MICROCOMPUTER SOLID WASTE FINANCIAL MODEL

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ABSTRACT

Applications of a microcomputer based solid waste financial model will be described. The model is written as an overlay to the Lotus 1-2-3 spreadsheet program. It makes use of the Lotus 1-2-3 macro programming capabilities and is menu driven, requiring minimal computer skills for use. The model allows engineers to estimate costs for recycling centers, waste-to-energy plants, and landfills. Outputs include summary tables of operational and capital costs, as well as a 20 year proforma income statement. The model was developed for the California Waste Management Board, an agency of the State of California, and will be distributed by them.

INTRODUCTION

The California Waste Management Board (CWMB), an agency of the State of California, has been tasked by the California Legislature with providing technical assistance to county and local governments in the planning of solid waste management systems. This computer program, Solid Waste Financial Model, has been developed as part of CWMB's technical assistance program.

California State Waste Management Policy encourages waste reduction, resource recovery and recycling, energy conversion, and the sound disposal of wastes which cannot be economically recovered. The evaluation of various alternatives to meet these goals requires standardized, reliable procedures for the comparison of alternatives.

The CWMB recognized that the widespread availability of relatively low cost microcomputers and powerful "spreadsheet" software could simplify these calculations. The CWMB contracted the Civil and Environmental Engineering Department of California Polytechnic State University (Cal Poly) at San Luis Obispo, to develop a spreadsheet based model to perform these calculations.

The Solid Waste Financial Model will be distributed on a nonprofit basis by the California Waste Management Board for a nominal fee. The pricing of the SWF Model had not yet been established by the CWMB at the time this paper was submitted (December 1985). It is expected that the cost will be nominal, reflecting reproduction costs. Distribution will include the program disk and the User's Guide [1]. A detailed programming guide will also be made available for the more advanced user [2]. Contact the CWMB at the address below for further information:

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OVERVIEW OF THE SOLID WASTE FINANCIAL MODEL

The model, entitled "Solid Waste Financial Model" (hereinafter referred to as SWF Model), is a preprogrammed "template" which uses the Lotus 1-2-3 spreadsheet program on the IBM-PC microcomputer. The SWF Model is composed of four parts, or modules. The first module, BASELINE, is the entry point into the SWF Model. A menu selection system allows the user to transfer from one module to another. Data entered into the BASELINE module is automatically transferred from one module to another. The modules are briefly described below. For brevity, only the ENERGY module will be discussed in detail. The model is documented by extensive built-in HELP screens, a Users Guide [1], and a detailed Programming Guide [2].

Baseline

This module is the normal entry point to the model. It is used to record basic data about the community including current population, future population estimates, solid waste quantities, and solid waste composition. The results of the BASELINE module are transferred to the other modules.

Recycle

This module uses the solid waste and population data assembled by the BASELINE module to plan recycling centers. Several types of centers can be planned including: buyback, curbside, dropoff, and commercial.

Energy

This module uses the solid waste data from the BASELINE module to help plan waste-to-energy systems. The module will help the user assemble capital and operating cost estimates, compute a proforma income statement, and assess the effects of changing interest rates and capital costs on project feasibility.

Landfill

This module helps the user plan a landfill site for municipal solid waste. The program uses solid waste data developed in the BASELINE module to estimate the acreage, equipment and labor requirements for a landfill. Estimates of capital costs, operating expenses, closure, and postclosure costs can also be made.

HARDWARE AND SOFTWARE REQUIREMENTS

The following hardware and software are required to utilize the SWF Model:

Hardware

(a) IBM-PC (or XT or AT) or other IBM-PC compatible computer capable of running LOTUS 1-2-3 and reading IBM-PC formatted 5¼ in. DSDD disks.
(b) IBM-PC graphics adapter card and B&W or RGB color monitor. (Hercules Graphics Card and IBM Monochrome Display are also acceptable).
(c) Graphics printer and suitable cables and interface card (Typically an IBM Graphics Printer or Epson FX-80. See the LOTUS 1-2-3 User's Manual for other printers.)
(d) At least 384 KB of RAM.
(e) Two DSDD floppy disk drives (or one DSDD floppy disk and hard disk).

Software

(a) IBM-PC DOS, Version 2.0 or higher.
(b) LOTUS 1-2-3, Version 1A (Note: Due to differences in macro programming commands, the SWF Model is not compatible with the LOTUS SYMPHONY program).

