Resource Enterprises, Inc

MUNICIPAL SOLID WASTE AS A FUEL

CONTAINED HEREIN IS A PROPOSAL TO REALIZE THE FINANCIAL BENEFITS ACCRUING TO A MUNICIPALITY BY TREATING ITS MUNICIPAL SOLID WASTE AS A FUEL

RESOURCE ENTERPRISES , INC
Dedicated to creating Pubic Private Partnerships in which the public and private sectors join to finance, design, build or refurbish and operate assets to insure the comprehensive management of municipal solid waste.

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MUNICIPAL SOLID WASTE AS A FUEL

This Proposal and Plan of Action presents the benefits, both environmentally and economic, when municipal solid waste is considered a fuel. The taxpayer is already willing to pay for proper solid waste management as a needed service for the health and safety of the community. Municipal solid waste should not be "disposed of" but rather its calorific value recovered so such waste can take its place in the hierarchy of solid waste management, reuse, recycle and recover.

MUNICIPAL SOLID WASTE AS A FUEL

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1.) PROPOSAL

Resource Enterprises, Inc. (Resource) will create a Special Purpose Corporation (SPC) to finance, build and operate Waste to Energy (WTE) facilities. The WTE technology used will be Afval Energie Bedriij's (AEB) waste fired power plant (WFPP), see Appendix 1, *WTE Technology: Afval Energie Bedrijf*. Once the WTE facility is operational the SPC will sell it to the appropriate public entity for $1.00 and take back in consideration a 20-year operating contract.

As the project will be a Public Private Partnership (PPP), the revenue generated by the sale of the products of production will be shared by the public entity owning the facility and the municipalities directing the flow of their municipal solid waste (MSW) to the facility.

Proceeding in such a course of action will result in billions of dollars in construction activity and the creation of hundreds of permanent, high skilled, high paying jobs.

In addition, the host of the WTE facility and the communities that direct their MSW to the facility will share millions annually from the sale of the products of production from the facility.

2.) PLAN OF ACTION

As discussed herein municipal solid waste is a "fairly good fuel". See Appendix 2, *Waste-to-Energy: Renewable energy source from Municipal Solid Waste*, prepared by the Solid Waste Processing Division (SWPD) of the American Society of Mechanical Engineers (ASME). It is on this premise that this Plan of Action is based.

- The appropriate stimulus or TARP monies will provide financing for WTE plants to be located on Deer Island in Boston Harbor and in Fall River. The monies will be deposited in local banks to be lent to the SPCs created to design, build and operate these facilities. As shown in the section on Project Financing, these monies will be borrowed by the SPCs at an appropriate rate of interest.

- With financing, Resource will assemble the project team, create the SPC and immediately begin design and construction. Concurrently the coordination necessary between the public agencies that are involved and the municipalities that will provide the municipal solid waste for the WTE plant will begin.

- As the SPC will be a non-profit, governmental agency, its creation will be done with the advice and consent of the public entity receiving control of the asset, the WTE facility. Further, with the exception of the grate system for the WTE plant, the remaining components will be competitively bid, with preference given to Massachusetts's contractors and vendors.

- The team assembled to provide public out reach will include representatives of the University of Massachusetts and the Department of Environmental Protection. The design of the facility to be located in Fall River will include a laboratory to ensure maximum achievable control technology is always employed and to encourage and test new and emerging renewable energy technologies.

3.) PROJECT ECONOMICS

The Special Purpose Corporation (SPC) that will be crated will reap the benefits of municipal solid waste as a renewable energy source for the citizens and taxpayers who created the MSW and control its disposition. This is how it will be accomplished so the WTE facilities can be generating revenues for the participating municipalities and banks.

1. TARP and/or stimulus monies will finance the SPC.
2. The SPC will be a non-profit corporation.
3. The monies provided will be secured by:
    a. Put or pay contracts with the municipalities that direct their MSW to the WTE facilities.
    b. A power contract with a utility.
    c. A license agreement with Afval Energie Bedrijf (AEB) that guarantees that AEB's technology will have 90% availability and 30% electrical efficiency.
    d. Bonded construction companies to build the facility in accordance with plans and specifications.
    e. Certified testing laboratories to ensure all state and local performance levels are achieved.
    f. The technology used, AEB, is tested and proven and work can commence immediately on all projects.
    g. Ownership of the asset, the WTE facility, remains with the public sector.
    h. Resource will, concurrently with the submission of this proposal to all interested stakeholders, request a line of credit from the Massachusetts Renewable Energy Trust Funds so that work can be started immediately on these projects.

It is important to note that the final numbers will vary dependent on local codes and project timing and other conditions. However of significant importance is the estimate revenue produced for the host municipality and the municipalities providing the MSW.

3.1) PROJECT ECONOMICS FOR DEER ISLAND

This Table presents the estimated construction costs and anticipated revenue from a 550,000 MTPY WTE plant located on Deer Island in Boston Harbor. This project will create almost a half billion dollars in construction activity and generate revenues of over $30,000,000 annually to the participating municipalities. The Plan of Action requires the design team to immediately verify the source of the municipal solid waste and the current price for its disposal The recent 2006 Solid Waste Data Update on the Beyond 2000 Solid Waste Master plan dated February 2008 indicates that by the year 2010, under certain scenarios, over 4 million tons of waste will have to be exported for disposal at landfills as far away as Ohio and North Carolina and the average cost of disposal of a ton of MSW ranges between $85 to $95 per ton.

As shown in Table 1 the rate received for the electricity generated is estimated at $0.067 $/KWh. This rate will eventually be determined in the power contract. This rate and the tipping fee are the drivers that generate the revenue returned to the municipalities of $33,911,412. However, by locating the WTE facility on Deer Island adjacent to the Massachusetts Water Resources Authority's(MWRA) wastewater treatment plant, that plant's entire electrical load could be satisfied by the WTE facility. It is understood that the wastewater treatment plant is presently paying $0.10 $/KWh and it is expected to increase. Using a rate of $0.10 $/KWh significantly increases the revenue returned to the participating municipalities.

Explanation of the numbers shown in Table 1 follows:

- Project cost includes license fees and would normally include land purchase costs. As the WTE facility will be located on Deer Island there are no land acquisition costs. The MWRA will receive a host fee.
- Total manpower costs represents the salaries of over 125 permanent employees. It should be noted that the economic performance of the facility is based on 90% availability and 30% electrical efficiency but as noted in Appendix 1 both the availability and electrical efficiency are expected to exceed those numbers. When these operating goals are exceeded the additional revenue generated will be reinvested in the facility and the employees that made it possible.
- Interest is shown at 3%. The monies to make these projects happen will be given to local banks, which will lend it to the SPC that has been created to design, build and operated the WTE facility.
- The tipping fee, shown in this case at $85per ton will reflect the rate currently being charged to the participating municipalities.
- The rate received for the sale of electricity, with the help of legislation such as the Green Communities Act, should be as high as allowed. Thus it is important that municipal solid waste be considered a renewable energy source and is included in any Renewable Portfolio Standard (RPS).
- The revenue received from other products of combustion and the costs of APC residue and sludge from flue gas cleaning will depend on local conditions and markets.
- Total revenue will be shared by the host community and the municipalities providing the municipal solid waste.

TABLE 1: PROJECT ECONOMICS FOR DEER ISLAND

Table 1 Boston		**Project data**			**Total capital investment**			**$ million**
		Analysis date	2009		Contractor Cost			$550,000
		Location	Deer Island		Project costs	**2%**		$22,000
		Annual design capacity	611,111	MTPA	Green investment subsidy		$2	$1,000
		Availability	90%		Total Investment Cost		**$0**	**$571,000**
		Annual throughput	550,000	MTPA				
		Daily troughput	1,511	MTPD				
		Caloric value MSW	10,000	GJ/MT				
		Electric efficiency	30%					
		Third party heating/cooling	0.0%					
			Units per				**Total Cost/**	**Total Cost/**
	Production Cost Summary		**MT MSW**		**Unit Cost/**	**Units**	**revenue**	**revenue**
					price		**per 1 MT**	**per Annum**
							MSW	
Variable Costs								
	Chemicals		13.55	kg	$0.158	$/kg	$2.146	$1,180,300
	Water		15.00	kg	$0.013	$/kg	$0.188	$103,400
Total variable cost							**$2.334**	**$1,283,700**
Fixed cost			**# man**		**$/man-year**			
	Operators		32		$85,000	average	$4.945	$2,720,000
	Maintenance		20		$85,000	average	$3.091	$1,700,000
	Personnel other		10		$85,000	$/man-year	$3.091	$850,000
		total salaries	62				$9.582	$5,270,000
		Overhead	50%				$4.791	$2,635,000
	Total manpower cost						$14.373	$7,905,000
	Maintenance		5.0%				$50.000	$27,500,000
	Interest		3.00%				$30.000	$16,500,000
	Insurance		1.00%				$10.000	$5,500,000
	Subtotal						$40	$22,000,000
Total fixed cost							**$104.373**	**$57,405,000**
Total cost of production							**$106.707**	**$58,688,700**
Income								
	Tipping Fee		1	MT			$85.000	$46,750,000
	CO2 Credits		85,800	MTPA			$20.000	$1,716,000
							$105.000	**$48,466,000**
Products		Electricity	834	KWh	$0.067	$/KWh	$55.878	$30,732,900
		District heating	0	KWh	$0.000	$/KWh	$0.000	$0
		Ferrous metals	27.8	kg	$0.300	$/kg	$8.352	$4,593,600
		Non-Ferrous metals	6.7	kg	$1.875	$/kg	$12.600	$6,930,000
		Precious metals concentrate	0.5	kg	$12.500	$/kg	$6.250	$3,437,500
		Aggregate	96.0	kg	$0.150	$/kg	$1.440	$792,000
		Sand	90.5	kg	$0.008	$/kg	$0.724	$398,112
		Salt	9.0	kg	$0.000	$/kg	$0.000	$0
		Gypsum	7.0	kg	$0.000	$/kg	$0.000	$0
		Dry APC-residue	5.0	kg	$0.033	$/kg	$2.500	$1,375,000
		Sludge from fluegas cleaning	5.0	kg	$0.033	$/kg	$2.500	$1,375,000
Total product income							**$80.244**	**$44,134,112**
Total cash cost/revenue							**$78.537**	**$33,911,412**

TABLE 1: PROJECT ECONOMICS FOR DEER ISLAND

It is reasonable to conclude from the estimates given in Table 1 that by proceeding with the WTE facility the following will result:

- Significant construction activity and employment will occur.
- Significant permanent high paying skilled jobs will be created.
- The bonding capacity of the host municipality will not be affected.
- The participating municipalities will receive significant revenues annually.

