PUBLIC BEWARE:

The DANGER of Corporate Landfill Gas-to-Energy Schemes and How to Fix It

Why Organics Recycling is an Alternative That Prevents Greenhouse Gases and Creates Jobs

RECYCLING WORKS!
A JOBS, ENERGY AND CLIMATE SOLUTION

SIERRA CLUB
FOUNDED 1892

The DANGER of Corporate Landfill Gas-to-Energy Schemes and How to Fix It

Why Organics Recycling is an Alternative That Prevents Greenhouse Gases and Creates Jobs

A report by:

Recycling Works! Campaign
www.recyclingworkscampaign.org

Sierra Club
www.sierraclub.org

International Brotherhood of Teamsters
www.teamster.org

Public Beware: The Danger of Corporate Landfill Gas to Energy Schemes and How to Fix It

Why Organics Recycling is an Alternative That Prevents Greenhouse Gases and Creates Jobs

Introduction

The United States is at a turning point, both economically and environmentally, and the policy choices we make in the near future will have a long-term impact on protecting our climate and reviving our economy. While the planet approaches a climate change tipping point, after which severe damages from global warming will be irreversible, millions of Americans are seeking quality employment. Clean energy solutions are available to both of these problems, but corporate landfill owners' narrow self-interests can stand in the way of the public good and the devotion of resources to the most effective solutions.

While major waste companies promote landfill gas to energy (LFGTE) projects that purport to capture methane released from landfills and convert it to electricity, a better solution lies in organics recycling. As part of a 21st century resource recovery infrastructure, organics recycling diverts methane-generating waste from landfills and has the potential to significantly curtail dangerous landfill methane emissions in the near term and going forward, create quality employment in the organics recycling and clean energy industries—allowing a truly sustainable and renewable source of energy to thrive.

Excecutive Summary

Curbing methane emissions is key to reversing global warming: While reducing carbon dioxide (CO_2) emissions is crucial to controlling global warming, we also need a strategy focused on curbing the more immediate threat posed by methane if we are going to avert the most significant impacts of climate change. Such a strategy will benefit future generations.

Methane is a powerful greenhouse gas, second only to CO_2 as a man-made cause of global warming[1]: Molecule for molecule, over the next 20 years, methane's ability to trap heat in the atmosphere is 72 times greater than that of CO_2.[2] This means that methane is much worse for global warming than CO_2 in the short term. As a result of human activity, the concentration of methane in the atmosphere has doubled in the last 200 years.[3]

Methane emissions at landfills must be reduced: Landfills are the second-largest man-made source of methane in the U.S.[4] In 2007, landfills emitted at least 132.9 million metric tons (146.5 million U.S. tons) of methane gas.[5]

Landfill gas to energy (LFGTE) projects create more problems than they solve: In LFGTE projects, landfills are fitted with equipment to capture emissions of methane gas, yet only a fraction of the methane gas generated is actually captured for conversion into energy. LFGTE projects usually increase the short-term impact methane emissions have on global warming. These projects also fail to recognize that the environmental impact of methane escaping from the gas collection system far outweighs the modest benefit of offsetting CO_2 emissions on the utility grid.

LFGTE projects are crowding out real solutions: The waste industry has invested heavily in promoting LFGTE projects because of the economic windfalls the programs provide to landfill operators.[6] LFGTE projects, which are proliferating at landfills across the country, are eligible for enormous state and federal subsidies,[7] and the waste industry has succeeded in getting landfill gas classified as a renewable energy source.[8] In many states, LFGTE is being subsidized for more than 10 cents per kilowatt hour which is more than twice as much as it costs to produce, providing a huge windfall and profit center all out of proportion.[9] This has left recycling programs under-promoted and under-funded.[10]

High-impact solutions to global warming are urgently needed: We are rapidly approaching the climate change tipping point—at which irreversible damage will occur. According to a growing consensus of scientists, we have at most 20 years to curtail global warming before its consequences become inevitable.[11]

Organics recycling can significantly decrease landfill methane emissions: Only organic discards (food scraps, yard waste, and paper) generate methane when they decompose in the oxygen-starved environment of a modern landfill. Keeping organic material out of landfills could dramatically reduce landfill methane emissions. Organics recycling, in which organic waste is collected separately for recycling into compost, much as we already separate other recyclables, is already established in many cities and countries worldwide. It has been recognized as a cost-effective option to reduce landfill methane emissions and combat global warming.[12]

A switch to a 21st century resource recovery infrastructure will create clean energy jobs to combat rising unemployment: The U.S. faces a difficult road ahead toward economic recovery. Unemployment has reached its highest rate in over 25 years and economist Paul Krugman has predicted a jobless recovery, in which "GDP is growing but the job market continues to worsen."[13] Many experts believe that clean energy technology and the jobs that come with it—jobs that can't be outsourced and that offer good pay and benefits—are essential to America's economic recovery, and to our ability to compete in the 21st century global economy.

Methane: A Potent Greenhouse Gas

"In the ongoing debate over global warming, climatologists usually peg carbon dioxide as the most dangerous of the atmosphere's heat-trapping gases. But methane, a greenhouse gas 20 times more potent than carbon dioxide, might be even more problematic."

Elizabeth Svoboda

"Global Warming Feedback Loop Caused by Methane, Scientists Say"

National Geographic News, August 29, 2006 [14]

While reducing CO_2 emissions has been the primary focus of the public, press, and policymakers, new studies suggest that more attention should be paid to the short-term impact of methane on Earth's atmosphere. Methane (CH_4) is second only to CO_2 as a leading man-made cause of global warming[15] and is magnitudes more powerful than CO_2 at trapping heat in the atmosphere.[16]

While methane breaks down faster in the atmosphere than CO_2[17], methane's *short-term* heat-trapping effects are more severe. Over a period of 100 years, the impact of one molecule of methane is 21 times greater than that of a molecule of CO_2. Over 20 years—the period of time during which effective action on global warming is crucial to avert irreversible damage from climate change — methane's ability to trap heat in the atmosphere is 72 times greater than that of CO_2.[18]

Methane levels in Earth's atmosphere are at historic highs. A recent study of gas bubbles trapped in Antarctic ice revealed that current levels of both CO_2 and CH_4 are higher now than at any time in the past 650,000 years.[19] Furthermore, the concentration of methane in the atmosphere has doubled in the last 200 years as a result of human activities.[20]

Landfills: A Leading Source of Methane Emissions in the U.S.

Landfills are the second-largest man-made source of methane in the U.S.[21] Although a reduction in methane emissions is critical, not enough has been done to curtail landfill methane emissions. The current waste-disposal system in the U.S.—and those who profit from it—is responsible for this inaction.

Over 20 years—the period of time during which effective action on global warming is crucial to avert irreversible climate change—methane's ability to trap heat in the atmosphere is 72 times greater than that of CO_2.

