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# SOLID WASTE MANAGEMENT ALTERNATIVES
# FOR NEWTON, MA

A Term Paper for Environmental Studies 302

(Hour C, Prof. Bolton)

by

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Newton and Waltham are two neighboring Massachusetts cities with a combined population of about 135,000 people who generate over 180,000 tons of solid waste per year. Refuse is collected weekly at the curbside by a private contractor and compacted at an old incinerator in Newton on Rumford Avenue. From there it is hauled 50 miles by trucks in 22-ton loads and dumped in a landfill. The current system followed a major analysis in 1972-75 of the previous solid waste management system, which was to incinerate the refuse in Newton. A committee, the 128 West Resource Recovery Council (128 WRRC), has been studying the feasibility of building a resource recovery plant to handle refuse from many of the west suburban communities of Boston. This paper examines some alternate refuse disposal methods suitable for Newton: incineration, landfill, and resource recovery. This is a necessary task in reality because hauling to Amesbury, the present system, can not be a long term solution due to the limited space there and the high cost of hauling that far.

No waste ever goes away. Not only do residuals remain whether refuse is incinerated, or buried, but other residuals are generated during waste management. Each of the alternatives has different residuals and social costs that affect different people. In this paper I will: look at the different residuals and how they affect the environment and people; state the pros and cons of the different methods and how they can be evaluated; and conclude that Newton should opt to contract its waste to a resource recovery plant.

## NEWTON

Newton is a city about 25 miles square that provides suburban homes for people working in nearby Cambridge and Boston. It also has several large shopping centers and a hospital. In 1973, to get a sense of size, Newton had 2000 businesses that employed 32,000 people. The income levels range more than one would expect in a generally wealthy city where neighborhoods often consist of families living in old, one-family houses. The city itself is quite densely settled and the few remaining open spaces have almost all been made into parks, many of them located on the banks of the Charles River which winds through much of the city. No suitable site for a landfill or resource recovery plant exists within Newton.

No suitable waste use in Newton

Solid waste is what people throw away; it doesn't include sewage. Since Newton is primarily a residential community the bulk of solid waste is from households and is not industrial. The composition of household waste in 1970 was 64% paper, 10-11% of both metal and glass, 6% lawn and garden waste, 5% wood, 4% rags, rubber, and leather, and 1% plastic (League of Women Voters of Newton, 1972). However, since then, a law prohibiting leaf burning has been passed, the use of plastic has increased, and putrescible waste (garbage) is no longer collected separately, so the composition is probably accordingly different (Table 1). The prediction by Camp, Dresser & McKee Inc., (197[illegible]) is that in 1985 an astounding 8.44 pounds per day per capita of waste will be generated, (assuming a population of 85,000, Newton's current population as of 1980). This is above the national average of 5.32 pounds (Goddard, 1975).

DEFINING ACTIVITIES:

-Waste Management Techniques-

Incineration:

Landfill and incineration are the two waste management techniques most commonly used. From 1967 until 1975, when Newton began its Transfer/Haul to Amesbury, the city incinerated its waste at Rumford Avenue. This incinerator was built in 1967 at a cost of $2.3 million. It had a capacity to burn 500 tons per day (TPD) at 1500-2000° F, but only handled 250 TPD. It was designed to reduce waste 90% by volume but did not accomplish this because employees ran the waste through the stokers too quickly (League of Women Voters of Newton, 1972).

Newton began reassessing its waste disposal program because this plant, designed to last 20 years, could not meet the State Department of Public Health emissions standard of 0.1 pounds of particulate per 1000 pounds of flue gas, corrected to less than 50 % excess air (extra air is mixed in to provide better combustion). The incinerator was built to meet only the 1967 standard of 0.85 pounds of particulate per 1000 pounds of flue gas, despite knowledge that future emissions standards would be more stringent. It was an example of poor planning, because the decision of 1967 to save money on emissions control equipment is one of the reasons Newton had to close the incinerator in 1975.

closed it in '75 but & How about renovations on the incinerator?

The incinerator landfill:

Incineration residue was trucked to the adjoining 15 acre landfill site and dumped. The site was wedged between an apartment building complex and the Charles River, and since it was not well managed, the apartment dwellers complained about rats and cockroaches from the dump, and the Charles River was being polluted by runoff.

However, the city's biggest worry was the site's projected three-year lifespan in 1972. Thus, an obvious need for a new waste disposal plan arose. The engineering firm of Camp, Dresser, & McKee Inc. proposed in 1974 a short term solution including compacting trash in Newton and hauling it elsewhere while Newton worked to establish a resource recovery plan. The first part of this suggestion was realized but the last part is not yet accepted.

<u>Sanitary Landfill</u>:

There is no suitable site in Newton for a sanitary landfill (hereby called landfill) large enough to handle all the waste from Newton. Therefore, Camp, Dresser & McKee porposed Transfer/Haul. A good landfill site should be isolated from houses and wetlands and have good drainage. Landfills are often lined with some material, such as asphalt, rubber, and clay, to inhibit leachate flow into the surrounding ground water (Geswein, 1975). Constructing an impermeable barrier around the waste site makes it possible to collect the leachate and treat it so it will not contaminate the water.

No good landfill in Newton Transfer/haul

The trash in a landfill must be covered over with six inches of dirt every night. Generally, the waste has already been compacted so a small area is filled each day and then covered with a bulldozer.

