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RENEWABLE ENERGY RESOURCES

FIELD TESTING

~~DRAFT~~ FINAL

PRE-RFP MARKET/ECONOMIC

ASSESSMENT FOR FIELD TEST NO. 3

POULTRY PROCESSING

MAY 1986

PREPARED FOR

EGYPTIAN ELECTRIC AUTHORITY

CAIRO, EGYPT

AND

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

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1. EXECUTIVE SUMMARY

An economic analysis was performed to evaluate a proposed industrial process heat (IPH) system for poultry processing at the General Poultry facility at Heliopolis, Cairo.

Two collector systems of area 4,000 sq.ft. and 3,200 sq.ft. were evaluated. Because of differences in assumptions in cost estimation, EEA and Lockwood Greene Engineers submitted separate cost estimates.

The Lockwood Greene Engineers estimates were based on a 4,000 sq.ft. collector area with a variable cost of \$55.00/sq.ft. and a fixed cost of \$39,186.00 with an energy savings of 342 barrels of oil equivalent.

EEA estimates provided data both for 4,000 and 3,200 sq.ft. of collector area. Each size category had a variable cost of \$25.81/sq.ft. for the REFT project and \$22.21/sq.ft. for locally manufactured collector systems. Fixed cost estimates were \$23,995 for the 4,000 sq.ft. area and \$17,432 for the 3,200 sq.ft. area. The EEA estimates showed an energy saving of 350 and 295 barrels of oil for the 4,000 and 3,200 sq.ft. collectors, respectively.

A benefit cost analysis methodology was employed to perform the economic analysis.

A \$35.00/barrel of light heating oil was used as the price of energy saved by using the solar thermal system. This price was escalated at 2% per year. Also, an oil price of \$25.00 per barrel was used for sensitivity analysis in order to account for the current downward trend in oil prices in the world market.

The economic analysis considered the following scenarios:

- o A 4,000 sq.ft. collector area at a price of \$55.00/sq.ft.
- o A 4,000 sq.ft. collector area at prices of \$25.81/sq.ft. and \$22.21/sq.ft.
- o A 3,200 sq.ft. collector area at prices of \$25.81/sq.ft. and \$22.21/sq.ft.
- o A flash tank system.
- o A condensate return system.
- o A 4,000 sq.ft. collector area priced at \$55.00 per sq.ft. combined with flash tank and condensate return systems.
- o A 4,000 sq.ft. collector area priced at \$25.81 per sq.ft. and \$22.21/sq.ft. combined with flash tank and condensate return systems.
- o A 3,200 sq.ft. collector area priced at \$25.81 per sq.ft. and \$22.21/sq.ft. combined with flash tank and condensate return systems.

Results of the economic analysis showed that none of the candidate solar thermal systems are economically viable.

A sensitivity analysis was also performed by decreasing collector price by 20%, 40% and 60%, or to \$20.00, \$15.00 and \$10.00/sq.ft. Results of the sensitivity analysis indicated that

the flat plate collectors will not be economical unless prices fall to \$10.00/sq.ft., and this applied only to the 3,200 sq.ft. category.

A separate analysis was also carried out on the economic performance of the solar thermal system combined with flash tank and condensate return systems. Results of the analysis showed that the combined system was economically viable.

The design, operation, maintenance, and repair experience with solar thermal systems that will be obtained through this field test to form a strong technical base for the design and application of other renewable energy technologies is an important factor which has not entered into the benefit cost calculation in this report.

These additional factors need to be considered seriously in the go-no-go decision of this field test.

2. INTRODUCTION

The Egyptian Electricity Authority (EEA), the United States Agency for International Development (USAID/Cairo), and a group of U.S. Consultants form a team responsible for the performance, conduct and management of the Renewable Energy Field Testing (REFT) Project whereby eleven systems are field tested for renewable energy applications in Egypt.

These field tests include the use of solar thermal, photovoltaic and grid connected wind form systems for industrial process heat, water pumping, ice making desalination, and grid connected electricity generation.

The project has broad objectives to investigate selected renewable energy options to:

- o Comprehensively strengthen Egyptian technical and institutional capabilities in the full spectrum of renewable energy planning and decision-making for technologies and applications.
- o Develop and sustain an Egyptian renewable energy infrastructure through the establishment of data

bases, information systems and organizations that effectively serve both the public and private sectors.

- o Design, install, operate and evaluate a series of renewable energy field tests which utilize commercially available technologies in applications having potential for widespread use in Egypt.
- o Conduct a formal management and technical training program, both on-the-job and specialized, and establish an intensive information dissemination program.

The Market/Economic Analysis Task is one of the supporting activities that will provide useful information for the accomplishment of the proposed project objectives. The Market/Economic Analysis Task is set up to accomplish the following objectives:

- o Evaluate the economic performance of candidate renewable energy technology/application systems in the field test program in the Egyptian economy.

- o Identify non-technical bottlenecks that could be encountered in the dissemination and wide use of renewable energy technologies.
- o Estimate the market environment in Egypt under which the supply of and the demand for pre-selected renewable energy technologies will be transacted.
- o Identify policy issues such as energy prices, incentives, tariffs and regulations that could be modified, instituted and/or removed to enhance the establishment of a true economic cost of energy resources.
- o Determine the economic environment under which investment decisions could be made for the widespread use of similar renewable energy technologies in Egypt.
- o Train Egyptian counterparts with the capability of performing market and economic assessments of similar energy projects.

The Market/Economic Analysis Task is performed in two parts. The first part is the Pre-RFP Market/Economic Analysis. This activity will perform a site specific Market/Economic

analysis of a particular field test in order to provide decision makers both at EEA and USAID/Cairo with information on the financial and economic viability of the proposed field test. This information is required as one of the pieces of information for a go-no-go decision on the issuance of an RFP.

The second part performs a market/economic analysis of specified renewable energy technologies throughout Egypt in industrial sectors represented by the eleven field tests.

This report represents the first part, the Pre-RFP Market/Economic Analysis for a field test designed to test the technical and economic viability of the use of solar industrial process heat (IPH), flash tank and condensate return systems for poultry processing.

3. BACKGROUND

The proposed site for Field Test #3, Poultry Processing, is at the General Poultry Corporation (GPC) plant, Heliopolis, Cairo. The plant employs 380 persons and slaughters 6,000 birds per hour, between 7 and 9 hours each day for 330 days a year. When the modernization process of the facility is completed, GPC will be able to process 80,000 to 100,000 birds per year. This plant produces approximately 30 percent of the poultry sector's annual production.

Each day 5 metric tons (5,000 kg) of dead birds are also processed in the rendering cookers in addition to waste parts from the production line.

Energy Resources

The poultry processing plant meets its energy needs from the national grid for electricity, and mazout for its boilers to produce steam.

The plant has three boilers, two of which have a capacity of 2,000 kg/hr each and one boiler with 4,000 kg/hr. Annual energy consumption for the plant is $31,684 \times 10^4$ kg of steam and $7,920 \times 10^3$ kwh of electricity.

Objectives of Proposed Field Test Site for IPH System

The primary objectives of this field test are to provide EEA with practical working experience using Solar Thermal Industrial Process Heat and to provide system design and operational training for Egyptian engineers for the purpose of assessing and implementing similar projects throughout Egypt. This field test will evaluate the viability of solar thermal industrial process heat, with steam flash tank technology and steam condensate return systems, for the poultry processing industry.

The application of solar IPH, flash tank, and condensate return systems for poultry processing at Heliopolis will serve as a demonstration of the capability of the combined technology of industrial process heat to reliably supply significant amounts of energy at other poultry processing facilities. It is important that this field test be designed to distinguish between the performance of the solar IPH and the performance of the flash tank and condensate return systems so that each can be evaluated for other applications.

4. ECONOMIC ANALYSIS

Objective

The objective of this analysis is to evaluate the economic viability of a solar thermal system for providing industrial process heat for poultry processing at the General Poultry Corporation plant at Heliopolis, Cairo and to determine whether or not an investment in this field test would result in the acquisition of useful information and know-how, not only technical, but also managerial and institutional, so that such experiences could be duplicated throughout the economy of Egypt.

Research Methodology

The method of analysis selected for accomplishing the above objective is the standard benefit cost analysis used in project evaluation. A benefit cost analysis involves first the pooling of anticipated benefits and costs (direct and indirect) resulting from the project throughout its economic life. The streams of benefits and costs are then expressed in present value terms using a common numeraire (a discount rate).

From this, the following evaluation characteristics can be calculated.

The Net Present Value (NPV) is the difference between the sum of the discounted stream of benefits and the sum of the discounted stream of costs, discounted by a given discount rate.

The Payback Period is the number of years it takes a project to generate sufficient benefits to cover its cost, or the number of years it takes the net present value to change from a negative to a positive value.

The Internal Rate of Return (IRR), sometimes called the economic rate of return, is that discount rate that would equate discounted benefits to discounted cost or reduce the net present value to zero.

Benefit-Cost Ratio (B/C). This is the ratio obtained by dividing the discounted value of all project benefits by the discounted value of project costs.

Simple Payback. This is a rule of thumb method used by investors to see if a particular financial venture is worth investing in or not. The simple payback is calculated by summing up all capital and operating cost and dividing that sum by the value of the first full year's benefit. In the private sector in most industrialized countries a simple payback of 3 to 5 years is expected. With renewable energy technology, a simple payback of

7-9 years is usually admissible. The inverse of the simple payback $\left(\frac{1}{\text{simple payback}}\right)$ is the rate of return on investment (ROI).

Figure 1 shows a schematic presentation of the benefit cost model.

The net present value is calculated using the following relationship:

$$\text{Net Present Value (NPV)} = (\text{Present Value of Benefits}) - (\text{Present Value of Costs})$$

Mathematically it is expressed as:

$$\text{NPV} = \sum_{i=1}^N \frac{P_E \times Q_E}{(1+r)^i} - \frac{C_0}{(1+r)^0} - \frac{C_i}{(1+r)^i}$$

where,

- N = Useful life of the project in years
- C₀ = Initial capital cost including construction
- P_E = Price of energy escalated at the rate of $(1+e)^i$
- Q_E = Quantity of energy produced in barrels of oil equivalent
- C_i = Annual operating and maintenance cost
- r = Rate of return
- e = Annual escalation rate for energy price.

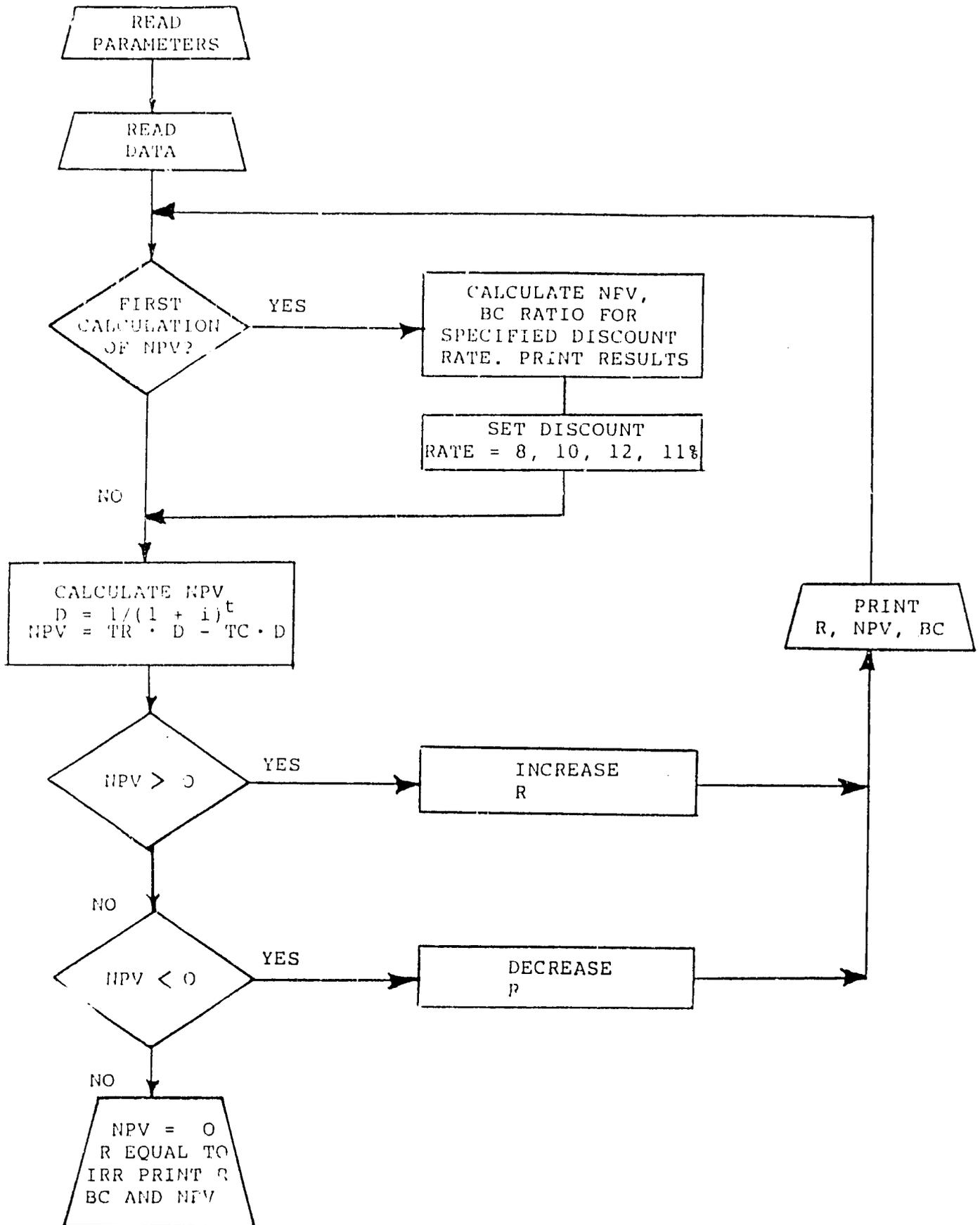


FIGURE 1. A FLOW CHART OF THE COMPUTER-BASED BENEFIT COST MODEL

Assumptions

The economic analysis of the IPH system is based on the following assumptions:

- o All energy conversions are made into barrels of oil equivalent where one metric ton is equivalent to U.S. 7.33 barrels.

- o Price of oil is valued at US\$ 35/barrel of light heating oil escalated at 2% per year. This price level may not be indicative of the price of oil that is rapidly changing at present. This price level was selected at a time when the price of oil was stable at or above US\$ 30.00/bbl. It should be noted that the analysis in this study is to look at what may happen in the long-run during the 1980s and 1990s. As such, the analysis should not be affected by what happens to commodity prices in the spot market in the very short-run. A revision of the price of oil in the analysis may be appropriate when the price level stabilizes.

- o A discount rate of 10% is used. This is the opportunity cost of money in international credit markets such as the World Bank.

- o Hardware is assumed to have a salvage value of 10% at the end of the life of the system and adjusted for inflation at 5 percent per year.
- o The system is expected to have a life of 20 years.
- o Some hardware items are purchased in Egypt. An exchange rate of L.E. 1.35 = US\$ 1.00 is used. All prices are in constant US\$ 1985.

Data Base

Two sets of cost estimates were used in this analysis. The first set of data was provided by Lockwood Greene Engineers for a 4,000 sq.ft. collector area (see Appendix B).

On the basis of the best available information, Lockwood Greene Engineers have provided the following cost estimates:

Collector Size	4,000 sq.ft.
Prices	
Variable cost	\$55.00/sq.ft.
Fixed cost	\$39,186
O+M cost	2% of total cost
Salvage value	4.2% of total cost
Energy savings	1,508 million BTU or 342 barrels of oil
Construction period	10 months
System life	20 years

The second set of data was provided by EEA for two collector sizes, 4,000 sq.ft. and 3,200 sq.ft. The EEA cost estimates also show two types of prices for each size category. The first set shows a price of \$25.81 per square foot of collector. This price is to be used for collectors purchased for the REFT Project. The second set shows a price of \$22.21 per sq.ft. which is to be used when evaluating IPH application elsewhere in Egypt (see Appendix C).

Cost estimates provided by EEA are as follows:

Collector Sizes	4,000 sq.ft. 3,200 sq.ft.
Prices	
Variable cost	\$22.21/sq.ft. (local) \$25.81/sq.ft. (U. S.)
Fixed cost	\$17,432 (local) \$23,995 (U. S.)
O + M cost	2% of hardware cost
Salvage value	4.2% of capital cost
Capacity credit	\$1,463
Energy savings	350 bbl for 4,000 sq.ft. 295 bbl for 3,200 sq.ft.
Construction period	10 months
System life	20 years

Analysis and Results

The economic evaluation of the IPH system for poultry processing was performed by examining the following sets of base line assumptions:

1. A 4,000 sq.ft. collector area at a price of \$55.00/sq.ft.
2. A 4,000 sq.ft. collector area at prices of \$25.81/sq.ft. and \$22.21/sq.ft.
3. A 3,200 sq.ft. collector area at prices of \$25.81/sq.ft. and \$22.21/sq.ft.
4. A flash tank system.
5. A condensate return system.
6. A 4,000 sq.ft. collector area priced at \$55.00 per sq.ft. combined with flash tank and condensate return systems.
7. A 4,000 sq.ft. collector area priced at \$25.81 per sq.ft. and \$22.21/sq.ft. combined with flash tank and condensate return systems.
8. A 3,200 sq.ft. collector area priced at \$25.81 per sq.ft. and \$22.21/sq.ft. combined with flash tank and condensate return systems.

Input data for the base line analysis are presented in Table 1. All base line analyses were performed assuming a price of \$35.00/bbl of oil. The economic evaluation of all systems were made using a discount rate of 10% although system performances are examined at varying discount rates ranging from 0% to 20% at 2% intervals.

Table 2 presents results of the base line analysis. As shown in this table, both the 4,000 and 3,200 sq.ft. collector systems at all collector prices do not pay during their economic life. The 4,000 sq.ft. collector system at a price of \$55.00 per sq.ft. has a simple payback of 22 years which is longer than

TABLE 1
ECONOMIC ANALYSIS OF IPH SYSTEM - GENERAL POULTRY
DATA INPUT BASE LINE

(Price of Oil \$35.00/bbl)

ITEMS	COLLECTOR SIZE					FLASH TANK	CONDENSATE RETURN
	← 4000 sq. ft. → @\$55.00/ft ²	← 4000 sq. ft. → @\$25.81/ft ²	← 3200 sq. ft. → @\$22.21/ft ²	← 3200 sq. ft. → @\$25.81/ft ²	← 3200 sq. ft. → @\$22.21/ft ²		
Variable cost	220,000	103,240	88,840	82,592	71,072	*/	*/
Fixed Cost	39,186	23,995	17,432	23,995	17,432	*/	*/
Capital Cost	259,186	127,235	106,272	106,587	88,504	\$23,461	\$67,254
Capacity Credit	1,463	1,463	1,463	1,463	1,463	NA	NA
Acquisition Cost	257,724	125,772	104,809	105,124	87,041	\$23,461	\$67,254
O & M	4,992	3,065	2,645	2,571	2,209	469	545
Salvage Value	24,516	14,179	11,843	11,878	9,863	2,614	7,495

SOURCE: LBII estimates based on engineering cost data provided by EEA and Lockwood Greene Engineers.

