The Waste-to-Energy Technology Act of 2011

Master of Public Administration in Environmental Science and Policy
Workshop in Applied Earth Systems Management

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Cover image and design:
Photo of the Spittelau waste-to-energy plant in Vienna, Austria from the Flickr page of Emiliano Dominici, design by Andrew McCornack.

Preface

This report concludes the work of the Workshop in Applied Earth Systems Management, a two-semester core course for the Master of Public Administration in Environmental Science and Policy at Columbia University's School of International and Public Affairs. During the summer semester we analyzed the environmental problems addressed by the Waste-to-Energy Technology Act of 2011 and the solutions the bill is advocating. During the fall semester our focus shifted to program design and policy implementation as we examined how the policy might be implemented if the Act was passed into law. This report reviews the work of both semesters and provides a program design and implementation plan for the Waste-to-Energy Technology Act of 2011.

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Acronyms and Abbreviations

The Act	The Waste-to-Energy Technology Act of 2011 (H.R. 66)
BTU	British Thermal Unit
CO_2	Carbon Dioxide
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
GWP	Global Warming Potential
HAPs	Hazardous Air Pollutants
IRS	Internal Revenue Service
kWh	Kilowatt Hour
MWh	Megawatt Hour
CH_4	Methane Gas
MSW	Municipal Solid Waste
NO_x	Nitrogen Oxide
RCRA	Resource Conservation and Recovery Act
RPS	Renewable Portfolio Standards
SO_x	Sulfur Oxide
VOCs	Volatile Organic Compounds
WtE	Waste-to-Energy
WWTP	Wastewater Treatment Plant

Executive Summary

Environmental problems are both local and global; the localized nature of soil, water, and air pollution, combined with the global nature of rising greenhouse gases in the atmosphere, makes these problems extremely difficult to solve. The focus of this report is the interpretation and program design for the Waste-to-Energy Technology Act of 2011 (the Act). This report posits that waste-to-energy has the potential to become an effective alternative waste management strategy while simultaneously providing the United States with a new energy source capable of generating a small but important proportion of our total energy needs. The fact that these two issues can potentially be addressed by one solution underscores the interdisciplinary nature of environmental problems and the need to consider environmental issues with economic analyses. As these myriad problems are complex and interconnected, so too must be the solutions.

In 2009 each person in the U.S. generated an average of 4.3 lbs. of waste per day. This added up to 243 million tons of municipal solid waste generated for 2009, 132 million tons of which ended up in landfills. The Act attempts to address the contribution of methane gas production in landfills to climate change, as well as their toxic releases such as liquid leachate. At the same time, it addresses our reliance on the extraction and burning of fossil fuels for energy. In light of limited and fragile resources – including land – traditional waste disposal methods are becoming less sustainable every day.

Waste-to-energy (WtE) technologies address these problems by diverting waste from landfills, where the U.S. sends 54% of its waste. Although reducing sources of waste is an important goal, the reality is that waste will continue to be produced. Recycling is a key focus of the Act: glass, plastic, metals, and paper will be removed from the waste stream and recycled. This will reduce our need for raw materials in manufacturing. The remaining waste can then be diverted from landfills and used to produce approximately 9 million kilowatt hours of electricity each day, reducing our need for coal by over 4,500 tons per day.

The Waste-to-Energy Technology Act promotes investment in waste-to-energy technologies via a 30% federal investment tax credit for qualifying facilities; the Act stipulates that a total of $1 billion in tax credits be allocated. This $1 billion has the potential to fund approximately 16 large-scale facilities capable of processing 1,000 tons of waste per day or 32 medium-scale facilities capable of processing 500 tons of waste per day; these will be in addition to the 86 facilities currently operating in the United States. The Act prioritizes recycling, reducing greenhouse gas emissions, protecting human health and the environment, and converting waste into energy efficiently. The Internal Revenue Service (IRS) and the Environmental Protection Agency (EPA) will implement the Act and existing staff from both agencies will be utilized as well as contractors as needed. The program will cost $1.462 million and will run for four years, with two rounds of application and allocation.

Waste-to-energy addresses some of the problems associated with both landfilling and fossil fuel consumption in a significant, albeit small, way. The $1 billion in tax credits will allow just under 17,000 tons of waste per day be diverted from landfills. With 75% of the waste processed being diverted on-site for recycling, 2,300 garbage trucks will no longer be needed to haul waste to landfills each day. Enough energy can be generated by this waste to power more than 272,000 homes. Waste-to-energy offers an alternative to two unsustainable practices and brings with it environmental benefits. We can no longer afford to bury our waste when a productive, environmentally friendlier alternative exists.

Introduction

The purpose of this report is to simulate the implementation of the Waste-to-Energy Technology Act of 2011. In this simulation we assume that the United States Congress passes the Act at the end of the calendar year of 2011 and the United States Environmental Protection Agency and The Secretary of the United States Treasury commence implementation on January 3, 2012.

This report is divided into three sections. This first section discusses the environmental problems caused by the use of landfills and other waste management methods and the solutions to these problems that are proposed by the Act. The second section discusses the history and political background of waste-to-energy legislation in the U.S.

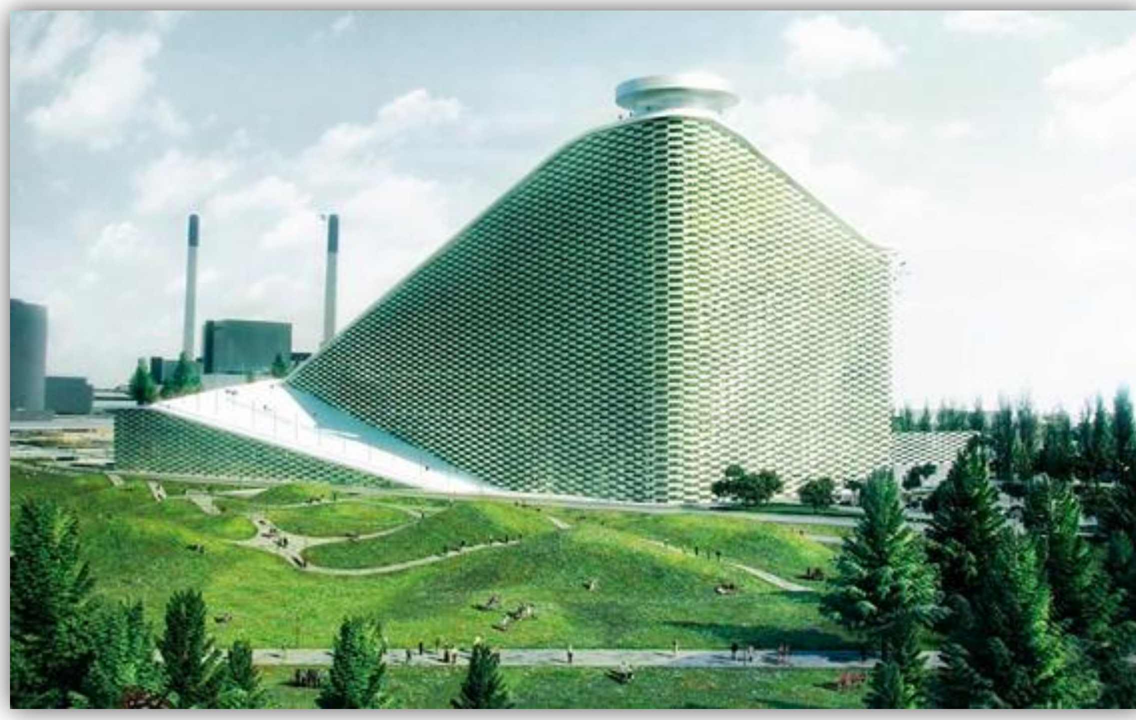
The third section of this report details the structure of the program design that we have developed. Also covered in this section are our recommendations for implementation, including an organizational and staffing plan, program budget, master calendar, and a system for measuring performance.

The report concludes with our final thoughts along with bibliographic information and an appendix of relevant documents.

Waste Disposal & Waste-to-Energy

Many environmental problems are associated with traditional waste management strategies, particularly landfilling. The first half of this section introduces the current state of municipal solid waste disposal in the United States and discusses the traditional ways that it is processed, including combustion, wastewater treatment, and landfilling. Local and global impacts of these processes are also considered.

Waste-to-energy presents a potential solution to many of the problems associated with these traditional waste management practices. The second half of this section explores waste-to-energy technologies, their efficiency in generating energy, an analysis of life cycle greenhouse gas emissions, and presents three case studies.

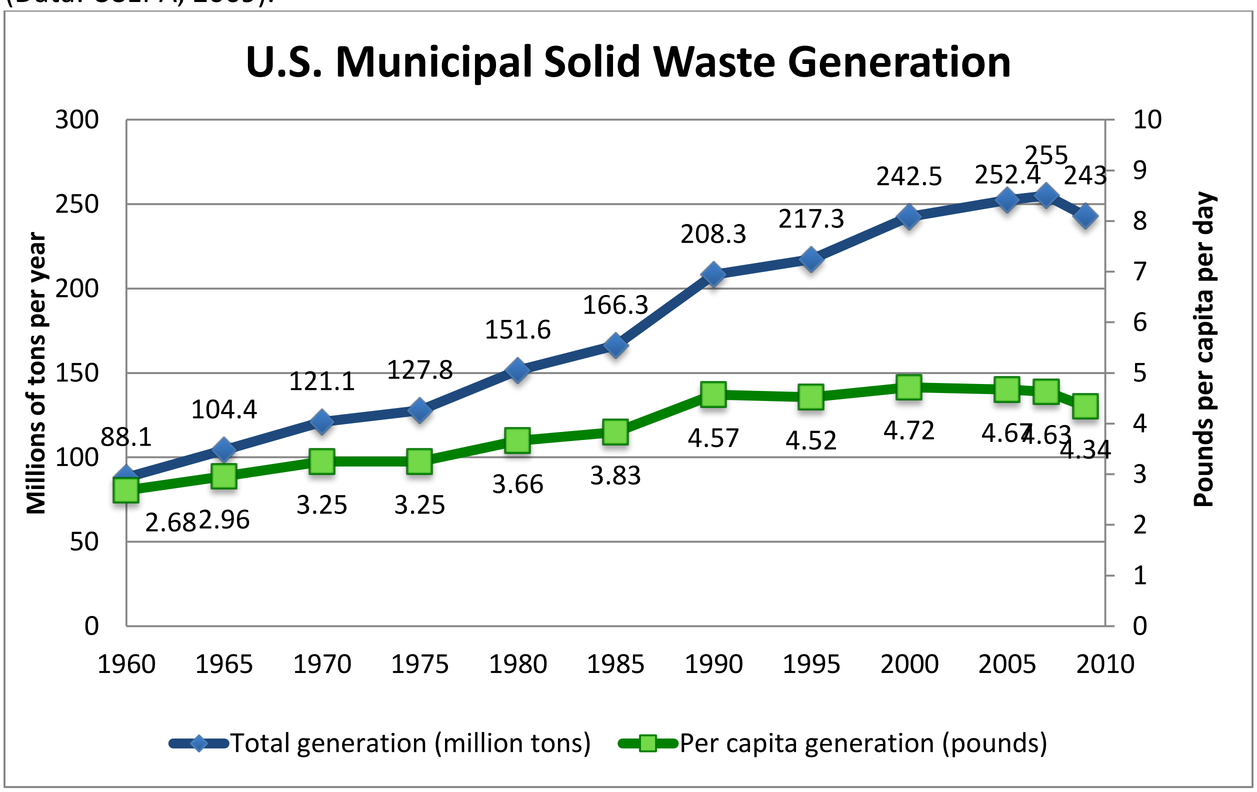


An architectural drawing of Copenhagen's Amagerforbraending waste-to-energy plant and ski slope, designed by BIG Architects and projected to open in 2016.

The Problem: Landfills & Waste Disposal in the U.S.

The most significant issue addressed by the Act is the impact of municipal solid waste (MSW) in the United States. The EPA defines MSW as common trash or garbage, generated by households, schools, hospitals, and businesses (USEPA, 2011). It consists primarily of non-toxic biodegradable materials such as paper, cardboard, wood, yard trimmings, and food scraps, as well as non-biodegradable plastic, metal, and glass. In 2009, Americans produced a total of 243 million tons of MSW, or about 4.3 pounds of waste per person per day (USEPA, 2011). Of this material, 82 million tons were either recycled or composted, leaving 132 million tons that was disposed of in landfills and 29 million tons that was combusted in waste-to-energy facilities (USEPA, 2009). Figure 1 below shows a steady rise in U.S. municipal solid waste production from 1960 to 2009 with a slight decrease after 2007; this decrease is due to increased rates of recycling but anticipated increases in population growth will likely continue to increase total MSW production in the United States. In the graph below the blue line represents total municipal solid waste generation per year and is measured in millions of tons whereas the green line represents municipal solid waste generation per person, per day and is measured in pounds.

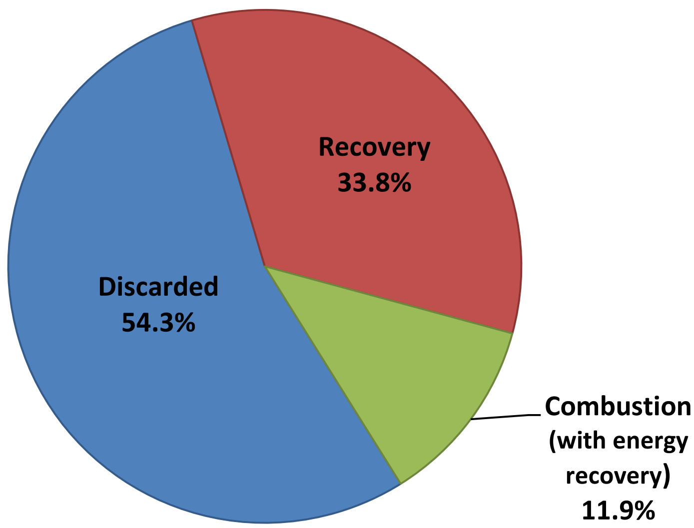
Figure 1: U.S. municipal solid waste generation, total and per capita per day, 1960 to 2009 (Data: USEPA, 2009).



METHODS OF DISPOSAL: INCINERATION

The two primary methods of MSW disposal in the U.S. has historically been landfilling and incineration. The practice of waste incineration, or the uncontrolled burning of waste, has created many environmental problems in the United States and worldwide. From 1910 to 1968 New York City had approximately 17,000 private waste incinerators with no air emission controls and 32 municipal incinerators with very few emission controls; these 32 municipal incinerators alone emitted almost one million tons of pollutants into the atmosphere (Walsh, Chillrud, Simpson, & Bopp, 2001). The toxins emitted included nitrogen oxides, sulfur oxides, and other hazardous chemicals such as dioxins and lead. With the passage of the Clean Air Act in 1970, many incinerator facilities were forced to close due to high compliance costs associated with the new pollution control regulations. When these facilities closed, the waste was redirected to landfills. Today, landfilling is the most common form of waste disposal in the U.S., receiving 54.3% of all MSW generated (see Figure 2 below).