A landfill is a facility that people will agree is necessary

Talk more about how they select a landfill

but then say that it should be built "somewhere else." Finding an acceptable site is difficult, and often when one is found, it is not near the source of the waste, and so the trash must be trucked long distances.

Resource Recovery:

Resource Recovery is not commonly used as the only disposal method because technology is still developing and costs are high. Certainly, recycling, used in many regions, is only a first step. There is a limited market for some recycled items, and recently Newton discontinued its collection of glass and cans for recycling because it cost more to collect than it brought in in revenues. Bundled newspapers are still picked up separately and are sold for a profit.

IF they had to discontinue recycling - how is R/R going to work

Another type of resource recovery is to burn the waste to produce energy in the form of steam.

The Saugus RESCO plant:

A mass-burning water wall plant has been operating in Saugus, Massachusetts, and seems to be the prototype waste-to-energy plant . Owned by the Refuse Energy Systems Company (RESCO), the plant was built by Rust Engineering, a subsidary of Wheelabator-Fye, Inc., in 1975, and handles 1150 TPD of waste from 18 nearby municipalities (Reilly, Runyon, Beach, [illegible]

RESCO

The plant, which has a 1500 TPD maximum capacity, cost nearly $40 million to design, build, and get into working order. It has been making a profit since 1979, after being coaxed through the planning, building, and beginning stages with capital from private companies.

In a process developed by von Roll, Ltd. of Zurich, Switzerland, the plant burns waste and produces up to 370,000 pounds per hour of superheated steam which it sells to a General Electric facility nearby in Lynn. The waste is dumped into a 6700 ton capacity pit in the plant, from where it is lifted by two cranes into a 750 ton capacity furnace. Then it falls to three different tiers in order to promote combustion. Finally the bottom ash passes over a grate with 2½ inch diameter holes and metal that does not fall through is sent to a scrap metal truck and sold. A strong magnet sifts out any remaining small ferrous material to also be sold as scrap. 7% by weight of the waste is recycled in this manner, a total of 60-80 TPD (Figure 1).

<u>Signal RESCO proposal:</u>

The 128 WRRC has received seven proposals for different resource recovery plants. This report deals with three of them. In January 1984 Signal RESCO submitted a revised proposal for a waste-to-energy plant,like its Saugus one,to the 128 WRRC, which is chaired by David Jackson. (In 1983 Wheelabator-Frye Inc. merged with the Signal Companies, Inc. to form Signal RESCO, Inc.) The plant is to be in Plainville, 28 miles away from Newton, and plans to serve communities about 20-25 miles away. Signal RESCO had originally proposed a 1500 TPD plant but changed this to a 645 TPD one, as requested, in order to reduce the tipping fee, the cost per ton of solid waste disposed, for the participating communities (Signal RESCO, January 1984 letter to David Jackson).

This plant would operate like the Saugus one but only handle 195,000 TPY, 150,000 of them provided by surrounding communities that will pay $28 per ton of waste. Signal RESCO will dredge up the remaining 45,000 TPY through private contracts.

Signal RESCO wants a contract from the communities by July 1984 and would then begin to build in 1985, planning to have the plant operational by 1987.

The WESTON proposal:

A second proposal put to the 128 WRRC from the Roy F. Weston, Inc. in May 1983, is for a 438,000 TPY capacity plant, of which 300,000 tons are to be supplied by contract communities. However different the Weston proposal may be from the Signal RESCO one in size and cost, the internal workings are to be done by Signal RESCO.

The Energy Answers proposal:

A third proposal from Energy Answers, Corporation is for a different type of plant. This waste-to-energy plant, SEMASS, to be built in Rochester, would work on the shred and burn system, exemplified by the Solid Waste Reduction Unit (SWARU) in Hamilton, Ontario. SWARU, operating since 1972, first shreds the refuse, and then burns it to produce steam to power a four megawatt steam turbine generator (Regional Municipality of Hamilton-Wentworth, letter to David Jackson). The SWARU plant cost only $8.95 million to build, as opposed to the Saugus RESCO plant's $38 million construction cost, but it must be correspondingly smaller.

SWARU cost less than Saugus Resco but is smaller

Incineration: RESIDUALS:

Several types of residuals were produced by the Rumford Avenue incinerator. Unburned residue is collected at the bottom of the stack, cooled by water, separated from the water, and hauled to the nearby dump. 35 to 45 truckloads per day were produced, and, according to the Newton League of Women Voters, (1972), it consisted of much unburned paper, tin cans, plastic bags, ashes, and a little glass.

Another residual produced was fly ash from the spray and baffle emissions control device attached to the stack. The smoke was sprayed with water, so that fly ash and water ran down the stack and then the ash settled to the bottom and was removed. The water was reused, as was the water to cool the unburned residue. Spray and baffle controls generally remove 60-75% of the fly ash from the furnace, so much still enters the outside air. Despite this fly ash removal technique, very black smoke could at times be seen emerging from the top of the Rumford Avenue stack.

spray baffle remove 60-75% on unburned residue

Generally, incinerators produce more stable inorganic compounds, such as hydorgen chloride, sulfuric acid, and sulfur dioxide, than unstable organic ones, such as hydrocarbons, aldehydes, alcohols, ketones, esters, and organic acids, because of a high combustion efficiency (Carotti and Smith, 1974). In some cases hydrogen cyanide and selenium, very toxic compounds, have been found.