NOTE : */ Included in Capital Costs

NA = Not Applicable

TABLE 2
ECONOMIC ANALYSIS OF IPH SYSTEM - GENERAL POULTRY
DATA OUTPUT BASE LINE

(Price of Oil \$35.00/dbl)

ITEMS	COLLECTOR SIZE					FLASH TANK	CONDENSATE RETURN
	← 4000 sq. ft. → @\$55.00/ft ²	← 3500 sq. ft. → @\$25.81/ft ²	← 3500 sq. ft. → @\$22.21/ft ²	← 3200 sq. ft. → @\$25.81/ft ²	← 3200 sq. ft. → @\$22.21/ft ²		
Energy Saving Barrels/year	342	350	350	295	295	736	1,176
Net present Value (\$183,797) @ 10%		(\$26,538)	(\$2,277)	(\$21,388)	(\$462)	\$233,045	\$344,866
Simple Payback (Yrs)	22	10	9	10	8	1	2
Payback period (Yrs)	N	N	N	N	N	1	3
\$ Output / \$ Input	0.78	1.76	2.09	1.78	2.12	15.68	5.49
Internal Rate of Return (IRR)	*/	*/	9.71	*/	9.93	34.50	70.57

SOURCE: LBII estimates based on engineering cost data provided by EEA and Lockwood Greene Engineers.

NOTE : N = System does not pay during its Economic Life.
*/ No estimate of IRR possible.

the life of the system. The two size categories show simple pay-backs of 10, 9 years and 10, 8 years at prices of \$25.81 and \$22.21/sq.ft. respectively.

The net present values at 10% discount are negative for all collector sizes and all collector prices, indicating that the financial benefits accruing to the project will not be able to offset the cost of acquisition and operation of the system during its economic life span.

The internal rate of return (IRR) is significantly lower than the 10% expected economic rate of return or cost of credit.

Both flash tank and condensate return systems, on the other hand, show positive results. The flash tank pays for itself in one year. The condensate return system pays back in three years. The internal rate of return for both the flash tank and condensate return system are very high: 34.50% and 70.57%, respectively, indicating very high economic gains to be realized by installing these systems.

The Application Review for Field Test #3 examines solar thermal together with flash tank and condensate return system (also referred to as waste heat recovery in this report) as a unit that will be installed at General Poultry. Accordingly, an economic evaluation of the combined solar thermal plus the waste heat recovery system was performed.

The input data used for this analysis is presented in Table No.3. Results of the economic analysis for the combined system are presented in Table 4. As shown in Table 4, the combined system is economically viable for all collector sizes and all price levels. The payback period for the 4,000 sq.ft. collector priced at \$55.00/sq.ft. is 7 years collectors priced at \$25.81 per sq.ft. and \$22.21/sq.ft. show payback periods of 5 and 4 years respectively. The 3200 sq.ft. size shows a 4 year payback period.

The combined system also shows very high internal rates of return for all size categories and collector prices.

It should be pointed out that there is no functional relationship between the technical or economic performance of solar thermal and waste heat recovery systems. One can install the solar thermal all by itself or in combination with the flash tank and/or condensate return systems.

As discussed earlier, the solar thermal systems of the two collector size categories were not found to be economically viable at the collector prices provided both by EEA and Lockwood Greene Engineers. A sensitivity analysis was performed to find out by how much collector prices may have to fall for the solar thermal system to show positive economic performance. To accomplish this, collector prices were reduced by 20%, 40% and 60%, or to \$20.00, \$15.00 and \$10.00 per square foot and

TABLE 3
 ECONOMIC ANALYSIS OF IPH SYSTEM - GENERAL POULTRY
 DATA INPUT - COMBINED SYSTEM */

(Price of Oil \$35.00/bbl)

ITEMS	COLLECTOR SIZE				
		4000 sq. ft.		3200 sq. ft.	
	@\$55.00/ft ²	@\$25.00/ft ²	@\$22.21/ft ²	@\$25.81/ft ²	@\$22.21/ft ²
Capital Cost <u>**</u> /	\$ 348,439	216,487	195,524	195,839	177,756
Acquisition Cost <u>**</u> /	348,439	216,487	195,524	195,839	177,756
U & M Cost	5,934	4,079	3,659	3,585	3,223
Salvage Value	34,625	24,288	21,952	21,987	19,972

SOURCE: LBI estimates based on engineering cost data provided by EEA and Lockwood Greene Engineers.

NOTE : */ Combined System means the aggregate of solar, flash tank and condensate return systems.
**/ All cost items are aggregated and shown as a single unit.

TABLE 4
 ECONOMIC ANALYSIS OF IPH SYSTEM - GENERAL POULTRY
 DATA OUTPUT - COMBINED SYSTEM

(Price of Oil \$35.00/bbl)

ITEMS	COLLECTOR SIZE				
	← 4000 sq. ft. → @\$55.00/ft ²	← 4000 sq. ft. → @\$25.81/ft ²	← 4000 sq. ft. → @\$22.21/ft ²	← 3200 sq. ft. → @\$25.81/ft ²	← 3200 sq. ft. → @\$22.21/ft ²
Energy Savings	2,254	2,262	2,262	2,207	2,207
Net Present Value @10%	402,027	551,372	575,634	556,523	577,449
Simple Payback (year)	4	3	2	3	2
Payback Period (year)	7	5	4	4	4
\$ output/\$input	4.54	7.20	7.99	7.83	8.65
Internal Rate of Return (IRR)	23.87	39.63	44.19	43.02	47.74

SOURCE: LBI estimates based on engineering cost data provided by EEA and Lockwood Greene Engineers.

economic analysis performed. Because solar collectors are manufactured from materials that are energy intensive and petrochemical derivatives (plastics), it would be unrealistic to reduce the price of collectors and perform a sensitivity analysis while the price of oil is pegged at \$35.00/barrel. Therefore, a \$25.00/barrel of light heating oil is used for the sensitivity analysis. The input data for the sensitivity analysis is shown in Table 5. The result of the sensitivity analysis is shown in Table No. 6.

At a discount rate of 10%, on which the economic evaluation is based, the 4,000 sq.ft. collector system was found to be uneconomical at all price levels tested for.

The 3,200 sq.ft. collector shows positive economic performance only if the price of collectors falls to \$10.00 per sq.ft. At this price level, the system will start showing positive net present value at the 15th year of its 20-year lifespan.

A year by year cash flow analysis for 18 different scenarios is presented in Appendix A, Tables A1-A18. These include simulation results for 12 base line assumptions (Tables A1-A12) and 6 scenarios for sensitivity analysis (Tables A13-A18).

TABLE 5
 ECONOMIC ANALYSIS OF THE SYSTEM - GENERAL POULTRY
 DATA INPUT SENSITIVITY ANALYSIS
 (Price of oil @ \$25.00/bbl)

ITEMS	SOLAR COLLECTORS							
	4000 sq ₂ ft.				3200 sq ₂ ft.			
	@ \$20/ft. ²	@ \$15/ft. ²	@ \$10/ft. ²	@ \$25/ft. ²	@ \$20/ft. ²	@ \$15/ft. ²	@ \$10/ft. ²	
Variable Cost	\$ 80,000	\$ 60,000	\$ 40,000	\$ 80,960	\$ 64,000	\$ 48,000	\$ 32,000	
Fixed Cost	\$ 20,176	\$ 20,176	\$ 20,176	\$ 20,176	\$ 20,176	\$ 20,176	\$ 20,176	
Capital Cost	\$ 100,176	\$ 80,176	\$ 60,176	\$ 101,136	\$ 84,176	\$ 68,176	\$ 52,176	
Capacity Credit	\$ 1,463	\$ 1,463	\$ 1,463	\$ 1,463	\$ 1,463	\$ 1,463	\$ 1,463	
Acquisition Cost	\$ 98,713	\$ 76,713	\$ 58,713	\$ 99,673	\$ 82,713	\$ 66,713	\$ 50,713	
O & M	\$ 2,523	\$ 2,093	\$ 1,723	\$ 2,462	\$ 2,123	\$ 1,803	\$ 1,483	
Salvage Value	\$ 11,162	\$ 8,934	\$ 6,705	\$ 11,161	\$ 9,379	\$ 7,596	\$ 5,813	
System Life	20	20	20	20	20	20	20	

SOURCE: IRII estimates based on engineering cost data provided by EEA and Lockheed Greene Engineers.

TABLE 6
ECONOMIC ANALYSIS OF IPH SYSTEM - GENERAL POULTRY
DATA OUTPUT SENSITIVITY ANALYSIS

(Price of oil @ \$25.00/bbl)

ITEMS	SOLAR COLLECTORS					
	@ \$20/ft. ²	4000 sq. ft. @ \$15/ft. ²	@ \$10/ft. ²	@ \$20/ft. ²	3200 sq. ft. @ \$15/ft. ²	@ \$10/ft. ²
Energy Savings Barrels/years	350	350	350	295	295	295
Net Present Value @ 10%	(\$30,909)	(\$9,495)	(\$15,373)	(\$25,590)	(\$7,077)	(\$11,435)
Simple Payback (yrs)	11	9	7	11	9	7
Payback Period (yrs)	NP	NP	15	NP	NP	15
\$Output/ \$ of Expenditure	1.55	1.71	2.45	1.55	1.88	2.39
Internal Rate of Return (IRR)	* /	8.28	13.37	* /	8.55	12.92

SOURCE: LBII estimates based on engineering cost data provided by EEA and Lockwood Greene Engineers.

NOTE: NP = No Economic Payback during System Life.

* / = No Estimate of IRR possible.

5. CONCLUSION

The economic analysis performed on the proposed IPH Field Test at General Poultry showed that both the 4,000 sq.ft. and the 3,200 sq.ft. flat plate collector systems were not economically viable.

However, the analysis indicated that when the solar thermal system was evaluated in combination with the two waste heat recovery systems (flash tank and condensate return systems) the project was economically viable. This favorable performance was caused not because of improvements made in economic efficiency by the solar thermal system, but rather because the economic efficiency of the waste heat recovery systems is so strong that it more than offsets the poor performance of the solar thermal system.

It should be emphasized that this analysis did not cover an evaluation of the complete array of solar thermal systems, such as solar collectors for domestic hot water, etc. The analysis was limited to the application of flat plate collectors for application in industrial process heat of a given temperature range. Therefore, implications drawn from this analysis should not be applied to other solar thermal uses.

The economic analysis has revealed some interesting and important economic, technical, institutional and policy issues.

It is clear that the proposed flat plate collector systems cannot be expected to bring about positive economic returns given current collector prices were evaluated on its own.

Therefore, it is necessary that:

- o Investigations be made in the technical field to determine if the efficiency of the system could be improved without increasing system cost.
- o The supply side of the collector market be prepared to manufacture and supply collector systems that are cost effective.
- o Policy makers be cognizent of the fact that the price of flat plate collectors must decrease by almost 60% compared to the best case scenario as used in this study (from \$22.21/sq.ft. to \$10.00 per sq.ft.) in order for industrial consumers to find it attractive to invest in solar thermal technology. Since the market, and thus the solar thermal industry, is at its infancy in Egypt, policy makers and the public sector have to play a lead role in removing

barriers and providing the appropriate fiscal or regulatory incentives to enhance the manufacture and widespread use of solar thermal technology.

It is the overall objective of the Renewable Energy Field Testing Project to investigate selected renewable energy options to:

- o Comprehensively strengthen Egyptian technical and institutional capabilities in the full spectrum of renewable energy planning and decision-making for technologies and applications.
- o Develop and sustain an Egyptian renewable energy infrastructure through establishment of data bases, information systems, and organizations that effectively serve both the public and private sectors.
- o Design, realize, and evaluate the performance of a series of field tests which utilize commercially available technologies in applications having potential for widespread use in Egypt.

- o Complete formal managerial and technical training, both on-the-job and specialized, and an intensive information dissemination program.

The design, operation, maintenance, and repair experience with solar thermal systems that will be obtained through this field test to form a strong technical base for the design and application of other renewable energy technologies is an important factor which has not entered into the benefit cost calculation in this report. These additional factors need to be considered seriously for the go-no-go decision.

APPENDIX A

TABLE A1

For Case of: POULTRY 4000 SQ FT @ \$55.00/FT SQ US MANUFACTURED LGE ESTIMATES
 Assuming Oil Escalation Rate of : 2.0%

	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) @ i =				
										4%	8%	10%	12%	
Acquisition	\$257,724													
Transport	\$0													
Construction	\$0													
Interconnection	\$0													
Total	\$257,724	\$632	\$35.00	0	\$0	57	\$1,995	\$256,556	(\$256,561)	(\$256,561)	(\$256,561)	(\$256,561)	(\$256,561)	(\$256,561)
\$0	\$4,992	\$35.70	0	\$0	342	\$1,209	\$4,992	\$7,217	(\$249,621)	(\$249,878)	(\$250,000)	(\$250,117)	(\$250,234)	(\$250,351)
\$0	\$4,992	\$36.41	0	\$0	342	\$1,454	\$4,992	\$7,462	(\$242,723)	(\$241,481)	(\$243,833)	(\$244,169)	(\$244,505)	(\$244,841)
\$0	\$4,992	\$37.14	0	\$0	342	\$1,701	\$4,992	\$7,711	(\$235,868)	(\$237,360)	(\$238,040)	(\$238,680)	(\$239,320)	(\$239,960)
\$0	\$4,992	\$37.89	0	\$0	342	\$1,957	\$4,992	\$7,965	(\$229,060)	(\$231,506)	(\$232,600)	(\$233,615)	(\$234,630)	(\$235,645)
\$0	\$4,992	\$38.64	0	\$0	342	\$2,216	\$4,992	\$8,224	(\$222,300)	(\$225,909)	(\$227,494)	(\$228,952)	(\$230,410)	(\$231,868)
\$0	\$4,992	\$39.42	0	\$0	342	\$2,480	\$4,992	\$8,488	(\$215,592)	(\$220,560)	(\$222,702)	(\$224,652)	(\$226,602)	(\$228,552)
\$0	\$4,992	\$40.20	0	\$0	342	\$2,750	\$4,992	\$8,758	(\$208,937)	(\$215,450)	(\$218,208)	(\$220,966)	(\$223,724)	(\$226,482)
\$0	\$4,992	\$41.01	0	\$0	342	\$3,025	\$4,992	\$9,033	(\$202,336)	(\$210,570)	(\$213,994)	(\$217,418)	(\$220,842)	(\$224,266)
\$0	\$4,992	\$41.83	0	\$0	342	\$3,305	\$4,992	\$9,313	(\$195,793)	(\$205,911)	(\$210,045)	(\$214,179)	(\$218,313)	(\$222,447)
\$0	\$4,992	\$42.66	0	\$0	342	\$3,591	\$4,992	\$9,599	(\$189,308)	(\$201,464)	(\$206,344)	(\$211,224)	(\$216,104)	(\$220,984)
\$0	\$4,992	\$43.52	0	\$0	342	\$3,883	\$4,992	\$9,891	(\$182,883)	(\$197,222)	(\$202,877)	(\$208,532)	(\$214,187)	(\$219,842)
\$0	\$4,992	\$44.39	0	\$0	342	\$4,181	\$4,992	\$10,189	(\$176,519)	(\$193,176)	(\$199,630)	(\$206,084)	(\$212,538)	(\$218,992)
\$0	\$4,992	\$45.29	0	\$0	342	\$4,484	\$4,992	\$10,492	(\$170,218)	(\$189,318)	(\$196,591)	(\$203,864)	(\$211,137)	(\$218,410)
\$0	\$4,992	\$46.18	0	\$0	342	\$4,794	\$4,992	\$10,802	(\$163,980)	(\$185,640)	(\$193,746)	(\$201,852)	(\$209,958)	(\$218,064)
\$0	\$4,992	\$47.11	0	\$0	342	\$5,110	\$4,992	\$11,118	(\$157,806)	(\$182,135)	(\$191,085)	(\$199,935)	(\$208,785)	(\$217,635)
\$0	\$4,992	\$48.09	0	\$0	342	\$5,432	\$4,992	\$11,440	(\$151,698)	(\$178,796)	(\$188,595)	(\$197,345)	(\$206,095)	(\$214,845)
\$0	\$4,992	\$49.01	0	\$0	342	\$5,761	\$4,992	\$11,769	(\$145,656)	(\$175,615)	(\$186,267)	(\$194,917)	(\$203,567)	(\$212,217)
\$0	\$4,992	\$49.99	0	\$0	342	\$6,096	\$4,992	\$12,104	(\$139,681)	(\$172,586)	(\$184,090)	(\$192,694)	(\$201,298)	(\$209,902)
\$0	\$4,992	\$50.99	0	\$0	342	\$6,438	\$4,992	\$12,446	(\$133,774)	(\$169,702)	(\$182,055)	(\$190,659)	(\$199,263)	(\$207,867)
\$0	\$4,992	\$52.01	0	\$0	342	\$6,787	\$4,992	\$12,795	(\$127,928)	(\$166,917)	(\$179,217)	(\$187,721)	(\$196,225)	(\$204,729)
\$24,516	\$4,992	\$52.01	0	\$0	342	\$7,138	\$4,992	\$13,146	(\$122,177)	(\$164,221)	(\$176,521)	(\$185,025)	(\$193,529)	(\$202,033)
\$282,240	\$108,672		0	\$0	6,897	\$298,651	\$182,912	(\$84,261)						

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TABLE A1 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

Internal Rate of Return		ERR		
Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
=====	=====	=====	=====	=====
0%	\$298,651	\$382,912	(\$84,261)	0.78
2%	\$241,395	\$356,681	(\$115,286)	0.68
4%	\$198,464	\$337,588	(\$139,123)	0.59
6%	\$165,807	\$323,458	(\$157,651)	0.51
8%	\$140,611	\$312,828	(\$172,217)	0.45
10%	\$120,903	\$304,700	(\$183,797)	0.40
11%	\$112,652	\$301,350	(\$188,698)	0.37
12%	\$105,281	\$298,385	(\$193,104)	0.35
13%	\$98,676	\$295,751	(\$197,075)	0.33
14%	\$92,739	\$293,402	(\$200,663)	0.32
15%	\$87,386	\$291,301	(\$203,914)	0.30
16%	\$82,546	\$289,413	(\$206,867)	0.29
18%	\$74,164	\$286,172	(\$212,008)	0.26
20%	\$67,196	\$283,504	(\$216,308)	0.24

TABLE A1 (Contd.)