Figure 2: Current management practices for municipal solid waste in the United States (Data: USEPA, 2009)**.**



METHODS OF DISPOSAL: WASTEWATER TREATMENT

The second major waste source targeted by the Act is sewage sludge, the byproduct of public wastewater treatment plants (WWTPs). There are currently over 16,000 WWTPs and 2,000 central sludge processing facilities in the U.S. (USDOE, 2004). The undesirable pollutants from wastewater are processed in treatment facilities and are broken down into a number of different forms, depending on the level of treatment. During the primary treatment phase, the sludge is made up of large solids that settle due to gravity. Next, the sludge is submitted to aerobic biological treatments, yielding a mass of organic matter known as “activated sludge.” Finally, the sludge goes through anaerobic biological processes like denitrification to produce a more refined biomass (Niessen, 2002). When sludge undergoes anaerobic digestion, it produces methane gas which can be used as a fuel source. This reduces facility operating costs because sewage contains 10 times the amount of energy as a wastewater treatment plant needs to operate (WERF, 2011). Utilizing methane, which is a powerful greenhouse gas, ensures that it will not be released into the atmosphere. However, only 650 processing facilities nationwide use anaerobic digestion to produce methane gas (WERF, 2011). After the waste is fully processed, the remaining waste is dried and then composted, incinerated, or landfilled (WERF, 2011).

METHODS OF DISPOSAL: LANDFILLS

Municipal solid waste landfills in the United States accept all types of nonhazardous wastes including household waste, construction and demolition debris, non-hazardous sludge, and industrial solid waste (USEPA, 2011). Several negative consequences result from the landfilling of municipal solid waste. These include air pollution caused from transporting trash from the source to the landfill, the production of methane gas (CH_4) during the anaerobic decomposition of waste in landfills, and the potential for groundwater contamination and air pollution from both improper management and insufficient monitoring practices. In addition, landfills occupy land that could be put to other uses and devalue the properties in the vicinity of the landfill (The Office of Representative Lloyd Doggett, 2011). While there are areas of the U.S. that still have sufficient space to dispose of MSW in nearby landfills, urban areas are finding it increasingly difficult to dispose of MSW locally and often haul trash to distant landfills.

Before the addition of Subtitle D to the Resource Conservation and Recovery Act (RCRA) in 1988, landfills were unregulated, exposed dumps that accepted all kinds of waste which resulted in a greater likelihood of air and water pollution. Subtitle D instituted the first federal standards for landfills, requiring that they be constructed with synthetic and clay liners to protect the surrounding soil and groundwater. Landfills built since 1988 are also required to have surface covers that prevent rainwater infiltration as well as gas collection wells to capture landfill gas such as methane. Although modern landfills are required to follow these more stringent regulations, these measures do not fully prevent the release of air and water pollutants (Taylor, 1999).

North Carolina Landfill

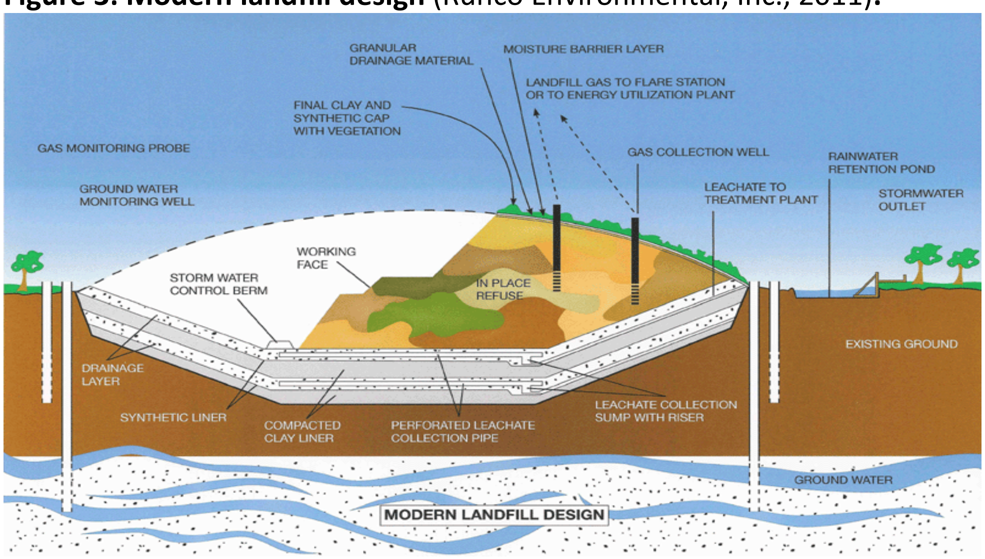
LOCAL ENVIRONMENTAL IMPACTS: LANDFILLS

The pollution of surface and groundwater by leachate is one of the most severe environmental impacts from landfills. Leachate is a liquid that is formed when rainwater filters through the waste pile and dissolves organic and inorganic materials. Leachate can be released during the operational period of the landfill and for many years after its closure but leachate produced earliest in the life cycle of a landfill is most toxic (Kjeldsen, Barlaz, Rooker, Baun, Ledin, & Christensen, 2002). Some of the compounds that can be leached are heavy metals such as cadmium, chromium, copper, lead, and industrial chemicals including pesticides and plasticizers. These compounds can contaminate groundwater sources through any breach in the landfill liner.

Some MSW material also has the potential to release hazardous air pollutants (HAPs) as it decomposes in landfills. These pollutants can be found in cleaners, paints, solvents, pesticides, and adhesives which can release toxins such as vinyl chloride, ethyl benzene, toluene, and benzene. The negative impacts of these toxins on human health include central nervous system damage, cancer, and reproductive problems (CCCC, 2011). HAPs present in leachate can also become gaseous and are called volatile organic compounds (VOCs). They are produced from paints, aerosols, cleaners, insect repellents, air fresheners, and other similar household products. VOCs contribute to local smog production and ozone formation, and have numerous health impacts such as respiratory problems, loss of coordination, and kidney and central nervous system damage. Additionally, landfills produce sulfur oxides (SO_X) and nitrogen oxides (NO_X) which contribute to local pollution problems such as smog and acid rain.

The federal government requires both the monitoring of landfill liners for leaks and the testing of nearby groundwater sources on a regular basis. Leaks are detected by a network of monitoring wells positioned between the final barrier layer and groundwater. The efficacy of this system depends on the number of wells in place, as more wells provide more opportunities to detect small-point leaks. Unfortunately, building wells adds to the overall monitoring costs of a landfill and can become expensive. Testing groundwater determines if a leak has occurred but fails to prevent groundwater pollution since it only alerts monitors after contamination; hence every landfill represents a compromise between environmental and fiscal responsibility (NNEMS, 1998). See Figure 3 below for a diagram of modern landfill design.

Figure 3: Modern landfill design (Runco Environmental, Inc., 2011)**.**



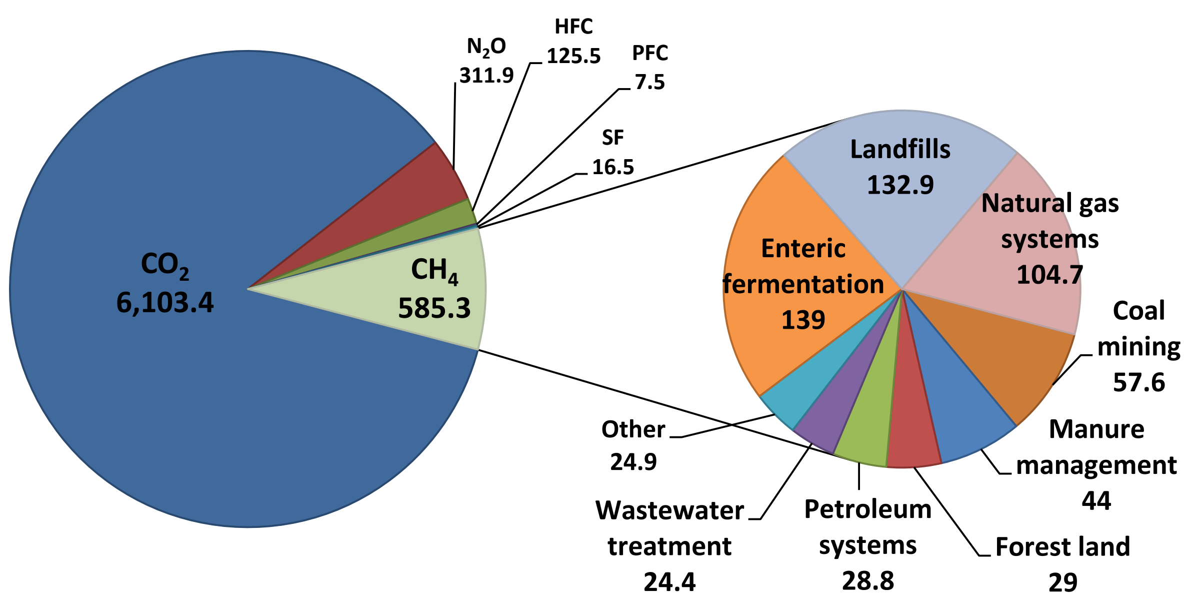
LOCAL ENVIRONMENTAL IMPACTS: TRANSPORTATION

The transportation of MSW over great distances from urban centers to rural landfills causes additional releases of pollution. According to the EPA, the national average for waste transport distance by truck is 20 miles (USEPA, 2010). This figure is in stark contrast to many densely populated urban centers in the U.S. In the case of New York City, waste is loaded onto trucks and driven to states as far away as Virginia, Ohio, and Pennsylvania (Cohen, 2008). Accidents can spill or dump waste at any point along the journey and gases are released into the atmosphere as the process of decomposition has already begun; this in addition to the carbon dioxide and other emissions being generated from the act of transporting waste by semi-truck or barge.

GLOBAL ENVIRONMENTAL IMPACTS: GREENHOUSE GAS EMISSIONS

The most serious global environmental impacts that result from landfilling municipal solid waste are greenhouse emissions, which contribute to climate change and global warming. According to the EPA's 2011 U.S. Greenhouse Gas (GHG) Inventory Report, waste activities in 2009 accounted for just over 2% of total U.S. GHG emissions. Methane gas (CH_4) is the primary GHG released by landfills and wastewater treatment plants and is created by the process of anaerobic decomposition; landfills account for 17% of total U.S. methane emissions while WWTPs are responsible for about 4% (see Figure 4 below). Methane is a significant contributor to global warming because it has a global warming potential (GWP) 21 times greater than carbon dioxide (CO_2), so relatively small amounts of methane can cause proportionately greater warming than other greenhouse gases. Significant methane production typically begins one or two years after the disposal of waste in a landfill and continues for another 10 to 60 years (USEPA, 2011). While landfills are required by federal law to capture methane gas, gas capture efficiencies are approximately 75%; on average, 25% of the total methane gas generated escapes the gas collection system and ends up in the upper atmosphere (USEPA, 1995). The 75% that is captured is either flared in order to convert the methane to carbon dioxide or is utilized to generate energy in a process known as landfill-gas-to-energy.

Figure 4: U.S. total GHG and methane emissions for 2007 in millions of metric tons (Data: McComb, 2009)**.**



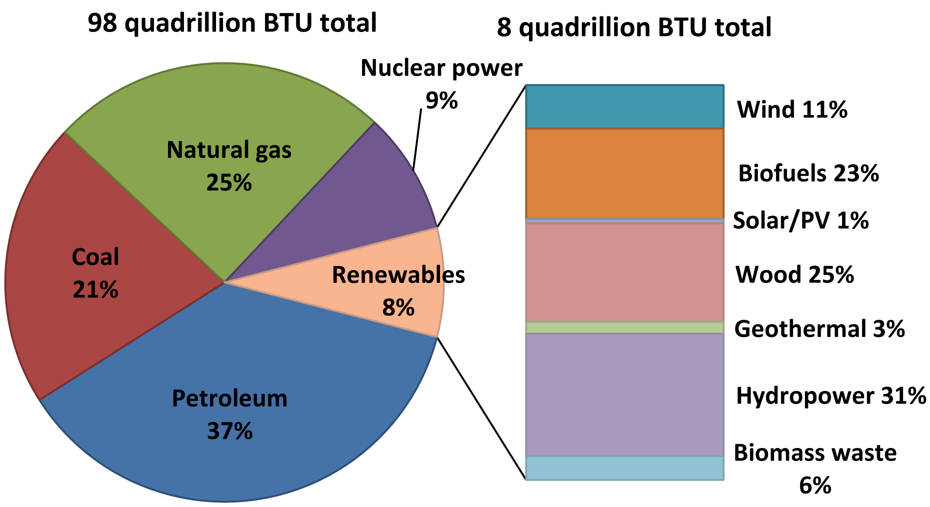
GLOBAL ENVIRONMENTAL IMPACTS: CLIMATE CHANGE

The EPA defines climate change as any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period of time. Current climate change trends are a result of increasing global averages of both air and ocean temperatures. This is believed to be primarily due to GHG emissions from the burning of fossil fuels. Greenhouse gases such as carbon dioxide and methane contribute to global climate change by trapping heat in the upper atmosphere, much like glass does in a greenhouse. Human consumption of fossil fuels since the industrial revolution has caused a steady and unnatural increase in atmospheric CO_2 concentrations. The result of this anthropogenic change has been increased rates of global warming.

DOMESTIC ENERGY NEEDS

The Act also addresses the demand for a greater number of clean, domestic energy sources in the United States. As U.S. population continues to grow, energy consumption continues to increase the demand for fossil fuels, which are a finite resource. As of 2009, the United States consumed 37% of its electricity needs from petroleum, 25% from natural gas, 21% from the burning of coal, 9% from nuclear power, and 8% from renewable sources; these renewable sources include hydropower, wood, biofuels, wind, biomass waste, geothermal, and solar/PV (USEIA, 2009). This breakdown is shown in Figure 5 below.

Figure 5: Renewable energy as a share of total primary energy consumption for 2010 (Data: USEIA, 2011).



Further, the $1 billion in tax credits that the Act authorizes would incentivize the construction of enough waste-to-energy facilities to process 16,667 dry tons of waste per day or 6.08 million tons per year. This means that 4.5% of the 132 million tons of waste that was landfilled in 2009 could have been diverted and instead processed for energy. The energy generated from this amount of waste is the equivalent of burning 4,533 tons of coal per day or 1.65 million tons per year. This represents 0.16% of the 1,000.4 million tons of coal consumed in the United States in 2009 (USEIA, 2010). This energy could generate over 9 million kilowatt hours (kWh) of electricity per day or 3,285 million kWh per year which could provide enough electricity to power 272,005.[1]

The conversion of MSW to energy in WtE facilities could help alleviate some of the consequences of global fossil fuel energy use by providing the U.S. with an additional source of domestic energy production. While the total potential energy that could be generated from all of the non-recyclable and non-compostable MSW in the country would replace just 4.5% of the electrical energy generated by coal combustion annually (DeCarolis, Kaplan, & Thorneloe, 2009), WtE could be added to the national renewable energy portfolio – along with the renewables listed above – thereby further reducing U.S. dependence on fossil fuels.