A study by Carotti and Smith in 1974 analyzed stack emissions from four incinerators in New York City, and although the data is from 1968-69, I believe the trend of emission composition will still hold true. In general, emissions were highest in the spring and lowest in the summmer. Of course, many exceptions for different compounds do exist. Also, the incinerator that had the lowest discharge rate also had a high rate of unburned organic matter, so clearly, complete combustion was not occurring. A less good emissions record for another plant is shown in Table 2. This Flushing incinerator had a 300 TPD capacity so it was comparable to Newton's Rumford Avenue one.

Why? because of temp? or demand?

These gases enter the air when the refuse is burned. More gases are given off when the residue is then dumped. These gases, and leachate, are discussed under the landfill section.

Landfill:

Methane gas and leachate are the two primary emissions in a landfill. In some cases methane can be collected and used as fuel, making this residual a valuable one. Leachate is produced when water trickles through the decomposing organic waste. Therefore, planned leachate drainage must be a part of proper disposal site management. Either the site should be built in an area where rain water will drain down and be caught and pumped out at the bottom, or some sort of impermeable barrier should line the bottom of the site. The composition of leachate is listed in Table 3.

is it easier to control land-fill emissions than incinerator emissions?

Other side effects of land disposal sites possibly include odors, fires, and as mentioned earlier, rat and cockroach infestations. These problems are avoided if the site is managed properly, though.

Then if site is managed properly couldn't it be used for a longer period of time?

Landfills take up space. Eventually, the site reaches its capacity and no more dumping can occur; it is a short range solution. Later these sites can be converted to recreational areas, or used in other ways to benefit the neighborhood. The old Rumford Avenue incinerator dump site is supposed to be turned into a park someday, but it is now still unused land.

waste is being compacted not that much space is being taken up you said it must be covered with dirt every night and is consequently compacted in to a small area

One more residual of a landfill is the exhaust of the land moving equipment needed to take the refuse from the trucks and then to move dirt over it. Since landfills tend to be removed from the source of refuse, the exhaust from all the trucks making the haul, and the wear and tear on the roads, the noise and inconvenience they create are all also residuals.

Resource recovery:

Trucking the waste long distances produces the same residuals for a resource recovery plant. However, the sites being considered by the 128 WRRC are all closer than Amesbury is to Newton.

which would the public prefer near their home RR or landfill is it LULU?

In general, a resource recovery plant will produce in part the same residuals as an incinerator because it, too, is burning the waste and also ends up with some unprocessible waste. The Saugus RESCO plant caused complaints of noise and also big black particulate flakes. (The emissions control was then tightened to eliminate this problem).

A waste-to-energy plant has one important residual, different in nature from all the others; it is the steam that is produced as the goal of the procedure. Each plant, depending upon its size, will produce more or fewer pounds per hour of steam to be piped to a power company.

## EFFECT ON NATURAL SYSTEMS & AMBIENT ENVIRONMENTAL QUALITY:

All three of these waste management techniques affect the environment in adverse ways. Paradoxically, while incinerators and resource recovery plants may produce more harmful residuals, it is easier to pin-point those from a landfill because they are more quantifiable. so people don't like land fills

Landfill:

Water:

Most of the landfill's effects can be seen in the amount of leachate run off and where it then goes. For instance, Newton's old incinerator dump was a low lying area next to the Charles River, and its run off contaminated the river water and ground water there. A real landfill would have more leachate than the dump because its refuse would be unburned.

From a natural systems model point of view, leachate was affecting surface and subsurface water. A qualitative model would show that as years passed, the ground water became more infiltrated with leachate. Since the river has a current the leachate would be moved away and so not build up, except maybe in a nearby, downstream cove, which could be tested.

The effects would be measured by looking at the concentration of the water and then estimating what part is due to the landfill. Another more direct way would be to dig out a certain amount, say a cubic yard of the landfill, and analyze the concentration there so that a ratio of quantity of refuse to amount of leachate produced, could be understood. A landfill will have much biochemical action occurring within it because the refuse contains much compacted organic material. However, because landfills are large and decomposition occurs everywhere but not necessarily uniformly throughout the acreage, a sample might not be representative.

Atmospheric:

Landfills also release gases that are vented through pipes stuck down into the mass. Of course, gases are formed everywhere and thus, unlike car exhaust, which can be measured by capturing tail pipe emissions, analyzing them, and then extrapolating as in the CALINE model, it is hard to estimate precise amounts of emissions from landfills.

The effects of methane and other hydrocarbons will be discussed under incineration.

Terrestrial:

A landfill, by its nature, fills in space and builds up its own terrestrial ecosystem. This land will eventually be available for other purposes; thus while the short range effects might cause growth of unwanted insects and rodents, the long term effect is to provide new, usable land where none was before.

Another effect comes from the large trucks that haul the compacted waste to the disposal site. Wear and tear on roads, noise, and exhaust must be considered as part of the process, the same as for a resource recovery plant, while generally an incinerator can be located within a city, so the refuse travels fewer miles.

do truck and machinery costs on roads outweigh the air quality in a city

Incineration:

Atmospheric:

Inherent to the incineration process are some of the same effects as those of the landfill because the residue is eventually sent to a landfill. However, the burning process sends many gases out in the stack effluent, despite state and federal codes keeping it to certain standards. In this case, it is relatively simple to measure the composition because it is all channeled out of one stack, so one monitor can check the entire plant.