The U.S. Environmental Protection Agency (EPA) estimates that the annual amount of garbage the U.S. produces is the equivalent of more than 82,000 football fields packed six feet deep in compacted garbage. Most of it ends up in landfills.[22]

There are more than 1,800 operational landfills in the US today.[23] While the total number of landfills has decreased over time, the average landfill size has increased.[24] The rise of mega-landfills coincides with the concentration of control of the nation's solid waste industry in the hands of a few large companies. Waste Management, Inc., and Republic Services, Inc. (since its acquisition of Allied Waste Industries, Inc. last year) are the two largest waste companies operating in the U.S. today.[25]

Together, these companies control over 40 percent of the U.S. solid waste market,[26] and over 60 percent of total U.S. landfill capacity.[27] They also operate some of the country's largest landfills. For example, Waste Management mega-landfill in Tulleytown, Pennsylvania, stands 300 feet high and takes in more than 40 million pounds of waste daily,[28] while Republic Services' Apex landfill outside of Las Vegas has a capacity of 202 million tons.[29]

Table 1. 20 largest landfills in the United States, by remaining capacity[32]

Landfill Name	State	Tons Remaining Capacity	Owner
Apex Regional Landfill	*NV*	*318,609,416*	*Republic*
Atlantic Waste Disposal Landfill	*VA*	*240,032,973*	*WMI*
Lockwood Regional Landfill	*NV*	*174,887,466*	*Public*
Columbia Ridge Landfill	*OR*	*117,498,647*	*WMI*
Okeechobee Landfill	*FL*	*116,355,309*	*WMI*
Altamont Sanitary Landfill & Resource Recovery	*CA*	*113,902,718*	*WMI*
Sunshine Canyon-North Valley Landfill	*CA*	*89,272,760*	*Republic*
Seneca Meadows Landfill	*NY*	*81,228,347*	*BFI Canada*
Roosevelt Regional Landfill	*WA*	*74,660,386*	*Republic*
Forward Inc Landfill	*CA*	*70,393,247*	*Republic*
Nu-Way Live Oak Landfill	*CA*	*69,793,973*	*WMI*
Butterfield Station Landfill	*AZ*	*67,132,638*	*WMI*
McCommas Bluff Landfill	*TX*	*62,509,498*	*Public*
Denver Arapahoe Disposal Site & Recycling Ctr	*CO*	*53,782,636*	*WMI*
Woodside Landfill	*LA*	*45,898,337*	*WMI*
Livingston Landfill	*IL*	*44,724,531*	*Republic*
Carleton Farms Landfill	*MI*	*40,444,269*	*Republic*
Southern States/Taylor County Landfill	*GA*	*39,747,034*	*Republic*
County Line Landfill	*IN*	*39,475,027*	*Republic*
Potrero Hills Sanitary Landfill	*CA*	*38,407,033*	*Republic*

Table 2. Big Two's ownership of largest landfills in the United States

(those with over one million tons remaining capacity)[33]

	No. of landfills	Total remaining capacity (billion tons)	Percent of total remaining capacity
Waste Management	*159*	*1.949*	*27%*
Republic Services (incl. Allied Waste)	*151*	*1.962*	*27%*
All others	*595*	*3.294*	*46%*
Total	**905**	**7.205**	**100%**

…Climate change scientists at NASA reported that methane emissions may account for fully a third of climate warming from greenhouse gases between 1750 and the present…

What happens to greenhouse gas emissions as these landfills grow? For every one million tons of waste, 432,000 cubic feet of landfill gas, which is about 50 percent methane, is generated per day.[30] In 2007, landfills emitted 132.9 million metric tons (146.5 million U.S. tons) of methane gas.[31]

Investing in Methane Reduction Is Critical to Reducing Global Warming

"Controlling methane could reap a big bang for the buck."[34]

Goddard Institute for Space Studies, July 18, 2005

Methane not only has a greater short-term environmental impact than CO_2, but climatologists now realize that methane may play a bigger role in the global warming process than previously thought. In 1999, the US Environmental Protection Agency (EPA) recognized the importance of methane reduction for achieving near-term results: "[Its] relatively short lifetime makes methane an excellent candidate for mitigating the impacts of global warming because emission reductions could lead to stabilization or reduction in methane concentrations within 10 to 20 years."[35]

In July 2005, climate change scientists at the National Aeronautics and Space Administration (NASA) reported that methane emissions may account for fully a third of climate warming from greenhouse gases between 1750 and the present, not a sixth as previously estimated. They concluded, "The potential effectiveness of CH_4 [reduction] in alleviating global warming is not always fully appreciated … CH_4 should receive greater weight in strategies for slowing global warming."[36] According to NASA climatologist Drew Shindell, "Control of methane emissions turns out to be a more powerful lever to control global warming than would be anticipated."[37]

While the industry promotes landfill gas-to-energy technology as a green alternative, it is actually a strategy that maximizes our dependence on hugely profitable landfills…

Landfill Gas to Energy: the Wrong Solution for Curbing Methane Emissions

"…the prevention, recycling and recovery of waste should be encouraged as should the use of recovered materials and energy so as to safeguard natural resources and obviate wasteful use of land."

European Commission 1999 Landfill Directive[38]

LFGTE projects, in which methane is collected and converted into energy, are currently operating in at least 400 landfills in the U.S., and at least 138 additional landfills are candidates for LFGTE projects.[39] All large landfills are required to install systems to capture gas, by drilling perforated pipes down into the decomposing garbage.

Landfills with LFGTE systems in place, however, capture a portion of the gas emitted by these pipes and typically send that gas to an engine that converts the heat into electricity. Those landfills not participating simply flare off the released gas. While the industry promotes LFGTE technology as a green alternative, it is actually a strategy that maximizes our dependence on landfills, rather than addressing the underlying problem: the inclusion of methane-generating organic materials in landfills.

Even with LFGTE technology in place, only a portion of the methane emitted by a landfill is captured, and substantial quantities continue to escape uncontrolled into the atmosphere. The EPA estimated that gas collection systems capture 75 percent of the methane produced by landfills,[40] yet the EPA's Region 9 has challenged the 75 percent collection rate assumption, stating, "We believe 30 percent is a superior efficiency assumption."[41]

LFGTE projects also fail to solve the long-term problem of methane emissions from inactive landfills. The EPA permits the removal of gas collection systems from service once a landfill has been closed for 15 years and emissions fall below a specified level,[42] and current law only requires that landfill owner/operators are able to pay for the monitoring and maintenance of closed landfills for 30 years.[43] In January 2008, however, state scientists were surprised to learn that a California landfill was still emitting methane 40 years after its closure.[44]

Thus, LFGTE programs don't stop landfill methane emissions at their source. It is uncertain how much methane they actually capture, and closed landfills continue to produce methane for decades. According to Nathanael Greene, director of renewable energy policy for the National Resources Defense Council, promoting the renewable energy benefits of landfills is like "putting lipstick on a pig."[45]

Landfill Gas-to-Energy: Intentionally Generating Greenhouse Gas

The practices used to manage landfills with LFGTE systems are multiplying the amounts of greenhouse gas generated, especially over the short-term. LFGTE systems need a certain rate of methane flow to work properly. LFGTE sites are managed to deliberately increase moisture, thus increasing gas production and methane concentration in order to make the system profitable. As the EPA found in 2003, operators of LFGTE systems increasingly add liquids to landfills in the form of "leachate recirculation" (the liquid that drains from a landfill) or other liquids in order to "promote degradation of biodegradable waste." This reportedly improves the "cost effectiveness for those sites where the landfill is utilized for its energy potential."[46]