ASSUMPTIONS TABLE

=====

Capital Costs:

Acquisition	\$257,724
Transportation	\$0
Construction	\$0
Interconnection	\$0
-----	-----
TOTAL (Cap.)	\$257,724

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	342 bbl/year
Fuel Use	0 bbl/year

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$4,992 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	\$24,516 /period
Replace Period	20 years

TABLE A2

For Case of: POULTRY 4000 SQ FT @ \$25.81/SQ FT SEA ESTIMATES REFT
 Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) @ i =				
										4%	8%	10%	12%	
1	Acquisition \$125,772													
1	Transport.	\$0												
1	Construction.	\$0												
1	Interconnection	\$0												
1	Total	\$125,772	\$511	\$35.00	0	\$0	58	\$2,042	\$126,283	(\$124,241)	(\$124,241)	(\$124,241)	(\$124,241)	(\$124,241)
2		\$0	\$3,065	\$35.70	0	\$0	350	\$12,495	\$3,065	\$9,430	(\$115,174)	(\$115,510)	(\$115,668)	(\$115,822)
3		\$0	\$3,065	\$35.41	0	\$0	350	\$12,745	\$3,065	\$9,680	(\$106,224)	(\$107,211)	(\$107,669)	(\$108,105)
4		\$0	\$3,065	\$37.14	0	\$0	350	\$13,000	\$3,065	\$9,935	(\$97,392)	(\$99,324)	(\$100,204)	(\$101,033)
5		\$0	\$3,065	\$37.89	0	\$0	350	\$13,260	\$3,065	\$10,195	(\$88,678)	(\$91,831)	(\$93,241)	(\$94,554)
6		\$0	\$3,065	\$38.64	0	\$0	350	\$13,525	\$3,065	\$10,460	(\$80,080)	(\$84,712)	(\$86,746)	(\$88,619)
7		\$0	\$3,065	\$39.42	0	\$0	350	\$13,795	\$3,065	\$10,730	(\$71,600)	(\$77,950)	(\$80,689)	(\$83,183)
8		\$0	\$3,065	\$40.20	0	\$0	350	\$14,071	\$3,065	\$11,006	(\$63,236)	(\$71,528)	(\$75,041)	(\$78,204)
9		\$0	\$3,065	\$41.01	0	\$0	350	\$14,353	\$3,065	\$11,288	(\$54,988)	(\$65,429)	(\$69,775)	(\$73,645)
10		\$0	\$3,065	\$41.83	0	\$0	350	\$14,640	\$3,065	\$11,575	(\$46,856)	(\$59,639)	(\$64,867)	(\$69,471)
11		\$0	\$3,065	\$42.66	0	\$0	350	\$14,933	\$3,065	\$11,868	(\$38,838)	(\$54,142)	(\$60,291)	(\$65,650)
12		\$0	\$3,065	\$43.52	0	\$0	350	\$15,231	\$3,065	\$12,166	(\$30,935)	(\$48,924)	(\$56,027)	(\$62,152)
13		\$0	\$3,065	\$44.39	0	\$0	350	\$15,536	\$3,065	\$12,471	(\$23,146)	(\$43,971)	(\$52,053)	(\$58,951)
14		\$0	\$3,065	\$45.28	0	\$0	350	\$15,847	\$3,065	\$12,782	(\$15,470)	(\$39,272)	(\$48,351)	(\$56,022)
15		\$0	\$3,065	\$46.16	0	\$0	350	\$16,164	\$3,065	\$13,099	(\$7,905)	(\$34,812)	(\$44,901)	(\$53,342)
16		\$0	\$3,065	\$47.11	0	\$0	350	\$16,487	\$3,065	\$13,422	(\$453)	(\$30,581)	(\$41,688)	(\$50,890)
17		\$0	\$3,065	\$48.05	0	\$0	350	\$16,817	\$3,065	\$13,752	\$6,889	(\$26,567)	(\$38,696)	(\$48,647)
18		\$0	\$3,065	\$49.01	0	\$0	350	\$17,153	\$3,065	\$14,088	\$14,122	(\$22,759)	(\$35,908)	(\$46,595)
19		\$0	\$3,065	\$49.99	0	\$0	350	\$17,496	\$3,065	\$14,431	\$21,245	(\$19,148)	(\$33,313)	(\$44,718)
20		\$0	\$3,065	\$50.99	0	\$0	350	\$17,846	\$3,065	\$14,781	\$28,261	(\$15,723)	(\$30,896)	(\$43,002)
21		(\$14,179)	\$3,065	\$52.01	0	\$0	350	\$18,203	(\$11,114)	\$25,317	\$41,641	(\$9,433)	(\$28,538)	(\$39,963)
		\$111,593	\$61,811			\$0	1,058	\$305,637	\$173,404	\$132,233				

ASSUMPTIONS TABLE

TABLE A2 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

Economic and Financial Analysis for Energy Investments — Egypt EEA

Capital Costs:

Acquisition	\$125,772
Transportation	\$0
Construction	\$0
Interconnection	\$0
TOTAL (Cap.)	\$125,772

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$3,065 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$14,179)/period
Replace Period	20 years

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Energy Savngs	350 bbl/year
Fuel Use	0 bbl/year

Disc. Rate	Internal Rate of Return			B/C Ratio
	PV of Benefits	PV of Costs	ERR NPV	
0%	\$305,637	\$173,404	\$132,233	1.76
2%	\$247,042	\$166,858	\$80,184	1.48
4%	\$203,107	\$161,466	\$41,641	1.26
6%	\$169,685	\$157,017	\$12,666	1.0
8%	\$143,900	\$153,333	(\$9,433)	0.94
10%	\$123,731	\$150,269	(\$26,538)	0.82
11%	\$115,287	\$148,932	(\$33,645)	0.77
12%	\$107,744	\$147,707	(\$39,963)	0.73
13%	\$100,985	\$146,583	(\$45,599)	0.69
14%	\$94,909	\$145,551	(\$50,642)	0.65
15%	\$89,431	\$144,601	(\$55,171)	0.62
16%	\$84,477	\$143,726	(\$59,249)	0.59
18%	\$75,899	\$142,171	(\$66,272)	0.53
20%	\$68,768	\$140,838	(\$72,070)	0.49

TABLE A3

For Case of: POULTRY SOLAR 4000 SQ FT @ \$22.21/SQ FT EEA ESTIMATES LOCALLY MANUFACTURED
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) @ i =				
										4%	8%	10%	12%	
1	Acquisition \$104,809													
1	Transport \$0													
1	Construction \$0													
1	Interconnection \$0													
1	Total \$104,809	\$441	\$35.00	0	\$0	58	\$2,042	\$105,250	(\$103,208)	(\$103,208)	(\$103,208)	(\$103,208)	(\$103,208)	(\$103,208)
2	\$0	\$2,645	\$35.70	0	\$0	350	\$12,495	\$2,645	\$9,850	(\$93,737)	(\$94,088)	(\$94,254)	(\$94,414)	(\$94,414)
3	\$0	\$2,645	\$36.41	0	\$0	350	\$12,745	\$2,645	\$10,100	(\$84,399)	(\$85,429)	(\$85,907)	(\$86,362)	(\$86,362)
4	\$0	\$2,645	\$37.14	0	\$0	350	\$13,000	\$2,645	\$10,355	(\$75,194)	(\$77,209)	(\$78,127)	(\$78,992)	(\$78,992)
5	\$0	\$2,645	\$37.89	0	\$0	350	\$13,260	\$2,645	\$10,615	(\$66,120)	(\$69,407)	(\$70,177)	(\$72,246)	(\$72,246)
6	\$0	\$2,645	\$38.64	0	\$0	350	\$13,525	\$2,645	\$10,880	(\$57,178)	(\$62,002)	(\$64,121)	(\$66,072)	(\$66,072)
7	\$0	\$2,645	\$39.42	0	\$0	350	\$13,795	\$2,645	\$11,150	(\$48,365)	(\$54,975)	(\$57,827)	(\$60,423)	(\$60,423)
8	\$0	\$2,645	\$40.20	0	\$0	350	\$14,071	\$2,645	\$11,426	(\$39,682)	(\$48,308)	(\$51,964)	(\$55,254)	(\$55,254)
9	\$0	\$2,645	\$41.01	0	\$0	350	\$14,353	\$2,645	\$11,708	(\$31,127)	(\$41,983)	(\$46,502)	(\$50,526)	(\$50,526)
10	\$0	\$2,645	\$41.83	0	\$0	350	\$14,640	\$2,645	\$11,995	(\$22,700)	(\$35,982)	(\$41,415)	(\$46,200)	(\$46,200)
11	\$0	\$2,645	\$42.66	0	\$0	350	\$14,933	\$2,645	\$12,288	(\$14,399)	(\$30,291)	(\$36,677)	(\$42,244)	(\$42,244)
12	\$0	\$2,645	\$43.52	0	\$0	350	\$15,231	\$2,645	\$12,586	(\$6,223)	(\$24,893)	(\$32,266)	(\$38,626)	(\$38,626)
13	\$0	\$2,645	\$44.39	0	\$0	350	\$15,536	\$2,645	\$12,891	\$1,829	(\$19,773)	(\$28,158)	(\$35,317)	(\$35,317)
14	\$0	\$2,645	\$45.28	0	\$0	350	\$15,847	\$2,645	\$13,202	\$9,757	(\$14,919)	(\$24,334)	(\$32,291)	(\$32,291)
15	\$0	\$2,645	\$46.18	0	\$0	350	\$16,164	\$2,645	\$13,519	\$17,564	(\$10,317)	(\$20,774)	(\$29,525)	(\$29,525)
16	\$0	\$2,645	\$47.11	0	\$0	350	\$16,487	\$2,645	\$13,842	\$25,250	(\$5,953)	(\$17,461)	(\$26,996)	(\$26,996)
17	\$0	\$2,645	\$48.05	0	\$0	350	\$16,817	\$2,645	\$14,172	\$32,816	(\$1,816)	(\$14,377)	(\$24,685)	(\$24,685)
18	\$0	\$2,645	\$49.01	0	\$0	350	\$17,153	\$2,645	\$14,508	\$40,264	\$2,105	(\$11,506)	(\$22,572)	(\$22,572)
19	\$0	\$2,645	\$49.99	0	\$0	350	\$17,496	\$2,645	\$14,851	\$47,595	\$5,821	(\$8,835)	(\$20,640)	(\$20,640)
20	\$0	\$2,645	\$50.99	0	\$0	350	\$17,846	\$2,645	\$15,201	\$54,810	\$9,343	(\$6,350)	(\$18,875)	(\$18,875)
21	(\$11,343)	\$2,645	\$52.01	0	\$0	350	\$18,203	(\$9,198)	\$27,401	\$67,316	\$15,222	(\$2,277)	(\$16,035)	(\$16,035)
	\$92,366	\$53,341		0	\$0	7,058	\$306,637	\$146,307	\$159,330					

ASSUMPTIONS TABLE

TABLE A3 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

Economic and Financial Analysis for Energy Investments -- Egypt EEA

Capital Costs:		Benefit Parameters:		Internal Rate of Return 9.71%				
				Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
Acquisition	\$104,809	Price of Oil	\$35.00 /bbl (yr. 1)	0%	\$305,537	\$146,307	\$159,330	2.09
Transportation	\$0	Oil Escalat.	2.0%/year	2%	\$247,042	\$140,529	\$106,512	1.75
Construction	\$0			4%	\$203,107	\$135,791	\$67,316	1.50
Interconnection	\$0	Energy Savngs	350 bbl/year	6%	\$169,685	\$131,895	\$37,790	1.29
		Fuel Use	0 bbl/year	8%	\$143,900	\$128,678	\$15,222	1.12
TOTAL (Cap.)	\$104,809			10%	\$123,731	\$126,008	(\$2,277)	0.98
Construct Time	10 months			11%	\$115,287	\$124,844	(\$9,557)	0.92
Operating and Normal Maintenance Costs:				12%	\$107,744	\$123,779	(\$16,035)	0.87
Operating Cost	\$2,645 /year			13%	\$100,985	\$122,803	(\$21,818)	0.82
Operating Lifetime	21 years			14%	\$94,909	\$121,906	(\$26,998)	0.78
Major Equipment Repair/Replacement:				15%	\$89,431	\$121,082	(\$31,652)	0.74
Replace Cost	(\$11,843/period)			16%	\$84,477	\$120,323	(\$35,846)	0.70
Replace Period	21 years			18%	\$75,899	\$118,976	(\$43,076)	0.64
				20%	\$68,768	\$117,621	(\$49,053)	0.58

TABLE A4 (Contd.)

ASSUMPTIONS TABLE

BENEFIT-COSTS TABLE (Calculated)

Economic and Financial Analysis for Energy Investments — Egypt EEP

Capital Costs:

Acquisition	\$105,124
Transportation	\$0
Construction	\$0
Interconnection	\$0
TOTAL (Cap.)	\$105,124

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$2,571 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$11,878)/period
Replace Period	20 years

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Energy Savings	295 bbl/year
Fuel Use	0 bbl/year

Internal Rate of Return ERR

Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
====	=====	=====	=====	=====
0%	\$257,609	\$145,095	\$112,514	1.76
2%	\$208,221	\$139,598	\$68,622	1.49
4%	\$171,190	\$135,072	\$36,118	1.27
6%	\$143,021	\$131,338	\$11,682	1.09
8%	\$121,287	\$128,247	(\$6,959)	0.95
10%	\$104,288	\$125,675	(\$21,386)	0.83
11%	\$97,170	\$124,553	(\$27,383)	0.78
12%	\$90,813	\$123,525	(\$32,712)	0.74
13%	\$85,116	\$122,582	(\$37,467)	0.69
14%	\$79,994	\$121,716	(\$41,722)	0.66
15%	\$75,377	\$120,919	(\$45,542)	0.62
16%	\$71,202	\$120,185	(\$48,983)	0.59
18%	\$63,972	\$116,881	(\$54,909)	0.54
20%	\$57,961	\$117,762	(\$59,801)	0.49

TABLE A5

For Case of: POULTRY SOLAR 3200 SQ FT @22.21/SQ FT EEA ESTIMATES LOCALLY MANUFACTURED
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cash Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) @ i =				
										4%	8%	10%	12%	
1	Acquisition \$87,041													
1	Transport \$0													
1	Construction \$0													
1	Interconnection \$0													
1	Total \$87,041	\$368	\$35.00	0	\$0	49	\$1,721	\$87,409	(\$85,686)	(\$85,688)	(\$85,688)	(\$85,688)	(\$85,688)	(\$85,688)
2	\$0	\$2,209	\$35.70	0	\$0	295	\$10,532	\$2,209	\$8,323	(\$77,665)	(\$77,982)	(\$78,122)	(\$78,258)	(\$78,258)
3	\$0	\$2,209	\$36.41	0	\$0	295	\$10,742	\$2,209	\$8,533	(\$69,797)	(\$70,667)	(\$71,070)	(\$71,455)	(\$71,455)
4	\$0	\$2,209	\$37.14	0	\$0	295	\$10,957	\$2,209	\$8,746	(\$62,020)	(\$63,722)	(\$64,498)	(\$65,228)	(\$65,228)
5	\$0	\$2,209	\$37.89	0	\$0	295	\$11,176	\$2,209	\$8,967	(\$54,355)	(\$57,131)	(\$58,373)	(\$59,530)	(\$59,530)
6	\$0	\$2,209	\$38.64	0	\$0	295	\$11,400	\$2,209	\$9,191	(\$46,800)	(\$50,876)	(\$52,666)	(\$54,315)	(\$54,315)
7	\$0	\$2,209	\$39.42	0	\$0	295	\$11,628	\$2,209	\$9,419	(\$39,357)	(\$44,941)	(\$47,350)	(\$49,543)	(\$49,543)
8	\$0	\$2,209	\$40.20	0	\$0	295	\$11,860	\$2,209	\$9,651	(\$32,023)	(\$39,309)	(\$42,197)	(\$45,177)	(\$45,177)
9	\$0	\$2,209	\$41.01	0	\$0	295	\$12,097	\$2,209	\$9,888	(\$24,797)	(\$33,967)	(\$37,784)	(\$41,183)	(\$41,183)
10	\$0	\$2,209	\$41.83	0	\$0	295	\$12,339	\$2,209	\$10,130	(\$17,680)	(\$28,899)	(\$33,488)	(\$37,530)	(\$37,530)
11	\$0	\$2,209	\$42.66	0	\$0	295	\$12,586	\$2,209	\$10,377	(\$10,670)	(\$24,093)	(\$29,487)	(\$34,189)	(\$34,189)
12	\$0	\$2,209	\$43.52	0	\$0	295	\$12,838	\$2,209	\$10,629	(\$3,765)	(\$19,534)	(\$25,762)	(\$31,134)	(\$31,134)
13	\$0	\$2,209	\$44.39	0	\$0	295	\$13,095	\$2,209	\$10,886	\$3,034	(\$15,211)	(\$22,293)	(\$28,339)	(\$28,339)
14	\$0	\$2,209	\$45.28	0	\$0	295	\$13,356	\$2,209	\$11,147	\$9,729	(\$11,112)	(\$19,064)	(\$25,785)	(\$25,785)
15	\$0	\$2,209	\$46.18	0	\$0	295	\$13,624	\$2,209	\$11,415	\$16,320	(\$7,226)	(\$16,059)	(\$23,449)	(\$23,449)
16	\$0	\$2,209	\$47.11	0	\$0	295	\$13,896	\$2,209	\$11,687	\$22,810	(\$3,542)	(\$13,261)	(\$21,314)	(\$21,314)
17	\$0	\$2,209	\$48.05	0	\$0	295	\$14,174	\$2,209	\$11,965	\$29,198	(\$49)	(\$10,657)	(\$19,362)	(\$19,362)
18	\$0	\$2,209	\$49.01	0	\$0	295	\$14,457	\$2,209	\$12,248	\$35,466	\$3,261	(\$8,234)	(\$17,578)	(\$17,578)
19	\$0	\$2,209	\$49.99	0	\$0	295	\$14,747	\$2,209	\$12,538	\$41,675	\$6,399	(\$5,976)	(\$15,948)	(\$15,948)
20	\$0	\$2,209	\$50.99	0	\$0	295	\$15,042	\$2,209	\$12,833	\$47,766	\$9,372	(\$3,660)	(\$14,458)	(\$14,458)
21	(\$9,663)	\$2,209	\$52.01	0	\$0	295	\$15,342	(\$7,654)	\$22,996	\$58,261	\$14,306	(\$462)	(\$12,074)	(\$12,074)
	=====	=====		=====	=====	=====	=====	=====	=====	=====				
	\$77,178	\$44,548		0	\$0	5,949	\$257,609	\$111,728	\$135,882					

