection potential of waste reduction, we must stem the flow of materials to landfills and halt the building and use of incinerator facilities. Landfills and incinerators destroy rather than conserve materials. For every item that is landfilled or incinerated, a new one must be extracted, processed, and manufactured from raw or virgin resources. Americans destroy nearly 170 million tons of paper, metals, plastics, food scraps, and other valuable materials in landfills and incinerators each year. More than two thirds of the materials we use are still burned or buried,[10] despite the fact that we have the technical capacity to cost-effectively recycle, reuse or compost 90% of what we waste.[11] Millions of tons of valuable resources are also needlessly wasted each year because products are increasingly designed to be used only once.[12]

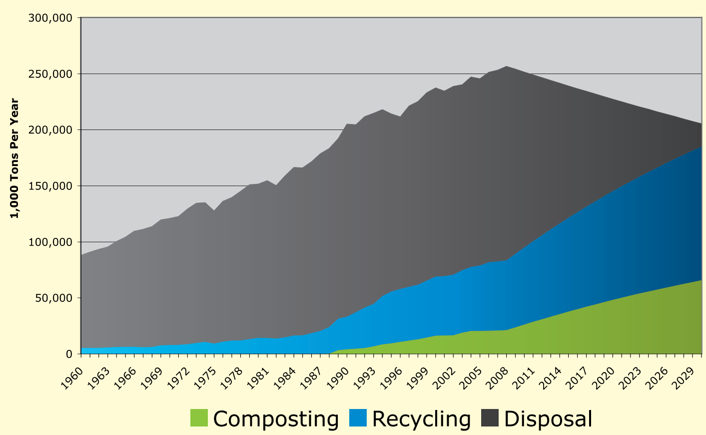
If we continue on the same wasting path with rising per capita waste generation rates and stagnating recycling and composting rates, by the year 2030 Americans could generate 301 million tons per year of municipal solid waste, up from 251 million tons in 2006. Figure ES-1, Business As Usual, visually represents the future projection of this trend based on our current wasting patterns. Figure ES-2, Zero Waste Approach, illustrates an alternate path based on rising recycling and composting rates and the source reduction of 1% of waste per year between 2008 and 2030. Under this zero waste approach, 90% of the municipal solid waste generated in the U.S. could be diverted from disposal facilities by 2030. Using the U.S. EPA's WAste Reduction Model (WARM) to estimate greenhouse gas reduction, the zero waste approach — as compared to the business-as-usual approach — would reduce greenhouse gases by an estimated 406 megatons CO_2 eq. per year by 2030. This reduction of 406 megatons CO_2 eq. per year is equivalent to closing 21% of the nation's 417 coal-fired power plants.

Figure ES-1: Business As Usual Recycling, Composting, Disposal



Source: Brenda Platt and Heeral Bhalala, Institute for Local Self-Reliance, Washington, DC, June 2008, using and extrapolating from U.S. EPA municipal solid waste characterization data. Waste composition in future assumed the same as 2006. The diversion level through recycling and composting flattens out at 32.5%. Takes into account U.S. Census estimated population growth.

Figure ES-2: Zero Waste Approach



Source: Brenda Platt and Heeral Bhalala, Institute for Local Self-Reliance, Washington, DC, June 2008. Past tonnage based on U.S. EPA municipal solid waste characterization data. Future tonnage based on reaching 90% diversion by 2030, and 1% source reduction per year between 2008 and 2030. Waste composition in future assumed the same as 2006. Takes into account U.S. Census estimated population growth.

Current assessments of greenhouse gas emissions from waste take an overly narrow view of the potential for the "waste sector" to mitigate climate change. This is largely a result of inventory methodologies used to account for greenhouse gases from waste. Conventional greenhouse gas inventory data indicate that the waste sector in the U.S. is solely responsible for 2.6% of all greenhouse gas emissions in 2005. This assessment, however, does not include the most significant climate change impact of waste disposal: We must continually extract new resources to replace those buried or burned. For every ton of discarded products and materials destroyed by incinerators and landfills, about 71 tons of manufacturing, mining, oil and gas exploration, agricultural, coal combustion, and other discards are produced.[13] More trees must be cut down to make paper. More ore must be mined for metal production. More petroleum must be processed into plastics.

By reusing instead of disposing of materials, we can keep more forests and other ecosystems intact, store or sequester large amounts of carbon, and significantly reduce our global warming footprint. For example, cutting deforestation rates in half globally over the next century would provide 12% of the global emissions reductions needed to prevent significant increases in global temperatures.[14]

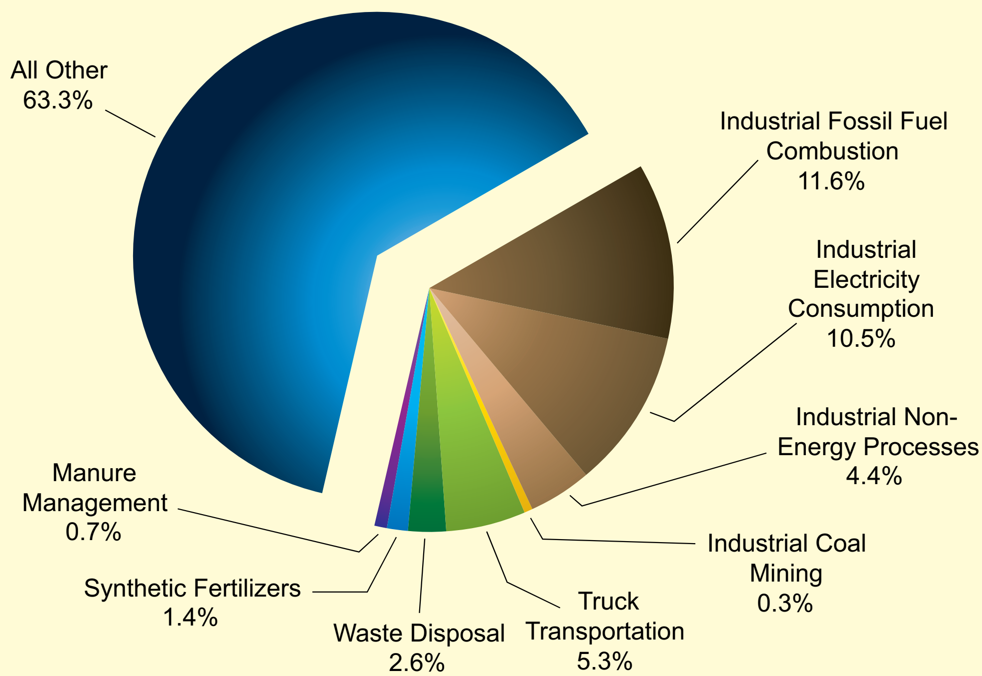
Reusing materials and reducing waste provide measurable environmental and climate benefits. According to a recent report to the California Air Resources Board, *Recommendations of the Economic and Technology Advancement Advisory Committee (ETAAC) Final Report on Technologies and Policies to Consider for Reducing Greenhouse Gas Emissions in California:*