Moran Terminal

Deer Island

TABLE 2: PROJECT ECOMONICS FOR FALL RIVER

This Table presents the estimated construction costs and anticipated revenue from a 1,100,000 MTPA facility located in Fall River Massachusetts. This facility will be developed as a major environmental center, the center piece being the WTE facility. This project will create close to one billion dollars in construction activity and over one hundred and fifty skilled permanent jobs. In addition this facility has the potential to generate almost 90 million dollars annually in revenues to be shared by the participating municipalities. Costs associated with site acquisition are not shown in this economic analysis and if the site is not publicly owned the economics can be adjusted accordingly.

The explanation and conclusions to be drawn from this analysis are similar as those presented for Table 1.

Shell Distribution Center - Fall River Harbor

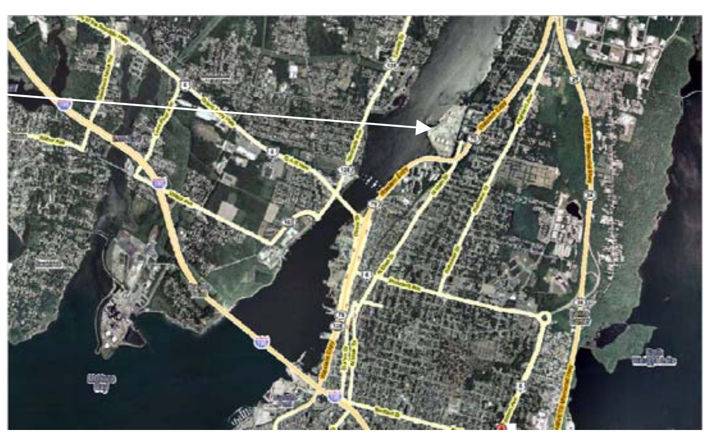


TABLE 2: PROJECT ECOMONICS FOR FALL RIVER

Table 2 Fall River		**Plant Startup**			**Total capital investment**			**$ million**
		Analysis date	2009		Contractor Cost			$893,478
		Location	Fall River		Owner Cost	2%		$35,739
		Annual design capacity	1,222,222		Green investment subsidy		$1	$1,625
		Availability	90%		**Total Investment Cost**		**$1**	**$927,592**
		Annual throughput	1,100,000	MTPA				
		Daily troughput	3,022	MTPD				
		Caloric value MSW	10,000	GJ/MT				
		Electric efficiency	30%					
		Third party heating/cooling	0.0%					
			Units per				**Total Cost/**	**Total Cost/**
	Production Cost Summary		**MT MSW**		**Unit Cost/**	**Units**	**revenue**	**revenue**
					price		**per 1 MT**	**per Annum**
							MSW	
Variable Costs								
	Chemicals		13.55	kg	€ 0.158		$2.146	$2,360,160
	Water		15.00	kg	€ 0.013	€/kg	$0.188	$206,250
Total variable cost							**$2.333**	**$2,566,410**
Fixed cost			**# man**		**€/man-year**			
	Operators	total labor and supervision	52		$85,000	average	$4.017	$4,418,653
	Maintenance	total labor and supervision	32		$85,000	average	$2.511	$2,761,658
	Personnel other	total labor and supervision	16		$85,000	average	$1.255	$1,380,829
		total salaries	101				$7.783	$8,561,140
		Overhead	50%				$3.891	$4,280,570
	Total manpower cost						**$11.674**	**$12,841,710**
	Maintenance		5.0%				$40.613	$44,673,900
	Interest		4.00%				$24.368	$26,804,340
	Insurance		1.00%				$8.123	$8,934,780
	Subtotal						$32	$35,739,120
Total fixed cost							**$84.777**	**$93,254,730**
Total cost of production							**$87.110**	**$95,821,140**
Income								
	Tipping Fee		1	MT			$85.000	$93,500,000
	CO2 Credits		171,600	MTPA			$20.000	$3,432,000
							$105.000	**$96,932,000**
Products		Electricity	834	KWh	$0.067	$/KWh	$55.878	$61,465,800
		District heating	0	KWh	$0.000	$/KWh	$0.000	$0
		Ferrous metals	27.8	kg	$0.300	$/kg	$8.352	$9,187,200
		Non-Ferrous metals	6.7	kg	$1.875	$/kg	$12.600	$13,860,000
		Precious metals concentrate	0.5	kg	$12.500	$/kg	$6.250	$6,875,000
		Aggregate	96.0	kg	$0.150	$/kg	$1.440	$1,584,000
		Sand	90.5	kg	$0.008	$/kg	$0.724	$796,224
		Salt	9.0	kg	$0.000	$/kg	$0.000	$0
		Gypsum	7.0	kg	$0.000	$/kg	$0.000	$0
		Dry APC-residue	5.0	kg	$0.033	$/kg	$2.500	$2,750,000
		Sludge from fluegas cleaning	5.0	kg	$0.033	$/kg	$2.500	$2,750,000
Total product income							**$80.244**	**$88,268,224**
Total cash cost/revenue							**$98.134**	**$89,379,084**

4.) DOCUMENTATION

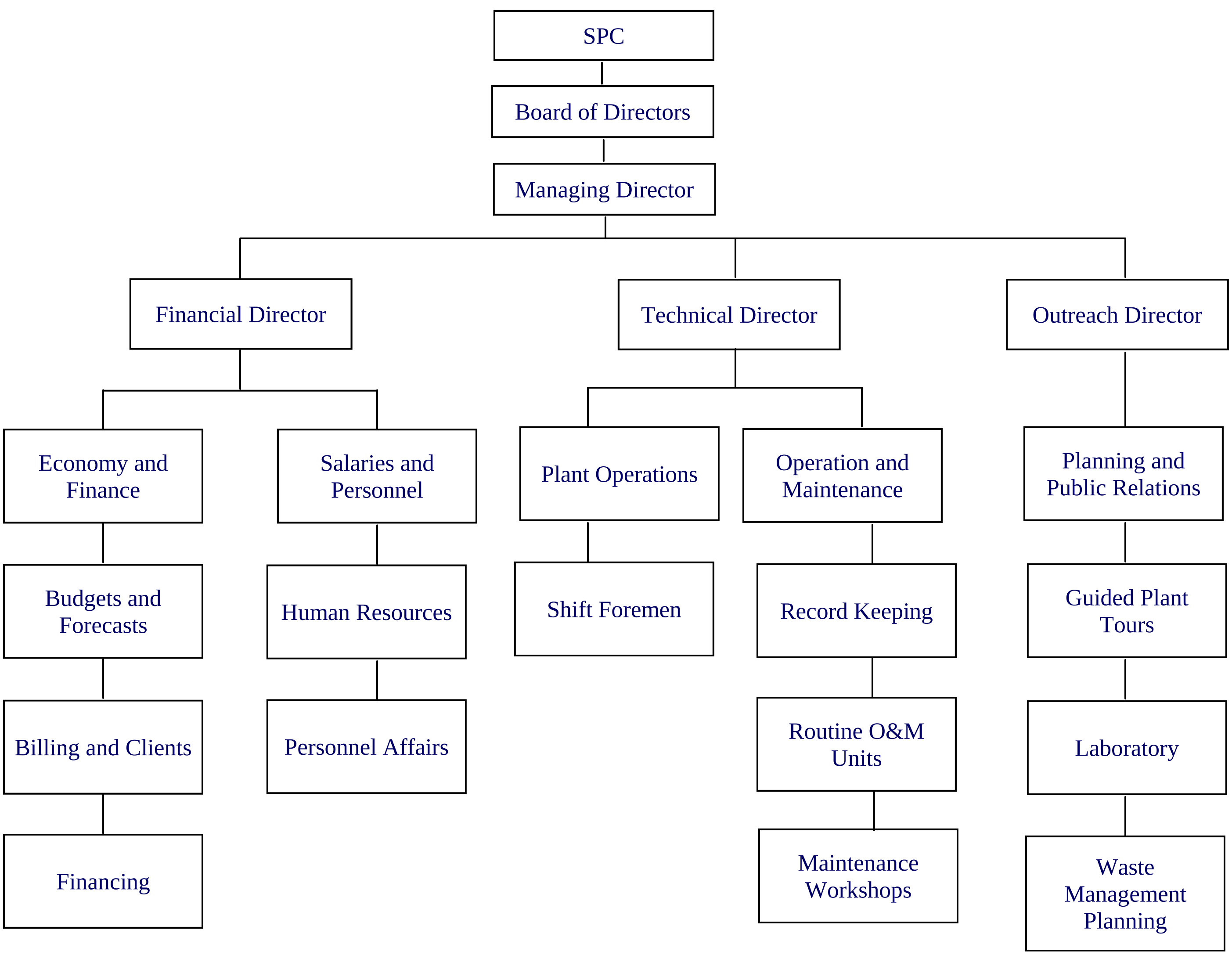
SPECIAL PURPOSE CORPORATION (SPC)

As noted the SPCs created for these projects will be non profits and all net revenues generated will be shared by the participating municipalities. The SPC will in affect be a service branch of the public entity owning the asset and will operate as an independent company. The public entity owning the asset will be the sole shareholder. This means that the SPC must operate independently on a normal, competitive basis on the waste, energy and raw materials market.

As shown, each SPC's organization will contain management level emphasizes on Public Outreach and Safety. Not only will there be pubic tours and educational programs the Fall River location will be equipped with a laboratory to monitor and analyze emissions from all WTE facilities in Massachusetts. It is recognized that there is no way to practically monitor what is in the waste stream going to a landfill. However by monitoring the air emissions from a WTE facility, any spike in any emissions can be immediately identified and appropriate action taken.

The Project Team that Resource will assemble to create the SPC and design, build and operate the WTE plant is shown in Figure 1.

The SPC Organizational Structure



5.) LOCATION

DEER ISLAND

The WTE plant will be located in the northwest quadrant of the island as indicated on the site plan. The existing topography will be maintained and the only visible evidence of the plant from Winthrop will be a low-rise administration and reception building. The stack will conform to any height limitations imposed by the proximity of Logan Airport. The stack should have an observation deck so visitors could enjoy spectacular views of the City of Boston and Boston Harbor. Such amenities should be included in the design, but such design decisions will be made in conjunction with the public agencies permitting and owning the plant. The receiving terminal for the barged MSW will be located on the lee of the island, its exact location to be determined. All construction materials and equipment will be delivered by barge, similar construction activity will be the same as that for the MWRA waste water treatment plant. All MSW will be delivered to Deer Island and all residue material removed by barge. The MSW will be transferred in intermodal containers from the existing transfer stations in Somerville and Roxbury and transferred to barges at the Moran Terminal in Charlestown.