Adding liquids to landfills not only generates more methane, but also causes a greater proportion of that methane to escape into the atmosphere for two reasons. First, the actions taken to increase moisture degrade gas collection. When leachate is recirculated in landfills, the landfill becomes waterlogged and compacted. These conditions preclude the use of the most effective and rigid methane collection pipes.[47] Second, because the top of such a landfill is left uncovered longer to allow for more rain penetration, it is impossible to maintain a seal to prevent the gas collection systems from also pulling air from the surface along with methane from the surrounding wastes. EPA scientists acknowledge that this leads to a "larger loss of fugitive emissions" than would occur in a traditional "dry tomb" landfill.[48]

However, the EPA continues to use methodology to estimate landfill gas emissions that was developed by the International Panel on Climate Change (IPCC) in 1996, and therefore predates the practice of introducing liquid into landfills to spur gas production.[49] A methodology based on

According to Nathanael Greene, director of renewable energy policy for the National Resources Defense Council, promoting the renewable energy benefits of landfills is like "putting lipstick on a pig."

the dry tomb landfill model, regardless of whether it has been modified to reflect annual precipitation, may result in underestimates of actual gas production in landfills utilizing leachate recirculation.

As the landfill industry acknowledged in testimony before the California Air Resources Board, practices that increase moisture in landfills further decrease methane capture rates: "[A] site with a collection system that is used solely for energy recovery is usually not capable of achieving as high a collection efficiency as compared to one that is compliant with [the EPA's New Source Performance Standards] regulations,"[50] which govern the emission of pollutants into the air and water.[51] Therefore, practices designed to speed decomposition and increase methane production result in significant short-term increases in uncontrolled methane emissions into the atmosphere.

LFGTE Is Big Business for Big Waste Companies

"That's a good business. We generate the methane anyway. Our return on this business on each of these projects is in excess of our 15 percent hurdle rate [minimally acceptable rate of return], and that's even without the tax credits that come with it. So it's a pretty good place for us to be, since we generate the methane anyway."[52]

Bob Simpson, Waste Management's Chief Financial Officer

The expansion of, and emphasis on, LFGTE projects as the solution to methane emissions did not happen by accident. Landfills and landfill gas projects are big businesses, for which aggregate annual federal and state government subsidies reach the hundreds of millions of dollars.[53] The waste industry has expended enormous resources to promote LFGTE projects,[54] which sustain landfilling over alternatives such as organics recycling.

Waste Management and Republic Services are both investing heavily in LFGTE projects. In October 2008, Waste Management, the largest U.S. developer of landfill gas projects, announced plans to partner with private and municipal landfill owners to help them develop new LFGTE programs.[55] Waste Management also plans to invest $400 million over the next five years to build 60 LFGTE facilities, adding to its existing 100 LFGTE projects at other U.S. landfills it manages.[56]

"Our return on this business on each of these projects is in excess of our 15 percent hurdle rate, and that's even without the tax credits that come with it. So it's a pretty good place for us to be…"

–Bob Simpson, Waste Management Chief Financial Officer

The Chief Financial Officer for Allied Waste (acquired by Republic Services in December 2008) told investors that increased energy costs make landfill gas projects economically appealing interesting: "The returns on capital on some of these projects are pretty good. So we'll continue to pursue them and should generate decent revenue."[57]

Waste Companies Massively Increased Lobbying for LFGTE

Waste Management leads the waste industry on lobbying expenditures, including targeting support for LFGTE, and has ramped up spending considerably in the past three years. In the first two quarters of 2009 alone, Waste Management spent $500,000 on its lobbying efforts. In 2008, the company spent $840,000, a 61 percent increase from 2006, when Waste Management spent $520,000. In comparison, Allied (now owned by Republic Services), spent only $200,000 on lobbying in 2008. Republic Services has spent considerably less.

Waste Management has lobbied aggressively to promote LFGTE in recent months. One company executive filed a lob-

bying report stating that he engaged in lobbying on "H.R. 1, H.R. 598, S. 350 and related legislation relating to a tax credit for production of electricity using landfill gas," to "support…S. 306, H.R. 1158, and related legislation providing a tax credit for production of pipeline quality gas from landfill gas," and to "support draft legislation that would include waste-to-energy and landfill gas in a proposed renewable energy portfolio standard."[59]

Also in 2008, the former Allied Waste lobbied on "issues related to H.R. 6049," the Renewable Energy and Job Creation Act of 2008. This legislation, passed by the House and Senate, extended the tax credit for the production of various renewable energy sources, including landfill gas, through 2010.[60]

LFGTE: Falsely Classified as a Renewable Energy Source

By successfully classifying landfill gas as a form of renewable energy, the waste industry doubly benefits from the profits of selling landfill gas and from both federal and state tax credits and subsidies. At the federal level, the industry lobby has secured landfill gas a place on the list of energy sources eligible for renewable electricity production credits. Section 45 of the federal tax code now provides landfill gas facilities with a credit of 1.5 cents/kilowatt hour for a period of ten years.[61]

On the state level, waste corporations make money from LFGTE projects through renewable portfolio standards (RPS). These standards, now in place in 29 states, including the District of Columbia, require that a state's electric utilities generate a specified percentage of electricity from renewable sources—such as wind, solar, biomass, or geothermal sources—by a given date.[62] These state RPS standards currently list landfill gas as a renewable or green power option. In Virginia, Pennsylvania, and Illinois, half of the green power product offerings get energy from landfill gas.[63] In Ohio, Georgia and West Virginia, landfill gas is included in 100 percent of green power offerings.[64]

Since 2000, the amount of renewable energy capacity serving green power markets has increased nearly 20-fold,[65] and more than half of all United States electricity customers now have the option to purchase some type of green power product from a retail electricity provider.[66] Even states that don't have mandatory RPS initiatives offer green power options, which are now available in 46 of the 50 states.[67] In 2006, 23 percent of the electricity sales from "renewable" energy nationwide were generated from landfill gas.[68] The federal government also includes landfill gas in its own renewable energy purchase requirements, which will increase to 7.5 percent of its electricity purchases by fiscal year 2013.[69]

Table 3. Largest LFGTE operators[58]

	Waste Management	Republic Services
Operational at landfills	*142*	*87*
Candidate landfills for LFGTE, per EPA	*59*	*79*
Total	**201**	**166**

…The waste industry doubly benefits from the profits of selling landfill gas and from both federal and state tax credits and subsidies.

Including landfill gas discourages the development of *truly* renewable energy sources, such as wind and solar, and undermines the expansion of organics recycling programs that not only eliminate the need for faulty methane capture but also represent significant downstream energy savings. The 23 percent of "renewable" landfill-gas-generated electricity sales cited above in state or federal renewable energy purchase requirements could have come from truly clean energy sources instead.

Clean Energy Technology is Urgently Needed to Halt Climate Change

"Business-as-usual would be a guarantee of global and regional disasters."