ASSUMPTIONS TABLE

TABLE A5 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

Economic and Financial Analysis for Energy Investments -- Egypt EEA

Capital Costs:

Acquisition	\$87,041
Transportation	\$0
Construction	\$0
Interconnection	\$0
<u>TOTAL (Cap.)</u>	<u>\$87,041</u>

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$2,209 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$9,863)/period
Replace Period	20 years

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Energy Savngs	295 bbl/year
Fuel Use	0 bbl/year

Internal Rate of Return 9.53%

Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
====	=====	=====	=====	=====
0%	\$257,609	\$121,726	\$135,882	2.12
2%	\$208,221	\$116,892	\$91,329	1.78
4%	\$171,190	\$112,929	\$58,261	1.52
6%	\$143,021	\$109,671	\$33,350	1.30
8%	\$121,287	\$106,981	\$14,306	1.13
10%	\$104,288	\$104,750	(\$462)	1.00
11%	\$97,170	\$103,777	(\$6,605)	0.94
12%	\$90,813	\$102,887	(\$12,074)	0.88
13%	\$85,116	\$102,071	(\$16,955)	0.83
14%	\$79,994	\$101,322	(\$21,328)	0.79
15%	\$75,377	\$100,633	(\$25,256)	0.75
16%	\$71,202	\$99,999	(\$28,797)	0.71
18%	\$63,972	\$98,873	(\$34,901)	0.65
20%	\$57,961	\$97,909	(\$39,947)	0.59

TABLE A6

For Case of: POULTRY SENSITIVITY ANALYSIS 4000 SQ FT @520.30/SQ FT
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) \$	NPV	NPV
1	Acquisition	\$98,713										
1	Transport	\$0										
1	Construction	\$0										
1	Interconnector	\$0										
1	Total	\$98,713	\$25.00	0	\$0	58	\$1,458	\$99,111	\$97,675	(\$97,675)	(\$97,675)	(\$97,675)
2		\$0	\$25.50	0	\$0	35	\$8,425	\$2,523	\$1,802	(\$1,519)	(\$91,747)	(\$91,959)
3		\$0	\$26.01	0	\$0	35	\$9,104	\$2,523	\$1,541	(\$45,435)	(\$86,106)	(\$86,717)
4		\$0	\$26.53	0	\$0	35	\$9,286	\$2,523	\$1,753	(\$79,423)	(\$80,737)	(\$81,336)
5		\$0	\$27.06	0	\$0	35	\$9,471	\$2,523	\$1,948	(\$73,484)	(\$75,630)	(\$76,590)
6		\$0	\$27.60	0	\$0	35	\$9,661	\$2,523	\$1,138	(\$77,617)	(\$70,772)	(\$72,159)
7		\$0	\$28.15	0	\$0	35	\$9,854	\$2,523	\$1,311	(\$61,834)	(\$66,153)	(\$67,434)
8		\$0	\$28.71	0	\$0	35	\$10,051	\$2,523	\$1,528	(\$55,103)	(\$61,760)	(\$63,020)
9		\$0	\$29.29	0	\$0	35	\$10,252	\$2,523	\$1,729	(\$50,455)	(\$57,584)	(\$58,720)
10		\$0	\$29.88	0	\$0	35	\$10,457	\$2,523	\$1,934	(\$46,881)	(\$53,615)	(\$54,710)
11		\$0	\$30.47	0	\$0	35	\$10,666	\$2,523	\$2,143	(\$43,880)	(\$49,841)	(\$50,832)
12		\$0	\$31.07	0	\$0	35	\$10,880	\$2,523	\$2,357	(\$41,502)	(\$46,841)	(\$47,710)
13		\$0	\$31.71	0	\$0	35	\$11,097	\$2,523	\$2,574	(\$38,996)	(\$42,855)	(\$43,707)
14		\$0	\$32.34	0	\$0	35	\$11,319	\$2,523	\$2,797	(\$36,314)	(\$39,620)	(\$40,391)
15		\$0	\$32.99	0	\$0	35	\$11,544	\$2,523	\$3,022	(\$33,314)	(\$36,620)	(\$37,386)
16		\$0	\$33.65	0	\$0	35	\$11,776	\$2,523	\$3,251	(\$30,005)	(\$33,601)	(\$34,245)
17		\$0	\$34.32	0	\$0	35	\$12,012	\$2,523	\$3,486	(\$26,899)	(\$30,861)	(\$31,554)
18		\$0	\$35.01	0	\$0	35	\$12,252	\$2,523	\$3,729	(\$23,904)	(\$28,232)	(\$29,182)
19		\$0	\$35.71	0	\$0	35	\$12,497	\$2,523	\$3,974	(\$21,019)	(\$25,736)	(\$26,589)
20		\$0	\$36.42	0	\$0	35	\$12,747	\$2,523	\$4,224	(\$18,872)	(\$23,167)	(\$23,992)
21		(\$8,915)	\$37.15	0	\$0	35	\$13,002	(\$8,915)	\$4,474	(\$17,206)	(\$20,909)	(\$21,695)
		\$87,798	\$50,881	0	\$0	7,058	\$218,312	\$140,674	\$77,634			

TABLE A6 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

=====

	Internal Rate of Return		ERR	
Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
=====	=====	=====	=====	=====
0%	\$218,312	\$140,679	\$77,634	1.55
2%	\$176,458	\$134,389	\$42,070	1.31
4%	\$145,076	\$129,353	\$15,723	1.12
6%	\$121,204	\$125,292	(\$4,089)	0.97
8%	\$102,786	\$121,992	(\$19,206)	0.84
10%	\$88,379	\$119,288	(\$30,909)	0.74
11%	\$82,348	\$118,119	(\$35,771)	0.70
12%	\$76,960	\$117,055	(\$40,095)	0.66
13%	\$72,132	\$116,083	(\$43,951)	0.62
14%	\$67,792	\$115,195	(\$47,403)	0.59
15%	\$63,879	\$114,381	(\$50,502)	0.56
16%	\$60,341	\$113,634	(\$53,293)	0.53
18%	\$54,214	\$112,313	(\$58,099)	0.48
20%	\$49,120	\$111,187	(\$62,067)	0.44

TABLE A6 (Contd.)

ASSUMPTIONS TABLE
=====

Capital Costs:

Acquisition	\$98,713
Transportation	\$0
Construction	\$0
Interconnection	\$0

TOTAL (Cap.)	\$98,713

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$2,523 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$8,915)/period
Replace Period	20 years

Benefit Parameters:

Price of Oil	\$25.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	350 bbl/year
Fuel Use	0 bbl/year

TABLE A7

For Case of: POULTRY SENSITIVITY ANALYSIS 4000 SQ FT @ \$15.00
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV)			@ i =
										4%	8%	10%	
1	Acquisition	\$78,711											
1	Transport	\$0											
1	Construction	\$0											
1	Interconnection	\$0											
1	Total	\$78,711	\$25.00	0	\$0	58	\$1,458	\$79,062	(\$77,604)	(\$77,604)	(\$77,604)	(\$77,604)	(\$77,604)
2		\$0	\$25.50	0	\$0	350	\$8,925	\$2,092	\$6,832	(\$71,034)	(\$71,278)	(\$71,393)	(\$71,504)
3		\$0	\$26.01	0	\$0	350	\$9,104	\$2,093	\$7,011	(\$64,553)	(\$65,267)	(\$65,599)	(\$65,915)
4		\$0	\$26.53	0	\$0	350	\$9,286	\$2,093	\$7,193	(\$58,158)	(\$59,558)	(\$60,195)	(\$60,795)
5		\$0	\$27.06	0	\$0	350	\$9,471	\$2,093	\$7,378	(\$51,852)	(\$54,134)	(\$55,155)	(\$56,106)
6		\$0	\$27.60	0	\$0	350	\$9,661	\$2,093	\$7,568	(\$45,631)	(\$48,984)	(\$50,456)	(\$51,812)
7		\$0	\$28.15	0	\$0	350	\$9,854	\$2,093	\$7,761	(\$39,498)	(\$44,093)	(\$46,076)	(\$47,880)
8		\$0	\$28.72	0	\$0	350	\$10,051	\$2,093	\$7,958	(\$33,450)	(\$39,450)	(\$41,992)	(\$44,280)
9		\$0	\$29.29	0	\$0	350	\$10,252	\$2,093	\$8,159	(\$27,489)	(\$35,042)	(\$38,186)	(\$40,985)
10		\$0	\$29.88	0	\$0	350	\$10,457	\$2,093	\$8,364	(\$21,612)	(\$30,858)	(\$34,639)	(\$37,969)
11		\$0	\$30.47	0	\$0	350	\$10,666	\$2,093	\$8,573	(\$15,820)	(\$26,886)	(\$31,333)	(\$35,209)
12		\$0	\$31.08	0	\$0	350	\$10,880	\$2,093	\$8,787	(\$10,113)	(\$23,118)	(\$28,254)	(\$32,663)
13		\$0	\$31.71	0	\$0	350	\$11,097	\$2,093	\$9,004	(\$4,489)	(\$19,542)	(\$25,385)	(\$30,172)
14		\$0	\$32.34	0	\$0	350	\$11,319	\$2,093	\$9,226	\$1,052	(\$16,150)	(\$22,712)	(\$28,257)
15		\$0	\$32.99	0	\$0	350	\$11,545	\$2,093	\$9,452	\$6,511	(\$12,931)	(\$20,233)	(\$26,323)
16		\$0	\$33.65	0	\$0	350	\$11,776	\$2,093	\$9,683	\$11,887	(\$9,879)	(\$17,905)	(\$24,554)
17		\$0	\$34.32	0	\$0	350	\$12,012	\$2,093	\$9,919	\$17,183	(\$6,984)	(\$15,746)	(\$22,936)
18		\$0	\$35.01	0	\$0	350	\$12,252	\$2,093	\$10,159	\$22,399	(\$4,238)	(\$13,736)	(\$21,456)
19		\$0	\$35.71	0	\$0	350	\$12,497	\$2,093	\$10,404	\$27,534	(\$1,639)	(\$11,865)	(\$20,103)
20		\$0	\$36.42	0	\$0	350	\$12,747	\$2,093	\$10,654	\$32,591	\$834	(\$10,123)	(\$18,867)
21		\$0	\$37.15	0	\$0	350	\$13,002	\$8,776	\$4,226	\$34,520	\$1,741	(\$9,495)	(\$18,428)
		\$85,396	\$42,209	0	\$0	7,058	\$218,312	\$127,605	\$90,708				

TABLE A7 (Contd.)

BENEFIT-COSTS TABLE (Calculated)
 =====

Internal Rate of Return 8.28%

Disc. Rate ====	PV of Benefits =====	PV of Costs =====	NPV =====	B/C Ratio =====
0%	\$218,312	\$127,605	\$90,708	1.71
2%	\$176,458	\$117,783	\$58,675	1.50
4%	\$145,076	\$110,556	\$34,520	1.31
6%	\$121,204	\$105,152	\$16,052	1.15
8%	\$102,786	\$101,045	\$1,741	1.02
10%	\$88,379	\$97,874	(\$9,495)	0.90
11%	\$82,348	\$96,553	(\$14,210)	0.85
12%	\$76,960	\$95,388	(\$18,428)	0.81
13%	\$72,132	\$94,345	(\$22,213)	0.76
14%	\$67,792	\$93,410	(\$25,618)	0.73
15%	\$63,879	\$92,571	(\$28,692)	0.69
16%	\$60,341	\$91,814	(\$31,474)	0.66
18%	\$54,214	\$90,509	(\$36,295)	0.60
20%	\$49,120	\$89,428	(\$40,308)	0.55

TABLE A8 (Contd.)

BENEFIT-COSTS TABLE (Calculated)
 =====

Internal Rate of Return 13.37%

Disc. Rate =====	PV of Benefits =====	PV of Costs =====	NPV =====	B/C Ratio =====
0%	\$218,312	\$89,002	\$129,310	2.45
2%	\$176,458	\$84,174	\$92,285	2.10
4%	\$145,076	\$80,382	\$64,695	1.80
6%	\$121,204	\$77,373	\$43,831	1.57
8%	\$102,786	\$74,960	\$27,825	1.37
10%	\$88,379	\$73,006	\$15,373	1.21
11%	\$82,348	\$72,168	\$10,180	1.14
12%	\$76,960	\$71,408	\$5,552	1.08
13%	\$72,132	\$70,717	\$1,415	1.02
14%	\$67,792	\$70,087	(\$2,296)	0.97
15%	\$63,879	\$69,513	(\$5,634)	0.92
16%	\$60,341	\$68,986	(\$8,646)	0.87
18%	\$54,214	\$68,060	(\$13,847)	0.80
20%	\$49,120	\$67,274	(\$18,154)	0.73

TABLE A8 (Contd.)

ASSUMPTIONS TABLE

=====

Capital Costs:

Acquisition	\$58,713
Transportation	\$0
Construction	\$0
Interconnection	\$0

TOTAL (Cap.)	\$58,713

Benefit Parameters:

Price of Oil	\$25.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	350 bbl/year
Fuel Use	0 bbl/year

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$1,723 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$4,458)/period
Replace Period	20 years

TABLE A9

For Case of: POLIPTY SENSITIVITY ANALYSIS FOR 3200 SQ FT COLLECTORS @ \$20.00/SQ FT
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) 4%	Discounted Cash Flow (NPV) 6%	Discounted Cash Flow (NPV) 10%	NPV @ i = 12%
1	Acquisition \$82,713												
1	Transport \$0												
1	Construction \$0												
1	Interconnection \$0												
1	Total \$82,713	5354	\$25.00	0	\$0	49	\$1,229	\$83,067	(\$81,838)	(\$81,838)	(\$81,838)	(\$81,838)	(\$81,838)
2	\$0	\$2,123	\$25.50	0	\$0	295	\$7,523	\$2,123	\$5,400	(\$76,646)	(\$76,836)	(\$76,928)	(\$77,617)
3	\$0	\$2,123	\$26.01	0	\$0	295	\$7,673	\$2,123	\$5,550	(\$71,515)	(\$72,060)	(\$72,342)	(\$72,592)
4	\$0	\$2,123	\$26.53	0	\$0	295	\$7,826	\$2,123	\$5,703	(\$66,444)	(\$67,552)	(\$68,057)	(\$68,533)
5	\$0	\$2,123	\$27.06	0	\$0	295	\$7,983	\$2,123	\$5,860	(\$61,435)	(\$63,245)	(\$64,055)	(\$64,859)
6	\$0	\$2,123	\$27.60	0	\$0	295	\$8,143	\$2,123	\$6,020	(\$56,488)	(\$59,148)	(\$60,317)	(\$61,293)
7	\$0	\$2,123	\$28.15	0	\$0	295	\$8,305	\$2,123	\$6,182	(\$51,601)	(\$55,252)	(\$56,827)	(\$58,261)
8	\$0	\$2,123	\$28.72	0	\$0	295	\$8,472	\$2,123	\$6,349	(\$46,777)	(\$51,548)	(\$53,569)	(\$55,389)
9	\$0	\$2,123	\$29.29	0	\$0	295	\$8,641	\$2,123	\$6,518	(\$42,014)	(\$48,027)	(\$50,529)	(\$52,756)
10	\$0	\$2,123	\$30.47	0	\$0	295	\$8,814	\$2,123	\$6,691	(\$37,314)	(\$44,679)	(\$48,491)	(\$50,344)
11	\$0	\$2,123	\$31.08	0	\$0	295	\$8,990	\$2,123	\$6,867	(\$32,674)	(\$41,499)	(\$45,644)	(\$48,133)
12	\$0	\$2,123	\$31.71	0	\$0	295	\$9,170	\$2,123	\$7,047	(\$28,097)	(\$38,475)	(\$42,574)	(\$46,107)
13	\$0	\$2,123	\$32.34	0	\$0	295	\$9,353	\$2,123	\$7,230	(\$23,581)	(\$35,605)	(\$40,276)	(\$44,251)
14	\$0	\$2,123	\$32.99	0	\$0	295	\$9,540	\$2,123	\$7,417	(\$19,126)	(\$32,878)	(\$38,121)	(\$42,551)
15	\$0	\$2,123	\$33.65	0	\$0	295	\$9,731	\$2,123	\$7,608	(\$14,733)	(\$30,288)	(\$36,118)	(\$40,994)
16	\$0	\$2,123	\$34.32	0	\$0	295	\$9,926	\$2,123	\$7,803	(\$10,400)	(\$27,626)	(\$34,250)	(\$39,569)
17	\$0	\$2,123	\$35.01	0	\$0	295	\$10,124	\$2,123	\$8,001	(\$6,128)	(\$25,492)	(\$32,509)	(\$38,264)
18	\$0	\$2,123	\$35.71	0	\$0	295	\$10,327	\$2,123	\$8,204	(\$1,917)	(\$23,275)	(\$30,886)	(\$37,069)
19	\$0	\$2,123	\$36.42	0	\$0	295	\$10,533	\$2,123	\$8,410	\$2,235	(\$21,170)	(\$29,373)	(\$35,975)
20	\$0	\$2,123	\$37.15	0	\$0	295	\$10,744	\$2,123	\$8,621	\$6,327	(\$19,173)	(\$27,963)	(\$34,974)
21	(\$7,132)	\$2,123	\$37.15	0	\$0	295	\$10,959	(\$5,009)	\$15,968	\$13,614	(\$15,747)	(\$25,590)	(\$33,319)
	\$75,581	\$42,814		0	\$0	5,949	\$184,006	\$118,395	\$65,611				

TABLE A9 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

Internal Rate of Return		ERR		
Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
====	=====	=====	=====	=====
0%	\$184,006	\$118,395	\$65,611	1.55
2%	\$148,729	\$112,981	\$35,748	1.32
4%	\$122,279	\$108,664	\$13,614	1.13
6%	\$102,158	\$105,194	(\$3,036)	0.97
8%	\$86,634	\$102,381	(\$15,747)	0.85
10%	\$74,491	\$100,081	(\$25,590)	0.74
11%	\$69,407	\$99,088	(\$29,681)	0.70
12%	\$64,866	\$98,185	(\$33,319)	0.66
13%	\$60,797	\$97,361	(\$36,565)	0.62
14%	\$57,139	\$96,609	(\$39,470)	0.59
15%	\$53,841	\$95,920	(\$42,079)	0.56
16%	\$50,859	\$95,287	(\$44,429)	0.53
18%	\$45,694	\$94,170	(\$48,476)	0.49
20%	\$41,401	\$93,219	(\$51,818)	0.44

TABLE A9 (Contd.)