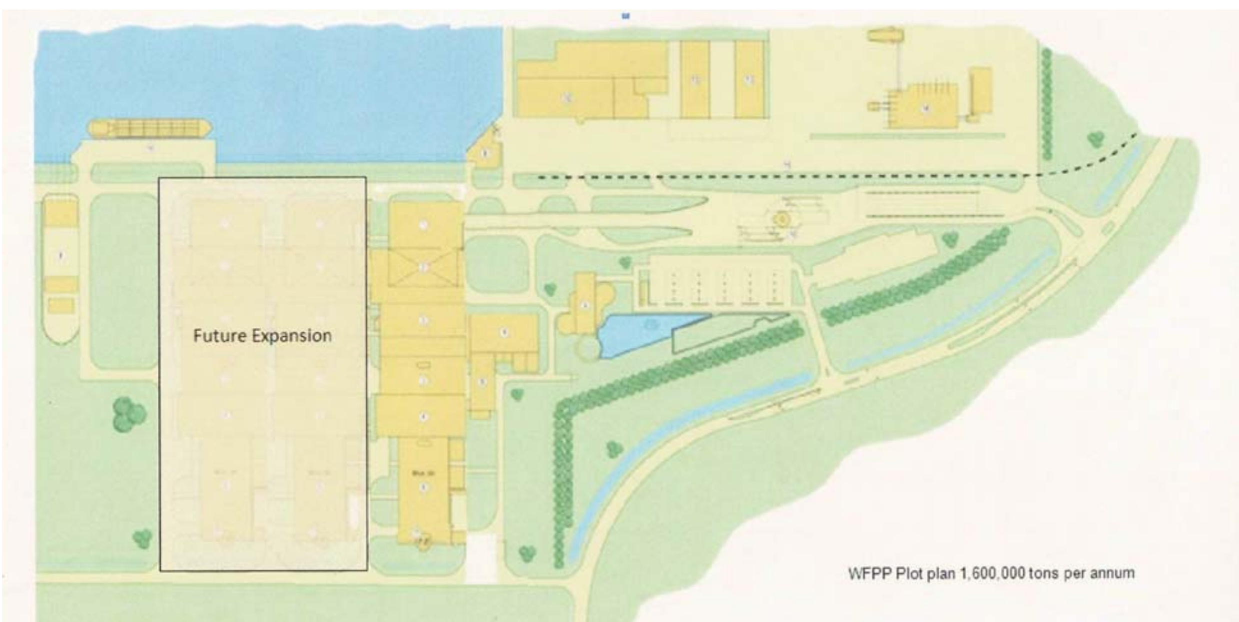
As the Deer Island plant will primarily serve the City of Boston, the design team will immediately consider another location for the plant. It should be noted that AEB is participating in a joint venture to distribute heat to business and approximately 15,000 households in the Amsterdam Nieuw-West district. The City of Boston has a street steam system. Recently a WTE plant was commissioned in Paris France along the Seine River, located only a few kilometers away from the Eiffel Tower. This facility processes 460,000 MTPY of MSW while producing 52 MWh of electricity and district heating to approximately 79,000 houses and apartments. To minimize the visual impact of the plant it is essentially built underground with a maximum elevation of 21 meters. The design team will investigate this option for a WTE plant to serve the City of Boston should barriers arise to locating the plant on Deer Island.

5.1) LOCATION

FALL RIVER.

The City of Amsterdam has developed an ecological concept for the port district in which AEB is located. It is called Eco-Port. The objective is to create a sustainable environment, maximizing synergies between adjacent industries and neighboring residential areas. As noted previously the Fall River location will contain a laboratory to monitor all WTE sites in Massachusetts and provide test facilities for new and emerging renewable energy technologies. Minimizing the negative impact on the environment is one on the most important priorities driving this proposal. WTE has been consistently shown to increase recycling, reduce the production of GHG and converse energy. The Fall River facility will make a major contribution to the Commonwealth's goal of stopping the exporting MSW.

A site particularly suited for the Fall River facility would be similar to the Shell Distribution Site. Here there is access to the site by road, rail and barge. Considering that the Fall River landfill is slated to close, resulting in a negative financial impact to the City of Fall River, this project will provide needed construction activity, jobs and income to the City.

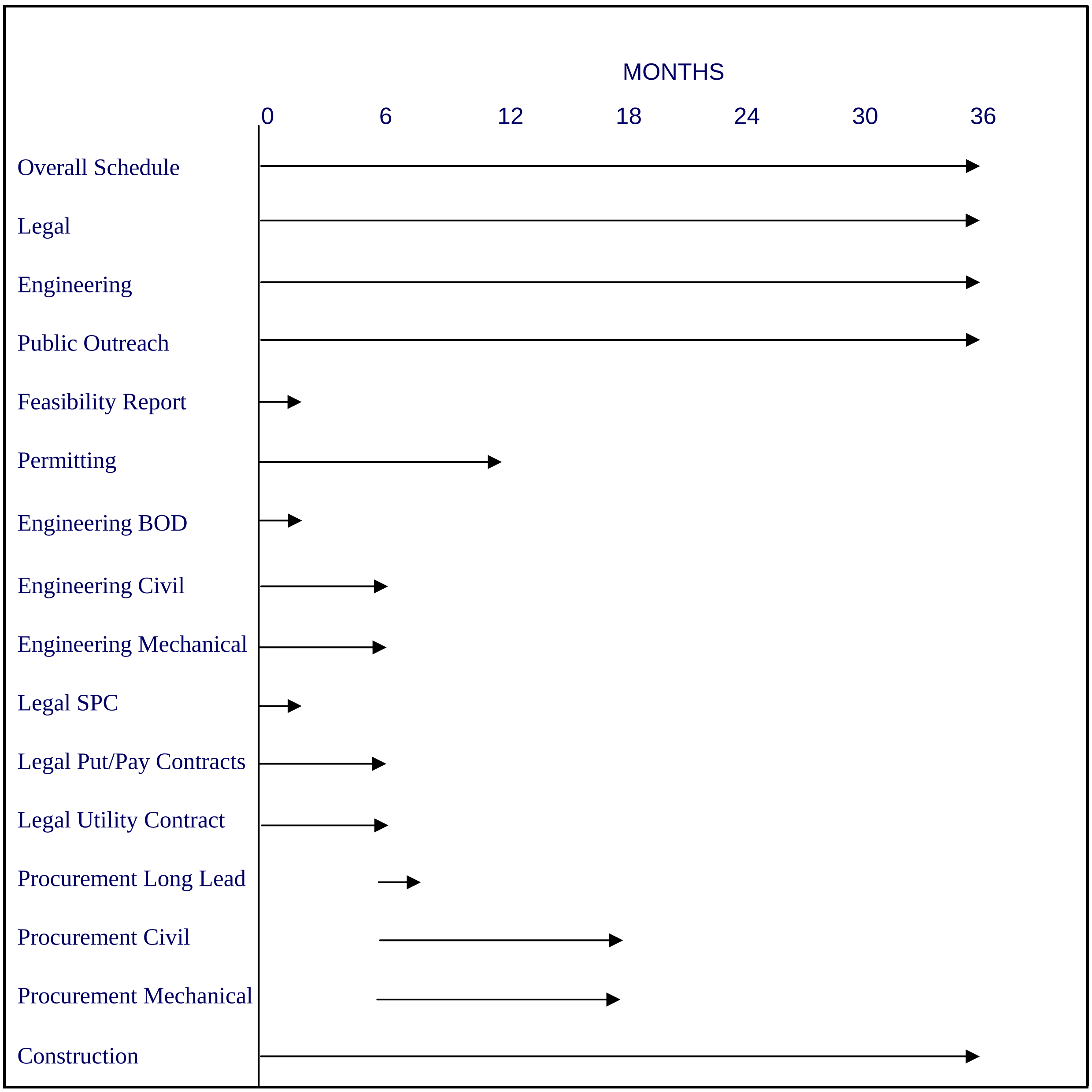


This is a typical plot plan for a 1,650,000 tons per annum WFFP Facility Consisting of 3 modules with a capacity of 530,000 tons each and each module consisting of 2 lines. The plot plan indicates how the plant would be expanded if staged development is considered the best way to proceed.

6.) PROJECT SCHEDULE

The immediacy of all aspects of the economy and the need for job creation is recognized. To that end all project items and construction work will be fast tracked. As shown on the following project schedule, Figure 2, these projects will be completed within 3 years and the procurement of the bulk of all work and purchase of equipment should be completed within 18 months.

PROJECT SCHEDULE



7.) CONCLUSION

The projects proposed herein offer the following benefits without adding additional tax burdens to the taxpayer while returning millions annually to the participating municipalities that use their MSW as a fuel.

- Environmental benefits;
  - Increased recycling
  - Close to 0 waste from the MSW stream
  - Reduction of GHG
  - Reduction of transportation air emissions from long distance hauls of MSW.

- Energy benefits;
  - Reduction on dependence on imported fuel.
  - Generation of electrical energy near where it is needed.

- Economic benefits;
  - Immediate construction activity
  - Immediate manufacturing activity
  - Creation of high paying skilled jobs
  - Revenue of the participating municipalities
  - Revenue for the participating banks.

The vision of Resource Enterprise is expressed by its logo, We all are obligated to reuse, recycle and recover the mountains of waste we generated in order to achieve the goal of "0" waste.

Appendix 1

WTE Technology: Afval Energie Bedrijf

City of Amsterdam
Waste and Energy Company

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Summary

Mid 2007 the Amsterdam Waste and Energy Company (AEB) commenced initial operations of their new Waste Fired Power Plant© (WFPP). The unit processes 530,000 metric tons of unsorted municipal solid waste producing electricity with a net efficiency of 30%. The major contributor to the efficiency increase from the conventional 22% to 30% is a new and patented technology, whereby steam from the high pressure turbine is reheated by steam, rather than flue gas, before entering the low pressure turbine. The plant completed a successful test run in August of 2007.

For a period of almost 3 years AEB operated a commercial scale pilot plant, with a maximum capacity of 50 tons per hour, to develop the necessary process steps, to recover ferrous, non-ferrous, as well as precious metals from the bottom ash. In the process of this recycling heavy metals and other toxicants are removed from the ash, rendering it suitable as a raw material for use in building materials, leaving less than 5% material to be landfilled.

Following a brief introduction, the operating results of both experiences, as well as data on the environmental performace are presented in the following paragraphs.

Introduction

A brief introduction might be in order. AEB is a Public Utility Company and is 100% owned by the City of Amsterdam. Amsterdam's waste management started back in 1882 and the first waste to energy was inaugurated in 1919. AEB is and self sustaining operation with a mission for optimal environmental performance, create maximum benefit to the citizens and home-grown R&D

The following is a summary of salient details:

- World's largest WtE facility; 1,500,000 MTPA
- WFPP® most efficient facility; 30% (850 kWh/MT MSW)
- Amongst the world's cleanest, emissions< 20% EPA limits
- Overall solids recycling rate 95% Upon completion of the Bottom Ash Recycling Unit
- Zero liquids discharge is an option
- Avoided CO2; 600,000 MTPA
- Turnover € 200 million
- Lowest tipping fees in the Netherlands; €75/MT average

The City of Amsterdam has developed an ecological concept for the port district in which we are located. It is called EcoPoort®. The objective is to create a sustainable environment, maximizing synergies between adjacent industries and neighboring residential areas. Minimizing the negative impact on the environment is one of the most important priorities to which the City applies the Best Practical Environmental Options or BPEO philosophy.