Procedure: steady state analysis

Carottis and Smith attached a 16-liter evacuated, stainless steel cylinder to the stack for an hour to collect an air sample. Different tests were then done for different chemical analyses; an example of the paraphrenalia for measuring $SO_2$, $NO_2$, NO, acids and aldehydes is shown in Figure 2.

Chemical mechanisms:

Tests like these give very precise answers about the concentration of the chemicals in parts per million of the effluent (see Table 2). However, because the wind carries the smoke long distances, it is virtually impossible to pin point which stack is responsible for how much damage and where it occurs, but the smoke does cause serious environmental problems.

Acid rain is one of these atmospheric phenomena increasingly making itself felt, especially in the north east. No doubt exists but that sulfur and nitrogen dioxide from smoke stacks cause the acid rain. The sulfur and nitrogen mixes with the water vapor in the air and forms sulfuric and nitric acids ($HNO_3$ and $H_2SO_4$) which make ensuing rain and snow correspondingly acidic (Miller, 1982). Acid rain can be easily documented by measuring the pH level in streams and lakes.

Another atmospheric chemical reaction that occurs as a result of stack emissions is the production of photochemical smog. The hydocarbons mix with nitrogen oxides in sunlight to produce the smog which is prevelent in more stagnent areas, such as valleys with much carbon burning industry.

smog is produced in heavy carbon burning industries

The other components of stack emissions also affect the environment as they change the composition of the air, but none are as harmful as the ones listed above because not as much is emitted.

Resource recovery:

A resource recovery plant shares with a landfill the effects of trucks driving long distances and with an incinerator the emissions from a smokestack.

EFFECTS ON RECEPTORS:

Major differences among the three waste disposal methods become clear when viewing their effects on receptors.

Landfill:

People do not like to live near a landfill because the equipment is noisy and garbage is being dumped there. However, a properly managed site should not have the problems already mentioned, such as odors and animals. In fact, a landfill nearby can ultimately make a house worth more if the land is later used for something that raises the value of the neighborhood. The effects on receptors would only be measureable if a reservoir were nearby or if people had wells. Usually the effects are not large.

Incinerators & Resource recovery:

These effects are more severe. Acid rain is now an international problem and it is killing plants and animals, ruining monuments, and rendering water unsafe. Experts estimate the effects by looking at the pH of bodies of water and counting the number of fish. A qualitative model works such that if the pH is at a certian level and there are no fish in the lake, experts can say the acid rain has effectively killed that body of water. Visible tests can also be used: recently the statue of Paul Revere in Boston looked as if it were crying, due to the striping effect of acid rain.

In general, the stack effluents cause respiratory problems in people if the air quality becomes bad enough. In particular, the effluents can cause nose, throat, and eye irritation, increase mortality by leading to cancer, decrease visibility; and stunt plant growth as well as deteriorate stone and man-made substances (Miller, 1982).

VALUES:

The City of Newton has these three options; ... it must pick one for its solid waste disposal system. Depending upon how much wieght is given to certain values, different decisions could be made.

what about comparing the emissions of the existing energy source with the savings that could be realized through RR?

Humanistic ethic:

A humanistic ethic is the main consideration: what is best for the people in the city? Interests are not wholly determined by monetary concerns, so what would be the best thing to do? What is good for the environment that will also be good for humans?

A landfill is good in that it fills in wetland and makes it useable, saleable land later on, and it pollutes little.

An incinerator is good because refuse is not trucked long distances so gas is not wasted, roads and trucks are not worn out, and vehicle exhaust is not emitted. In addition, refuse is converted to only 39-49 truckloads of ash and residue (at the Rumford Avenue facility), so less space is needed to finally dispose of it.

A resource recovery plant is good for these same reasons, plus it provides energy that would otherwise be provided by fossil fuels, nuclear, or hydroelectric power, and so saves the environment the effects of these forms of energy. (Solar power is deliberately not included because it is not yet producing energy on the scale of a power plant).

Naturalistic ethic:

A naturalistic ethic is harder to define. According to Rolston, (1983), "it holds that some natural objects...are morally considerable in their own right, apart from human interests, or that some ecosystems...have intrinsic values, such as aesthetic beauty [which is a human value] , from which we derive a duty to respect these landscapes." It is hard to separate human interests from environmental ones.

A landfill irreversibly changes the ecosystem it fills in. While, one assumes, no landfill will receive permission to operate in a rare environment, perhaps it may eradicate a wetlands that was home for a rare animal,and perhaps this animal's existence is more important than the landfill.

An incinerator and a resource recovery facility change the composition of earth's atmosphere and damage the environment. Perhaps more dead lakes in the Adirondacks do not balance the convenience of a city having its own refuse burning plant.

incin. and RR must be located somewhere as well

Monetary values:

People make decisions in conjunction with their wallets as well as with their ethics. In this case, I think monetary advantages, as shown in the market system, are going to be the most important factors: the cheapest option will be chosen.

Future welfare:

Long range planning must be considered in a decision that will set a course for many years. Part of this planning is deciding if one alternative might be better for future generations even if it is worse (more inconvenient or expensive) for this generation.

A landfill is a better alternative if viewed from a long term perspective rather than a short one. An unsightly hole covered with dirt now, will later provide land for a park, playgound, or open space, perhaps. However, the landfill also will eventually be full, leaving the next generation with a similar situation where it must find somewhere, maybe even farther away, to dispose of its waste.

? better in long run but you said that you run out of room

An incinerator is good for a future generation because once the present one spends the money to build the facility, it takes only operating costs in the future, and, one hopes, not another large outlay of money. Of course, this is countered by the incinerator's pollution of the future generation's environment.