ASSUMPTIONS TABLE
=====

Capital Costs:

Acquisition	\$82,713
Transportation	\$0
Construction	\$0
Interconnection	\$0

TOTAL (Cap.)	\$82,713

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$2,123 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$7,132)/period
Replace Period	20 years

Benefit Parameters:

Price of Oil	\$25.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	295 bbl/year
Fuel Use	0 bbl/year

TABLE A10

For Case of: RISKY SENSITIVITY ANALYSIS FOR 3200 SQ FT COLLECTOR @ \$15.00/SQ FT
Assuming Oil Escalation Rate of : 7.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV)			# 1 %	# 10 %
----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	Acquisition \$66,711													
1	Transport \$0													
1	Construction \$0													
1	Interconnection \$0													
1	Total \$66,711	\$301	\$25.00	0	\$0	49	\$1,229	\$1,804	(\$1,784)	(\$65,764)	(\$65,764)	(\$65,764)	(\$65,764)	(\$65,764)
2	\$0	\$1,803	\$25.50	0	\$0	295	\$7,523	\$1,803	\$5,720	(\$60,281)	(\$60,489)	(\$60,584)	(\$60,678)	(\$60,772)
3	\$0	\$1,803	\$26.01	0	\$0	295	\$7,673	\$1,803	\$5,870	(\$54,858)	(\$55,454)	(\$55,734)	(\$55,996)	(\$56,258)
4	\$0	\$1,803	\$26.53	0	\$0	295	\$7,826	\$1,803	\$6,023	(\$49,503)	(\$50,674)	(\$51,208)	(\$51,711)	(\$52,194)
5	\$0	\$1,803	\$27.06	0	\$0	295	\$7,983	\$1,803	\$6,180	(\$44,220)	(\$46,132)	(\$46,987)	(\$47,766)	(\$48,528)
6	\$0	\$1,803	\$27.60	0	\$0	295	\$8,143	\$1,803	\$6,340	(\$39,013)	(\$41,817)	(\$42,051)	(\$42,768)	(\$43,468)
7	\$0	\$1,803	\$28.15	0	\$0	295	\$8,305	\$1,803	\$6,501	(\$33,871)	(\$37,723)	(\$37,380)	(\$37,892)	(\$38,387)
8	\$0	\$1,803	\$28.72	0	\$0	295	\$8,472	\$1,803	\$6,664	(\$28,803)	(\$33,829)	(\$32,958)	(\$33,277)	(\$33,583)
9	\$0	\$1,803	\$29.29	0	\$0	295	\$8,641	\$1,803	\$6,829	(\$23,807)	(\$30,134)	(\$28,768)	(\$28,919)	(\$29,065)
10	\$0	\$1,803	\$29.88	0	\$0	295	\$8,814	\$1,803	\$7,001	(\$18,881)	(\$26,627)	(\$24,795)	(\$24,885)	(\$24,971)
11	\$0	\$1,803	\$30.47	0	\$0	295	\$8,990	\$1,803	\$7,177	(\$14,021)	(\$23,298)	(\$20,924)	(\$20,924)	(\$20,924)
12	\$0	\$1,803	\$31.06	0	\$0	295	\$9,170	\$1,803	\$7,357	(\$9,245)	(\$20,139)	(\$17,442)	(\$17,442)	(\$17,442)
13	\$0	\$1,803	\$31.71	0	\$0	295	\$9,353	\$1,803	\$7,540	(\$4,524)	(\$17,146)	(\$14,636)	(\$14,636)	(\$14,636)
14	\$0	\$1,803	\$32.34	0	\$0	295	\$9,540	\$1,803	\$7,727	0	(\$14,295)	(\$12,795)	(\$12,795)	(\$12,795)
15	\$0	\$1,803	\$32.99	0	\$0	295	\$9,731	\$1,803	\$7,928	\$4,761	(\$11,596)	(\$10,707)	(\$10,707)	(\$10,707)
16	\$0	\$1,803	\$33.65	0	\$0	295	\$9,926	\$1,803	\$8,133	\$9,211	(\$9,135)	(\$15,763)	(\$15,763)	(\$15,763)
17	\$0	\$1,803	\$34.32	0	\$0	295	\$10,124	\$1,803	\$8,321	\$13,654	(\$6,606)	(\$11,952)	(\$11,952)	(\$11,952)
18	\$0	\$1,803	\$35.01	0	\$0	295	\$10,327	\$1,803	\$8,524	\$18,036	(\$4,303)	(\$12,265)	(\$12,265)	(\$12,265)
19	\$0	\$1,803	\$35.71	0	\$0	295	\$10,533	\$1,803	\$8,730	\$22,339	(\$2,116)	(\$10,695)	(\$10,695)	(\$10,695)
20	\$0	\$1,803	\$36.42	0	\$0	295	\$10,744	\$1,803	\$8,941	\$26,583	(\$46)	(\$9,233)	(\$9,233)	(\$9,233)
21	(\$5,349)	\$1,803	\$37.15	0	\$0	295	\$10,959	(\$3,546)	\$14,505	\$33,203	\$3,666	(\$7,077)	(\$7,077)	(\$7,077)
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	\$61,364	\$36,361		0	\$0	5,949	\$184,006	\$97,725	\$86,282					

TABLE A10 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

=====

Internal Rate of Return 8.55%

Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
=====	=====	=====	=====	=====
0%	\$184,006	\$97,725	\$86,282	1.88
2%	\$148,729	\$92,895	\$55,834	1.60
4%	\$122,279	\$89,076	\$33,203	1.37
6%	\$102,158	\$86,026	\$16,132	1.19
8%	\$86,634	\$83,568	\$3,066	1.04
10%	\$74,491	\$81,568	(\$7,077)	0.91
11%	\$69,407	\$80,708	(\$11,300)	0.86
12%	\$64,866	\$79,926	(\$15,060)	0.81
13%	\$60,797	\$79,215	(\$18,418)	0.77
14%	\$57,139	\$78,560	(\$21,427)	0.73
15%	\$53,841	\$77,972	(\$24,131)	0.69
16%	\$50,859	\$77,428	(\$26,570)	0.66
18%	\$45,694	\$76,469	(\$30,775)	0.60
20%	\$41,401	\$75,654	(\$34,253)	0.55

TABLE A10 (Contd.)

ASSUMPTIONS TABLE

=====

Capital Costs:

Acquisition	\$66,713
Transportation	\$0
Construction	\$0
Interconnection	\$0

TOTAL (Cap.)	\$66,713

Benefit Parameters:

Price of Oil	\$25.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	295 bbl/year
Fuel Use	0 bbl/year

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$1,803 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$5,349)/period
Replace Period	20 years

TABLE A11

For Case of: POULTRY SENSITIVITY ANALYSIS FOR 3200 SQ FT COLLECTOR @ \$10.00/SQ FT
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) @ 1 = 12%					
										4%	8%	10%	12%		
1	Acquisition \$50,713														
1	Transport \$0														
1	Construction \$0														
1	Interconnection \$0														
1	Total \$50,713	\$247	\$25.00	0	\$0	49	\$1,229	\$50,960	(\$49,711)	(\$49,711)	(\$49,711)	(\$49,711)	(\$49,711)	(\$49,711)	(\$49,711)
2	\$0	\$1,483	\$25.50	0	\$0	295	\$7,523	\$1,483	\$6,040	(\$43,924)	(\$44,139)	(\$44,241)	(\$44,339)	(\$44,339)	(\$44,339)
3	\$0	\$1,483	\$26.01	0	\$0	295	\$7,673	\$1,483	\$6,190	(\$38,201)	(\$38,832)	(\$39,125)	(\$39,404)	(\$39,404)	(\$39,404)
4	\$0	\$1,483	\$26.53	0	\$0	295	\$7,826	\$1,483	\$6,343	(\$32,562)	(\$33,796)	(\$34,359)	(\$34,889)	(\$34,889)	(\$34,889)
5	\$0	\$1,483	\$27.06	0	\$0	295	\$7,983	\$1,483	\$6,500	(\$27,005)	(\$29,019)	(\$29,919)	(\$30,758)	(\$30,758)	(\$30,758)
6	\$0	\$1,483	\$27.60	0	\$0	295	\$8,143	\$1,483	\$6,660	(\$21,532)	(\$24,486)	(\$25,784)	(\$26,979)	(\$26,979)	(\$26,979)
7	\$0	\$1,483	\$28.15	0	\$0	295	\$8,305	\$1,483	\$6,822	(\$16,140)	(\$20,187)	(\$21,933)	(\$23,523)	(\$23,523)	(\$23,523)
8	\$0	\$1,483	\$28.72	0	\$0	295	\$8,472	\$1,483	\$6,989	(\$10,829)	(\$16,109)	(\$18,347)	(\$20,361)	(\$20,361)	(\$20,361)
9	\$0	\$1,483	\$29.29	0	\$0	295	\$8,641	\$1,483	\$7,158	(\$5,599)	(\$12,242)	(\$15,008)	(\$17,471)	(\$17,471)	(\$17,471)
10	\$0	\$1,483	\$29.88	0	\$0	295	\$8,814	\$1,483	\$7,331	(\$448)	(\$9,575)	(\$11,899)	(\$14,827)	(\$14,827)	(\$14,827)
11	\$0	\$1,483	\$30.47	0	\$0	295	\$8,990	\$1,483	\$7,507	\$4,623	(\$5,098)	(\$9,004)	(\$12,410)	(\$12,410)	(\$12,410)
12	\$0	\$1,483	\$31.08	0	\$0	295	\$9,170	\$1,483	\$7,687	\$9,616	(\$1,801)	(\$6,310)	(\$10,200)	(\$10,200)	(\$10,200)
13	\$0	\$1,493	\$31.71	0	\$0	295	\$9,353	\$1,483	\$7,870	\$14,532	\$1,325	(\$3,803)	(\$8,180)	(\$8,180)	(\$8,180)
14	\$0	\$1,493	\$32.34	0	\$0	295	\$9,540	\$1,483	\$8,057	\$19,371	\$4,287	(\$1,469)	(\$6,333)	(\$6,333)	(\$6,333)
15	\$0	\$1,483	\$32.98	0	\$0	295	\$9,731	\$1,483	\$8,248	\$24,134	\$7,095	5703	(\$4,646)	(\$4,646)	(\$4,646)
16	\$0	\$1,483	\$33.65	0	\$0	295	\$9,926	\$1,483	\$8,443	\$28,827	\$9,757	\$2,724	(\$3,103)	(\$3,103)	(\$3,103)
17	\$0	\$1,483	\$34.32	0	\$0	295	\$10,124	\$1,483	\$8,641	\$33,436	\$12,279	\$4,605	(\$1,694)	(\$1,694)	(\$1,694)
18	\$0	\$1,483	\$35.01	0	\$0	295	\$10,327	\$1,483	\$8,844	\$37,976	\$14,669	\$6,355	(\$406)	(\$406)	(\$406)
19	\$0	\$1,483	\$35.71	0	\$0	295	\$10,533	\$1,483	\$9,050	\$42,444	\$16,914	\$7,983	\$771	\$771	\$771
20	\$0	\$1,483	\$36.42	0	\$0	295	\$10,744	\$1,483	\$9,261	\$46,839	\$19,080	\$9,497	\$1,847	\$1,847	\$1,847
21	(\$3,566)	\$1,483	\$37.15	0	\$0	295	\$10,959	(\$2,083)	\$11,042	\$52,791	\$21,878	\$11,435	\$3,199	\$3,199	\$3,199
	\$47,147	\$29,907		0	\$0	5,949	\$184,006	\$77,054	\$106,952						

TABLE A11 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

=====

Internal Rate of Return 12.92%

Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
=====	=====	=====	=====	=====
0%	\$184,006	\$77,054	\$106,952	2.39
2%	\$148,729	\$72,810	\$75,920	2.04
4%	\$122,279	\$69,487	\$52,791	1.76
6%	\$102,158	\$66,858	\$35,299	1.53
8%	\$86,634	\$64,755	\$21,878	1.34
10%	\$74,491	\$63,056	\$11,435	1.18
11%	\$69,407	\$62,327	\$7,080	1.11
12%	\$64,866	\$61,668	\$3,199	1.05
13%	\$60,797	\$61,068	(\$272)	1.00
14%	\$57,139	\$60,523	(\$3,384)	0.94
15%	\$53,841	\$60,025	(\$6,184)	0.90
16%	\$50,859	\$59,569	(\$8,711)	0.85
18%	\$45,694	\$58,768	(\$13,074)	0.78
20%	\$41,401	\$58,089	(\$16,688)	0.71

TABLE A11 (Cont'd.)

ASSUMPTIONS TABLE

=====

Capital Costs:

Acquisition	\$50,713
Transportation	\$0
Construction	\$0
Interconnection	\$0
-----	-----
TOTAL (Cap.)	\$50,713

Benefit Parameters:

Price of Oil	\$25.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	295 bbl/year
Fuel Use	0 bbl/year

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$1,483 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$3,566)/period
Replace Period	20 years

TABLE A12

For Case of: POULTRY WASTE HEAT RECOVERY-FLASH TANK
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) @ i = 15%			
										2%	10%	12%	15%
1	Acquisition \$23,461												
1	Transport \$0												
1	Construction \$0												
1	Interconnection \$0												
1	Total \$23,461	\$78	\$35.00	0	\$0								
2	\$0	\$469	\$35.70	0	\$0	123	\$4,293	\$23,539	(\$19,246)	(\$19,246)	(\$19,246)	(\$19,246)	(\$19,246)
3	\$0	\$469	\$36.41	0	\$0	736	\$26,275	\$469	\$25,806	\$4,649	\$4,214	\$3,795	\$3,194
4	\$0	\$469	\$37.14	0	\$0	736	\$26,801	\$469	\$26,332	\$27,224	\$25,976	\$24,787	\$23,105
5	\$0	\$469	\$37.89	0	\$0	736	\$27,337	\$469	\$26,868	\$48,552	\$46,162	\$43,911	\$40,771
6	\$0	\$469	\$38.64	0	\$0	736	\$27,883	\$469	\$27,414	\$68,703	\$64,887	\$61,333	\$56,445
7	\$0	\$469	\$39.42	0	\$0	736	\$28,441	\$469	\$27,972	\$87,740	\$82,255	\$77,205	\$70,352
8	\$0	\$469	\$40.20	0	\$0	736	\$29,010	\$469	\$28,541	\$105,726	\$98,366	\$91,665	\$82,691
9	\$0	\$469	\$41.01	0	\$0	736	\$29,590	\$469	\$29,121	\$122,718	\$113,309	\$104,838	\$93,639
10	\$0	\$469	\$41.83	0	\$0	736	\$30,182	\$469	\$29,713	\$138,771	\$127,171	\$116,639	\$103,352
11	\$0	\$469	\$42.66	0	\$0	736	\$30,786	\$469	\$30,317	\$153,937	\$140,028	\$127,771	\$111,970
12	\$0	\$469	\$43.52	0	\$0	736	\$31,401	\$469	\$30,932	\$168,264	\$151,954	\$137,730	\$119,616
13	\$0	\$469	\$44.39	0	\$0	736	\$32,029	\$469	\$31,560	\$181,800	\$163,015	\$146,803	\$126,400
14	\$0	\$469	\$45.28	0	\$0	736	\$32,670	\$469	\$32,201	\$194,587	\$173,276	\$155,068	\$132,418
15	\$0	\$469	\$46.18	0	\$0	736	\$33,323	\$469	\$32,854	\$206,668	\$182,792	\$162,598	\$137,756
16	\$0	\$469	\$47.11	0	\$0	736	\$33,990	\$469	\$33,521	\$218,080	\$191,619	\$169,457	\$142,496
17	\$0	\$469	\$48.05	0	\$0	736	\$34,670	\$469	\$34,201	\$228,862	\$199,807	\$175,705	\$146,699
18	\$0	\$469	\$49.01	0	\$0	736	\$35,363	\$469	\$34,894	\$239,047	\$207,401	\$181,397	\$150,426
19	\$0	\$469	\$49.99	0	\$0	736	\$36,070	\$469	\$35,601	\$248,669	\$214,444	\$186,582	\$153,736
20	\$0	\$469	\$50.99	0	\$0	736	\$36,792	\$469	\$36,323	\$257,759	\$220,977	\$191,306	\$156,671
21	(\$2,614)	\$469	\$52.01	0	\$0	736	\$37,527	\$469	\$37,058	\$266,345	\$227,037	\$195,608	\$159,275
	Total \$20,847	\$9,458		0	\$0	14,843	\$642,712	(\$2,145)	\$40,423	\$275,018	\$233,045	\$199,799	\$161,745
								\$30,305	\$612,406				

TABLE A12 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

Disc. Rate	PV of Benefits	PV of Costs	NPV	Internal Rate of Return	ERR	B/C Ratio
0%	\$642,712	\$30,305	\$612,406			21.21
2%	\$519,493	\$29,449	\$490,044			17.64
4%	\$427,105	\$28,720	\$398,385			14.87
6%	\$356,824	\$28,104	\$328,721			12.70
8%	\$302,601	\$27,583	\$275,018			10.97
10%	\$260,189	\$27,143	\$233,045			9.59
11%	\$242,432	\$26,950	\$215,482			9.00
12%	\$226,570	\$26,771	\$199,799			8.46
13%	\$212,356	\$26,607	\$185,749			7.98
14%	\$199,579	\$26,455	\$173,124			7.54
15%	\$188,060	\$26,315	\$161,745			7.15
16%	\$177,643	\$26,185	\$151,457			6.78
18%	\$159,605	\$25,954	\$133,651			6.15
20%	\$144,609	\$25,755	\$118,854			5.61

TABLE A12 (Contd.)