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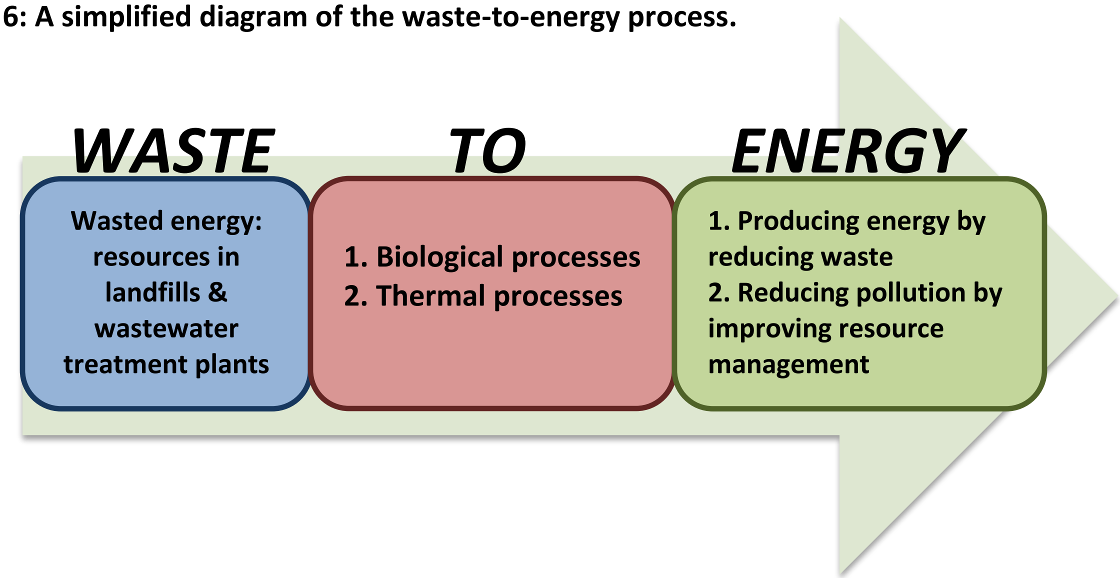
[1] 16,667 tons per day x 544 kilowatt hours per ton = 9,066,848 kilowatt hours per day. 9,066,848 kilowatt hours per day x 1 ton coal / 2000kWh = 4,533 tons of coal per day. And 9,066,848 kWh/day x 30days/1000kWh/home = 272,005 homes

The Solution: Waste-to-Energy Technologies

Waste-to-Energy refers to a group of technologies that generate energy from solid wastes using a variety of technologies ranging from simple combustion to more costly – but highly efficient – plasma arc gasification. WtE is primarily useful as an alternative to landfilling but also has the added benefit of supplementing domestic energy production. Two main waste-to-energy processes are in use throughout the world today: biological and thermal. Biological processes utilize naturally occurring microbial activity whereas thermal processes are strictly engineered and involve the application of a flame or heat. WtE is currently under-utilized in the United States: as of 2005 there were 1,654 landfills in the U.S. (USEPA, 2005) but only 86 WtE facilities (Michaels, 2010). Despite the fact that it is a proven technology in Europe and Asia, WtE has been unpopular in the United States for reasons that were discussed in the first section.

Figure 6: A simplified diagram of the waste-to-energy process.



BIOLOGICAL TECHNOLOGIES

In the process of natural decomposition, microbial activity degrades organic material in oxygen-starved (anaerobic) environments. Biological WtE technology harnesses this naturally occurring microbial activity to break down sewage sludge or the organic components of MSW. This process happens in a gas-tight reactor, where temperature, moisture content, pressure, and pH may be controlled so that the desired products can be separated and harvested. Biological waste treatment usually involves wet organic waste fermentation to yield biogas, which can be combusted to generate energy. Biological waste treatment also has the potential to yield biofuels and alcohols such as ethanol and methanol from organic material. The primary drawback to this type of technology is that the feedstock is limited to organic materials such as food scraps, yard and gardening waste, and sewage sludge. Non-organic waste must still be disposed of in other ways. Biological treatment is, therefore, not a comprehensive strategy but can be an important component of an integrated waste treatment facility.

THERMAL TECHNOLOGIES

Thermal treatment technologies can be applied to non-recyclable waste and has the general benefit of reducing the volume and mass of waste, generating thermal energy and electricity, and minimizing air and water pollutants (WTERT, 2011). The primary thermal technologies in use around the world today are combustion, pyrolysis, gasification, and plasma arc gasification. In all of these processes, control strategies such as filtering and scrubbing processes must be installed to reduce air pollutant emissions. In both biological and thermal processes, contaminants such as hydrogen sulfide and hydrochloric acid must be chemically removed from the produced gas so that it does not present air pollution problems when it is burned for energy (Niessen, 2002). However, each thermal technology shown in Figure 7 below represents a sequential environmental improvement over the previous technology, demonstrating substantial advancements in both environmental benefits and energy production.

Figure 7: Waste-to-energy products and byproducts by type of technology (Data: Young, 2010)**.**

	Process	Description	Feedstock	Temperature	Yields	Residuals
Biological	**Anaerobic Digestion**	Microbial processing of organic waste	Organic materials only	< 200° F	Biogas (CH_4, CO_2); compost	Partially digested solids (digestate)
Thermal	**Combustion**	Flame process, burning	All MSW	< 1,000° F	Direct heat or electricity	Ash, carbon char, metals, air emissions
	Pyrolysis	Directly applied heat; no burning	All MSW	1,200° - 2,200° F	Syngas; can be used for direct heat or electricity	Ash, carbon char, oils, tars, metals, air emissions
	Gasification	Higher heat with controlled burning; more complete breakdown	All MSW	1,450° - 3,000° F	Syngas; can be used for direct heat or electricity	Ash, slag, metals, air emissions
	Plasma Arc Gasification	Extreme heat completely breaks down molecules; nearly 100% energy conversion	All MSW	6,000° - 12,600° F	Syngas; can be used for direct heat or electricity	Vitrified slag, metals, air emissions

COMBUSTION

Combustion is the oldest and simplest technology of all the thermal processes and is currently the most widely used in the U.S. and world-wide. Resource material, usually MSW, is fed into an incinerator and a flame is applied in the presence of air. Average furnace temperatures are around 1,000° F (Young, 2010). Some of the contaminants produced in this process include nitrogen oxides, sulfur oxides, heavy metal oxides, dioxins, and furans (Young, 2010). End-of-process scrubbing and filtering removes contaminants, as required by law, while the ash and other residues require further disposal and are typically disposed of in a landfill. The energy retrieved from this WtE process is heat or steam which can be used to drive turbines for electricity generation or used more directly to supply heat.

PYROLYSIS

This technology involves breaking down large molecules into smaller molecules by applying a high temperature (1,200° - 2,200° F) in the absence of oxygen, or with very limited amounts of oxygen (Young, 2010). This is neither incineration nor combustion. The drawback to pyrolysis is that it may lead to an incomplete breakdown of organic materials. Compared to newer technologies it may yield less syngas, which is made up of carbon monoxide and hydrogen. This process also produces char (solid carbon), tars, and oils. The char is used as fuel, and oil and tars are used as lubricants and sealants or in the ingredients of other industrial processes. The ash that is produced in this process must be landfilled.

GASIFICATION

This process is similar to pyrolysis, except that controlled levels of oxygen and steam are added and the reactor is held at higher temperatures (1,450° - 3,000° F) (Young, 2010). More complete reduction of organic material may be accomplished, producing a higher yield of syngas, while also breaking down inorganic materials more completely than pyrolysis. The higher temperature may also melt and fuse the ash into a slag, creating a solid that stabilizes contaminants to the extent that it may be used for construction purposes.

PLASMA ARC GASIFICATION

Plasma arc gasification is an emerging technology and may one day prove to be the most efficient WtE technology; pilot facilities have shown that plasma arc has high energy recovery with low pollution effects. This technology is currently not utilized in the U.S. for the processing of MSW but is found in Japan, Indian, and Taiwan. In this process, plasma is created by passing an electric arc through an inert gas wherein the gas becomes ionized and the reactor holding the waste material is allowed to reach very high temperatures, from 6,000° to 12,600° F (Ducharme & Themelis; Young, 2010). At these extreme temperatures, virtually all chemical bonds break, including bonds in hazardous materials (Bozzelli & Hsien-Tsung, 2001). Cooling the gas also quickly inhibits certain toxins such as dioxins and furans from reforming (Ducharme & Themelis, 2010).

Plasma Torches Made by PyroGenesis

INTEGRATED WASTE TREATMENT

One emerging solution is the construction of integrated waste treatment facilities that combine a number of waste processing steps in one location. Integrated waste treatment is a comprehensive technology and is primarily an improvement in the management process that reduces transportation and labor costs. This involves a recyclable sorting component to minimize the number of recycled materials in the treated waste stream (Keppel Seghers, 2007). Additionally, the organic waste is sorted for biological treatments such as composting and anaerobic digestion. The outputs from this process include digestate for fertilizers, biogas as alternative fuels, and an overall reduction in the waste volume. The sludge and remaining waste solids are combusted, which may yield similar outputs to the isolated combustion and thermal technologies delineated above.

Case Study: Ecoparc

Ecoparc is Barcelona's solution to integrated waste management. The facility processes 245,000 metric tons per year (or 675 tons per day) of organic and undifferentiated municipal solid waste through diverse treatments such as pre-sorting of recyclable materials, composting, and methanization. Organic material is separated from the undifferentiated waste and from biostabilizers and the digestate is separated from methanization. This latter process generates methane, which is used to generate 13,000 megawatts (MW) of electricity per year. The facility composts 24,000 metric tons per year and recovers 11,000 tons of waste per year for recycling. It also creates 4 million cubic meters of biogas.

The first step in the process is pretreatment; there are two pathways for pretreatment, one for organic waste and one for residual waste. Both types of waste are mechanically sorted and residual waste undergoes pre-fermentation to defiber paper and cardboard. This process removes recyclable materials and prepares materials for composting.

The second step is methanization and co-generation. During this phase anaerobic fermentation releases biogas, a combination of methane and carbon dioxide, which can be used as renewable fuel in the generation of electricity and heat. Biogas is stored in a gasholder and then sent to the cogeneration station, which is equipped with a total power capacity of 5.24 MW. The combusted biogas produces electricity for the grid and heat which is used to maintain the temperature of the digesters. This electricity offsets the atmospheric emission of 4,536 tons of CO_2 per year.

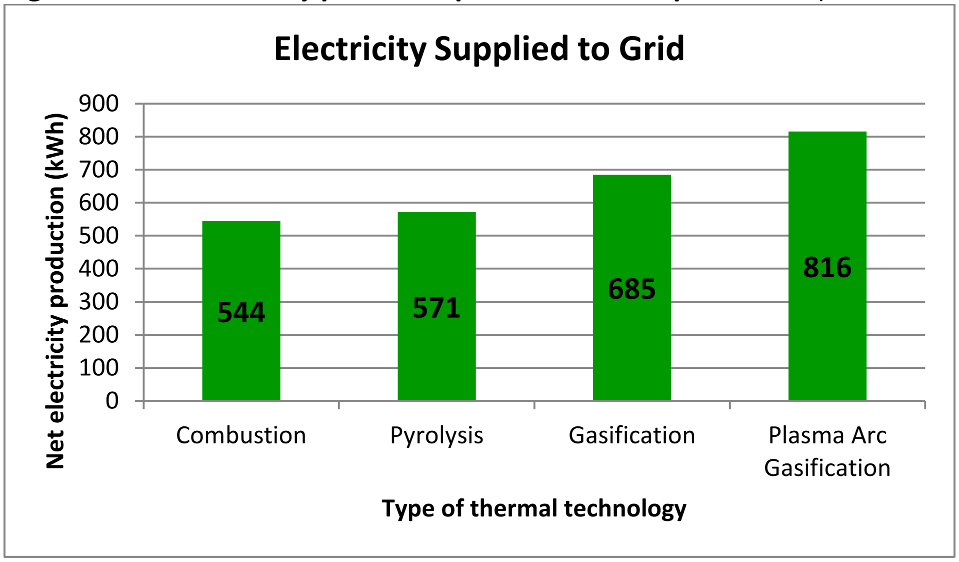
The third step involves composting; the facility has 38 composting tunnels arranged in four parallel blocks. Three are used for organic matter extracted from residual waste. The fourth is for sludge resulting from methanization. The compost undergoes maturation and stabilization phases, after which a mechanical process eliminates impurities, making it suitable for agriculture and gardening.

ecoparc
DE BARCELONA S.A.

BENEFITS OF WASTE-TO-ENERGY

The use of waste as an energy source can displace a portion of fossil fuels for energy generation which will have the added benefit of reducing emissions from the extraction and processing of coal and oil. Figure 8 below shows the net energy production of the four thermal WtE technologies.

Figure 8: Net electricity produced per ton of MSW processed (Data: Young, 2010).



A full life cycle analysis for each WtE facility is required by the Act in order to fully determine GHG reductions; however, it is estimated that WtE will generate less pollution than traditional energy sources and waste management practices. Data for air emissions as well as solid waste byproducts from landfilling, coal combustion, and waste-to-energy are shown in Figures 9 and 10 below.

Figure 9: Air emissions data from three energy sources (Data: Ensor & Shendrikar, 1986; Buekens & Huang, 1995).

Air Emissions			
	SO_2 (g/MWh)	NO_2 (g/MWh)	CO_2 (Mton/MWh)
Landfill-Gas-to-Energy	890	2300	3.3
Coal Combustion	620	3700	1.1
Waste-to-Energy	400	1400	0.6

Figure 10: Solid waste byproducts from landfilling, coal combustion, pyrolysis, and plasma arc gasification (Data: Fernandez & Menendez, 2011).

Solid Waste Byproducts (in mg/L or ppm)					
	Cadmium	**Chromium**	**Lead**	**Arsenic**	**Mercury**
Landfill Leachate	0.0001 - 0.4	0.02 - 1.5	0.001 - 5	0.01 - 1	0.00005 - 0.16
Coal Ash	0.024	0.018	0.051	0.2801	0.040
Fly Ash from Pyrolysis	0.0013	1.41	12.19	0.011	0.011
Vitrified Slag from Plasma Arc Gasification	0.0002 - 0.0014	0.00026 - 0.0022	0.023 - 0.104	0.0006	< 0.0005

This data shows that greenhouse gas emissions are reduced when we use waste as a resource, rather than have it decompose in a landfill, releasing methane. Waste-to-energy addresses the problems of air pollution and GHG emissions because these air emissions are lower than traditional waste processing facilities and lower than coal-fired power plants, as shown in the data above (Jenkins & Legrand, 2010; Niessen, 2002; Young, 2010). Solid waste byproducts such as heavy metals and arsenic are also greatly reduced when waste-to-energy is utilized. Depending on the technology employed, the volume of waste can also be reduced to very low levels due to intense resource recovery, and what is not recoverable may be processed further to an inert form such as vitrified slag, which is commonly used as a construction material. Metals, glass, and plastics will be separated for recycling, thereby reducing the need for extraction of raw materials for new products.

LIFE CYCLE GREENHOUSE GAS ANALYSIS

A life cycle greenhouse gas analysis measures the emissions of greenhouse gases at every stage of operation, over the entire lifetime of a facility. For the purposes of this report we will be considering the GHG emissions from coal burning, landfilling, and waste-to-energy processes. The EPA's Waste Reduction Model (WARM) tool allows waste managers to assess the carbon intensity of a variety of MSW inputs as well as the carbon benefits of recycling. The WARM tool calculates the GHG emissions for both conventional and alternative waste management practices, including source reduction, recycling, combustion, composting, and landfilling (USEPA, 2011).

Life cycle analysis is an important tool for policymakers in order to analyze the environmental impacts of different waste management strategies (Zaman, 2010). When considering the life cycle GHG impact of waste-to-energy, it is also important to consider the life cycle GHG analysis of the processes it replaces: coal burning and landfilling. Coal burning has high GHG emissions at all phases in its life cycle: from extraction to processing to disposal. Landfills, by contrast, have a low extraction impact as waste is generated from previously processed materials. However, the waste must then be transported and deposited and these two activities contribute to significant greenhouse gas emissions. Landfills also have a period of high methane and CO_2 releases for many years as the waste decomposes. By contrast, WtE technologies have low GHG emissions during extraction or acquisition, and produce a comparatively small amount of GHG emissions during processing.