> "Recycling offers the opportunity to cost-effectively decrease GHG emissions from the mining, manufacturing, forestry, transportation, and electricity sectors while simultaneously diminishing methane emissions from landfills. Recycling is widely accepted. It has a proven economic track record of spurring more economic growth than any other option for the management of waste and other recyclable materials. Increasing the flow through California's existing recycling or materials recovery infrastructures will generate significant climate response and economic benefits."[15]

In short, unsustainable consumption and waste disposal drive a climate-changing cycle in which resources are continually pulled out of the Earth, processed in factories, shipped around the world, and burned or buried in communities. The impact of this wasteful system extends far beyond local landfills and incinerators, causing greenhouse gas emissions up to thousands of miles away from these sources. In this way, U.S. related consumption and disposal are closely tied to greenhouse gas emissions from extractive and manufacturing industries in countries such as China.

Thus, reducing the amount of materials consumed in the first place is vital for combating climate change. In addition, when recovered materials are reused, recycled, and composted within local and regional economies, the climate protection benefits are even greater because significant greenhouse gas emissions associated with the transportation of products and materials are avoided.

Figure ES-3: Wasting Is Linked to 36.7% of Total U.S. Greenhouse Gas Emissions, 2005



Source: Institute for Local Self-Reliance, June 2008. Based on data presented in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2005*, U.S. EPA, Washington, DC, April 15, 2007. Industrial Electricity Consumption is estimated using Energy Information Administration 2004 data on electricity sales to customers. See Table ES-1, Electric Power Annual Summary Statistics for the United States, released October 22, 2007, and available online at: http://www.eia.doe.gov/cneaf/electricity/epa/epates.html. Waste disposal includes landfilling, wastewater treatment, and combustion. Synthetic fertilizers include urea production. All data reflect a 100-year time frame for comparing greenhouse gas emissions.

Key findings of this report

1. A zero waste approach is one of the fastest, cheapest, and most effective strategies we can use to protect the climate and environment. By significantly reducing the amount of waste landfilled and incinerated, the U.S can conservatively reduce greenhouse gas emissions by 406 megatons CO_2 eq. per year by 2030, which is the equivalent of taking 21% of the existing 417 coal-fired power plants off the grid.[16] A zero waste approach has comparable (and sometimes complementary) benefits to leading proposals to protect the climate such as significantly improving vehicle fuel efficiency and hybridizing vehicles, expanding and enhancing carbon sinks (such as forests), or retrofitting lighting and improving electronic equipment (see Table ES-1.) It also has greater potential for reducing greenhouse gas emissions than environmentally harmful strategies proposed such as the expansion of nuclear energy. Indeed, a zero waste approach would achieve 7% of the cuts in U.S. emissions needed to put us on the path to climate stability by 2050.

2. Wasting directly impacts climate change because it is directly linked to resource extraction, transportation, processing, and manufacturing. Since 1970, we have used up one-third of global natural resources.[17] Virgin raw materials industries are among the world's largest consumers of energy and are thus significant contributors to climate change because energy use is directly correlated with greenhouse gas emissions. Our linear system of extraction, processing, transportation, consumption, and disposal is intimately tied to core contributors of global climate change such as industrial energy use, transportation, and deforestation. When we minimize waste, we reduce greenhouse gas emissions in these and other sectors, which together represent 36.7% of all U.S. greenhouse gas emissions.[18] See Figure ES-3. It is this number that more accurately reflects the impact of the whole system of extraction to disposal on climate change.

3. A zero waste approach is essential. Through the Urban Environmental Accords, 103 city mayors worldwide have committed to sending zero waste to landfills and incinerators by the year 2040 or earlier.[19] More than two dozen U.S. communities and the state of California have also now embraced zero waste as a goal. These zero waste programs are based on (1) reducing consumption and discards, (2) reusing discards, (3) extended producer responsibility and other measures to ensure that products can safely be recycled into the economy and environment,* (4) comprehensive recycling, (5) comprehensive composting of clean segregated organics, and (6) effective policies, regulations, incentives, and financing structures to support these systems. The existing 8,659 curbside collection programs in the U.S. can serve as the foundation for expanded materials recovery.

4. Existing waste incinerators should be retired, and no new incinerators or landfills should be constructed. Incinerators are significant sources of CO_2 and also emit nitrous oxide (N_2O), a potent greenhouse gas that is approximately 300 times more effective than carbon dioxide at trapping heat in the atmosphere.[20] By destroying resources rather than conserving them, all incinerators — including mass-burn, pyrolysis, plasma, and gasification[21] — cause significant and unnecessary lifecycle greenhouse gas emissions. Pyrolysis, plasma, and gasification incinerators may have an even larger climate footprint than conventional mass-burn incinerators because they can require inputs of additional fossil fuels or electricity to operate. Incineration is also pollution-ridden and cost prohibitive, and is a direct obstacle to reducing waste and increasing recycling. Further, sources of industrial pollution such as incineration also disproportionately impact people of color and low-income and indigenous communities.[22]

* Extended producer responsibility requires firms, which manufacture, import or sell products and packaging, to be financially or physically responsible for such products over the entire lifecycle of the product, including after its useful life.