The same is true for a resource recovery plant. However, this alternative gives one large benefit to both a future and a present generation because it provides energy. Once the present generation constructs the plant, it will continue to produce the fuel into the future.

EQUITY OF COSTS & BENEFITS:

In a case such as this one, the entire city will either benefit or lose, according to how much tax money is spent on the facility and user costs. The only people who could make or not make money are the private frims that would build the plants or drive compacted trash to sites, or employees of the plants. These possible benefits will not influence this decision because they are unlikey to fall to Newton residents, since none of the disposal sites would be in Newton. Therefore, their revenues will not be very important to the Newton decision-makers.

employees of plant would not be Newton people

VALUATION OF COSTS:

Haul costs:

Haul costs for a landfill are the primary costs induced for a landfill, while the resource recovery option has many others. (Table 4). Haul costs range from about $.06-.11/ton-minute, depending upon vehicle and crew size, their efficiency, degree of compaction, etc. The haul cost per ton is the cost multiplied by the round trip time, including turn around time, and a correction for inflation, if the prediction is for the future. Turn around time is estimated as 10-15 minutes for a landfill, 5-10 for a resource recovery plant. The Weston proposal states haul costs of $15.30 per ton, for example.

<u>Construction costs:</u>

These costs are very high for a resource recovery plant, and almost as high for an incinerator. The RESCO Saugus plant cost nearly $40 million to build ten years ago.

TALK more about construction costs. This is where the big decision lies

<u>Other costs:</u>

The tipping fee for the Signal RESCO plant is to be $28 per ton, to increase with the expected consumer price index each January. Communities are responsible for the tipping fee of their contracted tonnage even if they do not produce that much waste. (This does not provide an incentive to conserve).

The Weston report proposes a tipping fee of $39, to decrease to $6 in 2006 AD. It also mentions two alternative fees: one starts and remains $34 for 20 years, the second starts at $26 and increases 4% annually for the operating period. See Table 5 for a breakdown of Weston costs.

These high technology plants have operating costs as well, which will be higher than for a landfill or incinerator. In 1971, the Rumford Avenue incinerator operating cost was $9.20 per ton. It would be considerably higher now due to inflation.

## VALUATION OF EFFECTS:

Since people will ultimately make the decision, and not computers programmed for cost-benefit analysis, human values will be important. The City of Newton is thinking of hiring an engineering firm to do an $11,000 study of the resource recovery alternatives. The engineers would, I assume, look at cost per ton to Newton as one of the most important determinants. However, if they were evaluating all the alternatives they should also examine the effects. Would people rather pay a few dollars more and reduce the acid rain threat by having a more expensive plant? This could be answered using a survey method, but it is such a hypothetical question and seems to have an inbuilt, ethically correct answer so people might feel oblidged to say spend more money.

Statistical models would probably provide the best answers in terms of accuracy. However, much knowledge about composition and effects of residuals would need to be calculated into a program that analyzed the results of one ton of solid waste being processed in any of the three alernate manners.

## CONCLUSION:

This decision will be made by the City of Newton in the next few years. I do not know what it will do. I would pick the Signal RESCO proposal for a resource recovery plant in Plainville. I think it is better because it is smaller and therefore will be easier to organize because fewer communities will be involved. Also, if something goes awry, fewer

How far away is Plainville? How far away will be the landfills communities are stuck with their waste. Since the Saugus RESCO plant is working so well, trained people and equipment parts would be available more readily than parts for a shred and burn facility.

Newton might very well choose to find a new landfill site. I think, however, that while a landfill is a good alternative, the resource recovery is a better one because it is long term, not short term. A landfill has a limited lifespan, and then a new site must be found. Eventually, the suitable sites will be farther and farther away from Newton and so more expensive per ton of waste porcessed.

*RR is better cause long term*

The resource recovery option costs more to begin, but once it is operating it makes money as energy continues to cost more. Thus as energy costs increase, so will the profits from selling the steam.

*makes money as energy begins to cost more*

Most important to me is the consideration that a resource recovery plant is a step toward solving one of the world's biggest problems, that of the energy crisis. While it does pollute the environment more than a landfill, it also contributes toward less overall pollution from power plants because it provides energy. I ruled out the option of building or renovating an incinerator because it has the same disadvantages of cost and pollution, but not this advantage of making energy.

*RR can solve energy crisis?.*

I hope Newton will see fit to take the risk and contract with the Signal RESCO firm for its resource recovery plant.