Physicist James Hansen, head of NASA's Institute for Space Studies[70]

According to a growing consensus of scientists, we have less than 10 years to begin to reduce global warming pollution.[71] The most recent report from the Intergovernmental Panel on Climate Change suggests that emissions must be reduced by 2015 to avoid extreme temperature increases and further rising sea levels.[72] Even in a best-case scenario, however, of greenhouse gas emissions peaking before 2015 and subsequently declining 50-85 percent, global temperatures and sea levels are already guaranteed to rise.[73] In September of this year, the United Nations Environment Program released peer reviewed scientific evidence that affirms that climate change is accelerating faster than previously estimated by the IPCC.[74]

The timeframe for investing in effective renewable energy, recycling, and other clean energy technologies is therefore extremely short and the consequences of inaction could include rising sea levels, severe disruptions in weather patterns, and the extinction of wildlife and plant species not only making the globe an unlivable place but also leading to major economic disasters. According to Nicholas Stern, the Chief Economist and Senior Vice-President of the World Bank from 2000 to 2003 and a former British Treasury economist, "The risk consequences of ignoring climate change will be very much bigger than the consequences of ignoring risks in the financial system."[75]

We know that greenhouse gases such as carbon dioxide, methane, nitrous oxide, and ozone cause global warming. The focus of research has now shifted to tracking the *pace* of climate change, and to finding ways to slow its pace while our actions can still have a meaningful impact.

New studies reveal that Earth is warming faster than previously thought.[76] The past 20 years included the 18 warmest on record.[77] Coral reefs from Madagascar to Texas are dying off as seas warm.[78] Vital ocean currents in Northern Europe are slowing.[79] Sea ice in the Arctic Ocean has dropped to its second lowest level in 30 years, a change that accelerates warming in other parts of the world.[80] Research published in *Nature Geoscience* in October 2008 found the first evidence that the rise in Antarctic temperatures in recent decades is due to human-caused greenhouse gas emissions. Previously, the Antarctic was the only continent where man-made climate change had not been proven.[81]

In November 2008, prominent U.S. scientists and economists wrote to Congress that: "We urge U.S. policy makers to put our nation onto a path today to reduce emissions on the order of 80 percent below 2000 levels by 2050. … There is no time to waste. The most risky thing we can do is nothing."[82]

The American public is also becoming more conscious of the implications of global warming, and wants to see swift action.[83] Two-thirds of Americans now believe that human activity is contributing to global warming.[84] Even in the midst of severe recession, 90 percent of Americans surveyed in September and October 2008 said that the US should act to reduce global warming, and 72 percent said that global warming was an issue of personal importance for them.[85]

Including landfill gas discourages the development of truly renewable energy sources, such as wind and solar, and undermines the expansion of organics recycling programs…

The Real Solution: Organics Recycling Prevents Landfill Gas Emissions

Landfills generate methane because only methanogenic (methane-producing) microbes can survive in the anaerobic, or oxygen-starved, environment in which the covered, compressed garbage in landfills decomposes. Environmental laws require that landfills be lined and covered to prevent contamination of ground water,[86] while compactors further compress the trash after it is dumped.[87] Under such conditions, those microbes break down organic waste and produce methane as a byproduct.[88] Only organic items, such as food scraps, yard trimmings, and paper, emit methane as they decompose.

Because it is only under the landfill conditions described above that organic discards generate methane, any national policy aimed at solving global warming must address ways to reduce methane emissions from landfills. There is, in fact, a simple way to achieve this goal: Stop dumping organic materials into landfills.

Recycling organics is an achievable, near-term goal. Organics currently make up about 60 percent of the country's garbage,[89] and separating them from landfill-destined trash would significantly lessen the amount of methane landfills generate.

Removing organics from the waste stream would also drastically reduce the huge volume of waste being dumped into the country's landfills, another pressing priority for the U.S. The vital issue of methane reduction aside, our current landfill system isn't sustainable. As the nation's population—and garbage production—increase, states and municipalities must build more landfills, expand existing landfills, or find other states that will accept their trash. New York City exports its trash to more than 30 landfills in at least four other states.[90] Such "solutions" cannot continue forever. Polling shows that American communities overwhelmingly don't want new landfills.[91]

Organics recycling is a proven alternative to unsustainable landfilling. Cities and countries worldwide are already separating organics from trash.[92] The European Union's "Landfill Directive" requires the diversion of organic waste from landfills, and calls on all member states to reduce the landfilling of biodegradable waste by 65 percent by the year 2016.[93] Toronto, a city with a population of 2.5 million,[94] has a goal of sending no organic waste to landfills by 2012. By 2004, the city was already diverting 36 percent of its organic waste, and had achieved a 90 percent participation rate. Today, Toronto diverts over 70 percent of its targeted organics discards.[95]

The U.S. has yet to adopt organics recycling on a significant scale. On the municipal level, there have been some successes; residential organics collection programs are located in states from Washington and Michigan to Minnesota and California. San Francisco's program, which includes businesses, has a 72 percent total waste diversion rate as of May, 2009[96] and hopes to reach 75 percent by 2010.[97] San Fernando, California has a diversion rate of more than 60 percent.[98]

In these programs, organic waste is sent to composting,

Even in the midst of severe recession, 90 percent of Americans surveyed in September and October 2008 said that the U.S. should act to reduce global warming…

RECYCLE CENTRAL:
Good Jobs, Green Jobs, Union Jobs

Recology (formerly Norcal Waste Systems) is a major California waste company that owns and operates numerous recycling, landfill, and organics composting operations. Recology runs four organics composting operations in Dixon, Marysville, Vacaville, and Gilroy, CA,[107] as well as an Organics Annex, opened in 2007 to handle organic waste collected in the City of San Francisco.

Also operated by Recology is Recycle Central, a $40 million, 200,000 square foot facility that sorts and processes San Francisco's recyclables. Recology's recycling and composting facilities are critical to San Francisco reaching an ambitious goal: diverting 75 percent of its waste from landfills by 2010.[108] In fact, San Francisco was already recycling 72 percent of its waste in May of 2009.[109]

But Recology does more than just operate some of the nation's premier organics recycling facilities. It is also proof that the recycling industry can create well-paid, clean energy jobs that lift communities into the middle class. According to the National Recycling Coalition, the recycling and reuse industries employ 1.1 million workers nationwide.[110] But making sure these jobs provide good pay and benefits is another story—one that is turning out right at Recology facilities like Recycle Central. When the facility was built, Teamsters Local Union 350 worked with city and community leaders, and Recology officials, to ensure that residents of the low-income areas near the center would be hired.

Today, Recology employs over 1,200 Teamster members. These employees work in all of Recology's operations, including Recycle Central and the Organics Annex. Employees start out earning approximately $20 an hour, earn pensions, and can participate in an incentive program that lets them own shares in the company.

"I look at my job as more of a career. It makes me want to go to work," says John F. Andrews, an oiler-greaser whose expertise helps Recycle Central's equipment run smoothly. "I'm able to provide for my wife and three young children," says Andrews, who has visited his son's school to talk to the kids about the importance of recycling. "I was blessed to get this job."

Equipment operator and shop steward Rudy Orosco says having a union makes these green jobs such good jobs. "Our Teamster contracts are the strongest in the industry," says Orosco, who has sent two kids to college thanks to his union-negotiated pay.