ASSUMPTIONS TABLE

=====

Capital Costs:

Acquisition	\$23,461
Transportation	\$0
Construction	\$0
Interconnection	\$0
-----	-----
TOTAL (Cap.)	\$23,461

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)	
Oil Escalat.	2.0%/year	
Enrgy Savngs	736 bbl/year	
Fuel Use	0 bbl/year	

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$469 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$2,614)/period
Replace Period	20 years

TABLE A13

For Case of: POULTRY WASTE HEAT RECOVERY-CONDENSATE RETURN
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) \$	# 1 = 10%	# 1 = 15%
1	Acquisition \$67,254											
1	Transport \$0											
1	Construction \$0											
1	Interconnection \$0											
1	Total \$67,254	\$91	\$35.00	0	\$0	196	\$6,860	\$67,345	(\$60,485)	(\$60,485)	(\$60,485)	(\$60,485)
2	\$0	\$545	\$35.70	0	\$0	1176	\$41,983	\$545	\$41,438	(\$22,116)	(\$22,814)	(\$23,486)
3	\$0	\$545	\$36.41	0	\$0	1176	\$42,823	\$545	\$42,278	\$14,130	\$12,127	\$10,217
4	\$0	\$545	\$37.14	0	\$0	1176	\$43,679	\$545	\$43,134	\$48,372	\$44,534	\$40,919
5	\$0	\$545	\$37.89	0	\$0	1176	\$44,553	\$545	\$44,008	\$80,719	\$74,592	\$68,887
6	\$0	\$545	\$38.64	0	\$0	1176	\$45,444	\$545	\$44,899	\$111,276	\$102,471	\$94,364
7	\$0	\$545	\$39.42	0	\$0	1176	\$46,353	\$545	\$45,808	\$140,143	\$128,328	\$117,572
8	\$0	\$545	\$40.20	0	\$0	1176	\$47,280	\$545	\$46,735	\$167,412	\$152,311	\$138,712
9	\$0	\$545	\$41.01	0	\$0	1176	\$48,226	\$545	\$47,681	\$193,173	\$174,554	\$157,970
10	\$0	\$545	\$41.83	0	\$0	1176	\$49,190	\$545	\$48,645	\$217,507	\$195,184	\$175,511
11	\$0	\$545	\$42.66	0	\$0	1176	\$50,174	\$545	\$49,629	\$240,495	\$214,318	\$191,491
12	\$0	\$545	\$43.52	0	\$0	1176	\$51,177	\$545	\$50,632	\$262,210	\$232,064	\$208,046
13	\$0	\$545	\$44.39	0	\$0	1176	\$52,201	\$545	\$51,656	\$282,724	\$248,524	\$219,005
14	\$0	\$545	\$45.28	0	\$0	1176	\$53,245	\$545	\$52,700	\$302,101	\$263,789	\$231,382
15	\$0	\$545	\$46.18	0	\$0	1176	\$54,310	\$545	\$53,765	\$320,406	\$277,947	\$242,384
16	\$0	\$545	\$47.11	0	\$0	1176	\$55,396	\$545	\$54,851	\$337,697	\$291,078	\$252,405
17	\$0	\$545	\$48.05	0	\$0	1176	\$56,504	\$545	\$55,959	\$354,031	\$303,256	\$261,533
18	\$0	\$545	\$49.01	0	\$0	1176	\$57,634	\$545	\$57,089	\$369,461	\$314,551	\$269,848
19	\$0	\$545	\$49.99	0	\$0	1176	\$58,787	\$545	\$58,242	\$384,035	\$325,026	\$277,421
20	\$0	\$545	\$50.99	0	\$0	1176	\$59,962	\$545	\$59,417	\$397,803	\$334,741	\$284,320
21	(\$7,495)	\$545	\$52.01	0	\$0	1176	\$61,162	(\$6,950)	\$8,112	\$412,416	\$344,866	\$291,381
	\$59,759	\$10,991		0	\$0	23,716	\$1,026,941	\$70,750	5956,192			

TABLE A13 (Cont'd.)

BENEFIT-COSTS TABLE (Calculated)

=====

Internal Rate of Return 70.53%

Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
=====	=====	=====	=====	=====
0%	\$1,026,941	\$70,750	\$956,192	14.52
2%	\$830,060	\$71,212	\$758,848	11.66
4%	\$682,439	\$71,331	\$611,108	9.57
6%	\$570,143	\$71,259	\$498,884	8.00
8%	\$483,504	\$71,088	\$412,416	6.80
10%	\$415,736	\$70,871	\$344,866	5.87
11%	\$387,364	\$70,755	\$316,609	5.47
12%	\$362,020	\$70,639	\$291,381	5.12
13%	\$339,308	\$70,523	\$268,785	4.81
14%	\$318,893	\$70,409	\$248,484	4.53
15%	\$300,487	\$70,298	\$230,188	4.27
16%	\$283,842	\$70,191	\$213,651	4.04
18%	\$255,021	\$69,988	\$185,033	3.64
20%	\$231,060	\$69,803	\$161,256	3.31

TABLE A13 (Contd.)

ASSUMPTIONS TABLE

=====

Capital Costs:

Acquisition	\$67,254
Transportation	\$0
Construction	\$0
Interconnection	\$0

TOTAL (Cap.)	\$67,254

Construct Time 10 months

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	1176 bbl/year
Fuel Use	0 bbl/year

Operating and Normal Maintenance Costs:

Operating Cost	\$545 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$7,495)/period
Replace Period	20 years

TABLE A.14

For Case of: POULTRY 4000 SQ FT SOLAR @ \$25.81/SQ FT PLUS WASTE HEAT RECOVERY REFT
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) @				
										4%	6%	10%	12%	
1	Acquisition \$216,487													
1	Transport \$0													
1	Construction \$0													
1	Interconnection \$0													
1	Total \$216,487	\$580	\$35.00	0	\$0	377	\$13,195	\$217,167	(\$203,972)	(\$203,972)	(\$203,972)	(\$203,972)	(\$203,972)	(\$203,972)
2	\$0	\$4,079	\$35.70	0	\$0	2262	\$80,753	\$4,079	\$78,674	(\$130,248)	(\$132,977)	(\$134,268)	(\$135,513)	(\$135,513)
3	\$0	\$4,079	\$35.41	0	\$0	2262	\$82,368	\$4,079	\$78,289	(\$57,863)	(\$55,856)	(\$59,568)	(\$70,101)	(\$70,101)
4	\$0	\$4,079	\$37.14	0	\$0	2262	\$84,016	\$4,079	\$79,937	\$13,200	(\$2,400)	(\$9,508)	(\$15,203)	(\$15,203)
5	\$0	\$4,079	\$37.89	0	\$0	2262	\$85,696	\$4,079	\$81,617	\$82,967	\$57,591	\$47,238	\$35,665	\$35,665
6	\$0	\$4,079	\$38.64	0	\$0	2262	\$87,410	\$4,079	\$83,331	\$151,459	\$114,305	\$97,520	\$82,950	\$82,950
7	\$0	\$4,079	\$39.42	0	\$0	2262	\$89,158	\$4,079	\$85,079	\$218,698	\$167,919	\$145,005	\$128,054	\$128,054
8	\$0	\$4,079	\$40.20	0	\$0	2262	\$90,941	\$4,079	\$86,852	\$284,707	\$218,603	\$190,573	\$165,345	\$165,345
9	\$0	\$4,079	\$41.01	0	\$0	2262	\$92,760	\$4,079	\$88,681	\$349,505	\$266,514	\$231,943	\$201,163	\$201,163
10	\$0	\$4,079	\$41.83	0	\$0	2262	\$94,615	\$4,079	\$90,536	\$413,115	\$311,805	\$270,348	\$233,811	\$233,811
11	\$0	\$4,079	\$42.66	0	\$0	2262	\$96,508	\$4,079	\$92,429	\$475,558	\$354,618	\$305,981	\$253,571	\$253,571
12	\$0	\$4,079	\$43.52	0	\$0	2262	\$98,438	\$4,079	\$94,359	\$536,850	\$395,086	\$339,053	\$290,697	\$290,697
13	\$0	\$4,079	\$44.39	0	\$0	2262	\$100,407	\$4,079	\$96,328	\$597,016	\$433,339	\$369,748	\$315,422	\$315,422
14	\$0	\$4,079	\$45.28	0	\$0	2262	\$102,415	\$4,079	\$98,336	\$656,074	\$469,497	\$339,230	\$307,958	\$307,958
15	\$0	\$4,079	\$46.18	0	\$0	2262	\$104,463	\$4,079	\$100,384	\$714,043	\$503,674	\$424,683	\$358,499	\$358,499
16	\$0	\$4,079	\$47.11	0	\$0	2262	\$106,552	\$4,079	\$102,473	\$770,943	\$535,978	\$449,198	\$377,220	\$377,220
17	\$0	\$4,079	\$48.05	0	\$0	2262	\$108,683	\$4,079	\$104,604	\$826,793	\$566,511	\$471,961	\$394,283	\$394,283
18	\$0	\$4,079	\$49.01	0	\$0	2262	\$110,857	\$4,079	\$106,778	\$881,610	\$595,370	\$493,087	\$409,835	\$409,835
19	\$0	\$4,079	\$49.99	0	\$0	2262	\$113,074	\$4,079	\$108,995	\$935,413	\$622,648	\$512,690	\$424,009	\$424,009
20	\$0	\$4,079	\$50.99	0	\$0	2262	\$115,336	\$4,079	\$111,257	\$988,221	\$648,425	\$530,863	\$438,928	\$438,928
21	(\$24,288)	\$4,079	\$52.01	0	\$0	2262	\$117,642	(\$20,209)	\$137,851	\$1,051,133	\$676,001	\$551,772	\$451,217	\$451,217
	\$13,195	\$81,260		0	\$0	45,247	\$1,978,291	\$274,423	\$1,703,868					

ASSUMPTIONS TABLE

TABLE A14 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

Economic and Financial Analysis for Energy Investments -- Egypt EEA

Capital Costs:

Acquisition	\$216,487
Transportation	\$0
Construction	\$0
Interconnection	\$0
<u>TOTAL (Cap.)</u>	<u>\$216,487</u>

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$4,079 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost (\$24,288)/period	
Replace Period	20 years

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Energy Savings	2862 bbl/year
Fuel Use	0 bbl/year

Internal Rate of Return 29.63%

Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
====	=====	=====	=====	=====
0%	\$1,975,290	\$274,459	\$1,700,831	7.20
2%	\$1,596,595	\$267,519	\$1,329,076	5.97
4%	\$1,312,650	\$261,517	\$1,051,133	5.02
6%	\$1,096,652	\$256,380	\$840,273	4.25
8%	\$930,005	\$252,004	\$678,001	3.63
10%	\$793,656	\$248,283	\$551,372	3.22
11%	\$745,083	\$246,637	\$498,446	3.02
12%	\$696,334	\$245,117	\$451,217	2.84
13%	\$652,645	\$243,713	\$406,936	2.66
14%	\$613,381	\$242,415	\$370,966	2.53
15%	\$577,977	\$241,215	\$336,762	2.40
16%	\$545,962	\$240,103	\$305,859	2.27
18%	\$490,526	\$236,114	\$252,412	2.06
20%	\$444,436	\$235,396	\$208,040	1.88

TABLE A16

For Case of: POULTRY 3200 SQ FT @ \$25.81/SQ FT SOLAR PLUS WASTE HEAT RECOVERY REFT
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cash Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) @ i =				
										4%	8%	10%	12%	
1	Acquisition \$195,839													
1	Transport \$0													
1	Construction \$0													
1	Interconnection \$0													
1	Total \$195,839	\$598	\$35.00	0	\$0	368	\$12,874	\$196,437	(\$183,562)	(\$183,562)	(\$183,562)	(\$183,562)	(\$183,562)	(\$183,562)
2	\$0	\$3,585	\$35.70	0	\$0	2207	\$78,790	\$3,585	\$75,205	(\$111,250)	(\$113,928)	(\$115,194)	(\$116,415)	(\$116,415)
3	\$0	\$3,585	\$36.41	0	\$0	2207	\$80,366	\$3,585	\$76,781	(\$40,262)	(\$48,101)	(\$51,739)	(\$55,206)	(\$55,206)
4	\$0	\$3,585	\$37.14	0	\$0	2207	\$81,973	\$3,585	\$78,388	\$29,425	\$14,126	\$7,155	\$589	\$589
5	\$0	\$3,585	\$37.89	0	\$0	2207	\$83,612	\$3,585	\$80,027	\$97,833	\$72,948	\$61,810	\$51,448	\$51,448
6	\$0	\$3,585	\$38.64	0	\$0	2207	\$85,285	\$3,585	\$81,700	\$164,984	\$128,552	\$112,544	\$97,807	\$97,807
7	\$0	\$3,585	\$39.42	0	\$0	2207	\$86,990	\$3,585	\$83,405	\$230,900	\$181,111	\$159,624	\$140,062	\$140,062
8	\$0	\$3,585	\$40.20	0	\$0	2207	\$88,730	\$3,585	\$85,145	\$295,604	\$230,793	\$203,317	\$178,578	\$178,578
9	\$0	\$3,585	\$41.01	0	\$0	2207	\$90,505	\$3,585	\$86,920	\$359,115	\$277,753	\$243,866	\$213,683	\$213,683
10	\$0	\$3,585	\$41.83	0	\$0	2207	\$92,315	\$3,585	\$88,730	\$421,456	\$322,140	\$281,496	\$245,680	\$245,680
11	\$0	\$3,585	\$42.66	0	\$0	2207	\$94,161	\$3,585	\$90,576	\$482,646	\$364,094	\$316,417	\$274,843	\$274,843
12	\$0	\$3,585	\$43.52	0	\$0	2207	\$96,044	\$3,585	\$92,459	\$542,706	\$403,749	\$348,823	\$301,423	\$301,423
13	\$0	\$3,585	\$44.39	0	\$0	2207	\$97,965	\$3,585	\$94,380	\$601,655	\$441,228	\$378,856	\$325,648	\$325,648
14	\$0	\$3,585	\$45.28	0	\$0	2207	\$99,925	\$3,585	\$96,340	\$659,514	\$476,652	\$406,802	\$347,727	\$347,727
15	\$0	\$3,585	\$46.18	0	\$0	2207	\$101,923	\$3,585	\$98,338	\$716,302	\$510,133	\$432,638	\$367,849	\$367,849
16	\$0	\$3,585	\$47.11	0	\$0	2207	\$103,962	\$3,585	\$100,377	\$772,038	\$541,775	\$458,727	\$386,127	\$386,127
17	\$0	\$3,585	\$48.05	0	\$0	2207	\$106,041	\$3,585	\$102,456	\$826,740	\$571,681	\$479,024	\$402,900	\$402,900
18	\$0	\$3,585	\$49.01	0	\$0	2207	\$108,162	\$3,585	\$104,577	\$880,417	\$599,945	\$499,714	\$418,131	\$418,131
19	\$0	\$3,585	\$49.99	0	\$0	2207	\$110,325	\$3,585	\$106,740	\$933,116	\$626,657	\$518,912	\$432,011	\$432,011
20	\$0	\$3,585	\$50.99	0	\$0	2207	\$112,531	\$3,585	\$108,946	\$984,827	\$651,901	\$536,726	\$444,661	\$444,661
21	(\$21,987)	\$3,585	\$52.01	0	\$0	2207	\$114,782	(\$18,402)	\$133,184	\$1,045,610	\$680,475	\$556,522	\$456,467	\$456,467
	=====	=====		=====	=====	=====	=====	=====	=====					
	\$173,852	\$72,398		0	\$0	44,508	\$1,927,362	\$243,150	\$1,684,212					

TABLE A15 (Contd.)

ASSUMPTIONS TABLE

BENEFIT-COSTS TABLE (Calculated)

Economic and Financial Analysis for Energy Investments — Egypt EEA

Capital Costs:

Acquisition	\$195,524
Transportation	\$0
Construction	\$0
Interconnection	\$0
<hr/>	
TOTAL (Cap.)	\$195,524

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$3,659 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$21,952) /period
Replace Period	20 years

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Energy Savngs	2262 bbl/year
Fuel Use	0 bbl/year

Internal Rate of Return 44.19%

Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
====	=====	=====	=====	=====
0%	\$1,975,290	\$247,362	\$1,727,928	7.99
2%	\$1,596,595	\$241,191	\$1,355,404	6.62
4%	\$1,312,650	\$235,842	\$1,076,808	5.57
6%	\$1,096,652	\$231,258	\$865,394	4.74
8%	\$930,005	\$227,349	\$702,657	4.09
10%	\$799,656	\$224,022	\$575,634	3.57
11%	\$745,083	\$222,549	\$522,534	3.35
12%	\$696,334	\$221,189	\$475,145	3.15
13%	\$652,649	\$219,932	\$432,717	2.97
14%	\$613,381	\$218,771	\$394,611	2.80
15%	\$577,377	\$217,695	\$360,681	2.65
16%	\$545,962	\$216,699	\$329,263	2.52
18%	\$490,526	\$214,918	\$275,607	2.25
20%	\$444,436	\$213,379	\$231,057	2.08

TABLE A16

For Case of: POULTR- 3200 SQ FT @ \$25.81/SQ FT SOLAR PLUS WASTE HEAT RECOVERY REPT
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cash Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) @ i =				
										4%	8%	10%	12%	
1	Acquisition \$195,839													
1	Transport \$0													
1	Construction \$0													
1	Interconnection \$0													
1	Total \$195,839	\$598	\$35.00	0	\$0	368	\$12,674	\$196,437	(\$183,562)	(\$183,562)	(\$183,562)	(\$183,562)	(\$183,562)	(\$183,562)
2	\$0	\$3,585	\$35.70	0	\$0	2207	\$76,790	\$3,585	\$75,205	(\$111,250)	(\$113,928)	(\$115,194)	(\$116,415)	(\$116,415)
3	\$0	\$3,585	\$36.41	0	\$0	2207	\$80,366	\$3,585	\$76,781	(\$40,262)	(\$48,101)	(\$51,739)	(\$55,206)	(\$55,206)
4	\$0	\$3,585	\$37.14	0	\$0	2207	\$81,973	\$3,585	\$78,388	\$29,425	\$14,126	\$7,155	\$589	\$589
5	\$0	\$3,585	\$37.89	0	\$0	2207	\$83,612	\$3,585	\$80,027	\$97,633	\$72,948	\$51,815	\$51,448	\$51,448
6	\$0	\$3,585	\$38.64	0	\$0	2207	\$85,285	\$3,585	\$81,700	\$164,984	\$128,552	\$112,544	\$97,807	\$97,807
7	\$0	\$3,585	\$39.42	0	\$0	2207	\$85,990	\$3,585	\$83,405	\$230,900	\$181,111	\$159,624	\$140,062	\$140,062
8	\$0	\$3,585	\$40.20	0	\$0	2207	\$88,730	\$3,585	\$85,145	\$295,604	\$230,793	\$203,317	\$178,578	\$178,578
9	\$0	\$3,585	\$41.01	0	\$0	2207	\$90,505	\$3,585	\$86,920	\$359,115	\$277,753	\$243,856	\$213,663	\$213,663
10	\$0	\$3,585	\$41.83	0	\$0	2207	\$92,315	\$3,585	\$88,730	\$421,456	\$322,140	\$281,496	\$245,660	\$245,660
11	\$0	\$3,585	\$42.66	0	\$0	2207	\$94,161	\$3,585	\$90,576	\$482,646	\$364,094	\$316,417	\$274,843	\$274,843
12	\$0	\$3,585	\$43.52	0	\$0	2207	\$96,044	\$3,585	\$92,459	\$542,706	\$403,749	\$348,823	\$301,423	\$301,423
13	\$0	\$3,585	\$44.39	0	\$0	2207	\$97,965	\$3,585	\$94,380	\$601,655	\$441,228	\$378,896	\$325,646	\$325,646
14	\$0	\$3,585	\$45.28	0	\$0	2207	\$99,925	\$3,585	\$96,340	\$659,514	\$476,652	\$408,802	\$347,727	\$347,727
15	\$0	\$3,585	\$46.18	0	\$0	2207	\$101,923	\$3,585	\$98,338	\$716,302	\$510,133	\$438,698	\$367,849	\$367,849
16	\$0	\$3,585	\$47.11	0	\$0	2207	\$103,962	\$3,585	\$100,377	\$772,038	\$541,775	\$458,727	\$386,187	\$386,187
17	\$0	\$3,585	\$48.05	0	\$0	2207	\$106,041	\$3,585	\$102,458	\$826,740	\$571,681	\$479,024	\$402,900	\$402,900
18	\$0	\$3,585	\$49.01	0	\$0	2207	\$108,162	\$3,585	\$104,577	\$880,427	\$599,945	\$499,714	\$418,131	\$418,131
19	\$0	\$3,585	\$49.99	0	\$0	2207	\$110,325	\$3,585	\$106,740	\$933,116	\$626,657	\$518,912	\$432,011	\$432,011
20	\$0	\$3,585	\$50.99	0	\$0	2207	\$112,531	\$3,585	\$108,946	\$984,827	\$651,901	\$536,726	\$444,661	\$444,661
21	(\$21,567)	\$3,585	\$52.01	0	\$0	2207	\$114,782	(\$18,402)	\$108,184	\$1,045,610	\$680,475	\$558,523	\$458,427	\$458,427
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
	\$172,852	\$72,236			\$0	44,508	\$1,927,282	\$148,15	\$1,661,112					

TABLE A16 (Contd.)