*Renovating an incinerator is an alternative! what about it.*

TABLE I CITY OF NEWTON

PROJECTED SOLID WASTE QUANTITIES

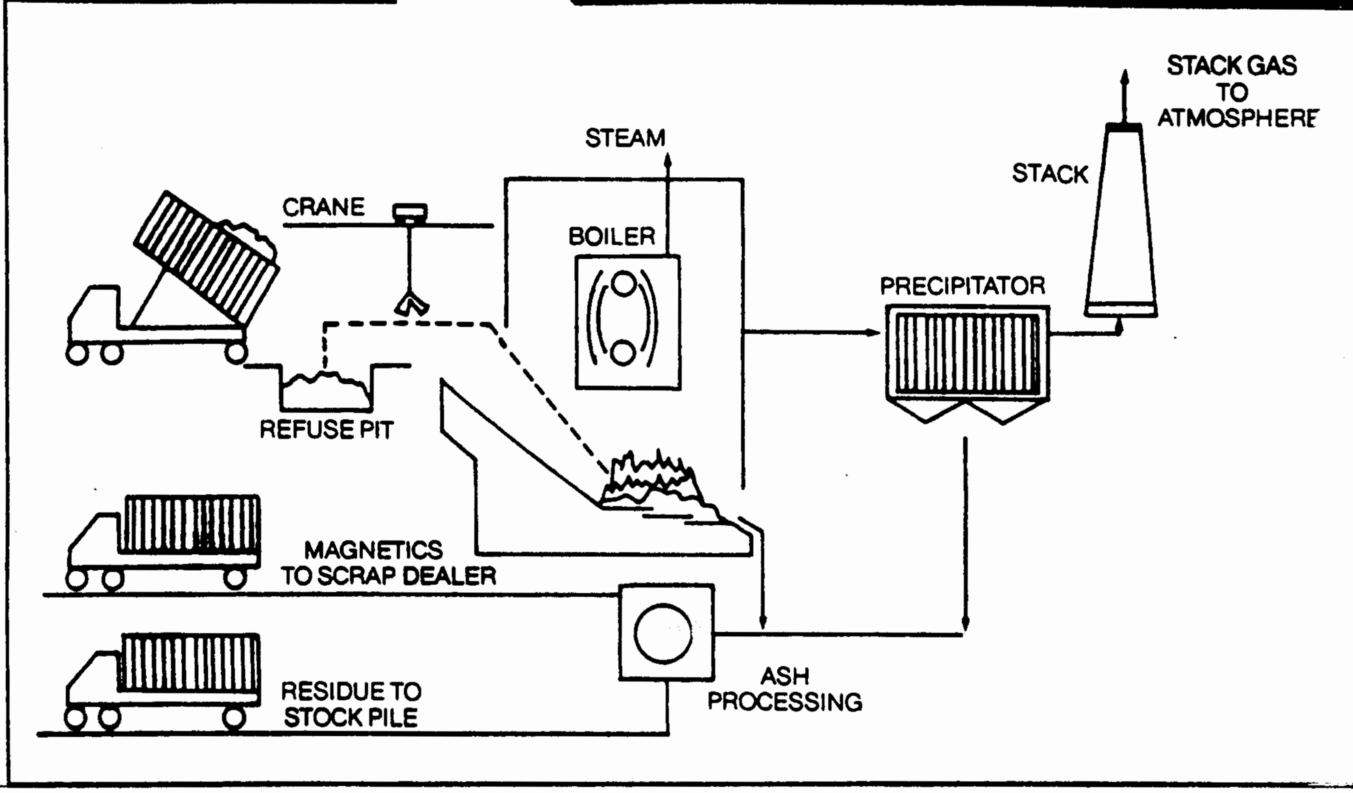
(tons per week)[A]

| | 1973 | 1975 | 1980 | 1985 | 1990 | 1995 |
|---|---|---|---|---|---|---|
| Household Wastes | 740 | 800 | 930 | 1,050 | 1,200 | 1,300 |
| Institutional Wastes | 60 | 70 | 80 | 90 | 100 | 110 |
| Trees, Brush & Yard Wastes | 100 | 100 | 120 | 140 | 150 | 170 |
| Bulky Wastes | 100 | 100 | 120 | 140 | 150 | 170 |
| Street Sweepings | 100 | 100 | 100 | 100 | 100 | 100 |
| Commercial Wastes | 380 | 410 | 470 | 540 | 600 | 670 |
| Industrial Wastes | 150 | 160 | 160 | 170 | 180 | 190 |
| Construction & Demolition Wastes | 260 | 260 | 270 | 280 | 290 | 300 |
| TOTAL | 1,890 | 2,000 | 2,250 | 2,510 | 2,770 | 3,010 |

A - Figures have been rounded off. These figures represent estimated total refuse quantities generated within the city and do not necessarily reflect the quantities currently collected or received at the municipal facilities nor necessarily the future quantities which would be received. See Discussion in Chapter 6.

from Camp, Dresser & McKee, 1974

Figure 1 RESCO system diagram




from Reilly, Runyon, and Beach, 1981

TABLE 2

**SOME STACK EMISSIONS FROM THE FLUSHING INCINERATOR, NEW YORK CITY (FEBRUARY 1969)**
**($N_2$ = 79.3%, $O_2$ = 19.4%, $CO_2$ = 1.32%, CO <0.01%)**

| Component | Conc. ppm/v | Rate of discharge ($ft^3$/day, 831F) | Rate of discharge ($ft^3$/day, STP*) | Rate of discharge (g. moles/day) | lb/day | lb/ton refuse |
|---|---|---|---|---|---|---|
| Effluent | – | $272 \times 10^6$ | $104 \times 10^6$ | $131 \times 10^6$ | $8.4 \times 10^6$ | $2.8 \times 10^6$ |
| $SO_2$ | 29 | 7,900 | 3,010 | 3,800 | 530 | 1.8 |
| Total HC as $CH_4$ | 21 | 5,700 | 2,180 | 2,750 | 96 | 0.32 |
| Total acids as HAc† | 1 | 270 | 104 | 131 | 17 | 0.06 |
| Total Aldehydes and ketones as HCHO | 0.84 | 230 | 87 | 110 | 7.2 | 0.024 |
| HCl‡ | 40 | 10,900 | 4,160 | 5,250 | 420 | 1.4 |
| HF‡ | 0.85 | 230 | 88 | 111 | 4.8 | 0.16 |
| $H_2SO_4$‡,§ | 25 | 6,800 | 2,600 | 3,280 | 700 | 2.34 |

*STP, 30 inches of mercury and 32F or 760 mm mercury and OC.