Blanca Ortega, a loader operator at Recology, feeds the sort lines with recyclable material to be sorted.

where it is turned into fertilizer and sold to customers in the agricultural industry, or sometimes to anaerobic digestion facilities, which first extract the energy value without releasing methane. Other uses for organic compost include fertilizer for public works projects like parks and sports fields[99], as well as for use by consumers in potting soil and green roof mixes.[100]

While the number of private organics recycling programs has increased (3,400 community composting programs were reported in 2006),[101] few new municipal programs are being created. In a 2007 nationwide survey, BioCycle magazine identified 42 communities or counties with source-separated residential organics collection, only a small increase from the 30 identified in 2006. There were also 13 mixed municipal solid waste composting programs to separate compostable material from trash, but no new plants were in development.[102]

The national food waste diversion rate is for the entire US only 3 percent.[103] Existing organics recycling programs are not extensive enough to meet demand, while new programs are being created haphazardly at best. North Carolina's organics recycling program has a diversion rate of only 6 percent, yet an operator who collects organic waste from restaurants and other businesses states, "I absolutely have to turn people down because there's no room. Our trucks are basically full. There are lots of people who'd like to get on the program, but we just don't have the capacity to do it."[104]

Americans would likely welcome the opportunity to participate in organics recycling to reduce global warming. In U.S. communities where recycling is not now required, 74 percent say they would support a local law making it mandatory.[105] A July 2007 Harris poll showed that 77 percent of Americans already recycle something in their homes.[106]

Organics Recycling: A Great Economic Value—and a Job Creation Engine

Environmentally and economically, composting is emerging as a great value: "The bottom line? Dollar for dollar, composting wins," one waste management magazine concluded.[111]

A "monetization" system developed by Dr. Jeffrey Morris of Sound Resource Management assigned an economic value to the environmental costs and benefits of composting organics vs. landfilling them, including the value of various uses for the compost. As Biocycle Magazine reported on this model, "So large is the cost differential between composting and other disposal options that the debate around the economic merit of composting is over. Truly, composting is the best bang for the buck."[112]

Organics recycling does more than reduce greenhouse gas emissions and trash; with the right regulatory and financial support from federal, state, and local governments, it could create a significant number of jobs. The potential of composting programs to create jobs is apparent in job creation data in the recycling sector. Even taking into account potential job loss caused by a decrease in landfill utilization, recycling still creates up to ten times more jobs than landfilling.[113]

A study in Niagara, Canada also found that the "true cost" of composting was 60-86 percent lower than alternative options, including LFGTE projects. When impacts on human health and climate change were factored in, composting emerged as the best economic value to a community and resulted in the least pollution. The report concluded that "every effort should be put towards source separation for composting before any 'disposal' technologies are considered."[114]

"I absolutely have to turn people down because there's no room. Our trucks are basically full. There are lots of people who'd like to get on the [organics recycling] program, but we just don't have the capacity to do it."

–Organics recycling operator in North Carolina

Conclusion: America cannot afford to subsidize the wrong solutions.

We must put our resources behind legitimate strategies that will create jobs and curb global warming.

Investing our country's resources in cost-effective programs that protect the environment and our national security and create jobs is vital to protect the environment and spur economic recovery. Organics recycling meets these criteria—LFGTE projects do not.

The waste industry claims it can transform the mountains of trash piling up in our nation's landfills into green energy, thus protecting the environment and reducing our dependence on foreign oil. There is money to be made in these claims. With the average American producing 4.62 pounds of solid waste per day (1,686.3 pounds annually)[115] *and the waste industry's massive investment in mega-landfills across the country, the subsidizing of hundreds of LFGTE projects is highly profitable.*

Because major waste corporations tout the benefits of these projects, policymakers and the media often fail to realize that LFGTE is an ineffective approach to curbing methane emissions. Instead, the subsidizing of LFGTE projects diverts funding away from organics recycling and other waste reduction and clean energy options that could truly lessen the amount of methane that the nation's landfills are releasing into the atmosphere.

Organics recycling plays a role in energy independence. Wide-scale use of recycling and organic compost could ease the need for energy to produce new goods.

With our economy in crisis and time running short to reduce global warming's catastrophic effects, America cannot afford to subsidize the wrong solutions. We must put our resources behind legitimate strategies that will create jobs and curb global warming. Organics recycling offers great promise on both of these fronts. We urge policymakers at every level to recognize and invest in that promise.

Building a 21st Century Resource Recovery Infrastructure Will Considerably Reduce Methane Emissions

NASA experts report that it "would be irresponsible not to consider all ways to minimize climate change."[116] It is therefore vital to provide incentives to keep organics out of landfills and stop the generation of methane gas before it starts. This means ending the subsidizing of LFGTE projects, removing LFGTE from lists of approved renewable energy sources, and directing resources toward the development of organics recycling, a practice that will both cut methane gas emissions and create quality employment opportunities.

Three Steps to Build the 21st Century Resource Recovery Infrastructure

1 **Set a national recycling rate goal of 75 percent by 2015 and provide the funding and incentives to reach this goal.**

Since the current national rate is about 33 percent, this is a practical way to curb landfill gas emissions as well as achieve other environmental, energy, and economic benefits. Local successes, such as in San Francisco, have already illustrated the viability of this approach, yet many other cities and states still have recycling rates of 10 percent or less. The nation's recycling rate can only be raised by diverting recyclable organics from landfills and incinerators.

2 **Direct public resources toward research and infrastructure development that supports the implementation of organics recycling and composting.**

Rather than subsidizing the LFGTE projects of highly profitable corporations, focus funding on recycling technology, clean energy jobs, and local economic development.

3 **Reform renewable energy portfolio standards to exclude landfill gas and direct tax credits and subsidies toward energy sources such as wind, water, solar, geothermal, and recycling.**

Exclude waste incineration projects, often owned and operated by the some companies promoting LFGTE development, from receiving public subsidies, since they are not a renewable energy source.

References

1 Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2001: The Scientific Basis (2001),* http://www.grida.no/climate/ipcc_tar/wg1/index.htm (accessed June 22, 2009).

2 IPCC, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, "Summary for Policymakers," *Climate Change 2007: The Physical Science Basis of Climate Change*, ed. S. Solomon et. al., (Cambridge and New York: Cambridge University Press, 2007), http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf (accessed June 22, 2009).

3 IPCC, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, "Changes in Atmospheric Constituents and in Radiative Forcing," *Climate Change 2007: The Physical Science Basis of Climate Change*, ed. S. Solomon et. al., (Cambridge and New York: Cambridge University Press, 2007): 212, http://ipcc-wg1.ucar.edu/wg1/wg1-report.html (accessed June 22, 2009).

4 IPCC, *Climate Change 2001*.; The dairy and beef industries overtook landfills as the country's leading source of methane in 2000; the digestion processes of cows produced 139 million metric tons of methane in 2007, or 6.1 million more than landfills.