It is important to recognize that WtE processes do emit some greenhouse gases during the collection, transportation, and processing phases, but this is less than – or equal to – the emissions from landfilling. WtE is a waste management strategy that can greatly reduce the need for landfills and minimize methane gas releases. The end result is a net reduction in greenhouse gas emissions from waste management activities when waste-to-energy replaces both landfilling and traditional fossil fuel combustion. Figure 11 below provides a conceptual framework that can be used to account for life cycle greenhouse gas emissions of WtE facilities in comparison to coal fired power plants and landfills.

Figure 11: Conceptual greenhouse gas life cycle analysis framework.

Life Cycle Stage	GHG Impact (Positive or Negative)	Explanation
Fossil Fuel Based Inputs	+	Emissions associated with raw material extraction, transport, consumption, and disposal.
Biological Inputs, Landfilled	+	Methane emissions from landfills are only partially captured, and methane is a stronger GHG than CO_2.
Biological Inputs, Anaerobic Digestion	-	Digestion is a controlled process so gases are captured more efficiently for biofuels and powering turbines.
Thermal WtE Processes	+	Depending on technology, emissions are either reduced or captured to an increasing degree.
Avoided Fossil Fuels Used for Electricity/Heat	-	Net quantity of GHGs produced for amount of electricity sold to the grid relative to fossil fuel combustion.
Avoided Landfill Gas Releases	-	Reduction in GHGs for waste to be used in WtE processes compared to GHG release from landfilling waste.
Recovered Recyclables	-	Reduction in GHGs from decreased use of raw materials through use of recycled products, and diverting recyclables from landfills.
TOTAL NET LIFE CYCLE GHG EMISSIONS	**SUM OF THE ABOVE**	

In order to comply with the stipulations of the Act, which require recipients demonstrate a reduction in life cycle greenhouse gas emissions, it will be necessary for a WtE facility to conduct this type of analysis. The framework given above considers the inputs, the process, and the GHG emissions that WtE displaces. Fossil fuel based inputs, such as plastics that cannot be recycled, and the waste-to-energy process of breaking down the materials, will both add some GHGs to the atmosphere. However, the avoided emissions associated with coal burning and landfilling count toward negative GHG emissions overall. This accounting framework will provide an overall figure of the efficiency of a facility and will allow program assessors to identify the facilities that demonstrate a reduction in life cycle GHG emissions, as required by the Act.

History and Political Background

THE HISTORY OF WASTE-TO-ENERGY

Waste-to-energy technologies have existed for many years and have been greatly impacted by key pieces of legislation in the U.S. over the past 40 years. The history of WtE in the United States can be divided into four main phases:

Phase 1: Development (1970 – 1979) – WtE was identified as an alternative to traditional waste management practices after strict regulations were passed on incineration and landfilling; two of these regulations include The Clean Air Act of 1970 and the Resource Conservation and Recovery Act of 1976. This was followed by the Public Utility Regulatory Policies Act, which stimulated renewable energy investment in response to the global energy crisis of the 1970s.

Phase 2: Investment & Expansion (1980 – 1993) – The 1980s were a boom period and 46 WtE facilities were built around the country (Combs, 2008). This was in part due to the 1980 Energy Security Act, which allowed tax credits for WtE projects. Moreover, the 1980 Crude Oil Windfall Profits Tax Act also allowed tax-free status on industrial development bonds for WtE projects. Unfortunately, tax reforms in the late 1980s eventually phased out these financial incentives.

Phase 3: Stagnation (1994 – 2004) – WtE tax credits expired in the mid-1990s and no WtE facilities have been built since. In addition, the 1994 U.S. Supreme Court ruling of *C&A Carbone, Inc. v. Town of Clarkstown* determined that local waste flow controls were unconstitutional, allowing for the commercial transport of waste to out-of-state landfills. As a result, many small waste management sites closed, including both landfills and WtE facilities. The option of transporting waste to mega-landfills at a low cost delayed the need to develop alternative waste management solutions.

Phase 4: A New Perspective (2005 – Present) – While the building of WtE plants had stopped in the U.S., countries in Europe and Asia embraced WtE technologies and implemented large projects in many urban centers. Only recently has the U.S. begun to reconsider WtE; the 2005 Energy Policy Act and the 2009 American Recovery and Reinvestment Act classified WtE projects as eligible to receive renewable energy production tax credits under Section 45 of the Tax Code (Energy Recovery Council, n.d.). Many states have since listed WtE as a renewable energy source that can contribute to emission reduction goals while reducing landfilled resources. The case study below highlights how WtE has been incorporated into many states renewable energy portfolios. Another significant milestone in waste management occurred in 2007; in the case of *United Haulers Association, Inc. vs. Oneida-Herkimer Solid Waste Management Authority*, the Supreme Court modified its 1994 ruling to allow local governments to intervene in waste flow decisions in certain cases.

Case Study: Maryland's Renewable Energy Portfolio and WtE

To increase renewable energy generation, some states have enacted Renewable Portfolio Standards (RPS), which require electricity utilities to provide a minimum percentage of electricity from renewable sources by a certain date. Currently 29 states have firm RPS policies while 8 additional states have RPS goals. Amounts range from 10% to 40% renewable energy between the years 2015 and 2035 (North Carolina State University, 2011)**. Although 26 states have energy laws that define WtE as a renewable energy technology, only 17 states include it as a qualifying technology in their RPS regulations** (USEPA, 2010)**. Some RPS regulations prioritize renewables in tiers to promote some technologies over others.**

In Maryland this past year, there was much controversy over including WtE as a Tier One renewable energy technology along with wind and solar. Maryland Senator Thomas Middleton proposed the Renewable Energy Portfolio Waste-to-Energy and Refuse-Derived Fuel Bill (S. 690) which required the approval of Governor Martin O'Malley. Governor O'Malley was urged by health and environmental groups, including the American Lung Association and Sierra Club, to veto the bill (Cella, 2011)**. The Governor eventually signed the bill, stating "It is only through a diverse, renewable fuel mix that we will be able to reach our aggressive goals, protect our precious environment, and create the economic engine to move Maryland forward"** (Office of Governor Martin O'Malley, 2011)**.**

AN AMENDMENT TO THE UNITED STATES TAX CODE

The Act amends Section 48 of Subtitle (A)(1)(a)(iv)(e) of the Internal Revenue Code to include "qualified waste-to-energy propert[ies]" as part of the existing Section 48 tax credit for investment in energy production facilities including wind, solar, and geothermal systems. The proposed change to the tax code provides tax exemption for up to 30% of the capital costs of a qualified facility from the investor's taxes for the year that the costs are incurred (Cornell University, 2011). Typical costs may include site development, construction, and equipment (Artz, Beachey, & Leary, 2002). A maximum of $1 billion in tax credits will be available within a two-year period of enactment.

At an estimated capital cost of $200,000 per ton of waste processed per day (WTERT, 2011), the Act could provide a 30% tax credit for a number of facilities that could convert a combined total of approximately 16,667 tons of waste per day into energy.[2] For example, the one billion dollars in tax credits could be allocated to sixteen new large-scale WtE facilities each capable of converting one thousand tons of waste per day into energy, 32 medium-scale WtE facilities capable of converting 500 tons of waste per day into energy, or some other combination of facilities with varying waste processing capacities.

[2] At $200,000 capital cost per ton of daily waste processing capacity as estimated by the Columbia University Waste-to-Energy Research Team, a 30% tax credit would mean $60,000 in tax forgiveness per ton of waste processing capacity. Dividing $1,000,000,000 in total tax credits provided by the Act by $60,000 in tax credits per ton of waste processing capacity yields the total waste processing capacity of all H.R. 66 projects, which is 16,666.7 tons of waste per day.

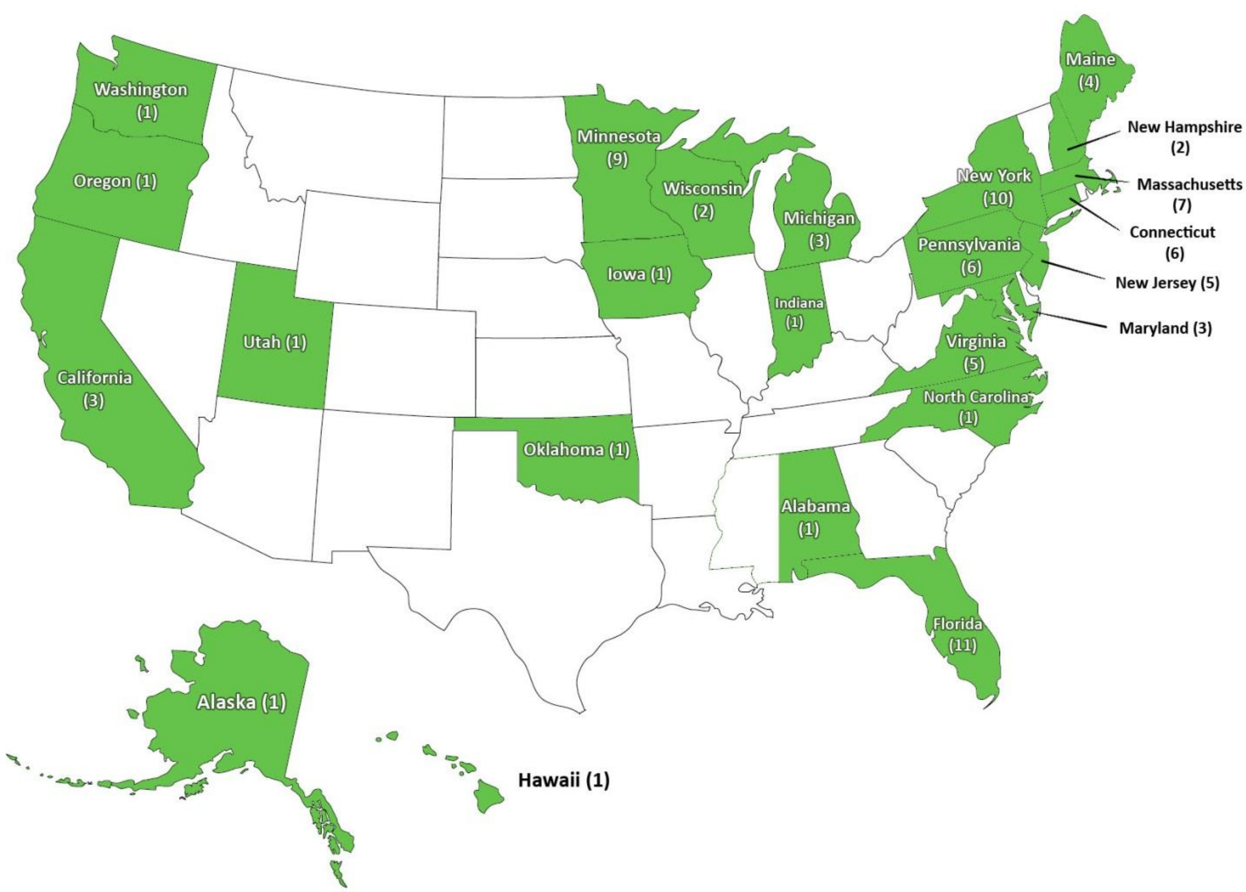
Other changes to the tax code define which types of WtE projects qualify for the program. These features are distinguished by degree of importance:

- **Essential:** facilities that use MSW or sewage sludge as the feedstock for producing solid, liquid, or gaseous fuel, or for producing energy;
- **Prioritized:** facilities that use the fewest recyclable materials, provide the greatest net reduction of life cycle greenhouse gases, provide the most energy at the lowest cost, and pose the fewest risks to human health and the environment;
- **Excluded:** facilities with poor waste management practices such as the recirculation of leachate in landfills (USLOC, 2011).

KEY STAKEHOLDERS & CURRENT POLITICAL LEADERSHIP

Trade associations like the American Biogas Council, the Energy Recovery Council, Integrated Waste Services Association, and the Solid Waste Association of North America are all potential beneficiaries of the Act. Other key private stakeholders include waste management companies and energy providers such as Covanta, which owns the largest number of WtE facilities in the U.S. Figure 12 below shows the number of waste-to-energy facilities by state.

Figure 12: The number of waste-to-energy facilities by state (Data: Michaels, 2010)**.**



Currently no public interest groups or organizations have opposed the legislation; however a few environmental groups are known to oppose WtE on ideological grounds. They argue that WtE pollutes the environment, harms public health, and disincentivizes recycling and composting. Some, such as the Global Anti-Incinerator Alliance, associate WtE with past incineration practices and fail to appreciate the significant differences and improvements with new technologies.

U.S. Representative Lloyd Doggett (D-TX) introduced the Act (House Resolution 66) in the United States House of Representatives on January 5, 2011 with six co-signers who are all from urban districts or regions neighboring large cities:

- Rep. Earl Blumenauer (D-OR) – Portland
- Rep. Rush Holt (D-NJ) – Greater New York City Metropolitan Area
- Rep. John Lewis (D-GA) – Atlanta
- Rep. Brad Miller (D-NC) – Raleigh and Greensboro
- Rep. Tim Ryan (D-OH) – Akron
- Rep. Albio Sires (D-NJ) – Greater New York City Metropolitan Area

The bill's signers represent regions that stand to benefit from waste-to-energy projects due to the waste management implications, a reduction in environmental impacts with respect to landfilling, and economic benefits of processing large streams of waste locally instead of exporting it. Furthermore, the legislation addresses the problem of property devaluation in the areas near landfills (The Office of Representative Lloyd Doggett, 2011).

Case Study: The Atlantic County Utilities Authority

The Atlantic County Utilities Authority (ACUA), located in Atlantic County, NJ, opened in 1978 as a wastewater treatment plant and began processing municipal solid waste in 1988. Today the ACUA has expanded its facilities to include on-site, single stream recycling, electronics recycling, composting, a compressed natural gas station, landfill-gas-to-energy capture, five wind turbines, and a solar array. The landfill processes 800 tons of waste per day after accounting for composting and recycling but is expected to reach maximum capacity by 2016 (ACUA, 2011)**. The high energy costs in Atlantic County, compounded by the fact that the landfill will reach capacity in five years' time with the current MSW stream, make the ACUA an ideal facility for waste-to-energy technology. For these reasons, the ACUA has sought to develop and build a waste-to-energy facility using plasma arc technology, which would not only complement the existing landfilling and recycling activities but would also realize the Authority's goal of improving sustainability while allowing the continued processing of MSW beyond 2016.**

Recently, the ACUA was approached by private investors who were interested in building and operating an on-site plasma arc facility. In addition to the interest from investors, there was also support from the local community for this project. The plans were in the application and permitting phase in the summer of 2011 when the New Jersey Department of Environmental Protection required the building of a 100 ton per day pilot project in order to gather appropriate data on plasma arc technology. Permitting challenges and other uncertainties led to the project being cancelled in September of 2011. Despite these setbacks, it is likely that the ACUA will continue to pursue projects that will ensure its ability to provide sustainable waste management services before the landfill reaches capacity in 2016.

The ACUA's wastewater treatment plant, wind farm, and solar arrays set against the back drop of Atlantic City.

Program Design & Implementation Plan

The remaining section of this report discusses the program design and implantation plan that we have created for an investment tax credit for waste-to-energy facilities. In this section we describe the program design, discuss who will do the work, how the program will be paid for, and what the first year of work will look like.

The program was designed around the mission and focus of the Act. It takes place in four phases, including pre-application, application, allocation, and certification. The program implementation tasks will be divided up between the EPA and the IRS, according to specifications of the Act and the organizational qualifications of each organization. The program activities and associated costs are calculated in the budget and revenue plan and a program master calendar gives an overview of the primary activities of the four year program. Finally, strategies for performance management are discussed.