We designed the WFPP for maximum output while minimizing the negative environmental impact. To do this we applied some 30 innovative and novel designs most of which we developed in house over the years. This paper addresses the following two major technologies:

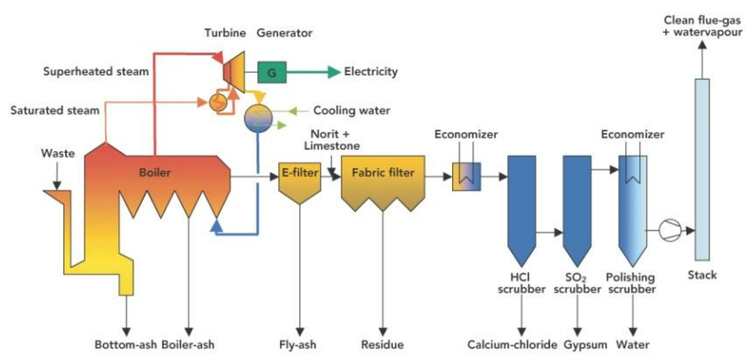
- High-efficiency W2E concept; Waste Fired Power Plant
  - Reheater concept to increase electric efficiency.
  - Flue-gas recirculation; lower emissions, increased efficiency
  - Use of WWTP bio-exhaust gas for improved drying and fuel efficiency
- Bottom Ash Recycling Pilot Unit
  - Dry separation
  - Wet non-ferrous separation from bottom ash

Waste Fired Power Plant

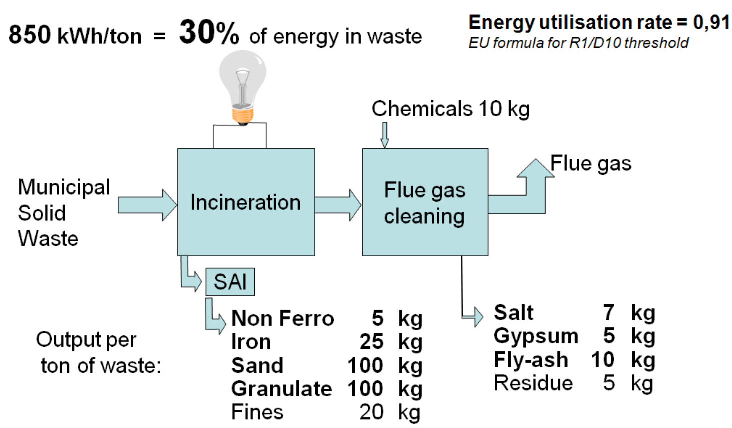
The following is the realization timeline for the Waste Fired Power Plant

- Start of construction Jan 2004
- Hot commissioning 19 March, 2007
- 100% Load 2 boilers mid April, 2007
- Turbine online mid June, 2007
- Handover 1st August, 2007
- Troubleshooting balance 2007
- Operational optimization 2008

A simplified blockflow diagram of the total system is shown here. The basic design concept is very similar to other modern WtE facilities. Application of the best available technologies to ensure high environmental standards, resulting stackgas performance at 20% of EPA limits as well as high energy and material recycling efficiencies. The investment in fluegas cleaning amounts to almost 50% of the total investment. In addition plant design is extremely robust ensuring high availability and long plant life.



This diagram on the right summarizes the efficiency concept for the production of electricity and recycling of products from the bottom ash per metric ton of waste. Electricity output is net, exclusive of the parasitic load and based on a LHV value on the MSW of 10 gigajoules/MT, or a HHV of about 11



Major products recovered from the bottom ash are ferrous and non-ferrous metals, including gold and silver, and products for the building industry.

Environmental Performance

Consideration for the environment has been a main guideline for all of AEB activities since its early day of existence. The City of Amsterdam has produced a development plan for the section of Amsterdam in which AEB is located, to ensure a harmonious existence of citizens and industry. The plan entitled “Ecoport® Amsterdam”; is an integrated sustainable concept for recovery of energy and reuse of solid remains for building and construction materials out of urban waste and sewage sludge at lowest costs. The Eco-Port® plan endeavors to minimize waste through waste reduction and the promotion of recycling of waste streams and by products, both through internal use as well as use by neighboring industries and population centers. AEB has been a cornerstone in the planning process from its very beginning and continues to be an integral part of the overall concept.

The WFPP® is built on the AEB site as an extension to the existing plant in the industrial and port area of Amsterdam. This permits the use the available infrastructure, particularly the access roads, railway and harbor.

The WFPP® is part of a broad approach to the maximum reuse of waste from our society to products for our society; "*Value from Waste*". Careful attention is paid to the potential of exploiting different waste flows and processes of other industries. The objective is to encourage industries to be established in AEB's vicinity and create synergistic relationships between all parties. The building of a new waste-water purification facility for the entire city of Amsterdam by Waternet on the site immediately adjacent to AEB, was a major step towards achieving this objective.

The construction of the new waste-water purification plant in the immediate vicinity of the Afval Energie Bedrijf will be used to utilize waste and save energy as a collaborative effort:

- The sewage sludge will be pumped directly to the existing WTE Plant (not the new WFPP® unit) and injected onto the incineration grate, where it will burn on top of the waste.
- The biogas released by fermentation in the waste-water purification process will be used in the Waste-to-Energy Plant's biogas engines to generate electricity. All heat generated will be supplied to district heating.
- Additional synergy will be achieved by using the exhaust gases from the biogas engines for drying waste. This means that 95% of the energy in the biogas will be used.
- The Waste-to-Energy Plant will supply heat and electricity to the waste-water purification plant.
- In the future, there will be an option for pre-warming waste-water. This will stimulate biological activity in the waste-water purification process, which will improve performance. Nitrogen removal in the winter months will be particularly optimized in this way. Connections will be provided for a future link to the steam condenser. Flue-gas heat could be used for this purpose.

The Afval Energie Bedrijf has an environmentally friendly attitude and tradition. It was granted a framework environmental permit based on the company effectively monitoring its impact on the environment itself. In addition to this, there is a best-effort obligation to continuously improve the environmental performance in the course of time.

'Green status'

The AEB has received the so-called "*Green Status*" for the WFPP®, which makes it fiscally attractive for banks and their clients to invest in the plant. The green status will make it possible to obtain the necessary additional means. Financial support has also been provided based on the CO2 Reduction Plan. Under the MEP (Environmental Effectiveness of Energy Production) scheme, a fixed subsidy will soon be granted for every MWh produced in a ten-year period. The province of Noord-Holland is also providing a substantial environment-related contribution. In addition to this, a major European subsidy was obtained under the 'Energy, environment and sustainable development' program.

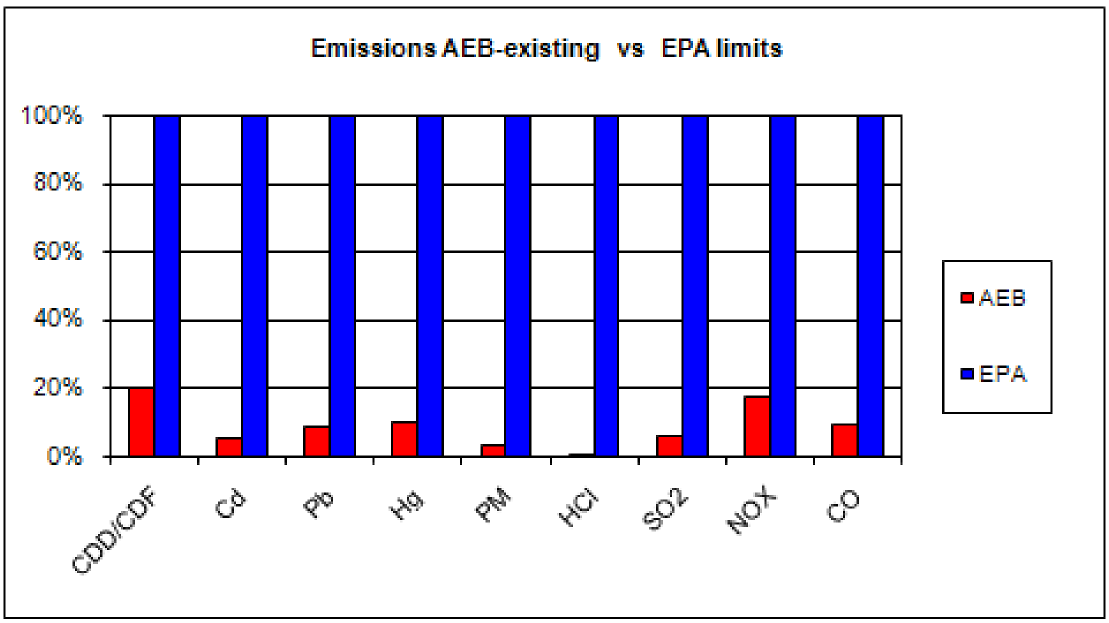
The European Investment Bank made a soft "*Green Loan*" available to their maximum limit of half of the total investment cost. A group of banks including the RABO Bank and the Triodos Bank provided a "*Green Loan*" of € 85 million, the largest issued in The Netherlands.

Stackgas Emissions

In addition to the emission limits imposed under the Dutch Environmental Management Act, AEB also used the even better operating parameters of the existing Waste-to-Energy Plant as a starting point. Surpassing these limits the existing facilities led to the design for the flue-gas cleaning system based on BAT (Best Available Technology). AEB expects to again surpass the limits set by the European Commission of Standards.

The Dutch emission limit for nitrogen oxides is one third of the EU standard. Owing to ammonia use, the optimum from an environmental technology viewpoint is operation using a set point for nitrogen oxide emission that is just below the Dutch standard. For all other components, the operational emission values are far below the Dutch and EU standards.

The following graph compares AEB's present performance with the EPA emission standard for new and large WTE facilities.



Noise

In- and outdoor noise levels comply with all standards in The Netherlands, the EU and those of EPA. Levels at AEB in Amsterdam ordinarily do not exceed the limits as shown in following table

Expected noise levels	distance	dBA
Indoor	> 1 meter	< 85
Outdoor day	> 200 meter	< 55
Outdoor night	> 200 meter	< 45

Noise levels are very much dependent on the equipment selected, insulation applied and the design of the building. The data represents levels, which can be attained with proper designs.