5. Landfills are the largest source of anthropogenic methane emissions in the U.S., and the impact of landfill emissions in the short term is grossly underestimated — methane is 72 times more potent than CO_2 over a 20-year time frame. National data on landfill greenhouse gas emissions are based on international accounting protocols that use a 100-year time frame for calculating methane's global warming potential.‡ Because methane only stays in the atmosphere for around 12 years, its impacts are far greater in the short term. Over a 100-year time frame, methane is 25 times more potent than CO_2. However, methane is 72 times more potent than CO_2 over 20 years.[23] (See Table ES-2.) The Intergovernmental Panel on Climate Change assesses greenhouse gas emissions over three time frames — 20, 100, and 500 years. The choice of which time frame to use is a policy-based decision, not one based on science.[24] On a 20-year time frame, landfill methane emissions alone represent 5.2% of all U.S. greenhouse gas emissions. (See Table ES-3.) Furthermore, landfill gas capture systems are not an effective strategy for preventing methane emissions to the atmosphere. The portion of methane captured over a landfill's lifetime may be as low as 20% of total methane emitted.[25]

6. The practice of landfilling and incinerating biodegradable materials such as food scraps, paper products, and yard trimmings should be phased out immediately. Non-recyclable organic materials should be segregated at the source and composted or anaerobically digested under controlled conditions.** Composting avoids significant methane emissions from landfills, increases carbon storage in soils and improves plant growth, which in turn expands carbon sequestration. Composting is thus vital to restoring the climate and our soils. In addition, compost is a value-added product, while landfills and incinerators present long-term environmental liabilities. Consequently, composting should be front and center in a national strategy to protect the climate in the short term.

"Scientifically speaking, using the 20-year time horizon to assess methane emissions is as equally valid as using the 100-year time horizon. Since the global warming potential of methane over 20 years is 72, reductions in methane emissions will have a larger short-term effect on temperature — 72 times the impact — than equal reductions of CO_2. Added benefits of reducing methane emissions are that many reductions come with little or no cost, reductions lower ozone concentrations near Earth's surface, and methane emissions can be reduced immediately while it will take time before the world's carbon-based energy infrastructure can make meaningful reductions in net carbon emissions."

– Dr. Ed J. Dlugokencky, Global Methane Expert, NOAA Earth System Research Laboratory, March 2008

Source: "Beyond Kyoto: Why Climate Policy Needs to Adopt the 20-year Impact of Methane," Eco-Cycle Position Memo, Eco-Cycle, www.ecocycle.org, March 2008.

‡ The Intergovernmental Panel on Climate Change (IPCC) developed the concept of global warming potential (GWP) as an index to help policymakers evaluate the impacts of greenhouse gases with different atmospheric lifetimes and infrared absorption properties, relative to the chosen baseline of carbon dioxide (CO_2).

** Anaerobic digestion systems can complement composting. After energy extraction, nutrient rich materials from digesters make excellent compost feedstocks.

Table ES-2: Potent Greenhouse Gases and Global Warming Potential (GWP)

Common Name	Chemical Formula	GWP for Given Time Horizon			
		SAR[1]	20 yr	100 yr	500 yr
Carbon Dioxide	CO_2	1	1	1	1
Methane	CH_4	21	72	25	8
Nitrous Oxide	N_20	310	289	298	153
<u>Hydrofluorocarbons</u>					
HFC-134a	CH_2FCF_3	1,300	3,830	1,430	435
HFC-125	CHF_2CF_3	2,800	6,350	3,500	1,100
<u>Perfluorinated compounds</u>					
Sulfur Hexafluoride	SF_6	23,900	16,300	22,800	32,600
PFC-14[2]	CF_4	6,500	5,210	7,390	11,200
PFC-116[2]	C_2F_6	9,200	8,630	12,200	18,200

1. IPCC Second Assessment Report (1996). Represents 100-year time horizon. These GWPs are used by the U.S. EPA in its *Inventory of U.S. Greenhouse Gas Emissions and Sinks.*
2. Released during aluminum production. PFC-116 has an expected lifetime of 1,000 years.

Source: Intergovernmental Panel on Climate Change (IPCC), "Table 2.14," p. 212, Forster, P., et al, 2007: Changes in Atmospheric Constituents and in Radiative Forcing. In: *Climate Change 2007: The Physical Science Basis.*

Table ES-3: Major Sources of U.S. Greenhouse Gas Emissions (Tg CO_2 Eq.), 2005, 100 Year vs. 20 Year Time Horizon

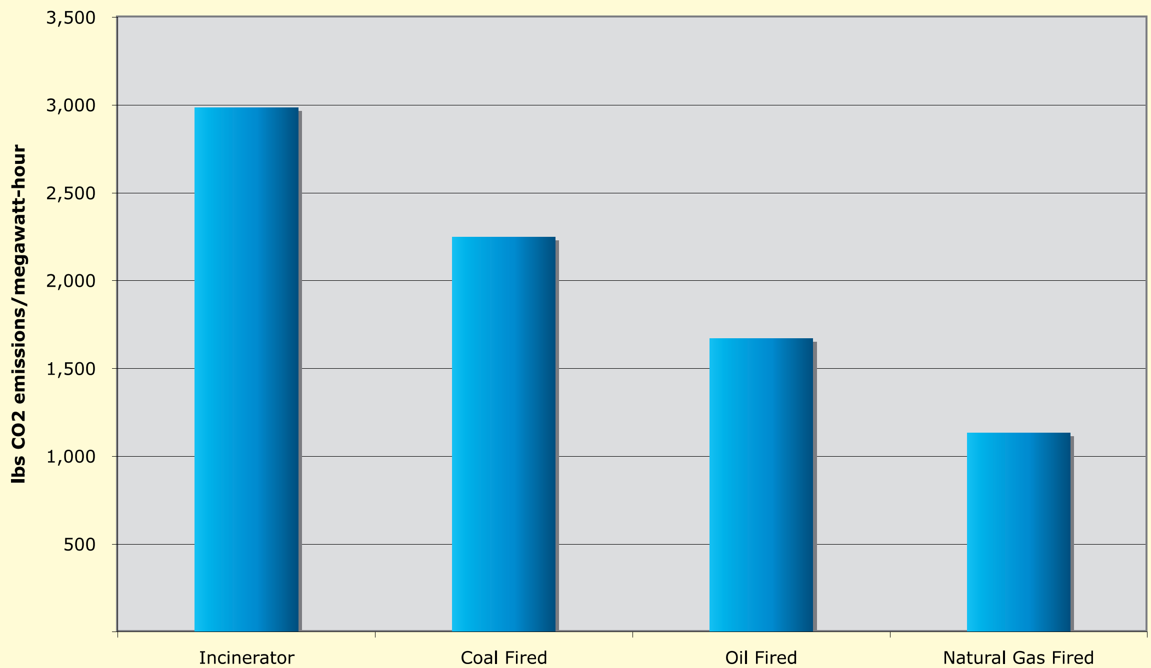
Emission Source	100 Yr Horizon		20 Yr Horizon[1]	
	Emissions	% of Total	Emissions	% of Total
Fossil Fuel Combustion (CO_2)	5,751.2	79.2%	5,751.2	65.7%
Agricultural Soil Mgt[2] (N_2O)	365.1	5.0%	340.4	3.9%
Non-Energy Use of Fuels[3] (CO_2)	142.4	2.0%	142.4	1.6%
Natural Gas Systems (CO_2 & CH_4)	139.3	1.9%	409.1	4.7%
Landfills (CH_4)	132.0	1.8%	452.6	5.2%
Substitution of ODS (HFCs, PFCs, SF_6)	123.3	1.7%	305.7	3.5%
Enteric Fermentation (CH_4)	112.1	1.5%	384.3	4.4%
Coal Mining (CH_4)	52.4	0.7%	179.7	2.1%
Manure Mgt (CH_4 & N_2O)	50.8	0.7%	150.5	1.7%
Iron & Steel Production (CO_2 & CH_4)	46.2	0.6%	48.6	0.6%
Cement Manufacture (CO_2)	45.9	0.6%	45.9	0.5%
Mobile Combustion (N_2O & CH_4)	40.6	0.6%	44.3	0.5%
Wastewater Treatment (CH_4 & N_2O)	33.4	0.5%	94.5	1.1%
Petroleum Systems (CH_4)	28.5	0.4%	97.7	1.1%
Municipal Solid Waste Combustion (CO_2 & N_2O)[4]	21.3	0.3%	21.3	0.2%
Other (28 gas source categories combined)	175.9	2.4%	286.0	3.3%
Total	**7,260.4**	100.0%	**8,754.2**	100.0%