THE ENERGY MODULE

The ENERGY module uses data transferred from the BASELINE module, and user input data to estimate capital and operating costs for a waste-to-energy system. The module also calculates a twenty year proforma income statement to aid in the economic feasibility evaluation of waste-to-energy systems.

Menu System

As in the other modules, ENERGY is menu driven. Figure 1 illustrates the ENERGY main menu. User selected options include HELP screens which provide capsule descriptions of each option and information on input data formats. Descriptions of the other options are described below.

```
D1:                                                                    CMD MENU
HELP  WASTEPROJ  TECHDES  CAPCOST  OPEXP  PROJREV  XPROFORMA  RETURN
Provides HELP information on ENERGY options.
                                        D

  ----------------------------ENERGY MODULE----------------------------

  The ENERGY module is used to estimate capital and operation costs of a
  waste-to-energy system.  Use of the module requires selection of a solid
  waste conversion technology by the user.  The module also requires that
  technical specifications and capital and operation costs be entered.
  Use of this module may require assistance from engineering staff or
  consulting engineers.



                              Version 1.2
                            October 4, 1985

    [ MOVE THE CURSOR TO THE OPTION OF YOUR CHOICE AND PRESS (ENTER) ]
```

FIG. 1 ENERGY MODULE MENU

WASTEPROJ Option

The WASTEPROJ option summarizes waste projection and waste composition data that was developed in the BASELINE model. The data is for reference purposes and cannot be changed in the ENERGY module.

TECHDES Option

The TECHDES option is used to enter basic specifications of the waste-to-energy system. TECHDES includes entries for nominal input capacity, energy output (in the form of electricity, steam, or hot water), water consumption, waste generation (wastewater and ash), annual schedule, and availability. Since some projects may also produce one or two forms of energy (i.e., steam and electricity or hot water) entries for all three catagories are not required. The annual operating schedule (hr/year) is an estimate of planned operating time. Availability is an estimate of reliability in meeting the planned operating schedule.

only

CAPCOST Option

The CAPCOST option is used to estimate the capital costs associated with a waste-to-energy plant. The user is prompted to enter the major capital cost components usually considered in a preliminary cost estimate. Up to ten user defined capital costs can also be entered.

Estimating capital costs of major projects is an art. Project reports summarizing actual costs of similar projects are commonly used as a starting point for such estimates. More refined cost estimates will require a preliminary engineering feasibility study and vendor quotes.

OPEXP Option

The OPEXP option is used to estimate the annual operating expenses of a waste-to-energy system. Data elements include labor cost estimates, expected maintenance expenses, and utility expenses. Provision is also made for user defined annual operating expenses.

An optional data entry screen can be used to estimate the annual cost of a sinking fund to accumulate funds for replacement of major components. The user specifies the name, capital cost (at replacement time), useful life, and an interest rate. An annual cost to accumulate the capital cost (assuming yearly compounding) will be calculated.

PROJREV Option

The PROJREV option is used to estimate project revenues. It allows for the input of electricity, steam, and hot water rates where applicable. User entry items include the average energy rate ($/kWh) and capacity payment ($/kW/year). The electrical output, availability, and estimated annual hours are transferred from the TECHDES option. The annual electricity revenue is automatically computed. Likewise steam, and/or hot water revenues can also be calculated.

PROFORMA Option

The PROFORMA option is used to calculate a 20 year proforma income statement. Due to the size and complexity of a proforma income statement, PROFORMA is actually stored as a separate file. When the PROFORMA option is selected from the ENERGY menu, data is transferred to the PROFORMA file, and a new menu with seven suboptions appears.

The PROFORMA option is patterned after the proforma income statement developed by Touche Ross and Company for the California Waste Management Board [3]. Since discussion of the format of proforma income statements is beyond the scope of this paper, it is assumed that the reader is familiar with their use and application.

PROFORMA is formulated similar to the Touche Ross model. Terminology and line numbers are the same. A 20 year basis was used since this is the most common. A technique for changing the module to another time period (i.e., 30 years) is described in the Programming Guide [2]. It requires knowledge of the Lotus macro programming lanuage.