Water

AEB does not discharge any waste water from its plant. Instead, this is purified and then used in the flue-gas cleaning process. Our various water flows are described below.

Cooling water

For cooling, we use surface water that is drawn from a nearby dock, the Aziëhaven, and discharged into the North Sea Canal. The amount of cooling water extracted in 2005 was 152Mm3. Since the beginning of the year, an improved method has been used to calculate the cooling load and the amount of cooling water consumed. Because of this, the data cannot be compared directly with those from previous years.

To prevent freshwater mussels collecting in the pipes and condenser, they are treated with sodium hypochlorite during the breeding season. This is monitored closely using a nursery tank. The amount of sodium hypochlorite used thus depends upon the timing and length of the mussels' breeding season. The next table shows the cooling water emissions in our reference year, 1998, and in 2005. No violations were reported last year.

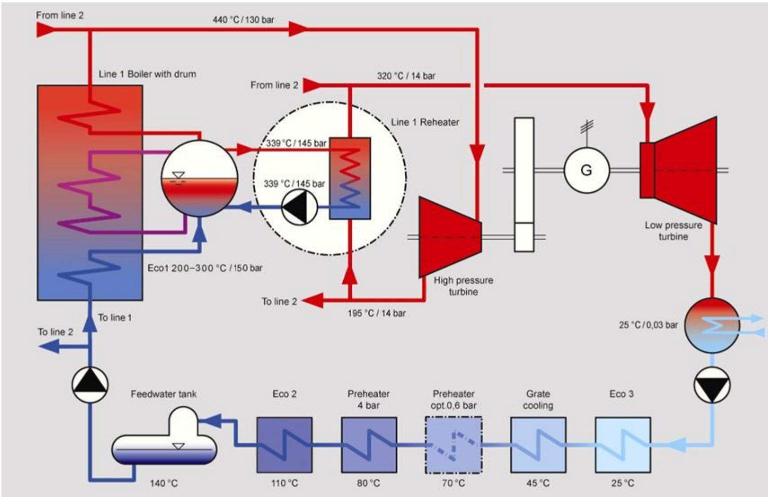
Demineralized water is needed for the steam cycle. This is obtained by passing industrial quality water through a series of filters to remove the salts and other minerals. These demineralization filters have to be rinsed and regenerated on a regular basis. That is done using water treated with sodium hydroxide or hydrochloric acid. The remaining regeneration water is then neutralized and, following a check of its pH value, discharged into the surface water. In 1998 some 21,273 cubic meters were released into the ADM dock; in 2005 that figure was 16,777 cubic meters. Cooling water data is shown in the following Table.

Cooling water emissions			
Discharge parameters	1998 results	2005 results	Permitted
Heat discharge	140MWth	166	1 96MWth
Temperature difference (in/out), summer	< 5°C	7°C	7°C
Temperature difference (in/out), winter	< 9°C	10°C	15°C
Average free chlorine content	0.45mg/l	0.24mg/l	0.5mg/l
Sodium hypochlorite consumption (NaOCl, 15%)	870 MT	795 MT	n/a

Contaminated rainwater

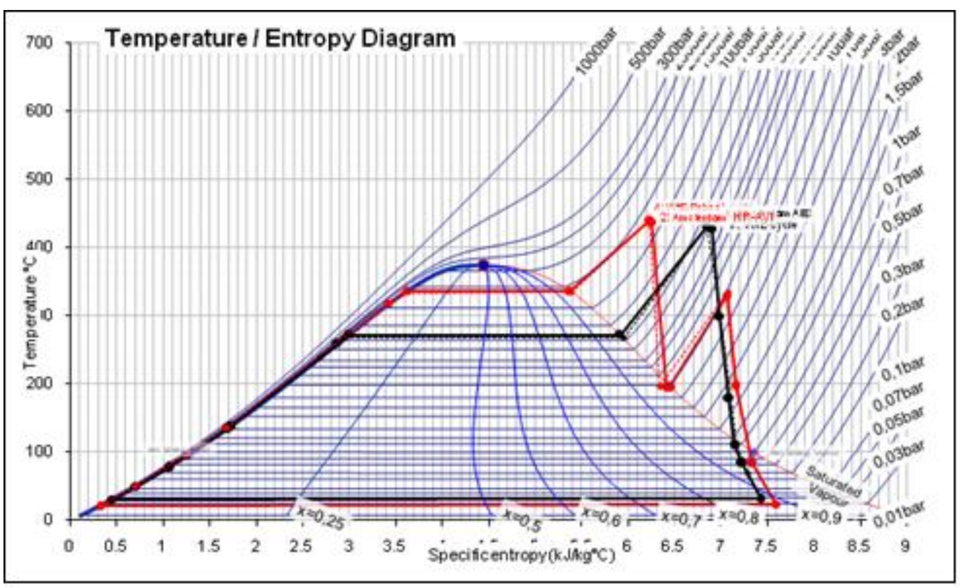
To prevent contamination of the road by the trucks, a wheel-cleansing units at both the bunker and the plant are included as well as a de-contamination system.

High Electric Efficiency 30%



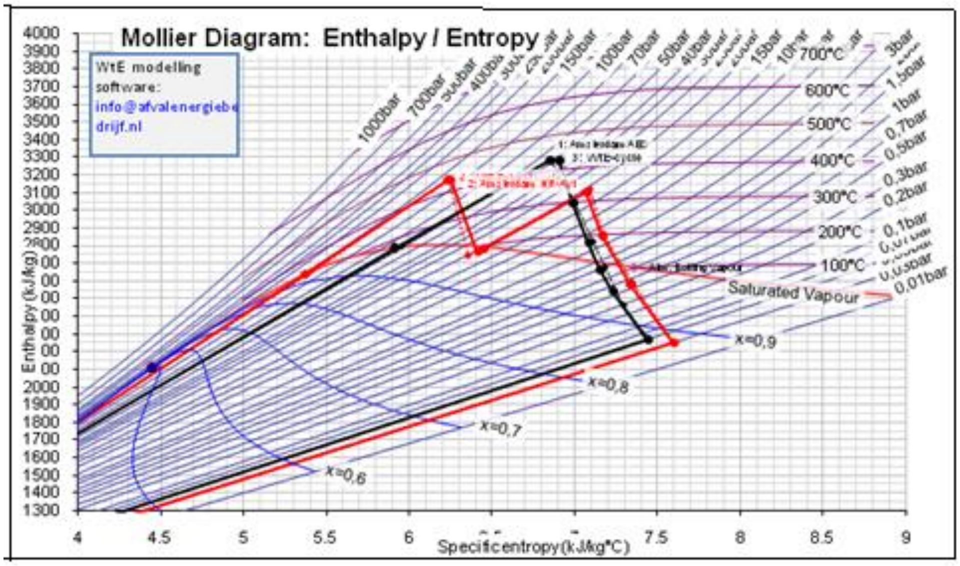
The exceptionally high electric efficiency of the WFPP® of 30% net, is accomplished through re-heating by steam rather than fluegas. The latter is not possible in WtE mainly because of the corrosive environment of the flue gas. Important parameters include:

- Steam temperature/pressure @ 440^{0}C and 130 bar
- Reheating the steam between the HP and LP turbines from 195^{0}C and 14 bar to 320^{0}C at a 14 bar pressure
- Low back pressure 0.03 bar at 25^{0}C
- Low excess air, 6% dry
- Heat recovery from a number of sources including fluegas and grate cooling to preheat boiler feed water.



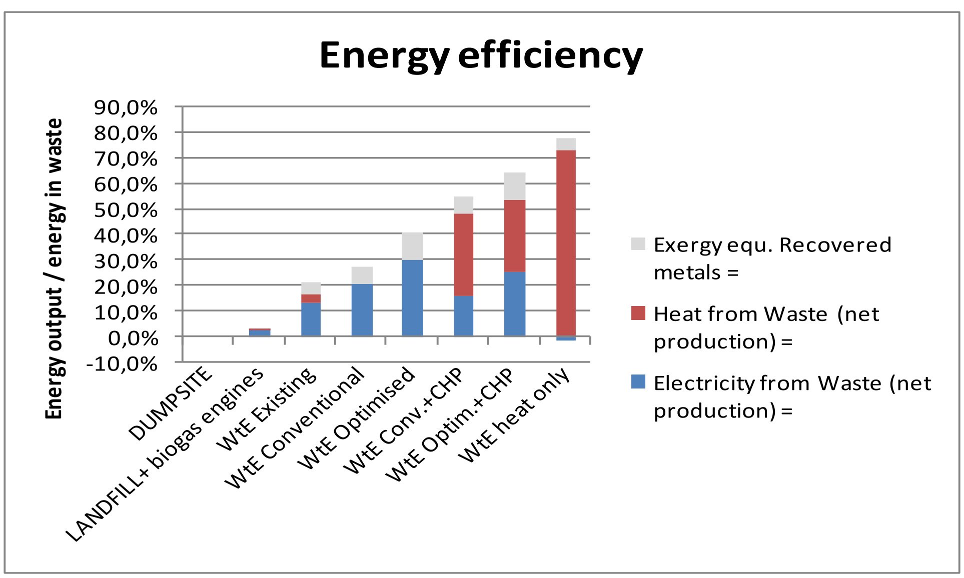
A comparison between the electric efficiencies of a conventional WtE facility having a net efficiency of 22% and that of the WFPP® with 30% efficiency is shown in this TS diagram. The surface encompassed by the black lines represents 22%, that by the red lines 30% efficiency. The rising slanted red line in the superheating area depicts the steam reheating step

Since comparing surfaces is somewhat difficult a representation of the difference in efficiency this TS diagram may make it easier. Just compare total length of the backward slanted black and red lines. They have a 22:30 ratio. What this means in total energy can be seen at the graph on the left



AEB has developed very detailed modeling tools to optimize the steam/water cycle of a WtE facility using the steam reheat technology. These tools can be made available to third parties with an interest in evaluating the reheat option.