ODS = Ozone Depleting Substances Tg = Teragram = million metric tons

1. Methane emissions converted to 20-year time frame. Methane's global warming potential is 72 over a 20-year time horizon, compared to 21 used for the 100-year time frame. N_2O emissions along with ODS, perfluorinated compounds, and hydrofluorocarbons have also been converted to the 20-year time horizon.
2. Such as fertilizer application and other cropping practices.
3. Such as for manufacturing plastics, lubricants, waxes, and asphalt.
4. CO_2 emissions released from the combustion of biomass materials such as wood, paper, food discards, and yard trimmings are not accounted for under Municipal Solid Waste Combustion in the EPA inventory. Biomass emissions represent 72% of all CO_2 emitted from waste incinerators.

Source: Institute for Local Self-Reliance, June 2008. Data for 100-year time horizon is from "Table ES-2: Recent Trends in U.S. Greenhouse Gas Emissions and Sinks," *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2005*, U.S. EPA, Washington, DC, April 15, 2007, p. ES-5 and p. 3-19.

Figure ES-4: Comparison of Total CO_2 Emissions Between Incinerators and Fossil-Fuel-Based Power Plants (lbs/megawatt-hour)



Source: U.S. EPA Clean Energy web page, "How Does Electricity Affect the Environment," http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html, browsed March 13, 2008.

7. Incinerators emit more CO_2 per megawatt-hour than coal-fired, natural-gas-fired, or oil-fired power plants (see Figure ES-4). Incinerating materials such as wood, paper, yard debris, and food discards is far from "climate neutral"; rather, incinerating these and other materials is detrimental to the climate. However, when comparing incineration with other energy options such as coal, natural gas, and oil power plants, the Solid Waste Association of North America (SWANA) and the Integrated Waste Services Association (an incinerator industry group), treat the incineration of "biomass" materials such as wood, paper, and food discards as "carbon neutral." As a result, they ignore CO_2 emissions from these materials. This is inaccurate. Wood, paper, and agricultural materials are often produced from unsustainable forestry and land practices that are causing the amount of carbon stored in forests and soil to decrease over time. Incinerating these materials not only emits CO_2 in the process, but also destroys their potential for reuse as manufacturing and composting feedstocks. This ultimately leads to a net increase of CO_2 concentrations in the atmosphere and contributes to climate change. The bottom line is that tremendous opportunities for greenhouse gas reductions are lost when a material is incinerated. It is not appropriate to ignore the opportunities for CO_2 or other emissions to be avoided, sequestered or stored through non-combustion uses of a given material. More climate-friendly alternatives to incinerating materials include options such as waste avoidance, reuse, recycling and composting. Any climate model comparing the climate impact of energy generation or waste management options should take into account lifecycle emissions incurred (or not avoided) by not utilizing a material for its "highest and best" use. These emissions are the opportunity costs of incineration.

8. Incinerators, landfill gas capture systems, and landfill "bioreactors" should not be subsidized under state and federal renewable energy and

green power incentive programs or carbon trading schemes. Far from benefiting the climate, subsidies to these systems reinforce a one-way flow of resources on a finite planet and make the task of conserving resources more difficult, not easier. Incineration technologies include mass-burn, pyrolysis, plasma, gasification, and other systems that generate electricity or fuels. All of these are contributors to climate change. Environment America, the Sierra Club, the Natural Resources Defense Council, Friends of the Earth, and 130 other organizations recognize the inappropriateness of public subsidization of these technologies and have signed onto a statement calling for no incentives for incinerators.[26] Incinerators are not the only problem though; planned landfill "bioreactors," which are being promoted to speed up methane generation, are likely to simply result in increased methane emissions in the short term and to directly compete with more effective methane mitigation systems such as composting and anaerobic digestion technologies. Preventing potent methane emissions altogether should be prioritized over strategies that offer only limited emissions mitigation. Indeed, all landfill operators should be required to collect landfill gases; they should not be subsidized to do this. In addition, subsidies to extractive industries such as mining, logging, and drilling should be eliminated. These subsidies encourage wasting and economically disadvantage resource conservation and reuse industries.

9. New policies are needed to fund and expand climate change mitigation strategies such as waste reduction, reuse, recycling, composting, and extended producer responsibility. Policy incentives are also needed to create locally-based materials recovery jobs and industries. Programs should be developed with the democratic participation of those individuals and communities most adversely impacted by climate change and waste pollution. Regulatory, permitting, financing, market development, and economic incentive policies (such as landfill, incinerator, and waste hauling surcharges) should be implemented to divert biodegradable organic materials from disposal. Policy mechanisms are also needed to ensure that products are built to last, constructed so that they can be readily repaired, and are safe and cost-effective to recycle back into the economy and environment. (See the list of priority policies, page 14.) Taxpayer money should be redirected from supporting costly and polluting disposal technologies to funding zero waste strategies.