Program Design

PROGRAM MISSION & FOCUS

The mission of the Waste-to-Energy Tax Credit Program is to provide an economic incentive for investment in waste-to-energy projects that would reduce the volume of waste while simultaneously providing a new source of alternative energy. Specifically, the tax credit seeks to stimulate investment in new waste-to-energy facilities by lowering the start-up capital costs of construction and technology acquisition or development. In addition, qualifying waste-to-energy facilities must promote recycling while meeting standards for environmental and human health protection. The Internal Revenue Service will collaborate with the Environmental Protection Agency to determine final distribution of 30% tax credits not to exceed $1 billion. The application portion of the program will be completed over the course of 2 years, with one application cycle for each year.

The Internal Revenue Service will collaborate with the Environmental Protection Agency to move program applicants through the four phases of applying for the Waste-to-Energy Technology tax credit:

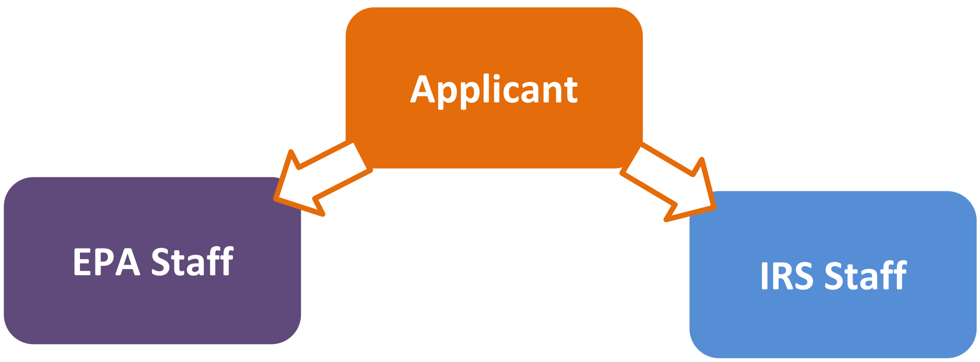
- Phase 1: Pre-application;
- Phase 2: Final application;
- Phase 3: Allocation of tax credit;
- Phase 4: Certification of tax credit.

Applicants will submit a pre-application to the EPA and IRS and a final application to the EPA. The EPA will review the final application and make recommendations to the IRS for allocation of the tax credit. The IRS will then allocate the tax credit based on the EPA's recommendation. Applicants then implement their projects and submit final documentation, after which the IRS certifies the tax credit allocation.

PHASE 1: PRE-APPLICATION

The applicant's first requirement in phase 1 is submission of a preliminary application to both the EPA and the IRS, as shown in the diagram below. This step enables both organizations to assess the applicant pool and plan for the human and financial resources needed in later phases of the program. The preliminary application is a simplified form that collects only key information: applicant name, tax information, requested tax credit amount, and project plan. The project plan may include siting information, waste processing capabilities, planned technology, and plans for meeting air and water quality standards. The EPA will review preliminary applications and then notify applicants of their status and the requirements for the final application in phase 2.

Phase 1: Applicant submits the pre-application to both the IRS and the EPA.



PHASE 2: FINAL APPLICATION

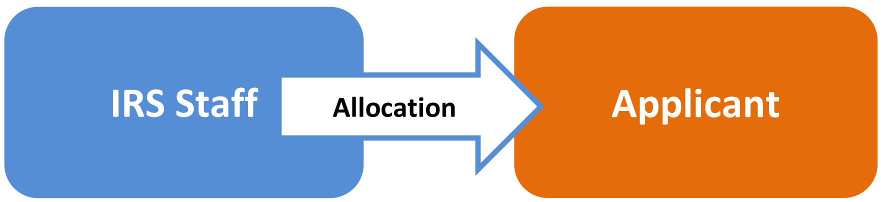
Once pre-applications are approved, applicants must submit a final application, which requires extensive documentation in thorough detail. The applicant must submit a business plan that demonstrates the commercial viability of the proposed project as well as proof of compliance with all federal, state, and local laws and regulations. In addition, applicants must submit a detailed recycling plan demonstrating maximum diversion of recyclables and an analysis of life cycle greenhouse gas emissions, which demonstrates overall reduction in emissions over the expected lifetime of the facility as compared to traditional waste disposal methods or industry standards. The EPA will review all project plans and communicate approval or rejection to the applicant. If approved, the EPA will recommend the projects to the IRS for allocation; if rejected, the EPA will provide the applicant with the reasons for rejection. The applicant can then modify or improve the plan and re-apply by the end of the two-year application period.

Phase 2: Applicant submits final application to the EPA; EPA staff evaluates each project; the EPA submits recommendation to the IRS where it is reviewed by an IRS tax attorney.

PHASE 3: ALLOCATION

The IRS reviews the final application for approval. An allocation is made to the applicant by the IRS, provisioning the applicant with a 30% tax credit based on the qualifying investment. The applicant signs a legal agreement with the IRS, which states that the applicant will receive the allocated tax credit if all stated requirements are met and if proof is received within one year.

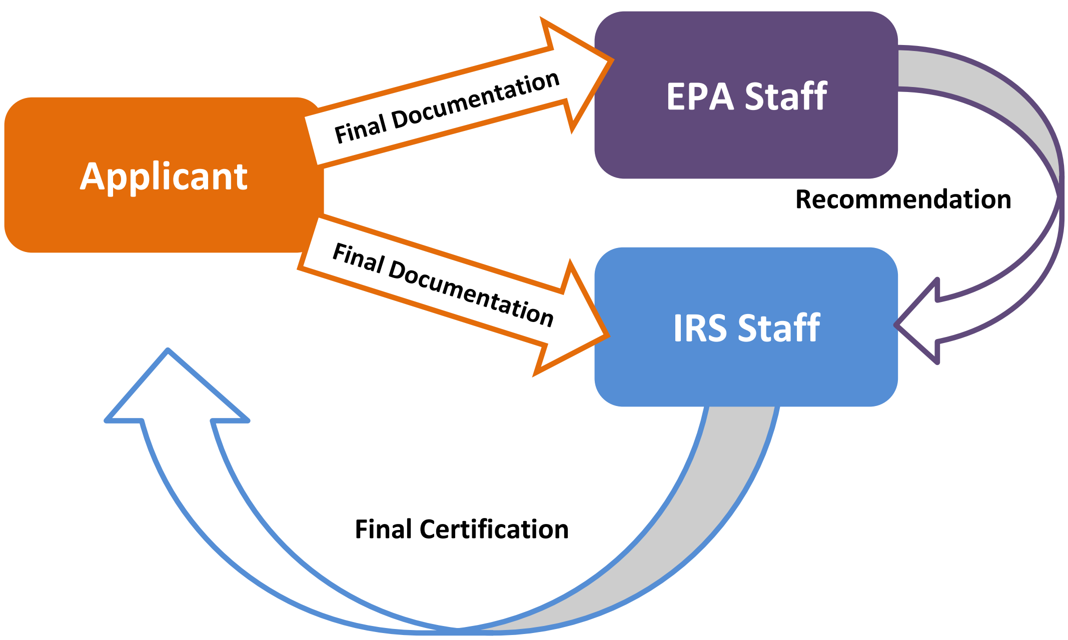
Phase 3: IRS approves the allocation of the tax credit, legal documents are signed, and the applicant will receive the tax credit once all program requirements are met.



PHASE 4: CERTIFICATION

From the date of receiving the tax allocation, applicants have one year to provide evidence that all program criteria and requirements have been met. This evidence is required before certification is finalized. Certification is the official award of the 30% tax credit, to be claimed in the tax year during which the qualifying investment costs are incurred.

Phase 4: Applicant provides final documentation to IRS and EPA within one year of allocation; EPA provides recommendation to the IRS; IRS issues final certification and officially awards applicant 30% tax credit.



Organization, Contracting, & Staffing Plan

PROGRAM IMPLEMENTATION TASKS

There are four primary tasks that need to be completed in order for the program to begin: the creation and writing of program guidelines, the establishment of the application system and the drafting of application documents, the appointment and training of staff, as well as making the decision of whether or not to hire contractors.

Take One: Staff Appointment and Training – Personnel needed to implement the tax credit program will be determined and appointed. All staff involved with program implementation will undergo standardized training on the Waste-to-Energy Technology Act of 2011, the details of the guidance for the tax program being implemented, and their duties associated with the implementation.

Task Two: Contracting – While the tax credit program is to be implemented primarily by the EPA and the IRS, there may be instances where the required information or expertise falls beyond the scope of these two agencies. In this case, it is the duty of the employee responsible for the related task to either consult with relevant experts to obtain that information; or if the task is extensive, to raise the issue with the EPA Program Manager so that the appropriate professionals or specialists can be contracted.

Task Three: Setting Guidelines & Drafting Guidance – EPA staff will draft and finalize detailed guidelines and standards for measurement against which project applications will be. Guidelines specify criteria for assessing maximum diversion of recyclables and reduction of greenhouse gas emissions from current industry levels.

Task Four: Establishing Application System & Posting Guidance – A standardized pre-application and final application form will be written for both the EPA and the IRS to ensure that the program is executed according to EPA guidelines and the U.S. Internal Revenue Service Code. Guidance for application submission, including due dates and the medium of submission (e.g., online, hard copy) should also be published.

PROPOSED PROGRAM ORGANIZATIONAL STRUCTURE

The implementation of the Waste-to-Energy Technology Tax Credit Program will utilize existing staff within the EPA and the IRS and will not require any new hires. All detailed project analysis will be performed by relevant divisions within the EPA, as show in Figure 13 below. The IRS will provide the approvals that finalize allocations and certifications of the tax credits, based on the EPA's recommendations; a diagram of the relevant IRS offices that will be involved in the program is shown on page 32 below. Most of the work for the program will be completed at the EPA's Headquarters and at the IRS Office of the Chief Counsel, both of which are located in Washington, DC. Additional work will be performed at the EPA's Office of Air Quality and Planning Standards which is located in Research Triangle Park, North Carolina.

Figure 13: Relevant EPA offices for this program.

ENVIRONMENTAL PROTECTION AGENCY STAFFING PLAN

Implementation of the Waste-to-Energy Technology Act Tax Credit Program will be performed primarily by six existing employees within three divisions of the Environmental Protection Agency. The designated staff will be assigned tasks related to evaluation, verification, approval, and distribution of the tax credit to qualifying waste-to-energy projects. Descriptions for each position are given below. The six EPA staff positions will be Program Manager, Assistant Program Manager, Administrative Assistant, and three Senior Scientists.

Several EPA offices will be directly involved in implementing the program. The Office of General Counsel will aid in drafting the requirements for the applications, to ensure that everything fits within the legal framework set out by the bill and to ensure that all ambiguous terms are clearly defined. The Office of Regulatory Policy and Management will review applications and determine project financial viability and will coordinate with the Office of Solid Waste and Emergency Response to ensure overall viability of recommended projects. The Program Manager will be deployed from the Office of Regulatory Policy and Management as they will coordinate the overall implementation of the tax credit program. The Office of Solid Waste and Emergency Response will review applications to determine if they meet the environmental criteria given in the bill, such as the recycling criteria. This office will be the primary source of waste-to-energy technology expertise through the appointment of the appropriate solid waste management expert as Assistant Program Manager. The Office of Air and Radiation will review applications in conjunction with the Office of Solid Waste and Emergency Response to determine if they meet the environmental criteria given in the bill, such as the air quality standards and the life cycle greenhouse gas reductions.

EPA POSITIONS

Position 1 – Program Manager

Description: The Program Manager will be staffed from the Office of Regulatory Policy and Management and will serve as the primary authority responsible for developing and managing the tax credit program. With the Assistant Program Manager's support, the Program Manager will be tasked with overseeing the development of measurable objectives and draft application to reflect those objectives, completion of application reviews, and ensuring that reviews and approvals are on track with the set timelines. In addition, the Program Manager will consult with the IRS Office of General Counsel to ensure compliance with all laws and regulations, and serve as the primary liaison to the IRS regarding application recommendations and approvals.

Position 2 – Assistant Program Manager

Description: The Assistant Program Manager will provide whatever necessary support the Program Manager needs to administer the tax credit program effectively. They will be responsible for coordination between EPA offices to ensure the timely review of applications, and will be appointed from the Office of Solid Waste and Emergency Response to serve as the point person for waste-to-energy expertise. The Senior Scientists will report directly to the Assistant Program Manager, who will work closely with the Program Manager to administer the program.

Position 3 – Administrative Assistant

Description: The Administrative Assistant will provide clerical support as needed to the Program Manager and the Assistant Program Manager. Some duties might include the drafting and editing of correspondence, the ordering and stocking of office supplies, the coordination of applications received, and the mailing of documentation to applicants.

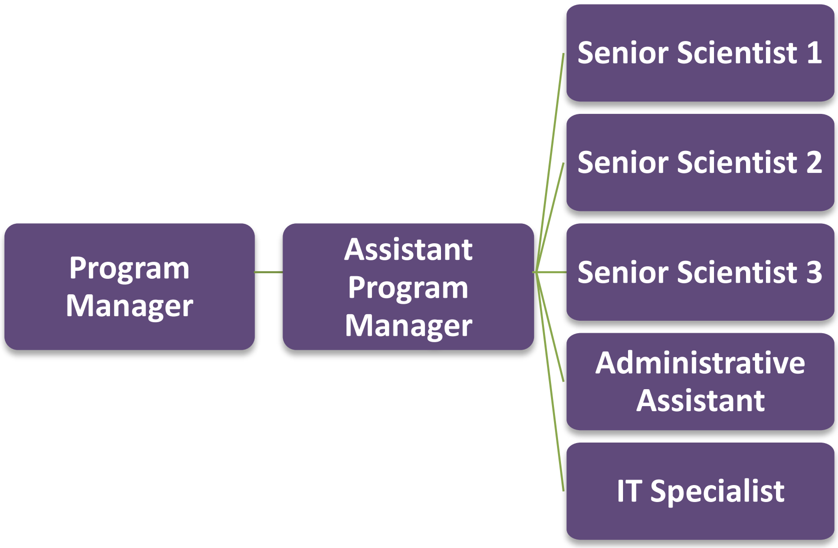
Positions 4, 5, & 6 – Senior Scientists

Description: The Senior Scientists will be responsible for overseeing the technical aspects of the selection process to ensure that proposals/applications meet the objectives specified. There will be 3 Senior Scientists, each responsible for their respective areas of expertise: recycling (Office of Solid Waste and Emergency Response) and air quality and greenhouse gas life cycle analysis (Office of Air and Radiation). The Senior Scientists will be expected to perform assessments to determine how well application criteria are met and are responsible for consulting with the appropriate experts within the EPA or through a third party regarding elements that fall outside their scope of expertise. The Senior Scientist responsible for air quality and life cycle greenhouse gas expertise is expected to consult the Office of Air Quality and Planning Standards regarding air quality and the National Risk Management Research Lab regarding life cycle analysis expertise.

In addition to these six employees, the program will also have an EPA IT specialist on staff; this IT specialist will help set up and administer the website for the program as well as a hotline that will be established to answer applicant questions. A diagram of the six EPA employees and the IT Specialist is given in Figure 14 below.

A more detailed description of each of the EPA offices involved in program implementation is given in Appendix A.

Figure 14: EPA staffing requirements for this program.



INTERNAL REVENUE SERVICE STAFFING PLAN

The workload for processing the applications within the IRS will be distributed to two tax attorneys, with the possibility of a third being tasked to assist in this process depending on the number of applications received. There will also be a Program Manager and an Administrative Assistant assigned to this program. The attorneys as well as the Program Manager and Administrative Assistant will be staffed from The Office of Passthroughs and Special Industries, which reports to the technical arm of the Office of Deputy Chief Counsel, which in turn reports to the Office of Chief Counsel (shown in Figure 15 below). Descriptions for each position are given below.