ASSUMPTIONS TABLE

BENEFIT-COSTS TABLE (Calculated)

Economic and Financial Analysis for Energy Investments -- Egypt EEA

Capital Costs:

Acquisition	\$195,839
Transportation	\$0
Construction	\$0
Interconnection	\$0
TOTAL (Cap.)	\$195,839

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$3,585 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$21,987)/period
Replace Period	20 years

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	2207 bbl/year
Fuel Use	0 bbl/year

Internal Rate of Return 43.02%

Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
0%	\$1,927,262	\$245,150	\$1,681,112	7.83
2%	\$1,557,774	\$240,260	\$1,317,514	6.48
4%	\$1,280,734	\$235,123	\$1,045,610	5.45
6%	\$1,069,988	\$230,701	\$839,287	4.64
8%	\$907,393	\$226,917	\$680,475	4.00
10%	\$780,212	\$223,689	\$556,523	3.49
11%	\$726,966	\$222,258	\$504,709	3.27
12%	\$679,403	\$220,935	\$458,467	3.08
13%	\$636,780	\$219,712	\$417,068	2.90
14%	\$598,467	\$218,581	\$379,886	2.74
15%	\$563,924	\$217,533	\$346,391	2.59
16%	\$532,687	\$216,562	\$316,126	2.46
18%	\$478,599	\$214,823	\$263,775	2.23
20%	\$433,630	\$213,320	\$220,310	2.03

TABLE A7 (Contd.)

ASSUMPTIONS TABLE
=====

Capital Costs:

Acquisition	\$78,713
Transportation	\$0
Construction	\$0
Interconnection	\$0
-----	-----
TOTAL (Cap.)	\$78,713

Construct Time 10 months

Benefit Parameters:

Price of Oil	\$25.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	350 bbl/year
Fuel Use	0 bbl/year

Operating and Normal Maintenance Costs:

Operating Cost	\$2,093 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	\$6,683 /period
Replace Period	20 years

TABLE A8

For Case of: POULTRY SENSITIVITY ANALYSIS FOR 4000 SQ FT @ \$10.00/SQ FT
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV)			# 1 =	# 2 =
====	=====	=====	=====	=====	=====	=====	=====	=====	=====	4t	8t	12t	=====	=====
1	Acquisition \$58,713													
1	Transport \$0													
1	Construction \$0													
1	Interconnection \$0													
1	Total \$58,713	\$287	\$25.00	0	\$0	58	\$1,458	\$59,000	(\$57,542)	(\$57,542)	(\$57,542)	(\$57,542)	(\$57,542)	(\$57,542)
2	\$0	\$1,723	\$25.50	0	\$0	350	\$8,925	\$1,723	\$7,202	(\$50,817)	(\$50,873)	(\$50,995)	(\$51,111)	(\$51,111)
3	\$0	\$1,723	\$26.01	0	\$0	350	\$9,104	\$1,723	\$7,381	(\$43,793)	(\$44,546)	(\$44,895)	(\$45,228)	(\$45,228)
4	\$0	\$1,723	\$26.53	0	\$0	350	\$9,286	\$1,723	\$7,563	(\$37,070)	(\$38,542)	(\$39,213)	(\$39,845)	(\$39,845)
5	\$0	\$1,723	\$27.06	0	\$0	350	\$9,471	\$1,723	\$7,746	(\$30,447)	(\$32,847)	(\$33,921)	(\$34,921)	(\$34,921)
6	\$0	\$1,723	\$27.60	0	\$0	350	\$9,661	\$1,723	\$7,938	(\$23,923)	(\$27,445)	(\$28,992)	(\$30,417)	(\$30,417)
7	\$0	\$1,723	\$28.15	0	\$0	350	\$9,854	\$1,723	\$8,131	(\$17,497)	(\$22,321)	(\$24,403)	(\$26,297)	(\$26,297)
8	\$0	\$1,723	\$28.72	0	\$0	350	\$10,051	\$1,723	\$8,328	(\$11,165)	(\$17,467)	(\$20,129)	(\$22,530)	(\$22,530)
9	\$0	\$1,723	\$29.29	0	\$0	350	\$10,252	\$1,723	\$8,529	(\$4,936)	(\$12,854)	(\$16,150)	(\$19,085)	(\$19,085)
10	\$0	\$1,723	\$29.88	0	\$0	350	\$10,457	\$1,723	\$8,734	\$1,201	(\$8,484)	(\$12,446)	(\$15,936)	(\$15,936)
11	\$0	\$1,723	\$30.47	0	\$0	350	\$10,666	\$1,723	\$8,943	\$7,242	(\$4,342)	(\$6,998)	(\$13,056)	(\$13,056)
12	\$0	\$1,723	\$31.08	0	\$0	350	\$10,880	\$1,723	\$9,157	\$13,190	(\$415)	(\$5,789)	(\$10,424)	(\$10,424)
13	\$0	\$1,723	\$31.71	0	\$0	350	\$11,097	\$1,723	\$9,374	\$19,045	\$3,308	(\$2,802)	(\$8,018)	(\$8,018)
14	\$0	\$1,723	\$32.34	0	\$0	350	\$11,319	\$1,723	\$9,596	\$24,808	\$6,836	(\$22)	(\$5,819)	(\$5,819)
15	\$0	\$1,723	\$32.99	0	\$0	350	\$11,545	\$1,723	\$9,822	\$30,481	\$10,180	\$2,564	(\$3,809)	(\$3,809)
16	\$0	\$1,723	\$33.65	0	\$0	350	\$11,776	\$1,723	\$10,053	\$36,063	\$13,349	\$4,971	(\$1,972)	(\$1,972)
17	\$0	\$1,723	\$34.32	0	\$0	350	\$12,012	\$1,723	\$10,289	\$41,556	\$16,353	\$7,210	(\$294)	(\$294)
18	\$0	\$1,723	\$35.01	0	\$0	350	\$12,252	\$1,723	\$10,529	\$46,961	\$19,198	\$9,293	\$1,240	\$1,240
19	\$0	\$1,723	\$35.71	0	\$0	350	\$12,497	\$1,723	\$10,774	\$52,280	\$21,895	\$11,231	\$2,641	\$2,641
20	\$0	\$1,723	\$36.42	0	\$0	350	\$12,747	\$1,723	\$11,024	\$57,512	\$24,449	\$13,034	\$3,921	\$3,921
21	(\$4,458)	\$1,723	\$37.15	0	\$0	350	\$13,002	(\$2,735)	\$15,737	\$64,695	\$27,825	\$15,373	\$5,552	\$5,552
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
	\$54,255	\$34,747		0	\$0	7,058	\$218,312	\$89,002	\$129,310					

TABLE A17

For Case of: POULTRY 3200 SQ FT @ \$22.21/SQ FT SOLAR PLUS WASTE HEAT RECOVERY LOCALLY MANUFACTURED
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV) @ i =				
										4%	8%	10%	12%	
1	Acquisition	\$177,756												
1	Transport	\$0												
1	Construction	\$0												
1	Interconnection	\$0												
1	Total	\$177,756	\$537	\$35.00	0	\$0	368	\$12,874	\$178,293	(\$165,419)	(\$165,419)	(\$165,419)	(\$165,419)	(\$165,419)
2		\$0	\$3,223	\$35.70	0	\$0	2207	\$78,790	\$3,223	\$75,567	(\$92,759)	(\$95,450)	(\$96,722)	(\$97,945)
3		\$0	\$3,223	\$36.41	0	\$0	2207	\$80,366	\$3,223	\$77,143	(\$21,436)	(\$29,312)	(\$32,958)	(\$36,451)
4		\$0	\$3,223	\$37.14	0	\$0	2207	\$81,973	\$3,223	\$78,750	\$48,573	\$33,202	\$26,199	\$19,602
5		\$0	\$3,223	\$37.89	0	\$0	2207	\$83,612	\$3,223	\$80,389	\$117,290	\$92,291	\$81,105	\$70,691
6		\$0	\$3,223	\$38.64	0	\$0	2207	\$85,285	\$3,223	\$82,062	\$184,739	\$148,141	\$132,059	\$117,255
7		\$0	\$3,223	\$39.42	0	\$0	2207	\$86,990	\$3,223	\$83,767	\$250,941	\$200,928	\$179,344	\$159,694
8		\$0	\$3,223	\$40.20	0	\$0	2207	\$88,730	\$3,223	\$85,507	\$315,920	\$250,821	\$223,223	\$198,373
9		\$0	\$3,223	\$41.01	0	\$0	2207	\$90,505	\$3,223	\$87,282	\$379,656	\$297,977	\$263,940	\$233,625
10		\$0	\$3,223	\$41.83	0	\$0	2207	\$92,315	\$3,223	\$89,092	\$442,291	\$342,545	\$301,724	\$265,752
11		\$0	\$3,223	\$42.66	0	\$0	2207	\$94,161	\$3,223	\$90,938	\$503,725	\$384,667	\$336,785	\$295,032
12		\$0	\$3,223	\$43.52	0	\$0	2207	\$96,044	\$3,223	\$92,821	\$564,020	\$424,476	\$365,318	\$321,716
13		\$0	\$3,223	\$44.39	0	\$0	2207	\$97,965	\$3,223	\$94,742	\$623,196	\$462,100	\$399,506	\$346,034
14		\$0	\$3,223	\$45.28	0	\$0	2207	\$99,925	\$3,223	\$96,702	\$681,273	\$497,657	\$427,517	\$368,195
15		\$0	\$3,223	\$46.18	0	\$0	2207	\$101,923	\$3,223	\$98,700	\$738,269	\$531,260	\$453,508	\$388,391
16		\$0	\$3,223	\$47.11	0	\$0	2207	\$103,958	\$3,223	\$100,739	\$794,206	\$563,017	\$477,624	\$406,736
17		\$0	\$3,223	\$48.05	0	\$0	2207	\$106,041	\$3,223	\$102,818	\$849,101	\$593,029	\$500,000	\$423,566
18		\$0	\$3,223	\$49.01	0	\$0	2207	\$108,162	\$3,223	\$104,939	\$902,974	\$621,390	\$520,761	\$436,851
19		\$0	\$3,223	\$49.99	0	\$0	2207	\$110,325	\$3,223	\$107,102	\$955,842	\$648,193	\$540,025	\$452,779
20		\$0	\$3,223	\$50.99	0	\$0	2207	\$112,531	\$3,223	\$109,308	\$1,007,725	\$673,521	\$557,897	\$465,470
21		(\$19,972)	\$3,223	\$52.01	0	\$0	2207	\$114,782	(\$16,749)	\$101,531	\$1,067,754	\$701,740	\$577,449	\$479,102
		=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
		\$157,784	\$64,937		0	\$0	44,508	\$1,937,262	\$221,781	\$1,704,481				

TABLE A17 (Contd.)

ASSUMPTIONS TABLE

BENEFIT-COSTS TABLE (Calculated)

Economic and Financial Analysis for Energy Investments — Egypt EEA

Capital Costs:

Acquisition	\$177,756
Transportation	\$0
Construction	\$0
Interconnection	\$0
TOTAL (Cap.)	\$177,756

Construct Time 10 months

Operating and Normal Maintenance Costs:

Operating Cost	\$3,223 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost	(\$19,372)/period
Replace Period	20 years

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	2207 bbl/year
Fuel Use	0 bbl/year

Internal Rate of Return 47.74%

Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
0%	\$1,927,262	\$222,781	\$1,704,480	8.65
2%	\$1,557,774	\$217,553	\$1,340,221	7.16
4%	\$1,280,734	\$212,980	\$1,067,754	6.01
6%	\$1,069,988	\$209,033	\$860,954	5.12
8%	\$907,393	\$205,652	\$701,740	4.41
10%	\$780,212	\$202,764	\$577,449	3.85
11%	\$726,966	\$201,482	\$525,485	3.61
12%	\$679,403	\$200,297	\$479,106	3.39
13%	\$636,780	\$199,201	\$437,579	3.20
14%	\$598,467	\$198,186	\$400,281	3.02
15%	\$563,924	\$197,247	\$366,677	2.86
16%	\$532,687	\$196,376	\$336,312	2.71
18%	\$478,599	\$194,816	\$283,783	2.46
20%	\$433,630	\$193,467	\$240,163	2.24

TABLE A18

For Case of: POLTRY 4000 SQ FT @ \$55.00/SQ FT PLUS WASTE HEAT RECOVERY
Assuming Oil Escalation Rate of : 2.0%

Year	Capital Cost	Operating Cost	Cost of Oil \$/Bbl.	Fuel Used (Bbl)	Fuel Cost	Saved Energy Equiv.	Value of Saved Energy	Annual Cost	Cash Flow Current \$	Discounted Cash Flow (NPV)				
										8%	10%	12%	15%	
1	Acquisition \$348,439													
1	Transport \$0													
1	Construction \$0													
1	Interconnection \$0													
1	Total \$348,439	\$989	\$35.06	0	\$0	376	\$11,148	\$349,428	(\$336,280)	(\$336,280)	(\$336,280)	(\$336,280)	(\$336,280)	
2	\$0	\$5,934	\$35.70	0	\$0	2254	\$80,468	\$5,934	\$74,534	(\$267,267)	(\$268,522)	(\$269,732)	(\$271,468)	
3	\$0	\$5,934	\$36.41	0	\$0	2254	\$82,077	\$5,934	\$76,143	(\$201,986)	(\$205,593)	(\$209,011)	(\$213,893)	
4	\$0	\$5,934	\$37.14	0	\$0	2254	\$83,719	\$5,934	\$77,785	(\$140,238)	(\$147,153)	(\$153,665)	(\$162,748)	
5	\$0	\$5,934	\$37.89	0	\$0	2254	\$85,393	\$5,934	\$79,459	(\$81,834)	(\$92,881)	(\$103,167)	(\$117,317)	
6	\$0	\$5,934	\$38.64	0	\$0	2254	\$87,101	\$5,934	\$81,167	(\$26,593)	(\$42,483)	(\$57,111)	(\$76,963)	
7	\$0	\$5,934	\$39.42	0	\$0	2254	\$88,843	\$5,934	\$82,909	\$25,654	\$4,317	(\$15,107)	(\$41,119)	
8	\$0	\$5,934	\$40.20	0	\$0	2254	\$90,620	\$5,934	\$84,686	\$75,067	\$47,774	\$23,201	(\$9,282)	
9	\$0	\$5,934	\$41.01	0	\$0	2254	\$92,432	\$5,934	\$86,498	\$121,800	\$88,126	\$58,136	\$18,994	
10	\$0	\$5,934	\$41.83	0	\$0	2254	\$94,281	\$5,934	\$88,347	\$165,995	\$125,594	\$89,995	\$44,108	
11	\$0	\$5,934	\$42.66	0	\$0	2254	\$96,166	\$5,934	\$90,232	\$207,790	\$160,383	\$119,047	\$66,412	
12	\$0	\$5,934	\$43.52	0	\$0	2254	\$98,090	\$5,934	\$92,156	\$247,314	\$192,683	\$145,540	\$86,220	
13	\$0	\$5,934	\$44.39	0	\$0	2254	\$100,052	\$5,934	\$94,118	\$284,690	\$222,671	\$169,697	\$103,812	
14	\$0	\$5,934	\$45.28	0	\$0	2254	\$102,053	\$5,934	\$96,119	\$320,032	\$250,514	\$191,725	\$119,434	
15	\$0	\$5,934	\$46.18	0	\$0	2254	\$104,094	\$5,934	\$98,160	\$353,452	\$276,362	\$211,811	\$133,306	
16	\$0	\$5,934	\$47.11	0	\$0	2254	\$106,176	\$5,934	\$100,242	\$385,052	\$300,359	\$230,124	\$145,625	
17	\$0	\$5,934	\$48.05	0	\$0	2254	\$108,299	\$5,934	\$102,365	\$414,931	\$322,637	\$246,822	\$156,565	
18	\$0	\$5,934	\$49.01	0	\$0	2254	\$110,465	\$5,934	\$104,531	\$443,183	\$343,318	\$262,047	\$166,278	
19	\$0	\$5,934	\$49.99	0	\$0	2254	\$112,674	\$5,934	\$106,740	\$469,895	\$362,516	\$275,927	\$174,903	
20	\$0	\$5,934	\$50.99	0	\$0	2254	\$114,928	\$5,934	\$108,994	\$495,150	\$380,337	\$288,582	\$182,562	
21	(\$34,625)	\$5,934	\$52.01	0	\$0	2254	\$117,226	(\$28,691)	\$145,917	\$526,456	\$402,027	\$303,709	\$191,478	
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	
	\$313,814	\$119,669		0	\$0	45,456	\$1,968,304	\$433,483	\$1,534,821					

TABLE A18 (Contd.)