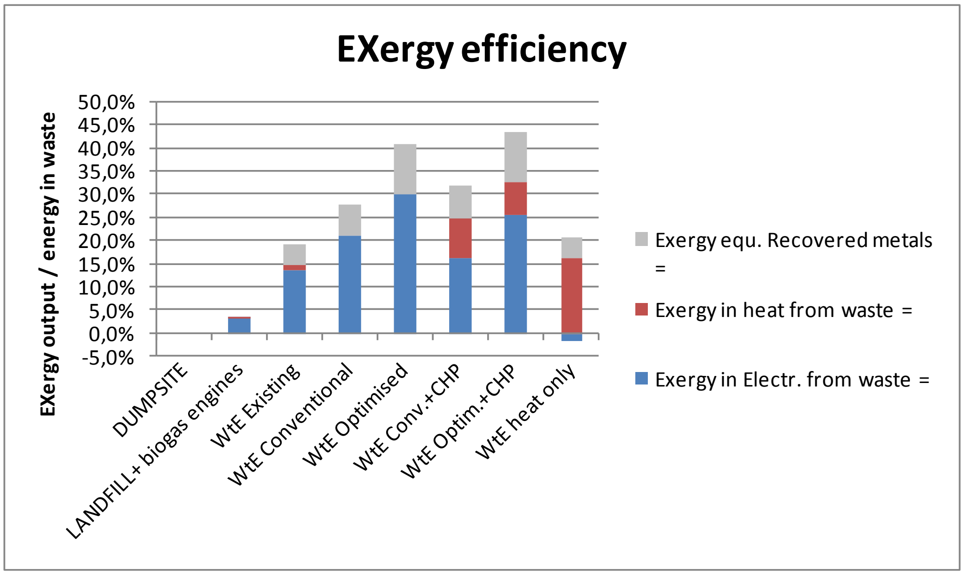
A comparison of the electric energy and heat produced by the different conventional and high efficiency or optimized WtE facilities, as well as with a modern landfill.



The WtE Existing bar represents the average WtE facility in the Netherlands at about 15% electric efficiency, which is not unlike the average in Western Europe. The WtE Conventional represent a more modern plant with 22% efficiency. WtE Optimized is our WFPP at 30%.

The red surfaces show the amount of energy recovered if the plant also delivers hot water or low pressure steam or just water and/or steam.

Although one may argue about the amount of energy recovered from a modern landfill with methane recovery, it is significantly less than any WtE facility. The efficiency of methane recovery is only about 50 to 75% and recovery is usually abandoned after 10 years or so, because the methane volume drops below the economic recovery level. Methane production however continues for another 50 years or more.



Since there is a large difference in the value of electricity and that of low pressure steam or hot water, a better comparison of the energy efficiencies is to comparing Exergies.

Exergy, as we all know, is defined as the energy available to do useful work. The bar chart clearly shows the superiority of the Waste Fired Power Plant design, with and without the production of heat.

The gray surfaces by the way represent the energy recovered by the recycling of metals from the bottom ash, a subject I shall be speaking about shortly.

This table provides a summary of the results of the test runs as measured by the suppliers of the equipment as well as by testing authority. It shows that in all instances and for both lines of the WFPP, the results exceed the guaranteed minimums, and that the plant was able to meet guaranteed efficiencies operating at 110% of the designed capacity.

	100% Load		110% Load		Units
Date	24-7-2007		25-7-2007		
Timespan	16:00 - 22:00		8.00 - 14:00		
Duration	6		6		h
Net Goal	≥30		>30		%
Measuring company	Supplier	KEMA (Tüv)	Supplier	KEMA (Tüv)	
Boiler efficiency (Thermal)	85,2	85,5±1	85,8	85,5±1	%
Net electr. Efficiency	30,5	30,6±1,6	30,8	30,9±1,6	%
	* Design	* Measured	* Design	* Measured	

Additional details of the operational parameters during the test run for both production lines are included in the following table.

Worth noting is the very high boiler efficiency of 85.2%, due in part to a fluegas recycle rate of about 25% and the installation of ample economizer capacity.

	Guaranteed value	Guarantee measurement		Units
		boiler 35	boiler 36	
Waste Throughput	33,6	34,89	34,94	Mg/h
Calorific value	10	9,94	10,26	MJ/kg
Steam production	28,4	28,46	28,52	kg/s
=	102	102	103	Mg/h
Boiler outlet temperature	180°constant	177,35 - 183,75		°C
Boiler efficiency	85	85,2		%
850°C residence time	>2	5		s
Power from waste	93,3	96,9	97,07	MW
Thermal boiler load	102,7	103,63	102,93	MW
Own consumption	< 850	498		kW

More details are shown in the third table. In addition to efficiency data, this table includes data on the stack gas composition. All date confirms that all guarantee were met or exceeded..

	Guaranteed value	Guarantee measurement		Units
		boiler 35	boiler 36	
Control range Steam flow	2	-0,72 / +1,18	-1,57 / 0,75	%
Control range Steam temp	4	3,87	1,92	±K
O2-concentration (boiler outlet)	6,5	6,0 - 6,73	ø<6,5	%
CO (boiler outlet)	≤30	6		mg/m3
NOx (boiler outlet)	70	66 - 68		mg/m3
NH3 (boiler outlet)	≤5	3		mg/m3
TOC in bottomash	≤1,5	0,1 - 0,66		%

Bottom Ash Recycling

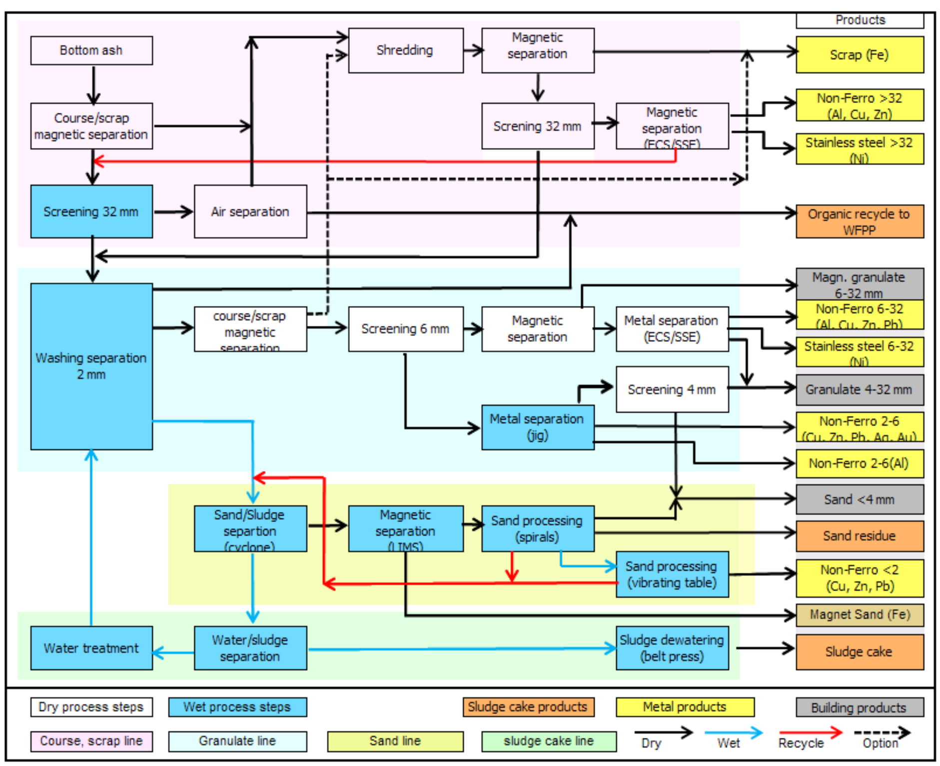
Let us now turn our attention to bottom ash recycling. Every ton of MSW produces about one quarter ton of ash. If untreated this means millions and millions of tons of MSW to be transported and landfilled, polluting air soil and water and taking up millions of acres of valuable land. AEB's bottom ash treatment recovers most of the valuable metals and other materials, reducing landfill required to about 2%.

The unit shown is a commercial size pilot plant with a maximum capacity of 50 MTPH. Tests have been completed and designs for a full size plant are well under way.

The almost complete recovery of all solids after combustion is also a major factor in the overall economics of waste management in which the avoided landfill cost plays a major role.

In the previous energy and exergy evaluations we have seen that the recovery of metals is a major contributor to the overall efficiency. It is worth mentioning that an increase in energy efficiency causes a reduction in Greenhouse Gasses.

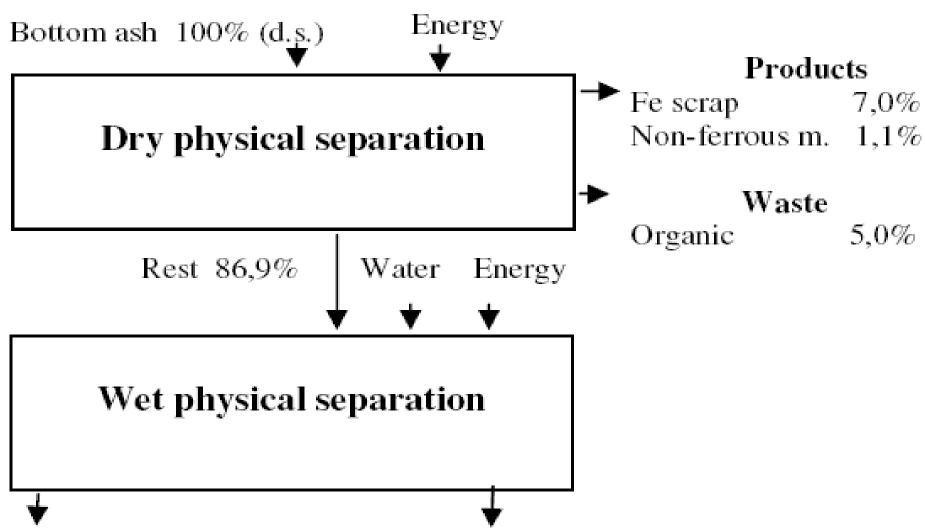
The bottom and fly ash from the different sections of the plant have greatly different compositions. They are therefore recovered separately are treated independently as can be seen from the this block flow diagram.



Amsterdam bottom ash contains 13% ferrous and 2.2% non-ferrous metals. The non-ferrous metals fraction also contains precious metals; approximately 3000 ppm of silver and 100 ppm of gold .The residue (ash), approximately 80%, can be used as a secondary building product (road filler, concrete, asphalt, lime sand stone), after removal of heavy metals to pass strict Dutch leaching tests. AEB did select wet separation since bench scale test showed better performance in the recovery of metals.

Following dry separation, the ash separated according to size and density of the particles, the non-ferrous fractions are removed by eddy current separation, density separation and jigging. The resulting fractions are the coarse non-ferrous (6-20 mm), fine non-ferrous (2-6 mm) and the very fine non-ferrous (<2 mm) products. The 2-6 mm aluminum scrap is separated from the heavy non-ferrous by density separation.

Values of the different products, intermediate product and waste streams are shown in this diagram.



Products		Waste	
Fe scrap (6-20mm)	4,6%	Organic (all sizes)	4,5%
Non-ferrous metals (from sand)	0,5%	2-6 mm magnetic	1,3%
Non-ferrous metals (from 2-6mm)	0,3%	Sand magnetic	2,1%
Non-ferrous metals (from 6-20mm)	0,6%	Sludge	13,0%
Al (2-6mm)	0,3%		
Sand product	16,3%	Total	20,9%
2-6mm granulate	20,6%		
6-20mm granulate	13,2%		
>20mm	9,6%		
Total	66%		

Although organic material after dry and wet separation are shown as waste, which is correct considering this process only, these stream are fed back to the grate for combustion, thus recycled.