5 US EPA, *Inventory of US Greenhouse Gas Emissions and Sinks, 1990-2007*, (EPA 430-R-09-004, April 15, 2009), http://epa.gov/climatechange/emissions/downloads09/InventoryUSGhG1990-2007.pdf (accessed June 2, 2009); United States Environmental Protection Agency (US EPA) Landfill Methane Outreach Program, "An overview of landfill gas energy in the United States," (June 2008), http://www.epa.gov/lmop/docs/overview.pdf (accessed June 2, 2009).

6 Solid Waste Association of North America, "Landfill gas tax credit included in corporate tax bill," Press Release, Oct. 14, 2004, http://www.swana.org/www/TECHNICALDIVISIONS/LandfillGas/tabid/114/tabid/101/newsid536/47/LANDFILL-GAS-TAX-CREDIT-INCLUDED-IN-CORPORATE-TAX-BILL/Default.aspx (accessed June 22, 2009); Nichola Groom, "Garbage is dirty, but is it a clean fuel?" *Reuters*, May 20, 2008, http://www.reuters.com/article/environmentNews/idUSN1230791320080521?sp=true (accessed June 22, 2009); Waste Management, "Waste Management Expands Renewable Energy Program to Develop Landfill Gas to Energy Projects," Press Release, October 1, 2008, http://wastemanagementottawa.ca/files/WMRE%20Third%20Party%t20National%20Media%20Releasepercent20Canada%2020081001.pdf, Accessed June 22, 2009.

7 Nichola Groom, "Garbage is dirty, but is it a clean fuel?" *Reuters*, May 20, 2008.

8 Dagher L. Bird and Swezey B, *Green Power Marketing in the United States: A Status Report, Tenth Edition*, (National Renewable Energy Laboratory: December, 2007).

9 United States Department of Energy, Office of Energy Efficiency and Renewable Energy, *Database of State Incentives for Renewables and Efficiency, Financial Incentives/Policies for Renewable and Efficiency* (2009).

10 D. Koplow, *Evaluating Subsidies for Landfill Gas to Energy Programs,* (National Recycling Coalition: June 2001).

11 Kevin Watkins et al, *United Nations Development Programme Human Development Report 2007/2008*, (United Nations: 2007), http://hdr.undp.org/en/media/hdr_20072008_en_complete.pdf (accessed July 7, 2009); Jim Hansen et al, "Dangerous human-made interference with climate: a GISS modelE study", Atmos. Chem. Phys., 7 (2007): 2287-2312; Holland et al, "Future abrupt reductions in the summer Arctic sea ice," GEOPHYSICAL RESEARCH LETTERS, 33 (2006): L23503; and Hansen et al, "Climate change and trace gases," Phil Trans R Soc A (2007): 365.

12 Michael Pollan, *The Omnivore's Dilemma: A Natural History of Four Meals* (New York: The Penguin Press, 2006), 46-47; Richard Manning, "The oil we eat: Following the food chain back to Iraq," *Harper's*, February 2004: 37-45, http://www.harpers.org/archive/2004/02/0079915 (accessed June 22, 2009).

13 Paul Krugman, "It's a Postmodern Recovery," *The New York Times*, July 31, 2009.

14 Elizabeth Svoboda. "Global Warming Feedback Loop caused by Methane, Scientists Say," *National Geographic News,* (August 29, 2008), http://news.nationalgeographic.com/news/2006/08/060829-methane-warming.html (accessed June 22, 2009).

15 IPCC, *Climate Change 2001.*

16 Ibid.

17 US EPA, *2009 US Greenhouse Gas Inventory Report* (April, 2009), http://www.epa.gov/climatechange/emissions/usinventoryreport.html (accessed June 22, 2009).

18 IPCC, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, "Changes in Atmospheric Constituents and in Radiative Forcing," *Climate Change 2007: The Physical Science Basis of Climate Change*, ed. S. Solomon et. al., (Cambridge and New York: Cambridge University Press, 2007): 212

19 Richard Black. "CO_2 'highest for 650,000 years,'" *BBC News*, Nov. 24, 2005, http://news.bbc.co.uk/2/hi/science/nature/4467420.stm (accessed June 22, 2009).

20 IPCC, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, "Changes in Atmospheric Constituents and in Radiative Forcing," *Climate Change 2007: The Physical Science Basis of Climate Change*, ed. S. Solomon et. al., (Cambridge and New York: Cambridge University Press, 2007) http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf (accessed June 22, 2009).

21 US EPA, 2009 *US Greenhouse Gas Inventory Report*, April, 2009; and "Clean Fuel from Dirty Garbage?" *Reuters*, May 21, 2008.

22 Diana Holden, "Wal-Mart, Waste, and the Developing World," *Business Week*, August 5, 2009.

23 US EPA, *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2007* http://epa.gov/osw/nonhaz/municipal/pubs/msw07-fs.pdf (accessed June 22, 2009).

24 US EPA, Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2007.

25 *Waste Age*, "100 Top Players in the Waste Industry," June 1, 2007.

26 Jonathan Ellis, "Waste Management," *Merrill Lynch*, April 30, 2009; and Jonathan Ellis, "Republic Services Inc.," *Merrill Lynch*, May 4, 2009.

27 Jonathan Ellis, "Digging into the Landfills," *Merrill Lynch*, Feb. 20, 2009.

28 Heather Rogers, *Gone Tomorrow: The Hidden Life of Garbage* (New York Press, 2005): 17.

29 Chartwell, "Currently Operating Non-Hazardous Solid Waste Disposal Operations in the US," 2005 (database).

30 US EPA, "An overview of landfill gas energy in the United States," May 2007, http://www.epa.gov/lmop/docs/overview.pdf (accessed June 22, 2009).

31 US EPA, *Inventory of US Greenhouse Gas Emissions and Sinks*, 1990-2007, April 15, 2009.

32 Waste Business Journal, 2007

33 Waste Business Journal, *Directory and Atlas of Non-Hazardous Waste Sites,* (2008), includes all landfills and demolition landfills with one million or more remaining tons capacity.

34 *Goddard Institute for Space Studies,* "Methane's Impacts on Climate Change May Be Twice Previous Estimates,"July 18, 2005, http://www.giss.nasa.gov/research/news/20050718/ (accessed June 22, 2009).

35 US EPA, *US Methane Emissions 1990-2020: Inventories, Projections, and Opportunities for Reductions*, (EPA-430-R-99-013: September, 1999), http://www.epa.gov/methane/reports/methaneintro.pdf (accessed June 22, 2009).

36 J. Hansen et al., "Efficacy of climate forcings," Journal of Geophysical Research, 110, (2005): D18104.

37 *Goddard Institute for Space Studies*, "Methane's Impacts on Climate Change May Be Twice Previous Estimates," July 18, 2005.

38 European Commission, COUNCIL DIRECTIVE 1999/31/EC (European Commission: April 26, 1999).

39 US EPA, "Benefits of Landfill Gas Energy," http://www.epa.gov/lmop/benefits.htm (accessed June 22, 2009); US EPA, "Energy Projects and Candidate Landfills," lmopdata.xls, http://www.epa.gov/lmop/proj/index.htm (accessed June 1, 2009).