10. Improved tools are needed for assessing the true climate implications of the wasting sector. The U.S. EPA's WAste Reduction Model (WARM), a tool for assessing greenhouse gases from solid waste management options, should be revised to more accurately account for the following: lifetime landfill gas capture rates; avoided synthetic fertilizer, pesticide, and fungicide impacts from compost use; reduced water irrigation energy needs from compost application; increased plant growth from compost use; and the timing of emissions and sinks. (For more detail, see the discussion of WARM, page 13.) New models are also needed to accurately take into account the myriad ways that the lifecycle impact of local activities contributes to global greenhouse gas emissions. This would lead to better-informed municipal actions to reduce overall greenhouse gas emissions. In addition, lifecycle models are needed to accurately compare the climate impact of different energy generation options. Models that compare incineration with other electricity generation options should be developed to account for lifecycle greenhouse gas emissions incurred (or not avoided) by not utilizing a material for its "highest and best" use.

THERE WILL ALWAYS BE "DISCARDS" IN OUR SOCIETY, BUT HOW MUCH OF THAT BECOMES "WASTE" IS A MATTER OF CHOICE.

Rapid action to reduce greenhouse gas emissions, with immediate attention to those gases that pose a more potent risk over the short term, is nothing short of essential. Methane is one of only a few gases with a powerful short-term impact, and methane and carbon dioxide emissions from landfills and incinerators are at the top of a short list of sources of greenhouse gas emissions that may be quickly and cost-effectively reduced or avoided.

Stop Trashing the Climate answers important questions surrounding wasting and climate change, and recommends key steps to reduce waste that would result in the equivalent of taking 21% of the 417 U.S. coal-fired power plants off the grid by 2030. One strategy highlighted for its critical importance is composting. This report explains the unique benefits of composting to mitigate greenhouse gases in the short term and calls for composting as a core climate and soil revitalization strategy moving forward.

It should be noted that *Stop Trashing the Climate* does not assess human health impacts or environmental impacts that do not have a direct bearing on climate change. A full assessment of solid waste management options should consider costs, human health impacts, job and business impacts, and other environmental effects in addition to climate change. Published data addressing these other areas indicate that aiming for zero waste is not only good for the climate but also good for the economy, job creation, the environment, and public health.[27]

Resource conservation, reduced consumption, product redesign, careful materials selection, new rules and incentives, democratic participation, internalizing costs,* and materials reuse, recycling, and composting have never been such a necessity as they are today. Indeed, aiming for a zero waste economy by preventing waste and recovering materials is essential for mitigating climate change. The time to act is now. We have to redesign our production, consumption, and resource management systems so that they can be sustained for generations to come.

* For example, where the price of a product reflects its true environmental and social costs including the cost of disposal.

EPA WAste Reduction Model (WARM) — Room for Improvement

Ten years ago, the U.S. EPA released the first version of a tool to help solid waste managers weigh the greenhouse gas and energy impacts of waste management practices — its WAste Reduction Model, or WARM. Since then, EPA has improved and updated WARM numerous times. WARM focuses exclusively on the waste sector and allows users to calculate and compare greenhouse gas emissions for 26 categories of materials landfilled, incinerated, composted or recycled. The model takes into account upstream benefits of recycling, the carbon sequestration benefits from composting, and the energy grid offsets from combusting landfill gases and municipal solid waste materials. The methodology used to estimate emissions is largely consistent with international and domestic accounting guidelines. The latest version, Version 8, was released in 2006, but may already be outdated based on new information learned in recent years. As a result, the model now falls short of its goal to allow for an adequate comparison among available solid waste management options. Serious shortcomings that could be addressed in future releases include the following:

- **Incorrect assumptions related to the capture rate of landfill gas recovery systems** that are installed to control methane emissions. The model relies on instantaneous landfill gas collection efficiency rates of 75% and uses a 44% capture rate as the national average for all landfills. However, capture rates over the lifetime of a landfill may be as low as 20%.[1]

- **Lack of credit for the ability of compost to displace synthetic fertilizers, fungicides, and pesticides**, which collectively have an enormous greenhouse gas profile. Composting also has additional benefits that are not considered, such as its ability to increase soil water retention that could lead to reduced energy use related to irrigation practices, or its ability to increase plant growth, which leads to improved carbon sequestration. (Recognized as a shortcoming in EPA's 2006 report, *Solid Waste Management and Greenhouse Gases.*)

- **A failure to consider the full range of soil conservation and management practices** that could be used in combination with compost application and the impacts of those practices on carbon storage. (Recognized as a shortcoming in EPA's 2006 report, *Solid Waste Management and Greenhouse Gases.*)

- **Lack of data on materials in the waste stream that are noncompostable or recycled at a paltry level** such as polystyrene and polyvinyl chloride.

- **Inability to calculate the benefits of product or material reuse.**

- **No reporting of biogenic emissions from incinerators** as recommended by the Intergovernmental Panel on Climate Change guidelines: "if incineration of waste is used for energy purposes, both fossil and biogenic should be estimated… biogenic CO_2 should be reported as an information item…"[2] For incinerators, biogenic materials represent three-quarters of all waste combusted and 72% of all CO_2 being emitted.[3]

- **A failure to adequately take into account the timing of CO_2 emissions and sinks.** Incinerators, for instance, release CO_2 instantaneously, while composting may store carbon for decades. Paper reuse and recycling also store carbon for many years. It is not appropriate to neglect such delays in the release of CO_2 into the atmosphere.[4] The EPA acknowledges that its model treats the timing of these releases the same: "Note that this approach does not distinguish between the timing of CO_2 emissions, provided that they occur in a reasonably short time scale relative to the speed of the processes that affect global climate change. In other words, as long as the biogenic carbon would eventually be released as CO_2, whether it is released virtually instantaneously (e.g., from combustion) or over a period of a few decades (e.g., decomposition on the forest floor), it is treated the same."[5] We now know that the timing of such releases is especially critical given the 10-15 year climate tipping point agreed upon by leading global scientists.[6] The U.K. Atropos© model is one example of a new modeling approach for evaluating solid waste management options that includes all biogenic emissions of carbon dioxide and also accounts for the timing of these emissions.[7]

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1 Bogner, J., et al, *Waste Management, In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA), p. 600.