In addition to the metals, three different building products are produced. The first is a 6-20 mm granulate, the second is a 2-6 mm granulate and the last one is the sand (100 µm-2 mm). All three products are sold to building companies as raw material for building products. Summarizing the results of the process, per 1000 kilograms of MSW the following materials are expected to be produced in the commercial bottom ash treatment plant being designed.

- Sand 85 kg bricks
- Granulate 110 kg concrete
- Iron 25 kg trade
- Metals Non-Ferrous 5 kg trade
- fly-ash 11 kg filler in asphalt
- $CaCl_2$-salt 7 kg industry, road
- Gypsum 5 kg construction
- Residue (gas cleaning) 2 kg disposal vitrification

A summary of the estimated and allocated cost of production for the different material fractions in the bottom ash shows a total cost of 30.9 Euro per ton of material versus a commercial value of 37.3 Euro, or in US currency $40 versus $48. While this difference is important, it pales by comparison to the savings in the avoided cost of landfilling this material, which in many instances would exceed $100 per ton.

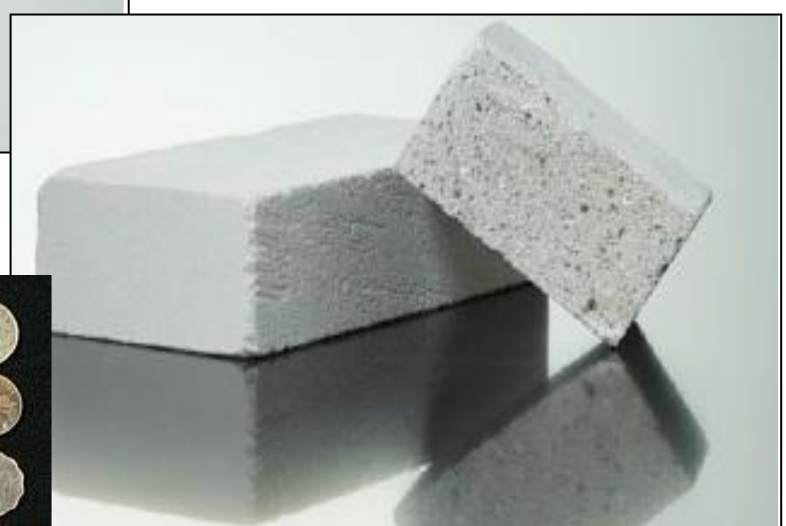
Wet separation		Cost/ton dry solids (Euro)	Fraction of input (%)	Returns (Euro/t)	Cost (Euro/t)
2-20 mm fraction	Basic washing plant	11	100,0		11,0
6-20 mm fraction	Coarse granulate sorting	2,4	23,4		0,6
	Coarse non-ferrous(alloys)	1500	0,7	10,5	
	Coarse granulate(product)*	7	15,2	1,1	
	Magnetic fraction(product)	120	5,3	6,4	
	Organic (will be incinerated)	80	2,2		1,8
2-6 mm fraction	Fine granulate sorting	4,6	28,7		1,3
	Fine non-ferrous(alloys)	1500	0,3	4,4	
	Fine precious metals (Au,Ag)	10000	0,03	2,9	
	Gold separation	100	0,3		0,3
	Fine Al	1000	0,4	4,0	
	Fine granulate(product)	7	23,7	1,7	
	Magnetic fraction(product)	50	1,5		0,8
	Organicwill be incinerated)	80	2,8		2,2
63 µm-2 mm fraction	Two polishing steps	5	21,9		1,1
	Sand (product)	5	18,7	0,9	
	Magnetic fraction(product)	50	2,4		1,2
	Non-ferrous(alloys)	1000	0,6	5,5	
	Organic(will be incinerated)	80	0,2		0,2
<63 µm fraction	Dewatering of sludge	20	15,0		3,0
	Disposal of sludge cake	50	15,0		7,5
Total			89,0	**37,3**	**30,9**

These are some samples of the materials recycled from Amsterdam's municipal solid waste. It might surprising the learn that the silver content; in the Ditch waste equals 10% of the Dutch silver consumption. Equally surprising was for us to find out that the copper content in the bottom ash is higher than Chilean ore. Some of the products are shown here.

This is sample of a mix of non-ferrous metals

Gravel for concrete

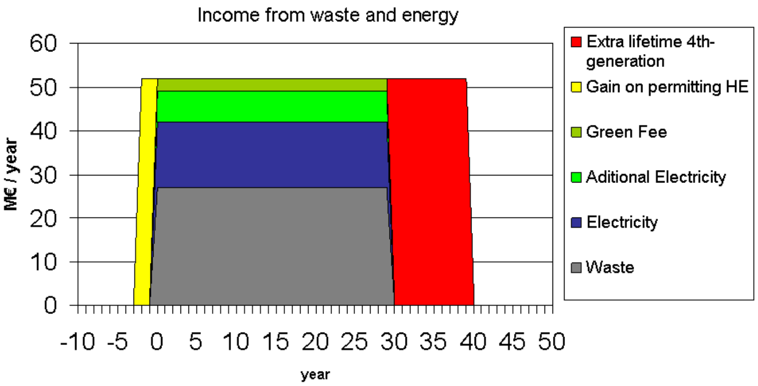
Sandstone brick



And some of the coins we find

Economics

Apart from environmental considerations, there are good economic reasons for AEB's decision to design and build the plant using Best Available Technologies. This include our choice of the extensive flue gas cleaning technology, not discussed today but an important factor in the overall economics.



This graph summarizes the economic impact of our design concepts. The gray and blue areas represent income from tipping fees and electricity sales at conventional levels.

By proposing the cleanest and most efficient designs possible we reduced the permitting time to less than one year. Not s single voice of opposition was raised by nearby residents or NGO's. Resultant savings in cost and time are shown in yellow.

Green represents the additional income from electricity sales by raising the efficiency from 22 to 30%.

Since about half of the MSW is biogenic, half of the electricity produced can be considered renewable and in many countries is sold at higher prices than conventional electricity.

In some countries, such as Holland, green fees or subsidies are paid when producing renewable energy. This income is represented by the dark green area.

Lastly building a plant robustly designed will extend its life well beyond the normal 30 years or so, with great economic benefits in the years that follow.

Appendix 2

American Society of Mechanical Engineers (ASME)

Waste-to-Energy: A Renewable Energy Source from Municipal Solid Waste

1828 L Street, N.W.
Suite 906
Washington, D.C. 20036

Tel 202.785.3756
Fax 202.429.9417
www.asme.org

Waste-to-Energy:
A Renewable Energy Source from Municipal Solid Waste

EXECUTIVE SUMMARY

ASME SWPD Supports WTE - The Solid Waste Processing Division (SWPD) of the American Society of Mechanical Engineers (ASME) supports national policies that encourage the recovery of energy from the controlled combustion of municipal solid waste (MSW), also called Waste to Energy (WTE).

Proven Technology - WTE is a proven, environmentally sound process that provides reliable electricity generation and sustainable disposal of post-recycling MSW. WTE technology is used extensively in Europe and other developed nations in Asia such as Russia, Japan, Singapore, and Taiwan.

WTE Reduces Greenhouse Gases - New policies to encourage WTE can have a sizable effect on reducing the nation's greenhouse gas emissions.(1) In fact, nation-wide use of the WTE technology can become one of the big contributors to America's planned reduction in greenhouse gas emissions.

WTE Reduces Dependence on Fossil Fuel - New policies to encourage WTE can also have a meaningful impact in reducing dependence on fossil fuels and increasing production of renewable energy. MSW is currently comprised of 56% biogenic and 44% non-biogenic materials (2). Combusting the biogenic fraction of WTE is considered renewable by the DOE (1). Currently, there are 86 WTE facilities in the U.S. that process 29 million tons of MSW per year (1). The nation currently landfills about 248 million tons of waste per year so there is significant potential to increase energy production from WTE. Every ton of MSW processed in a WTE facility avoids the mining of one third ton of coal or the importation of one barrel of oil. If all waste were processed in modern WTE facilities it could satisfy 3 to 4 percent of the country's electricity demand.

Additional Environmental Benefits of WTE -

- Complements recycling and reduces landfilling
- Reduces truck traffic and associated emissions
- Recovers and recycles metals thus reducing mining operations

WTE Provides Clean Energy – WTE technology has significantly advanced with the implementation of the Clean Air Act (3), dramatically reducing all emissions. The EPA concluded WTE now produces electricity with less environmental impact than almost any other source (Letter of EPA Administration to Integrated Waste Services Association, Feb. 14. 2003).

Reliable Electricity – WTE operates 24/7 to reduce base load fossil fuel generation and is desirably located in proximity to urban areas where the power is needed the most.

ASME SWPD Recommendations to Congress and the Administration:

- Include WTE in the federal Renewable Portfolio Standard.
- Consider the reduction in greenhouse gases benefits of WTE in climate change policy.
- Direct the EPA to consider "life cycle analysis" of waste disposal options and also to consider Maximum Achievable Control Technology (MACT) type regulations on all emission sources, as have been applied to WTE facilities.

Introduction

ASME represents 127,000 engineers who are engaged in every aspect of energy generation and utilization. The Solid Waste Processing Division (SWPD) of ASME is dedicated to the recovery of energy and materials from the solids discarded by society and the environmental quality of technologies used in all aspects of waste management.

Municipal solid waste (MSW) is an unavoidable by product of human activities. Waste management is a particularly serious issue in the US because we consume an estimated 20 to 25 percent of the world's energy and materials and generate twice as much MSW per capita as developed nations in the European Union and Japan. Therefore, there exists a great need for waste reduction and recycling of materials. However, international and US experience has shown that after recycling there remains a large fraction of MSW to be disposed of.

The two proven means for disposal are burying MSW in landfills or combusting it in specially designed chambers at high temperatures, thereby reducing it to one tenth of its original volume. The heat generated by combustion is transferred to steam that can flow through a turbine to generate electricity. This process is called waste-to-energy (WTE). It converts the energy from combustion of MSW to electricity and recovers and recycles the metals contained in the MSW while the remaining ash is either used in landfills for daily cover and landfill roads or cleaned up and used off site for other construction purposes (as is done now in the EU and Japan).

The US WTE industry has existed for over thirty years and its technology has continuously been improved. For example, MSW combustion facilities of all types were once considered a significant source of mercury and dioxin emissions. However, during the 1990's, the WTE industry implemented new EPA regulations on Maximum Achievable Control Technology (MACT) and WTE power plants have become one of the cleanest sources of electricity and heat energy.