BENEFIT-COSTS TABLE (Calculated)

Internal Rate of Return 23.87%

Disc. Rate	PV of Benefits	PV of Costs	NPV	B/C Ratio
=====	=====	=====	=====	=====
0%	\$1,968,304	\$433,483	\$1,534,821	4.54
2%	\$1,590,948	\$423,156	\$1,167,793	3.76
4%	\$1,308,008	\$414,271	\$893,737	3.16
6%	\$1,092,774	\$406,694	\$686,080	2.69
8%	\$926,716	\$400,260	\$526,456	2.32
10%	\$796,828	\$394,801	\$402,027	2.02
11%	\$742,448	\$392,388	\$350,060	1.89
12%	\$693,871	\$390,162	\$303,709	1.78
13%	\$650,341	\$388,108	\$262,233	1.68
14%	\$611,212	\$386,210	\$225,002	1.58
15%	\$575,933	\$384,455	\$191,478	1.50
16%	\$544,031	\$382,831	\$161,201	1.42
18%	\$488,791	\$379,927	\$108,864	1.29
20%	\$442,864	\$377,421	\$65,444	1.17

TABLE A13 (Contd.)

ASSUMPTIONS TABLE

=====

Capital Costs:

Acquisition	\$348,439
Transportation	\$0
Construction	\$0
Interconnection	\$0

TOTAL (Cap.)	\$348,439

Construct Time 10 months

Benefit Parameters:

Price of Oil	\$35.00 /bbl (yr. 1)
Oil Escalat.	2.0%/year
Enrgy Savngs	2254 bbl/year
Fuel Use	0 bbl/year

Operating and Normal Maintenance Costs:

Operating Cost	\$5,934 /year
Operating Lifetime	21 years

Major Equipment Repair/Replacement:

Replace Cost (\$34,625)/period	
Replace Period	20 years

APPENDIX B

GENERAL POULTRY NUMBER 01

C. SOLAR THERMAL COLLECTION SYSTEM
VARIABLE COST (MID 1986)

DESCRIPTION	SUBTOTAL	TOTAL
SOLAR COLLECTORS @ \$10.00/FT ²	\$10	
COLLECTOR AREA 4000 FT ²	4000	
COLLECTOR COST	\$40,000	
SOLAR CIRCULATING PUMPS	\$1,750	
SOLAR DISTRIBUTION PUMPS	\$1,250	
STRUCTURAL STEEL	\$15,000	
SOLAR CONTROLS	\$3,000	
INSTRUMENT AIR SYSTEM/PIPING	\$750	
LOW VOLTAGE CABLE	\$1,500	
EXCAVATION AND FOUNDATIONS	\$2,000	
ELECTRICAL	\$500	
TOTAL EQUIPMENT (MID 1985)	\$65,750	
ESCALATION FACTOR	1.1	
TOTAL EQUIPMENT (MID 1986)		\$72,325
PIPING COST @ (40% COLLECTOR COST)	0.40	\$16,000
INSULATION COST @ (25% PIPING COST)	0.25	\$4,000
TOTAL MATERIAL COST	\$92,325	
LABOR COST (71.5% MATERIAL COST)	\$66,012	
MODIFIER, LABOR MIX	0.43	
MODIFIED LABOR COST		\$28,385
MATERIAL + LABOR	\$129,710	
FREIGHT, DUTY, TAXES TO EGYP @ 10%	0.10	\$12,071
SUBTOTAL	\$132,781	
CONTRACTOR OVERHEAD AND PROFIT @ 45%	0.45	\$59,752
SUBTOTAL	\$192,533	
CONTINGENCY @ 15%	0.15	\$28,880
TOTAL VARIABLE COST		\$221,413
COST PER FT ²	\$55	

GENERAL POULTRY MANUFACTURE

FIXED COST (MID 1986)

DESCRIPTION	SUBTOTAL	TOTAL
CONTRACTOR'S RENTAL SUPPLIES	\$4,000	
CONTRACTOR'S FACILITIES	\$7,000	
CONTRACTOR'S UTILITIES	\$1,000	
CONTRACTOR'S MATERIAL HANDLING	\$1,500	
CONTRACTOR'S CLEAN-UP	\$2,000	
DISMANTLING AND MOVING	\$2,000	
BOXING AND CRATING	\$5,000	
U.S. TRANSPORTATION	\$5,000	
SUB-TOTAL	\$23,500	\$23,500
CONTRACTOR'S OVERHEAD AND PROFIT @ 45%	0.45	\$10,575
SUB-TOTAL	\$34,075	
CONTINGENCY @ 15%	0.15	\$5,111
TOTAL FIXED COST		\$39,186

LGE COST BASED ON CURRENT FIELD TEST PROJECT

TOTAL VARIABLE COST	\$221,413
TOTAL FIXED COST	\$39,186
TOTAL SYSTEM CONSTRUCTION COST	\$260,599

CEA COST DATA BASED ON FUTURE PROJECT
USING IN-COUNTRY CONTRACTOR AND EQUIPMENT

VARIABLE COST @ \$28.62/FT ²	\$28.62	
COLLECTOR SIZE (FT ²)	4000	
TOTAL VARIABLE COST		\$114,480
EEA FIXED COST		\$26,757
TOTAL SYSTEM CONSTRUCTION COST		\$141,237

CONSTRUCTION COST SUMMARY

A. STEAM FLASH TANK SYSTEM	\$23,461
B. CONDENSATE RETURN SYSTEM	\$67,254
C. SOLAR THERMAL COLLECTION SYSTEM	\$260,599
TOTAL CONSTRUCTION COST A, B, & C	\$351,315

GENERAL FOUILITY PURCHASE

CONSTRUCTION COST ESTIMATE
A. STEAM FLASH TANK SYSTEM

DESCRIPTION	SUBTOTAL	TOTAL
TOTAL EQUIPMENT (MID-1985)	\$7,500	
ESCALATION FACTOR	1.1	
TOTAL EQUIPMENT (MID-1986)		\$8,250
PIPING COST @ (40% EQUIP COST)	0.40	\$3,300
INSULATION COST @ (25% PIPING COST)	0.25	\$825
TOTAL MATERIAL COST	\$12,375	
LABOR COST (71.5% MATERIAL COST)	\$8,848	
MODIFIER, LABOR MIX	0.43	
MODIFIED LABOR COST		\$3,805
MATERIAL + LABOR	\$16,180	
CONTRACTOR OVERHEAD AND PROFIT @ 45%		\$7,281
TOTAL SYSTEM CONSTRUCTION COST		\$23,461

B. CONDENSATE RETURN SYSTEM

DESCRIPTION	SUBTOTAL	TOTAL
TOTAL EQUIPMENT (MID-1985)	\$21,500	
ESCALATION FACTOR	1.1	
TOTAL EQUIPMENT (MID-1986)		\$23,650
PIPING COST @ (40% EQUIP COST)		\$9,460
INSULATION COST @ (25% PIPING COST)		\$2,365
TOTAL MATERIAL COST	\$35,475	
LABOR COST (71.5% MATERIAL COST)	\$25,365	
MODIFIER, LABOR MIX	0.43	
MODIFIED LABOR COST		\$10,907
MATERIAL + LABOR	\$46,382	
CONTRACTOR OVERHEAD AND PROFIT @ 45%		\$20,872
TOTAL SYSTEM CONSTRUCTION COST		\$67,254

GENERAL POULTRY MNPAC01

	F-CHART	INPUT GAL/DAY	OUTPUT BTU/YR	OUTPUT BTU/DAY	OUTPUT BTU/HR	ENERGY SAVED
SCALDER CONSUMPTION @ 140 F		12,718			(1,690,258)	
SOLAR SYSTEM ENERGY SAVINGS			1,508,920,000	4,572,485	571,561	
SOLAR SYSTEM FUEL SAVINGS						-33.9%

FLASH TANK SYSTEM	MASS FLOW CONDENSATE FROM RENDERING COOKERS MB LB/HR	ENERGY CONDENSATE FROM RENDERING COOKERS QB BTU/HR	CONVERSION METHODOLOGY %FLASH STM	MASS FLOW FLASH STM LB/HR	ENERGY SAVED BTU/HR
FLASH TANK SYSTEM INPUT	12,297	3,922,688			
FLASH TANK ENERGY SAVINGS					
FLASH TANK FUEL SAVINGS			10.6%	1,301	1,227,560

CONDENSATE RETURN SYSTEM	CONDENSATE FROM RENDERING COOKERS AND SCALDERS M8 AND M13 LB/HR	CONDENSATE FROM RENDERING COOKERS AND SCALDERS Q8 AND Q13 BTU/HR	USING H1v (H1 @ 212F) - (H1 @ 72F) =	BTU/LB	ENERGY SAVED BTU/HR
M8 ENERGY SAVINGS	12,297	3,922,688		100	
M13 ENERGY SAVINGS	1,736	380,251		40	
TOTAL ENERGY SAVINGS	14,032	4,302,938		140	
TOTAL FUEL SAVINGS					1,964,532

F-CHART	ENERGY SAVED BTU/YR	FUEL SAVED BTU/YR	FUEL SAVED GAL/YR	FUEL SAVED BBL/YR	%SAVINGS	CONSTRUCTION COST
SCALDER CONSUMPTION @ 140 F						
SOLAR SYSTEM ENERGY SAVINGS	1,508,920,000					
SOLAR SYSTEM FUEL SAVINGS		2,012,144,820	14,372	342	-3.5%	\$260,599

FLASH TANK SYSTEM	ENERGY SAVED BTU/YR	FUEL SAVED BTU/YR	FUEL SAVED GAL/YR	FUEL SAVED BBL/YR	%SAVINGS	CONSTRUCTION COST
FLASH TANK SYSTEM INPUT						
FLASH TANK ENERGY SAVINGS	3,246,037,710					
FLASH TANK FUEL SAVINGS		4,328,591,287	30,919	736	-7.6%	\$23,461

CONDENSATE RETURN SYSTEM	ENERGY SAVED BTU/YR	FUEL SAVED BTU/YR	FUEL SAVED GAL/YR	FUEL SAVED BBL/YR	%SAVINGS	CONSTRUCTION COST
M8 ENERGY SAVINGS						
M13 ENERGY SAVINGS						
TOTAL ENERGY SAVINGS	5,186,365,707					
TOTAL FUEL SAVINGS		6,916,018,670	49,400	1,176	-12.1%	\$67,254

EXISTING BOILER F	BTU/YR	GAL/YR	BBL/YR
CONSUMPTION (56,958,353,761)		(406,845)	(9,687)
PROPOSED BOILER F	BTU/YR	GAL/YR	BBL/YR
CONSUMPTION (45,713,729,432)		(312,154)	(7,432)
			%SAVINGS
			-23.3%

APPENDIX C

EGYPTIAN ELECTRICITY AUTHORITY
AL KHAYMA - MANSARA - CITY - CAIRO - EGYPT
TELEGRAM: ELECTEGCCCF TELETYPE: EGYPT POWER EN

FR : Anhar Hegazi
To : Dr. Soliman, Project Economist
Date : 3/10/ 1986

Subject : Cost Figures for The Economic Analysis of FT # 3.

Reference a/m subject and my letter dated Jan/ 5/86 to Mr. Spongberg . Please be advised that based on recent local market prices survey " Reefco " cost figures for the project has to be as follows.

A - For the case of the present " REFT " project.

- Variable cost	33. 25 \$ / ²
- Fixed cost	26, 757

B - In Case of local Replication

- Variable cost	25. 3 \$ / ²
- Fixed cost	20, 176 \$

Detailed analysis of cost items as attached for your information.

C C - Dr . E. EL Sharkawi , EEA
- Dr T. EL Tablawi , EEA
- Mr . Eric Peterson , USAID

Solar Thermal Collection Systems

Cost Estimates

March / 9/ 1986

Variable Cost

The estimate of variable cost " Area Dependent " are Based on (10,000) ft² collector area. Two different estimates are given for the following cases.

A - Project implemented within " REFT " project, where the following are considered

- 1- Only collectors, pumps and controlles are imported from the states, other elements are locally supplied.
- 2- labor is 80% Egyptian and 20% USA which lead to labor modifier of (0.31)

based on
 USA labor cost & 21.77/ hr
 Egypt labor cost & 3 / hr ≈ 32.4 $\frac{\text{L.E}}{\text{hr}}$

B - Project Replcation in Egypt using local production, where the following are considered

- 1- Only, pumps and controlles may be imported
- 2- labor is 100 % Egyptian, i.e labor modifier is (0.14)

In addition the following is considered for sizing system components:

- 1- Pump capacities 0.7 watt / ft² i.e 10,000 ft² system use (7 kw pump.) cost of imported pump ≈ 300-500LE = 220-370 $\frac{\text{Kj}}{\text{hr}}$
- = 2,600 including Taxis = 1800 F Ø B

EGYPTIAN ELECTRICITY AUTHORITY

ARABIA NABR CITY SAFO EGYPT
TELEGRAM: ELECTRICITY ALEX. POST: POWER 1

- 2- 1986 collector selling prices in Egypt is (140 LE/M² ≈ \$ 9.7 / ft² because of the limited market, some companies already started to reduce their prices. It is expected to reach. (125 L.E/m² next year, ≈ \$ 8.66 / ft²
- 3- 10,000 ft² system → 500 panel x3 met section

panel	
-------	--

 i.e (1500 mL) of stell sections ≈ 7500 LE = 5600\$
- 4- Field Experience show cost of piping, insulation and fittings of almost 25% of collector cost.
- 5- storage capacity is "1.5 Gal / ft² " present cost of 3m³ tank ≈ 2200 LE .
- 6- Controls include:

- 120 Airvent x 20 L.E = 2400	}	
- 5 diff ³¹ therm. x 250 = 1250	}	4150
- 5 thermost. x 100 = 500	}	LE

 imputed item prices in local market.
 4150 L.E ≈ 3,074 ≈ 3,100 \$

These assumptions concluded the following output as shown latter in details.

	REFT	Local Replication
1 - Variable costs\$/ft ²	33.25	25.3
	(31.36 x 1.06)	(23.87 x 1.06)
2 - Fixed Cost	26.757	20.176

EGYPTIAN ELECTRICITY AUTHORITY

AMBASSY SAHAR CITY CAIRO EGYPT
TELEPHONE 411 TELETYPE TELEX 2007 POWER LN

Cost Estimate

- Variable Cost

<u>Cost item</u>	REFT	<u>Local</u>
- Collector Cost 10,000 Ft \$ 10,0 / ft ² \$ 8.66/ ft ²	100,000 —	— 86,600
- Storage Tanks	14,000	14,000
- Pumps"circulating & dist	2,600	2,600
- Steel Structure	5,600	5,600
- Controls & Vents	3,100	3,100
- Cables & Switch bord	1,500	1,500
- Excavation & Foundation	1,000	1,000
- Piping & insulation and Fittings (25% Of collector)	25,000	21,650
<hr/>		
* Sub total (Materil cost)	152,8	136,05
labor cost		
REFT 0.715 x 0.31= 0.22	33.958	13.62
Local 0.715 x 0.14 = 0.1		
<hr/>		
* Total Material & labor Freight & Duties for imported item (10%)	186.67 10.00	149.67 —
<hr/>		
	196.67	149.67

* include taxis & Duties & Freight

al

* Sub-Total	196,670	149,670
Contractor Overhead and profit (45%)	24,700	40,815
	-----	-----
	221,370	190,485
* Contingency 10%	22,137	19,049
	-----	-----
	243,507	209,534
6% Engineering	14,610	12,572
	-----	-----
* Final Total	258,117	222,106
Variable Cost \$ / sq.ft.	25.81	22.21

B. Fixed Cost

o Contractor Rental Supplies	4,000	2,000
o Contractor Facilities	3,000	3,000
o Contractor Utilities	1,000	1,000
o Contractor Material Handling	1,500	1,500
o Contractor Clean Up	2,000	2,000
o Contractor Dismantling and Moving Boxing & US Transport	4,300*	2,000
	-----	-----
	15,830	11,500
Contractor Overhead (30%)	4,749	3,450
	-----	-----
	20,579	14,950
Contingency 10%	2,058	1,495
	-----	-----
Total	22,637	16,445
Engineering 6%	1,358	987
	-----	-----
Total Cost	23,995	17,432

N.B.: Modified Exhibit A is attached.

* Only for imported items.

EXHIBIT A

* Sub - total	196.670	149.67
Contractor Overhead and profit (45%)	24,700 88.50	40815 67.35
	<u>221370</u>	<u>19048.5</u>
* contingency 10 %	285.19 28.517	217.02 21.702
	<u>22137</u>	<u>19049</u>
6% Engineering	243507 1313.687 18.821	209534 238.722 14.323
	<u>14610</u>	<u>12572</u>
* Final Total	258117 332.508	222106 253.045
Variable cost \$ / ft ²	25.81/ft ² 53.251	22.21/ft ² 25.3045

B- Flexd Cost

- Contractor Rental Supplies	4,000	2,000
- .. Facilities	3,000	3,000
- .. Utilities	1,000	1,000
- .. Material Handling	1,500	1,500
- .. Clean up	2,000	2,000
- .. Dismantling and Moving Boxing & Us Transprot	4,300	2,000
	<u>15,830</u>	<u>11,500</u>
Contractor overhead (45%)	30 7-123 4749	5,175 3450
	22,953-20579	16,675-14950
Contingency 10%	2,295-2058	1,667-1495
Total	<u>25,248-22637</u>	<u>18,342-16445</u>
Engineering 6%	1,515-1358	1,834-987
	<u>23995</u>	<u>17432</u>
	26,763 Total Fixed cost	20,176

A.I. Hegar
5/14/86
[Handwritten signatures and scribbles]

* Only for imported items 106,200 C-5

N.B.: 14 May 1986 modifications of EEA Letter dated March 10, 1986,
Subject: Cost Figures for the Economic Analysis of FT #3.