40 US EPA, *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*, (EPA-530-R-02-006: June 2002).

41 US EPA Region 9, *Ideas for Consideration to Strengthen WARM Model* (2007): 1.

42 US EPA 40 C.F.R. §60.742(b)(2)(v)(C)

43 US EPA, "Closure and Post-Closure Care Requirements for Municipal Solid Waste Landfills (MSWLFs)," http://www.epa.gov/waste/nonhaz/municipal/landfill/financial/mswclose.htm (accessed June 22, 2009).

44 Virginia Henessey, "Old landfill still venting gas," *Monterey County Herald*, January 20, 2008.

45 Nichola Groom, "Garbage is dirty, but is it a clean fuel?" *Reuters*, May 20, 2008.

46 Susan Thorneloe, *US EPA's Field Test Program to Update Data on Landfill Gas Emissions* (EPA ORD, 2003): 3, 8.

47 AEA Technology, *Methane emissions from UK landfills* (UK Department of the Environment, Transport and the Regions, 1999), at p. 2-10.

48 Susan Thorneloe, *Innovative Air Monitoring at Landfills Using Optical Remote Sensing with Radial Plume Mapping* (EPA ORD, 2007): 4.

49 US EPA, *Inventory of US Greenhouse Gas Emissions and Sinks, 1990-2007*, (EPA 430-R-09-004, April 15, 2009), http://epa.gov/climate-

change/emissions/downloads09/InventoryUSGhG1990-2007.pdf (accessed June 2, 2009), p. ES-1.

50 Solid Waste Industry for Climate Solutions "Current MSW Industry Position and State-of-the-Practice on LFG Collection Efficiency, Methane Oxidation, and Carbon Sequestration in Landfills," (July 2007).

51 US EPA Region 7 Air Program, "New Source Performance Standards," http://www.epa.gov/Region7/programs/artd/air/nsps/nsps.htm (accessed June 22, 2009).

52 "Waste Management at Raymond James Institutional Investors Conference," *Fair Disclosure Wire*, March 9, 2009.

53 D. Koplow. "Evaluating Subsidies for Landfill Gas to Energy Programs," (National Recycling Coalition, June 2001).

54 Solid Waste Association of North America, "Landfill gas tax credit included in corporate tax bill," Press Release, Oct. 14, 2004.

55 Waste Management, "Waste Management Expands Renewable Energy Program to Develop Landfill Gas to Energy Projects," Press Release, October 1, 2008.

56 Nichola Groom, "Garbage is dirty, but is it a clean fuel?" *Reuters*, May 20, 2008.

57 *Fair Disclosure Wire*, "Q2 2008 Allied Waste Industries, Inc. Earnings Conference Call," July 30, 2008.

58 US EPA, "Energy Projects and Candidate Landfills," lmopdata.xls, http://www.epa.gov/lmop/proj/index.htm (accessed June 1, 2009).

59 Robert Eisenbud, Lobbying Report, Waste Management, Q1, 2009 (April 1, 2009).

60 THOMAS, "Congressional Research Service Summary, HR 6049," 110th Congress; Blank Rome Government Relations LLC, Lobbying Report, Allied Waste Industries, Q3, 2008 (Oct. 20, 2008).

61 USC Title 26, 45, "Electricity produced from certain renewable resources, etc.," http://www.law.cornell.edu/uscode/html/uscode26/usc_sec_26_00000045----000-.html

62 Federal Energy Regulatory Commission, "Electric Market National Overview, OE Energy Market Snapshot," (National Version, April 2009) http://www.ferc.gov/market-oversight/mkt-snp-sht/2009/05-2009-snapshot-us.pdf (accessed June 2, 2009).

63 US Department of Energy, Energy Efficiency and Renewable Energy, "Green Power Network," http://eere.energy.gov/greenpower (accessed July 7, 2009).

64 Ibid.

65 Dagher L. Bird and Swezey B, *Green Power Marketing in the United States: A Status Report, Tenth Edition*, (National Renewable Energy Laboratory: December, 2007).

66 Ibid.

67 Ibid.

68 Ibid.

69 "Energy Policy Act of 2005," Public Law 109-58 (August 8, 2005): Sec. 203. http://www.epa.gov/oust/fedlaws/publ_109-058.pdf (accessed July 7, 2009).

70 *Environmental News Service*, "Earth's Climate Approaches Dangerous Tipping Point," June 1, 2007, http://www.ens-newswire.com/ens/jun2007/2007-06-01-01.asp (accessed June 22, 2009).

71 Kevin Watkins et al, *United Nations Development Programme Human Development Report 2007/2008*, (United Nations: 2007), http://hdr.undp.org/en/media/hdr_20072008_en_complete.pdf (accessed July 7, 2009); Jim Hansen et al, "Dangerous human-made interference with climate: a GISS modelE study", Atmos. Chem. Phys., 7 (2007): 2287-2312; Holland et al, "Future abrupt reductions in the summer Arctic sea ice," GEOPHYSICAL RESEARCH LETTERS, 33 (2006): L23503; and Hansen et al, "Climate change and trace gases," Phil Trans R Soc A (2007): 365.

72 "Introduction," *Climate Change 2007: Synthesis Report* (Nov. 12-17, 2007), http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf, accessed August 11, 2009.

73 IPCC, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, "Summary for Policymakers," *Climate Change 2007: The Physical Science Basis of Climate Change,* ed. S. Solomon et. al., (Cambridge and New York: Cambridge University Press, 2007), http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf (accessed June 22, 2009), Table 5.1, p. 45.

74 United Nations Environment Programme (UNEP), *Climate Change Science Compendium 2009*, http://www.unep.org/compendium2009/PDF/Compendium2009_fullreport.pdf (accessed October 5, 2009).

75 James Pomfret, "Risks of global warming greater than financial crisis: Stern," *Reuters*, October 27, 2008, http://www.reuters.com/article/environmentNews/idUSTRE49Q19120081027 (accessed June 22, 2009).

76 Peter N. Spotts, "Earth nears tipping point on climate change," *The Christian Science Monitor,* May 30, 2007, http://www.csmonitor.com/2007/0530/p02s01-wogi.html (accessed June 22, 2009); Paul Eccleston, "Climate change 'tipping point' within 100 years," *The Daily Telegraph*, February 5, 2008, http://www.telegraph.co.uk/earth/earthnews/3324256/Climate-change-'tipping-point'-within-100-years.html (accessed June 22, 2009); Timothy Lenton, et al., "Tipping elements in the Earth's climate system," *Proceedings of the National Academy of Sciences of the United States of America*, 105 no. 6 (February 12, 2008): 1786-1793, http://www.pnas.org/content/105/6/1786.full (accessed June 22, 2009); Jim Hansen et al, "Dangerous human-made interference with climate: a GISS modelE study", *Atmos. Chem. Phys.*, 7 (2007): 2287-2312; and Juliet Eilperin, "Debate on Climate Shifts to Issue of Irreparable Change." *Washington Post,* January 29, 2006.

77 *The Pew Center*, "The Causes of Global Climate Change," (August 2008), referencing Hadley Centre 2005, http://www.pewclimate.org/docUploads/global-warming-science-brief-august08.pdf (accessed June 22, 2009).