†Total acids include acetic, propionic and butyric expressed as acetic acid.

‡Chloride, fluoride, and sulfate are expressed as the respective acids.

‡,§Same contribution by sulfur dioxide although sulfite was not detected; sulfite is air oxidized to sulfate to same extent in alkaline solution.

from Carotti and Smith, 1974

TABLE 3

TYPICAL SANITARY LANDFILL LEACHATE COMPOSITION*

| Analysis | Range of Values+ | |
|---|---|---|
| | Low | High |
| pH | 3.7 | 8.5 |
| Hardness (carbonate) | 35 | 8,120 |
| Alkalinity (carbonate) | 310 | 9,500 |
| Calcium | 240 | 2,570 |
| Magnesium | 64 | 410 |
| Sodium | 85 | 3,800 |
| Potassium | 28 | 1,860 |
| Iron (total) | 6 | 1,640 |
| Chloride | 96 | 2,350 |
| Sulfate | 40 | 1,220 |
| Phosphate | 1.5 | 130 |
| Organic nitrogen | 2.4 | 550 |
| Ammonia nitrogen | 0.2 | 845 |
| Conductivity | 100 | 1,200 |
| BOD | 7,050 | 32,400 |
| COD | 800 | 50,700 |
| Suspended solids | 13 | 26,500 |

* Source: Leonard S. Wegman Co., Inc. Typical specifications of an impermeable membrane. Lycoming County Board of Commissioners, Pennsylvania. Unpublished data, 1974.

+ Values are given in milligrams per liter except pH (pH units) and conductivity (micromhos per centimeter).



from Geswein, 1975

Figure 2

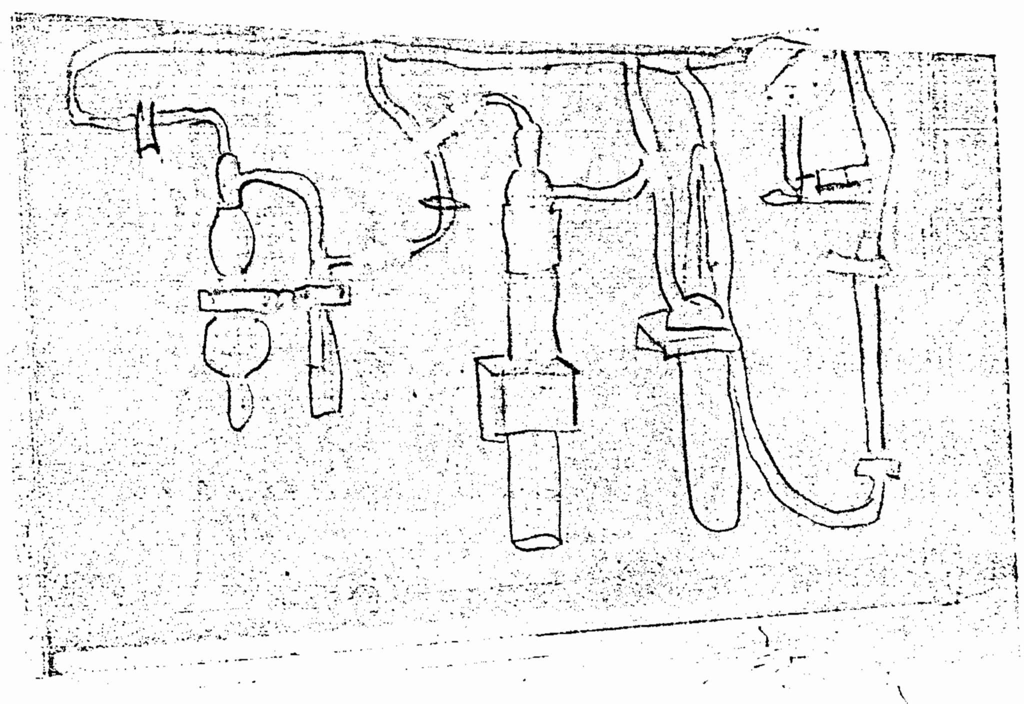
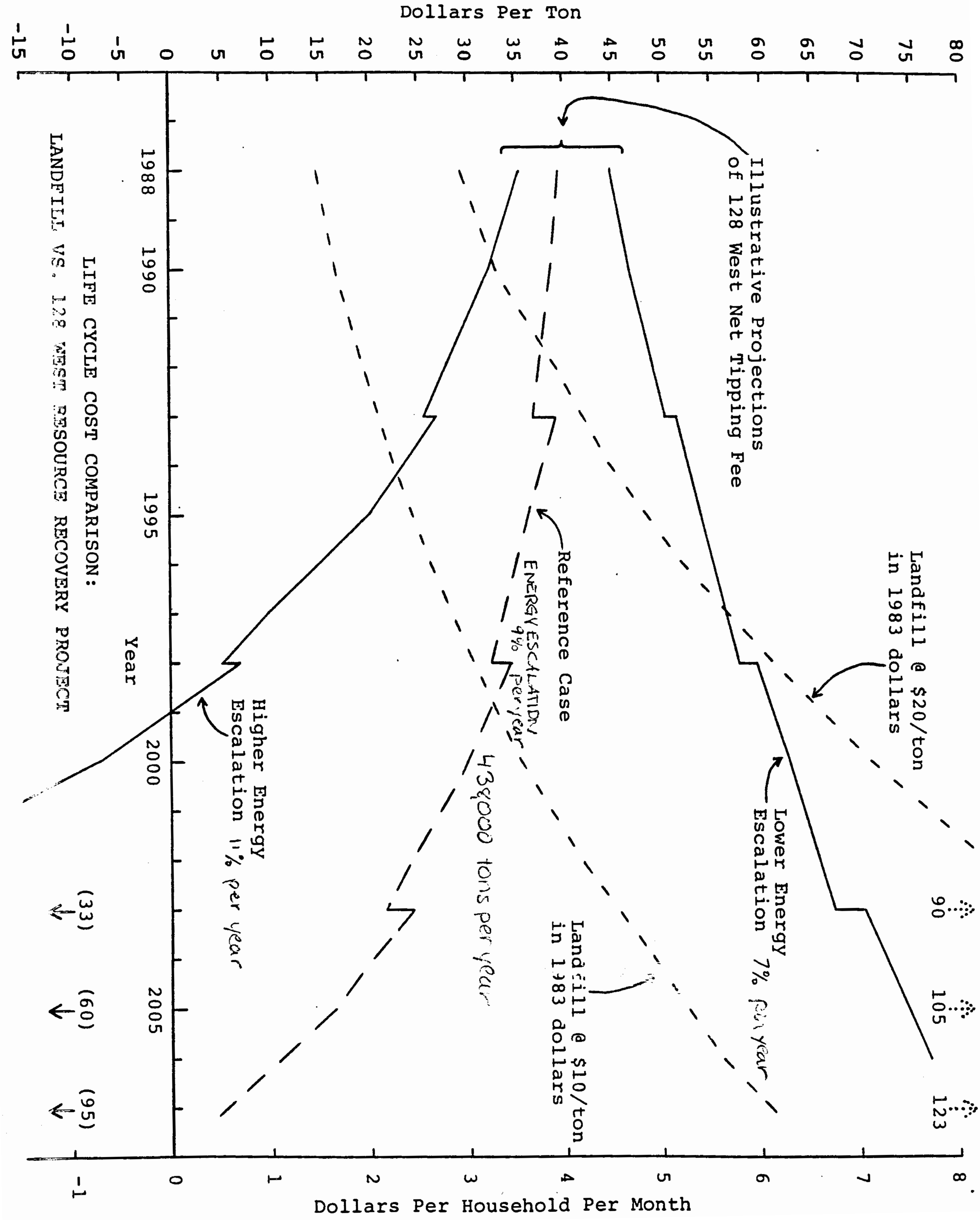