Currently there are 86 WTE facilities in the U.S. processing 29 million tons of MSW annually and generating 2.3 GW of electricity. Every ton of MSW processed in a WTE facility avoids the mining of one third ton of coal (9.6 million tons per year) or the importation of one barrel of oil (29 million barrels per year). As our nation begins to focus on conservation and renewables, WTE has already proved to be a reliable technology.

Unfortunately, there have been some setbacks. For instance, the Supreme Court Carbone ruling on "Flow Control" in 1994 (C & A Carbone v. Town of Clarkstown, New York, 511 U.S. 383 (1994)[(4)] forced many major urban areas in the U.S. to opt for long distance transport of their solid wastes to newly built giant landfills and stopped the growth of this useful energy producing technology in the US. Consequently, from 1995 through 2006, there were no new WTE plants built in the nation. A more recent Supreme Court decision on Flow Control has restored the ability of communities to control the flow of wastes to WTE facilities.

In contrast to what was happening in the U.S., from 1995 through 2006, hundreds of new WTE facilities were built in the European Union, Japan, China, and over thirty other nations where landfilling is regarded as environmentally undesirable and energy- and land-wasteful. In fact, in the years 2000-2007, the global WTE capacity grew at the rate of about four million tons each year. The growth of WTE in the European Union is partly due to a directive of the European Community that mandates that wastes containing over 2 percent combustible material shall not be landfilled in order to reduce landfill emissions of methane, the second most important greenhouse gas, and preserve land for future generations.(5)

In the U.S., as major urban areas have run out of nearby landfill space, post-recycled MSW is increasingly being transported long distances to other states for burial.(6) This has substantially increased the cost to landfill this MSW, and has also increased the associated environmental impacts because of the emissions from transport vehicles to and from the landfills. It has also increased the environmental advantages of WTE versus landfilling. As a result, some WTE facilities have recently begun to expand their capacity by adding new processing lines to their existing operations. These facilities are basing their requests for financing and permitting on their successful records of operation and environmental compliance.

The Conventional WTE Process

The conventional WTE combustion process is similar to the stoker burners in many coal- and wood-fired boilers. Waste is continuously fed onto a moving grate in a furnace where high temperatures are maintained. Air is added to the combustion chamber to ensure turbulence and the complete combustion of the components to their stable and natural molecular forms of carbon dioxide and water vapor.

The hot combustion gases released during the WTE process are directed through boilers to generate superheated steam that can drive turbine generators that produce electricity. Exhausted steam can also be used efficiently for district heating and for industrial processing if those choices are available.

It is interesting to note that, according to the EPA and IPCC protocols, combusting the biogenic fraction of MSW (about 56 percent of the carbon in MSW) results in a GHG reduction because these waste materials decompose into nearly equal portions of carbon dioxide and methane gas if they are landfilled. Methane is 21 times more potent as a GHG than carbon dioxide.

Energy Benefits of WTE

MSW, depending upon the moisture and energy content of the waste materials, is a good fuel source. The thermal treatment of MSW results in the generation of 500-600 kWh of electricity per ton of MSW combusted. European WTE facilities often recover another 600 kWh in the form of steam or hot water that is used for district heating. This additional energy recovery is not generally achieved in the US due to the absence of district heating systems. The corresponding savings in fossil fuel use range from one to two barrels of oil per ton of MSW.

Renewable Energy Source

WTE is designated as renewable by the 2005 Energy Policy Act, by the US Department of Energy (DOE), and by twenty-three state governments. Excluding hydroelectric power, only 2 percent of the US electricity is generated from renewable energy sources. A third of this renewable energy is due to WTE which at this time processes about 8 percent of the US MSW, while nearly 64 percent is landfilled (2004 BioCycle/Columbia national survey; www.wtert.org/sofos/SOG2006.pdf). As of July, 2008, energy recovered from WTE plants in the US is greater than all wind and solar energy combined.

Environmental Benefits

In addition to its energy benefits, WTE avoids the conversion of greenfields to landfills. The 2,500-acre Freshkills landfill of New York City filled up in about 50 years. Under current regulations (daily cover, etc.), it would have filled in 20-25 years. Although the US is blessed with abundant land, the continuous use of land for landfilling is not sustainable, especially in the coastal areas that are experiencing the highest population growth.

Since WTE facilities are a point source of emissions, they have been subjected to very stringent environmental regulations. This is not possible for landfills which are dispersed sources extending over hundreds of acres. For example, EPA assumes that 75 percent of the landfill gas (LFG) is captured in landfills that are equipped for such capture. Other studies estimate the actual LFG capture to be much lower since, under current EPA regulations, landfills are not required to capture LFG during the first five years of operation of a cell.

Landfill gas contains about 50 percent methane which is 21 times more potent as a greenhouse gas than carbon dioxide.(7) Comparative studies of WTE and landfilling have shown that for each ton of MSW combusted, rather than landfilled, the overall carbon dioxide reduction can be as high as 1.3 tons of CO2 per ton of MSW when both the avoided landfill emissions and the avoided use of fossil fuel are taken into account.

WTE processing of MSW has the additional benefit of reducing the transport of MSW to distant landfills and the attendant emissions and fuel consumption. It also reduces interstate truck traffic. According to U.S. Department of Transportation traffic statistics, an average of 7 deaths and over 40 serious injuries occur per year, based on the number of trucks required to transport New Jersey's two million tons per year of excess MSW to landfills in Pennsylvania, Virginia, and Ohio.(6)

Diesel fuel consumption of trucking to and from landfills and by equipment used in the burial of MSW in landfills generates air emissions and has other negative environmental impacts. All this energy consumption and diesel exhaust can be avoided by WTE facilities that use MSW as the fuel for generating electricity and steam energy at plants located near urban centers.

Material Recovery

Another beneficial effect of modern MSW combustion with energy recovery is material recovery. Using magnetic separators, the U.S. WTE industry recovers and recycles over 770,000 tons of ferrous scrap metal annually from the combustion ash residue.(8) At some facilities, non-ferrous metals are also removed through the use of "eddy current separators" that cause these materials to literally jump out of the remaining ash and into a recovery area. Metal processors sort this mixed metal into brass, aluminum, copper and other base metals.(9) The remaining ash can be used in the construction and maintenance of landfills and as an aggregate in construction.(10, 11)

Existing Obstacles for WTE Technology

The progress of WTE in the US has thus far been stifled by three factors that can be addressed through federal legislation and collective local efforts:

- Inconsistent environmental regulations for various energy sources.
- Failure to consider all environmental factors when local community environmental decisions are made.

- Uneven support by local officials and federal agencies.

Flow Control

Flow control is the authority needed by a municipality to direct the "flow" of its generated solid wastes into a disposal process chosen by the community, e.g., the local WTE facility. Normally, a community must issue bonds for construction of a large WTE facility and employ flow control to have firm waste delivery contracts in place during the term of the bond issue.(12)

When the US Supreme Court appeared to rule in the 1994 "Carbone" case that all existing attempts at such control were illegal under the Constitution because they restrained "commerce", they eliminated the ability of a community to finance WTE facilities. However, in the 2007 "United Haulers" decision, the Supreme Court has clarified the ability of local communities to finance long term revenue bond issues and control the flow of waste to these facilities. Moreover, the court recognized that Congress has, in RCRA, carved out a vital role for local government in the management of the nation's solid waste.

Implementation of Regulations

Environmental impact statements for any waste management facility (recycling, composting, WTE, waste hauling, and landfilling) should include a life-cycle analysis of all associated environmental and energy impacts that will result from each option. Even recycling, though laudatory, has negative, as well as positive, environmental effects. The impacts of the failure to make any community "improvement" should also be weighed in the evaluation of choices.

U.S. WTE facilities have complied with very stringent EPA regulations, known as Maximum Achievable Control Technology (MACT), at an estimated cost of over one billion dollars. By law, the Clean Air Act requires that every five years a review of these stringent emissions limits is conducted in order to determine whether lower limits are achievable.(13) Air quality regulations for all forms of combustion processes should have consistent health-based emissions limits for all facilities. If an emission is dangerous from one type of facility, then it is likely to be equally dangerous from another.

Disposal of solid waste from major urban areas in landfills frequently involves long haul trucking resulting in diesel exhaust pollution and the need for multiple waste transfer stations. Additionally, the landfilling process also results in diesel exhaust emissions and the long term generation of gaseous pollutants from the decomposition of trash in a landfill.

Public decision makers should carefully consider all environmental factors before adopting a solution to an environmental problem such as disposal of MSW. In addition, the public should be educated to know the benefits and burdens associated with each potential solution before making a final decision.

Recommended Actions by US Environmental Protection Agency

The US Environmental Protection Agency needs to fulfill its obligation to the public by advocating for the best solutions to environmental problems, including the disposal of MSW. Sound science should be the basis for decision-making. EPA must lead by educating the public as to the pros and cons that go with any solution and, thus, help overcome misconceptions about proven technological solutions. By means of public education, USEPA must lead in the application of the best environmental solutions.

In recent years, the EPA has taken a more active role in educating the public, by distinguishing in its annual reports between tonnages of MSW going to WTE and to landfilling, instead of lumping them together as “disposal”. Also, some EPA regions have taken a pro-active role in educating the public in the benefits of WTE. For example, EPA Region 2 organized a one-day seminar in Puerto Rico at which they educated the general public on the benefits of WTE vs. landfilling, especially for an island where land is very scarce and precious. EPA has also re-instituted the hierarchy of integrated solid waste management, which places waste-to-energy above landfill disposal. We applaud these efforts undertaken by the EPA and feel that now is the time to build upon them.

It is given that no one wants a new public facility of any sort near their homes, whether it is an airport, highway, water treatment plant or a waste disposal facility. We feel that it is paramount that environmental regulators coordinate with local officials to hold public hearings where new facilities and technologies and the “do-nothing” consequences can be discussed. Additionally, we feel that the EPA should actively promote WTE as a mutually beneficial endeavor for both local communities and the nation.

Recommended Actions by Congress

The following actions are recommended by the ASME Solid Waste Processing Division to advance the use of WTE technology in the US and reap the energy benefits of a homegrown, renewable energy source and of reduced local, regional, and global emissions:

- Congress should re-examine and reconsider the level of regulatory limits required for all new sources of energy. MACT regulations have worked well for waste-to-energy facilities and they are equally able to control emissions from all other sources of combustion based energy production.

- Congress, in an effort to expand WTE, should consider enacting legislation that would make renewable energy credits available for WTE under the definitions of green or renewable energy.

- Congress should direct EPA to study and post notice regarding the effects of the "whole picture" for all available waste management options.

The ASME Solid Waste Processing Division believes that these policy recommendations, if fully adopted, could successfully take advantage of a unique opportunity to develop a renewable, clean energy source at a critical time for our nation. The country will also be well served by recovery of reusable materials, reduced truck traffic and highway congestion, less dependence on landfill for solid waste disposal, and less dependence on foreign sources of energy.

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