Figure 15: Relevant IRS offices for this program.

IRS POSITIONS

Position 1 – Program Manager

Description: The Program Manager will be staffed from The Office of Passthroughs and Special Industries and will serve as the primary authority responsible for developing and managing the tax credit program. The Program Manager will be tasked with overseeing the development of measurable objectives and draft application to reflect those objectives, completion of application reviews, and ensuring that reviews and approvals are on track with the set timelines. In addition, the Program Manager will consult with the Office of General Counsel to ensure compliance with all laws and regulations, and will serve as the primary liaison to the IRS regarding application recommendations and approvals.

Position 2 – Administrative Assistant

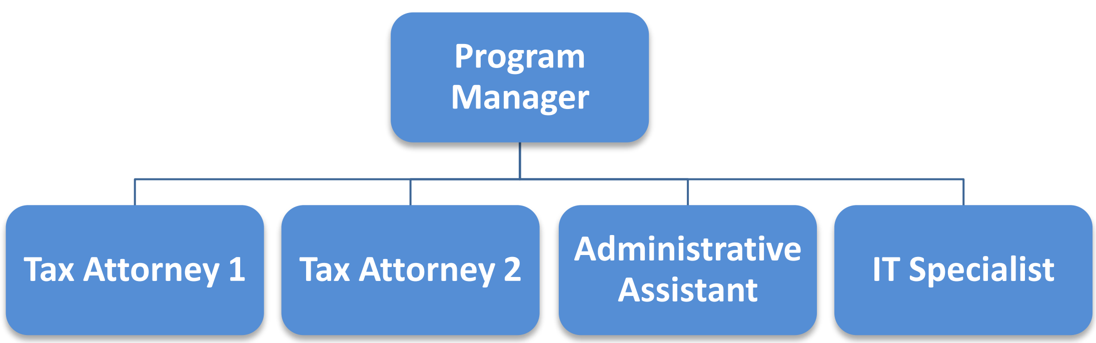
Description: The Administrative Assistant will provide clerical support as need to the Program Manager and the tax attorneys. Some duties might include the drafting and editing of correspondence, the ordering and stocking of office supplies, the coordination of applications received, and the mailing of documentation to applicants.

Positions 3 & 4 – Two IRS Tax Attorneys

Description: The IRS Attorneys will conduct reviews of the applications and will draft and finalize all legal agreements. While the EPA is responsible for all of the project analysis and evaluation to determine which projects have merit, the IRS is responsible for approving or rejecting those decisions.

In addition to these four employees, the program will also have an IRS IT specialist on staff; this IT specialist will help with any technical web or computer issues that may arise. A diagram of the four IRS employees and the IT Specialist is given in Figure 16 below.

Figure 16: IRS staffing requirements for this program.



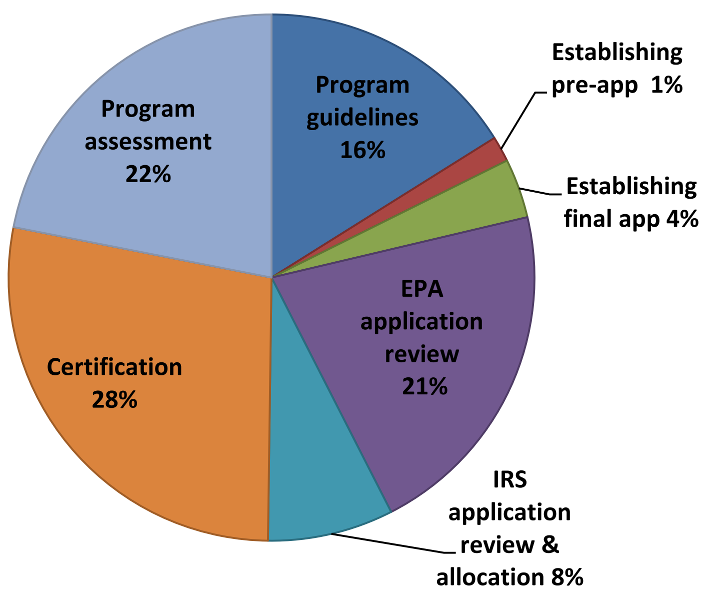
Budget & Revenue Plan

The Waste-to-Energy budget and revenue plan translates the goals of the legislation into specific actions to be accomplished by the IRS and the EPA over a four-year period and is expected to cost roughly $1,462,275. The budget is for all costs associated with program implementation and includes the following actions:

- Appointing staff
- Setting program guidelines
- Establishing application system
- Reviewing applications
- Allocating funds
- Certifying applicants
- Providing the tax credit
- Program assessment

A breakdown of the cost percentage for each of these tasks is shown in Figure 17 below.

Figure 17: Budget breakdown by task for the entire program.



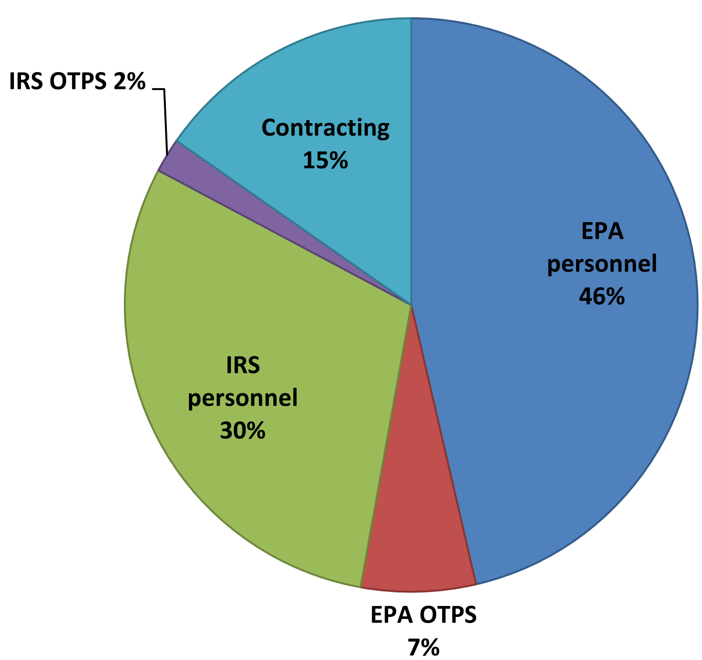
General schedules and senior executive pay scales from the U.S. Government Salary Table were used to determine personnel costs for IRS and EPA employees and can be found in Appendix B. Program and line item budgets for each organization and for each of the four years can be found in Appendix C and are based on the organizational and staffing requirements discussed in the previous section. All employees will be given 30% fringe benefits in accordance with federal government policies. Other costs, listed as "Other than Personnel" (OTP) were estimated based on current average prices for related goods. The Act's program budget also accounts for hiring outside contractors that would be responsible for assessing the financial viability of applications and conducting site visits prior to final applicant certification. The annual summary of the line-item budget for the program is given below.

SUMMARY OF THE LINE ITEM BUDGET

	Year 1	Year 2	Year 3	Year 4	Total
Personnel					
Salaries	$264,264	$149,779	$233,631	$220,288	**$867,962**
Fringe Benefits (30%)	$79,279	$44,934	$70,089	$66,086	**$260,389**
Subtotal	**$343,543**	**$194,712**	**$303,720**	**$286,375**	**$1,128,350**
OTPS					
Office Supplies and Expenses	$30,200	$17,700	$47,600	$38,425	**$133,925**
Subtotal	**$30,200**	**$17,700**	**$47,600**	**$38,425**	**$133,925**
Contracting					
Subtotal	**$0**	**$35,000**	**$95,000**	**$70,000**	**$200,000**
Total	**$373,743**	**$247,412**	**$446,320**	**$394,800**	**$1,462,275**

The major components of the program budget are summarized in Figure 18 below. As the figure depicts, over 80% of the program's total costs are for personnel services. It is also evident from this figure that the majority of the work required by the Act will be the responsibility of EPA. For this reason, selecting qualified EPA staff members for this program and providing them with adequate funding will be integral to the success of the Waste-to-Energy Technology Act.

Figure 18: Budget breakdown by organization for the entire program.



Program Master Calendar

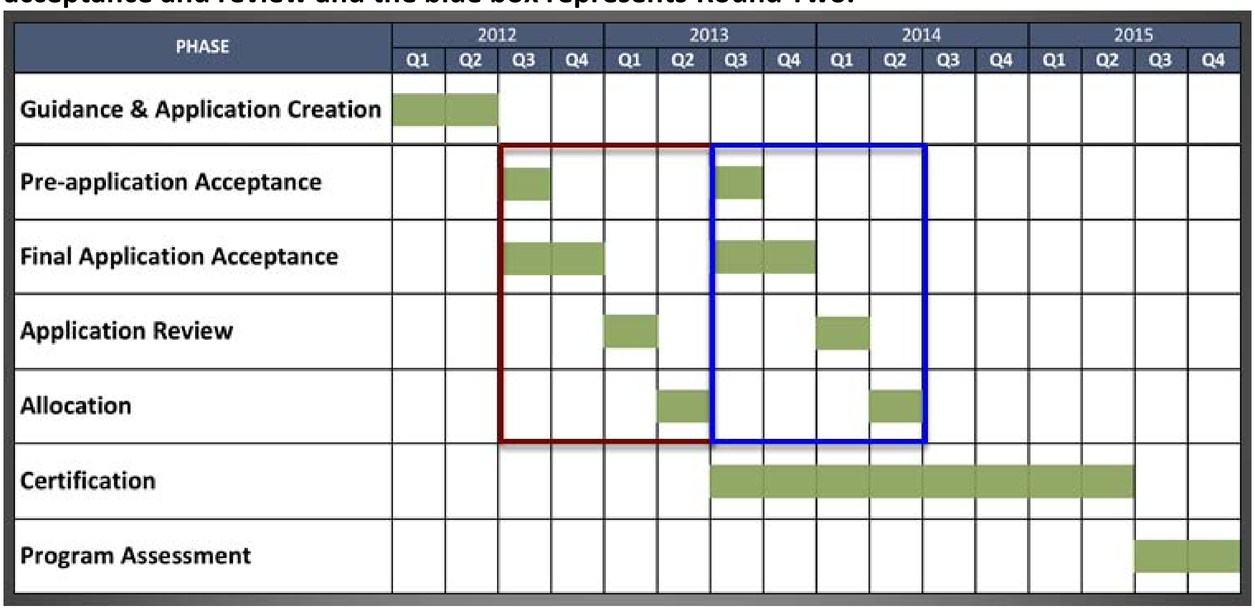
The master calendar incorporates all the information from the program design and is for the entire four years of the program. The application acceptance, review, and allocation are a year-long process and are repeated in two rounds with Round One ending in the second quarter of the second year and Round Two ending in the second quarter of the third year.

The timeframe for each task is:

- Six months for preparation & guidance creation;
- Two six month rounds of application acceptance;
- Two three month rounds of application review;
- Two three month rounds of allocation;
- Applicants will have one year to submit final documentation;
- Program assessment (including a report to Congress) within six months of program completion.

The four-year program calendar as illustrated in a Gantt chart is shown in Figure 19 below.

Figure 19: Four year program calendar; the red box represents Round One of application acceptance and review and the blue box represents Round Two.



A more detailed master calendar is shown in Appendix D.

Performance Management

The general objective of the performance management system is to measure the effectiveness of the Act by analyzing the use of financial resources as well as the total efficiency of program implementation. There are several advantages to this system, the most important of which are that it allows for detection and correction of problems in all phases of implementation.

Step 1: Performance Objectives

The first step in a performance management design is to understand the principal objectives. The objectives are closely related to the program goals and are related to the implementation and the efficiency and effectiveness of the process itself. The objectives include:

- Setting guidelines and making them available to the public;
- Creating the timeline for reviewing and reporting pre-applications;
- Reviewing the final applications within the timeline, with emphasis on the objectives of the bill;
- Completing the process of allocation and determining the amount of the qualifying credit that will be allocated;
- Completing the certification process and awarding the tax credits to approved projects.

Step 2: Performance Measurements

This step designs the concrete measurements of analysis and attempts to answer the question "Is the work being done?" with "work" defined as the accomplishment of the goals of the bill and the goals of the implementation process listed above. It is important for constructing quality measurements and indicators to consider what these goals must entail:

- The data and reporting must be transparent and openly available to the public;
- The measurements and indicators must be understandable, clear, concrete and must be related to the defined objectives;
- The data must be collected from known sources to ensure reliability;
- The data must be economically feasible and timely.

In order to define the measurements we need to define the framework of our system, creating a dashboard of the areas where quantifiable results will be obtained. These areas include:

- Staff and budget inputs will measure how effectively assigned work is being completed while tracking all money spent on the program;
- Process efficiency will identify the expected results of the overall program while requiring broader indicators;
- Impacts will report both projected (before operations begin, i.e. pre-application, final application and allocation phases) and actual measurements (after operations begin, i.e. the certification phase).

Step 3: Performance Accountability

Once we have identified the appropriate areas of analysis, we need to design concrete indicators. In other words, we need to determine what information needs to be collected, the indicators used for measurement, and the outcomes, which measure quality and effectiveness. One example of concrete indicators used for deciding on inputs, measuring indicators, and determining the outcomes of environmental impacts are shown below in Figure 20.

Figure 20: Environmental impacts indicators.

Inputs
1. Type of waste-to-energy technology used. 2. Technologies used in pollution control. 3. Recycling strategies.
Indicators
1. Tons of pollutants emitted compared to EPA standards. 2. Tons of greenhouse gases avoided. 3. Kw generated per ton of waste. 4. Percent recyclable materials diverted from the waste stream.
Outcomes
1. Percent of emissions reduced compared with estimations 2. Quality of the estimations 3. Efficiency of the electricity generation process 4. Recycling maximization

Step 4: Data Collection

Each type of indicator listed above must specify the type of data required and the frequency expected. Also, it is important to identify who will collect the data and where the data will be collected from in order to construct the indicators. The data collection system for the areas of measurement is shown in appendix E and includes three types of measurement: staff and budget inputs, process inputs, and impacts inputs.

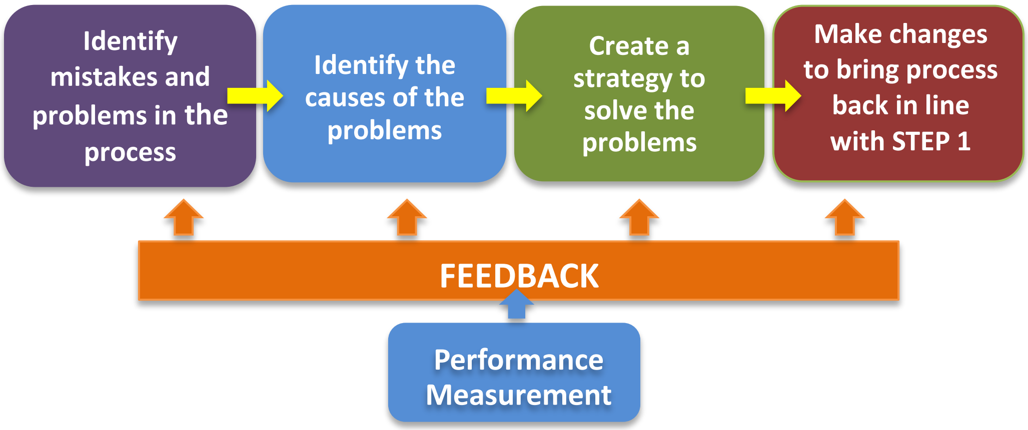
Step 5: Analyzing and Reporting the Performance Data

The goal of this step in the performance system is try to answer the question "Is the work being done well?" Once all data is collected it will need to be organized and reported. Analysis will be presented in tabular and graphical format, forming a summary report of performance. The report will compare the results of the pre-established goals and summarize the analysis. The information reported should be added to the performance measurement system of each organization, and a summary will be presented to Congress, as required by the Act.