PROFORMA HELP Option

Three HELP screens are provided in PROFORMA. These HELP screens provide the user with a short description of all PROFORMA options.

PROFORMA BOND Option

The PROFORMA BOND option is used to enter basic assumptions related to revenue bond financing. The option computes the required bond proceeds to finance the project. It is computed based on user entered assumptions and data transferred from the TECHDES, CAPCOST, OPEXP, and PROJREV options.

PROFORMA INFL Option

The PROFORMA INFL option is used to enter assumptions regarding future inflation of both revenue and expenses. Either constant inflation or different inflation values for each year can be entered. Entries are provided for 21 years.

PROFORMA XREV Option

The PROFORMA XREV option computes the revenue portion of the proforma income statement. The computation utilizes data from the ENERGY and PROFORMA options and does not require user input. Since the computation requires six iterations, calculation is relatively slow requiring up to five minutes. To avoid this long wait when it is only desired to view or print out a table, two alternatives are allowed. Alternative 1 is a recalculation and should be used when the data is initially entered and when any changes have been made in other ENERGY and PROFORMA options. Alternative 2 is used to view the table, using the {RIGHT} and {LEFT}, cursor keys. If changes were made in other ENERGY and PROFORMA options, they will not be reflected in the proforma income statement when alternative 2 is used.

Figure 2 is a partial listing of the revenue portion of the proforma income statement. The complete table can be viewed by moving the cursor with {RIGHT}

```
S41:                                                                    READY

    S          T            U        V        W        X        Y
41
42
43                 YEAR        0        1        2        3        4
44    REVENUE
45    -------
46  1.  BOND $'s (A)      $50,497
47  2.  EQUITY $'s (B)    $11,500
48  3.  INT EARNED (C)     $4,801   $2,578       $0       $0       $0
49  4.  INT ANNUAL (C1)        $0       $0     $680     $680     $680
50  5.  PWR CAP (D,E)          $0       $0     $903     $903     $903
51  6.  PWR ELEC(F,G,AC1)      $0       $0   $4,965   $5,591   $6,144
52  7.  STEAM (H,I,AC2)        $0       $0       $0       $0       $0
53  8.  TIP FEE (J)            $0       $0   $6,187   $5,874   $5,656
54                      ---------------------------------------------
55             SUBTOTAL  $66,798   $2,578  $12,734  $13,047  $13,382
56
57  NOTE:  ALL DOLLAR VALUES IN THOUSANDS
58
59  [ PRESS  {ALT}A  TO RETURN TO PROFORMA MENU ]
60
                                                          CALC
```

FIG. 2 PROFORMA REVENUE STATEMENT

and {LEFT} cursor keys. The letters in parentheses after each row name refer to the bond assumptions table in the BOND option. Note that the tipping fee shown on line 8 is calculated to achieve the desired debt coverage. For example, a debt coverage of 1.00 results in a tipping fee which will exactly balance revenues and expenses. After calculation and review is complete, use the {ALT} A keys to return to the PROFORMA menu.

PROFORMA EXP Option

The PROFORMA EXP option is used to view the expense portion of the proforma income statement. As shown in Fig. 3 this portion of the table summarizes project expenses. The entire table can be viewed by using the {RIGHT} and {LEFT} cursor keys. If changes have been made in other ENERGY or PROFORMA options, the table must be recalculated by entering the PROFORMA XREV option and selecting Alternative 1.

PROFORMA ANAL Option

The ANAL option is used to view the analysis portion of the proforma income statement. As shown in Fig. 4, the table summarizes the cash flow over the lifetime of the project. The net present value (NPV) and residual are also calculated. These values can be

```
S61: 'NOTE:  ALL DOLLAR VALUES IN THOUSANDS                                   READY
```

	S	T	U	V	W	X	Y
61	NOTE: ALL DOLLAR VALUES IN THOUSANDS						
62		YEAR	0	1	2	3	4
63	EXPENSES						
64	--------						
65	9. CONST COST (K)		$46,000				
66	10. FINAN COST (L)		$2,480				
67	11. OTHER FEES (M)		$930				
68	12. MAINT FUND (N)		$460				
69	13. DSR FUND (O)		$6,336				
70	14. INSUR/CAPT (P)		$0				
71	15. START-UP (Q,AC3,A		$0	$2,062			
72	16. I/CONST (R)		$5,555	$5,554			
73	17. DEBT SERV (R,S)				$6,341	$6,341	$6,341
74	18. OPERATE (T,AC3)				$2,129	$2,293	$2,469
75	19. MAINT (U,AC4)				$1,094	$1,178	$1,269
76	20. LANDF ASH (V,AC5)				$1,106	$1,162	$1,220
77	21. INSURE/YR (W,AC6)				$0	$0	$0
78	22. PROP TAX (X,AC7)				$479	$488	$498
79			----------	----------	----------	----------	----------
80		SUBTOTAL	$61,761	$7,616	$11,149	$11,462	$11,797
						CALC	