Figure 1. System used for the measurement of $SO_2$, $NO_2$, NO, total acids and total aldehydes

from Carotti and Smith, 1974

Table 4 from Weston proposal, 1983



from WESTON 1983

Table 5

BREAKDOWN OF PROJECTED COSTS AND REVENUES ON A PER CONTRACT COMMUNITY TON BASIS FOR THE 128 WEST REFERENCE CASE

| Year of Operation: | 1 | 5 | 10 | 15 | 20 |
|---|---|---|---|---|---|
| January of Calendar Year: | 1988 | 1992 | 1997 | 2002 | 2007 |
| CAPITAL: | | | | | |
| Debt Service | 52.61 | 58.17 | 65.12 | 72.07 | 79.02 |
| Carrying Cost | 4.55 | 5.32 | 6.47 | 7.87 | 9.58 |
| Total Capital Payment | 57.15 | 63.48 | 71.59 | 79.94 | 88.60 |
| OPERATION AND MAINTENANCE (O&M): | | | | | |
| O&M Fee | 20.26 | 27.57 | 40.51 | 59.52 | 87.46 |
| Pass-Through Costs | 9.40 | 11.34 | 15.12 | 20.56 | 28.42 |
| Total O&M Costs | 29.66 | 38.91 | 55.63 | 80.08 | 115.88 |
| REVENUES (Contract Community Tons (CCT) Only) | | | | | |
| Energy (76.5% Credit) | 26.71 | 37.71 | 56.40 | 84.31 | 125.90 |
| Ferrous (50% Credit) | 1.02 | 1.20 | 1.46 | 1.77 | 2.15 |
| Total Revenues | 27.73 | 38.90 | 57.86 | 86.08 | 128.05 |
| NET COST (if CCT Only) | 59.08 | 63.49 | 69.35 | 73.94 | 76.42 |
| PRIVATE HAULER (PH) REVENUES (per CCT) | | | | | |
| PH Fee Less Variable Cost | 6.99 | 7.90 | 9.12 | 10.37 | 11.56 |
| Additional Energy Revenues | 12.29 | 17.34 | 25.95 | 38.78 | 57.91 |
| Additional Ferrous Revenues | 0.47 | 0.55 | 0.67 | 0.81 | 0.99 |
| Total PH Revenue (per CCT) | 19.74 | 25.80 | 35.74 | 49.97 | 70.46 |
| NET CONTRACT COMMUNITY SERVICE FEE | 39.33 | 37.70 | 33.62 | 23.98 | 5.96 |
| Rounded | 39 | 38 | 34 | 24 | 6 |
| In January 1983 Dollars | 28 | 19 | 12 | 6 | 1 |

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