2 Intergovernmental Panel on Climate Change 2006, "Chapter 5: Incineration and Open Burning of Waste," *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, p. 5.5.

3 Based on U.S. EPA, 2006 MSW Characterization Data Tables, "Table 3, Materials Discarded in the Municipal Waste Stream, 1960 to 2006," and "Table 29, Generation, Materials Recovery, Composting, Combustion, and Discards of Municipal Solid Waste, 1960 to 2006." The 72% biogenic emission figure is based on data reported on the U.S. EPA Clean Energy web page, "How Does Electricity Affect the Environment," http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html, browsed March 13, 2008; and in Jeremy K. O'Brien, P.E., SWANA, "Comparison of Air Emissions from Waste-to-Energy Facilities to Fossil Fuel Power Plants" (undated), available online at: http://www.wte.org/environment, browsed March 13, 2008.

4 Ari Rabl, Anthony Benoist, Dominque Dron, Bruno Peuportier, Joseph V. Spadaro and Assad Zoughaib, Ecole des Minesm Paris, France, "Editorials: How to Account for CO_2 Emissions from Biomass in an LCA," *The International Journal of LifeCycle Assessment* 12 (5) 281 (2007), p. 281.

5 U.S. EPA, *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*, EPA 530-R-06-004, September 2006, p. 13.

6 Climate Change Research Centre, 2007. "2007 Bali Climate Declaration by Scientists." Available online at http://www.climate.unsw.edu.au/bali/ on December 19, 2007.

7 Dominic Hogg et al, Eunomia, *Greenhouse Gas Balances of Waste Management Scenarios, Report to the Greater London Authority*, Bristol, United Kingdom, January 2008, pp. i-ii.

A Call To Action — 12 Priority Policies Needed Now

In order for a zero waste strategy to reduce greenhouse gas emissions by 406 megatons CO_2 eq. per year by 2030, the following priority policies are needed:

1. Establish and implement national, statewide, and municipal zero waste targets and plans: Any zero waste target or plan must be accompanied by a shift in funding from supporting waste disposal to supporting zero waste jobs, infrastructure, and local strategies.

2. Retire existing incinerators and halt construction of new incinerators and landfills: The use of incinerators and investments in new disposal facilities — including mass-burn, pyrolysis, plasma, gasification, other incineration technologies, and landfill "bioreactors" — obstruct efforts to reduce waste and increase materials recovery. Eliminating investments in incineration and landfilling is an important step to free up taxpayer money for resource conservation, efficiency, and renewable energy solutions.

3. Levy a per-ton surcharge on landfilled and incinerated materials: Many European nations have adopted significant landfilling fees of $20 to $40 per ton that are used to fund recycling programs and decrease greenhouse gases. Surcharges on both landfills and incinerators are an important counterbalance to the negative environmental and human health costs of disposal that are borne by the public.

4. Stop organic materials from being sent to landfills and incinerators: Implement local, state, and national incentives, penalties, or bans to prevent organic materials, particularly food discards and yard trimmings, from ending up in landfills and incinerators.

5. End state and federal "renewable energy" subsidies to landfills and incinerators: Incentives such as the Renewable Electricity Production Tax Credit and Renewable Portfolio Standards should only benefit truly renewable energy and resource conservation strategies such as energy efficiency, and the use of wind, solar, and ocean power. Resource conservation should be incentivized as a key strategy for reducing energy use. In addition, subsidies to extractive industries such as mining, logging, and drilling should be eliminated. Instead, subsidies should support industries that conserve and safely reuse materials.

6. Provide policy incentives that create and sustain locally-based reuse, recycling, and composting jobs: Incentives should be directed to revitalize local economies by supporting environmentally just, community-based, and green materials recovery jobs and businesses.

7. Expand adoption of per-volume or per-weight fees for the collection of trash: Pay-as-you-throw fees have been proven to increase recycling and reduce the amount of waste disposed.[1]

8. Make manufacturers and brand owners responsible for the products and packaging they produce: Manufactured products and packaging represent 72.5% of all municipal solid waste.[2] When manufacturers are responsible for recycling their products, they use less toxic materials, consume fewer materials, design their products to last longer, create better recycling systems, are motivated to minimize waste costs, and no longer pass the cost of disposal to the government and the taxpayer.[3]

9. Regulate single-use plastic products and packaging that have low or non-existent recycling levels: In less than one generation, the use and disposal of single-use plastic packaging has grown from 120,000 tons in 1960 to 12,720,000 tons per year today.[4] Policies such as bottle deposit laws, polystyrene food takeout packaging bans, and regulations targeting single-use water bottles and shopping bags have successfully been implemented in several jurisdictions around the world and should be replicated everywhere.[5]

10. Regulate paper packaging and junk mail and pass policies to significantly increase paper recycling: Of the 170 million tons of municipal solid waste disposed each year in the U.S., 24.3% is paper and paperboard. Reducing and recycling paper will decrease releases of numerous air and water pollutants to the environment, and will also conserve energy and forest resources, thereby reducing greenhouse gas emissions.[6]

11. Decision-makers and environ-mental leaders should reject climate protection agreements and strategies that embrace landfill and incinerator disposal: Rather than embrace agreements and blueprints that call for supporting waste incineration as a strategy to combat climate change, such as the U.S. Conference of Mayors Climate Protection Agreement, decision-makers and environmental organizations should adopt climate blueprints that support zero waste. One example of an agreement that will move cities in the right direction for zero waste is the Urban Environmental Accords signed by 103 city mayors worldwide.

12. Better assess the true climate implications of the wasting sector: Measuring greenhouse gases over the 20-year time horizon, as published by the IPCC, is essential to reveal the impact of methane on the short-term climate tipping point. Also needed are updates to the U.S. EPA's WAste Reduction Model (WARM) as well as new models to accurately account for the impact of local activities on total global emissions and to compare lifecycle climate impact of different energy generation options.

San Francisco's "Fantastic Three" Program.

1 See the U.S. EPA's "Pay As You Throw" web site at http://www.epa.gov/epaoswer/non-hw/payt/index.htm.

2 See "Table 3: Materials Discarded in Municipal Solid Waste, 1960-2006," U.S. EPA, 2006 MSW Characterization Data Tables.