FIG. 3 PROFORMA EXPENSE STATEMENT

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S81:                                                                          READY
```

	S	T	U	V	W	X	Y
81		YEAR	0	1	2	3	4
82	NET PROCEEDS		$5,038	($5,038)	$1,585	$1,585	$1,585
83	----------						
84	23. $/TON; NOMINAL (Y)				$33.24	$31.56	$30.38
85	24. $/TON YEAR 0 (Y,AC6)				$28.65	$25.26	$22.58
86	25. DEBT COVERAGE				1.25	1.25	1.25
87							
88	NET PRESENT VALUE (NPV)						
89	----------						
90	26. TIPPING FEE		$0	$0	$6,187	$5,874	$5,656
91	27. LANDFILL COST EST(Z)				$2,897	$3,042	$3,194
92					----------	----------	----------
93	28. AVOIDED COST EST				($3,289)	($2,832)	($2,462)
94	29. AVOIDED COST YEAR		$0	$0	($2,836)	($2,267)	($1,830)
95	(AC6)						
96	30. NPV (AA)		$16,795				
97							
98	31. RESIDUAL (AB)		$0				
99			---------				
100	32. NET SAVINGS		$16,795	NOTE: ALL DOLLAR VALUES IN THOUSANDS			
						CALC	

FIG. 4 PROFORMA ANALYSIS STATEMENT

used as a figure of merit in comparing alternatives. The entire table can be viewed by using the {RIGHT} and {LEFT} cursor keys.

SENSITIVITY ANALYSIS

Sensitivity analysis is a planning tool used to compare several options or alternatives. Prior to the widespread availability of microcomputers and powerful integrated programs such as Lotus 1-2-3, sensitivity analysis was tedious and expensive. Lotus 1-2-3 has built-in capabilities to simplify sensitivity analyses. These tools can be used to automatically copy data from the model onto user developed Lotus worksheets and to construct graphics from these user constructed worksheets. For example, several versions of the model could be prepared by using different values of a key variable, i.e., bond interest rate, or energy payments. Then the Lotus 1-2-3 File Xtract and File Combine commands could be used to copy the summary tables from ENERGY and PROFORMA to another worksheet for analysis. The user is referred to the Lotus Users Manual for complete details (Reference 4).

After data from several case studies has been stored in a worksheet, either by hand, or by automatic transfer, graphics can be generated. Lotus 1-2-3 can generate circle, bar, or line charts directly from a worksheet. By a suitable choice of axes and variables, the desired sensitivity analysis can be automatically plotted.

SUMMARY AND CONCLUSIONS

Under the direction of the California Waste Management Board, a microcomputer based Solid Waste Financial Model has been developed. The model can be used by engineers and planners to compare solid waste management alternatives and to perform sensitivity analyses to analyze the effects of varying financing and marketing conditions on project feasibility. Basing the model on a commercially available spreadsheet program simplified the program development.

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REFERENCES

[1] Vigil, S. A., and Zevely, J. A. "User's Guide to the Solid Waste Financial Model." San Luis Obispo, California: California Polytechnic State University, June 1985.

[2] Zevely, J. A., and Vigil, S. A. "Programming Guide to Solid Waste Financial Model" San Luis Obispo, California: California Polytechnic State University, June 1985.

[3] "Financing Resource Recovery Facilities in California: A Primer." Touche Ross and Company, and Brown, Vence and Associates, for the California Pollution Control Financing Authority and the California Waste Management Board, 1983.

[4] "Lotus 1-2-3 User's Manual for the IBM Personal Computer, the XT and the Compaq Portable Computer." Release 1A, Cambridge, Massachusetts: Lotus Development Corporation, 1983.

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