Step 6: Using Performance Information to Drive Improvement

In the final step we try to answer the question "How can we do the work better?" In order to answer this question we must first analyze the indicators calculated and identify the critical values, that is, what is and is not working according to plan. Lastly, we can incorporate the feedback for each result into the improvement process, as shown in Figure 21 below.

Figure 21: The improvement process (Artley, Ellison, & Kennedy, 2001).



An ongoing feedback process will allow adjustments to be made in order to improve efficiency. Indicators for this process are shown in Appendix E and are again given by staff and budget inputs, process inputs, and impacts inputs.

GENERAL RECOMMENDATIONS

Fluid communication between the EPA and the IRS will be needed to measure the performance of the program. Program Managers for each organization should evaluate the performance of their staff and be aware of issues that might be overlooked in the performance management plan. The EPA and IRS should work jointly on the performance management system, assigning professional hours for measurement and evaluation as needed. This performance system can be added to the current system of each institution.

Conclusion

Waste management practices in the United States often involve the landfilling of household and business waste. Yet despite the many regulations and engineering advances in the construction and management of landfills, the fact is that landfilling is still burying waste in the Earth. As this report has demonstrated, the pollution prevention techniques of modern landfills do not always prevent the release of hazardous substances to the surrounding land, air, and water. Waste-to-energy can alleviate many of these problems by providing a waste management solution that reduces transportation distances, significantly cuts life cycle greenhouse gas emissions, and recovers energy from a resource that would have otherwise been wasted.

If waste-to-energy presents a better alternative for the environment and human health, why has it not been more widely used in the United States? The answer is simply that there have been financial and political challenges that have hampered the proliferation of waste-to-energy as a viable alternative to landfilling. First, waste-to-energy facilities have historically had a difficult time competing with the low tipping fees at landfill sites. Second, the lack of legislative and other incentives for waste-to-energy has halted construction of new facilities for the last 15 years. Lastly, waste-to-energy has been viewed unfavorably by many environmental groups; some argue that financial and political support for waste-to-energy will reduce efforts to promote recycling and composting and that we should emphasize these practices first, rather than the processing of waste for energy.

While it is true that many materials in the MSW waste stream can be recovered and recycled and should not be used as inputs in a waste-to-energy process, waste-to-energy does not directly compete with recycling; in fact, the two can, and often do, take place side-by-side. Many communities that use waste-to-energy also have high recycling rates. The environmental concerns about waste-to-energy emissions are largely based on the older technologies and not on the potential for newer, cleaner conversion technologies such as plasma arc gasification. The internal controversy among environmentalists between recycling and waste-to-energy is interfering with the potential for each of these solutions to garner the political and financial support that is necessary to improve and develop further.

The Waste-to-Energy Technology Act of 2011 seeks to incentivize the development of waste-to-energy facilities through a 30% investment tax credit. If passed, the Act would encourage the construction of new facilities by providing investors with savings in the form of a tax credit, thereby reducing startup costs. Eligible facilities will need to use the fewest recyclable materials as inputs, provide the greatest net reduction in life cycle greenhouse gases, provide the most energy at the lowest cost, and pose the fewest risks to human health and the environment. Due to these requirements, this tax credit may stimulate the development of plasma arc gasification, an expensive but highly efficient process with higher waste conversion efficiencies than the older technologies and yielding the most net energy with the least amount of pollutants.

Our program design is comprised of four phases and includes a pre-application, final application, certification, and allocation phase. The EPA and IRS will work together to implement the program and each organization will play a crucial role in each of the four phases. Further, the program is expected to last four years, cost $1.462 million to implement, and will provide a total of $1 billion in tax credits which could fund 16 large-scale to 32 medium-scale facilities. These facilities could process 16,667 tons of waste per day or 6.08 million tons per year and generate 9 million kilowatt hours of electricity per day or 3,285 million kWh per year.

As waste-to-energy technology develops and spreads, it will likely become more affordable. The handful of WtE facilities that the Act could fund may serve as pilot projects, demonstrating that a technologically advanced alternative to landfilling is possible. In a world of limited land and resources, landfilling can only become more expensive economically, politically, and environmentally. As an integrated waste management system, waste-to-energy is an emerging solution to local, as well as global environmental problems. It is one step closer to sustainability.

References

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Appendices

Appendix A: EPA Offices Involved in Program Implementation

The following information is from the US EPA website: www.epa.gov/aboutepa/organization.html.

About the Office of Regulatory Policy and Management (ORPM)

The Office of Regulatory Policy and Management (ORPM) provides support and guidance to EPA's program and Regional offices as they develop their regulations. ORPM also provides information and tools to offices throughout EPA that help them analyze their programs and seek out ways to improve their performance.

About the Office of Solid Waste and Emergency Response (OSWER)

The Office of Solid Waste and Emergency Response provides policy, guidance, and direction for the Agency's emergency response and waste programs. OSWER develops guidelines for the land disposal of hazardous waste and underground storage tanks, and provides technical assistance to all levels of government to establish safe practices in waste management. The Office of Resource Conservation and Recovery ensures responsible management of waste through programs and projects that handle recycling, municipal solid waste, and hazardous waste. The Office of Superfund Remediation and Technology Innovation manages the Superfund program, which responds to abandoned and active hazardous waste sites and accidental oil and chemical releases. The Technology Innovation & Field Services Division encourages innovative technologies to address contaminated soil and groundwater.

The Office of General Counsel (OGC)

The Office of General Counsel (OGC) is the chief legal adviser to EPA, providing legal support for Agency rules and policies, case-by-case decisions (such as permits and response actions), and legislation. In addition, OGC lawyers, together with attorneys in the U.S. Department of Justice's Environment and Natural Resources Division, represent the Agency in court challenges to agency actions (such as regulations), appeals of enforcement cases, and Supreme Court litigation. OGC lawyers carry out these functions not only with respect to EPA's environmental programs, but also in connection with EPA's day-to-day operations, including entering into contracts, awarding grants, managing property and money, and working with EPA's employees. The primary role of OGC lawyers is to provide legal advice to EPA and to articulate the Agency's legal positions in the federal courts and before other tribunals and organizations.

The Office of Air and Radiation (OAR)

The Office of Air and Radiation (OAR) develops national programs, policies, and regulations for controlling air pollution and radiation exposure. OAR is concerned with pollution prevention and energy efficiency, indoor and outdoor air quality, industrial air pollution, pollution from vehicles and engines, radon, acid rain, stratospheric ozone depletion, climate change, and radiation protection. OAR is responsible for administering the Clean Air Act, the Atomic Energy Act, the Waste Isolation Pilot Plant Land Withdrawal Act, and other applicable environmental laws.

The Office of Air Quality and Planning Standards (OAQPS)

OAQPS's primary mission is to preserve and improve air quality in the United States. To accomplish this, OAQPS compiles and reviews air pollution data, develops regulations to limit and reduce air pollution, assists states and local agencies with monitoring and controlling air pollution, makes information about air pollution available to the public, and reports to Congress the status of air pollution and the progress made in reducing it.

The Office of Atmospheric Programs (OAP)

OAP protects the ozone layer, addresses climate change, and improves regional air quality. It runs market-based programs such as the Acid Rain Program and public/private partnership programs such as ENERGY STAR.

Appendix B: United States Government Salary Table

The following information is from the U.S. Office of Personnel Management website at www.opm.gov/oca/11tables/html/gs.asp.

SALARY TABLE 2011-GS - RATES FROZEN AT 2010 LEVELS

Effective January 2011 - Annual Rates by Grade and Step

Grade	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 10	WGI
1	17803	18398	18990	19579	20171	20519	21104	21694	21717	22269	552
2	20017	20493	21155	21717	21961	22607	23253	23899	24545	25191	646
3	21840	22568	23296	24024	24752	25480	26208	26936	27664	28392	728
4	24518	25335	26152	26969	27786	28603	29420	30237	31054	31871	817
5	27431	28345	29259	30173	31087	32001	32915	33829	34743	35657	914
6	30577	31596	32615	33634	34653	35672	36691	37710	38729	39748	1019
7	33979	35112	36245	37378	38511	39644	40777	41910	43043	44176	1133
8	37631	38885	40139	41393	42647	43901	45155	46409	47663	48917	1254
9	41563	42948	44333	45718	47103	48488	49873	51258	52643	54028	1385
10	45771	47297	48823	50349	51875	53401	54927	56453	57979	59505	1526
11	50287	51963	53639	55315	56991	58667	60343	62019	63695	65371	1676
12	60274	62283	64292	66301	68310	70319	72328	74337	76346	78355	2009
13	71674	74063	76452	78841	81230	83619	86008	88397	90786	93175	2389
14	84697	87520	90343	93166	95989	98812	101635	104458	107281	110104	2823
15	99628	102949	106270	109591	112912	116233	119554	122875	126196	129517	3321

Appendix C: Program and Line Item Budgets for the EPA, IRS, and Contractors

Environmental Protection Agency (EPA) Program Budget for Year 1

Personnel

				Year 1								
				Q1		Q2		Q3		Q4		
				Guidance and Application Creation		Guidance and Application Creation		Accepting Preliminary Applications		Reviewing Preliminary Applications		Total
Title	GS Level	Step	Base Salary	% Time	Salary	% Time	Salary	% Time	Salary	% Time	Salary	
Program Manager	15	2	$127,883	94.62%	$30,249	48.46%	$15,494	3.00%	$959	17.69%	$5,656	$52,358
Assistant Program Manager	12	4	$82,359	76.92%	$15,838	46.15%	$9,503	2.50%	$515	7.69%	$1,584	$27,440
Senior Scientist	13	5	$100,904	61.54%	$15,524	30.77%	$7,762	0.00%	$0	0.00%	$0	$23,286
Senior Scientist	13	5	$100,904	61.54%	$15,524	30.77%	$7,762	0.00%	$0	0.00%	$0	$23,286
Senior Scientist	13	5	$81,230	61.54%	$12,497	30.77%	$6,248	0.00%	$0	0.00%	$0	$18,745
Administrative Assistant	7	5	$47,838	50.00%	$5,980	25.00%	$2,990	2.00%	$239	5.00%	$598	$9,807
IT Specialist	9	7	$61,952	25.00%	$3,872	25.00%	$3,872	10.00%	$1,549	10.00%	$1,549	$10,842
Fringe Benefits (30%)					$29,845		$16,089		$979		$2,816	$49,729
Subtotal					**$129,329**		**$69,720**		**$4,240**		**$12,203**	**$215,492**

Environmental Protection Agency (EPA) Program Budget

Annual Summary of Personnel Costs

				Year 1		Year 2		Year 3		Year 4		
Title	GS Level	Step	Base Salary	% Time	Salary	% Time	Salary	% Time	Salary	% Time	Salary	**Total**
Program Manager	15	2	$127,883	40.94%	$52,358	22.60%	$28,897	30.17%	$38,586	34.19%	$43,726	**$163,567**
Assistant Program Manager	12	4	$82,359	33.32%	$27,440	17.64%	$14,532	27.64%	$22,768	30.10%	$24,787	**$89,526**
Senior Scientist	13	5	$100,904	23.08%	$23,286	13.85%	$13,971	25.77%	$26,002	17.31%	$17,464	**$80,723**
Senior Scientist	13	5	$100,904	23.08%	$23,286	13.85%	$13,971	25.77%	$26,002	17.31%	$17,464	**$80,723**
Senior Scientist	13	5	$81,230	23.08%	$18,745	13.85%	$11,247	25.77%	$20,932	17.31%	$14,059	**$64,984**
Administrative Assistant	7	5	$47,838	20.50%	$9,807	15.50%	$7,415	24.25%	$11,601	19.75%	$9,448	**$38,270**
IT Specialist	9	7	$61,952	17.50%	$10,842	10.00%	$6,195	10.00%	$6,195	10.00%	$6,195	**$29,427**
Fringe Benefits (30%)					$49,729		$28,868		$45,626		$39,943	**$164,166**
Subtotal					**$215,492**		**$125,097**		**$197,712**		**$173,087**	**$711,387**

Environmental Protection Agency (EPA) Program Budget

Annual Summary of OTPS

Category	Year 1	Year 2	Year 3	Year 4	Total
Training	$8,000	$0	$0	$0	**$8,000**
Stationery Supplies	$1,750	$350	$1,150	$1,850	**$5,100**
Copying	$1,125	$175	$1,075	$1,425	**$3,800**
Mail	$2,150	$250	$1,150	$1,850	**$5,400**
Equipment	$2,800	$400	$4,150	$5,600	**$12,950**
Communications, utilities, Misc.	$1,325	$175	$2,075	$2,800	**$6,375**
Travel	$3,000	$0	$20,000	$20,000	**$43,000**
Subtotal	**$20,150**	**$1,350**	**$29,600**	**$33,525**	**$84,625**

Internal Revenue Services (IRS) Program Budget

Personnel

				Year 1								
				Q1		Q2		Q3		Q4		
				Guidance and Application Creation		Guidance and Application Creation		Accepting Preliminary Applications		Reviewing Preliminary Applications		
Title	GS Level	Step	Base Salary	% Time	Salary	% Time	Salary	% Time	Salary	% Time	Salary	Total
Program Manager	15	2	$127,883	30.77%	$9,837	30.77%	$9,837	2.50%	$799	5.00%	$1,599	$22,072
Tax Attorney	14	3	$112,224	61.54%	$17,265	30.77%	$8,633	2.50%	$701	7.69%	$2,158	$28,757
Tax Attorney	14	3	$112,224	61.54%	$17,265	30.77%	$8,633	2.50%	$701	7.69%	$2,158	$28,757
Administrative Assistant	7	5	$47,838	40.00%	$4,784	20.00%	$2,392	2.50%	$299	5.00%	$598	$8,073
IT Specialist	9	7	$61,952	25.00%	$3,872	25.00%	$3,872	10.00%	$1,549	10.00%	$1,549	$10,842
Fringe Benefits (30%)					$15,907		$10,010		$1,215		$2,418	$29,550
Subtotal					**$68,930**		**$43,376**		**$5,265**		**$10,480**	**$128,052**

Internal Revenue Services (IRS) Program Budget

Annual Summary of Personnel Costs

				Year 1		Year 2		Year 3		Year 4		
Title	GS Level	Step	Base Salary	% Time	Salary	% Time	Salary	% Time	Salary	% Time	Salary	**Total**
Program Manager	15	2	$127,883	17.26%	$22,072	5.63%	$7,193	6.25%	$7,993	17.69%	$22,625	**$59,884**
Tax Attorney	14	3	$112,224	25.63%	$28,757	15.10%	$16,942	25.48%	$28,596	22.79%	$25,574	**$99,869**
Tax Attorney	14	3	$112,224	25.63%	$28,757	15.10%	$16,942	25.48%	$28,596	22.79%	$25,574	**$99,869**
Administrative Assistant	7	5	$47,838	16.88%	$8,073	13.13%	$6,279	21.25%	$10,166	15.00%	$7,176	**$31,693**
IT Specialist	9	7	$61,952	17.50%	$10,842	10.00%	$6,195	10.00%	$6,195	10.00%	$6,195	**$29,427**
Fringe Benefits (30%)					$29,550		$16,065		$24,463		$26,143	**$96,222**
Subtotal					**$128,052**		**$69,615**		**$106,008**		**$113,288**	**$357,079**