3 Beverly Thorpe, Iza Kruszewska, Alexandra McPherson, *Extended Producer Responsibility: A waste management strategy that cuts waste, creates a cleaner environment, and saves taxpayer money*, Clean Production Action, Boston, 2004. Available online at http://www.cleanproductionaction.org.

4 U.S. EPA, "Table 22: Products Discarded in the Municipal Waste Stream, 1960 to 2006 (with Detail on Containers and Packaging)," 2006 MSW Characterization Data Tables. Available online at: http://www.epa.gov/garbage/msw99.htm.

5 See, for instance, Californians Against Waste web site, "Polystyrene & Fast Food Packaging Waste," http://www.cawrecycles.org/issues/polystyrene_main.

6 U.S. EPA, "Table 3: Materials Discarded in the Municipal Waste Stream, 1960 to 2006," and "Table 4: Paper and Paperboard Products in MSW, 2006," 2006 MSW Characterization Data Tables. For catalog data, see Forest Ethics, Catalog Campaign web page at http://www.catalogcutdown.org/.

ENDNOTES:

1 Chris Hails et al., *Living Planet Report 2006* (Gland, Switzerland: World Wildlife Fund International, 2006), available online at http://assets.panda.org/downloads/living_planet_report.pdf; Energy Information Administration, *Emission of Greenhouse Gases in the United States 2006* (Washington, DC, November 2007), available online at http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html; U.S. Census Bureau International Data Base, available online at http://www.census.gov/ipc/www/idb/; and John L. Seitz: *Global Issues: An Introduction*, (2001). "The U.S. produced approximately 33% of the world's waste with 4.6% of the world's population" (Miller 1998) quoted in Global Environmental Issues by Francis Harris (2004).

2 Jon Creyts, Anton Derkach, Scott Nyquist, Ken Ostrowski, Jack Stephenson, *Reducing U.S. Greenhouse Gas Emissions: How Much and at What Cost? U.S. Greenhouse Gas Abatement Mapping Initiative, Executive Report* (McKinsey & Company, December 2007). Available online at: http://www.mckinsey.com/clientservice/ccsi/greenhousegas.asp.

3 Dr. Rajendra Pachauri, Chair of the Intergovernmental Panel on Climate Change, quoted in "UN Climate Change Impact Report: Poor Will Suffer Most," *Environmental News Service*, April 6, 2007 (available online at: http://www.ens-newswire.com/ens/apr2007/2007-04-06-01.asp); Office of the Attorney General, State of California, "Global Warming's Unequal Impact" (available online at http://ag.ca.gov/globalwarming/unequal.php#notes_1); and *African Americans and Climate Change: An Unequal Burden*, July 1, 2004, Congressional Black Caucus Foundation and Redefining Progress, p. 2 (available online at www.rprogress.org/publications/2004/CBCF_REPORT_F.pdf).

4 The Urban Environmental Accords were drafted as part of the United Nations World Environment Day in 2005.

5 Each coal-fired power plant emits 4.644 megatons CO_2 equivalent. In 2005, there were 417 coal-fired power plants in the U.S. See U.S. EPA's web page on Climate Change at http://www.epa.gov/cleanenergy/energy-resources/refs.html#coalplant. Removing 87 plants from the grid in 2030, represents 21% of the coal-fired plants operating in 2005.

6 Scientific experts are now in general agreement that developed nations such as the U.S. need to reduce greenhouse gas emissions 80% below 1990 levels by 2050 in order to stabilize atmospheric greenhouse gas concentrations between 450 and 550 ppm of CO_2 eq. See for instance, Susan Joy Hassol, "Questions and Answers Emissions Reductions Needed to Stabilize Climate," for the Presidential Climate Action Project (2007). Available online at climatecommunication.org/PDFs/HassolPCAP.pdf.

7 In order to reduce the 1990 U.S. greenhouse gas emissions by 80% by 2050, greenhouse gas levels in 2030 should decrease to 3.9 gigatons CO_2 eq., which is approximately 37% of the 1990 level. This is based on a straight linear calculation. Emissions in 2005 were 7.2 gigatons CO_2 eq. Emissions in 2050 would need to drop to 1.24 gigatons CO_2 eq. to reflect an 80% reduction of the 1990 level of 6.2 gigatons. Between 2005 and 2050, this represents an annual reduction of 132.44 megatons CO_2 eq., resulting in a 3.9 gigaton CO_2 eq. emission level for 2030. U.S. greenhouse gas emissions are on a trajectory to increase to 9.7 gigatons CO_2 eq. by 2030. See Jon Creyts et al, *Reducing U.S. Greenhouse Gas Emissions: How Much and at What Cost?* p. 9. This means that annual greenhouse gas emissions by 2030 need to be reduced by 5.8 gigatons CO_2 eq. to put the U.S. on the path to help stabilize atmospheric greenhouse gas concentrations. A zero waste approach could achieve an estimated 406 megatons CO_2 eq., or 7% of the annual abatement needed in 2030.

8 It is important to note that emissions cuts by developed nations such as the U.S. may have to be even greater than the target of 80% below 1990 levels by 2050. Achieving this target may leave us vulnerable to a 17-36% chance of exceeding a 2°C increase in average global temperatures. See Paul Baer, et. al, *The Right to Development in a Climate Constrained World*, p. 20 (2007). In addition, there is ample evidence that climate change is already negatively impacting the lives of many individuals and communities throughout the world. To prevent climate-related disasters, the U.S. should and must take immediate and comprehensive action relative to its full contribution to climate change. As Al Gore has pointed out, countries (including the U.S.), will have to meet different requirements based on their historical share or contribution to the climate problem and their relative ability to carry the burden of change. He concludes that there is no other way. See Al Gore, "Moving Beyond Kyoto," *The New York Times* (July 1, 2007). Available online at http://www.nytimes.com/2007/07/01/opinion/01gore.html?pagewanted=all

9 Jon Creyts et al, *Reducing U.S. Greenhouse Gas Emissions: How Much and at What Cost?*, pp. xvii, 60-62, 71.

10 U.S. EPA, 2006 MSW Characterization Data Tables, "Table 29, Generation, Materials Recovery, Composting, Combustion, and Discards of Municipal Solid Waste, 1960 to 2006," Franklin Associates, A Division of ERG. Available online at: http://www.epa.gov/garbage/msw99.htm.