78 Union of Concerned Scientists, "Early Warning Signs of Global Warming: Coral Reef Bleaching," (Nov. 10, 2003), http://www.ucsusa.org/global_warming/science_and_impacts/impacts/early-warning-signs-of-global-2.html (accessed June 22, 2009); Sean Markey, "Global Warming Has Devastating Effect on Coral Reefs, Study Shows." *National Geographic News*, May 16, 2006, http://news.nationalgeographic.com/news/2006/05/warming-coral.html (accessed June 22, 2009); and Nicholas A.J. Graham, et al. "Dynamic fragility of oceanic coral reef ecosystems." *Proceedings of the National Academy of Sciences of the United States of America* 94 no. 22 (May 30, 2006): 8425-8429, http://www.pnas.org/content/103/22/8425.full.pdf+html (accessed June 22, 2009).

79 Timothy Lenton, et al., "Tipping elements in the Earth's climate system." *Proceedings of the National Academy of Sciences of the United States of America* 105 no. 6 (Feb. 12, 2008): 1786-1793; and Juliet Eilperin, "Debate on Climate Shifts to Issue of Irreparable Change," *Washington Post*, January 29, 2006.

80 *Associated Press*, "Global warming 'tipping point': Arctic sea ice drops to 2nd lowest level," August 28, 2008, http://www.nydailynews.com/news/us_world/2008/08/28/2008-08-28_global_warming_tipping_point_arctic_sea_.html (accessed June 22, 2009).

81 Nathan P. Gillett, et al. "Attribution of polar warming to human influence." *Nature Geoscience* 1 (2008): 750 - 754, http://www.nature.com/ngeo/journal/v1/n11/abs/ngeo338.html (accessed June 22, 2009).

82 Union of Concerned Scientists, "U.S. Scientists and Economists' Call for Swift and Deep Cuts in Greenhouse Gas Emissions," May, 2008, http://www.ucsusa.org/assets/documents/global_warming/Scientist_Economists_Call_to_Action_fnl.pdf (accessed June 22, 2009).

83 *Reuters*, "Two-third of world worried by warming, U.S. lags," April 3, 2007, http://www.reuters.com/article/domesticNews/idUSL0368232220070403 (accessed June 22, 2009).

84 *Harris Poll #44*, "For Earth Day: Two-thirds of Americans Believes Humans Are Contributing to Increased Temperatures," April 18, 2008, http://www.harrisinteractive.com/harris_poll/index.asp?PID=898 (accessed June 22, 2009).

85 Yale Project on Climate Change, George Mason University Center for Climate Change Communication, "Climate Change in the American Mind: Americans' climate change beliefs, attitudes, policy preferences, and actions," (March, 2009).

86 US EPA, Code of Federal Regulations, Title 40, Part 258 Subtitle D, Criteria for Municipal Solid Waste Landfills (see blue book – 24).

87 *Waste Age Magazine*, "Efficiency, Flat-Out," August 1, 1998, http://wasteage.com/mag/waste_efficiency_flatout/ (accessed June 22, 2009).

88 US EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2005*, http://www.epa.gov/climatechange/emissions/downloads06/07CR.pdf (accessed June 22, 2009).

89 US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2006," http://www.epa.gov/osw/nonhaz/municipal/pubs/msw06.pdf (accessed June 22, 2009).

90 Solid Waste Digest 12:7 (July, 2002), p. 6

91 Jim Johnson, "A tough sell: Overcoming resistance to landfills not getting easier, survey shows," *Waste News*, November 6, 2006

92 *Biocycle*, "Nova Scotia rates soar above national average," February 2008; Richard Butts, "City of Toronto's Waste Diversion Initiatives," Solid Waste Management Services, City of Toronto, http://www.epa.gov/Region5/solidwaste/butts.pdf (accessed June 22, 2009); "San Francisco Touts 72% Recycling Rate," *Recycling Today,* May 13, 2009; Jennifer Langston, "Seattle recycling more commercial food waste," Seattle *Post-Intelligencer*, Sept. 19, 2008; "Strategic Plan: 2006-2009," *Compost New Zealand,* http://www.wasteminz.org.nz/sectorgroups/compost/CompostNZ-StrategicPlan2006.pdf (accessed June 22, 2009).

93 European Commission, COUNCIL DIRECTIVE 1999/31/EC (April 26, 1999).

94 City of Toronto, http://allabout-toronto.com/ (accessed June 22, 2009).

95 Richard Butts, "City of Toronto's Waste Diversion Initiatives," Solid Waste Management Services, City of Toronto, http://www.epa.gov/

Region5/solidwaste/butts.pdf (accessed June 22, 2009)

96 *Recycling Today*, "San Francisco Touts 72% Recycling Rate," May 13, 2009.

97 Julia Bernstein, "$38 Millions Recycling Facility Opens in SF," *Bay City News,* March 5, 2003.

98 *Biocycle*, "Source Separated Residential Composting in the US," December, 2007.

99 Clarissa Morawski, "Composting—Best Bang for MSW Management Buck," *BioCycle,* (October 2008): 23-28.

100 *Biocycle*, "2008 Trends, Compost Market Outlook," (January 2008): 22-23.

101 US EPA, *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2006.*

102 *Biocycle,* "Source Separated Residential Composting in the US," December, 2007.

103 Ibid.

104 Ibid.

105 *ABC News/Washington Post/Stanford poll*, "Concern Soars About Global Warming As World's Top Environmental Threat," April 20, 2007, http://abcnews.go.com/images/US/1035a1Environment.pdf (accessed June 22, 2009).

106 *Harris Poll #67*, "One-Quarter of Americans Do Not Recycle in Their Own Homes," July 11, 2007, http://www.harrisinteractive.com /harris_poll/index.asp?PID=783 (accessed June 22, 2009).

107 Norcal Subsidiaries, http://www.norcalwaste.com/companies.htm (accessed June 1, 2009).

108 Julia Bernstein, "$38 Millions Recycling Facility Opens in SF," *Bay City News*, March 5, 2003.

109 *Recycling Today,* "San Francisco Touts 72% Recycling Rate," May 13, 2009.

110 National Recycling Coalition, "Top 10 Reasons to Recycle," http://www.nrc-recycle.org/top10reasonstorecycle.aspx (accessed June 22, 2009).

111 *Biocycle,* "Dollar for Dollar, Composting Wins," Editorial, October 2008: 4.

112 *Biocycle,* "Composting—Best Bang for MSW Management Buck," October, 2008: 23-28.

113 US EPA, *Puzzled About Recycling's Value? Look Beyond the Bin,* (EPA-530-K-97-008, January 1998); G. Goldman, A. Ogishi, "The Economic Impact of Waste Disposal and Diversion in California", report to the California Integrated Waste Management Board, April 2001, http://are.berkeley.edu/extension/EconImpWaste.pdf (accessed June 22, 2009); B. Platt, N. Seldman, "Wasting and Recycling in the United States 2000," *Institute for Local Self-Reliance*, 2000.

114 *CM Consulting*, "Measuring the benefits of composting source separated organics in the Region of Niagara," December 2007.

115 US EPA, *Municipal Solid Waste in the United States: 2007 Facts and Figures,* (EPA-530-R-08-010, 2007).

116 Hansen, et al., "Global temperature change," *PNAS 103 no. 39* (September 26, 2006).