Annual Summary of OTPS

Category					
Training	**Year 1**	**Year 2**	**Year 3**	**Year 4**	Total
Stationery Supplies	$4,000	$0	$0	$0	$4,000
Copying	$1,000	$850	$900	$750	$3,500
Mail	$625	$675	$850	$550	$2,700
Equipment	$1,150	$750	$900	$750	$3,550
Communications, utilities, Misc.	$1,550	$1,400	$2,200	$1,850	$7,000
Travel	$725	$675	$1,150	$1,000	$3,550
Subtotal	$1,000	$0	$0	$0	$1,000
	$10,050	**$4,350**	**$6,000**	**$4,900**	**$25,300**

Contractor Program Budget

Annual Summary

Role	Year 1	Year 2	Year 3	Year 4	Total
Financial Viability Assessment for Final Application Review	$0	$35,000	$35,000	$5,000	$75,000
Site Visits for Certification	$0	$0	$60,000	$65,000	$125,000
Total	**$0**	**$35,000**	**$95,000**	**$70,000**	**$200,000**

Line Item Budget

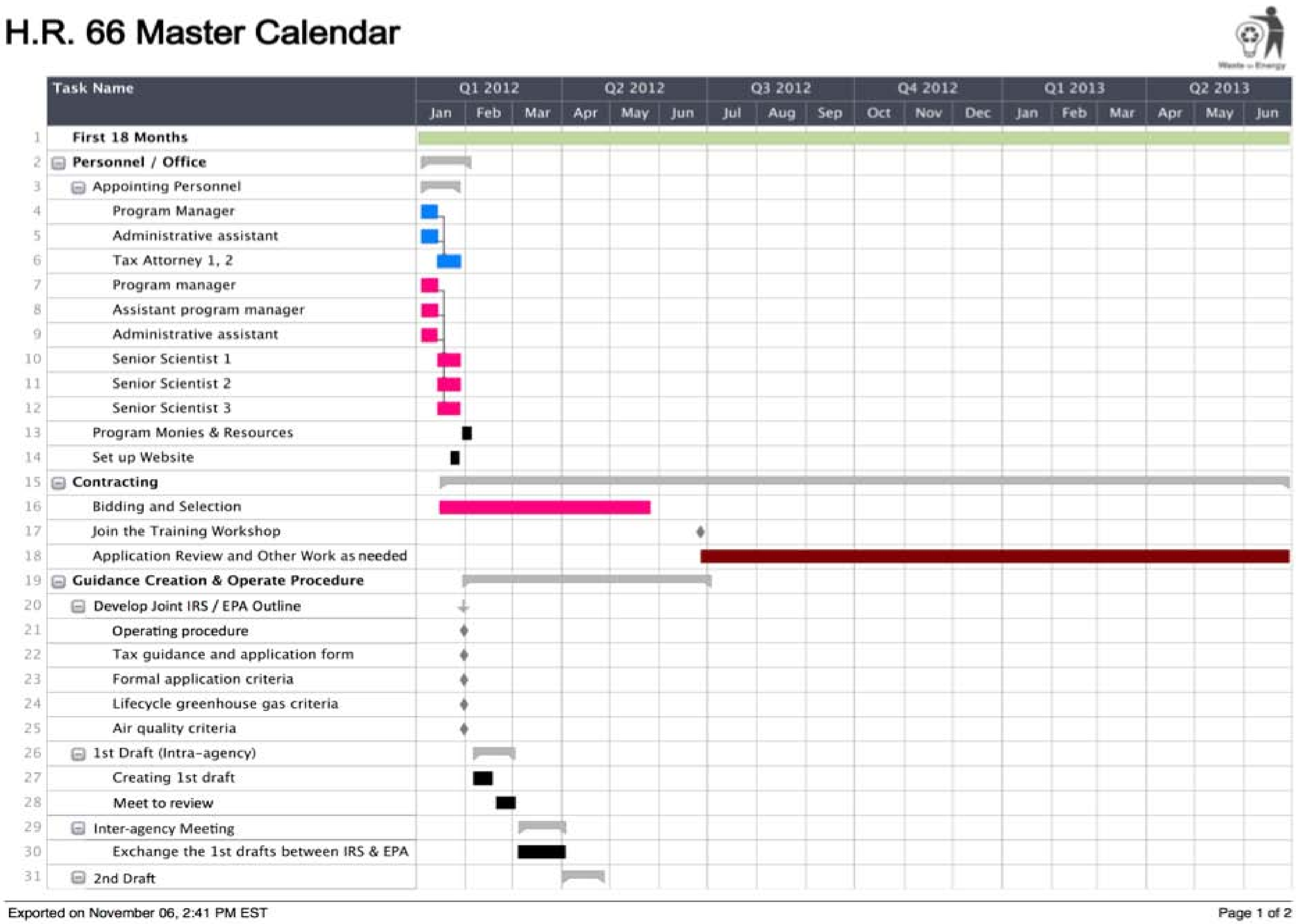
	Year 1					Year 2				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
Personnel										
Salaries	$152,507	$86,997	$7,312	$17,449	$264,264	$80,617	$41,066	$10,648	$17,449	$149,779
Fringe Benefits (30%)	$45,752	$26,099	$2,194	$5,235	$79,279	$24,185	$12,320	$3,194	$5,235	$44,934
Subtotal	**$198,259**	**$113,096**	**$9,505**	**$22,683**	**$343,543**	**$104,801**	**$53,385**	**$13,842**	**$22,683**	**$194,712**
OTPS										
Office Supplies and Expenses	$15,250	$13,050	$400	$1,500	$30,200	$600	$15,000	$600	$1,500	$17,700
Subtotal	**$15,250**	**$13,050**	**$400**	**$1,500**	**$30,200**	**$600**	**$15,000**	**$600**	**$1,500**	**$17,700**
Contracting										
Subtotal	**$0**	**$0**	**$0**	**$0**	**$0**	**$35,000**	**$0**	**$0**	**$0**	**$35,000**
Total	**$213,509**	**$126,146**	**$9,905**	**$24,183**	**$373,743**	**$140,401**	**$68,385**	**$14,442**	**$24,183**	**$247,412**

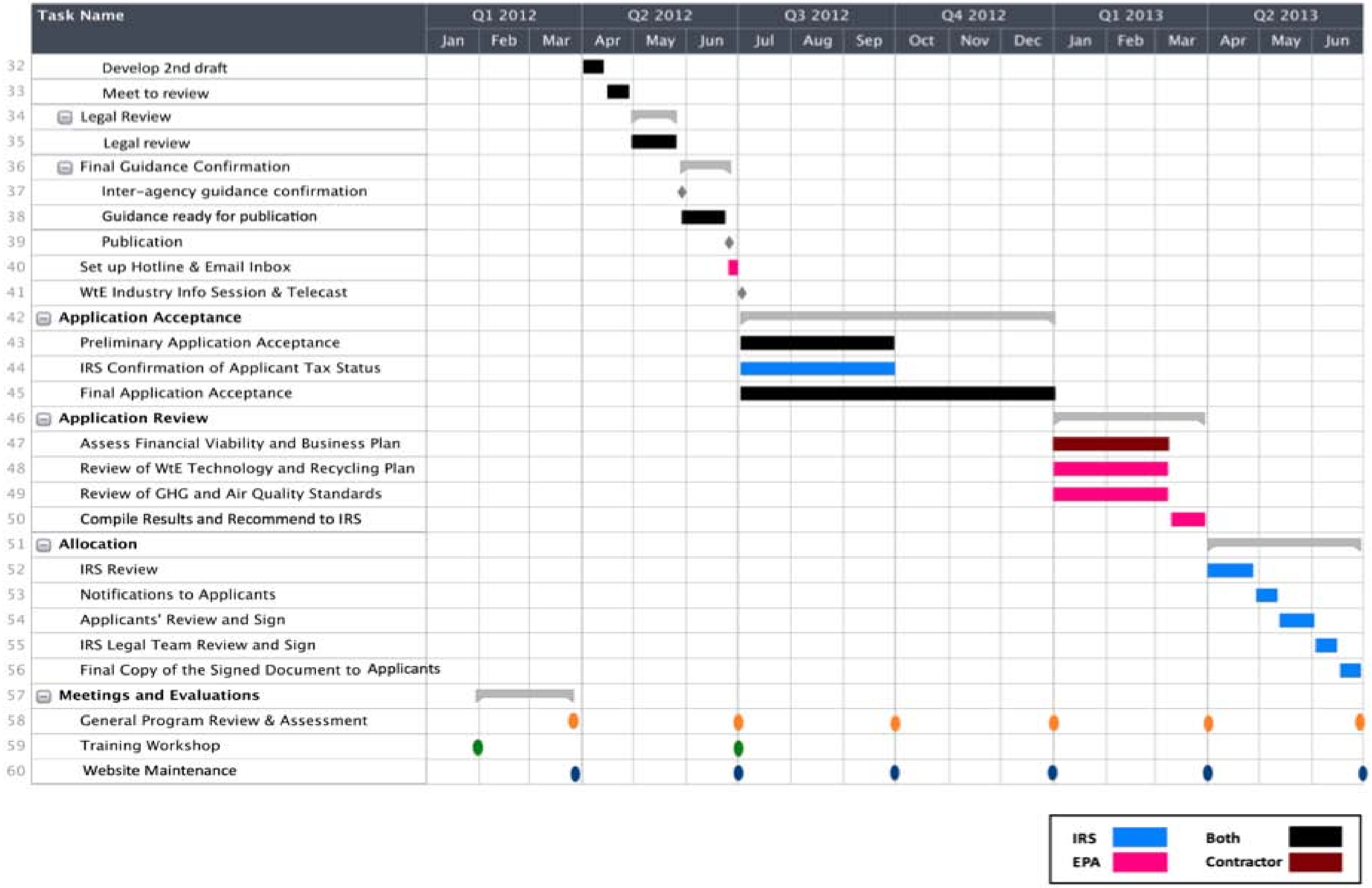
	Year 3					Year 4				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
Personnel										
Salaries	$80,617	$41,066	$104,637	$7,312	$233,631	$7,312	$7,312	$148,279	$57,385	$220,288
Fringe Benefits (30%)	$24,185	$12,320	$31,391	$2,194	$70,089	$2,194	$2,194	$44,484	$17,216	$66,086
Subtotal	**$104,801**	**$53,385**	**$136,028**	**$9,505**	**$303,720**	**$9,505**	**$9,505**	**$192,763**	**$74,601**	**$286,375**
OTPS										
Office Supplies and Expenses	$600	$15,000	$31,600	$400	$47,600	$400	$400	$33,525	$4,100	$38,425
Subtotal	**$600**	**$15,000**	**$31,600**	**$400**	**$47,600**	**$400**	**$400**	**$33,525**	**$4,100**	**$38,425**
Contracting										
Subtotal	**$35,000**	**$0**	**$60,000**	**$0**	**$95,000**	**$0**	**$0**	**$60,000**	**$10,000**	**$70,000**
Total	**$140,401**	**$68,385**	**$227,628**	**$9,905**	**$446,320**	**$9,905**	**$9,905**	**$286,288**	**$88,701**	**$394,800**

Annual Summary of Line Item Budget

	Year 1	Year 2	Year 3	Year 4	Total
Personnel					
Salaries	$264,264	$149,779	$233,631	$220,288	**$867,962**
Fringe Benefits (30%)	$79,279	$44,934	$70,089	$66,086	**$260,389**
Subtotal	**$343,543**	**$194,712**	**$303,720**	**$286,375**	**$1,128,350**
OTPS					
Office Supplies and Expenses	$30,200	$17,700	$47,600	$38,425	**$133,925**
Subtotal	**$30,200**	**$17,700**	**$47,600**	**$38,425**	**$133,925**
Contracting					
Subtotal	**$0**	**$35,000**	**$95,000**	**$70,000**	**$200,000**
Total	**$373,743**	**$247,412**	**$446,320**	**$394,800**	**$1,462,275**

Appendix D – Program Master Calendar





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Appendix E – Performance Management Indicators

STEP THREE: PERFORMANCE ACCOUNTABILITY INDICATORS

Staff and Budget Inputs Indicators:

Inputs
1. Hours worked. 2. Number of projects reviewed. 3. Staff persons trained. 4. Costs for supplies/ travel, etc.
Indicators
1. Hours/applications. 2. Volume of calls for customer assistance. 3. FAQ topics. 4. Supplies, travel costs/project phase.
Outcomes
1. Staff time is efficiently used. 2. Guidance is sufficient. 3. Budget is sufficient.

Process Efficiency Indicators:

Inputs
1. Total number of projects in each phase of the process. 2. Inter-organization performance: number of projects sent and received by organization. 3. Dates for each project: when initiated and when moved from one phase to the next. 4. Results from each phase: total approved, pended, or rejected, totaling the number received. 5. Total amounts of allocations and certifications. 6. Quality: whether a unit of work was done correctly.
Indicators
1. Percent of pre-applications that continue to final application. 2. Projects reviewed on time expected. 3. Number of allocations/applications.
Outcomes
1. Ratio between allocations and certifications. 2. Ratio project evaluated correctly vs. total. 3. Percent of the fund correctly allocated. 4. Document correctly received and sent between organizations.

Impacts Indicators:

Inputs
4. Type of waste-to-energy technology used. 5. Technologies used in pollution control. 6. Recycling strategies.
Indicators
5. Tons of pollutants emitted compared to EPA standards. 6. Tons of greenhouse gases avoided. 7. Kw generated per ton of waste. 8. Percent recyclable materials diverted from the waste stream.

Outcomes
5. Percent of emissions reduced compared with estimations 6. Quality of the estimations 7. Efficiency of the electricity generation process 8. Recycling maximization

STEP FOUR: DATA COLLECTION INDICATORS

Areas of Measurement	Data Collection	Periodicity
Staff & Budget Inputs	• Self-reported by staff members and extracted from reports. The Assistant Program Manager will assess reviewers' thoroughness and quality on a quarterly basis, reporting to the Program Manager. • The finance department of IRS and EPA will provide the spending information in each program phase. The report will contain all points addressed in the budget plan.	• Information will be gathered monthly, followed by an annual total. • In the case of IRS, information about performance will be measured weekly during the application process.
Process	• Information will be collected in every phase of the program and a report generated with the number of projects analyzed and the corresponding status of the applications. • There must be coordinated meetings between EPA and IRS in the application phase.	• Information will be reported quarterly and summed annually in accordance with budget timeframes.
Impacts	• Environmental estimation data will be obtained from the reports and presented for the corresponding environmental assessments and regional permits. The local environmental agency and the project applicant will provide this information.	• Reports will be projected as part of the final application process until a project becomes operational. Afterwards, actual reports will be submitted at the end of the calendar year following certification. These will continue on an annual basis until the program ends.

STEP SIX: USING PERFORMANCE INFORMATION TO DRIVE IMPROVEMENT

Area of performance	Feedback
Staff & Budget Inputs	• The application volume can be tracked to give feedback to the Program Manager for staffing. • The FAQ section of the website can be tracked to give feedback to the contractors on difficulties with the application process.
Process	• Documentation of the review process for feedback on application requirements to Program Manager. • Analyzing the number and types of disqualified applications to give feedback to Program Manager on requirements of qualified WtE facilities.
Impacts	• Comparisons between application to rank the cleanest technologies and the most efficient projects to create a benchmarking approach for WtE facilities.