11 Gary Liss, Gary Liss & Associations, personal communication, March 2008; and Robert Haley, Zero Waste Manager, City and County of San Francisco, Department of the Environment, personal communication, May 1, 2008.

12 In 1960, for example, single-use plastic packaging was 0.14% of the waste stream (120,000 tons). In less than one generation, it has grown to 5.7% and 14.2 million tons per year. See U.S. EPA, 2006

MSW Characterization Data Tables, “Table 18, Products Generated in the Municipal Solid Waste Stream, 1960 to 2006 (with Detail on Containers and Packaging).”

13 Brenda Platt and Neil Seldman, Institute for Local Self-Reliance, *Wasting and Recycling in the U.S. 2000*, GrassRoots Recycling Network, 2000, p. 13. Based on data reported in Office of Technology Assessment, *Managing Industrial Solid Wastes from manufacturing, mining, oil, and gas production, and utility coal combustion* (OTA-BP-O-82), February 1992, pp. 7, 10.

14 Toni Johnson, Council on Foreign Relations, “Deforestation and Greenhouse Gas Emissions,” web site at www.cfr.org/publication/14919/ (updated January 7, 2008).

15 *Recommendations of the Economic and Technology Advancement Advisory Committee (ETAAC): Final Report on Technologies and Policies to Consider for Reducing Greenhouse Gas Emissions in California*, A Report to the California Air Resources Board (February 14, 2008), pp. 4-15, 4-16. Available online at www.arb.ca.gov/cc/etaac/ETAACFinalReport2-11-08.pdf.

16 Each coal-fired power plant emits 4.644 megatons CO_2 equivalent. In 2005, there were 417 coal-fired power plants in the US. See U.S. EPA's web page on Climate Change at http://www.epa.gov/cleanenergy/energy-resources/refs.html#coalplant. Removing 87 plants from the grid in 2030, represents 21% of the coal-fired plants operating in 2005.

17 Paul Hawken, Amory Lovins and L. Hunter Lovins, *Natural Capitalism*, Little Brown and Company, (1999), p. 4; and Worldwide Fund for Nature (Europe), “A third of world's natural resources consumed since 1970: Report,” Agence-France Presse (October 1998).

18 Institute for Local Self-Reliance, June 2008. Industrial emissions alone represent 26.8%. Truck transportation is another 5.3%. Manure management is 0.7% and waste disposal of 2.6% includes landfilling, wastewater treatment, and combustion. Synthetic fertilizers represent 1.4% and include urea production. Figures have not been adjusted to 20-year time frame. Based on data presented in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2005*, U.S. EPA, Washington, DC, April 15, 2007. Industrial Electricity Consumption is estimated using Energy Information Administration 2004 data on electricity sales to customers. See Table ES-1, Electric Power Annual Summary Statistics for the United States, released October 22, 2007, and available online at: http://www.eia.doe.gov/cneaf/electricity/epa/epates.html.

19 See City of San Francisco web site, Urban Environmental Accords, at http://www.sfenvironment.org/our_policies/overview.html?ssi=15. Browsed May 1, 2008.

20 On a 20-year time horizon, N_2O has a 289 global warming potential. On a 100-year time horizon, its global warming potential is 310.

21 The EPA defines incineration as the following: “Incinerator means any enclosed device that: (1) Uses controlled flame combustion and neither meets the criteria for classification as a boiler, sludge dryer, or carbon regeneration unit, nor is listed as an industrial furnace; or (2) Meets the definition of infrared incinerator or plasma arc incinerator. Infrared incinerator means any enclosed device that uses electric powered resistance heaters as a source of radiant heat followed by an afterburner using controlled flame combustion and which is not listed as an industrial furnace. Plasma arc incinerator means any enclosed device using a high intensity electrical discharge or arc as a source of heat followed by an afterburner using controlled flame combustion and which is not listed as an industrial furnace.” See U.S. EPA, Title 40: Protection of Environment, Hazardous Waste Management System: General, subpart B-definitions, 260.10, current as of February 5, 2008.

22 Pace, David, “More Blacks Live with Pollution,” Associated Press (2005), available online at: http://hosted.ap.org/specials/interactives/archive/pollution/part1.html; and Bullard, Robert D., Paul Mohai, Robin Saha, Beverly Wright, *Toxic Waste and Race* at 20: 1987-2007 (March 2007).

23 The Intergovernmental Panel on Climate Change has revised the global warming potential of methane compared to carbon dioxide several times. For the 100 year planning horizon, methane was previously calculated to have 21 times the global warming potential of CO_2. In 2007, the IPCC revised the figure to 25 times over 100 years and to 72 times over 20 years. See IPCC, “Table 2.14,” p. 212, Forster, P., et al, 2007: Changes in Atmospheric Constituents and in Radiative Forcing. In: Climate *Change 2007: The Physical Science Basis.*

24 “Beyond Kyoto: Why Climate Policy Needs to Adopt the 20-year Impact of Methane,” Eco-Cycle Position Memo, Eco-Cycle, www.ecocycle.org, March 2008.

25 Bogner, J., M. Abdelrafie Ahmed, C. Diaz, A. Faaij, Q. Gao, S. Hashimoto, K. Mareckova, R. Pipatti, T. Zhang, *Waste Management, In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 600. Available online at: http://www.ipcc.ch/ipccreports/ar4-wg3.htm.

26 *No Incentives for Incinerators* Sign-on Statement, 2007. Available online at http://www.zerowarming.org/campaign_signon.html.

27 See for instance Clarissa Morawski, *Measuring the Benefits of Composting Source Separated Organics in the Region of Niagara*, CM Consulting for The Region of Niagara, Canada (December 2007); Jeffrey Morris, Sound Resource Management Group, *Comparison of Environmental Burdens: Recycling, Disposal with Energy Recovery from Landfill Gases, and Disposal via Hypothetical Waste-to-Energy Incineration*, prepared for San Luis Obispo County Integrated Waste Management Authority, San Luis Obispo, California (February 2004); Jeffrey Morris, “Comparative LCAs for Curbside Recycling Versus Either Landfilling or Incineration with Energy Recovery, *International Journal of LCA* (2004); Brenda Platt and David Morris, *The Economic Benefits of Recycling*, Institute for Local Self-Reliance, Washington, DC (1993); and Michael Lewis, *Recycling Economic Development through Scrap-Based Manufacturing*, Institute for Local Self-Reliance (1994)

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